Safran Power USA
Twinsburg Technical Publications
8380 Darrow Road, Twinsburg,
Ohio 44087, USA
Tel: 330.487.2000

3CPE0

COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR 23069 SERIES

List of Part Numbers

23069-013	**23069-013-1**	**23069-015**
23069-015-1	**23069-16**	**23069-016-1**
23069-020	**23069-020-1**	**23069-021**

TITLE PAGE

EXCLUSIVE DISTRIBUTORS

1. Contact Information

A. Customer Portal

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

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

HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator Models 23069-013, -002, -003, -004, -004-1, -009, -013, -014, -015, -024, -025.

Attached to this transmittal letter is Revision No. 7 of the Component Maintenance Manual with IPL (basic issue dated March 30, 1984).

REVISION 7, DATED JANUARY 20, 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 fully revised to include the latest engineering information and also to include Temporary Revisions, Service Bulletin(s) and Service Information Letter(s) as listed below. The content has been fully converted to provide customers with electronic delivery and is distributed in a “pdf” format compatible with the Adobe Acrobat Reader® that can be obtained from Adobe.

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

Key items included in this revision:

- Company logo changed to “SAFRAN”.
- Copyright information date changed to 2020.
- Updated Introduction to the latest standard.
- Changes in Description and Operation section:
  - Updated the specifications of external starting power supply limitations in the Table 1.
  - Updated Table 2 for specifications of starter-generator weight, QAD Kit weight and Overhung moment with QAD Kit for various models.
  - Updated Table 3 for mounting flange and drive shaft specification for the models 23069-021, -024, -025.
  - Added Bearing Shield P/N 23088-1346 for models 23069-015-1, -004-1 along withMOD information in the Table 4.
  - Updated Table 3 for mounting flange and drive shaft specification for the models 23069-021, -024, -025.
  - Added Bearing Shield P/N 23088-1346 for models 23069-015-1, -004-1 along withMOD information in the Table 4.

- Changes in Testing and Fault Isolation section:
  - Updated Table 1001 for the models 23069-020-1,-015,-024,-025 for combinationof self-cooled and forced air cooled.
  - Added Residual Voltage Test in the Table 1004: Fault Isolation.
  - Added model applicability for the Speed Pickup Test, Speed Pickup Dielectric Test, Starter No Load Speed and Radial Vibration Test in the Table 1004: Fault Isolation.
  - Added model applicability for the Speed Pickup Dielectric Test, Starter No Load Speed and Radial Vibration Test in the Table 1005: Data Sheet.
- Changes in Disassembly section:
  - Added warning for the Table 3001 - Disassembly Tools.
  - Separated the procedure point 4.L.(2) for the model 23069-016-1 to indicate thecorrect amount and type of screws and washers.
  - Updated the procedure point for the MOD information for the models 23069-015-1and -004-1 in the Paragraph 4.S.
- Changes in Cleaning section:
  - Added Table 4001 - Cleaning Tools.
- Changes in Repair section:
  - Added warning for the Table 6001 - Repair Tools.
  - Updated Table 6002 for the insulating tape material address and vendor code.
  - Incorporated TR 24-10 for the commutator refinishing procedure.
  - Updated the torque value for the blind rivet nut (15) from 45 lbf.in. (5,1 Nm) to 25 lbf.in. (2,82 Nm).
  - Updated the terminal studs removal procedure (Paragraph 19.A.) as per the GSIL 2015-01.
  - Updated the terminal studs installation procedure (Paragraph 19.A.) as per the GSIL 2015-01.

- Changes in Assembly section:
  - Added warning for the Table 7001 - Assembly Tools.
  - Updated the torque value for the bolts (45) and center bolt (60) from 20 to 25 lbf.in. (2,3 to 2,8 Nm) to 22.7 to 35 lbf.in. (2,6 to 3,9 Nm).
  - Updated the procedure point for the MOD information for the models 23069-015-1and -004-1 in the Paragraph 7.A.(4).
- Changes in Fits and Clearances section:
  - Updated tolerance value for the temperature for terminal block P/N 23069-1238. in the Table 8001 - Acceptance Limits.
  - Incorporated TR 24-08 in the Table 8002 - Torque Limits.
- Changes in Special Tools, Fixtures and Clearances section:
  - Incorporated TR 24-09 for the Figure 9001 Armature Shaft Adapters.
- Changes in Illustrated Parts List section:
  - Corrected the indenture level for the item -35, -35A, -35B in the IPL 10001.
  - Corrected the replaced by information for the item -65C, -65D, -65E in the IPL 10001.
  - Added alternate P/N 01-200376 for the item -101B in the IPL 10001.
  - Corrected the SUPSD BY P/N from 23094-1304 to 23093-1304 for the item 105.
  - Added Bearing Shield P/N 23088-1346 as the item -276B in the IPL 10001 as per the SB 23069-015-1-24-11 for models 23069-015-1,-004-1.
  - Added stud lock P/N 02-4089-07 for the stator and housing assembly 23069-1536 in the IPL 10004.

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

THIS PAGE INTENTIONALLY LEFT BLANK

RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	Mar 30/84	Mar 30/84	SP
1	Jan 15/85	Jan 15/85	SP
2	Sep 25/97	Sep 25/97	SP
3	Sep 20/00	Sep 20/00	SP
4	Aug 12/03	Aug 12/03	SP
5	Dec 16/11	Dec 16/11	SP
6	Feb 13/15	Feb 13/15	SP
7	Jan 20/20	Jan 20/20	Safran

Revision Number	Date Issued	Date Inserted into CMM	Initials

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

RECORD OF TEMPORARY REVISIONS

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials
TR 24-01	Various	Mar 14/03	Mar 14/03	SP	Dec 16/11	SP
TR 24-02	Various	Jul 28/03	Jul 28/03	SP	Dec 16/11	SP
TR 24-03	Various	Dec 10/03	Dec 10/03	SP	Dec 16/11	SP
TR 24-04	Various	Sep 13/04	Sep 13/04	SP	Dec 16/11	SP
TR 24-05	Various	Feb 22/05	Feb 22/05	SP	Dec 16/11	SP
TR 24-06	Various	Jan 11/06	Jan 11/06	SP	Dec 16/11	SP
TR 24-07	Various	Jan 31/08	Jan 31/08	SP	Dec 16/11	SP
TR 24-08	8006	Apr 05/16	Apr 05/16	Safran	Jan 20/20	Safran
TR 24-09	9002	Apr 05/16	Apr 05/16	Safran	Jan 20/20	Safran
TR 24-10	6011	Jun 23/16	Jun 23/16	Safran	Jan 20/20	Safran
TR 24-11	6003	Nov 05/19	Nov 05/19	Safran	Jan 20/20	Safran

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials

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

SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
23069-013-24-01	Incorporated	-	Jul 27/90	23069-0XX-24-05	Incorporated	1	Jan 12/00
23069-015-1-24-01	Superseded	-	Oct 15/90	23069-0XX-24-06	Limited Distribution	-	Jul 7/99
23069-015-1-24-02	Superseded	1	Apr 22/94	23088-107X-24-01	Incorporated	-	Apr 9/09
23069-015-1-24-03	Incorporated	-	May 10/94	23069-013-1-24-01	Incorporated	-	Oct 26/12
23069-015-1-24-04	Incorporated	1	May 21/96	23069-0XX-24-07	Incorporated	-	Apr 25/13
23069-015-1-24-05	Incorporated	1	May 24/96	23069-02X-24-01	Limited Distribution	-	Nov 12/13
23069-015-1-24-06	Incorporated	2	Oct 22/97	23069-015-1-24-11	Incorporated	-	Aug 30/19
23069-015-1-24-07	Incorporated	-	May 21/96				
23069-015-1-24-08	Valid	-	May 31/96				
23069-015-1-24-09	Valid	-	May 31/96				
23069-015-1-24-10	Limited Distribution	1	Jan 18/13				
23069-016-1-24-01	Superseded	1	Apr 22/94				
23069-020-1-24-01	Incorporated	1	Jan 12/00				
23069-021-24-01	Superseded	3	Jan 12/00				
23069-021-24-02	Incorporated	1	Jan 12/00				
23069-024-24-01	Limited Distribution	1	Jul 30/09				
23069-025-24-01	Limited Distribution	1	Jul 30/09				
23069-00X-24-01	Incorporated	1	Oct 16/90				
23069-0XX-24-01	Incorporated	-	Oct 2/90				
23069-0XX-24-02	Incorporated	3	Jul 7/99				
23069-0XX-24-03	Incorporated	1	Jul 7/99				
23069-0XX-24-04	Incorporated	2	Jul 7/99				

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued

Retain this record in front of CMM. On receipt of service bulletins, record service bulletin number, status (valid or invalid), revision number (if applicable) and date issued. Unless invalidated, all service bulletins affecting the 23069 Series of DC Starter-Generators should be kept with CMM.

SERVICE INFORMATION LETTER LIST

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued
02-5600	Incorporated	4	Jul 07/15	23069-013-24-01	Limited Distribution	2	Apr 12/19
03-6009-XX-01	Valid	-	May 02/95	23069-013-24-02	Limited Distribution	1	Jan 16/19
23072-1400-01	Incorporated	1	Feb 07/94				
23075-120X-01	Superseded	1	May 22/90				
23075-1230-01	Incorporated	-	Feb 13/92				
23069-015-1-01	Valid	-	Jul 14/89				
23069-015-1-02	Limited Distribution	-	May 10/94				
23069-015-1-03	Limited Distribution	1	Jun 26/95				
23069-015-1-04	Limited Distribution	-	May 21/96				
23069-16-01	Limited Distribution	-	Jun 26/95				
23069-00X-01	Invalid	-	Sep 09/87				
23069-00X-02	Invalid	-	Sep 09/87				
23069-00X-03	Incorporated	-	Aug 18/88				
23701	Valid	1	Jun 19/00				
23703	Incorporated	-	Jan 24/97				
23704	Cancelled	1	Sep 05/08				
GSIL 2006-01	Incorporated	-	Sep 26/06				
GSIL 2006-02	Incorporated	1	Feb 10/09				
GSIL 2006-03	Incorporated	-	Sep 15/06				
GSIL 2008-01	Valid	-	Feb 29/08				
GSIL 2011-01	Valid	-	Dec 16/11				
GSIL 2015-01	Valid	-	May 08/15				

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

Retain this record in front of the CMM. On receipt of Service Information Letters, record the Service Information Letter number, status, revision number (if applicable) and date issued. Unless invalidated, all Service Information Letters affecting the 23069 Series of DC Starter-Generators should be kept with the CMM.

LIST OF EFFECTIVE PAGES

LIST OF EFFECTIVE PAGES (Continued)

LIST OF EFFECTIVE PAGES (Continued)

LIST OF EFFECTIVE PAGES (Continued)

LIST OF EFFECTIVE PAGES (Continued)

LIST OF EFFECTIVE PAGES (Continued)

LIST OF EFFECTIVE PAGES (Continued)

LIST OF EFFECTIVE PAGES (Continued)

TABLE OF CONTENTS

Title **Page**

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS (Continued)

LIST OF TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for service and overhaul of the 23069 Series DC Starter-Generators. Line maintenance is supported by Maintenance Manual (MM) 23700. A DC Starter-Generator overhaul includes:

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

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

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

Only an overhaul and an acceptance test can authorize the assignment of zero operating hours Time Since Overhaul (TSO) to a DC Starter-Generator. Repairs performed that are part of an overhaul do not affect TSO and the equipment is released on a continued time basis.

An illustrated parts list is included at the back of this CMM for part 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 aircraft CMMs. This manual is formatted to conform to ATA Specification No. 100.

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

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

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

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

2. User Qualification and Certification Requirements

The information contained in this manual is to be used 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 145.33.)

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

3. Quality Assurance Requirements

The repair station's 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 used shall be calibrated and controlled per ISO 10012-1 with all standards traceable to the National Bureau of Standards or an equivalent standards regulatory authority.

Quality Assurance shall be responsible for certifying that personnel, skills, and materials meet the requirements of the work to be performed. Quality assurance shall also maintain documented evidence that specifications (applicable to special processes such as soldering, non-destructive testing, plating, etc.) have been complied with during repair and/or overhaul of the starter-generator.

Components of the starter-generator undergoing overhaul that are recovered as products of disassembly shall be examined 100% to determine serviceability.

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

4. Safety Advisory

This manual describes physical and chemical processes that require the use of commercially available materials that state precautionary measures to be followed.

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.

Give careful attention to applicable warnings and cautions. Before starting any 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 fixture are on hand.

Warnings, Cautions and Notes are used throughout the text to highlight and emphasize important points, as they become necessary. Warnings give information that must be followed precisely to avoid personal injury and/or possible death. Cautions contain information that must be followed to avoid damage to equipment. Notes assist the reader and make the technician's job easier.

5. 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, USA 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 authorized 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 Safran Power, USA warranty or service policy for any product or for any application.

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

6. 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
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
Λ	Ohm

7. Abbreviations

This manual contains these abbreviations.

ADE	Anti-drive End
AR	As Required
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
SP	Safran Power
SPD	Standard Practice Document
SI	System International
TIR	Total Indicated Runout

THIS PAGE INTENTIONALLY LEFT BLANK

DESCRIPTION AND OPERATION

1. Introduction

The 23069 Series DC Starter-Generators operate as a motor providing torque for engine starting and (after engine startup) generating DC electrical power.

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

At the drive end, a dampener assembly absorbs torsional vibration generated by changes in engine gearbox speed and electrical load conditions. The dampener assembly consists of a dampener plate, a friction ring, and a dampener backplate. At the drive end is a speed pickup providing a signal, for starter cut-off, to the generator control unit (GCU).

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

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

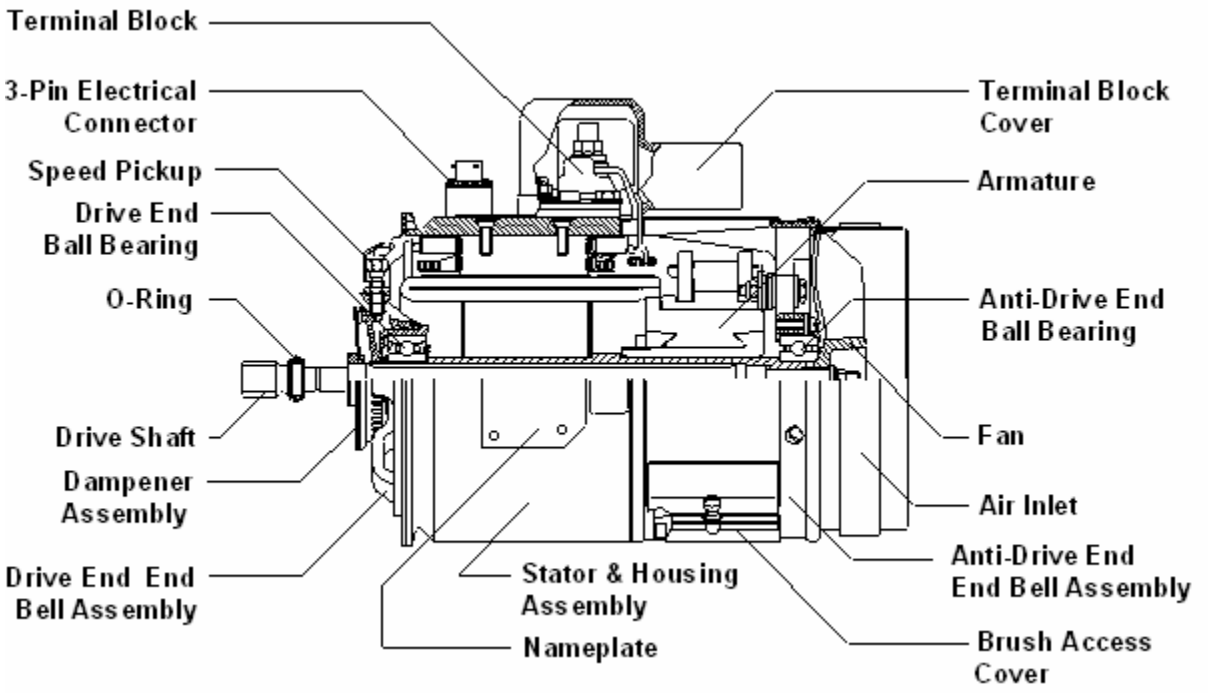


Figure 1 - Typical DC Starter-Generator Features

2. Equipment Specifications

Characteristic	Model Number	Specification
Output rating	All models	9 kW
Rating for continuous load within speed range	23069-013 23069-013-1 23069-015 23069-020	300 amps, 30 V DC, 6,950 to 12,000 RPM.
	23069-015-1 23069-16 23069-016-1	300 amps, 29.5 V DC, 7,200 to 12,000 RPM.
	23069-020-1 23069-021 23069-024 23069-025	300 amps, 30 V DC, 7,200 to 12,000 RPM
External starting power supply limitations	23069-013 23069-013-1 23069-015-1 23069-16 23069-016-1 23069-020 23069-020-1 23069-024	1,700 amps Max., Self limiting with 30 V Max.
External starting power supply limitations	23069-015 23069-021 23069-025	1,700 amps Max., Self limiting with 28 V Max.
Direction of rotation	All models	COUNTERCLOCKWISE as viewed from drive end.
Air inlet opening	23069-013-1 23069-015-1 23069-16 23069-016-1*	3.00 in. (76,2 mm) diameter *Model 23069-016-1 has two application specificair inlets.
	23069-020	5.53 in. (140,5 mm) diameter
	23069-016-1* 23069-020-1 23069-021 23069-024 23069-025	2.50 in. (63,5 mm) diameter
	All other models	5.50 in. (139,7 mm) diameter
Cooling	All models	Self-cooled during ground operations. Combination self-cooled and blast-cooled in flight.
Cooling air pressure	All models	6 inches H_20

Table 1 - Electrical Performance and Physical Characteristics

Characteristic	Model Number	Specification
Terminal designations	23069-015-1 23069-16 23069-016-1	Shunt start: B+Positive E–Negative A+Shunt Field D Equalizer
	All other models	Series start:B+Positive E–Negative C+Starting A+Shunt Field D Equalizer
Starter-Generator Mounting	23069-015-1 23069-16	Direct mount
	All other models	QAD mount

Table 1 - Electrical Performance and Physical Characteristics (Continued)

Characteristic	Model Number	Specification
Starter-Generator Max. Weight	23069-013	28.8 lbs. (13,06 kg) Max. without QAD kit
	23069-013-1	28.3 lbs (12,8 kg) Max. without QAD kit
	23069-015	28.4 lbs (12,9 kg) Max. without QAD kit
	23069-015-1 23069-16	28.7 lbs (13,01 kg) Max. 29.4 lbs (13,3 kg) Max.
	23069-016-1	28.3 lbs (12,8 kg) Max. without QAD kit and air inlet
	23069-020	28.2 lbs (12,7 kg) Max. without QAD kit
	23069-020-1	29.3 lbs (13,2 kg) Max. without QAD kit
	23069-021	29.3 lbs (13,2 kg) Max. without QAD kit
	23069-024	29.3 lbs (13,2 kg) Max. without QAD kit
	23069-025	29.3 lbs (13,2 kg) Max. without QAD kit
QAD Kit Max. Weight	23069-013	1.25 lbs (0,56 kg) Max.
	23069-016-1	1.30 lbs (0,58 kg) Max.
	23069-021	1.40 lbs (0,63 kg) Max.
	23069-013-1	2.25 lbs (1,02 kg) Max.
	23069-015	1.30 lbs (0,58 kg) Max. P/N: 23069-502
		2.40 lbs (1,09 kg) Max. P/N: 23069-509
	23069-020	QAD kit furnished by customer
	23069-020-1	1.90 lbs (0,86 kg) Max.
	23069-024	1.90 lbs (0,86 kg) Max.
	23069-025	1.40 lbs (0,59 kg) Max.

Table 2 - Overhung Moment and Weight

Characteristic	Model Number	Specification
Air Inlet Max. Weight	23069-016-1	0.80 lbs (0,36 kg) Max. P/N: 23069-1740
		0.20 lbs (0,09 kg) Max. P/N: 23069-1430
Overhung Moment with QAD Kit	23069-013	130 lbf.in. (14,7 N·m) approximate
	23069-013-1	153 lbf.in. (17,3 N·m) approximate
	23069-015	131 lbf.in. (14,8 N·m) approximate
	23069-015-1	125 lbf.in. (14,1 N·m) Max.
	23069-16	133 lbf.in. (15,0 N·m) Max.
	23069-020-1	145 lbf.in. (16,4 N·m) Max.
	23069-016-1	130 lbf.in. (14,7 N·m) Max. w/23069-1740 air inlet
		125 lbf.in. (14,1 N·m) Max. w/23069-1430 air inlet
	23069-020	127 lbf.in. (14,3 N·m) approximate
	23069-021	139 lbf.in. (15,7 N·m) Max.
	23069-024	145 lbf.in. (16,4 N·m) Max.
	23069-025	139 lbf.in. (15,7 N·m) Max.

Table 2 - Overhung Moment and Weight (Continued)

Characteristic	Model Number	Specification
Mounting Flange and Drive Shaft Mating Specification	23069-013 23069-013-1	Spline and QAD mounting flange conform to MS3331-1P mating with MS3326-2 drive pad.
	23069-015	Spline and QAD mounting flange conform to AND10262-XII-A or AND10262 (modified) mating with AND20002-XII-A drive pad.
	23069-015-1 23069-16	Spline and end bell mounting flange conform to MS3331-1 mating with MS3326-2 drive pad.
	23069-016-1	Spline and QAD mounting flange conform to MS3331-P mating with MS3326-2 drive pad.
	23069-020	Spline and QAD mounting flange conform to MS18056. Drive pad is specified by customer.
	23069-020-1 23069-021 23069-024 23086-025	Spline conforms to AS972. QAD mounting flange conforms to MS3331-1P mating with MS3326-2 drive pad.

Table 3 - Mounting Flange and Drive Shaft Specifications

Characteristic	Model Number	Specification
Drive Shaft	23069-013 23069-013-1 23069-016-1 23069-020-1 23069-021 23069-024 23069-025	Shear torque: 1600 lbf.in. (180,8 N·m) Max. Number of teeth: 12 Pitch diameter: 0.6000 in. (15,240 mm)
	23069-015	Shear torque: 1700 lbf.in. (192,1 N·m) Nom. Number of teeth: 16 Pitch diameter: 0.800 in. (20,32 mm)
	23069-015-1 23069-16	Shear torque: 1500 lbf.in. (169,5 N·m) Max. Number of teeth: 12 Pitch diameter: 0.6000 in. (15,240 mm)
Drive Shaft	23069-020	Shear torque: 700 lbf.in. (79,1 N·m) Max. Number of teeth: 16 Pitch diameter: 0.800 in. (20,32 mm)

Table 3 - Mounting Flange and Drive Shaft Specifications (Continued)

3. Equipment Improvements and Modifications

The DC Starter-Generators can incorporate one or more modifications. A modification is indicated by a letter in the MOD status box on the nameplate or modification status label. Information regarding modifications is listed in SERVICE BULLETIN LIST at front of this CMM.

4. MOD Status

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

23069-											Description
001	002	003	004	004-1	009	013	014	015	024	025	
A	-	A	-	-	-	-	-	-	-	-	03-6009-07 Bearing and 30300-1413 Brush
-	-	-	A	-	-	-	-	-	-	-	03-6009-07 Bearing
B	A	B	B	-	A	A	-	-	-	-	03-6009-18 Bearing
-	B	-	G	-	C	-	B	C	-	-	23069-355 Bearing and Brush Support Assembly
C	-	D	-	-	-	C	-	-	-	-	23069-356 Bearing and Brush Support Assembly

Table 4 - MOD Status

23069-											Description
001	002	003	004	004-1	009	013	014	015	024	025	
-	C	-	-	-	D	-	-	-	-	-	23088-1073 Drive End Bearing Support Assembly
-	-	C	E	-	B	B	D	A	-	-	03-6009-23 Bearing
-	-	-	C	-	-	-	-	-	-	-	03-6009-19 Bearing
-	-	-	D	-	-	-	-	-	-	-	23069-1503 Armature and 23069-1551 Drive End Bearing Support Assembly
-	-	-	F	-	-	-	C*	B*	-	-	23088-1321 Brush *See Note
F	-	E	-	-	-	D	A	D	-	-	23088-1072 Drive End Bearing Support Assembly
-	-	-	J	-	-	-	-	-	-	-	23069-1503 Armature and 23069-1552 Drive End Bearing Support Assembly
-	-	-	K	-	-	-	-	-	-	-	23069-1500 Armature and 23069-1552 Drive End Bearing Support Assembly
-	-	-	L*	A*	-	-	-	-	-	-	23088-1340 and 23088-1342 Bearing Shields, 23088-1350 Fan, 23069-359 Support Assembly and MS35206-227 Screws. *See Note
-	D	-	-	-	-	-	-	-	-	-	23093-1304 Brush
-	-	-	-	-	-	-	E	E	A	A	23093-1301 Brush
-	-	-	M	B	-	-	-	-	-	-	23088-1346 Bearing Shield

Table 4 - MOD Status (Continued)

23069-											Description
001	002	003	004	004-1	009	013	014	015	024	025	
NOTE: Electrical contact brushes P/N 30300-1410 have been superseded by P/N 23093-1304 in models 23069-002. Reference SB 23069-002-24-01.											
NOTE: Electrical contact brushes P/N 23088-1321 have been superseded by P/N 23093-1301 in models 23069-014/ -015. Electrical contact brushes P/N 30300-1413 have been superseded by P/N 23093-1301 in models 23069-014/ -015/ -024/ -025. Reference SB 23069-0XX-24-07.											
NOTE: Drive End Bearing Shield P/N 23088-1340 have been replaced by P/N 23088-1346 in models 23069-004/-004-1.											

Table 4 - MOD Status (Continued)

5. DC Starter-Generator Operation

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

A. Starter Operation

The 23069 Series of DC Starter-Generators operate either as a shunt or series start motor depending upon configuration.

Shunt Start – During engine start cycle, the aircraft power bus applies DC voltage across terminals B+ and E– supplying current to armature and stator windings. At the same time, voltage is applied to shunt field terminals A and E from GCU (Generator Control Unit). Starter power can be supplied by aircraft batteries or a ground power source. See Figure 2.

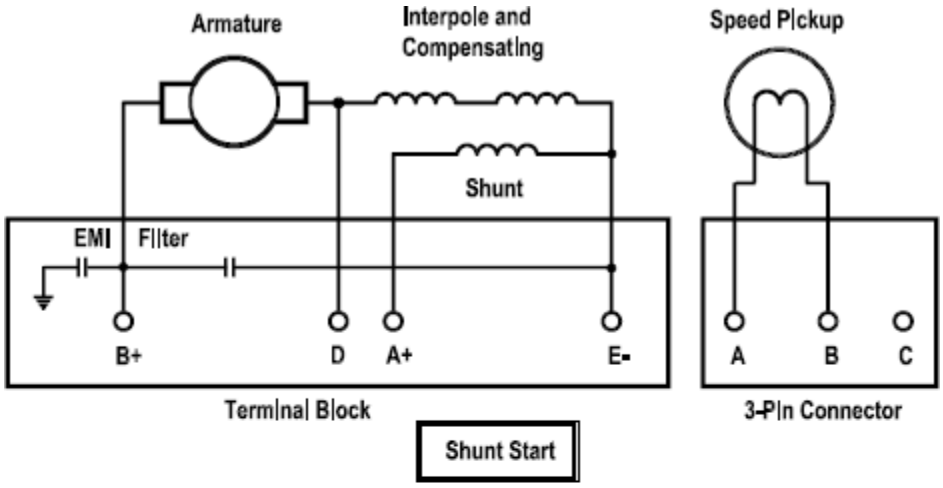
During engine start cycle (as rotational speed of armature increases) the magnetic flux, generated by shunt field windings, creates a back EMF (electromotive force) opposing voltage supplied by the starting power source. This causes armature current and starter output torque to decrease. Field weakening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

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

Series and Shunt - In a series-wound generator, output voltage varies directly with load current. In a shunt-wound generator, output voltage varies inversely with load current.

B. Generator Operation

Following starter operation, the GCU will build up output voltage from the generator residual voltage. During generator operation, the machine provides a DC output (terminals B+ and E–) regulated by the generator shunt field current (terminal A). By quickly reacting to changes in generator operating conditions such as engine speed or electrical load, the GCU regulates the current level provided to the generator shunt field (terminal A). By regulating the shunt field current, system voltage is maintained at a nominal 28 V DC.



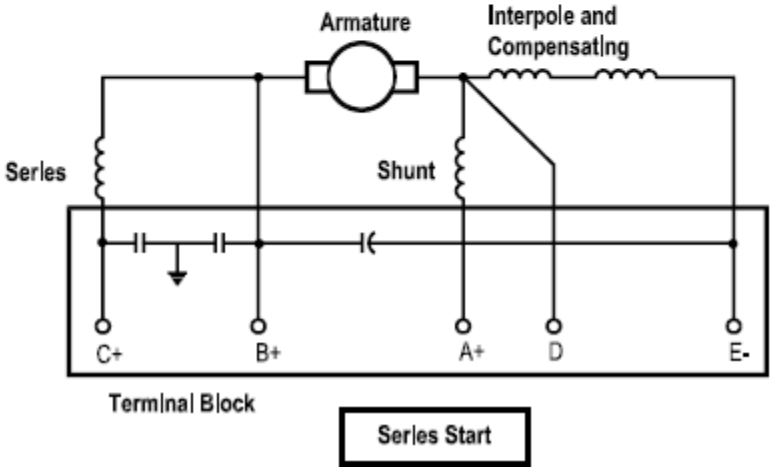


Figure 2 - DC Starter-Generator Schematic

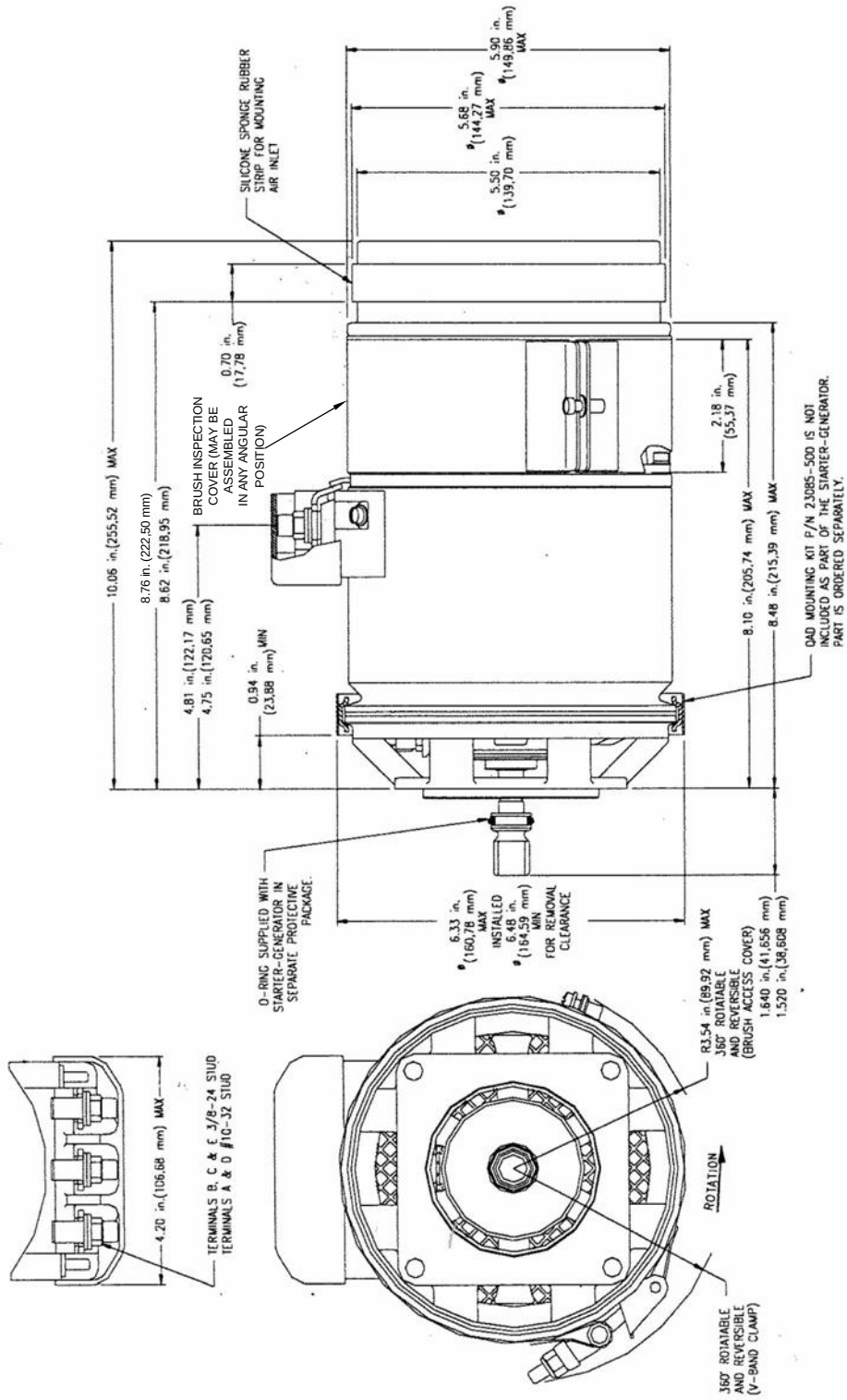


Figure 3 - Outline Drawing of 23069-013

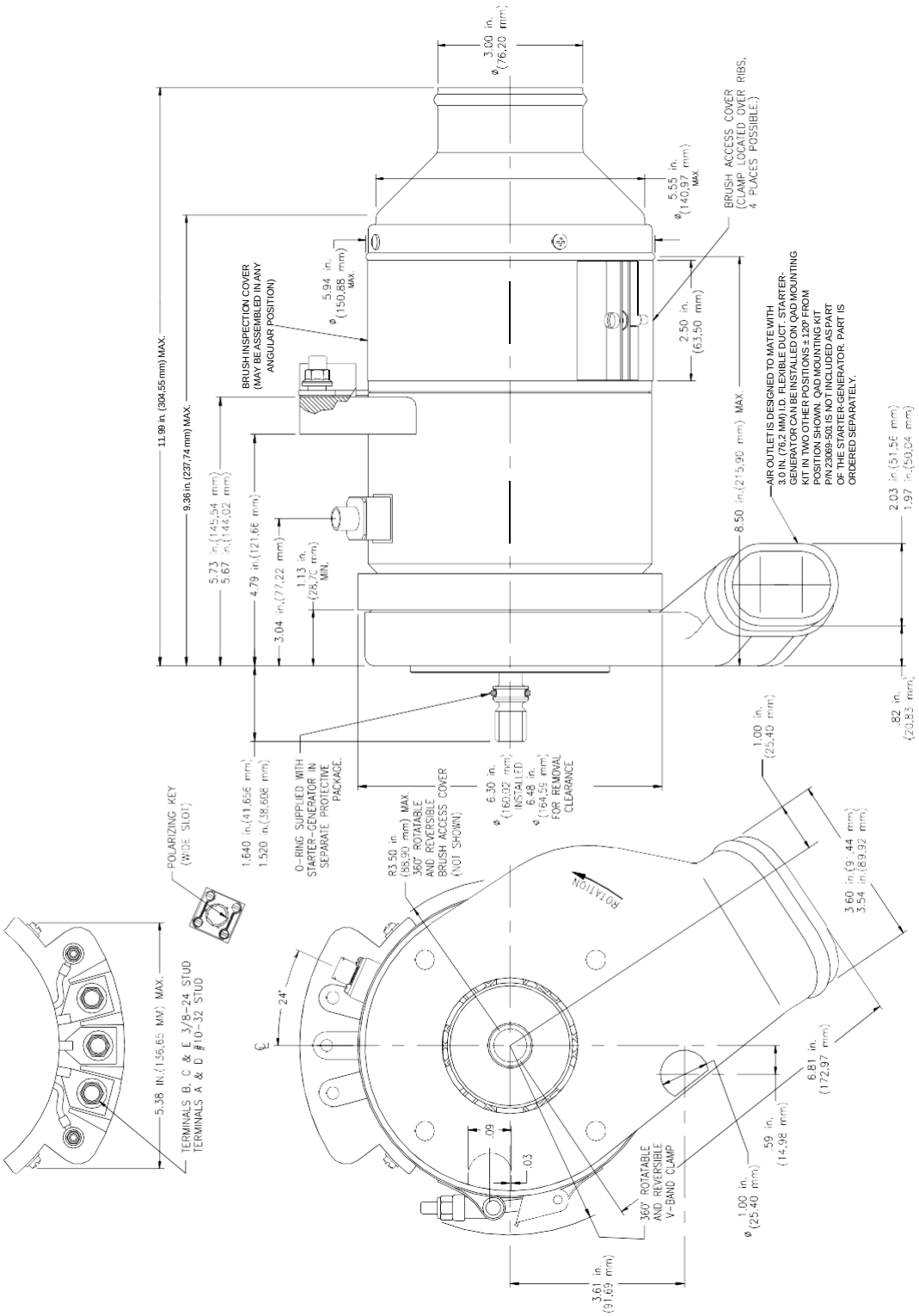


Figure 4 - Outline Drawing of 23069-013-1

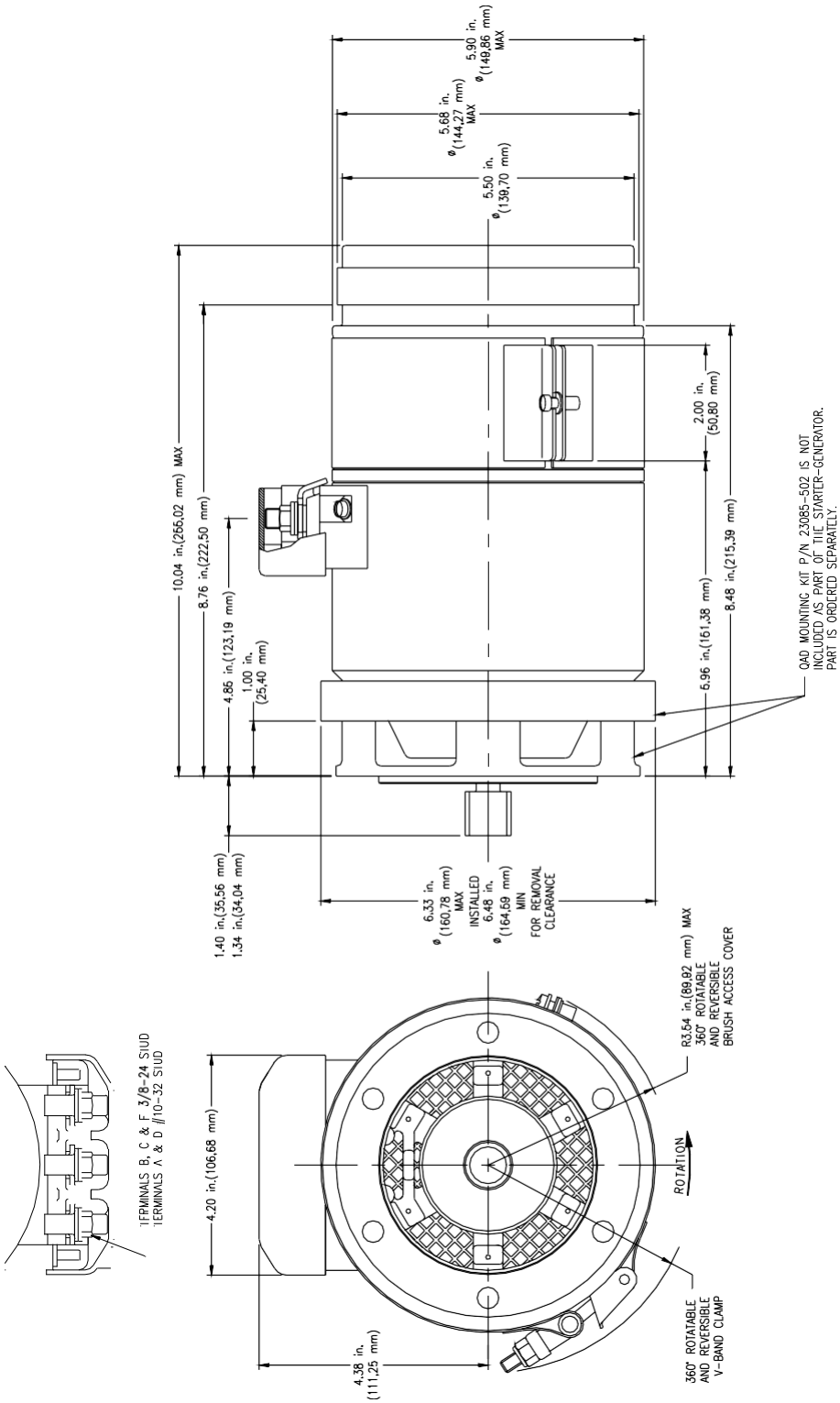


Figure 5 - Outline Drawing of 23069-015 (Sheet 1 of 2)

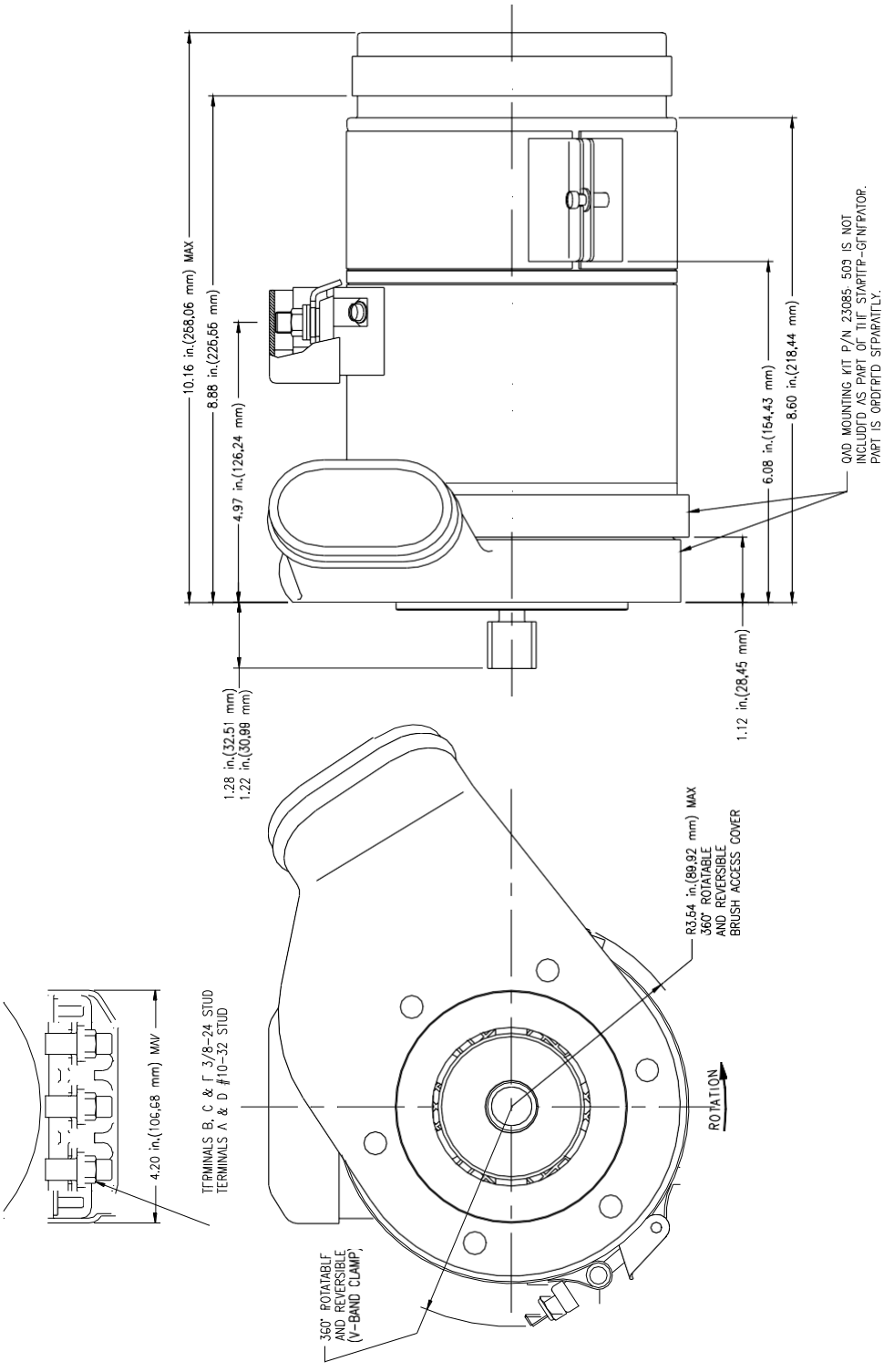


Figure 5 - Outline Drawing of 23069-015 (Sheet 2 of 2)

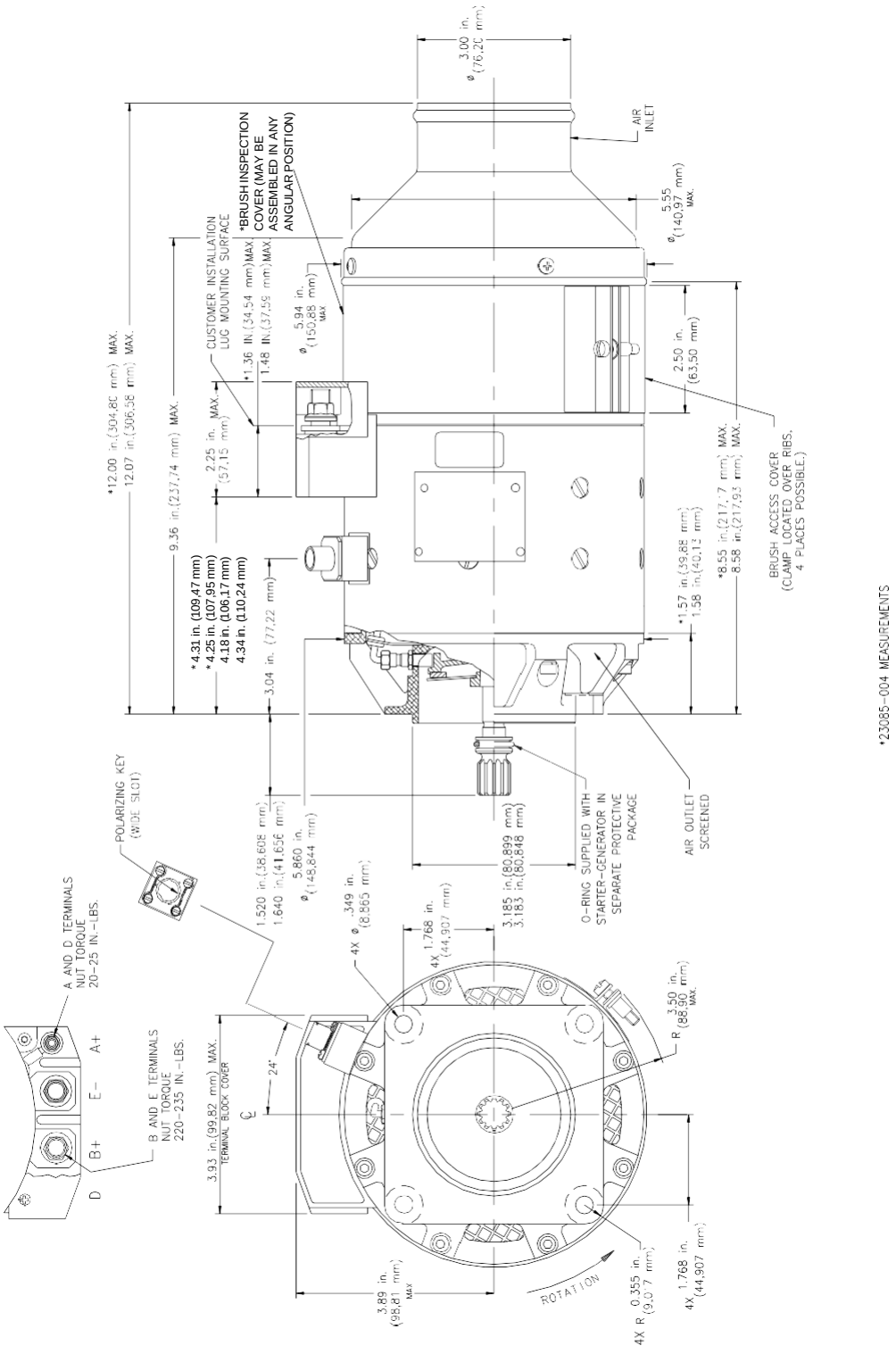


Figure 6 - Outline Drawing of 23069-015-1 and 23069-16

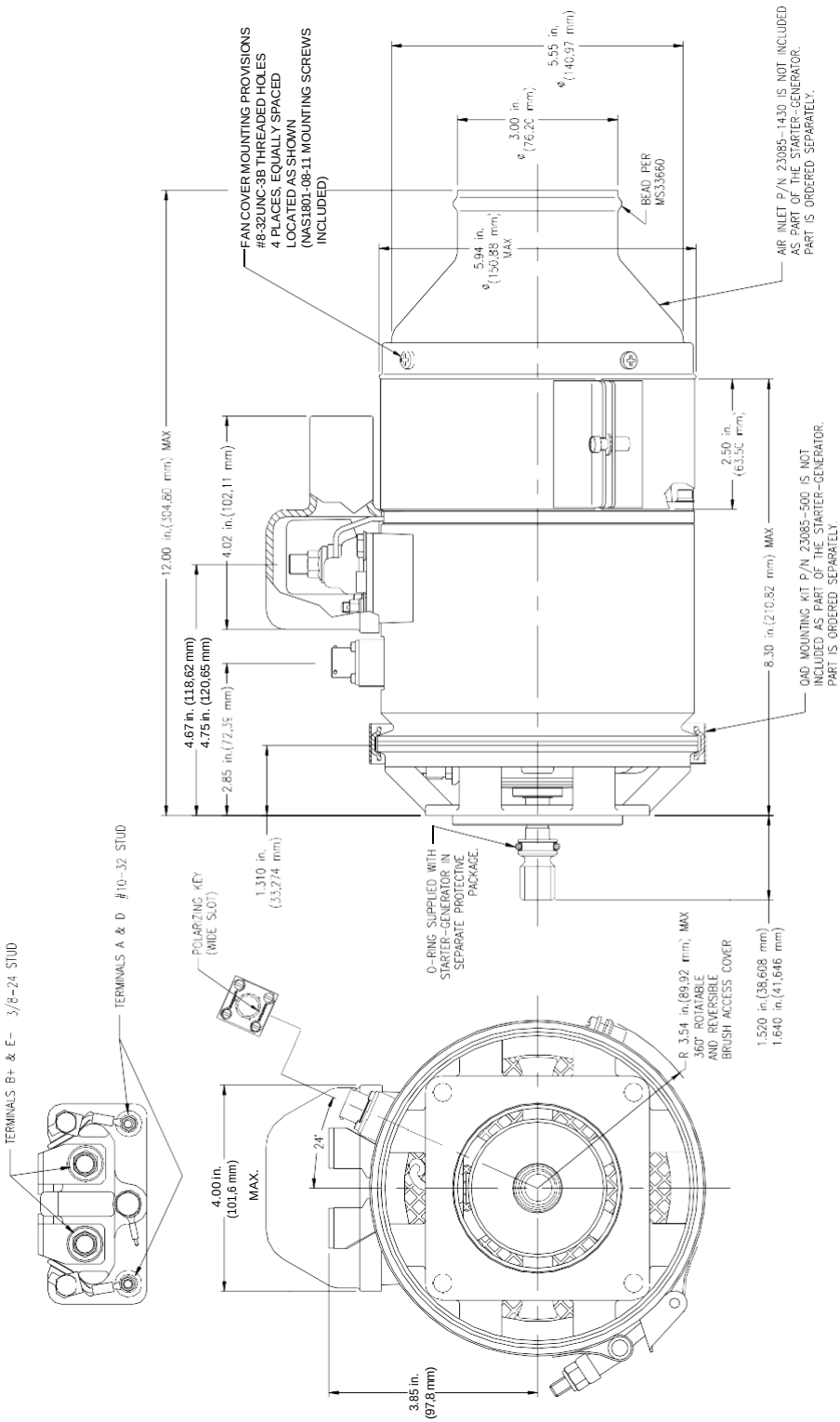


Figure 7 - Outline Drawing of 23069-016-1 (Sheet 1 of 2)

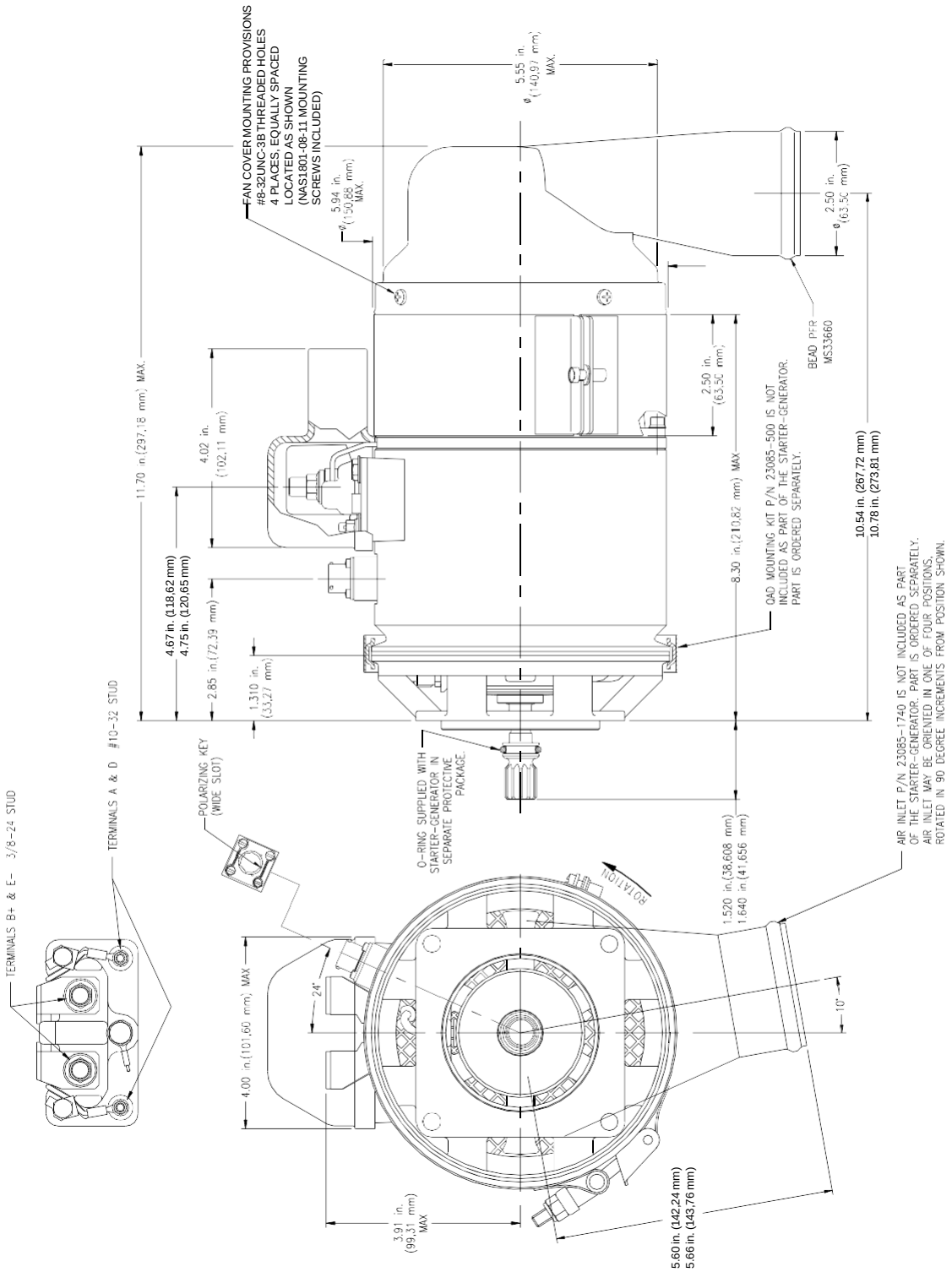


Figure 7 - Outline Drawing of 23069-016-1 (Sheet 2 of 2)

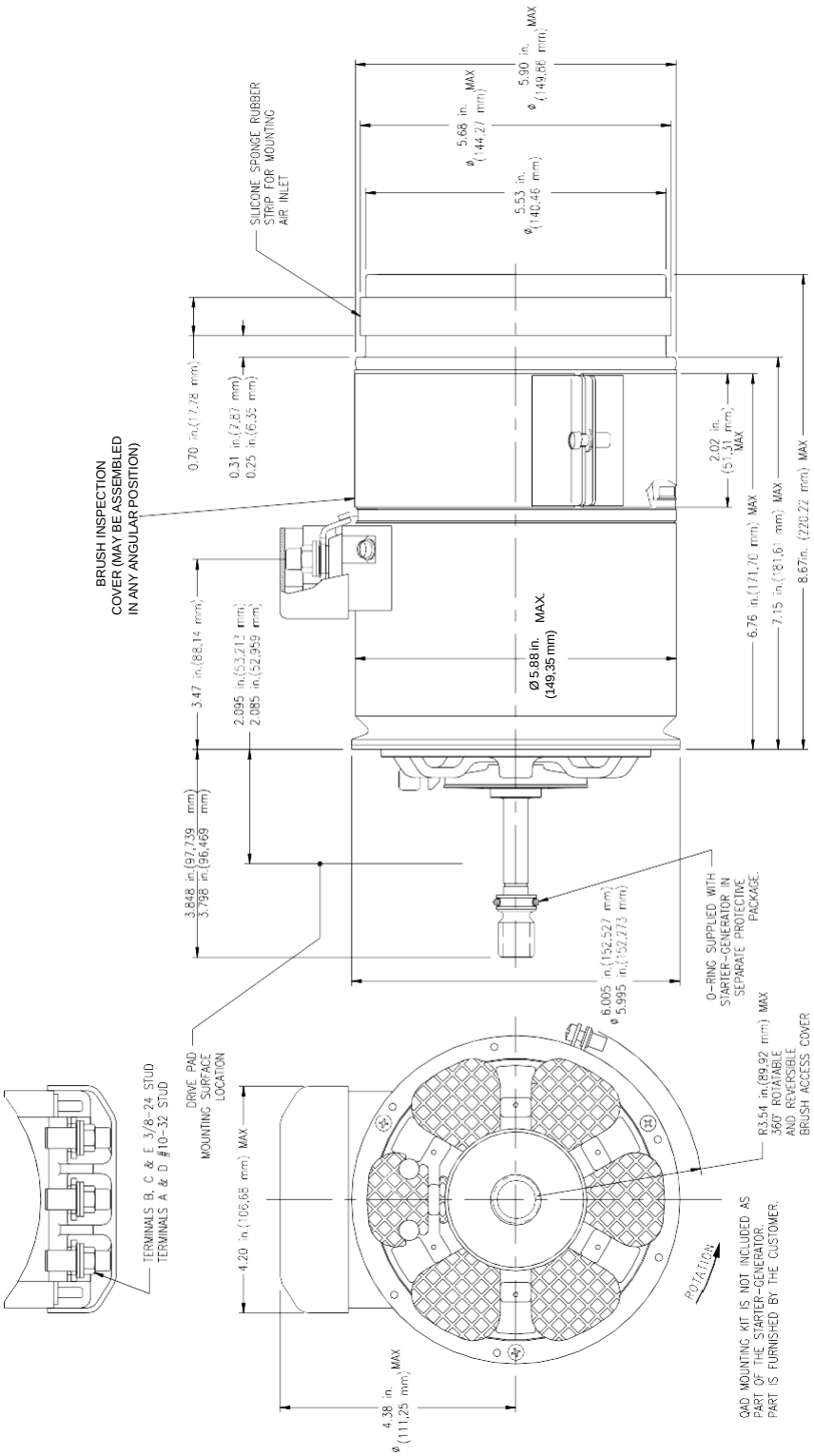


Figure 8 - Outline Drawing of 23069-020

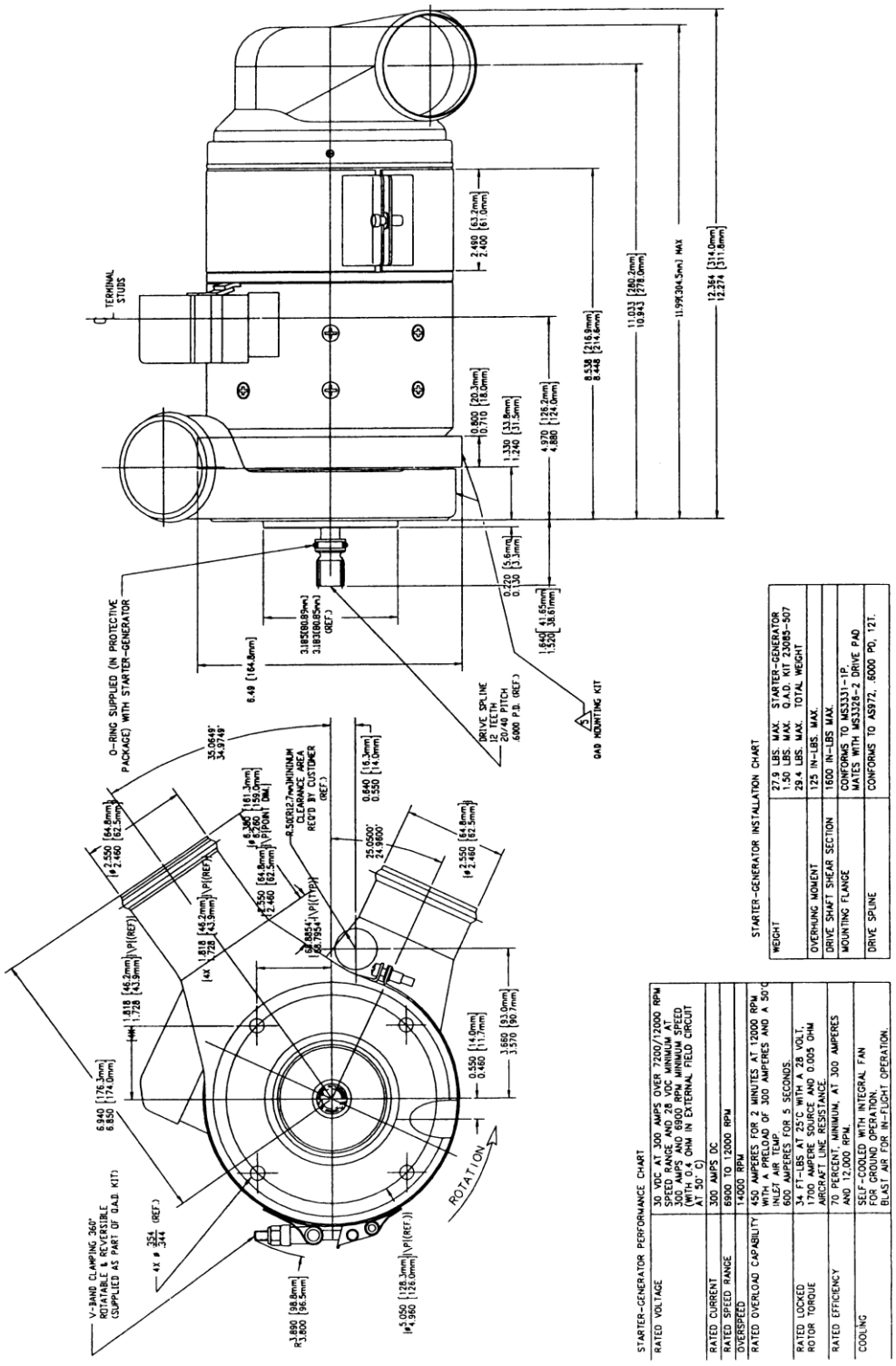


Figure 9 - Outline Drawing of 23069-020-1

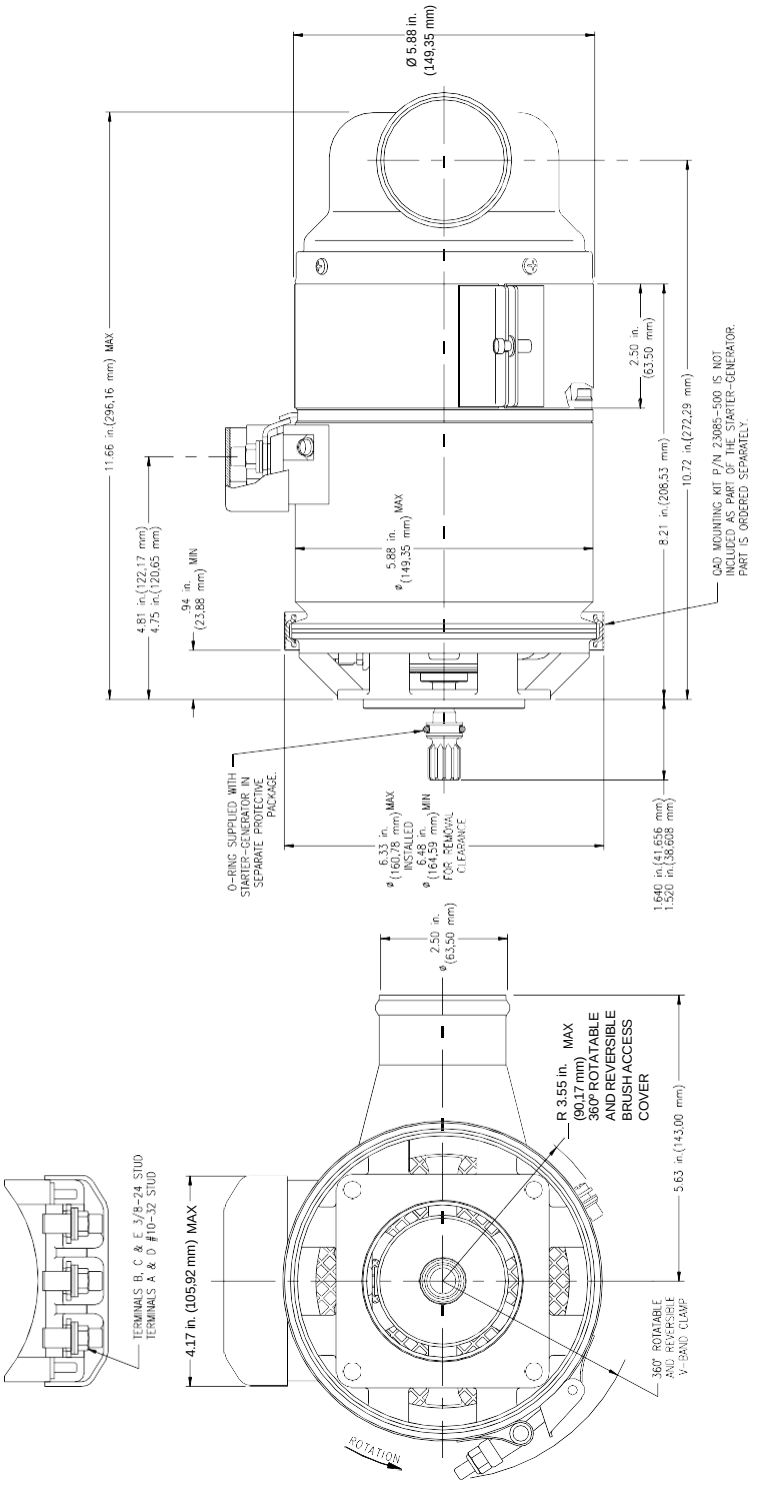


Figure 10 - Outline Drawing of 23069-021, -024, -025

TESTING AND FAULT ISOLATION

1. Introduction

WARNING: THE DC STARTER-GENERATOR CAN MAKE HIGH-OUTPUT CURRENT THAT CAN CAUSE DAMAGE TO EQUIPMENT OR BURNS TO YOUR SKIN. MAKE SURE ALL POWER IS CLOSED TO GENERATOR BEFORE YOU REMOVE OR REPLACE THE TEST EQUIPMENT, INSTRUMENTS, OR ASSEMBLIES. MAKE SURE TO BE VERY CAREFUL WHEN YOU DO ENERGIZED 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 section describes performance tests which are classified as either verification or acceptance tests. Verification testing assists in fault isolation or confirming the cause for removal (before repair or overhaul) of a starter-generator. Acceptance testing is conducted after overhaul. Record all test results on a copy of data sheet provided at the end of acceptance testing procedures.

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.

2. Test Conditions

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

Parameter	Operating Conditions
Ambient Temperature	50 to 104 °F (10 to 40 °C)
Barometric Pressure (For all models except 23069-001, -002, -003 and -013)	27 to 33 inch (914 to 1117 millibar) of mercury
Barometric Pressure (For models 23069-001, -002, -003 and -013)	Ambient Atmospheric at sea level up to 6000 feet.
Load Current Tolerance	± 5 Amps DC

Table 1001 - Performance Test Conditions

Parameter	Operating Conditions
Speed Tolerance	± 50 RPM
Mounting	Drive shaft must be in horizontal position.
Terminal Voltage Tolerance	±0.2 V DC
Forced Cooling Air	All the models are combination of self-cooled and force air cooled. Air pressure (static) equal to 6 in. (15,2 cm) H_20, measured 6 in. (15,2 cm) upstream of starter-generator air inlet. Self-cooled for minimum speed test.
	DELETED.
	Air inlet duct to be straight, 3 in. dia. x 36 in. long (7,6 cm dia. x 91,4 cm long.)
Brush Seating	100% in direction of rotation, 75% in axial direction. Refer to Safran Power Standard Practice Document SPD 1006 for Brush Installation, Seating, and Run-in procedures.

Table 1001 - Performance Test Conditions (Continued)

3. Test Equipment

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

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

Equipment	Range and Accuracy or Equipment Rating	Ref. Des.
Ammeter	0 to 10 Amps ± 1% of reading	A_1
Commutation Viewing Adapter	Special Tool - Figure 9002	--
DC Voltmeter	0 to 30 V DC ± 1% of reading	V_4
DC Voltmeter (2 req'd)	0 to 50 V DC ± 1% of reading	V_2, V_3
DC Voltmeter	0 to 50 mV DC ± 1% of reading	V_1

Table 1002 - Test Equipment

Equipment	Range and Accuracy or Equipment Rating	Ref. Des.
Dial Indicator with ball or mushroom indicator tip. Optional: Magnetic Base to fit dial indicator	Accuracy: 0.0001 inch	Not Illustrated
Dummy Terminal Block	Use dummy terminal block during testing to avoid damage to filter capacitors.	--
Generator Drive Stand	Range: To be able to test minimum operating speed at continuous load. Also, to be able to do the overspeed test at no load.	--
Generator Load Switch	30V, 300 amps	SW_1
Hi-Pot Tester	250 VAC RMS at commercial frequency	--
Manometer	0 to 10 inch (0 to 254 mm) H_20 ± 5% of reading	--
Oscilloscope	Digital: Bandwidth of 100 MHz Sampling rate of 100 MS/s Analog: Bandwidth of 60 MHz	--
Precision Shunt (Generator)	0 to 50 mV DC, 500 Amps	SH_1
Precision Shunt (Starter)	1000A, 100 mV DC	SH_1
Resilient Cradle or Wooden Cradle or V-block support	--	Not Illustrated
Shunt Field Switch	30 V DC, 10 Amps	SW_3
Strobe Light	--	Not Illustrated
Thermometer	65 to 300° ± 1° F (18 to 150° ± 0.45° C) (applies to display unit) or commercially available	--
Variable Load Bank	30 V DC, 0 to 300 Amps	--
Voltage Regulator Switch	30 V DC, 10 Amps	SW_2
Vibration Meter	Metrix vibration meter with probe magnet or equivalent	Not Illustrated
Voltage Regulator	0 to 30 V DC	--

Table 1002 - Test Equipment (Continued)

4. 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 lbf.ft (± 1,36 Nm)

Table 1003 - Setpoint Tolerances

5. Test Set Up

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

A. Perform an Initial Inspection

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

(2) Make sure a dummy terminal block is attached to stator and housing assembly before proceeding with Acceptance Testing.

B. Check each Brush Set for Correct Brush Seating

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

(1) Make sure all brushes (105) are correctly seated according to procedures in Safran Power Standard Practice Document 1006 (SPD 1006).

C. Clean the Starter-Generator

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

NOTE: It is not required to clean the starter-generator before acceptance testing but is recommended. The starter-generator can fail dielectric test if not properly cleaned.

(1) Refer to CLEANING section for details.

D. Attach Dummy Terminal Block to Starter-Generator or Remove Terminal Block Grounding Lead

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

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

(1) For all models except 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A': Make sure the slotted tongue terminal lugs of filter assembly (10002-60) are disconnected from the bearing retainer screws (260) and cover the leads with rubber caps or equivalent before proceeding with Acceptance Testing.

(2) For models 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A': Make sure the slotted tongue terminal lugs of filter assembly (10002-60) are disconnected from the anti-drive end end bell (10002-5A) and cover the leads with rubber caps or equivalent before proceeding with Acceptance Testing.

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

(4) Disconnect the terminal block ground lead as an optional procedure.

(a) For all models except 23069-016-1: Disconnect the terminal block groundby removing the screw (10004-45), lock washer (10004-50) and washer(10004-55) from the terminal block in front of the D terminal.

(b) For model 23069-016-1 only: Disconnect the terminal block ground by removing the screw (10004-60), lock washer (10004-65) and washer(10004-70A) from the terminal block.

E. Install Commutation Viewing Adapter (See Figure 1001 and Figure 9002)

(1) Remove air inlet (65). Refer to DISASSEMBLY section for details.

(2) Remove brush access cover (95). Refer to DISASSEMBLY section for details.

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

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

(3) Put commutation viewing adapter on bearing and brush support assembly (165).

CAUTION: DO NOT CENTER BRACKETS DIRECTLY OVER AN OPENING IN BEARING AND BRUSH SUPPORT ASSEMBLY.

(4) Center brackets of commutation viewing adapter over one rib of bearing and brush support assembly. See Figure 1001.

(5) Insert screw into blind rivet nut on bracket of commutation viewing adapter and tighten screw to a torque of 25 to 35 lbf.in. (2,8 to 3,9 N·m).

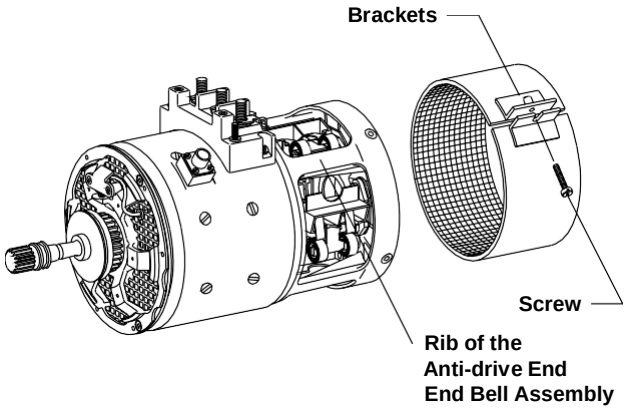


Figure 1001 - Installing Commutation Viewing Adapter

F. For QAD Kit Models

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

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

(1) Install spline adapter and mounting adapter (25) to drive stand.

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

(3) Make sure drive stand and mating spline are properly engaged.

(4) Install V-retainer coupling (10).

(5) Tighten the nut (15) to the torque mentioned on the V-retainer coupling (10).

G. For Direct Mount Models

(1) Install spline adapter to drive stand.

(2) While supporting anti-drive end, align and install to mounting pad.

(3) Make sure drive stand and mating spline are properly engaged.

(4) Secure starter-generator to drive stand.

H. Connect Starter-Generator to Electrical Test Circuit

(1) Turn all power OFF at drive stand.

(2) Connect starter-generator to test circuit, refer to Figure 1002.

(3) Assemble terminal block hardware to dummy terminal block, see Figure 10004. Refer to ASSEMBLY section for details.

(4) For all models: Torque the self-locking nuts (10004-10) to a torque of 220 to 235 lbf.in (24,86 to 26,55 N·m).

(5) For all models: Torque the self-locking nuts (10004-25) to a torque of 22.7 to 35 lbf.in (2,6 to 3,9 N·m).

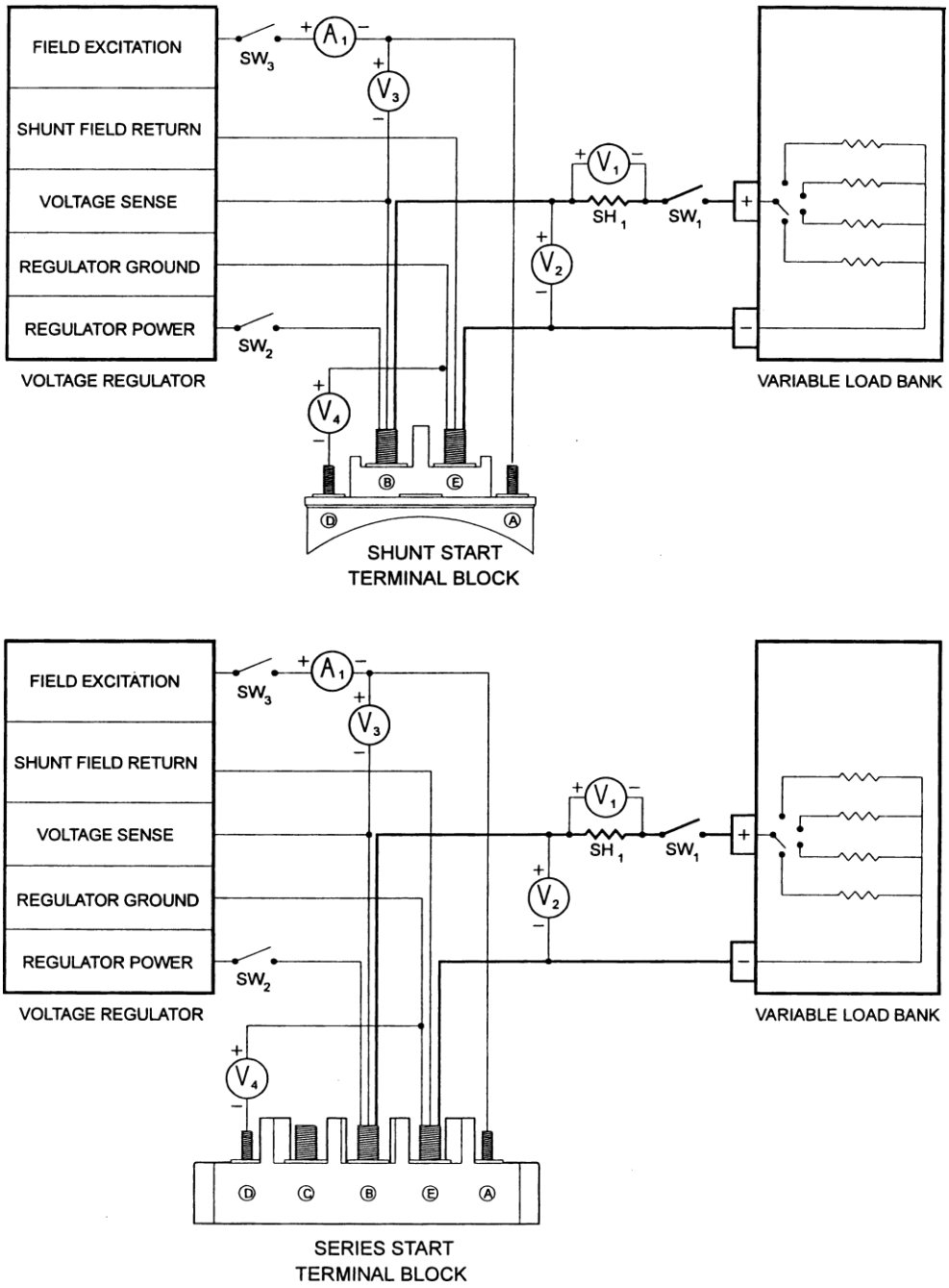


Figure 1002 - Generator Test Connection Diagram

6. Test Procedures

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.

Tests must be performed in the following sequence.

A. Continuous Operating Speed, Equalizing Voltage and Minimum Speed for Regulation

(1) Operating Instructions

(a) Install thermocouple to outside of housing assembly (adjacent to a main pole of stator).

(b) Operate starter-generator at 12,000 RPM, 30 V DC (V_2), 300 amps (V_1/SH_1) for 15 minutes.

(c) Record voltage between terminals "D" and "E", air-in temperature, and winding or frame temperature, then immediately operate generator at minimum speed for regulation:

NOTE: Stabilization not necessary.

1 For Series Start Models (23069-013, -002, -003, -013, -014, -015, -024 and -025): 7,200 RPM, 30V, 300 amps

2 For Shunt Start Models (23069-015-1, -004-1, -009): 6,550 RPM, 29.5V, 150 amps

(d) Record field current. Calculate resistance between terminals "B" and "A" by dividing B-A voltage by field current.

(e) For models 23069-020-1, -015, -024, -025 only, open the load bank (SW1)and field circuit (SW3) and record residual voltage "B" to "E".

(2) Acceptance Limits:

(a) D-E Voltage (V_4): Must be within limits of Figure 1003.

(b) Field Current (A_1): 10 amps Max.

(c) External Field Circuit Resistance (B-A): 0.5 Λ Min.

(d) Residual Voltage: 0.8 V Min. (Applicable to Models 23069-020-1, -015, -024,and -025 Only)

NOTE: Continue immediately with Minimum Speed Test.

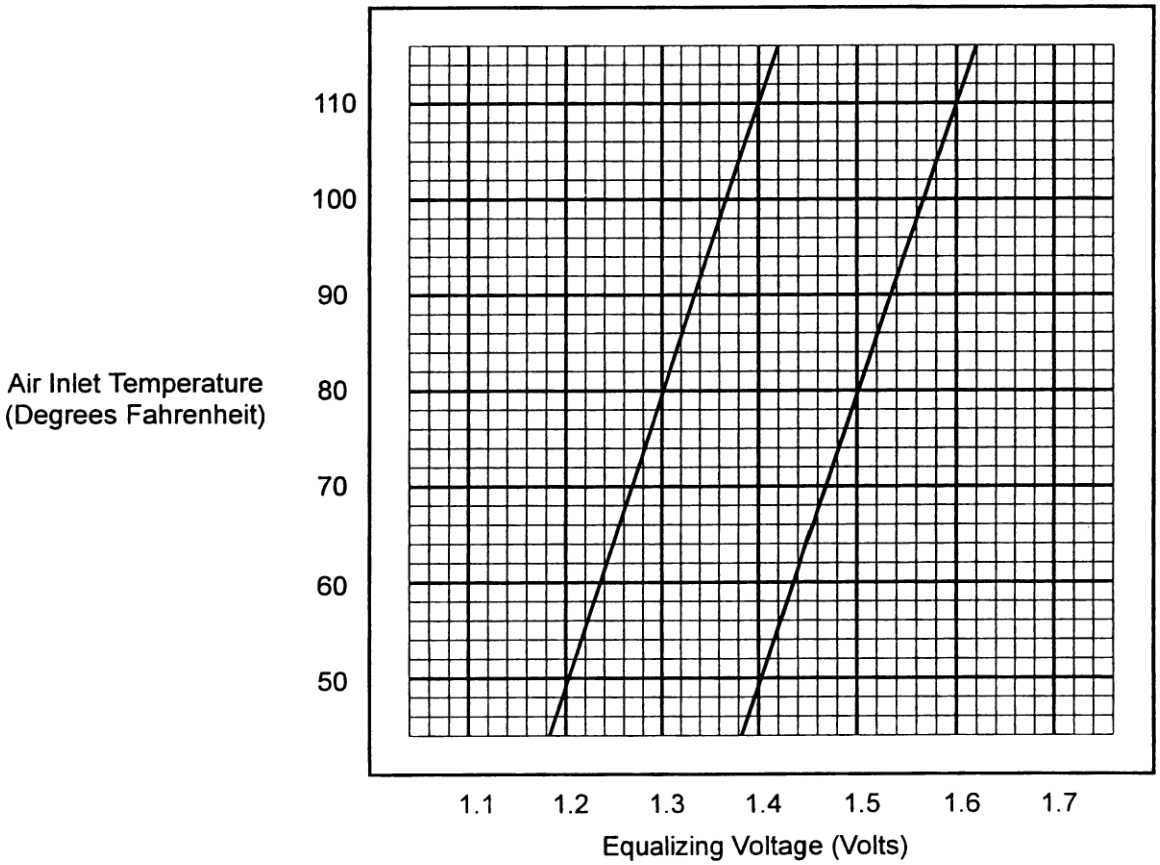


Figure 1003 - Equalizing Voltage Acceptance Limits

B. Minimum Speed Test (See Figure 1002)

NOTE: Stabilization not necessary.

(1) Operating Instructions

(a) For models 23069-013, -002, -003, -004, -004-1, -009 and -013 only: Disconnect air supply tube.

(b) For Shunt Start Models (23069-015-1, -004-1, -009): 6,100 RPM, 27.0 V DC (V_2), 150 A (V_1/ SH_1) for 15 minutes.

(c) For Series Start Models (23069-013, -002, -003, -013, -014, -015, -024 and -025): 6,950 RPM, 28.5 V DC (V_2), 300 A (V_1/ SH_1) for 15 minutes.

(d) Record voltage between terminals B and A (V_3) and field current at terminal A (A_1). Calculate resistance between terminals B and A by dividing B to A voltage (V_3) by field current (A_1).

(2) Acceptance Limits:

(a) Field current: 10.0 amps Max.

(b) External field circuit resistance (B-A): 0.5 Λ Min.

NOTE: Immediately proceed to Residual Voltage Test.

C. Residual Voltage Test

(1) Operating Instructions:

(a) Operate the starter-generator at 12,000 RPM with open load bank (SW1) and field circuit (SW3).

(b) Record residual voltage, B-E (V_2).

(2) Acceptance Limits:

(a) Residual voltage B-E (V_2): 3.6 V Max.

NOTE: Immediately proceed to overspeed test.

D. Overspeed Test

(1) Operating Instructions:

Increase the starter-generator speed to 14,000 RPM (with field switch open) for 5 minutes.

(2) Acceptance Limits:

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

E. Commutation Check (See Figure 1004)

(1) Operating Instructions:

Operate at 12,000 RPM, 30V DC (V_2), 300 A (V_1/ SH_1).

(2) Acceptance Limits:

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking to extend 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 the sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush must be considered “arcing”.

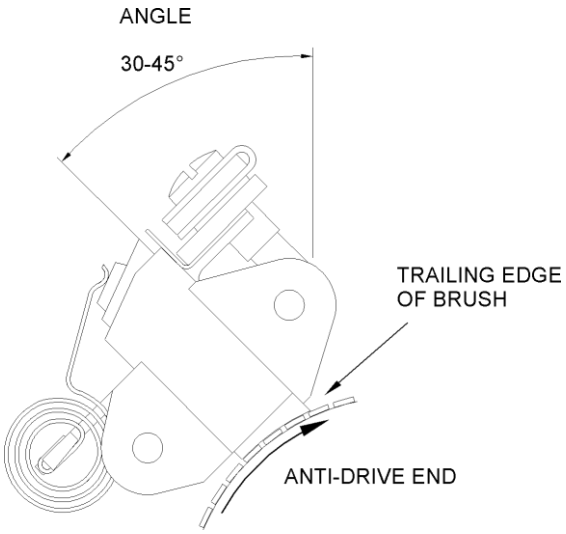


Figure 1004 - Correct Viewing Angles

F. Speed Pick-Up Test (Not Applicable on Models 23069-013, -003, -013, -014, -015, -024 and -025)

(1) Operating Instructions:

(a) Connect 20kΛ ± 10% load to speed pickup output connector with oscilloscope connected across connector (Pin A to Pin B). Observe the output voltage.

(b) Run generator at 6,000 RPM with field switch open.

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

(2) Acceptance Limits: (See Figure 1005)

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

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

(c) For models 23069-013-1: The frequency of the signal must be from 4350 to4450 Hz.

(d) For models 23069-015-1, -004-1 and -009: The frequency of the signal mustbe from 4150 to 4250 Hz.

NOTE: If unacceptable results are reached:

- Make sure correct dampener back plate and gear is used, refer to GSIL 2008-01.

- Adjust air gap of speed pickup for correct voltage reading and waveform.

(3) Disconnect and remove load from pins A and B of 3-pin connector (185).

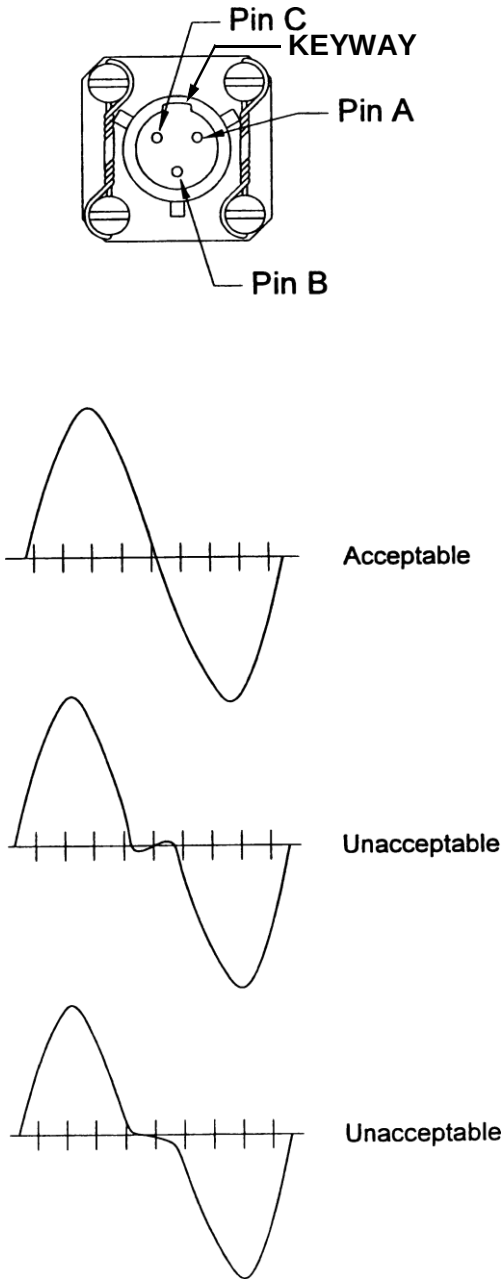


Figure 1005 - Speed Pickup Voltage Wave Form

G. Starter-Generator Dielectric Test

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

CAUTION: DO NOT DO 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.

(1) Operating Instructions:

(a) Turn all power off at generator drive stand.

(b) Disconnect starter-generator from test circuit.

(c) Disconnect stator leads from terminal block.

(d) Remove terminal block from stator.

(e) Make sure that a dummy terminal block is attached to the starter-generator, (Refer to Paragraph 5.D.) or make sure that the ground lead from the terminal block is isolated. EMI capacitors in terminal block will be damaged if subjected to dielectric test.

(f) Remove commutator viewing adapter.

(g) Connect all stator terminal leads (A+, B+, C+ where applicable, D and E-) of dummy terminal block together.

(h) Make sure the high potential tester is OFF and in safe condition to touch leads.

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

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

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

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

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

(l) Slowly decrease voltage to zero.

(m) Turn the power supply OFF.

(n) 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 no more than 5 mA will be evidence of damp, dirty, weak or defective components.

H. Speed Pick-Up Dielectric Test (Not Applicable on Models 23069-013, -003, -013, -014, -015, -024 and -025)

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

(1) Operating Instructions:

(a) Connect three pins of speed pick-up output connector together.

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

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

(c) Slowly decrease voltage to zero.

(d) Turn the power supply OFF.

(e) 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 no more than 2 mA will be evidence of damp, dirty, weak or defective components.

I. Starter No Load Speed and Radial Vibration Test (Not applicable to Models 23069-015-1, -004-1 and -009)

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

(1) Remove power from tester and dismount starter-generator.

(2) Mount starter-generator in a resilient cradle (foam rubber cushioned) with the drive shaft supported (centered).

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

(4) Connect a 0.2 Λ resistor between terminals A and C.

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

(6) With no mechanical load, gradually increase the voltage between terminals C and E until voltage reaches 28 V DC (V2).

(7) Record starter-generator speed.

(8) With a vibration meter, measure and record total frame vibration amplitude.

(9) Acceptance Limits:

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

(b) Total radial vibration amplitude must not be more than 0.001 inch (0,0254 mm) deflection.

(10) Turn power supply OFF.

(11) Remove starter-generator from resilient cradle.

J. Locked Rotor Test (See Figure 1006)

NOTE: This test is done during acceptance testing. The starter-generator must be overhauled, have an armature with a resurfaced commutator and has been balanced as per SPD 1001.

(1) Operating Instructions:

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

(b) Connect DC power supply ammeter and voltmeter to starter-generator terminals as shown in Figure 1006.

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

CAUTION: FOR MODELS MODELS 23069-013, -002, -003, -004, -004-1, -009, -013: DO NOT ENERGIZE STARTER-GENERATOR MORE THAN 5 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER IS MORE THAN 9.5 V OR 630 A WITH ARMATURE IN LOCKED CONDITION.

CAUTION: FOR MODELS 23069-020-1, -015, -024, -025: DO NOT ENERGIZESTARTER-GENERATOR MORE THAN 4 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER IS MORE THAN 9.5 VOR 630 A WITH ARMATURE IN LOCKED CONDITION.

(d) For Series Start Models (23069-013, -002, -003, -013, -014, -015, -024 and -025): With 0.2 Λ connected between terminals “A” and “C” quickly increase voltage between terminals “C” and “E” until output torque is 20.0 lbf.ft (27,1 N·m).

CAUTION: DO NOT ENERGIZE STARTER-GENERATOR MORE THAN 5 SECONDS. TURN POWER OFF IMMEDIATELY IF POWER IS MORE THAN 10 V OR 650 A WITH ARMATURE IN LOCKED CONDITION.

(e) For Shunt Start Models (23069-015-1, -004-1 and -009): Connect 0.0 Λresistor between terminals “A” and “B”, increase the voltage between terminals “B” and “E” until output torque is 15.0 lbf.ft (20,3 N·m).

(f) Record terminal voltage and line current.

(2) Acceptance Limits:

(a) For Series Start Models (23069-013, -002, -003, -013, -014, -015, -024 and -025):

1 C-E Voltage: 9.5 V DC Max.

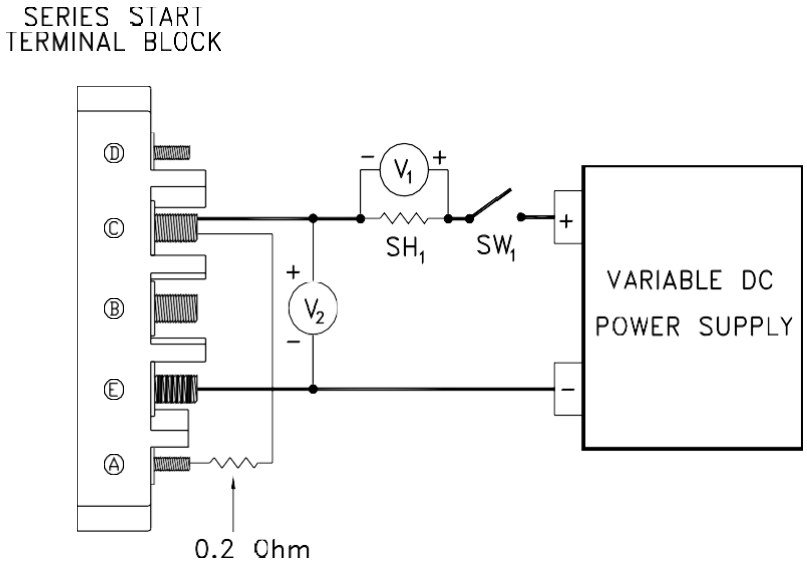
2 Line Current: 630 amps Max.

(b) For Shunt Start Models (23069-015-1, -004-1 and -009):

1 B-E Voltage: 10.0 V DC Max.

2 Line Current: 650 amps Max.

NOTE: If current is high, repeat test with different armature position.



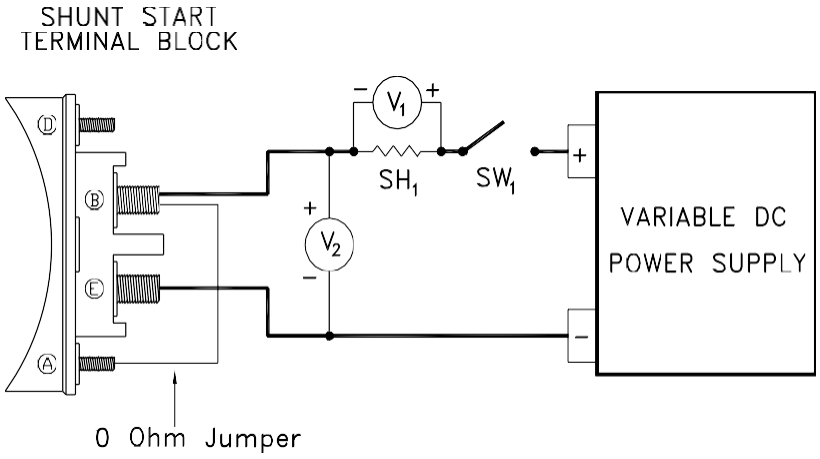


Figure 1006 - Locked Rotor Test Connection Diagram

K. Residual Voltage Test

(1) Connect starter-generator to the test circuit shown in Figure 1002.

(a) For Series Start Models (23069-013, -002, -003, -013, -014, -015, -024 and -025):

1 Operate the starter-generator at 7,200 RPM with field circuit open.

(b) For Shunt Start Models (23069-015-1, -004-1 and -009):

1 Operate the starter-generator at 6,550 RPM with field circuit open.

(c) Record residual voltage, B-E (V_2).

(2) Acceptance Limits:

Residual Voltage: 0.5 V Min.

L. Commutator Runout Test

NOTE: This check is accomplished only during acceptance testing and only for starter-generators that have been overhauled and have an armature with a re-surfaced commutator.

(1) Operating Instructions:

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

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

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

(c) 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.

(d) 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.

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

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

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

(2) Acceptance Limits:

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

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

7. Final Assembly After Acceptance Testing

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

8. Fault Isolation Table

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

Fault	Probable Cause	Corrective Action
A. Continuous Operating Speed and Equalizing Voltage Test		
High Equalizing Voltage (V_4)	Cooling air is low.	Check air flow path for blockage. Remove all blockages.
	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 loose connections. If loose brush lead is found and no sign of arcing is present, secure brush lead to complete brush holder.
	Brush circuit(s) open.	Remove brush access cover. Inspect all brush leads for open circuit. If open circuit is found, overhaul or repair starter-generator as necessary.
	Armature either shorted or grounded.	Disassemble starter-generator. Clean the armature. Dielectric test the armature as given in CHECK section. If the armature is unsatisfactory, examine the armature for shorts with a growler. Replace the armature if short or ground is found.
	Stator and Housing Assembly either shorted or grounded.	Disassemble starter-generator. Clean stator and housing assembly. Dielectric test the stator and housing assembly as given in CHECK section. If the stator and housing assembly is unsatisfactory replace it.

Table 1004 - Fault Isolation Table

Fault	Probable Cause	Corrective Action
B. Minimum Speed Test		
Exceeded field current limit (A_1)	Excessive load applied during testing.	Check and adjust applied load at load bank, as necessary.
Low external field resistance	Cooling air flow is low.	Check air flow path for obstructions. Clear all obstructions.
Low external field resistance	Brushes not fully seated.	Perform brush run-in procedure, refer to Safran Power SPD1006.
	Brushes hung up in complete brush holder assemblies	Inspect for proper positioning and correct formation of brush leads. Refer to SPD 1006.
	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Perform brush run-in procedure, refer to Safran Power SPD 1006.
	Armature either shorted or grounded.	Clean armature. Refer to CLEANING section. Perform dielectric test on the armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Perform dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
C. Residual Voltage Test		
High residual voltage indicated	Stator windings and/or housing material are incorrect (slight differences in batches of laminations).	Replace the stator assembly. Inspect armature OD, reference SPD 1001 minimum lamination diameter. If stator fails, test the residual voltage.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
D. Overspeed Test		
Noisy	Cooling fan blades rubbing or fan is out of balance.	Check fan blades and air inlet for damage. Replace cooling fan or air inlet.
	Defective or incorrectly installed bearings.	Remove brushes from brush holder and inspect bearings. Replace bearings.
Starter-Generator vibrates	Defective or incorrectly installed bearings.	Replace bearings.
	Out of balance armature.	Refer to REPAIR for armature balance. If out of balance condition cannot be repaired, replace armature.
E. Commutation Test		
Commutator/ Brushes show too much sparking with no load	Incorrectly seated or installed brushes.	Check the installation of the brushes. Perform brush run-in procedure, refer to Safran Power SPD 1006. Repair commutator surface. Replace armature.
	Loose brush holder(s).	Check attaching hardware. Perform dielectric test on bearing and brush support assembly. Perform brush run-in procedure, refer to Safran Power SPD 1006.
	Brush spring pressure below limit.	Refer to FITS AND CLEARANCES section for brush spring pressure. Replace brush spring.
	Partially or completely open armature winding.	Replace armature.
	Incorrectly filmed or irregular commutator surface.	Repair commutator surface. Replace armature.
	Shorted or grounded stator and housing assembly.	Perform dielectric test. If stator and housing fails test, replace.
	Armature out of balance.	If correct balance cannot be maintained, replace armature.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
F. Speed Pickup Test (For models 23069-002, -004, -004-1 and -009 only)		
Incorrect waveform	Incorrect air gap between speed pickup and dampener back plate and gear.	Adjust air gap, reference FITS AND CLEARANCES.
	Damaged dampener back plate and gear.	Replace.
	Damaged speed pickup.	Replace.
No output voltage	Speed pickup leads are shorted to starter-generator frame.	Check for continuity. Replace speed pickup if no continuity is found.
	Speed pickup coil or lead wires open.	Replace.
Output voltage not within limits	Incorrect air gap between speed pickup and dampener back plate and gear. Low output. High output.	Adjust air gap, reference FITS AND CLEARANCES section. Reduce air gap. Increase air gap.
Insulation breakdown on speed pickup	Speed pickup leads are grounded to the stator and housing assembly. or speed pickup has internal short or ground.	CHECK for continuity between starter-generator frame and speed pickup leads. Replace speed pickup if continuity is not found.
G. Dielectric Test		
Starter-Generator insulation breakdown	Grounded bearing and brush support assembly.	Perform dielectric test. If bearing and brush support assembly fails test, replace insulating sleeves and washers.
	Grounded armature.	Perform dielectric test. Replace armature if unit fails test.
	Grounded stator and housing assembly.	Perform dielectric test. Replace stator if unit fails test.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
H. Speed Pickup Dielectric Test (For models 23069-013-1, -004, -004-1 and -009 only)		
Insulation breakdown	Lead wires are grounded to stator and housing assembly or speed pickup has short to ground.	Check for continuity between starter-generator frame and pins A and B of connector. Replace speed pickup if there is continuity.
I. Starter No Load Speed and Radial Vibration Test (For models 23069-013, -002, -003, -013, -014, -015, -024 and -025 only)		
Low or no torque	Stator winding either shorted, grounded or open.	Perform dielectric test. Replace stator and housing assembly if unit fails test.
	Armature winding shorted, grounded or open.	Perform Dielectric test. If armature fails test, check for shorts with growler, if shorts are found, replace.
Starter-generator vibration	Drive shaft not centered.	Center drive shaft. Re-test starter-generator.
	Armature out of balance.	Refer to REPAIR for armature balance. If armature cannot be balanced, replace.
	Defective or incorrectly installed bearings.	Replace bearings. Re-test starter-generator.
J. Locked Rotor Test		
Low or no torque	Stator winding either shorted, grounded or open.	Perform Dielectric test. Replace stator and housing assembly if unit fails test.
	Armature winding shorted, grounded or open.	Perform Dielectric test. If armature fails test, check for shorts with growler, if shorts are found, replace.
	Brushes incorrectly seated or installed.	Using a wire hook tool, pull brush sets away from commutator surface. CHECK commutator surface for damage. REPAIR, if limits are not more than in FITS AND CLEARANCES section. Perform brush run-in procedure, refer to Safran Power SPD 1006. Test starter-generator.

Table 1004 - Fault Isolation Table (Continued)

Fault	Probable Cause	Corrective Action
Low or no torque	Open brush circuit.	Inspect all brush leads for an open circuit. If an open circuit is found, replace brush (new brush only). Perform brush run-in procedure, refer to Safran Power SPD 1006. Test starter-generator.
Exceeded voltage or current limits	Armature winding either shorted, grounded or open.	Perform dielectric test. If armature fails test, check for shorts with a growler, if shorts are found, replace.
	Shorted, grounded or open stator winding.	Check for continuity on all leads of stator winding. Perform Dielectric test. If stator and housing assembly fails continuity check or dielectric test, replace.
K. Residual Voltage Test		
High residual voltage indicated	Stator windings and/or housing material are incorrect (slight differences in batches of laminations).	Replace the stator assembly. Inspect armature OD, reference SPD 1001 minimum lamination diameter. If stator fails, test the residual voltage.
L. Commutator Runout Check		
Bar-to-bar runout or total indicator runout exceeded.	Shifted commutator bars.	REPAIR commutator surface. REPLACE armature if not repairable.

Table 1004 - Fault Isolation Table (Continued)

VERIFICATION / FINAL ACCEPTANCE DATA SHEET

Model Number:_____ Inspected by:_____

Serial Number:_____ Date:_____

Modification Level:_____

Inspection/Test	Requirements/Limits	Measurements	Accept	Reject
Visual inspection	Check for physical damage			
Continuous Operating Speed and Equalizing Voltage Test	Air inlet temperature	°F	-----	-----
	Measured equalizing voltage D to E (V_4) (refer to Figure 1003)	V DC		
	Field current (A_1) (10 A Max)	A		
	Calculated external field resistance (B-A) (0.5 Λ Min)	Λ		
	For models 23069-020-1, -015, -024, and -025 only: B to E residual voltage 0.8 V Min.	V DC		
Minimum Speed Test	B to A voltage (V_3)	V DC		
	Field current (A_1) (10.0 A Max.)	A		
	Calculated B to A resistance (0.5 Λ Min.)	Λ		
Residual Voltage Test	B to E residual voltage (V_2) (3.6 V DC Max)	V DC		
Overspeed Test	No sign of electrical or mechanical failure			
Commutation Test	Not to be more than pinpoints			
Speed Pickup Test (Applicable for models 23069-013-1, -004, -004-1 and -009 only)	Peak-to-Peak output (2.5 to 4.5 V DC)	V_{p-p}		
	Voltage wave form			
	For model 23069-013-1: Frequency signal (4350 to 4450 Hz). For models 004, -004-1 and -009: Frequency signal (4150 to 4250 Hz)	Hz		
Starter-Generator Dielectric Test	Leakage 5 mA Max.	mA		

Table 1005 - Data Sheet

Inspection/Test	Requirements/Limits	Measurements	Accept	Reject
Speed Pickup Dielectric Test (Applicable for models 23069-013-1, -004, -004-1 and -009 only)	Leakage 2 mA Max.	mA		
Starter No Load Speed and Radial Vibration Test (Applicable for models 23069-013, 002, -003, -013, -014, -015, -024, -025 only)	No Load Speed (4,500 RPM Min)	RPM		
	Vibration Amplitude (0.001 inch (0,0254 mm) Max)	inch mm		
Locked Rotor Test (Series)	Line Current (630 A Max.)	A		
	C to E voltage (9.5 V DC Max.)	V DC		
Locked Rotor Test (Shunt)	Line Current (650 A Max.)	A		
	B to E voltage (10.0 V DC Max.)	V DC		
Residual Voltage Test	B to E residual voltage (0.5 V Min. for all Models)	V DC		
Commutator Runout Test	Bar-to-bar (0.0002 inch Max.) (0,005 mm Max.)	Inch mm		
	Total indicated runout (0.0008 inch Max.) (0,020 mm Max.)	Inch mm		

Table 1005 - Data Sheet (Continued)

THIS PAGE INTENTIONALLY LEFT BLANK

SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

This section is unassigned.

THIS PAGE INTENTIONALLY LEFT BLANK

DISASSEMBLY

1. Introduction

This section provides disassembly instructions for 23069 Series of DC Starter-Generators. Disassemble only to the extent required to replace defective parts, unless complete overhaul is required. Additional disassembly of major components is not necessary unless specifically instructed in the CHECK or TESTING AND FAULT ISOLATION sections. Before disassembly, wipe exterior surfaces with a clean cloth to remove dust, dirt, or other foreign materials.

- Do not remove threaded inserts. Refer to CHECK section for details.
- Do not disassemble riveted parts. Refer to REPAIR section to determine whether part(s) can be replaced.
- During overhaul, replace bearings, brushes and o-rings. Parts that have been removed during disassembly, such as, insulating parts, retaining rings, screws, self-locking nuts and lock washers, must be discarded regardless of their condition. The screws that attach the brush leads to the brush holder do not need to be replaced unless damaged.

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

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

2. Disassembly Tools and Fixtures

In addition to standard shop tools, those special tools, fixtures, and equipment listed in Table 3001 are required for 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 Description	Source/Figure Reference
Adapters, Armature Shaft (Drive End, Anti-drive End)	Figure 9001
Adapter, Commutation Viewing	Figure 9002
Arbor press	Commercially Available
Bearing Puller (Snap-On A78 or equivalent)	Commercially Available
Drivers, Bearing (Inner Race And Outer Race)	Figure 9003
Driver, Liner	Figure 9004
Fixture, Commutator Turning	Figure 9005

Table 3001 - Disassembly Tools and Fixtures

Tools Description	Source/Figure Reference
Fixtures, Rivet Alignment And Rivet Press	Figure 9006
Mallet, Plastic or Leather	Commercially Available
Pliers, External Snap Ring	Commercially Available
Plug, Adjustment, Speed Pickup	Figure 9007
Support, Armature	Figure 9008
Support, Bearing and Brush Support Assembly	Figure 9009
Supports, Hub (Drive End And Anti-drive End)	Figure 9010
Support, Stator (Horizontal and Vertical)	Figure 9011, Figure 9012
Driver, Dampener Hub	Figure 9013
Driver, Dampener Plate	Figure 9014
Torque Wrench	Not illustrated
Wire Hook Tool	Not illustrated
Wrench, Spline	Figure 9015
Fastener Header, Plusnut®	Figure 9016
Hammer, Slide	Figure 9017
Hex head screw, (8-32, 5/8 inch Length), (Used with the slide hammer tool to secure to dampener back plate and gear)	Not illustrated

Table 3001 - Disassembly Tools and Fixtures (Continued)

3. Disassembly Materials

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

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

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

Table 3002 - Disassembly Materials

4. Disassembly of Starter-Generator

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

A. Remove QAD Mounting Kit (5), if present

NOTE: For all models, but models 23069-015-1 and -004-1. When a starter-generatoris removed for service, QAD kit usually stays on aircraft.

(1) Loosen self-locking nut (15) from T-bolt (20) and remove V-retainer coupling (10) from the starter-generator.

(2) Remove mounting adapter (25) from the starter-generator.

B. Remove ID Plate (30), Modification Status Label (40) and (if present) Caution Label (45), Patent Label (50) and FAA-PMA Labels (52)

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

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

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

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

(2) Remove the remaining metal from under the head of each drive screw (35).

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

(4) Discard the four drive screws (35) from the stator and housing assembly (285).

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

(6) Remove modification status label and keep for reference when transferring information to a new modification status label or replacement nameplate.

WARNING: HANDLE THE TOOL CAREFULLY. WEAR EYE PROTECTION.

(7) Remove and discard the patent notification label (50), FAA-PMA label (52) and caution decal (45) from stator and housing assembly (285).

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

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

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

(c) Use alcohol to remove adhesive residue.

(d) Wipe dry with a soft dry cloth.

C. Remove Terminal Block Cover (55), if present

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

NOTE: Model 23069-013-1 does not use a terminal block cover.

(1) On model 23069-016-1, pull cover off terminal block (10004-40G) for removal.

(2) On all other models, remove two attaching screws (60) that attach the terminal block cover to the terminal block.

(3) Remove the terminal block cover.

D. Remove Air Inlet Cover (65) (See Figure 3001)

NOTE: Record the position of the air inlet relative to the terminal block, and fixing hole pattern used, to assist with assembly.

(1) Where applicable, remove and discard lockwire from attaching screws of air inlet cover (65).

(2) Remove four attaching screws (70) and, where applicable, flat washers (75) which attach air inlet cover (65) to bearing and brush support assembly (165).

(3) Remove air inlet cover (65).

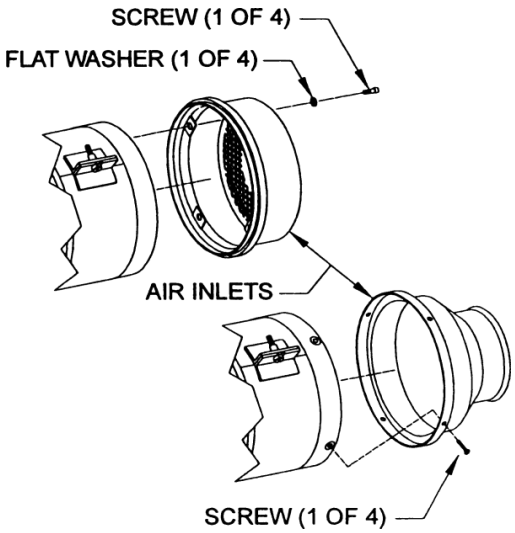


Figure 3001 - Air Inlet Removal

E. Remove Air Inlet Support Ring (80) from Air Inlet (See Figure 3002)

NOTE: For models using bearing and brush support assembly P/N 23069-350.

NOTE: Removal of air inlet support ring or bearing and brush support assembly is not necessary unless damaged.

(1) Remove the screws (85) and flat washers (90) from the air inlet support ring.

(2) Remove air inlet support ring (80) from bearing and brush support assembly.

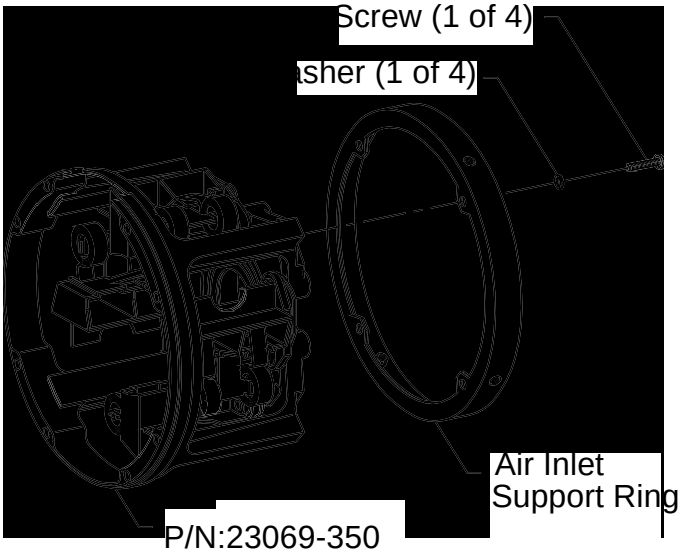


Figure 3002 - Air Inlet Support Ring Removal

F. Remove Brush Access Cover (95)

(1) Remove screw (100) from self-locking blind rivet nut (101) that secures brush access cover (95) around the bearing and brush support assembly (165).

(2) Remove brush access cover (95).

G. Remove Brushes (105) from Bearing and Brush Support Assembly (165) (See Figure 3003)

NOTE: If brushes (105) are to be reused, identify the brushes and complete brush holders (10002-20) with the numbers 1 through 4.

(1) Remove four screws (110) that attach brush shunt leads to complete brush holder.

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

(2) Use a wire hook tool to lift two brush springs (10002-70) away from brush (105). Remove brush from complete brush holder (10002-20).

(3) Slowly return brush spring to a resting position on complete brush holder.

(4) Identify brush (105) with the number on complete brush holder (10002-20) from which it was removed.

(5) Repeat Paragraph 4.G.(2) and Paragraph 4.G.(4) at each remaining brush (105).

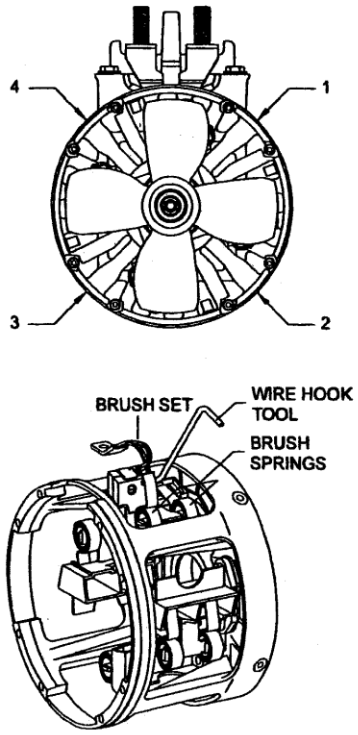


Figure 3003 - Brush Removal

H. Remove Fan (115) from Drive Shaft (130) (See Figure 3004)

(1) Put an applicable spline wrench on drive spline to prevent the drive shaft (130) from turning while removing self-locking nut (120).

(2) Remove self-locking nut (120) and flat washer (125) from the drive shaft (130).

(3) Slide fan (115) off the drive shaft splines.

(4) For models 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A' remove ADE bearing shield (277).

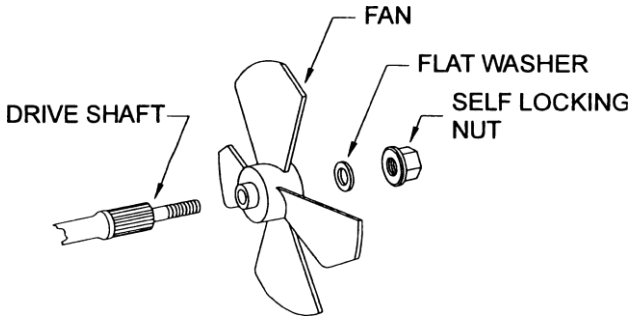


Figure 3004 - Fan Removal

I. Remove Drive Shaft (130) with Attached Dampener Hub (140), Dampener Plate (145), Friction Ring (150) and O-ring (135), if Applicable, from Armature (250) Shaft (See Figure 3005)

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.

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

(1) Lightly tap anti-drive end of drive shaft (130) with a plastic or leather mallet to disengage from armature shaft.

(2) Pull drive shaft (130) out of drive end of starter-generator. See Figure 3005.

(3) Remove friction ring (150) from drive shaft (130).

(4) Remove dampener plate (145) from dampener hub (140) on drive shaft (130).

(5) If present, remove and discard O-ring (135) from drive shaft (130).

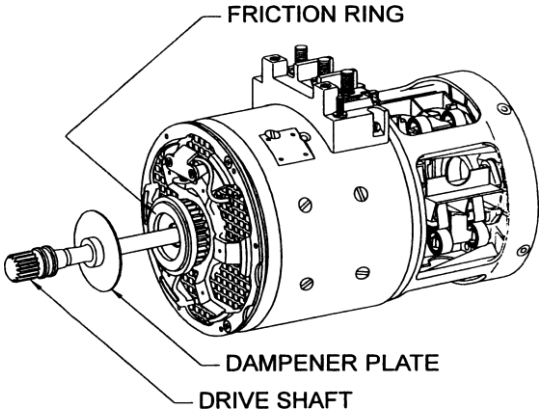


Figure 3005 - Removing the Drive Shaft, Friction Ring and Dampener Plate

J. Remove Dampener Hub (140) from Drive Shaft (130) (See Figure 3006)

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

CAUTION: PUT A FOAM CUSHION UNDER DRIVE SHAFT TO PREVENT DAMAGE.

(1) Place foam cushion and anti-drive-end hub support on arbor press table.

(2) Set a dampener hub driver on the hub support.

(3) Slip drive shaft (130) through the center of the dampener hub support until dampener hub is installed on dampener hub driver.

(4) Slowly press drive shaft down into hub support until dampener hub (140) disengages from drive shaft (130).

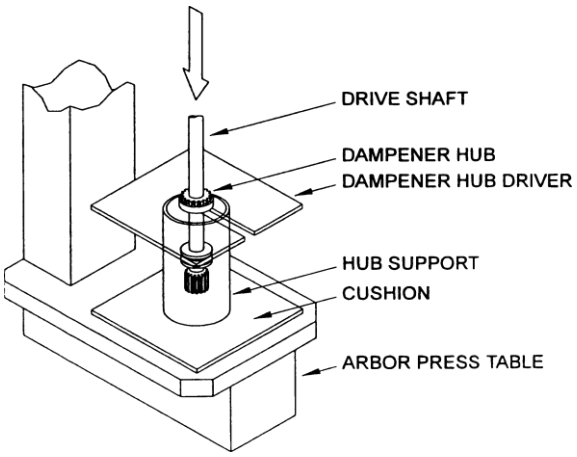


Figure 3006 - Dampener Hub Removal

K. Remove Dampener Backplate (155), Retaining Ring (160) and Spacer (280) or baffle disc (275) from Armature (250) Shaft (See Figure 3007 and Figure 3008)

(1) The below procedure is only applicable to the models which uses dampener back plate ((155), (-155C) and (-155E)) with no threaded hole in them. See Figure 3007.

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

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

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

(b) Remove dampener backplate (155) from armature shaft using a suitable bearing puller.

(c) Remove retaining ring (160) with external snap ring pliers from armature shaft.

(d) Remove spacer (280) or baffle disc (275) and discard if damaged.

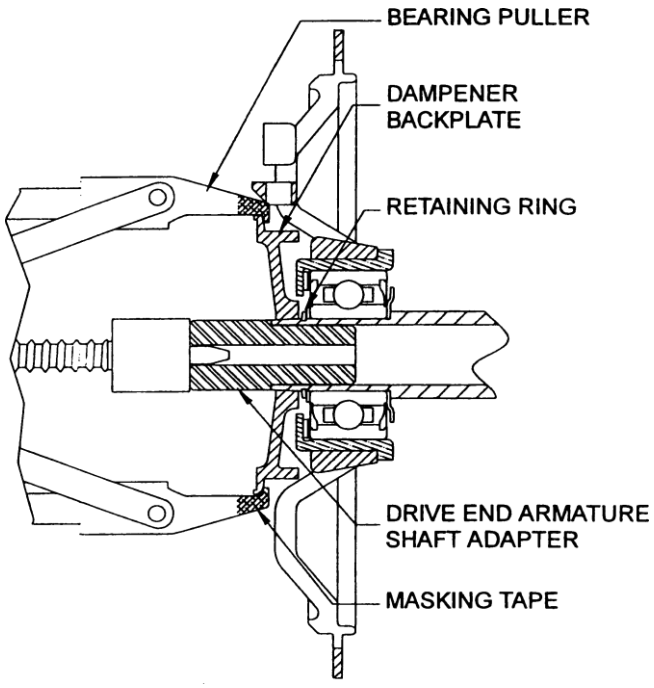


Figure 3007 - Dampener Backplate Removal

(2) The below procedure is only applicable to the models which uses dampener back plate (-155A) or dampener back plate and gear (-155F)) with threaded hole in them. See Figure 3008.

CAUTION: YOU CAN CAUSE DAMAGE TO THE ARMATURE SHAFT IF YOU DO NOT USE THE SLIDE HAMMER TOOL.

(a) Put the slide hammer on the face of the dampener back plate and gear (-155F).

(b) Attach the slide hammer to the dampener back plate and gear with two hex head screws.

(c) Tighten the two hex head screws.

(d) Pull the slide hammer quickly away from the dampener back plate and gear until the hammer hits the nut on the tool.

1 Repeat the hitting motion until the dampener back plate and gear until the dampener back plate and gear is loose.

(e) Remove dampener back plate and gear (-155F) from the armature (250) shaft.

(f) Remove the two hex head screws and the slide hammer.

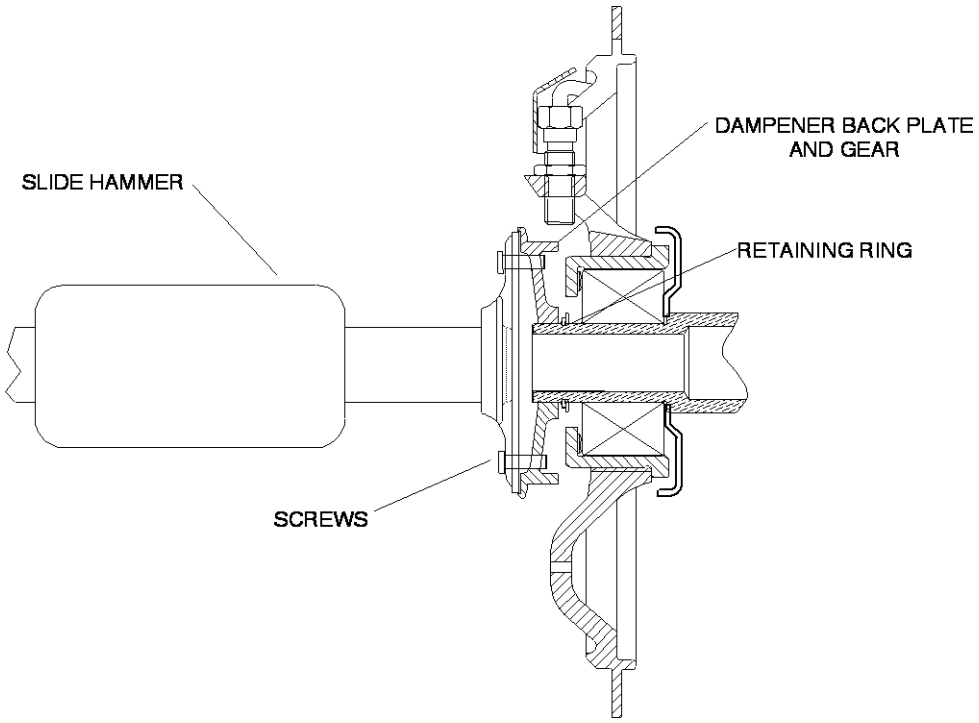


Figure 3008 - Removal of the Dampener Back Plate and Gear from the Armature Shaft

L. Remove Bearing and Brush Support Assembly (165) and attached Armature (250) from stator and housing assembly (285) (See Figure 3009)

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

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

(2) For all models except 23069-016-1: Using impact screwdriver, remove eight screws (170), spring lock washers (175) and flat washers (180) that attach the bearing and brush support assembly (165) to stator and housing assembly (285).

(3) For model 23069-016-1: Using impact screwdriver, remove six screws (170), twoscrews (172), eight spring lock washers (175) and eight flat washers (180) thatattach the bearing and brush support assembly (165) to stator and housing assembly (285).

(4) Set the starter-generator on a horizontal stator support. Insert the drive end armature shaft adapter into the drive end of the armature (250) shaft.

(5) Gently tap on the drive end armature shaft adapter with a plastic or leather mallet until the bearing and brush support assembly (165) separates from the stator and housing assembly.

(6) Carefully remove the bearing and brush support assembly (165) and attached armature (250) from the stator and housing assembly.

(7) Carefully lift bearing and brush support assembly with attached armature from stator and housing assembly (285) and place on bench.

(a) On units without bearing pre-load using 23088-1070, 23088-1071 or 23088-1551 drive end bearing and brush support assemblies, remove baffle disc (275) from armature shaft.

(b) On units with bearing pre-load using 23088-1072, 23088-1073 or 23069-1552 drive end bearing and brush support assemblies, remove spacer (280) from armature shaft.

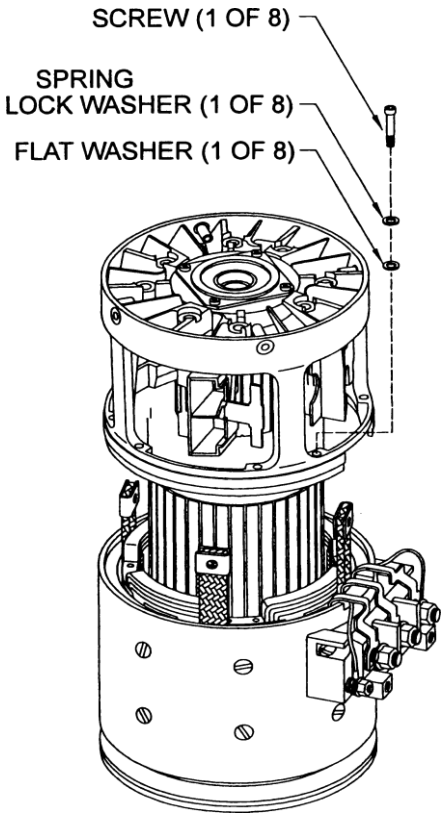


Figure 3009 - Remove the Bearing and Brush Support Assembly with Attached Armature

M. Remove 3-pin Connector (185) and Spacer (190) from Stator and Housing Assembly (285) (See Figure 3010)

NOTE: For models 23069-013-1, -004, -004-1, and -009 only.

(1) Remove and discard lockwire from four attaching screws (195) of 3-pin connector (185).

(2) Remove four screws (195) attaching 3-pin connector (185) and spacer (190) to stator and housing assembly (285).

(3) If lead contacts are crimped, remove pins A, B and C from 3-pin connector (185) using a pin insertion/extraction tool.

(4) If lead contacts are soldered, carefully unsolder leads from pins.

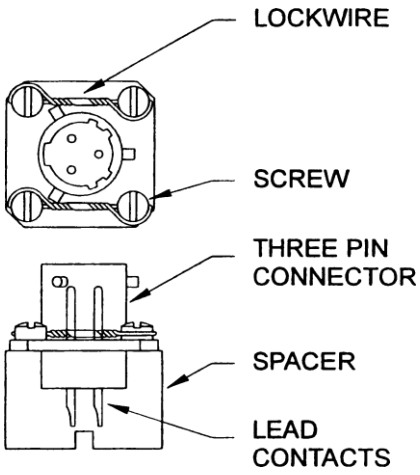


Figure 3010 - Connector Removal

N. Remove Drive End Bearing Support Assembly (200) from Stator and Housing Assembly (285) (See Figure 3011)

NOTE: Do not remove screen unless damaged.

(1) Remove screws (205) attaching drive end bearing support assembly (200) to stator and housing assembly (285).

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

(2) On models 23069-015-1 and -004-1, remove spring lock washers (210) and flatwashers (215) from attaching screws (205). Discard screws (205) and springlock washers (210).

(3) Lightly tap the outer diameter of the drive end bearing support assembly (200) with a plastic or leather mallet to loosen it from the stator and housing assembly (285).

(4) Remove drive end bearing support assembly (200) from stator and housing assembly (285).

(5) If applicable, remove and discard spring wave washer (240) and shims (245) from drive end bearing support assembly.

NOTE: The spring wave washer (240) can be re-used if it passes the inspection criteria given in the CHECK section.

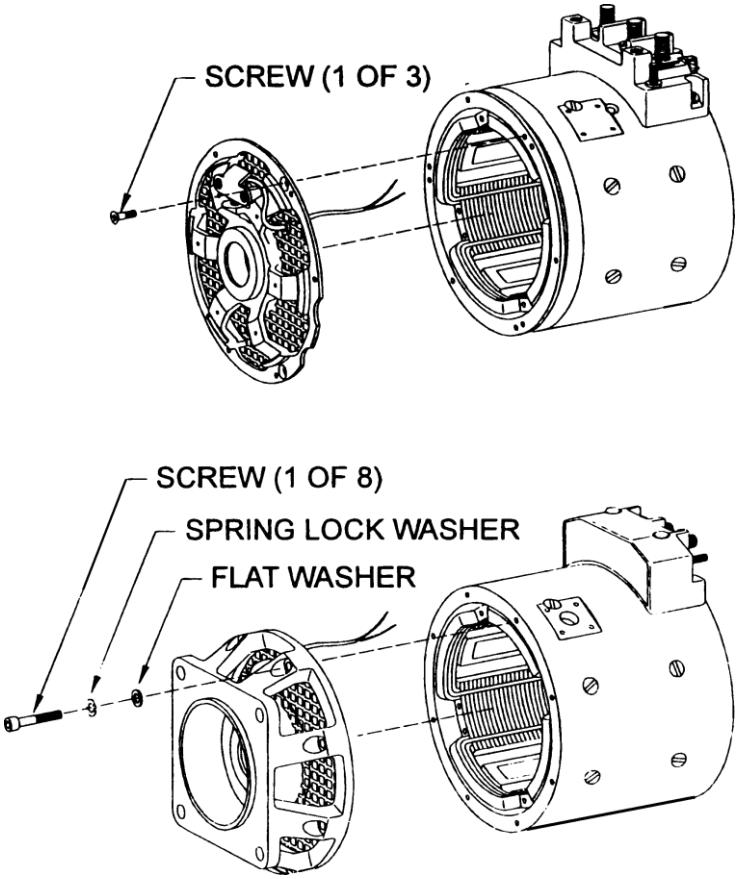


Figure 3011 - Drive End Bearing Support Assembly Removal

O. Remove Speed Pickup Guard (220), Speed Pickup (230) and Grommet (235) from Drive End Bearing Support Assembly (200) (See Figure 3012)

NOTE: For models 23069-013-1,-004, -004-1, and -009 only. Do not remove speedpickup unless damaged.

(1) On models 23069-013-1 and -009, remove two screws (225) attaching speedpickup guard to drive end bearing support assembly.

(2) Pull leads of speed pickup (230) through grommet (235).

(3) Loosen jam nut and back nut away from drive end bearing support assembly (200).

(4) Remove speed pickup (230) from drive end bearing support assembly (200).

(5) Remove and discard grommet (235) from screen.

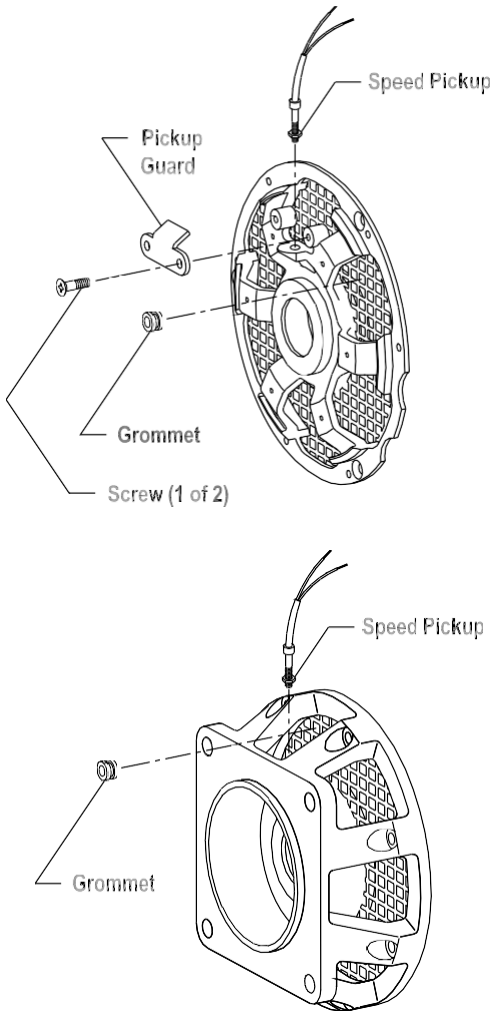


Figure 3012 - Speed Pickup Removal

P. Remove Armature (250) from Bearing and Brush Support Assembly (165) (See Figure 3013)

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

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

(2) Put bearing and brush support assembly (165), with attached armature (250), onto bearing and brush support assembly support.

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

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

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

(4) While supporting armature securely with one hand, carefully press armature shaft down and away from bearing and brush support assembly (165).

(5) Carefully remove armature (250) from inside of bearing and brush support assembly support.

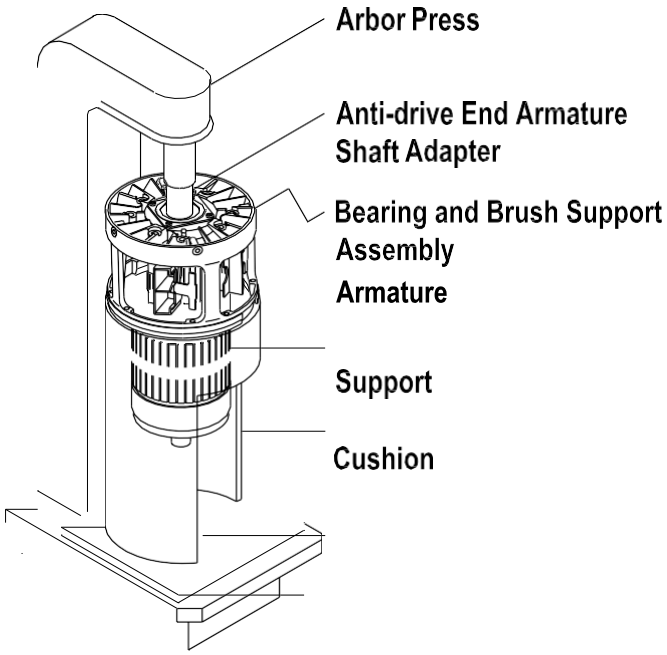


Figure 3013 - Armature Removal

Q. Remove Bearing Retainer (255) from Bearing and Brush Support Assembly (165) (See Figure 3014)

(1) Remove and discard four screws (260) attaching bearing retainer (255) to bearing and brush support assembly.

(2) Remove filter leads from attaching screws (260).

(3) Remove and discard spring lock washers (265) from attaching screws (260).

(4) Remove bearing retainer.

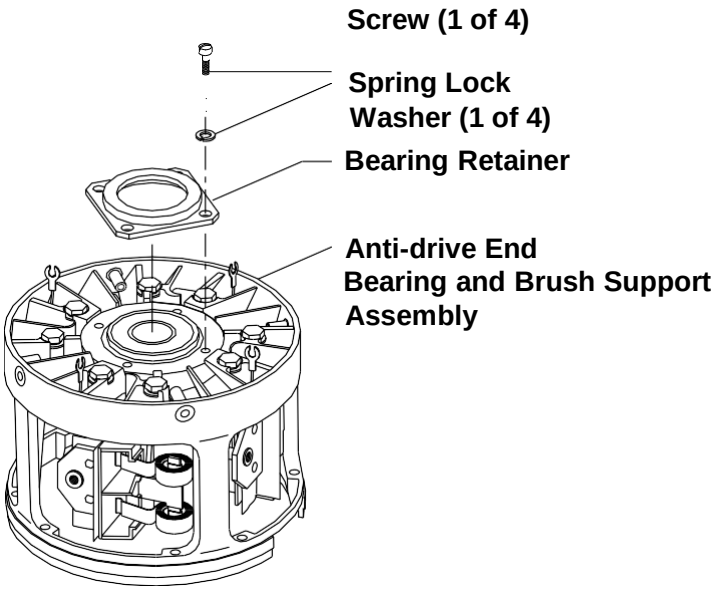


Figure 3014 - Bearing Retainer Removal

R. Remove Ball Bearing (270) from Bearing and Brush Support Assembly (165) (See Figure 3015)

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

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

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

(3) Set an inner race bearing driver on inner race of ball bearing (270) installed in bearing and brush support assembly (165).

(4) Slowly press bearing from bearing and brush support assembly (165) and into anti-drive end hub support.

(5) Remove bearing (270) from inside of anti-drive end hub support.

(6) Discard bearing (270).

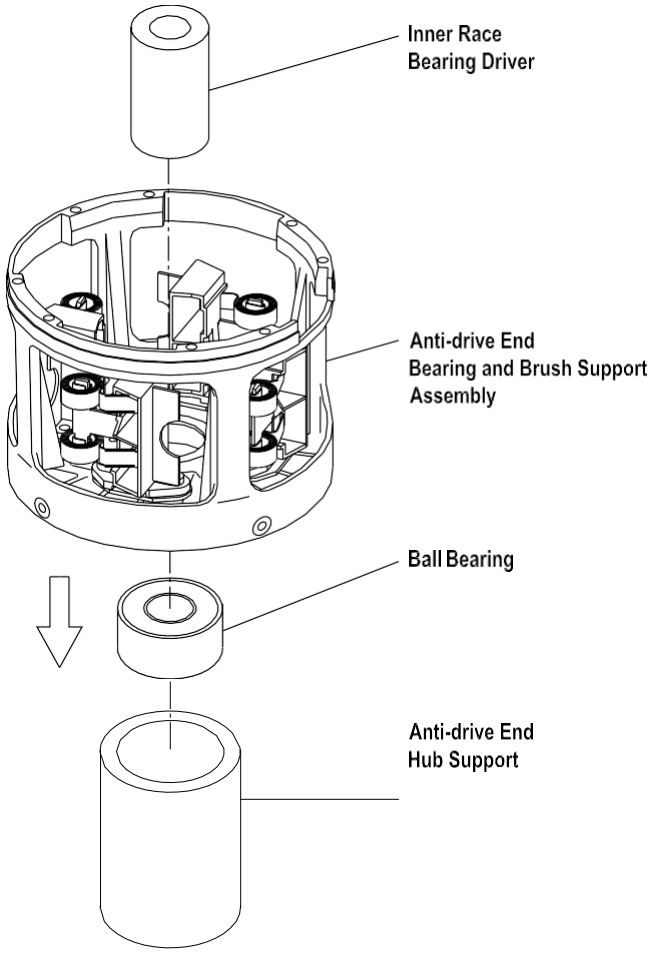


Figure 3015 - Ball Bearing Removal

S. Remove Drive End Ball Bearing (270) and drive end Bearing Shield (276B) from Armature (250) Shaft (See Figure 3016)

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

(1) Place armature support onto bench.

(2) Place anti-drive end of armature into armature support.

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

(4) Remove bearing (270) from armature shaft using a suitable bearing puller.

(5) Discard bearing (270).

(6) For models 23069-015-1 Post 'MOD M' and 23069-16 Post 'MOD B' remove drive end bearing shield (276B) from armature shaft.

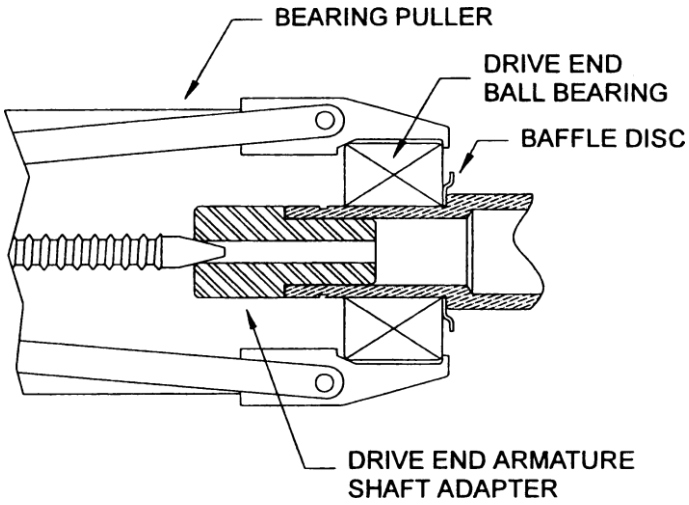


Figure 3016 - Ball Bearing and Baffle Disc Removal

5. Disassembly of Bearing and Brush Support Assembly

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

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

A. Remove Complete Brush Holder (20) from Anti-drive End End Bell (5) (See Figure 3017)

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

(1) For models 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A' remove four screws (10001-181) and lock washers (10001-182) which attach the filter leads to the anti-drive end end bell.

(2) Remove two bolts (25), flat washers (35), and insulating washers (30) from bearing and brush support assembly.

(3) Remove complete brush holder (20) and filter assembly (60) from bearing and brush support assembly.

(4) Remove insulating sleeves (40) from through holes in bearing and brush support assembly.

(5) Discard non-metallic washers and insulation sleeves.

(6) Repeat Paragraph 5.A.(2) through Paragraph 5.A.(5) as required for remaining complete brush holders (20).

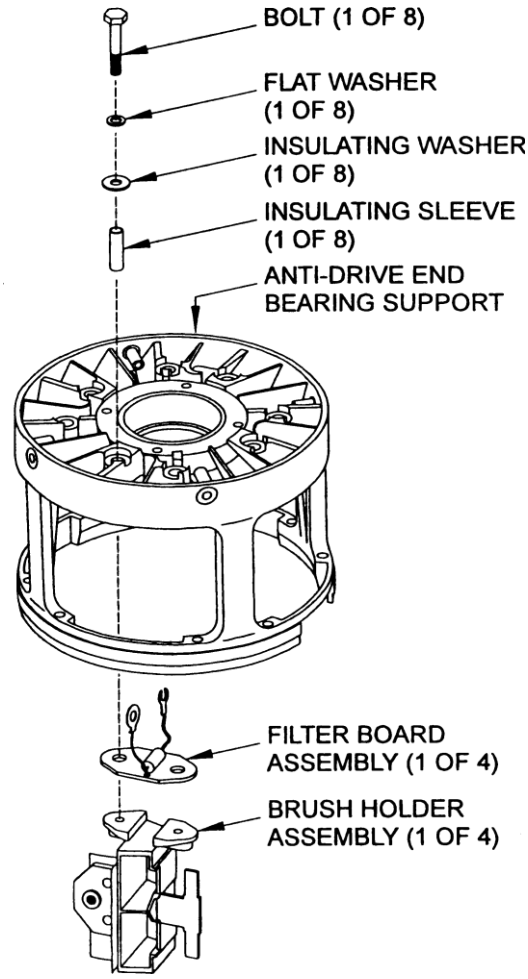


Figure 3017 - Brush Holder Removal

B. Remove Brush Springs (70) from Brush Holder Assemblies (20) (See Figure 3018)

(1) Remove any of the damaged brush springs (70) from brush holder assembly.

(2) Discard damaged brush springs (70).

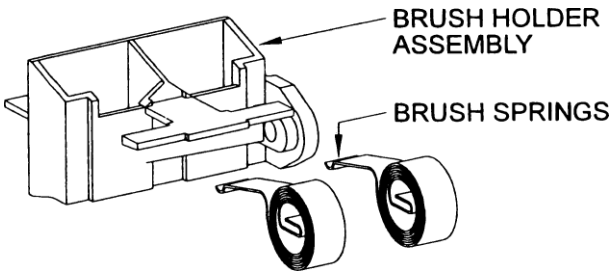


Figure 3018 - Brush Spring Removal

C. Disassemble each Complete Brush Holder (20).

NOTE: Do not disassemble complete brush holders unless necessary.

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

6. Disassembly of Drive End Bearing Support Assembly

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

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

A. Remove Screen (25) from Drive End Bearing Support (5) (See Figure 3019)

NOTE: Do not remove screen (25) from drive end bearing support (5) unless damaged.

(1) Remove and discard attaching drive screws (30) and flat washers (35) from the drive end bearing support (5).

(2) Remove and discard screen (25).

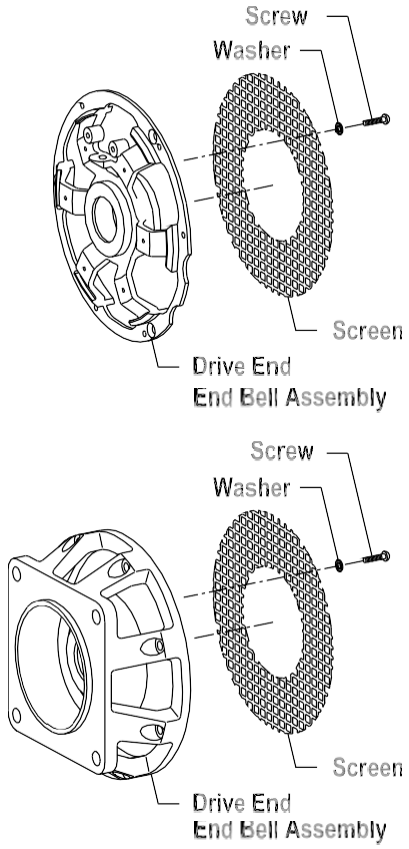


Figure 3019 - Screen Removal

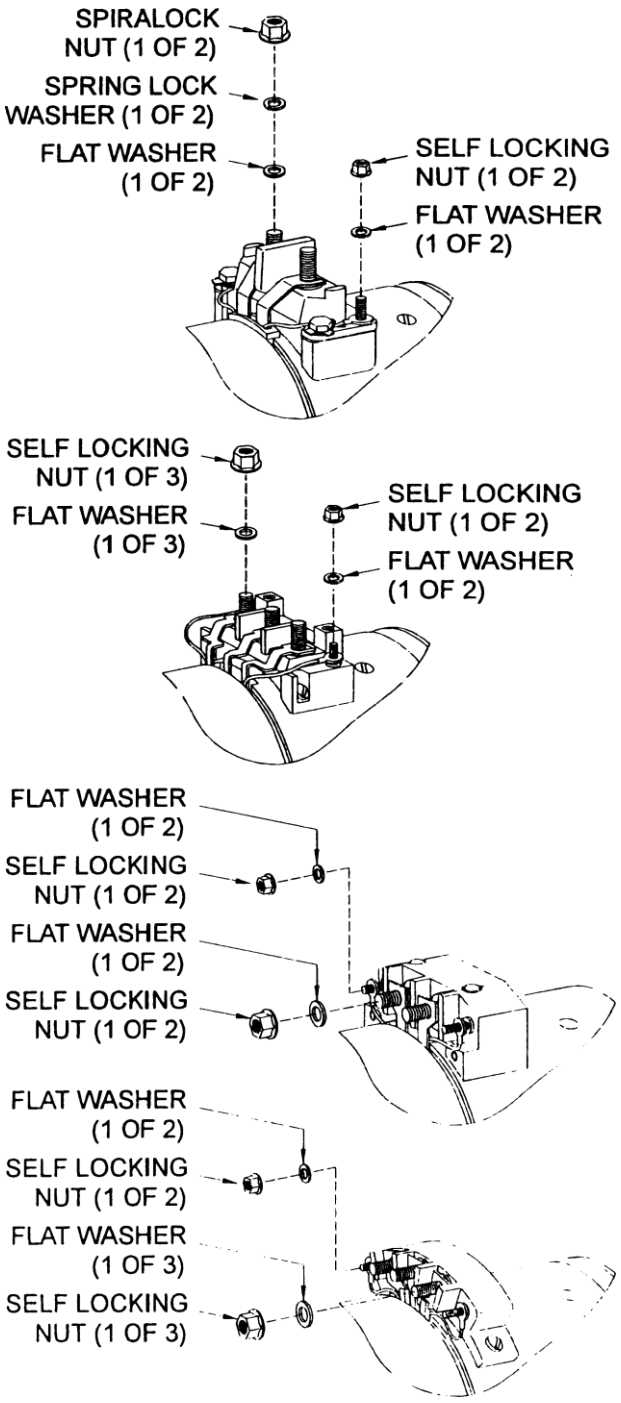


Figure 3020 - Hardware Removal from Terminal Block

7. Disassembly of Stator and Housing Assembly

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

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

A. Remove Hardware from Terminal Block (40) if present (See Figure 3020)

(1) On model 23069-016-1, remove spiralock nuts (10D), spring lock washers (15H),and flat washers (20) from terminal studs B and E.

(2) On all other models, remove self-locking nuts (10) and flat washers (15) from terminal studs B, E and, where applicable, C.

(3) Remove and discard self-locking nuts (25) and flat washers (30) from terminal studs A and D.

(4) Discard spring lock washers and flat washers.

B. Remove Terminal Studs B and E (35) from Terminal Block (40G) (For model 23069-016-1 only)

NOTE: Do not disassemble terminal studs unless necessary.

(1) Refer to the REPAIR section for removal and installation of terminal studs.

C. Remove Terminal Block (40G) from Stator Housing (5C) (See Figure 3021)

NOTE: For model 23069-016-1 only.

(1) Bend tabs of tab lock washers down and away from attaching bolts.

(2) Remove bolts (45B, 60), tab lock washers (50A, 65), and insulating washers (55C, 70A) attaching terminal block to stator housing.

(3) Discard tab lock washers and insulating washers.

(4) Remove small terminal leads from terminal studs A and D.

(5) Remove terminal block from stator housing.

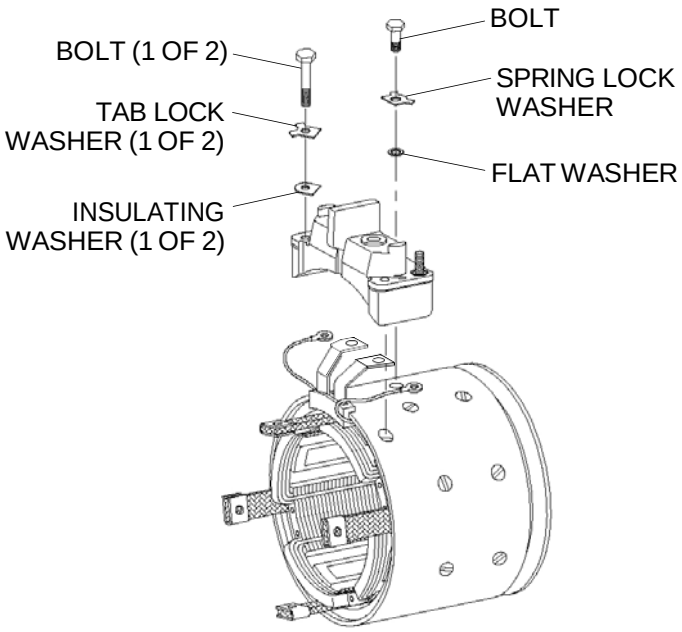


Figure 3021 - Terminal Block Removal (23069-016-1)

D. Remove Grommet (75) from Stator Housing (5C) (See Figure 10004)

NOTE: For model 23069-016-1 only. Do not remove grommet unless damaged.

(1) Remove grommet (75) from stator leads B and E.

(2) Discard grommet (75).

E. Remove Terminal Block (40) from Stator Housing (5) (See Figure 3022)

NOTE: For all models, except 23069-016-1.

(1) Remove bolts/screws (45), spring lock washers (50), and flat washers (55) attaching terminal block (40) to stator housing (5).

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

(3) Remove terminal block (40) from stator housing (5).

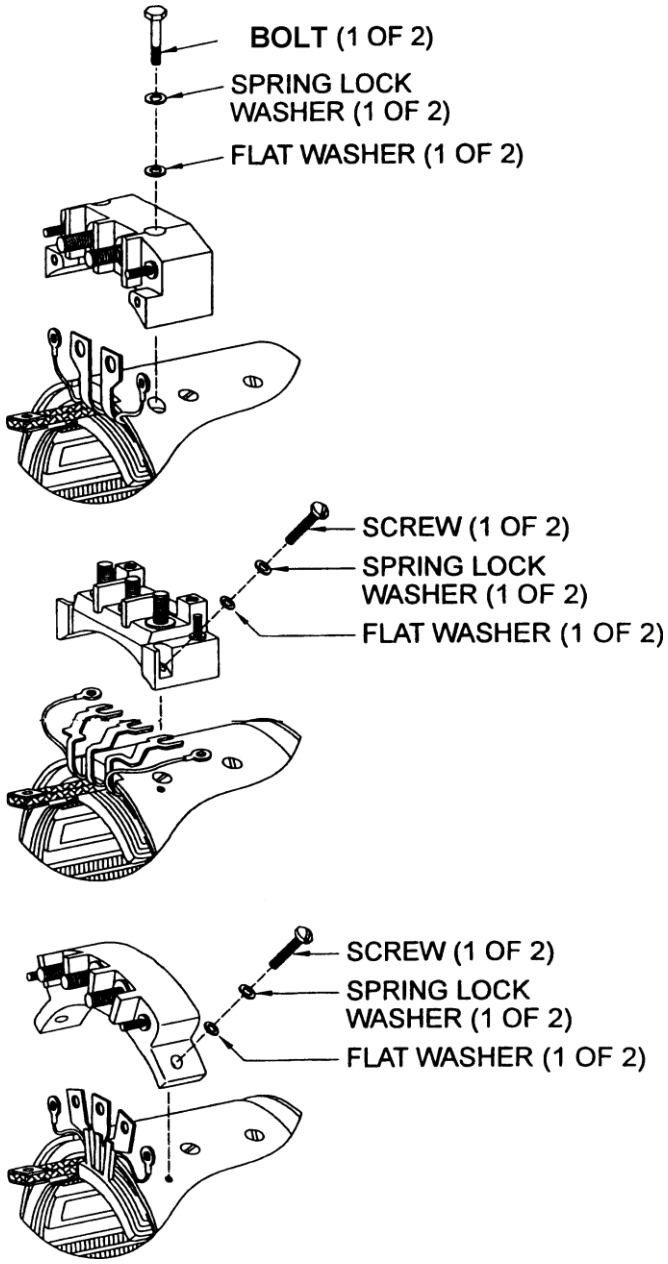


Figure 3022 - Terminal Block Removal

THIS PAGE INTENTIONALLY LEFT BLANK

CLEANING

1. Introduction

This section contains the cleaning procedures for 23069 Series DC Starter-Generators.

2. Cleaning Tools

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

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 Description	Source/Figure 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

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 kΛ x 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 kΛ x 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 4001 - Cleaning Materials and Equipment

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

Table 4001 - Cleaning Materials and Equipment (Continued)

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: **WHEN YOU OPERATE COMPRESSED AIR, CONTROL THE PRESSURE TO LESS THAN OR EQUAL TO 29 PSIG (200 KPA). WEAR GOGGLES OR FACE PROTECTION TO GIVE PROTECTION TO THE EYES. FOLLOW NECESSARY PRECAUTIONS TO PREVENT INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR IS FREE FROM OIL AND WATER WHEN YOU CLEAN OR DRY COMPONENTS. THIS PRECAUTION PREVENTS CONTAMINATION OF THE COMPONENTS.

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

B. Clean the Parts

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

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

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

Table 4002 - Cleaning Procedures

C. Rinse the Parts

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

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

E. Dry the Parts

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

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

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

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

(3) 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.

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 OPERATE COMPRESSED AIR, CONTROL THE PRESSURE TO LESS THAN OR EQUAL TO 29 PSIG (200 KPA). WEAR GOGGLES OR FACE PROTECTION TO GIVE PROTECTION TO THE EYES. FOLLOW NECESSARY PRECAUTIONS TO PREVENT INJURY TO OTHER PERSONNEL IN AREA.

CAUTION: MAKE SURE THAT COMPRESSED AIR IS FREE FROM OIL AND WATER WHEN YOU CLEAN OR DRY COMPONENTS. THIS PRECAUTION PREVENTS CONTAMINATION OF THE COMPONENTS.

(b) Use compressed air to remove rinse water.

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

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

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

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

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

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

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

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

THIS PAGE INTENTIONALLY LEFT BLANK

CHECK

1. Introduction

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

This section provides tables, figures, and a glossary of damage condition terms for use in performing a satisfactory inspection of the starter-generator parts. During overhaul, all parts listed in this section must be inspected to determine serviceability.

Refer to FITS AND CLEARANCES section for dimensional acceptance limits. If a part is worn or damaged beyond repair, it is unserviceable and must be replaced.

Refer to Safran Power SPD 1006 for additional brush inspection/acceptance procedures.

2. Inspection Tools

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.

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

Tools Description	Source/Figure Reference
Compression Digital Hand Tester	Larson Systems Inc. Minneapolis, MN 55449-4425 Ph: 763-780-2131 www.larsonsystems.com (V0PWK9) or Commercially Available
Dial Indicator	Commercially Available
Dial Bore Gauge Dial Snaps Gauge (0.00004 in. (0,001 mm accuracy)	Commercially Available
Dynamic Balancer	Standard Practice Document 1001
Growler	Commercially Available
High Potential Tester	Table 1002
LCR Meter	Commercially Available

Table 5001 - Inspection Tools

Tools Description	Source/Figure Reference
Magnifier, 7X to 10X	Commercially Available
Ohmmeter	Commercially Available
Pull Scale	Commercially Available
Surface Plate	Commercially Available
V-blocks	Commercially Available
¼ inch drive, 6 point deep well socket	Commercially Available

Table 5001 - Inspection Tools

3. Inspection Materials

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.

Materials necessary for the model inspection are listed in Table 5002.

Material	Description/Specification	Source/CAGE Code
Brush	Nonmetallic, soft bristle	Commercially Available
Cleaning Pads/Wiping Cloths	Lint-free, soft fabric	Commercially Available
Isopropyl Alcohol See **WARNING** before using this material.	TT-I-735, Grade A Flash Point: 53°F (12°C), FLAMMABLE Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available

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. The current flow is then detected by an iron feeler, such as a hacksaw blade.

The most common way of using a growler is the ‘feeler method’ in which the growler spans a slot containing a winding. The feeler of iron is rubbed against the armature winding. If the winding is shorted, the feeler will be pulled down to the slot and will stick and vibrate.

4. General Information

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

A. Visually Examine Mechanical Components for:

- signs of corrosion
- chipped-off enamel
- nicks, cracks, dents, scratches
- gouging, scoring, pitting or glazing mating surfaces
- fretting corrosion on mating surfaces
- base and finish coating quality on surfaces
- loose or defective attaching parts
- distortion or rounding
- discoloration
- crossed or stripped threads
- condensation at drain holes
- torn or cracked seals
- tears in screen or insulating tape
- galling or glazing of friction lining residue
- bent or distorted springs
- rounding, stripping or uneven wear on gear teeth or internal spline
- foreign matter obstructions in air flow path.

B. Visually Examine Electrical Components for:

NOTE: Do not remove solder from joints or open any connections.

- loose or defective attaching parts
- damage caused by too much heat
- electrical arcing paths
- poor soldering connections

- corroded contacts or terminals
- loose or defective electrical connector, contacts or terminals
- corroded electrical pins or connector
- bent connector pins
- loose, broken or shorted terminations.

5. Initial Inspection

NOTE: If damage is found during initial inspection, stop inspection immediately and, if needed, begin additional disassembly of starter-generator, ref. DISASSEMBLY section. If no mechanical or electrical defect is found, proceed to ASSEMBLY section.

A. Visually Examine the Starter-Generator in a brightly lit work area in accordance with (IAW) Paragraph 4.A.

(1) If damage caused during shipment or handling is found, stop inspection and advise your supervisor of damage.

(2) If damage from operation is found, record the components or assemblies in need of repair or replacement and continue with inspection.

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 cloth moistened with isopropyl alcohol.

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

(3) Make sure that all attaching hardware, solder joints, electrical wiring, and connections that are visible, are serviceable.

(4) Examine all wiring and insulation for damage and deterioration. Do not remove solder from joints or open any connections.

C. Examine installation between:

(1) Stator and housing assembly and drive-end bearing support assembly (if attached during inspection).

(2) Stator and housing assembly and bearing and brush support assembly (if attached during inspection).

D. Examine Drive Spline for:

Cracked, broken or stripped teeth.

6. Non-Destructive Testing (NDT) Inspection

A. Inspection Requirements

NOTE: Dimensional, electrical, and NDT inspections are to be performed only if a part or assembly is damaged.

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

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

7. Replace Service Parts and Common Hardware

A. Overhaul

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

B. Service Repair

During repair, inspection or servicing, replace 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 Guidelines

A. Overhaul Inspection - (TSO)

Starter-generator overhaul is done during regular scheduled maintenance and includes examination of, and when necessary, repair or replacement of damaged parts and assemblies.

During overhaul, all disassembled parts and assemblies must be fully examined to determine condition for continued service. A starter-generator is assigned zero operating hours Time Since Overhaul (TSO) after completion of the following: overhaul, all detailed checks, and unit has passed acceptance testing.

B. Service Repair Inspection - Continued Time

Starter-generator servicing is done during unscheduled maintenance to repair or replace damaged parts and assemblies. Do not remove any part or assembly for inspection unless given instructions in this section or TESTING AND FAULT ISOLATION.

When servicing, visually examine only those parts or assemblies that have been removed during disassembly. After servicing, the starter-generator is returned to service on a “continued time” basis.

C. The following terms are referenced throughout this section:

- DISCARD

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

- REPAIR

If damage to a part is found or the part is outside of the acceptance limits in the FITS AND CLEARANCES section, you can repair the part using the procedures found in the REPAIR section.

- DISASSEMBLE

If damage to part is found, or part of assembly is out of acceptance limits as per the FITS AND CLEARANCES section, then you can disassemble the part from the assembly and repair or replace the damaged part(s).

- REPLACE

If damage that causes a part to be outside of acceptance limits in the FITS AND CLEARANCES section is found or there is no REPAIR procedure for the part, replace part and retain for re-manufacture (if applicable). Parts and assemblies that qualify for re-manufacture are the armature and stator and housing assembly.

D. Surfaces

Numbers (e.g.; 1,2,3,4) in an illustration indicates a parts specific surface.

E. Dimensions

Letters (e.g.; A,B,C,D) in an illustration indicate dimension or tolerance.

F. Component Testing

Component testing on the following assemblies: (1) Stator Housing, (2) Armature, (3) Armature between Commutator Bars and Retaining Bands and (4) Bearing and Brush Support Assembly can be found in the TESTING AND FAULT ISOLATION section. Reference TESTING for Component Testing Fault Isolation Table.

9. Inspection of Parts and Assemblies

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

Refer to FITS AND CLEARANCES section for applicable component acceptance limits.

Ref. REPAIR if part is damaged. If damage to a part or sub-assembly is not repairable, discard.

A. Mounting Adapter (25) (See Figure 5001)

(1) Examine mounting adapter (25) 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) 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.A.(2).

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

(a) REPLACE if damage is found.

(4) Examine mounting adapter (25) for damaged or missing guide pin(s) (26).

(a) REPAIR pin(s) (26) if damage exists or they are not within limits of the FITS AND CLEARANCES section.

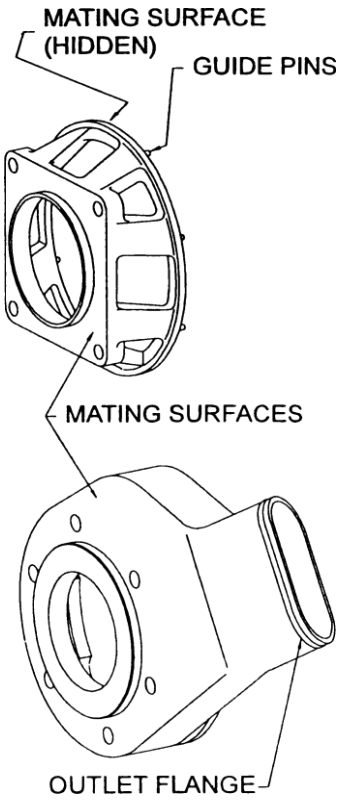


Figure 5001 - Mounting Adapter

B. V-Retainer coupling (10) and T-bolt (20)

(1) Examine V-retainer coupling (10) IAW the procedures found in Paragraph 4.A.

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

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

(2) Examine the T-bolt (20) IAW the procedures found in Paragraph 4.A.

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

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

C. Identification plate (30) (See Figure 5002)

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

(1) Examine the part IAW the procedures found in Paragraph 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 (30).

(c) DISCARD the original identification plate.

(2) Make sure that the drive screws (35) that attach ID plate are in place, and tight.

(a) DISCARD loose drive screws (35).

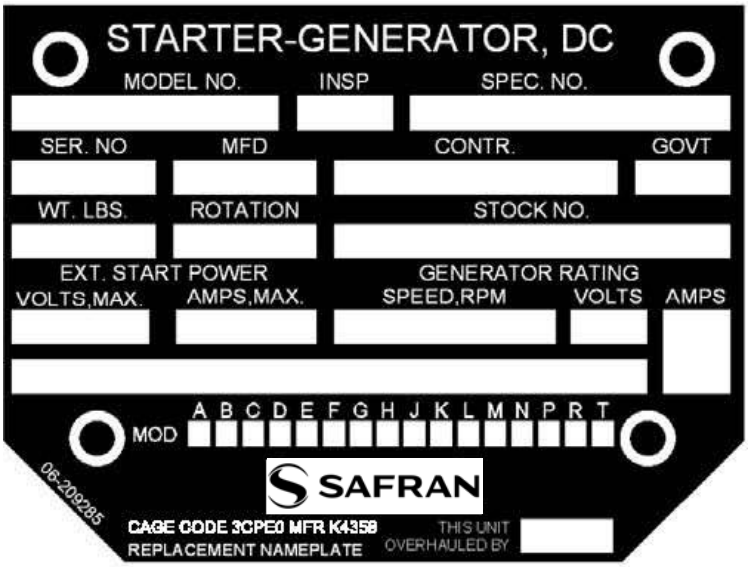


Figure 5002 - Replacement Identification Plate

D. Terminal block cover (55)

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

(a) DISCARD the part if damage exists.

E. Air Inlet (65) (See Figure 5003)

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

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

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

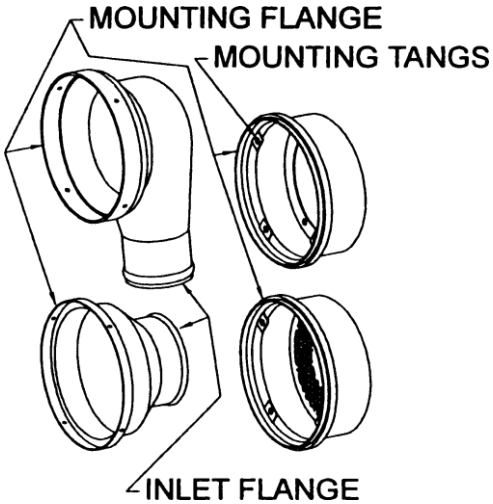


Figure 5003 - Air Inlet

F. Air Inlet Support Ring (80)

Make sure blind rivet nuts on bracket are tightly attached.

G. Brush Access Cover (95) (See Figure 5004)

(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 part if the insulating tape is loose or worn.

(3) Examine the screw (100) threads IAW the procedures found in Paragraph 4.A.

(a) DISCARD the part if damage is found.

(4) Make sure that the blind rivet nut (101) on the bracket is tightly attached.

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

(b) Older configuration of brush access cover (95) have welded nut, if welded nut is damaged refer Paragraph 15.B. of REPAIR section.

(5) Examine the blind rivet nut (101) threads IAW the procedures found in Paragraph 4.A.

(a) DISCARD the part if damage is found.

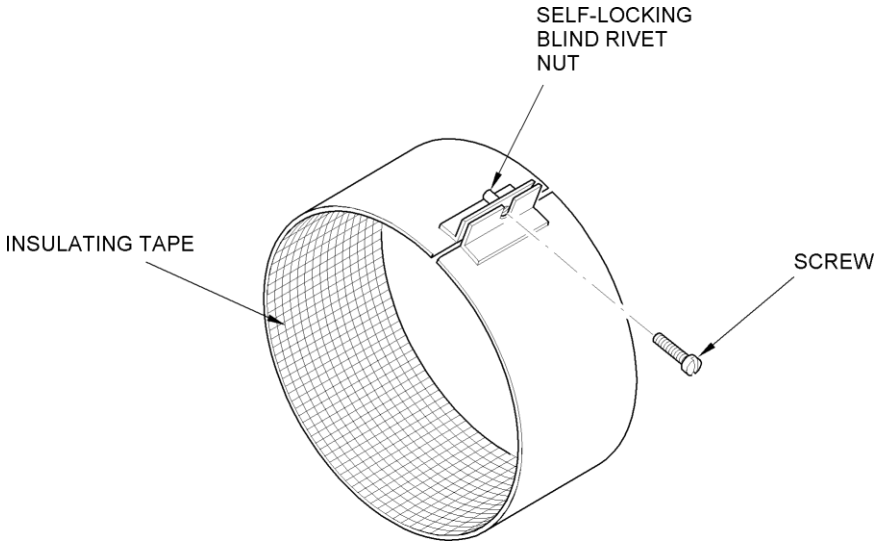


Figure 5004 - Brush Access Cover

H. Fan (115) (See Figure 5005)

(1) 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.

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

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

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

(a) Discard if fan is damaged.

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

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

(4) If the visual inspection under 10X magnification finds indications which can be cracks perform a liquid penetrant inspection IAW Paragraph 6.A.(2).

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

(a) REPLACE if damage is found.

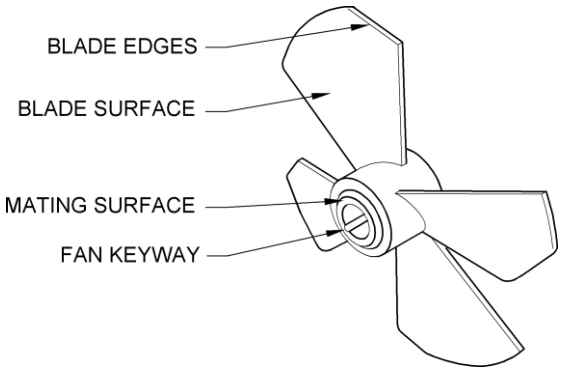


Figure 5005 - Fan

I. Brushes (105) (See Figure 5006)

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

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

(a) DISCARD brushes if damaged.

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

NOTE: The brushes must be replaced at overhaul or restoration for a zero time since overhaul.

(a) Replace the brushes if the remaining wear will not let the brushes stay in service until the next overhaul. Seat new brushes in accordance with instructions in SPD 1006.

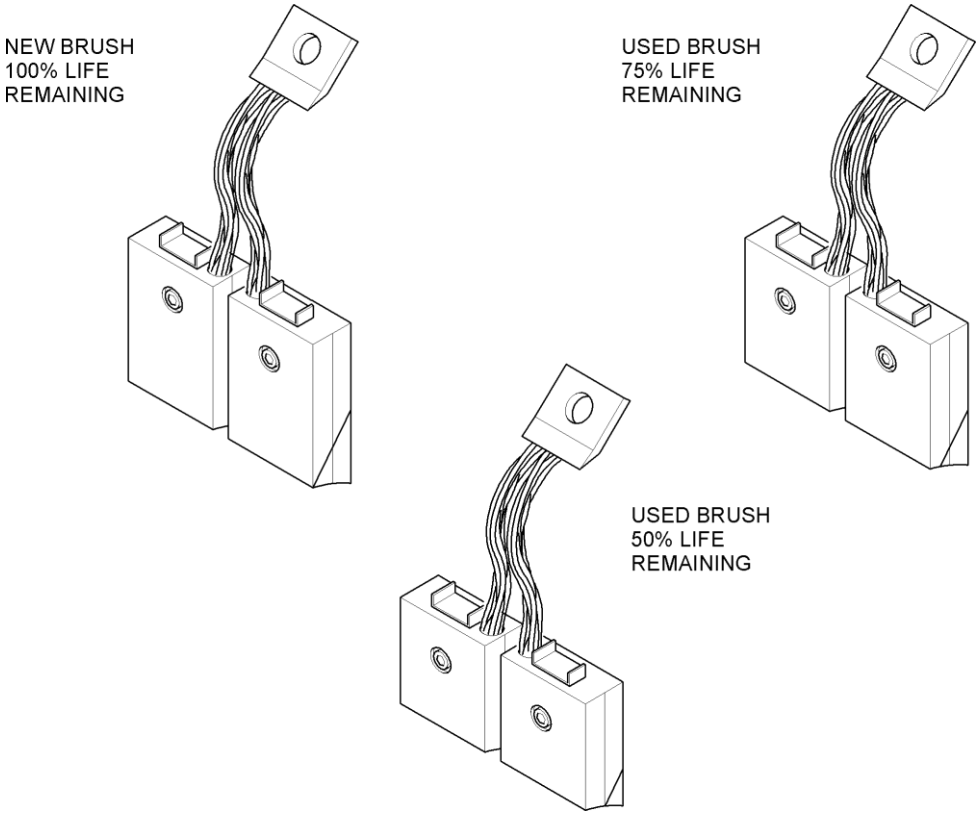


Figure 5006 - Brush Wear (Typical)

J. Drive Shaft (130) and Dampener Hub (140) (See Figure 5007)

(1) Examine the drive shaft (130) and dampener hub (140) IAW the procedures found in Paragraph 4.A.

(a) DISASSEMBLE the drive shaft (130) and dampener hub (140) if cracks or thread damage beyond two threads exist.

(b) REPAIR the drive shaft (130) and dampener hub (140) if dents, nicks and scratches exist.

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

(a) DISASSEMBLE drive shaft (130) and dampener hub (140) if damaged.

(b) DISCARD the damaged part.

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

(a) DISASSEMBLE the drive shaft (130) and dampener hub (140) if the diameter is not within the limits in the FITS AND CLEARANCES section.

(b) DISCARD the out of specification part.

(4) Perform a magnetic particle inspection IAW procedures found in Paragraph 6.A.(1).

(a) DISCARD the drive shaft (130) and dampener hub (140) if damage is found.

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

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

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

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

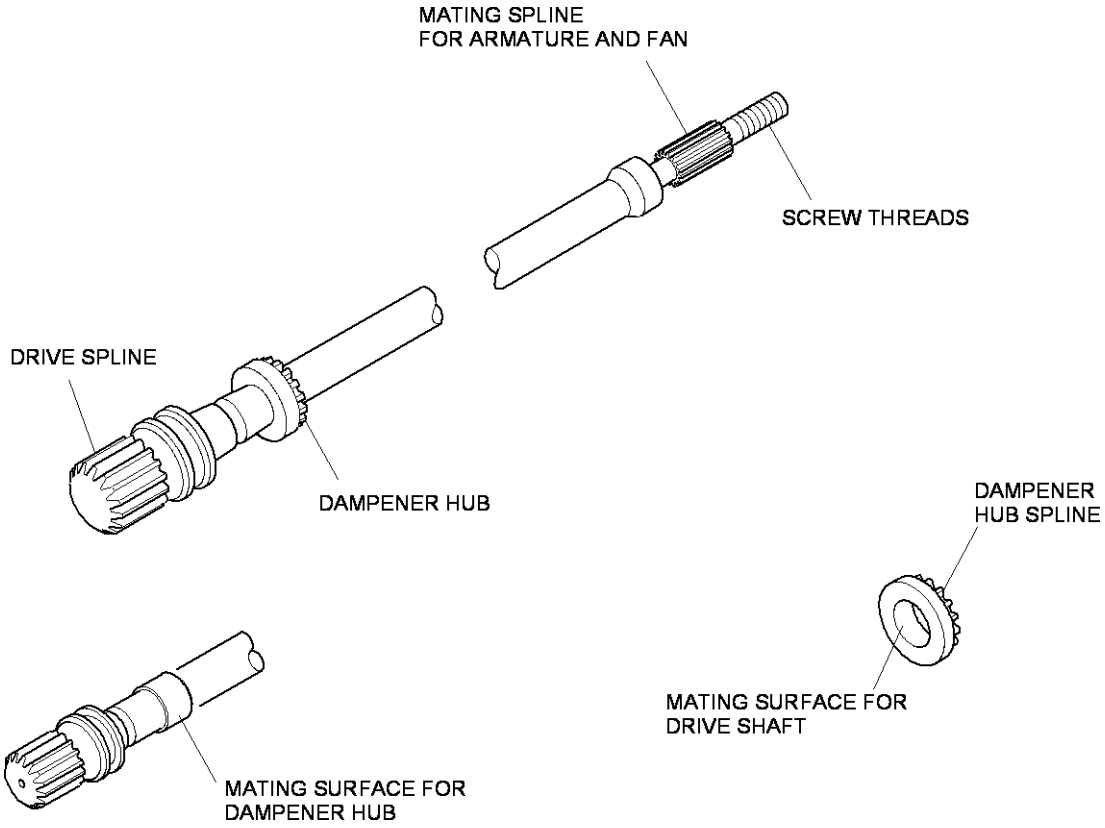


Figure 5007 - Drive Shaft and Dampener Hub

K. Dampener Plate (145) (See Figure 5008)

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

(a) DISCARD the part if cracks exist.

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

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

(a) DISCARD the part if damaged.

(3) Measure the dampener plate (145) 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.(1).

(a) DISCARD the part if damaged.

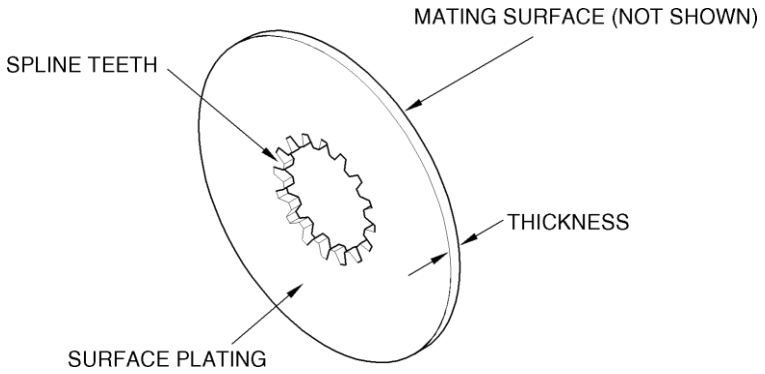


Figure 5008 - Dampener Plate

L. Friction Ring (150) (See Figure 5009)

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

(1) If friction ring is brown in color, it must be discarded because it contains asbestos.

(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 (150) thickness.

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

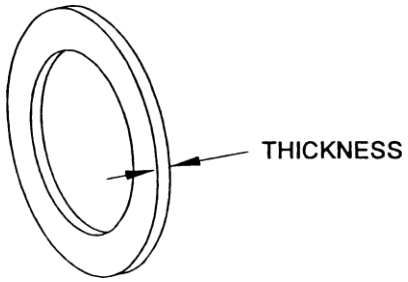


Figure 5009 - Friction Ring

M. Dampener Backplate (155) (See Figure 5010)

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

(a) DISCARD the part if cracks exist.

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

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

(2) Perform a magnetic particle inspection IAW the procedures found in Paragraph 6.A.(1).

(a) DISCARD if damage is found.

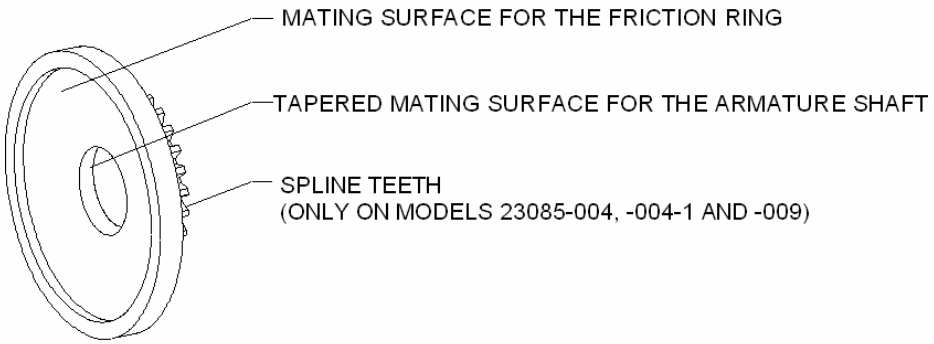


Figure 5010 - Dampener Backplate

N. Bearing and Brush Support Assembly (165) (See Figure 5011 and Figure 5012)

(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 scoring, gouging or glazing on the mating surfaces (marked 1, 2, 3 and 6 on Figure 5011) 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.A.(2).

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

(a) REPLACE if damage is found.

(4) Measure bearing liner diameter “A”. See Figure 5011.

(a) DISASSEMBLE the bearing and brush support assembly (165) 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 (10002-10, 10002-12) (marked 4 and 5 on Figure 5011) for damage.

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

(6) Visually examine blind rivet nut (10002-15) (marked 7 on Figure 5011) for crossed or stripped threads.

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

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

(8) Inspect the brush lead terminal board (10002-45) for damage.

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

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

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

(9) Examine the brush holder (10002-42), including the brush spring supports and center supports for cracks, warping, and discoloration caused by electrical arcing. Inspect the insulation sheets (10002-50) for damage.

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

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

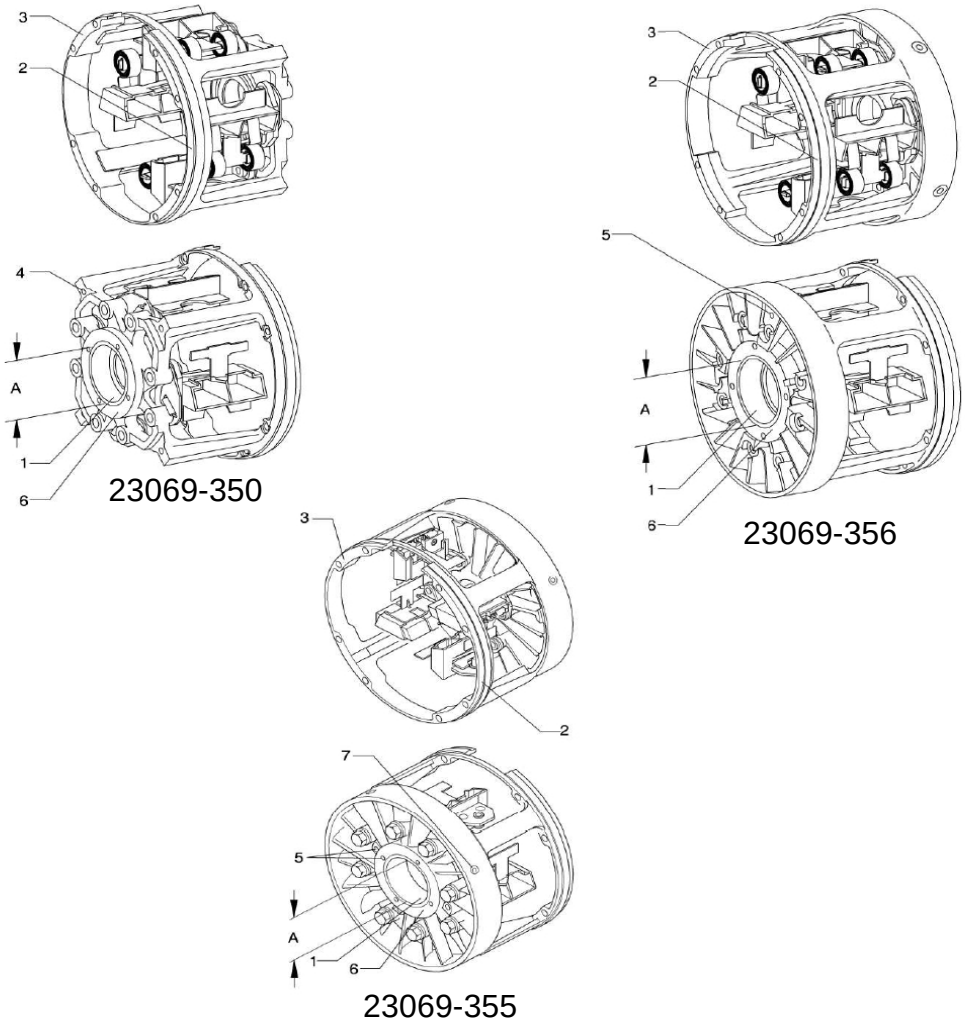


Figure 5011 - Bearing and Brush Support Assembly

(10) Measure the capacitor capacitance value on each filter assembly (10002-60) at a frequency of 900 to 1100 Hz, 77° F (25° C).

(a) DISCARD the filter assembly (10002-60) if capacitance values fall outside the required limits in the FITS AND CLEARANCES section.

(11) Measure brush spring (10002-70) force using pull scale with harness. See Figure 5012**.**

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.

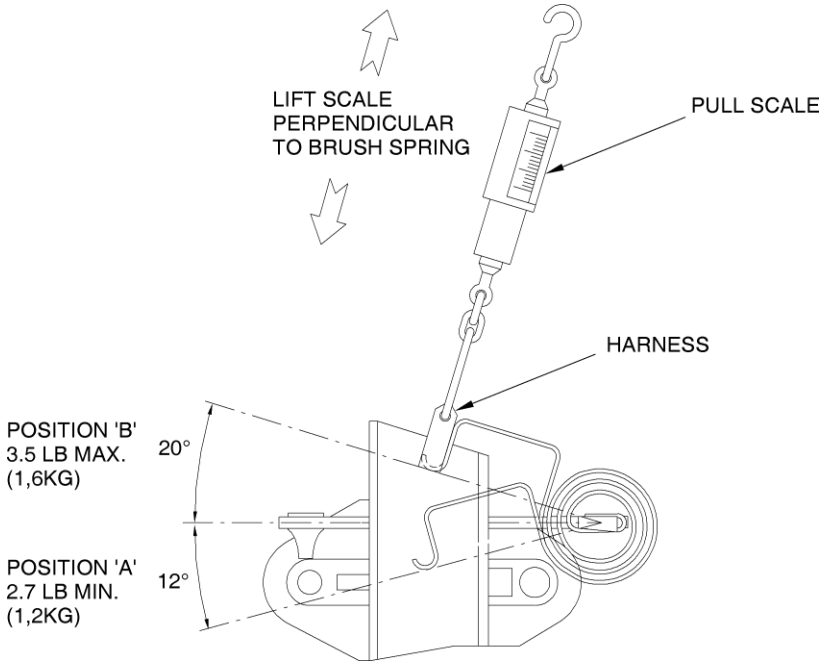


Figure 5012 - Determine Spring Force

(12) Perform a dielectric test.

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

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

CAUTION: 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 FILTER ASSEMBLY LEADS ARE ISOLATED FROM THE BEARING AND BRUSH SUPPORT ASSEMBLY.

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

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

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

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

(e) Turn high potential tester power OFF.

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

(g) Acceptance Limits:

1 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 (165) fails dielectric test, clean bearing and brush support assembly, and repeat dielectric test.

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

If bearing and brush support assembly (165) fails dielectric test, replace bearing and brush support assembly.

O. Drive End Bearing Support Assembly (200) (See Figure 5013)

(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 scoring, gouging 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.A.(2).

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

(a) REPLACE if damage is found.

(4) Measure bearing liner diameter using a gage with an accuracy of ± 0.00004 inch (0,0010 mm). See Figure 5013**.**

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

(5) Examine the threaded hole for crossed or stripped threads

(a) DISCARD drive end bearing support assembly (200) if thread hole damaged.

(6) Examine the helicoil inserts (10003-15) for damage.

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

(7) Examine guard screen (10003-25) for tears.

(a) DISASSEMBLE drive end bearing support assembly (200) if damage is found.

(b) DISCARD drive screws (10003-30), flat washers (10003-35) and damaged guard screen (10003-25).

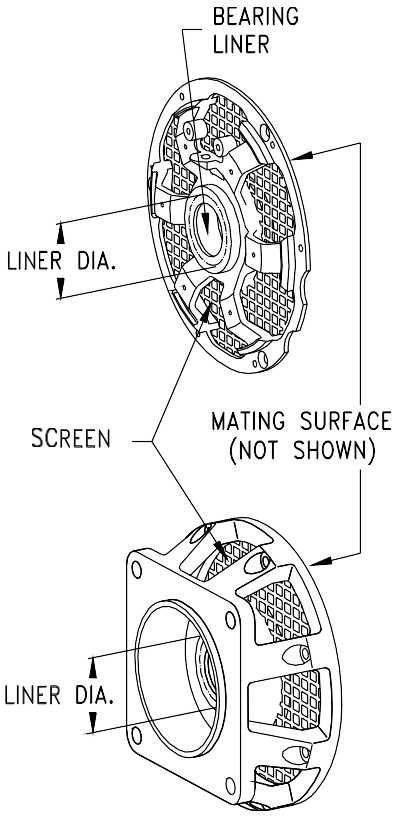


Figure 5013 - Drive End Bearing Support Assembly

P. Speed Pickup Guard (220) (See Figure 5014)

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

- DISCARD the part if damaged.

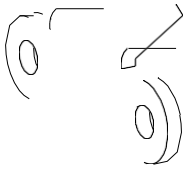


Figure 5014 - Speed Pickup Guard

Q. Speed Pickup (230) (See Figure 5015)

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

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

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

(2) Examine the insulation sleeving for damage.

(a) DISCARD the part if damage exists.

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

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

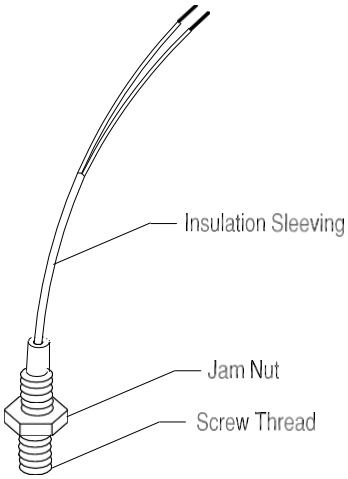


Figure 5015 - Speed Pickup

R. Spring Wave Washer (240) (See Figure 5016)

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

(a) DISCARD the spring wave washer (240) if damage is found.

(2) Use a Compression Digital Hand Tester, or equivalent, to measure the force required to compress the spring from the free height (H_F) to the compressed height (H_C). See Figure 5016.

(a) DISCARD if the load given in Table 5003 is not met.

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

Table 5003 - Spring Wave Washer inspection

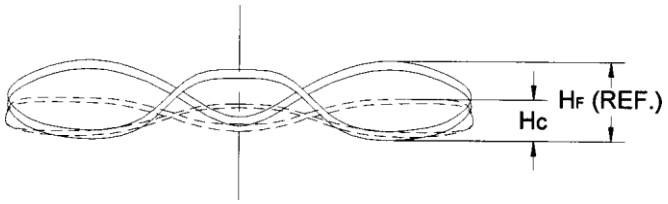


Figure 5016 - Spring Wave Washer Load Inspection

S. Armature (250) (See Figure 5017)

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

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

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

(b) REPAIR if minor dents, scratches and nicks or scoring, gouging or glazing 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 scoring, gouging 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 5017.

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

(b) REPLACE armature if damage is not repairable.

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

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

(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.

1 Reject the armature shaft if too much play is found when engaging the drive shaft.

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

(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 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 3.3. of this section for additional information about use of growler during inspection.

(a) REPLACE the armature if a short exists.

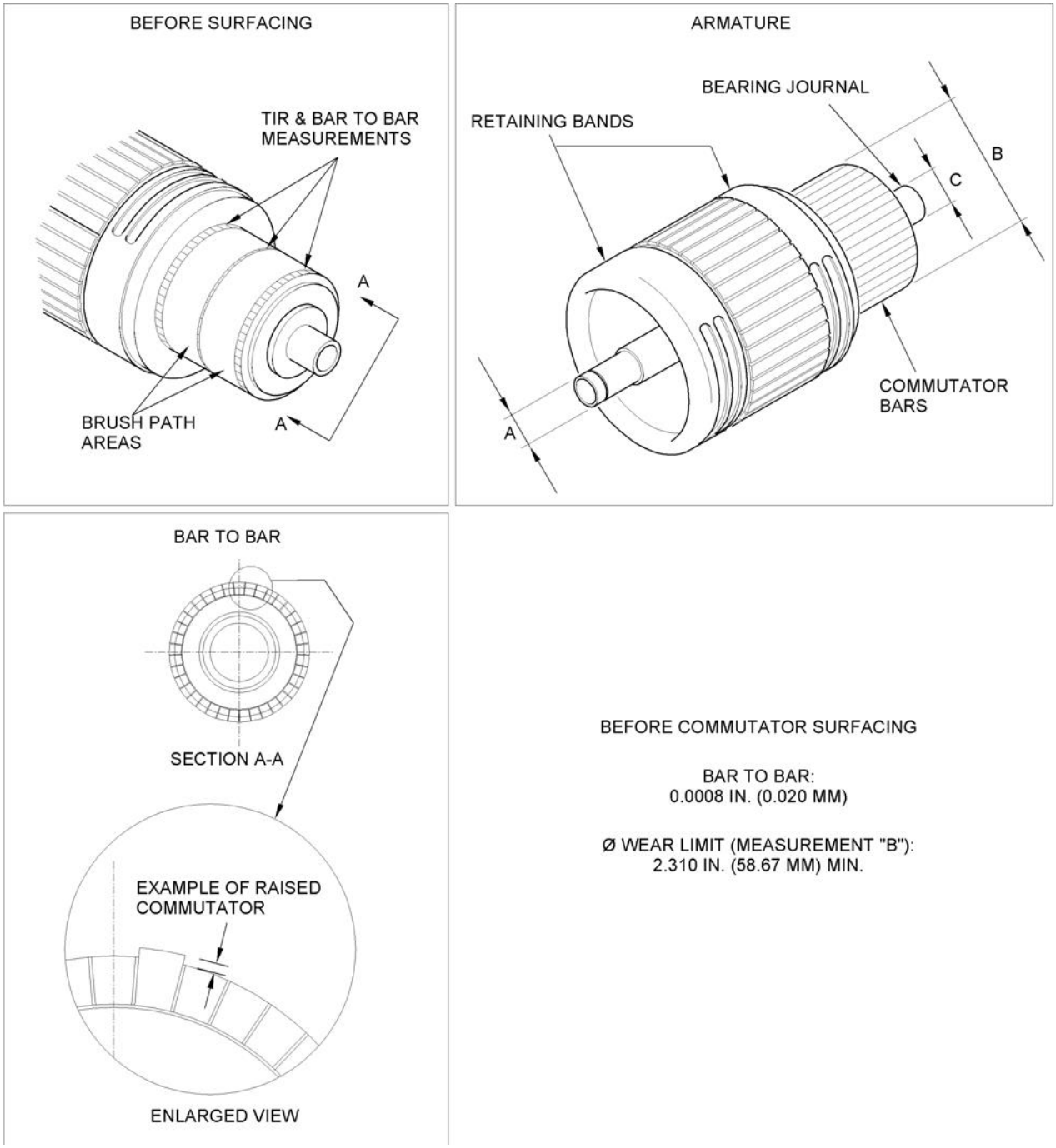


Figure 5017 - Armature

(14) Perform a dielectric test.

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 cleaning, replace the armature.

T. Bearing Retainer (255) (See Figure 5018)

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

(a) DISCARD the part if damaged.

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

(a) DISCARD the part if damaged.

(b) Mating surface index:

1 Mating surface with bearing and brush support assembly.

2 Mating surface with anti-drive end ball bearing.

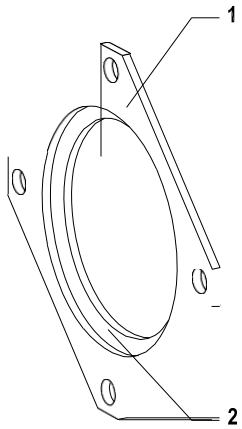


Figure 5018 - Bearing Retainer

U. Baffle Disc (275) (See Figure 5019)

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

(a) DISCARD the part if damaged.

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

(a) DISCARD the part if damaged.

(b) Mating Surface Index:

1 Mating surface with drive end ball bearing.

2 Mating surface with shoulder of armature shaft.

3 Mating surface with armature shaft.

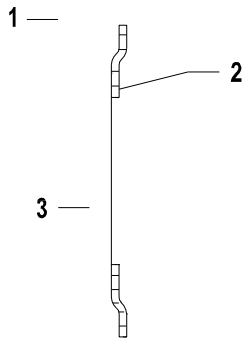


Figure 5019 - Baffle Disc

V. Stator and Housing Assembly (285) (See Figure 5020)

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

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

(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.

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

(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 HIGH POTENTIAL TESTER POWER BEFORE CONNECTING OR DISCONNECTING HIGH VOLTAGE ELECTRICAL LEADS CAN CAUSE SERIOUS DAMAGE TO THE STATOR AND HOUSING ASSEMBLY.

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

(a) Jumper all stator leads together.

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

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

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

(e) At a rate not to 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.

(f) Turn high potential tester power OFF.

CHECK

(g) Disconnect test leads.

(h) Disconnect jumper from stator leads.

(i) Acceptance Limits:

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

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

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

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

(a) REPLACE the stator and housing assembly (285) if an open circuit exists.

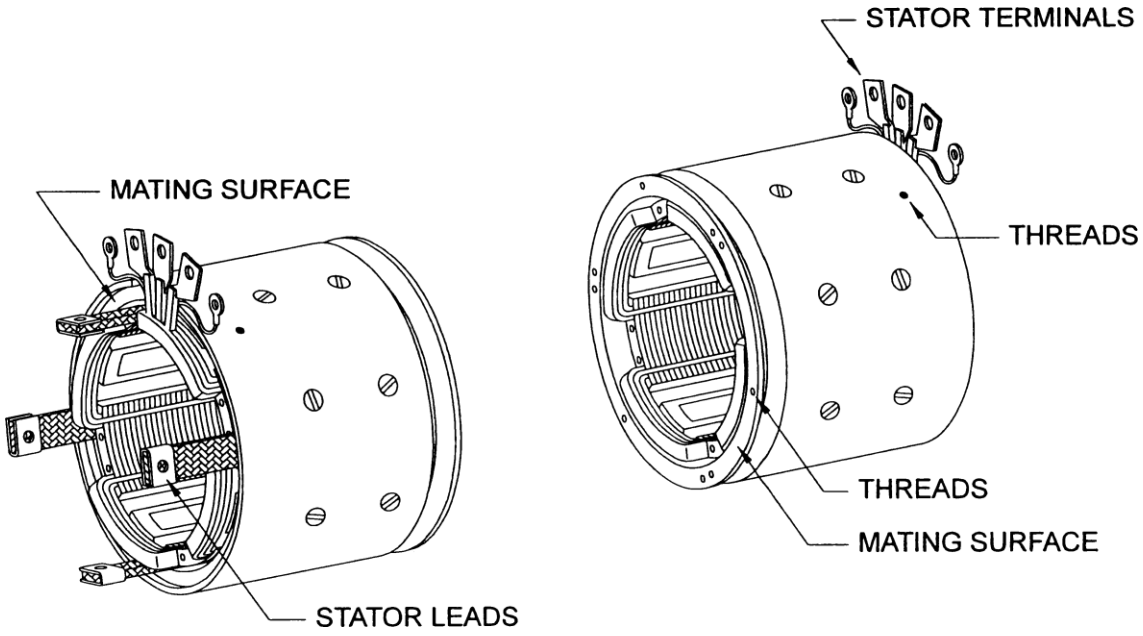


Figure 5020 - Stator and Housing Assembly

W. Terminal Block (10004-40) (See Figure 5021)

CAUTION: THE USE OF REMANUFACTURED TERMINAL BLOCKS IS NOT AUTHORIZED BY SAFRAN POWER, USA. DAMAGED TERMINAL BLOCKS (OTHER THAN REPAIRABLE THREAD DAMAGE) MUST BE DISCARDED.

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

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

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

(c) REPLACE the terminal block stud(s), terminals B and E if thread damage of more than two turns exists.

(2) For Terminal Block (23032-1509). See Figure 5021:

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

1 Measure the capacitance values between terminals B and E at the frequency shown in the FITS AND CLEARANCES section.

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

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

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

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

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

(3) For Terminal Blocks (23069-1370, 23069-1238 and 23081-1312). See Figure 5021:

(a) Using an LCR meter, measure the capacitance values between terminals B and E and between B and the ground lead.

1 Measure the capacitance values between terminals B and E at the frequency shown in the FITS AND CLEARANCES section.

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

2 Measure the capacitance values between terminal B and ground lead at the frequency shown in the FITS AND CLEARANCES section.

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

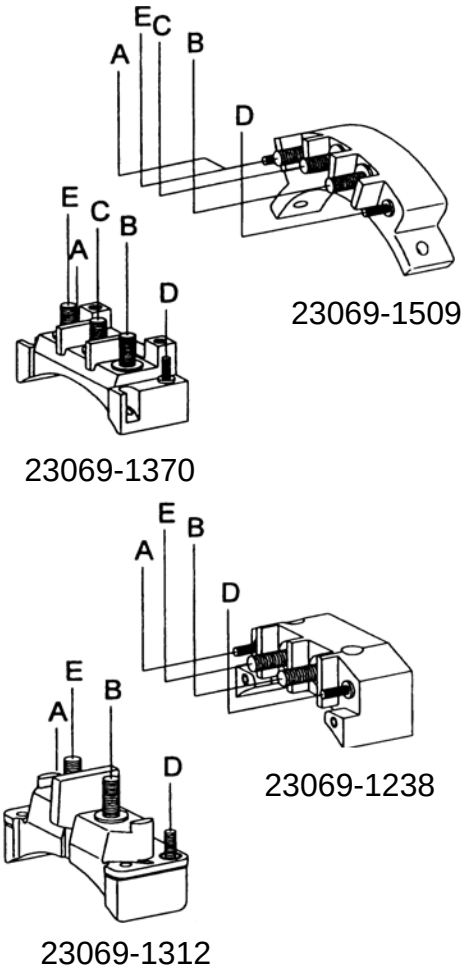


Figure 5021 - Terminal Block

10. Terminology

Table 5004 lists definitions of terms used to describe various damage conditions.

Term	Definition	Probable Cause
Corrosion	The chemical or electrochemical reaction between a material, usually a metal, and environment that produces a deterioration of the material and its properties.	Environmental condition that causes deterioration.
Crack	Break in material.	Severe stress from overload or shock; possible extension of a scratch.
Dent	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	Sharp bottomed depression with or without rough outer edges.	Dropping, banging.
Rounding	Removal of surface metal at corners or dulling of edges.	Result of abrasion, vibration, or poor mating surfaces.
Scoring	Deep scratch following path of part motion.	Result of localized lubrication break-down between sliding surfaces.
Scratch	Shallow furrow or surface irregularity, usually longer than wide.	Movement of a sharp object across the surface.

Table 5004 - Terminology

Term	Definition	Probable Cause
Short	Electrical condition where two conductors are connected by a path of very low electrical resistance, often with evidence of sparking or arcing.	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, usually non-metallic, along an irregular path.	Too much tension, caused by external force.
Wear	Slow removal of base material. Wear is often not visible to the naked eye.	Result of abrasive substances contacting rolling surfaces and acting as a lapping compound.

Table 5004 - Terminology (Continued)

THIS PAGE INTENTIONALLY LEFT BLANK

REPAIR

1. Introduction

CAUTION: ANY USE OF PARTS, MATERIALS, OR PROCESSES NOT AUTHORIZED BY SAFRAN POWER, USA FOR MAINTENANCE AND/OR OVERHAUL OF STARTER-GENERATOR CAN AFFECT CONTINUED AIRWORTHINESS AND/OR INVALIDATE CERTIFICATION.

A. Repairs are limited to:

- damaged surfaces
- damaged threads
- bearing journal and liner overhaul
- commutator refinishing
- armature balancing
- restoring surface coatings
- re-identify FAA-PMA marking
- correcting output voltage polarity

B. Replacements are as follows:

- helicoil inserts
- air inlet gasket
- brush access cover insulating tape
- bearing liner
- brush access cover blind rivet nut
- replacing Rivnut® fastener
- repair of complete brush holder
- removal and replacement of mounting adapter guide pins

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

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.

In addition to standard shop tools, the following tools are required for repair, equivalent tools can be used. Tools listed below are not available for purchase from Safran Power, USA.

Tools Description	Source/Figure Reference
Adapters, Armature Shaft (Drive End and Bearing and Brush Support)	Figure 9001
Battery, 6 Volt, DC power source	Commercially Available
Commutator turning fixture	Figure 9005
Crimp Tool	Commercially Available
Drive end bearing hub supports	Figure 9010
Helicoil insertion/removal tool	Commercially Available
Liner driver	Figure 9004
PlusNut® Fastener Header	Figure 9016
Rivet Alignment and Press Fixture	Figure 9006
Switch (for field flashing)	30V, 10 amps

Table 6001 - Repair Tools

Tools Description	Source/Figure Reference
Terminal Stud Remover P/N: E23824-SQ5 Extracto© Stud Remover 3/8 inch-24 Equipped with 1/2 inch drive	Not illustrated Titan Tool Company, inc. 7410 West Ridge road Fairview, PA 16415 Ph: (814) 474-1583 Fax: (814) 474-5337 www.titantoolco.com
Terminal Stud Driver P/N: M1-AQ5-08 Mustang© Stud Driver 3/8 inch-24 Equipped with 1/2 inch drive	Not illustrated Titan Tool Company, inc. 7410 West Ridge road Fairview, PA 16415 Ph: (814) 474-1583 Fax: (814) 474-5337 www.titantoolco.com
Thread chasers	Commercially Available
Torque Wrench	Commercially Available
V-blocks	Commercially Available

Table 6001 - Repair Tools (Continued)

3. Repair Materials

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

NOTE: 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
Chemical Film Solution Alodine 1200	Chemical Film Solution MIL-C-5541, Class 1A or Class 3	Henkel Surface Technology Madison Heights, MI 48071-0000 (V1N6B3)
Coating, Zinc Phosphate	TT-C-490, Type 1	Commercially Available

Table 6002 - Repair Materials

Material	Description/Specification	Source/CAGE Code
Ink, Marking, White	Markem P/N 7132 White Ink	Markem-Imaje Corporation Keene, NH www.markem.com (V38360)
Ink, Marking, Black	Markem P/N 7132 Black Ink	
Oil, Machine	N/A	Commercially Available
Pads, Cleaning	Lint-free cotton	Commercially Available
Primer, Zinc Chromate	TT-P-1757, Comp. G,YEL	Commercially Available
Sandpaper	400/600 Grit (non-aluminum oxide only)	Commercially Available
Sealant, Silicone, One Part	Silastic RTV 732, Black	Dow Corning Corporation PO Box 994 Midland, MI 48686-0994 Ph: (989) 496 4400 FAX: (989) 496 6731 www.dowcorning.com (V71984)
Solder	QQ-S-571 Type Sn60, refer to ANSI/J-STD-001B	Commercially Available
India Stone	N/A	Commercially Available
Tape, Insulating	P/N SG13-06R, 8 mil, PTFE coated fiberglass, acrylic adhesive	Saint Gobain Performance Plastics, Corporation, Div Composites, 14MC Caffrey St. Hoosick Falls, USA www.plastics.saint-gobain.com (V1ECV7)
Thread Locking Primer	Primer, Loctite Grade 7649	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com or, Commercially Available
Thread Locking Adhesive	Loctite Grade 243	

Table 6002 - Repair Materials (Continued)

4. Surface Repair

A. Repair formed metal components having surface damage or corrosion and qualifying for repair

CAUTION: REMOVE ONLY DAMAGE EXTENDING ABOVE SURFACE OF PART.

(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.

CAUTION: REMOVE ONLY DAMAGE EXTENDING ABOVE POLISHED SURFACE. MAKE SURE DIMENSIONAL TOLERANCES ARE WITHIN LIMITS.

(2) Remove minor raised edges, burrs, nicks, or scratches on any polished or load-bearing surface.

5. Thread Repair

A. Repair damaged threads as follows:

(1) Repair if two or less threads are damaged.

CAUTION: DO NOT USE THREAD CUTTING DIE TO REPAIR DAMAGED THREADS.

(a) Repair damaged threads with thread chaser.

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

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

(2) Discard if more than two threads are damaged.

6. Helical coil Insert Replacement

A. Replacement Procedure

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

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

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

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

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

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

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

(5) Break off helicoil insert installation tang.

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

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

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

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

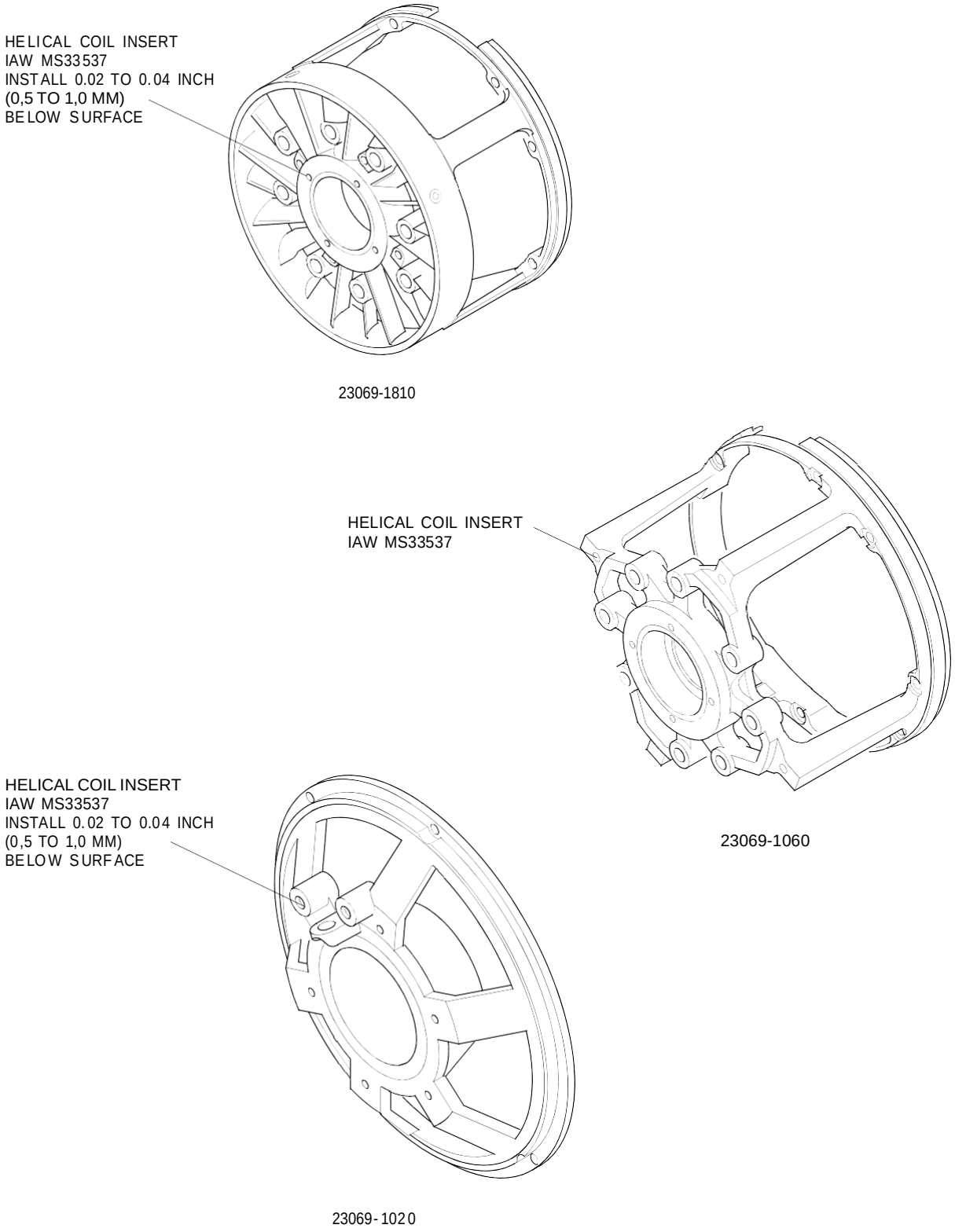


Figure 6001 - Helical Coil Insert Replacement

7. Replacing Rubber Gasket on Air Inlet

A. Models 23069-013, -003, and -013 Only.

WARNING: DO NOT GET SILICONE SEALANT ON YOUR SKIN OR IN YOUR EYES. YOU MUST PUT ON PVC GLOVES AND EYE PROTECTION. IF YOU GET SOME ON YOUR SKIN, FLUSH WITH WATER. IF YOU GET SOME IN YOUR EYES, FLUSH WITH CLEAN WATER AND GET MEDICAL AID.

NOTE: Best adhesion obtained with adhesive thickness of 15 mils (0,38 mm).

(1) Apply a coating of silicone rubber sealant (RTV 732) to surface of air inlet where rubber gasket is to be installed.

NOTE: Excess adhesive can be removed before curing by wiping effected area with a cloth moistened with a suitable solvent.

(2) Using only contact pressure, replace rubber gasket on air inlet.

(3) Allow adhesive to cure for 24 hours at ambient room temperature.

NOTE: Adhesive reacts with moisture in air during curing. A minimum of 20% humidity is required for a full cure within the 24 hour period.

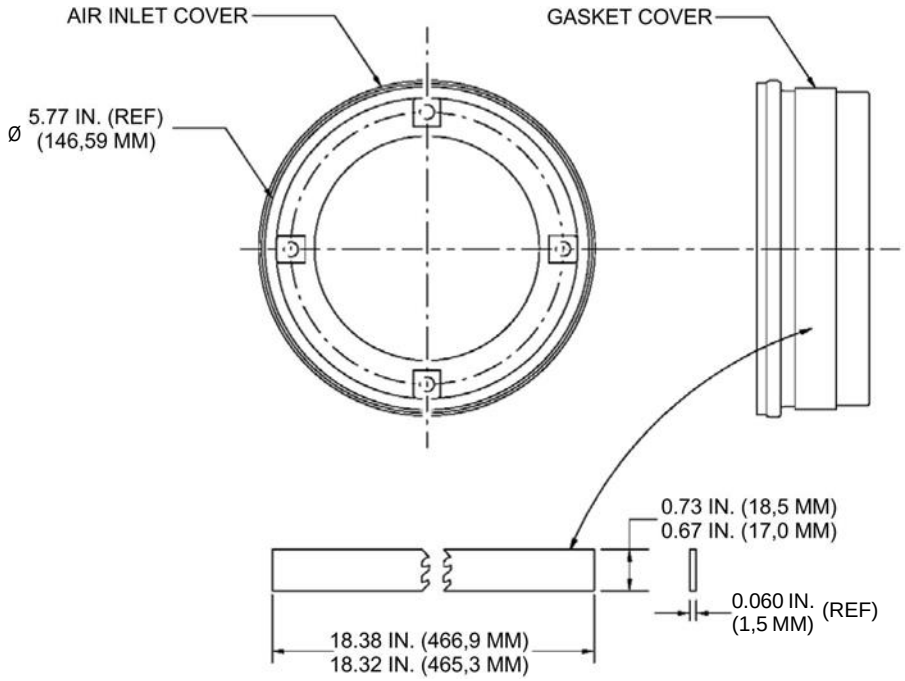


Figure 6002 - Air Inlet Assembly with Gasket

8. Bearing Journal and Liner Overhaul

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

A. Restoration

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

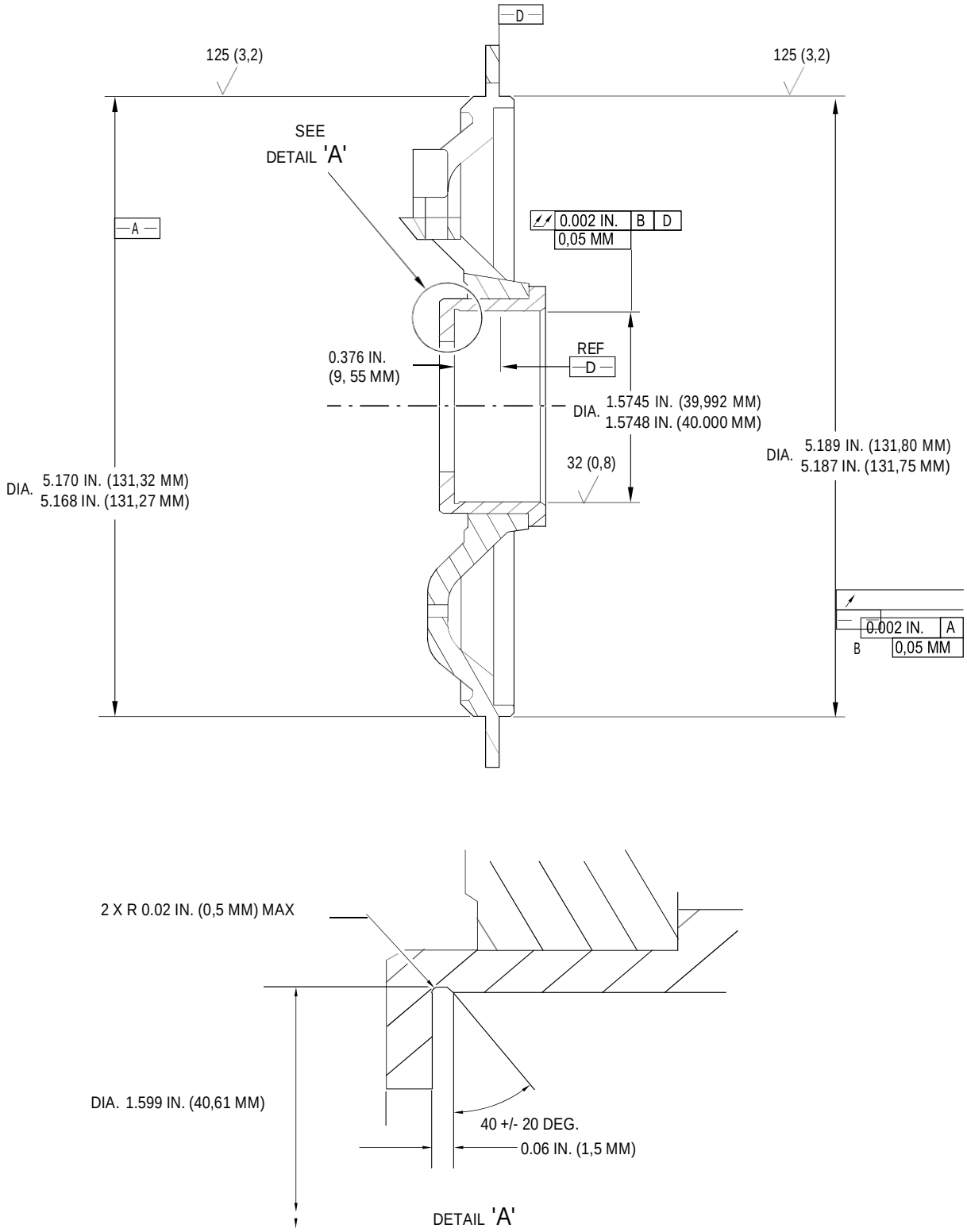


Figure 6003 - Drive End End Bell Dimensions

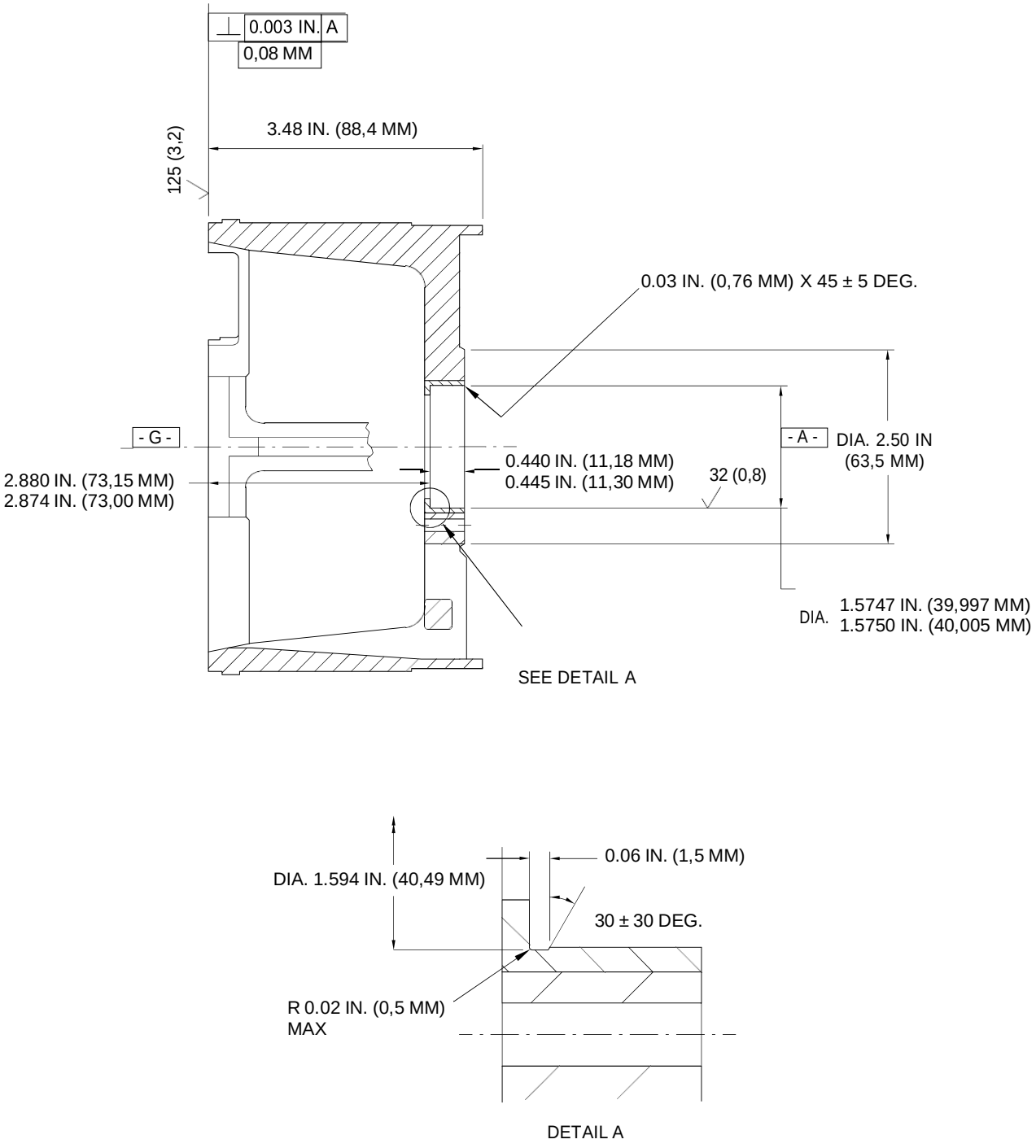


Figure 6004 - Anti-Drive End End Bell Dimensions

9. Commutator Refinishing

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

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

A. Setup

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

(1) Install bearing (270D) into commutator turning fixture, ref. SPECIAL TOOLS, FIXTURES, AND EQUIPMENT section (Figure 9005).

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

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

(4) Position tail stock so 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

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

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

(1) Cut the commutator to a surface finish of 64 to 100 microinches (1,6 to 2,5 microns) RMS. The finish surface should extend to the full extent of the armature.

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

WARNING: **WHEN YOU OPERATE COMPRESSED AIR, CONTROL THE PRESSURE TO LESS THAN OR EQUAL TO 29 PSIG (200 KPA). WEAR GOGGLES OR FACE PROTECTION TO GIVE PROTECTION TO THE EYES. FOLLOW NECESSARY PRECAUTIONS TO PREVENT INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR IS FREE FROM OIL AND WATER WHEN YOU CLEAN OR DRY COMPONENTS. THIS PRECAUTION PREVENTS CONTAMINATION OF THE COMPONENTS.

(2) Clean the armature (250) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

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

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

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

(b) All cuts must be equally spaced and parallel with the centerline of the armature shaft within 0.005 inch (0,13 mm) of true position.

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

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

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

WARNING: **WHEN YOU OPERATE COMPRESSED AIR, CONTROL THE PRESSURE TO LESS THAN OR EQUAL TO 29 PSIG (200 KPA). WEAR GOGGLES OR FACE PROTECTION TO GIVE PROTECTION TO THE EYES. FOLLOW NECESSARY PRECAUTIONS TO PREVENT INJURY TO OTHER PERSONNEL IN AREA.**

CAUTION: MAKE SURE THAT COMPRESSED AIR IS FREE FROM OIL AND WATER WHEN YOU CLEAN OR DRY COMPONENTS. THIS PRECAUTION PREVENTS CONTAMINATION OF THE COMPONENTS.

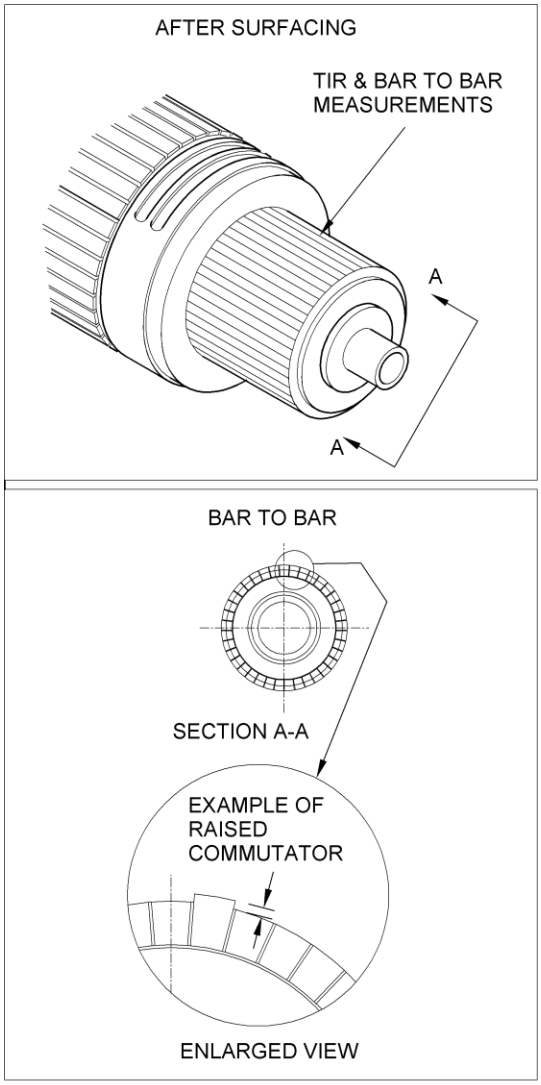
(7) Clean the armature (250) surfaces with compressed air, 29 PSIG (200 kPa) maximum.

(8) After the commutator is refinished:

(a) Measure the commutator bar-to-bar and total indicator reading (TIR) run-out in full circumference of the commutator. Support the armature (250) on two V-blocks.

(b) Make sure that the armature (250) is balanced IAW procedures found in Paragraph 10.

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



AFTER COMMUTATOR SURFACING

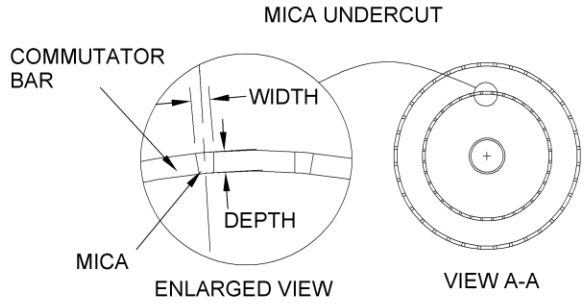
BAR TO BAR:
0.0001 IN. (0.003 MM)

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

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

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

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



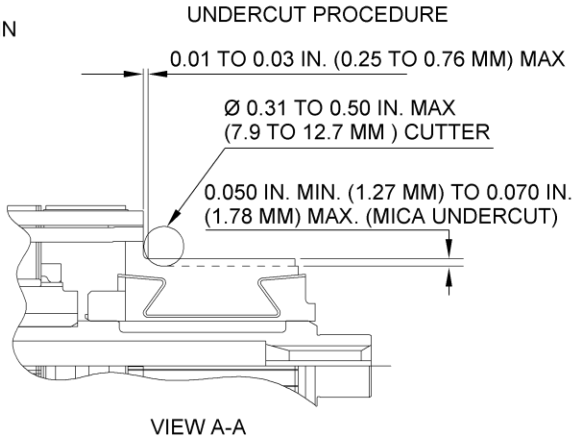


Figure 6005 - Armature Repair

10. Balancing Armature

Balance armature to limits in FITS AND CLEARANCES and according to procedure in Safran Power, USA SPD 1001.

11. Restoring Surface Coatings

A. Removal of Surface Coatings

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

B. Restore Surface Coatings

Restore damaged or removed surface coatings IAW procedures in Safran Power, USA SPD 1002.

C. Restore or Apply Insulating Enamel

Restore or apply insulating enamel to bearing and brush support assembly IAW procedures in Safran Power, USA SPD 1002.

12. Re-identify FAA-PMA Marking

On Applicable Models 23069-013, -002, -014, -015, -024 and -025.

If FAA-PMA marking has been covered with a new coat of paint, apply a new FAA-PMA marking using white marking ink with approximately 1/4” (6 mm) high letters to left of nameplate and reading in same direction as the nameplate.

13. Polarizing Output Voltage Field - (See Figure 6006)

A. If Polarity Of Output Voltage Has Been Reversed:

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

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

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

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

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

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

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

(5) Turn power supply OFF and disconnect power leads

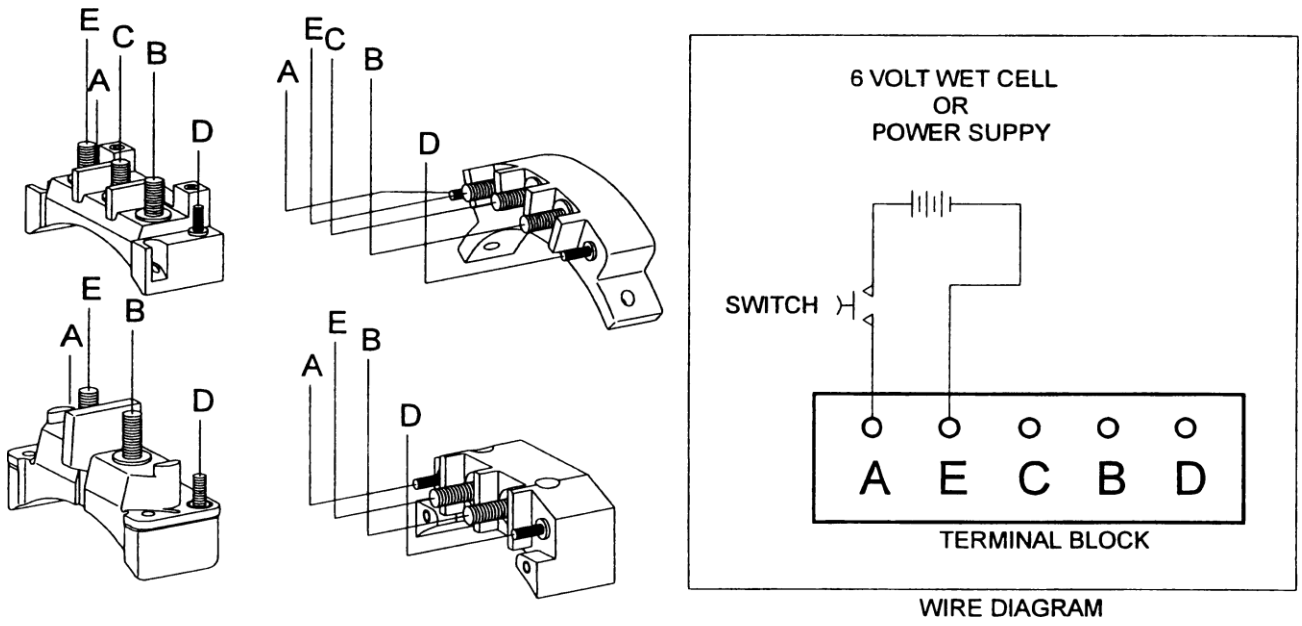


Figure 6006 - Polarizing the Field

14. Replacing Brush Access Cover (10001-95) Insulating Tape - Figure 6007

A. Replacing Tape

(1) Remove all signs of insulating tape and clean inside surface of brush access cover.

(2) If plating on inside surface of brush access cover is damaged, touch up surface coating following procedures in Safran Power, USA SPD 1002.

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

(4) Starting at one of the two sides of brush access cover band, line up sides of tape roll with sides of cover band.

(5) Apply insulating tape (directly from roll) to inner surface of brush access cover.

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

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

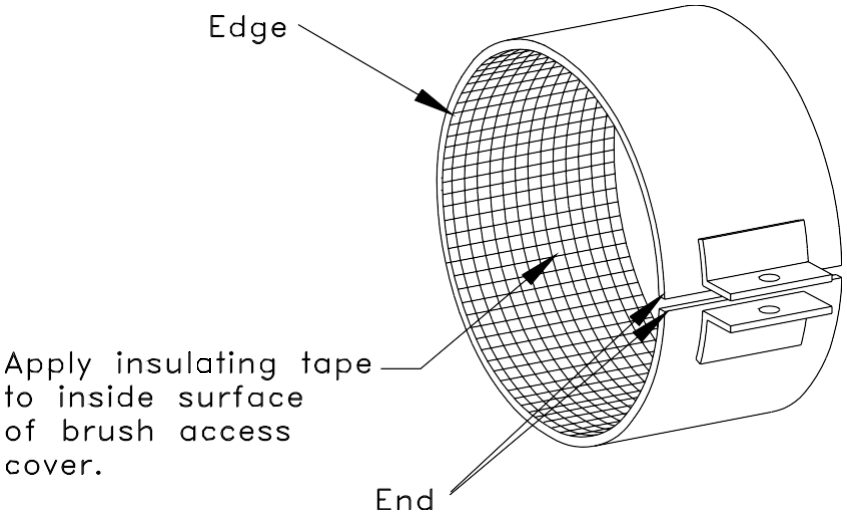


Figure 6007 - Brush Access Cover Insulating Tape Repair

15. Brush Access Cover Self-locking Rivet Nut Replacement

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

A. Replace Self-Locking Blind Rivet Nut (101) as follows: (See Figure 6008)

(1) Remove self-locking blind rivet nut (101) from brush access cover (95) by drilling a 0.25 inch (6,35 mm) hole through self-locking blind rivet nut (101). The inboard and outboard sides of self-locking blind rivet nut should become loose and fall off.

NOTE: A PlusNut® Fastener Header tool (Figure 9016) is required for repair procedure.

(2) Turn 1/2 inch nut in a counterclockwise direction until stud is fully extended. Engage all threads on stud in self-locking blind rivet nut (101) until nut is tight against tool face.

(3) Insert fastener header tool into hole in brush access cover (95).

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

NOTE: Do not overtighten self-locking blind rivet nut (101). Over-tightening can cause damage to threads.

(5) Turn nut until firm resistance is felt. Self-locking blind rivet nut (101) should be physically reformed. If self-locking blind rivet nut is loose, tighten nut until self-locking blind rivet nut is secure. Loosen nut by turning counterclockwise.

(6) Remove fastener header tool from self-locking blind rivet nut (101) by turning counterclockwise.

(7) Torque test self-locking blind rivet nut (101) to 60 lbf.in. (6,8 Nm).

(8) If the plating on the outer surface of the blind rivet nut (101) is damaged, coat the surface IAW the instructions in Paragraph 11.

B. Spot Welded Nut Removal

(1) Using caution to avoid touching surface of clamp, mill existing nut to remove from clamp.

NOTE: If finish is removed, touch up with phosphate and/or paint, as required.

(2) Clamp the band in a vice and using an 0.250 drill, carefully drill out the through hole.

(3) Using a small “ignition” flat file, file a notch in edge of hole to serve as a keyway for the rivet.

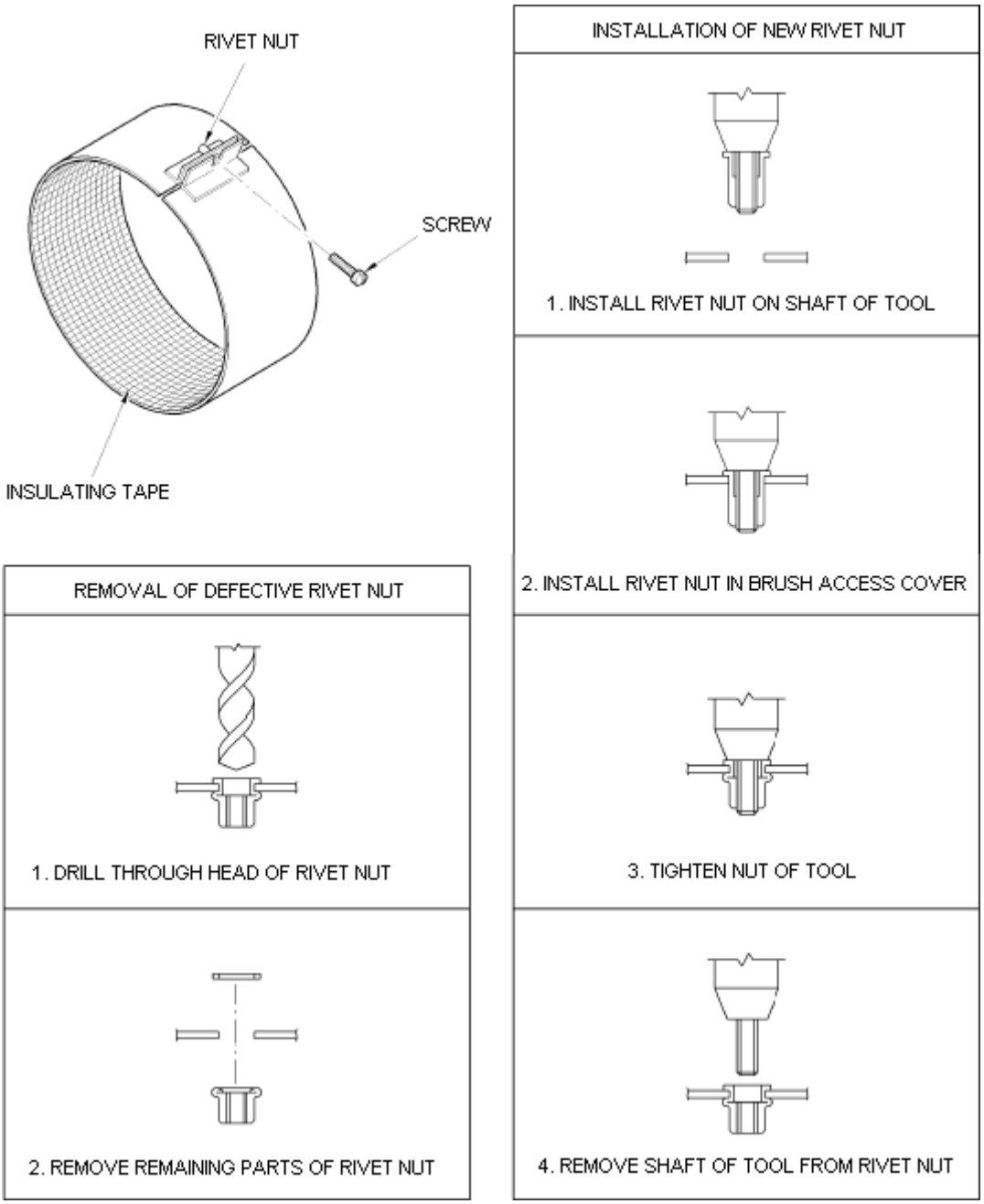


Figure 6008 - Self-Locking Rivet Nut Replacement

16. Repair of the Complete Brush Holder

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

A. Repair the Complete Brush Holder (20) as follows:

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

(a) Using a #40 drill bit, remove 2 rivets (55) from brush lead terminal board (45).

(b) Remove and discard brush lead terminal board (45) and insulation sheet (50).

(c) Repeat Paragraph 16.A.(1)(a) and Paragraph 16.A.(1)(b) for each complete brush holder (20).

(2) Assembly of complete brush holder (20). See Figure 6009.

(a) Secure rivet alignment fixture to press table.

(b) Secure rivet press tool to arbor press.

(c) Place insulation sheet (50) and brush lead terminal board (45) onto the brush holder (42) and insert two rivets (55) through the holes.

NOTE: When parts are correctly aligned, the section of insulation sheet (50) which extends outside the brush lead terminal board (45) will fold up against the brush holder (42).

(d) Set the brush holder (42) upside down onto rivet alignment fixture and align the rivets (55) with the two cones on the fixture.

(e) Press rivets (55) as shown in Figure 6009. The diameter of the rivet head must be a minimum of 1.5 times the diameter of the rivet.

(f) Repeat Paragraph 16.A.(2)(a) through Paragraph 16.A.(2)(e) for the remaining complete brush holder (20).

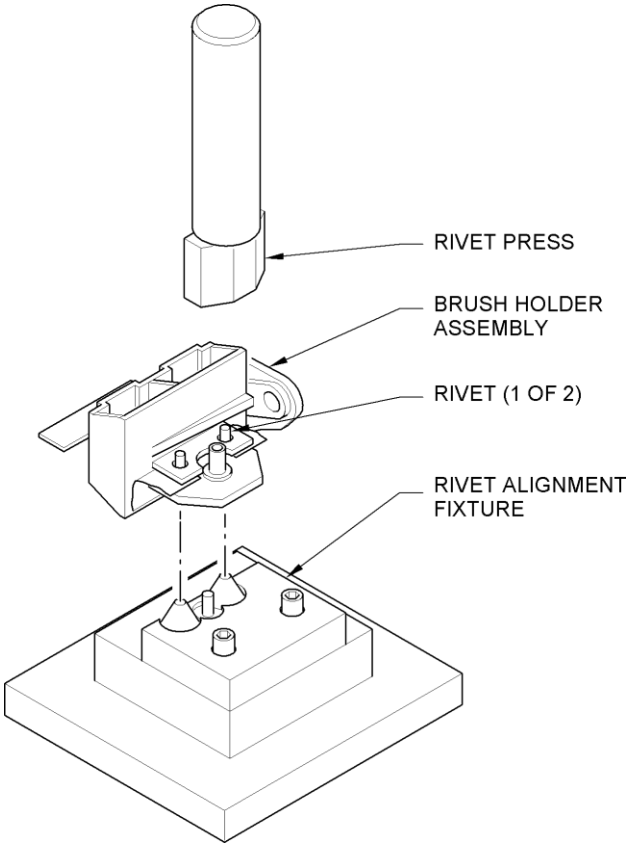


Figure 6009 - Brush Holder Rivet Alignment

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

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

A. Procedure.

(1) Remove blind rivet nut (15) from anti-drive end end bell (5A) using a No. 2 drill. Drill a hole through the blind rivet nut. The inboard and outboard sides of the blind rivet nut should become loose and fall off.

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

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

(4) Making sure key of blind rivet nut is engaged in key slot on end bell, insert blind rivet nut into hole in anti-drive end end bell (5A).

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

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

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

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

(8) Torque the test blind rivet nut to 25 lbf.in. (2,82 Nm). Apply the torque in a clockwise direction with screw seated on the rivnut flat.

NOTE: Do not turn the rivet nut.

(9) Touch up plating on the anti-drive end end bell (5A), if necessary, IAW the instructions in Paragraph 11.

18. Removal and Replacement of the Mounting Adapter 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 the mounting adapter guide pin (26).

A. Tools

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

B. Procedure. See Figure 6010.

(1) Secure the mounting adapter (25) in a vice making sure it is secured enough to handle the force required to pull the guide pin (26).

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

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 before inserting into the mounting adapter.

(4) Insert a new guide pin (26) into the hole in the mounting adapter (25).

(5) Using an arbor press or light hammer, lightly tap the guide pin into the hole. Refer to Table 6003 for finished height of guide pin.

Mounting Adapter Part No.	Height of Pin from Surface
23069-1020 23069-1400 23069-1405	0.14 to 0.16 inch (3,55 to 4,06 mm)
23069-1450	0.11 to 0.13 inch (2,8 to 3,3 mm)
23069-1830	0.16 to 0.18 inch (4,06 to 4,57 mm)

Table 6003 - Guide Pin Height

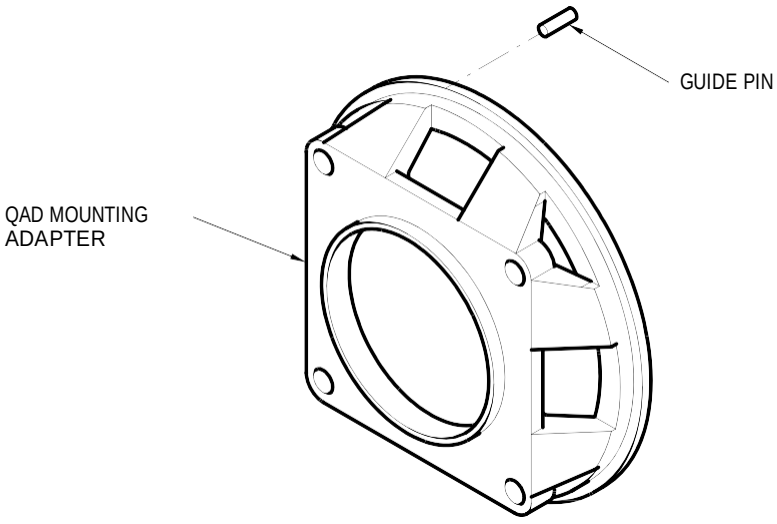


Figure 6010 - Repair of the Mounting Adapter Guide Pin

19. Removal and Replacement of B or E Terminal Block Studs (For Model 23069-016-1only)

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

A. Remove Terminal Studs B and E (35) from Terminal Block (40G) See Figure 6011.

(1) Remove terminal studs from the terminal block with the stud removal tool as follows:

(a) Screw the stud removal tool onto one of the terminal studs.

(b) Apply force in counter-clockwise direction to drive head of the stud removal tool.

(c) Continue to rotate the stud removal tool until the terminal stud is removed from the terminal block.

(d) Remove the terminal stud from the stud removal tool:

1 Move the clutch ring away from the collet holder.

2 Grip the collet holder with a wrench and rotate the drive head of the stud removal tool in clockwise direction until the tension is released between the stud removal tool and the terminal stud.

3 Screw the terminal stud out of the hex collet.

(e) Repeat this process on the other terminal stud.

(2) Clean the threads in the terminal block with a wire brush.

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

(3) Use a cotton swab with isopropyl alcohol to remove any residue.

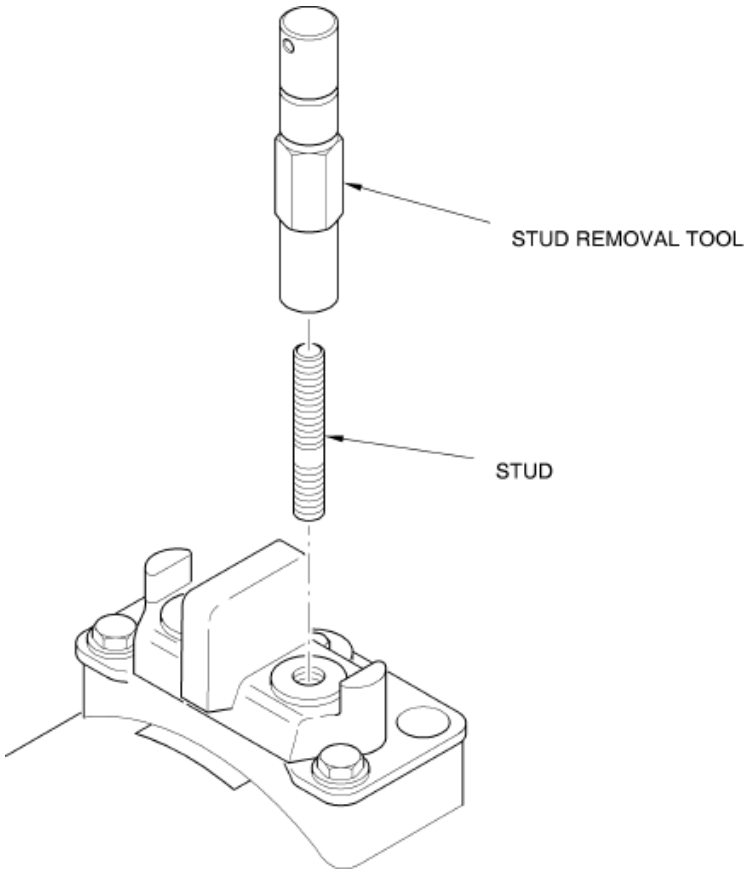


Figure 6011 - Removal of Terminal Studs with Stud Removal Tool

B. Install Terminal Studs B and E (35) into Terminal Block (40G) (See Figure 6012)

(1) Installation of terminal stud with stud driver tool:

(a) Screw the stud driver onto one of the two terminal studs.

NOTE: To make adjustments to the stud engagement length, lift the clutch ring and turn the drive head.

NOTE: The stud driver tool can be powered by hand or can be attached to a non-impacting power tool.

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

(b) Spray threadlock primer (7649) on the threads of the threaded insert in the terminal block where the stud will be installed.

(c) Spray threadlock primer (7649) on the threads of the stud that will engage with the terminal block threaded insert threads.

(d) Let the threadlock primer (7649) dry for 70 seconds.

(e) Apply threadlocker (243) on the threads of the stud that will engage with the terminal block threaded insert threads. Apply a full 360° around the threads.

(f) Immediately install the terminal stud through the hole in one of the large stator leads (and washer if applicable) and into the terminal block by turning stud driver tool.

(g) Tighten the stud to 300 to 325 lbf.in. (33,9 to 36,7 Nm) torque.

NOTE: Make sure the flange on the terminal stud is fully seated against the terminal block.

(h) Remove the stud driver by turning it counter-clockwise until it releases from the terminal stud.

(i) Do these steps again to install the other terminal stud.

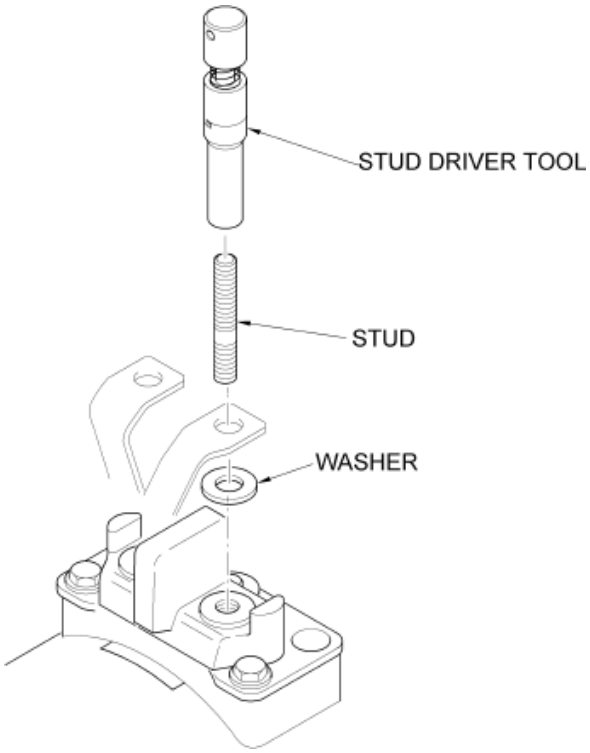


Figure 6012 - Installation of Terminal Stud with Stud Driver Tool

ASSEMBLY

1. Introduction

This Section gives assembly instructions for DC Starter-Generator 23069 series. Assemble the unit in a clean work area away from machining or other metal removing operations. Clean all parts in accordance with (IAW) instructions in the CLEANING section before final assembly.

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

- Surface Repair and Coating - Refer to SPD 1002.
- Brush Holder Alignment Fixtures - Refer to SPD 1004.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Assembly Tools and Fixtures

In addition to standard shop tools, the following tools and fixtures are needed for assembly.

The assembly tools and fixtures listed below cannot be procured from Safran Power, USA. Equivalent tooling and fixture requirements meeting with Safran Power, USA specifications can be used. Reference SPECIAL TOOLS, FIXTURES AND EQUIPMENT section.

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 Description	Source/Figure Reference
Adapters, Armature Shaft (Drive End, Anti-drive End)	Figure 9001
Adapter, Commutation Viewing	Figure 9002
Arbor Press	Commercially Available
Brush Holder Alignment Fixture	SPD 1004
Drivers, Bearing (Inner and Outer Race)	Figure 9002
Driver, Liner	Figure 9004
Fixture, Commutator Turning	Figure 9005
Fixtures, Rivet Alignment and Rivet Press	Figure 9006
Heat Gun	Commercially Available

Table 7001 - Assembly Tools

Tools Description	Source/Figure Reference
Indicator, Dial	Not illustrated
Leather or Plastic Mallet	Commercially Available
Pliers, Snap Ring	Commercially Available
Plug, Adjustment, Speed Pickup	Figure 9007
Support, Armature	Figure 9008
Support, Bearing and Brush Support Assembly	Figure 9009
Supports, Hub, (Drive End and Anti-drive End)	Figure 9010
Support, Stator, Horizontal and Vertical	Figure 9011, Figure 9012
Driver, Dampener Hub	Figure 9013
Driver, Dampener Plate	Figure 9014
Torque Wrench	Not illustrated
Tweezers	Not illustrated
Wire Hook Tool	Not illustrated
Wrench, Spline	Figure 9015

Table 7001 - Assembly Tools (Continued)

3. Assembly Materials

The following materials are needed for assembly of the starter-generator.

NOTE: Assembly 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
Acrylic coating	HumiSeal Type 1B31, Type AR MIL-I-46058,	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 Fax: (718) 932-4345 www.humiseal.com (V0SR97)
Cloth	Lint-free	Commercially Available

Table 7002 - Assembly Materials

Material	Description/Specification	Source/CAGE Code
Electrical Insulation Tape	N/A	Commercially Available
Epoxy bonding cement	Two Part Resin: P/N 02-7001-27 (50mL Dual-Pack) Can also be ordered in: -Pints, -Quarts -Gallons	Ellsworth Adhesives P.O. Box 1002 W129 N10825 Washington Dr. Germantown, WI 53022-8202 Ph: (800) 888-0698 Fax: (262) 253-8619 www.ellsworth.com or Commercially Available
Isopropyl alcohol	TT-I-735, Grade A Flash Point: 53° F (12° C), **FLAMMABLE**. Refer to the Material Safety Data (MSD) Sheet for the material for additional safety information	Commercially Available
Lockwire	MS20995C20 and MS20995C32, IAW MS33540	Commercially Available
Red insulating enamel	Synthite ER-41	John C. Dolph Company 320 New Road, PO Box 267 Monmouth, NJ 08852 Ph: (732) 329-2333 Fax: (732) 329-1143 www.dolphs.com (V72688)
Sleeving, heat shrinkable	MIL-I-23053/5	Commercially Available
Lubricating and Assembly Paste	Altemp QNB 50	Klueber Lubrication Londonderry, NH Ph: (603) 647-4104 www.klueber.com or Commercially Available
Masking Tape	N/A	Commercially Available

Table 7002 - Assembly Materials (Continued)

Material	Description/Specification	Source/CAGE Code
Protective Paper	MIL-B-121A, Grade A, Type II, Class I	National Paper and Packaging Co. Cleveland, OH 44103 www.nationalpaper.com or Commercially Available
Sandpaper	180 Grit, non-aluminum oxide	Commercially Available
Solder, resin core	IPC J-STD-006, type Sn60, apply in accordance with ANSI/J-STD-001B	Commercially Available
Solvent	Toluene/TT-548	Commercially Available
Thread Locking Adhesive, Grade D	Loctite Grade D MIL-S-22473	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com or Commercially Available
Thread Sealing Compound	Lead Free/Soft Set Gasoila	GSA Supply on-line www.gsasupplyco.com or Federal Process Co. 4620 Richmond Rd. Beachwood, OH 44128

Table 7002 - Assembly Materials (Continued)

4. Assembly of Stator and Housing Assembly

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

A. Attaching Grommet (75) to Stator Housing (5C)

NOTE: For model 23069-016-1 only.

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

(2) Install grommet over large stator leads (B and E).

B. Attaching Terminal Block (40) to Stator Housing (5) (See Figure 3022)

NOTE: For all models, except 23069-016-1.

CAUTION: BEFORE ACCEPTANCE TESTING, ATTACH AN UNSERVICEABLE TERMINAL BLOCK TO THE STATOR AND HOUSING ASSEMBLY. ACCEPTANCE TESTING CAN DAMAGE THE INTERNAL CAPACITORS OF A TERMINAL BLOCK (40).

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

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

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

(2) Bend the terminal leads on the stator housing to allow the terminal block studs to enter the holes in the lugs. Once the terminal block is inserted into the lugs, the terminal block and lugs are pressed back in position.

(3) Put small stator leads onto terminal studs A and D.

(4) Put spring lock washer (50) and flat washer (55) onto each of two bolts (45).

(5) Place two bolts into through holes of terminal block and torque to 22.7 to 35 lbf.in. (2,6 to 3,9 Nm).

C. Attaching Terminal Block (40) to Stator Housing (5C) (See Figure 3021)

NOTE: For model 23069-016-1 only.

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

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

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

(2) Bend the terminal leads on the stator housing to allow the terminal block studs to enter the holes in the lugs. Once the terminal block is inserted into the lugs, the terminal block and lugs are pressed back in position.

(3) Put small stator leads onto terminal studs A and D. Place lead wires in grooves on each side of terminal block.

NOTE: Make sure flat edges of insulating washers and tab lock washers are set against shoulder of terminal block.

(4) Put tab lock washer (50A) and insulating washer (55C) on to each of two bolts (45B).

(5) Put two bolts into corner holes of terminal block. Torque to 22.7 to 35 lbf.in. (2,6 to 3,9 Nm).

(6) Put flat washer (70A), spring lock washer (65) and ground lead of terminal block on attaching center bolt (60).

(7) Put bolt into center hole of terminal block. Torque bolt to 22.7 to 35 lbf.in. (2,6 to 3,9 Nm).

D. Attaching Hardware on Terminal Block (40)

(1) Secure stator lead to terminals A and D with plain washer (30) and self-locking nut (25) at each location.

NOTE: Do not tighten the nuts (25) on terminal block (40) studs A and D. They will be tightened at the time of installation into the aircraft. It is necessary to install the wires from the GCU at that time.

(2) On model 23069-016-1, install flat washers (20), spring lock washers (15H), andspiralock nuts (10D) on terminal studs B and E.

(3) On all other models install flat washers (15), and self-locking nuts (10) on terminal studs B, E and, where applicable, C.

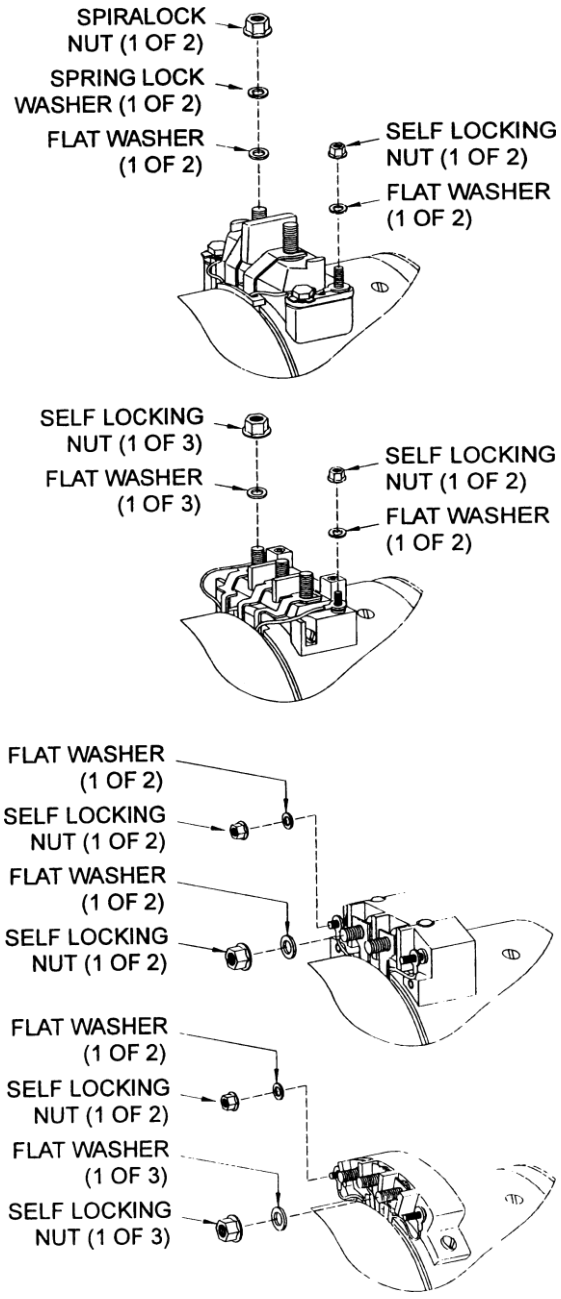


Figure 7001 - Attaching Hardware on Terminal Block

5. Assembly of Drive End Bearing Support Assembly

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

A. Attaching Screen (25) to Drive End End Bell (5) (See Figure 3019)

(1) Attach screen to drive end end bell and secure with drive screws (30) and flat washers (35).

(2) Bond screen to drive end end bell.

NOTE: Models 23069-015-1 and -004-1 with direct mount enables do not needto have screen bonded with epoxy resin.

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

(a) Mix parts A and B of epoxy bonding cement resin equally on a smooth flat surface using a spatula until resin is fully mixed.

(b) Apply a thin layer of epoxy bonding cement from applicator to ribs of drive end end bell. The epoxy should be applied to center of thickest section of each rib, about 0.25 to 0.50 in. (6,4 to 12,7 mm) from outer diameter of screen. The epoxy must be just thick enough to cover screen material.

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

(3) Cure epoxy resin by placing drive end bearing support assembly in an oven at a temperature of 200° F (93,3° C) for 40 minutes.

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

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

6. Assembly of the Bearing and Brush Support Assembly

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

A. Check to make sure the latest configuration of the Anti-drive End End Bell is used (See Figure 7002 for details)

(1) For models 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A': Make sure the heli-coils and spotfaces are present so the filter leads have a connection. The anti-drive end end bell P/N 23069-1810 used in the bearing and brush support assembly P/N 23069-355 must conform to the latest machining standard.

(2) For models 23069-016-1, -014, -015, -024, -025: Make sure the rivnuts to attach the radial air inlet are at the correct angle of 10 degrees in four locations. This will ensure the air inlet will be at the correct clocking angle.

NOTE: Older versions of the anti-drive end end bell have the rivnuts at 25 degrees.

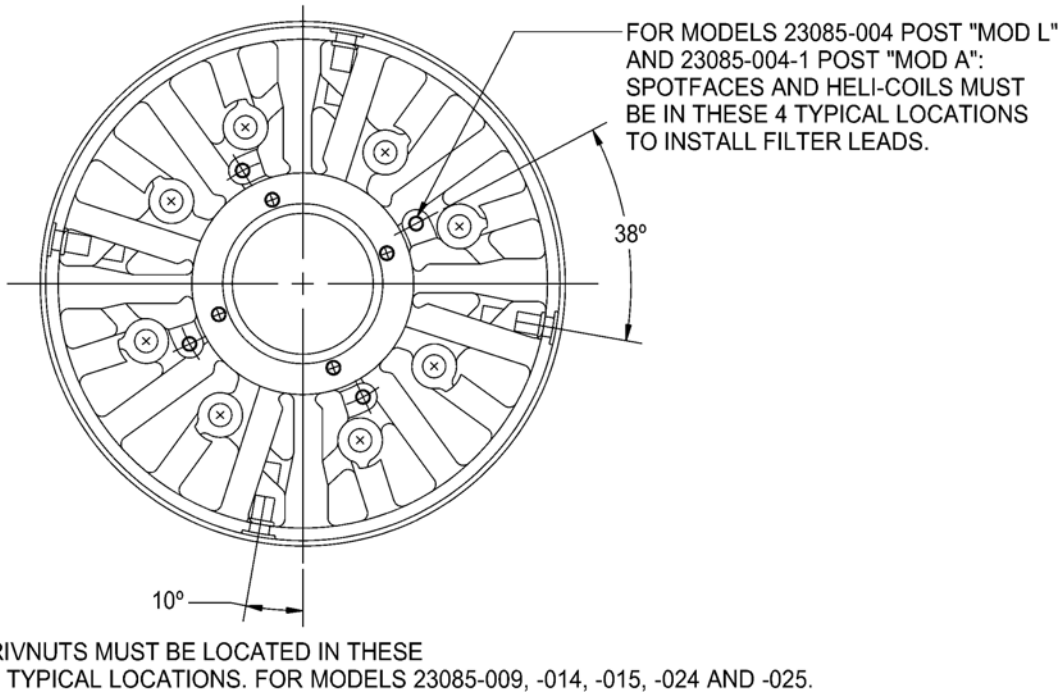


Figure 7002 - Identification of the Latest Configuration of the Anti-Drive End End Bell P/N 23069-1810

B. Install the Brush Springs (70) onto the Complete Brush Holder (20)

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

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

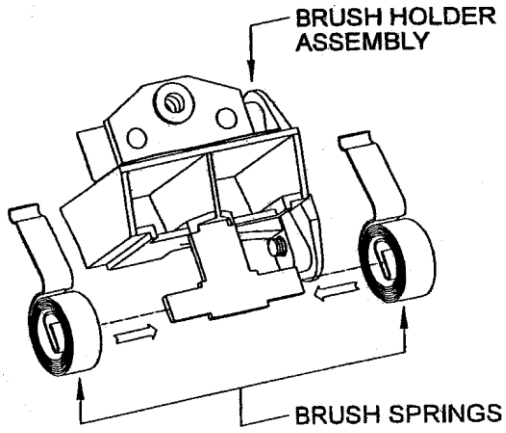


Figure 7003 - Brush Spring Installation

C. Attach each Complete Brush Holder (20) to the Anti-drive End End Bell (5)

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

(1) Insert two insulating sleeves (40) into two adjacent through holes in the anti-drive end end bell (5). Make sure the insulating sleeves extend out of the through holes on both sides of anti-drive end end bell.

(2) Put a filter board assembly (60) onto the ends of the exposed insulating sleeves on inboard side of anti-drive end end bell (5). Install the filter assembly (60) so that the side with the open end terminal lug is closest to the bearing liner.

(3) Put the non-metallic washer (30) onto the ends of each exposed insulating sleeve on outboard side of anti-drive end end bell. Make sure that insulating sleeves do not slide and that filter board assembly does not fall off.

(4) Bend the soldered terminal lug (not the slotted terminal) of the filter assembly (60) approximately 45° and position the lug on the nearest non-metallic washer (30) already in place on the anti-drive end end bell (5).

(5) Put a flat washer (35) onto each of the two attaching bolts.

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

(6) Apply thread-locking adhesive to the threads of two attaching bolts (25).

(7) Insert one of the two attaching bolts, with flat washer, through the soldered ring terminal, insulating washer, anti-drive end end bell (with insulating sleeve installed in the through hole), and filter board assembly.

(8) Insert other attaching bolt, with flat washer, through the insulating washer, anti-drive end end bell (with insulating sleeve installed in the through hole), and filter board assembly.

(9) Put the complete brush holder assembly against the filter board assembly on inboard side anti-drive end end bell. Align threaded holes in brush holder assembly with through holes of filter board assembly.

(10) Attach complete brush holder assembly to anti-drive end end bell with the two attaching bolts. Attach loosely. Do not tighten the bolts (25) at this time.

(11) Repeat Paragraph 6.C.(1) through Paragraph 6.C.(10) to attach remaining brush holder assemblies.

(12) Align brush holders with appropriate alignment fixture, refer to SPD 1004.

(13) Place the bearing and brush support assembly (165) onto the brush holder alignment fixture.

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

(14) Adjust all complete brush holders (20) until they are properly aligned.

(15) Evenly tighten attaching bolts to 22.7 to 35 lbf.in. (2,6 to 3,9 N·m).

(16) Remove the bearing and brush support assembly 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.**

(17) If insulating enamel is damaged, apply insulating enamel to bearing and brush support assembly according to the procedure in SPD 1002.

D. Perform a Dielectric Test

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

7. Final Assembly of DC Starter-Generator

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

A. Installing Baffle Disc (275) and Ball Bearing (270) onto Drive End of Armature (250) Shaft

NOTE: On bearing pre-load units using 23088-1072/-1073 or 23069-1552 drive end bearing support assemblies, drive end bearing must be assembled with part mark facing inboard toward armature.

NOTE: On non-bearing pre-load units using 23088-1070/-1071 or 23069-1550/-1551 drive end end bell assemblies, bearing orientation is not required.

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

(1) Place armature support on arbor press table.

(2) Set armature (commutator end down) onto armature support.

(3) For all models: except 23069-015-1 Post ‘MOD M’ and 23069-16 Post ‘MOD B’ Install baffle disc to drive end of armature shaft with concave side facing down toward armature.

(4) For models 23069-015-1 Post ‘MOD M’ and 23069-16 Post ‘MOD B’: Install the drive end bearing shield (276B) on the armature shaft as shown in Figure 7004.

(5) Set ball bearing onto armature shaft.

NOTE: The Safran Power, USA part marking on the ball bearing (270) must be facing towards the inside of the starter-generator.

(6) Set inner race bearing driver on ball bearing.

(7) Press ball bearing down onto armature shaft making sure bearing is fully installed against baffle disc or drive end bearing shield.

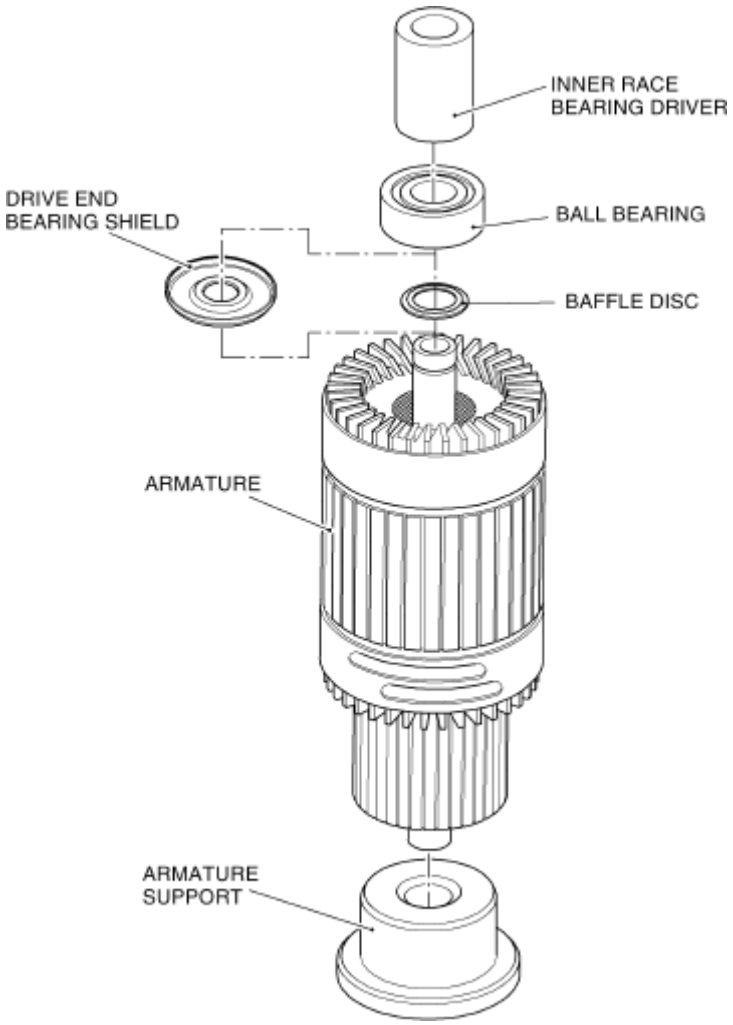


Figure 7004 - Baffle Disc or Bearing Shield and Ball Bearing Installation on Drive End of Armature Shaft

B. Installing Baffle Disc (275) or Spacer (280) and Retaining Ring (160) onto Drive End of Armature (250) Shaft

(1) On bearing pre-load units, install a spacer onto drive end of armature shaft.

(2) On non-bearing pre-load units, put a second baffle disc onto drive end of armature shaft with concave side facing away from armature.

(3) Using snap ring pliers, put retaining ring in groove (on drive end of armature shaft) making sure ring is fully engaged in groove.

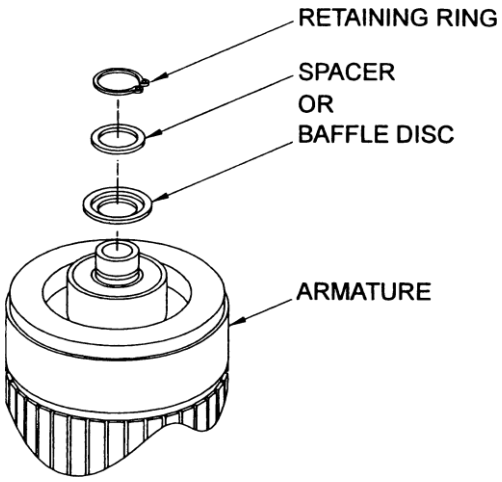


Figure 7005 - Baffle Disc, Spacer, Retaining Ring Installation

C. Pressing Anti-drive end Ball Bearing (270) into Bearing And Brush Support Assembly (165) (See Figure 7006)

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

NOTE: On bearing pre-load units, anti-drive end bearing must be assembled with part mark facing inboard side of bearing and brush support assembly.

NOTE: On non-bearing pre-load units, bearing orientation is not required.

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

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

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

(3) Apply lubricating and assembly paste to the inside diameter of the bearing liner of bearing and brush support assembly (165).

(4) Set a anti-drive end ball bearing onto bearing liner of bearing and brush support assembly.

(5) Set an outer race bearing driver onto anti-drive end ball bearing.

(6) Press anti-drive end ball bearing into bearing liner of bearing and brush support assembly. Make sure bearing is fully installed against inner lip of bearing liner.

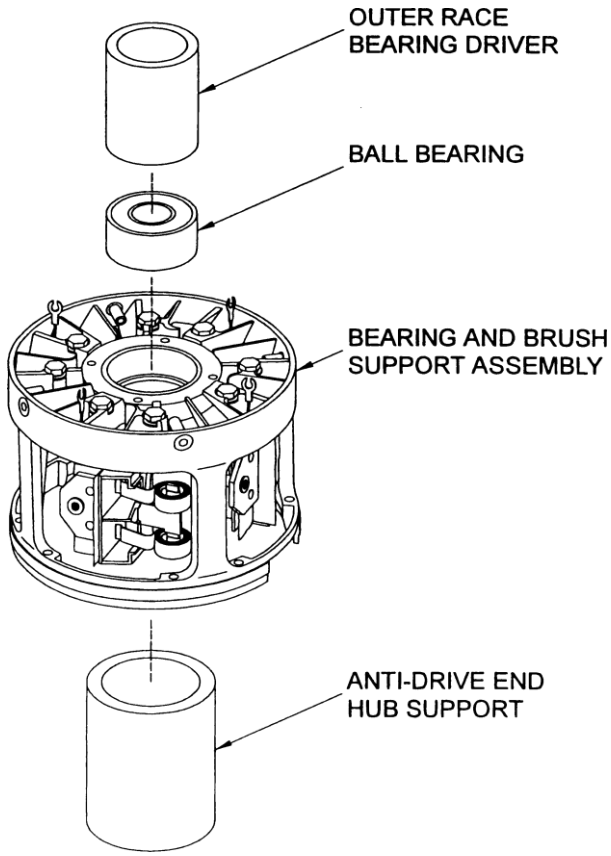


Figure 7006 - Ball Bearing Installation

D. Attaching Bearing Retainer (255) to Bearing and Brush Support Assembly (165) (See Figure 7007)

NOTE: Slotted leads are not to be attached until after acceptance testing.

(1) Isolate slotted leads of filter board assemblies (10002-60) with rubber cap or equivalent.

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

(2) For models 23069-015-1 and -004-1 only: Apply thread sealing compound tothreads of four attaching screws (260).

(3) For all models except 23069-015-1 and -004-1: Put spring lock washer (265) ontofour attaching screws.

(4) Attach bearing retainer to bearing and brush support assembly with attaching screws.

NOTE: Lock wire is not required for the screws (260).

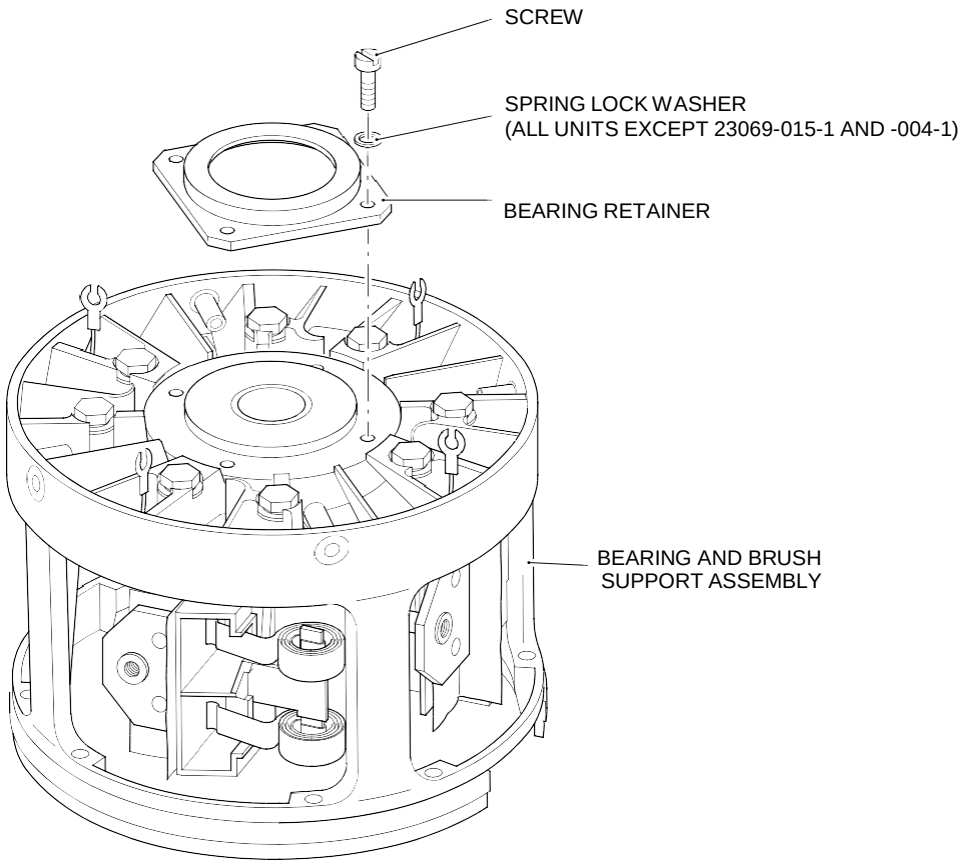


Figure 7007 - Attaching Bearing Retainer

E. Preparing Armature (250) for Coarse Brush Seating

(1) Prepare the armature for coarse brush seating. Refer to SPD 1006.

NOTE: Make sure taped end of sandpaper is in the normal direction of rotation and abrasive side of sandpaper faces away from the commutator. See Figure 7008.

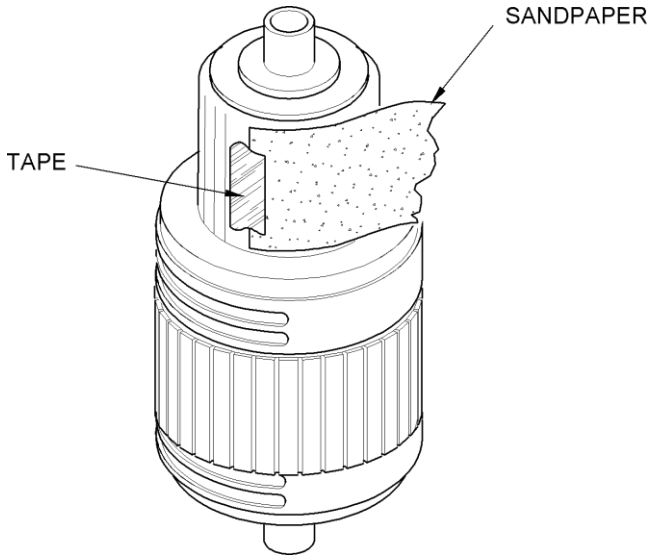


Figure 7008 - Preparing Armature for Rough Seating

F. Attaching Bearing and Brush Support Assembly (165) to Armature (250) (See Figure 7009)

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

(1) Set armature support on arbor press table.

(2) Set armature (drive end down) onto armature support.

(3) Set bearing and brush support assembly (brush holder side down) onto commutator end of armature shaft.

(4) Set inner race bearing driver onto anti-drive end ball bearing.

(5) Press ball bearing in bearing and brush support assembly onto armature shaft making sure bearing is fully installed against shoulder.

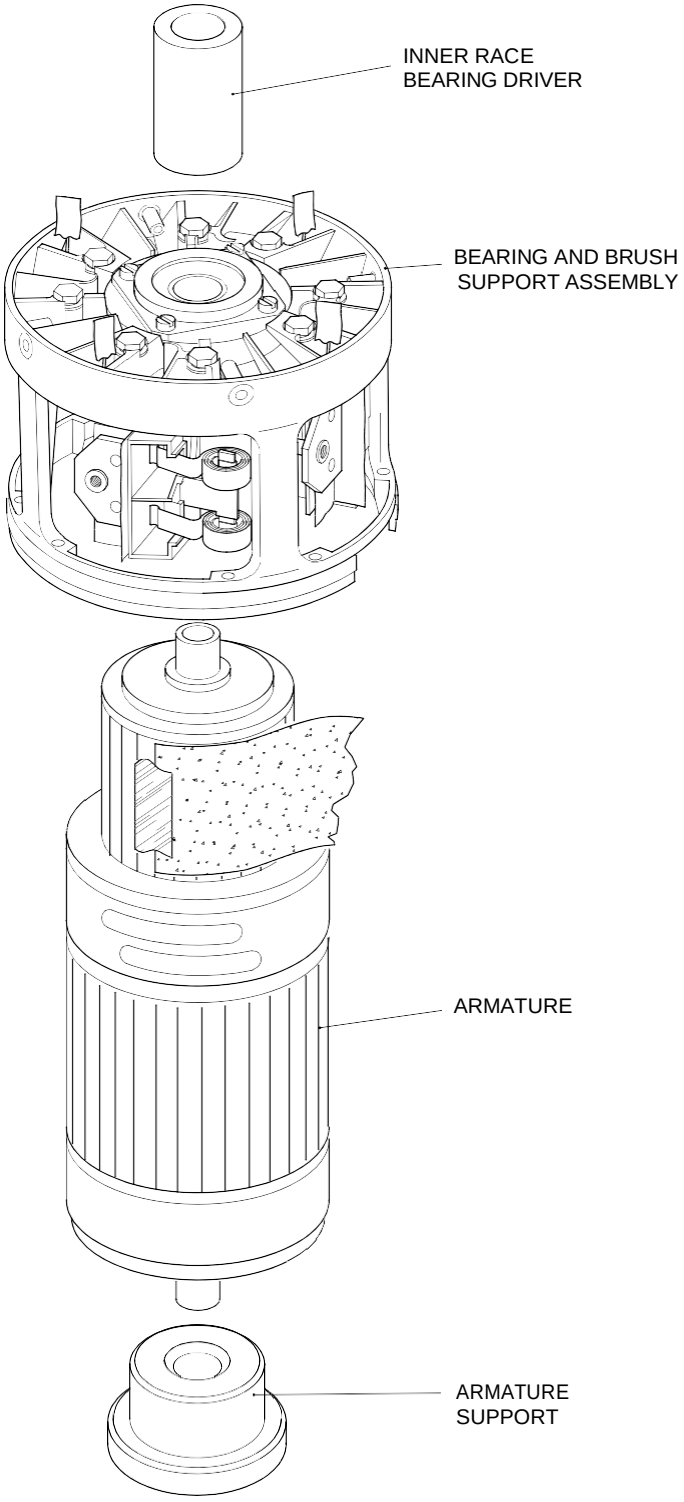


Figure 7009 - Attaching Armature

G. Installing Rubber Grommet (235), Speed Pickup (230), and Speed Pickup Guard (220) to Drive End Bearing Support Assembly (200) (See Figure 7010)

NOTE: For models 23069-013-1, -004, -004-1, and -009 only.

(1) On models 23069-015-1, -004-1 and -009 only; press rubber grommet into anopening in screen of drive end bearing support assembly.

(2) Screw speed pickup into threaded hole in drive end bearing support assembly.

(3) Insert applicable speed pickup adjustment plug(s) into bearing liner of drive end bearing support assembly.

NOTE: If a plug is not available, do not adjust pickup until after dampener backplate (155) is installed.

(4) Adjust speed pickup until it lightly touches outer diameter of plug.

(5) Torque hex jam nut on speed pickup to 15 to 25 lbf.in. (1,7 to 2,8 Nm).

(6) Remove speed pickup adjustment plug (if present).

(7) For speed pickup 23072-1280:

(a) If sleeving was removed at disassembly, put 1/8” (3,175 mm) diameter heat shrinkable sleeving over pickup leads.

(b) Shrink sleeving onto leads.

NOTE: Speed pickup 23072-1400 does not need sleeving.

(8) On applicable models, insert speed pickup leads through rubber grommet in screen.

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

(9) On models 23069-013-1 and -009, apply thread sealing compound to threads oftwo attaching screws (225).

(10) On models 23069-013-1 and -009, attach speed pickup guard to drive end bearingsupport assembly with two attaching screws.

(11) Tighten the screws (225) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

NOTE: Lock wire is not required for the screws (225).

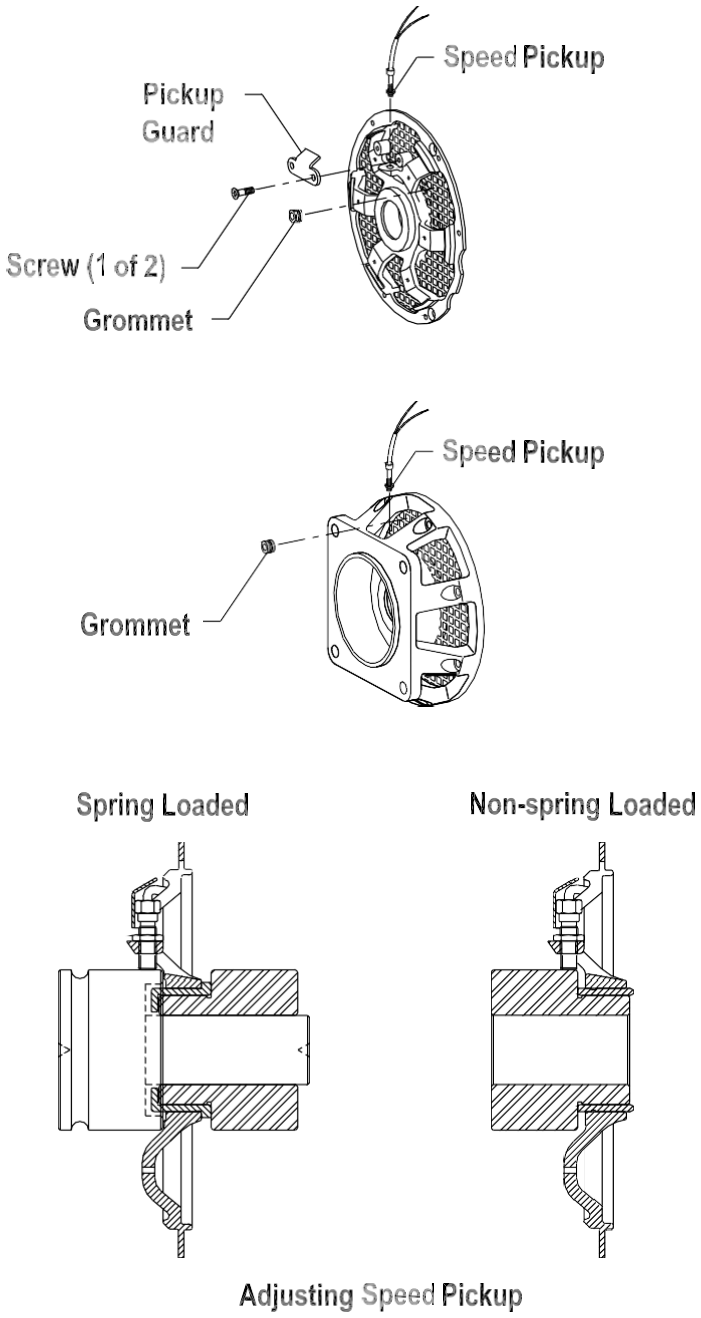


Figure 7010 - Attaching Rubber Grommet to Screen of Drive End Bearing Support Assembly

H. Attaching Drive End Bearing Support Assembly (200) to Stator And Housing Assembly (285) (See Figure 7011)

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

(2) On models with speed pickup (230): hold drive end bearing support assembly and thread speed pickup leads inside stator and housing assembly and through opening atop assembly.

NOTE: Do not pull speed pickup leads tight when threading through stator and housing assembly.

(3) Align through holes in drive end bearing support assembly with threaded holes in stator and housing making sure drive end bearing support assembly is fully engaged with pilot bore of stator and housing assembly.

(4) On models 23069-015-1 and -004-1, install spring lock washer (210) and flatwasher (215) to eight attaching screws (205A).

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

(5) Apply thread sealing compound to threads of attaching screws (205 and 205A).

(6) Insert attaching screws into through holes in drive end bearing support assembly.

(7) Tighten attaching screw securing drive end bearing support assembly to stator and housing assembly.

(8) For all models except 23069-015-1 and -004-1: Tighten the three screws (205) toa torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

(9) For models 23069-015-1 and -004-1: Tighten the eight screws (205A) to a torqueof 22.7 to 35 lbf.in. (2,6 to 3,9 Nm).

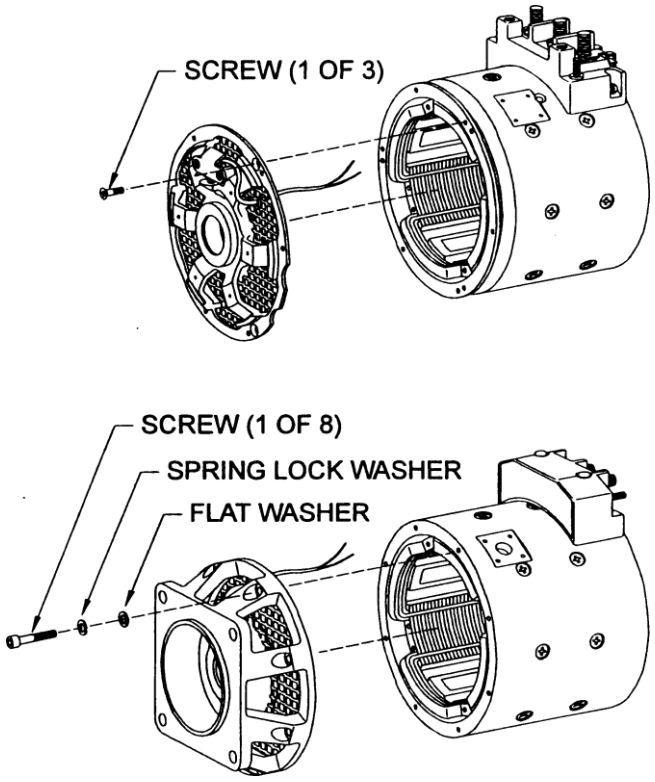


Figure 7011 - Attaching Drive-End Bearing Support Assembly to Stator and Housing Assembly

I. Determining Shim Requirements for Spring Wave Washer (240) (See Figure 7012)

NOTE: This procedure applies to bearing pre-load units using 23088-1072/-1073 or 23069-1552 drive end end bell assemblies.

(1) Using a dial indicator, or equivalent, mounted on appropriate stand, measure distance from mounting surface of bearing and brush support assembly (165) to inner race (without spacer or snap ring installed) of bearing (270) on drive end of armature (250) shaft. Record as dimension “A”.

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

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

NOTE: Calculated difference between dimensions “A” and “B” is the gap for the spring wave washer. Desired gap of the compressed spring wave washer is between 0.040 and 0.063 inch (1,02 and 1,60 mm).

(4) If required, make up a shim pack with enough shims (245) to reduce gap to below 0.063 inch (1,60 mm).

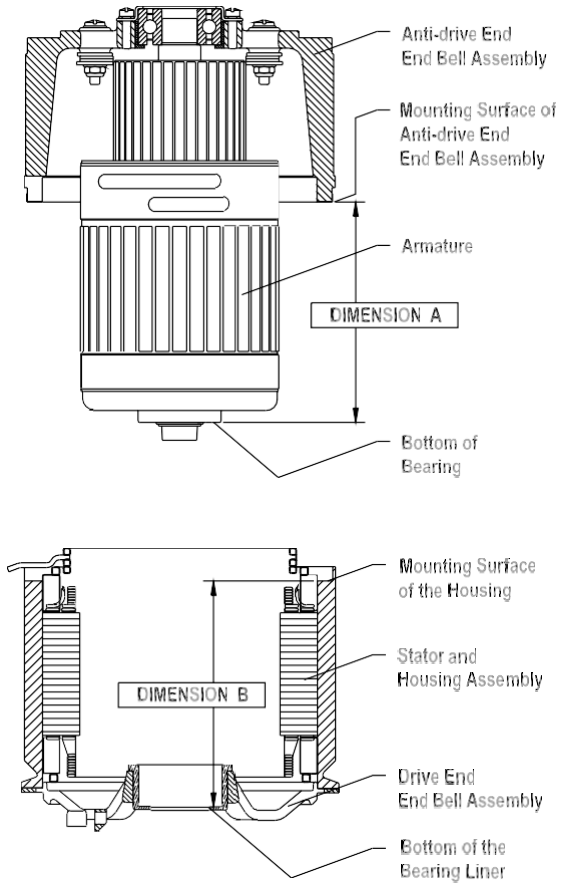


Figure 7012 - Determining Shim Requirements

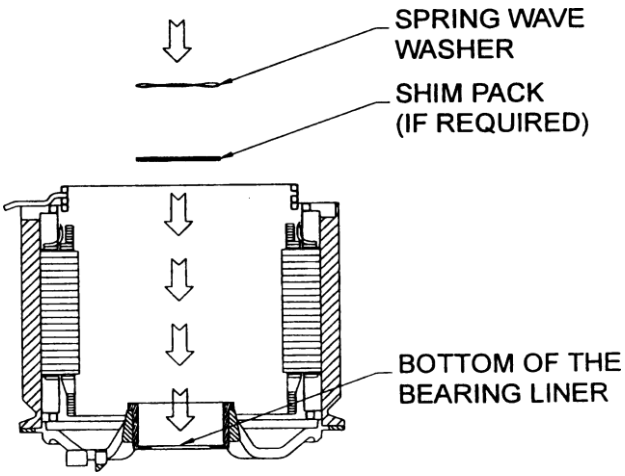


Figure 7013 - Installing Shim Pack

J. Installing Shim Pack (245) and Spring Wave Washer (240) into Drive End Bearing Support Assembly (200) (See Figure 7013)

NOTE: This procedures applies to bearing pre-load units using 23088-1072/-1073 or 23069-1552 drive end end bell assemblies.

(1) If shim pack is needed, put into bottom of bearing liner of drive end.

(2) Put spring wave washer into bearing liner on top of shim pack (if present).

K. Attaching Bearing and Brush Support Assembly (165) with Attached Armature (250) to Stator and Housing Assembly (285)

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

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

(2) Apply lubricating and assembly paste to the inside liner of the drive end bearing support assembly (200).

(3) Set stator and housing assembly with attached drive end bearing support assembly (200) (drive end down) onto drive end outboard hub support.

NOTE: Make sure the shim(s) and the spring wave washer are correctly located in the drive end bearing liner.

(4) Insert armature with attached bearing and brush support assembly into stator and housing assembly making sure bearing (270) on armature shaft is aligned with bearing liner of drive end bearing support assembly.

(5) Align four brush harness straps with brush holder assemblies. If necessary, use a probe to move brush harness straps to correct positions.

(6) Set inner race bearing driver onto anti-drive end ball bearing.

(7) Press drive end ball bearing into bearing liner of drive end bearing support assembly making sure screw holes (of bearing and brush support assembly) are aligned with holes in stator and housing assembly and both assemblies are fully installed against each other.

NOTE: Model 23069-016-1 uses two screws (172) (P/N 05-341303) near terminalblock and six screws (170) (P/N NAS1352-08-14P) at all remaining locations. See Figure 7014 for correct screw locations.

(8) Put spring lock washers (175) and flat washers (180) onto each screw (170 and 172).

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

(9) Apply thread sealing compound to threads of eight attaching screws.

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

(11) Tighten screws (170 and 172) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

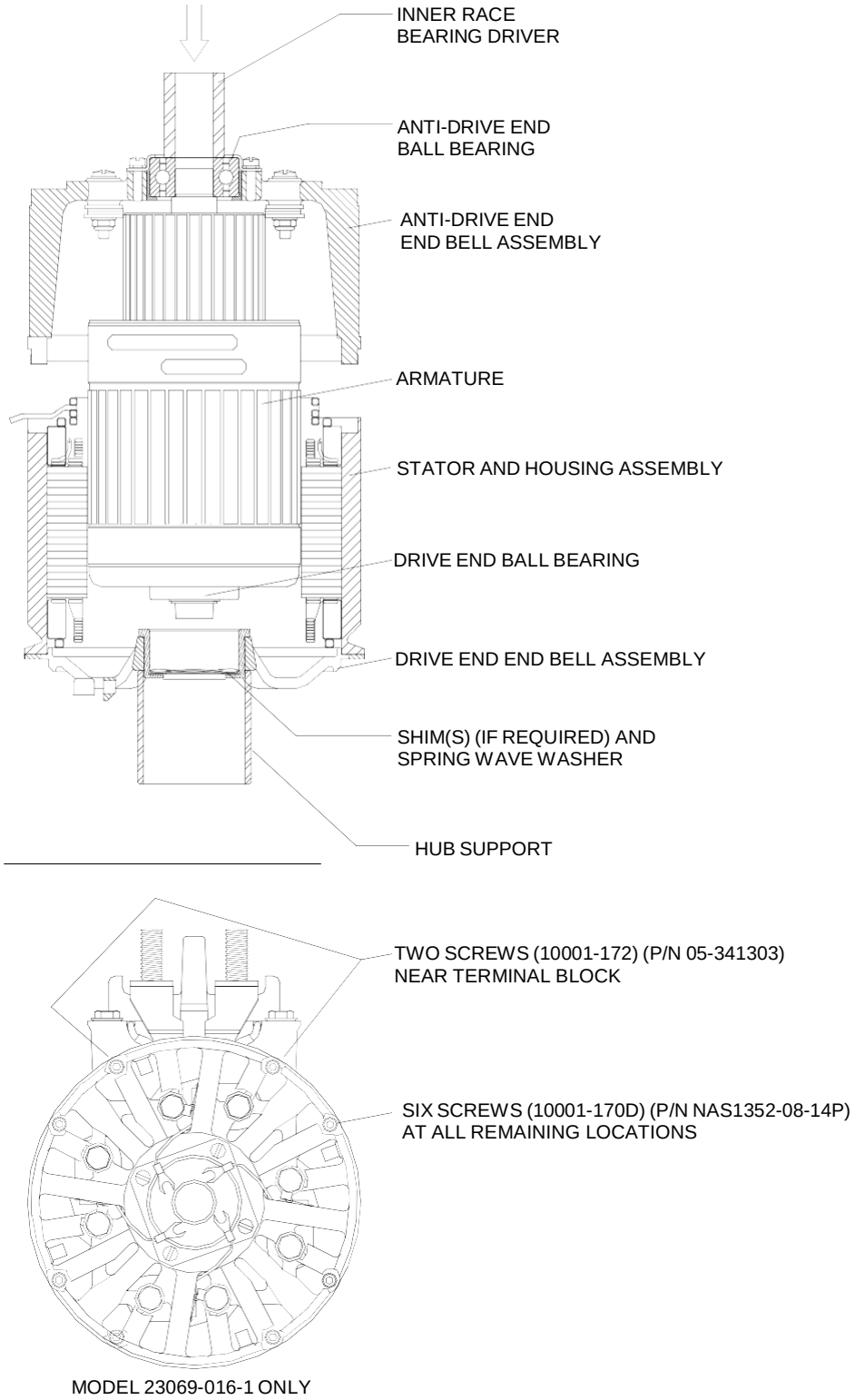


Figure 7014 - Attaching Bearing and Brush Support Assembly with Attached Armature to Stator

L. Installing Dampener Backplate (155) and Friction Ring (150) onto Armature (250) Shaft (See Figure 7015)

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

(2) Twist dampener backplate (155) onto drive end of armature shaft until fully installed.

(3) Put friction ring into recess of dampener backplate (155).

NOTE: Friction ring can not stay in place until drive shaft with dampener plate is installed.

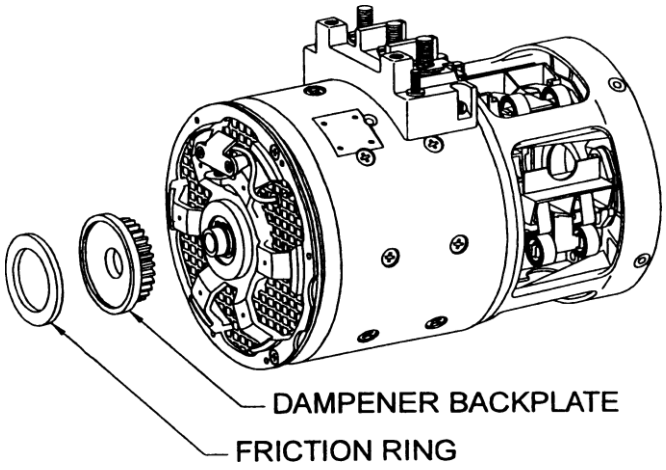


Figure 7015 - Installing Dampener Backplate

M. Assembling Dampener Hub (140) and Dampener Plate (145) onto Drive Shaft (130) (See Figure 7016)

CAUTION: DO NOT FORCE DAMPENER HUB ON DRIVE SHAFT MATING TAPER. TOO MUCH FORCE CAN CAUSE THE DAMPENER HUB TO FRACTURE.

(1) If dampener hub was removed from drive shaft, twist dampener hub onto drive shaft taper making sure hub is fully installed.

(2) Put dampener plate (145) into dampener plate driver.

(3) Put drive shaft (130) (with attached dampener hub) through dampener plate (145) and driver aligning the splines.

(4) Using a leather or plastic mallet, lightly tap drive end of drive shaft (130) to install dampener plate (145) onto dampener hub.

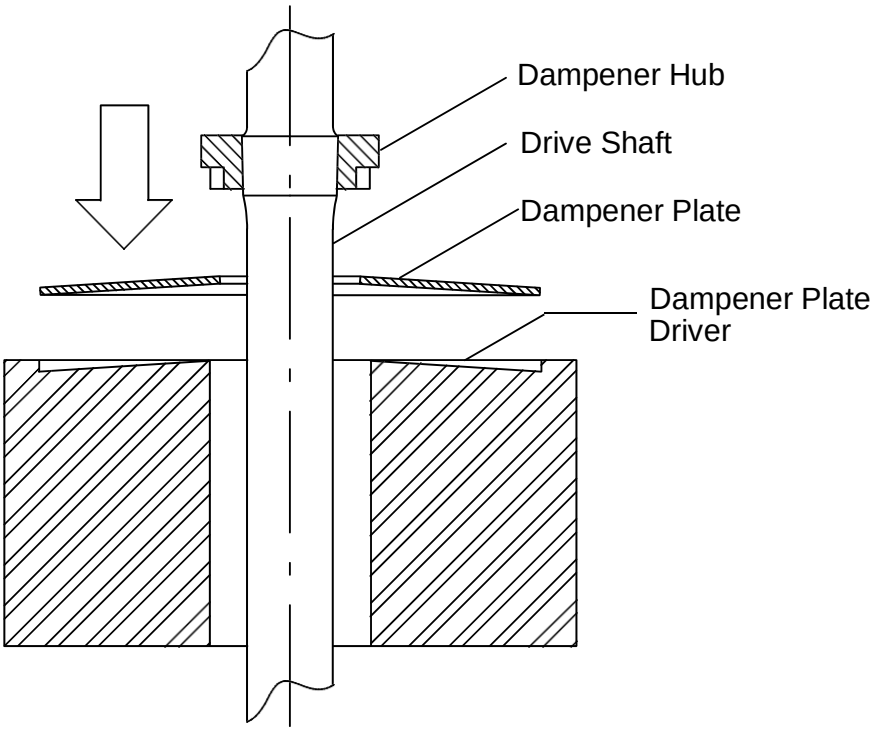


Figure 7016 - Assembling Dampener Hub and Plate

N. Inserting Drive Shaft (130) into Armature (250) Shaft

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

(1) Insert drive shaft into drive end of armature shaft.

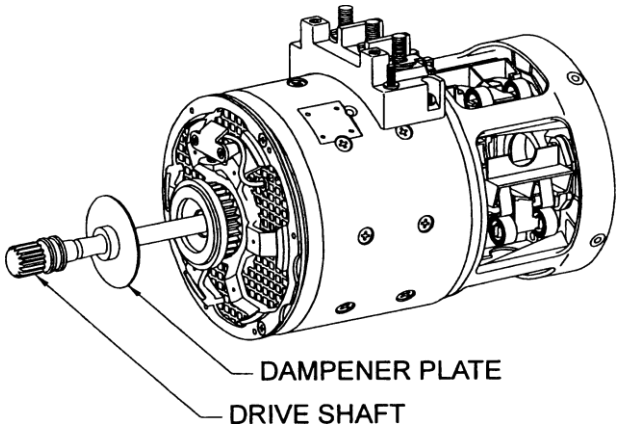


Figure 7017 - Inserting Drive Shaft into Armature Shaft

(2) Push drive shaft through armature shaft until dampener plate (145) is fully engaged against friction ring (150).

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

O. Attaching Fan (115) to Drive Shaft (130) (See Figure 7018)

(1) For models 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A', assemble the anti-drive end bearing shield (277) on the flange of the fan (115). Make sure the part identification stamping on the anti-drive end bearing shield faces the fan blades.

(2) Align splines of fan with splines of drive shaft and push fan onto drive shaft.

(3) Attach fan to drive shaft with flat washer (125) and self-locking nut (120).

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

(4) Torque self-locking nut to 100 to 120 lbf.in. (11,3 to 13,5 Nm).

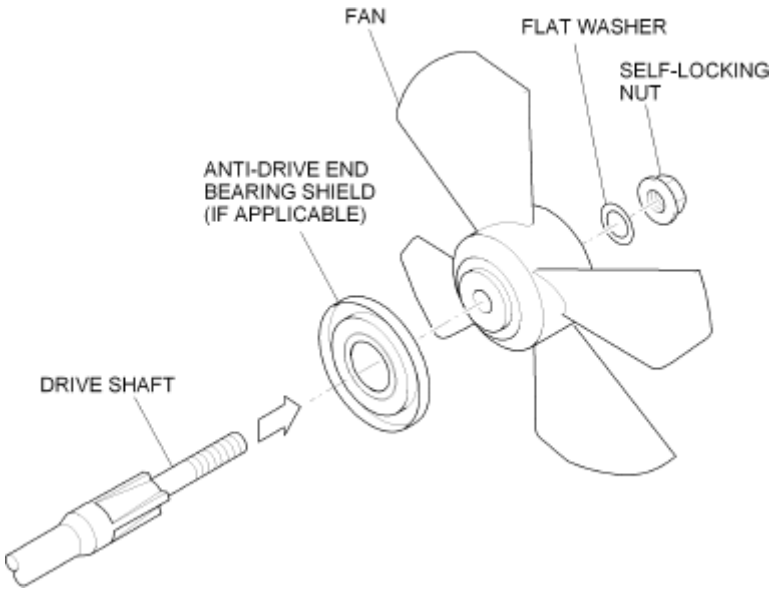


Figure 7018 - Attaching Fan to Drive Shaft

P. Attaching Spacer (190) and Three Pin Connector (185) to Stator and Housing Assembly (285) (See Figure 7019)

NOTE: For models 23069-013-1, -004, and -004-1, and -009 only.

(1) Thread speed pickup (230) leads through spacer.

(2) If pins were removed from 3-pin connector (with speed pickup leads still attached to pins):

insert pins using a pin insertion tool.

(3) If pins were not removed from 3-pin connector:

(a) Remove insulation from lead ends.

(b) Slide a piece of 1/8" (3,175 mm) diameter heat shrinkable sleeving onto end of each lead.

CAUTION: ATTACH A HEAT SINK WHEN SOLDERING LEAD AND TERMINAL CONNECTIONS.

(c) Solder speed pickup leads to lead contacts. Solder black lead to pin A and white lead to pin B.

(d) Slide sleeving over soldered connections.

(e) Shrink sleeving.

(4) Make sure speed pickup leads are not loose.

(5) Put spacer on stator and housing assembly with leads entering slot on spacer.

NOTE: Polarizing key of 3-pin connector must be pointing toward drive end of unit.

(6) If speed pickup leads are long, wind leads into coils inside spacer.

(7) Put 3-pin connector on spacer.

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

(8) Apply thread sealing compound to threads of four attaching screws (195).

(9) Attach 3-pin connector and spacer to stator and housing assembly with four screws.

(10) Tighten screws (195) to a torque of 4.2 to 5.5 lbf.in. (0,47 to 0,62 Nm).

(11) For models 23069-013-1, -004, and -004-1 safety the four screws (195) withlockwire (MS20995C20) IAW MS33540. See Figure 7019.

NOTE: For model 23069-016-1 lockwire is not required for the screws (195).

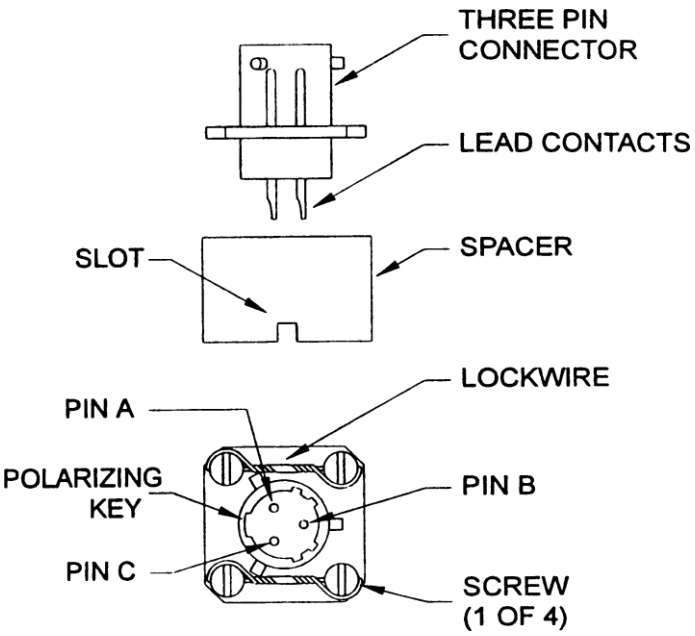


Figure 7019 - Attaching Spacer and 3-Pin Connector

Q. Install the Brushes (105)

NOTE: If new brushes (105) are to be used, identify the brushes with the numbers 1 through 4.

CAUTION: RAISE AND LOWER BRUSH SPRINGS SLOWLY. DO NOT LIFT BRUSH SPRINGS MORE THAN NEEDED TO INSERT BRUSH SETS INTO BRUSH HOLDER ASSEMBLY.

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

(2) At each brush holder location, lift one brush spring at a time with a wire hook tool and insert brush set into a brush holder assembly.

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

(4) Install four electrical brushes (105) into the corresponding complete brush holders (10002-20).

(5) Secure the four brush (105) leads and four braided stator leads to complete brush holders (10002-20) with four screws (110) to a torque of 25 to 35 lbf.in. (2,8 to 3,9 Nm). Form the brush leads as given in SPD 1006 to prevent brushes (105) from hanging up.

R. Coarse Seat the New Brushes (105)

(1) Coarse seat the brushes (105) IAW SPD 1006.

NOTE: The sandpaper should first touch the leading edge (short side) of the brush (105) when the armature (250) is rotated in its normal direction.

(2) Remove sandpaper IAW SPD 1006 when the brushes are seated.

WARNING: WHEN YOU OPERATE COMPRESSED AIR, CONTROL THE PRESSURE TO LESS THAN OR EQUAL TO 29 PSIG (200 KPA). WEAR GOGGLES OR FACE PROTECTION TO GIVE PROTECTION TO THE EYES. FOLLOW NECESSARY PRECAUTIONS TO PREVENT INJURY TO OTHER PERSONNEL IN AREA.

CAUTION: MAKE SURE THAT COMPRESSED AIR IS FREE FROM OIL AND WATER WHEN YOU CLEAN OR DRY COMPONENTS. THIS PRECAUTION PREVENTS CONTAMINATION OF THE COMPONENTS.

(3) Blow out the carbon residue from inside unit with clean, dry compressed air.

S. Perform Brush (105) Run-in

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

(1) Run-in the brushes (105) IAW SPD 1006.

NOTE: A correctly seated brush (105) has a smooth and semi-gloss contact surface.

T. Attaching Stator and Brush (105) leads to each Brush Holder Assembly (10002-20)

Reference SPD 1006.

U. Attaching Air Inlet Support Ring (80) to Bearing and Brush Support Assembly (165) (See Figure 7020)

NOTE: For models 23069-013-1, -004, -009, -015, -024 and -025 using a 23069-350 bearing and brush support assembly only.

(1) Put flat washers (90) on each screw (85).

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

(2) Apply thread sealing compound to four attaching screws (85) of air inlet support ring.

(3) Install air inlet support ring with attaching screws to bearing and brush support assembly.

(4) Tighten screws (85) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

NOTE: Lock wire is not required for the screws (85).

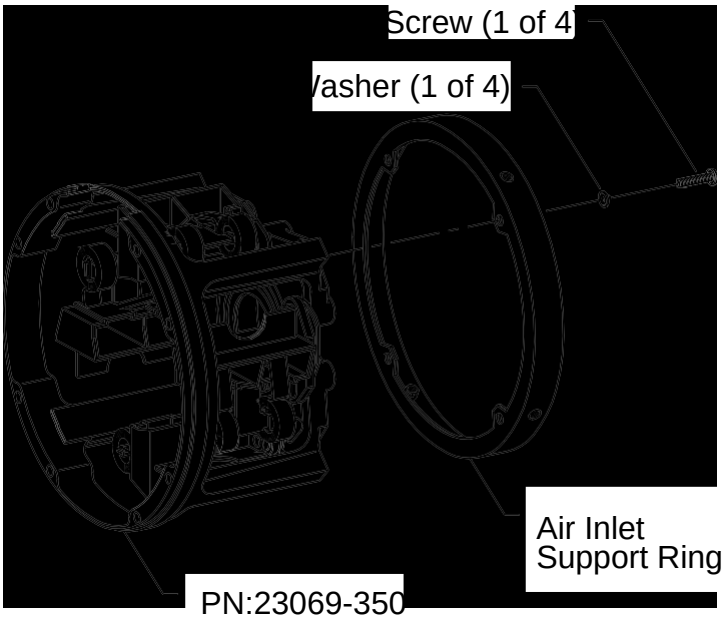


Figure 7020 - Installing Air Inlet Support Ring

V. Install Air Inlet (65), if present

(1) For models 23069-016-1, -014, -015, -024, -025: Make sure the rivnuts to attach the radial air inlet are at the correct angle of 10 degrees in four locations. This will ensure the air inlet will be at the correct clocking angle. See Figure 7021.

NOTE: Older versions of the anti-drive end end bell have the rivnuts at 25 degrees.

(2) Using a vertical stator support, place unit fan up, on a work bench.

(3) Position air inlet (65) on bearing and brush support assembly (165).

(4) Attach air inlet (65) to bearing and brush support assembly (165) with four screws (70) and flat washers (75). Tighten the screws to a Torque of 13.5 to 18.0 lbf.in (1,5 to 2,0 N.m).

NOTE: Do not apply thread sealing compound to the screws until after acceptance testing.

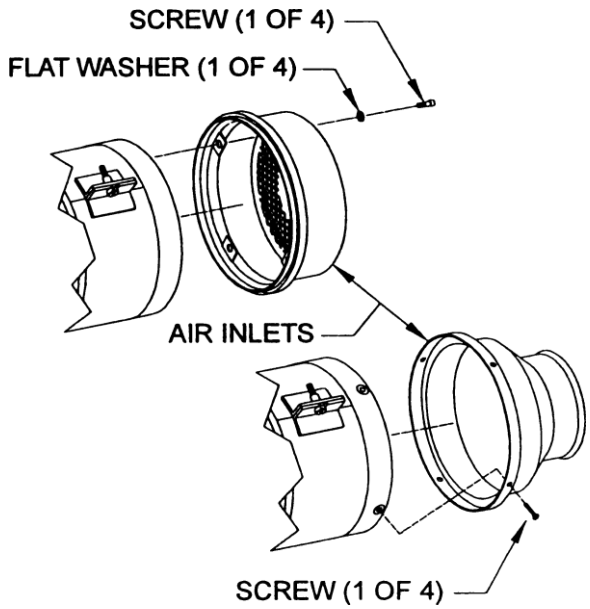


Figure 7021 - Attaching Air Inlet

W. Attach Commutation Viewing Adapter to Starter-Generator

(1) Put commutation viewing adapter over openings in bearing and brush support assembly (165).

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 bearing and brush support assembly (165).

(3) Tighten screw (100) into blind rivet nut on bracket of commutation viewing adapter.

NOTE: Lockwire is not used on screw (100).

X. Attach Replacement Nameplate (30), Modification Status Label (40), Caution Label (45), Patent Label (50) and (if applicable) FAA-PMA Label (52) to Stator and Housing Assembly (285) (See Figure 7022)

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

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

(1) If starter-generator has been modified and original nameplate is not damaged:

(a) Put a blank modification status label on a wooden work surface.

(b) Stamp letter “X” under applicable letter(s) on modification status label.

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

(c) Clean the surface of the stator and housing assembly next to nameplate using a cloth moistened with isopropyl alcohol.

(d) Apply modification status label to stator and housing assembly next to nameplate and oriented to read in same direction as nameplate.

(2) If starter-generator was modified and nameplate was damaged:

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

(b) Set a replacement nameplate on a wooden work surface.

(c) Transfer all information from old nameplate by stamping information with 0.125 in. (3,18 mm) letter punch set and a light hammer on replacement nameplate.

(d) Stamp letter “X” under applicable letters on replacement nameplate.

(e) Remove and discard old nameplate.

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

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

(g) Attach replacement nameplate to stator and housing assembly using four drive screws (35).

WARNING: KEEP ACRYLIC COATING AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. ACRYLIC COATING IS FLAMMABLE.

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

(h) Apply acrylic coating to replacement nameplate.

(i) Allow coating to air dry.

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

(a) Put a replacement nameplate on a wooden work surface.

(b) Transfer all information from old nameplate by stamping information with 0.125 in. (3,18 mm) letter punch set and a light hammer onto replacement nameplate.

(c) Remove and discard old nameplate.

(d) Attach replacement nameplate to stator and housing assembly using four drive screws (35).

WARNING: KEEP ACRYLIC COATING AWAY FROM SOURCES OF HEAT, SPARKS AND FLAME. ACRYLIC COATING IS FLAMMABLE.

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

(e) Apply acrylic coating to replacement nameplate.

(f) Allow coating to air dry.

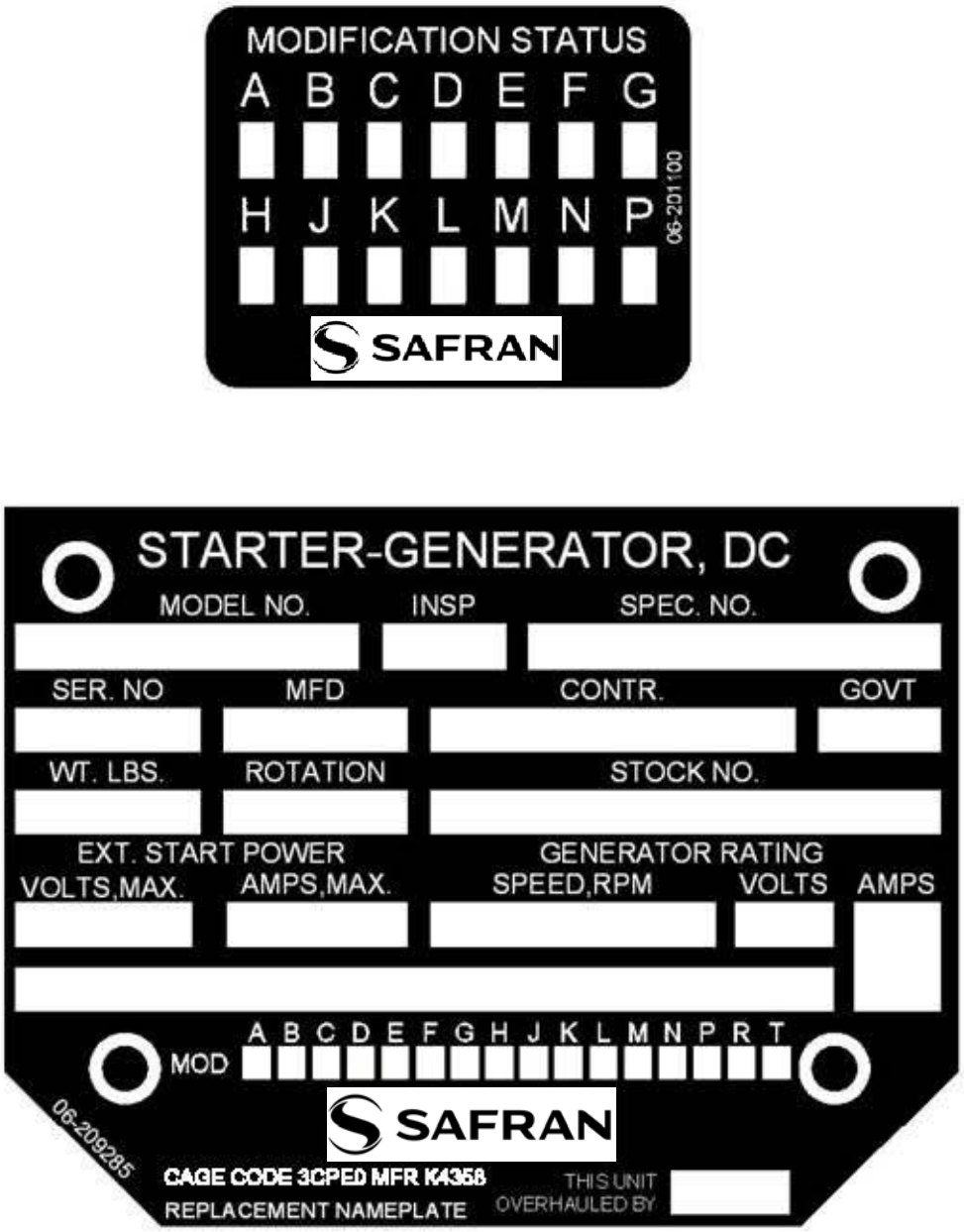


Figure 7022 - Attaching ID Plates and Labels

(4) If caution, patent or FAA-PMA label is damaged or unreadable:

(a) Remove label(s) from 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 IGNITION. DO NOT BREATHE THE FUMES. PREVENT SKIN CONTACT. PUT ON PROTECTIVE CLOTHING AND EYE PROTECTION.

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

(c) Apply new label(s) to stator and housing assembly as follows:

1 Caution Label - next to terminal block.

2 Patent Label - next to nameplate and aligned to read in same direction as nameplate.

3 FAA-PMA Label - (if applicable), near caution label and aligned to read in same direction as caution label.

8. Perform Acceptance Test on Starter-Generator

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

CAUTION: BEFORE ACCEPTANCE TESTING, ATTACH AN UNSERVICEABLE TERMINAL BLOCK (10004-40) TO THE STATOR AND HOUSING ASSEMBLY (285).

CAUTION: MAKE SURE THE SLOTTED TONGUE TERMINAL LUGS ARE DISCONNECTED FROM THE BEARING AND BRUSH SUPPORT ASSEMBLY (165) AND TAPED BEFORE ACCEPTANCE TESTING.

Perform acceptance test procedure on the assembled starter-generator as detailed in the TESTING AND FAULT ISOLATION section.

9. Final Assembly after Acceptance Testing

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

A. Attach serviceable Terminal Block (40) to Housing if dummy Terminal Block was used

(1) Refer Paragraph 4.B. and Paragraph 4.C. for installation of terminal block (40) to stator and housing assembly (10001-285).

B. Install Terminal Block Hardware

(1) Refer Paragraph 4.D. for installation of terminal block hardware.

C. Attaching Terminal Block Cover (10001-55) to Starter-generator, if present

NOTE: When starter-generator is removed from service, the terminal block cover usually stays on the aircraft.

(1) On models 23069-015-1 and -004-1, put terminal block cover on terminal blockand snap into place.

(2) On all or models, but model 23069-013-1, attach terminal block cover to terminalblock with two attaching screws (10001-60).

NOTE: Model 23069-013-1 does not use a terminal block cover.

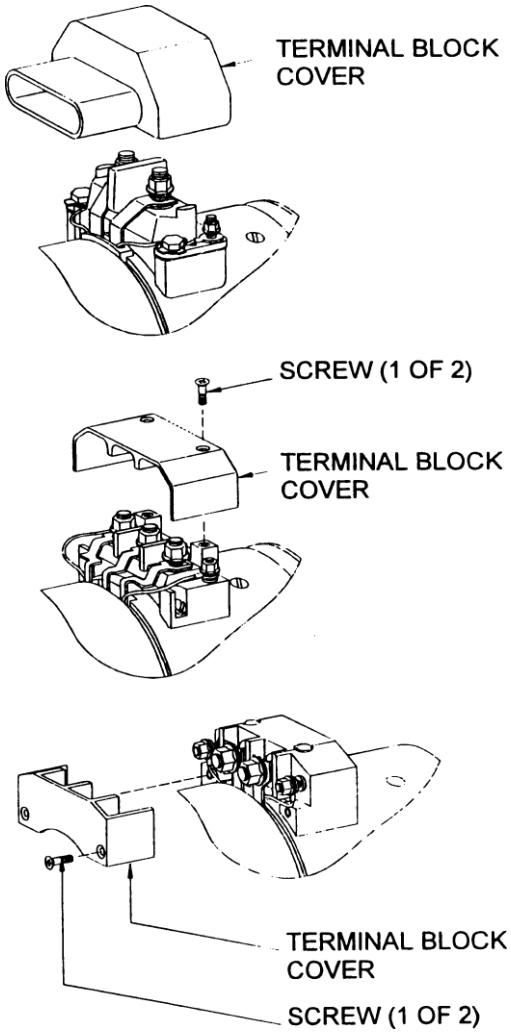


Figure 7023 - Attaching Terminal Block Cover

D. Remove Commutation Viewing Adapter

(1) Unthread the screw (100) from self-locking blind rivet nut that secures commutation viewing adapter to bearing and brush support assembly (165). Remove the commutation viewing adapter.

(2) Form the brush (105) leads as given in SPD 1006.

E. Attaching Brush Access Cover (95) to Starter-Generator

(1) Position brush access cover on bearing and brush support assembly (165).

CAUTION: THE JOINT FORMED BY THE BRUSH ACCESS COVER MUST NOT BE POSITIONED OVER AN ACCESS WINDOW IN THE HOUSING.

(2) Center brackets of brush access cover over one rib of bearing and brush support assembly.

(3) Tighten the screw (100) into blind rivet nut (101) on brackets of brush access cover to a torque of 20 to 30 lbf.in. (2,26 to 3,4 Nm).

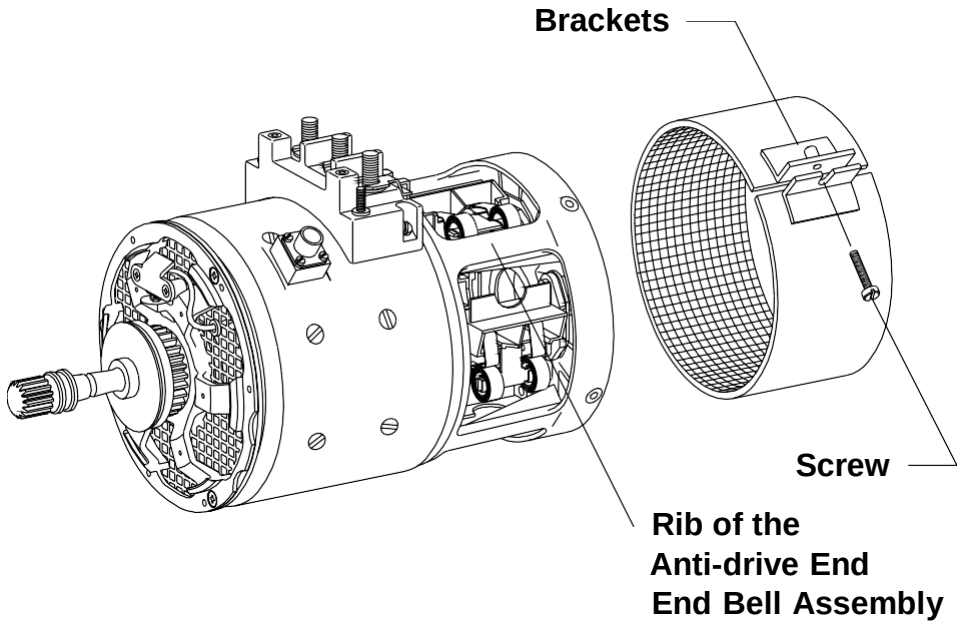


Figure 7024 - Attaching Brush Access Cover

F. Attach Filter Assembly (10002-60) leads on Finned Bearing and Brush Support Assembly

For models 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A':

(1) Remove four screws (70) which attach air inlet (65) to bearing and brush support assembly (165).

(2) Remove air inlet (65)

(3) Put a lock washer (182) on each of four screws (181).

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

(4) Apply thread sealing compound to threads of screws (181).

(5) Put a slotted terminal of filter assembly (10002-60) on each screw (181) and install the screws into the holes in the finned end of the bearing and brush support assembly (165) as shown in Figure 7025.

(6) Tighten the screws (181) to a torque of 7.7 to 10.3 lbf.in (0,87 to 1,16 Nm).

(7) Apply thread sealing compound to threads of four screws (70).

(8) Position air inlet (65) on bearing and brush support assembly (165) and secure with four screws (70) and washer (75) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

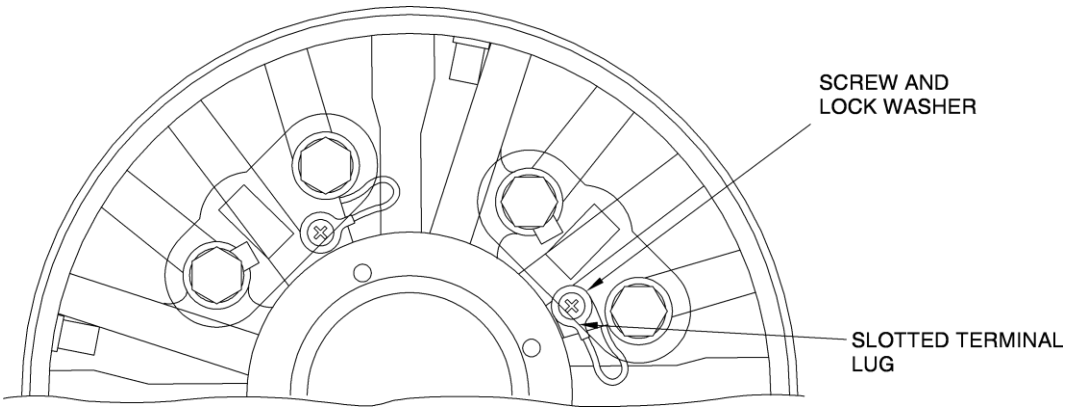


Figure 7025 - Filter Board Assembly Lead Attachment on Finned Bearing and Brush Support Assembly

G. Attach Filter Assembly (10002-60) Leads on Bearing Retainer

For all models except 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A':

(1) Remove four screws (70) which attach air inlet (65) to bearing and brush support assembly (165).

(2) Remove air inlet (65).

(3) Loosen one of the screws (260) attaching bearing retainer (255) to bearing and brush support assembly (165).

NOTE: Make sure that only one attaching screw of bearing retainer (255) is loosen at a time. This is done to prevent the bearing from moving.

(4) If present, remove electrical insulation from filter lead terminals.

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

(5) Apply thread sealing compound to thread of attaching screw of bearing retainer.

(6) Put a slotted lead of filter board assembly (10002-60) and spring lock washer (265) on the screw (260) and install the screw into the hole of bearing retainer (255).

(7) Tighten the screw (260) to a torque of 13.5 to 18 lbf.in. (1,5 to 2 Nm).

(8) Repeat this process at remaining screw locations.

(9) Apply thread sealing compound to threads of four screws (70).

(10) Position air inlet (65) on bearing and brush support assembly (165) and secure with four screws (70) and washer (75) to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm).

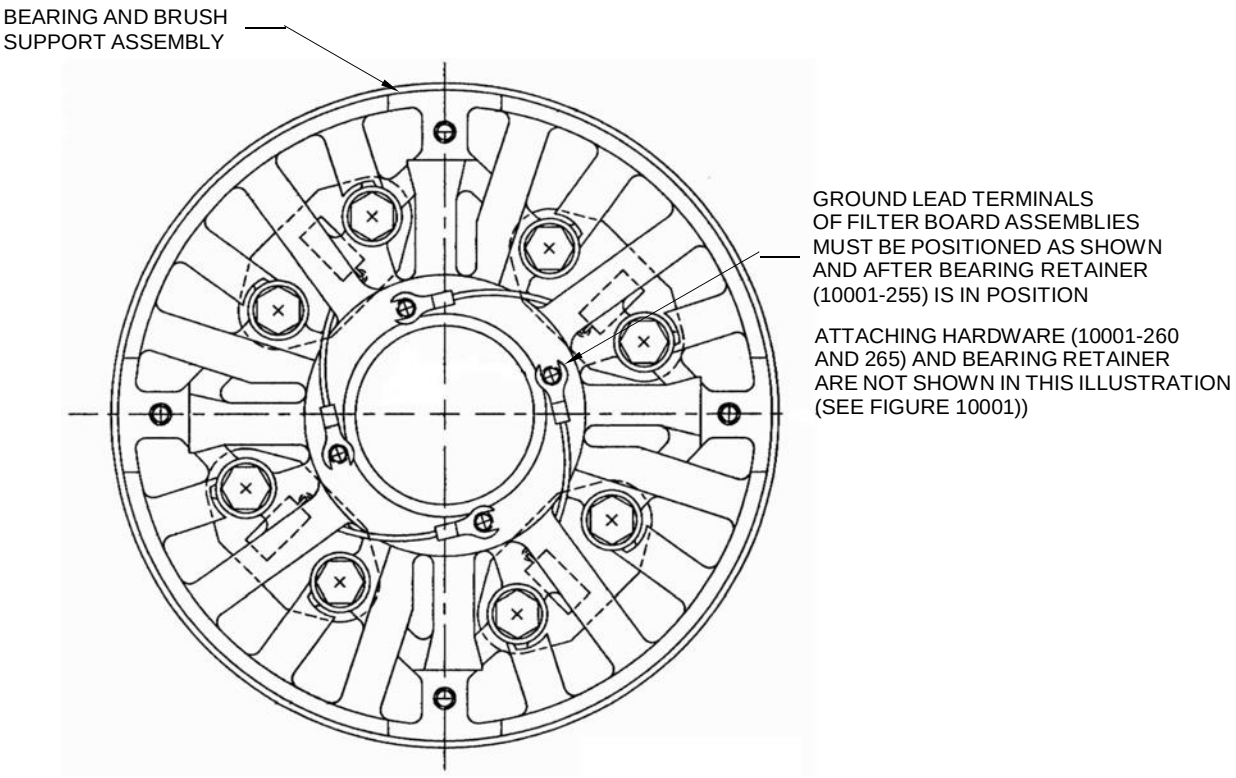


Figure 7026 - Filter Board Assembly Lead Attachment on Bearing Retainer

H. Attach QAD kit (5), if present

NOTE: For all models, but models 23069-015-1 and -004-1. When a starter-generatoris removed for service, QAD kit usually stays on aircraft.

(1) Attach V-retainer coupling (10) over drive end bearing support assembly.

(2) Attach mounting adapter (25) into inner rim of V-retainer coupling.

(3) Tighten self-locking nut (15) on T-bolt (20) to lock V-retainer and mounting kit in position.

10. Preparation for Shipment/Storage

Refer to STORAGE section for shipment/storage instructions.

11. Package the Starter-Generator for Shipment or Storage

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

Coat drive spline with synthetic aviation grease. Wrap the drive spline with protective paper according to MIL-B-121A, Grade A, Type II, Class 1.

Place O-ring (10001-135) into a small plastic bag and attach to starter-generator.

For shipment or storage, seal starter-generator unit in suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

THIS PAGE INTENTIONALLY LEFT BLANK

FITS AND CLEARANCES

1. Introduction

A. The following paragraphs provide information for determining the acceptability of fits and clearances of the starter-generator and mounting adapters.

B. Examine the parts for damage. Refer to CHECK section, for details.

C. Repair the parts before assembly. Refer to REPAIR section, for details.

D. The acceptance limits for starter-generator components, subassemblies and mounting adapters are listed in Paragraph 2.

E. The required torque values to be used during repair and assembly of starter-generator components and attaching parts are listed in Paragraph 3.

2. Component Acceptance Limits

Refer to Table 8001 for starter-generator component, subassembly and mounting adapters acceptance limits. Paragraph designations in the CHECK column refer to the applicable inspection procedure found in the CHECK section.

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

Ref.	Nomenclature	Inspection	Part Number	Acceptance Limits
9.A.	Mounting Adapter	Guide pin height	23069-1020 23069-1400 23069-1405	0.14 to 0.16 inch (3,55 to 4,06 mm)
			23069-1450	0.11 to 0.13 inch (2,8 to 3,3 mm)
			23069-1830	0.16 to 0.18 inch (4,06 to 4,57 mm)
9.J.	Drive Shaft	Drive spline diameter	23069-1355 23069-1356 23069-1357 23069-1358	0.757 inch (19,23 mm) Min. over Pin Dia. of 0.1094 inch (2,779 mm)
			23069-1690 23069-1354	0.921 inch (23,39 mm) Min. over Pin Dia. of 0.096 inch (2,44 mm)
		Armature mating spline diameter	All Models	0.4813 inch (12,225 mm) Min. over Pin Dia. of. 0.060 inch (1,524 mm)
9.K.	Dampener Plate	Thickness	All Models	0.038 inch (0,97 mm) Min.
		Internal spline diameter	All Models	Gage pin dia: 0.090 inch (2,29 mm) Distance between two pins: 0.6547 inch (16,629 mm) max

Table 8001 - Acceptance Limits

Ref.	Nomenclature	Inspection	Part Number	Acceptance Limits
9.L.	Friction Ring	Thickness	All Models	0.060 inch (1,52 mm) Min.
9.N.	Brush Spring	Pressure	All Models	2.7 to 3.5 lb. (1,2 to 1,6 kg)
9.N.	Bearing and Brush Support Assembly	Bearing liner diameter	All Models	1.5747 to 1.5750 inch (39,997 to 40,005 mm) See Figure 8002.
		Filter Assembly (10002-60)	Capacitance value	0.3 to 0.36 μF checked at a frequency of 900 to 1100 Hz.
9.O.	Drive End Bearing Support Assembly	Bearing bore diameter	All Models	1.5745 to 1.5748 inch (39,992 to 40,000 mm) See Figure 8002.
9.Q.	Speed Pickup	Resistance, lead to ground		More than 1 MΛ
		Resistance between leads	23072-1400	20 to 45 Λ
		Resistance between leads	23072-1280	95 to 137 Λ
9.S.	Armature	Bearing journal diameters (A, C) see Figure 5017	All Models	0.6691 to 0.6694 inch (16,995 to 17,003 mm) See Figure 8001
		Commutator diameter (B) see Figure 5017		2.310 inch (58,67 mm) Min.
		Mica Undercut (Before recut)		Depth: 0.045 inch (1,14 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.040 inch (1,02 mm) to 0.050 inch (1,27 mm)
		Mica Undercut (After recut)		Depth: 0.050 inch (1,27 mm) min. to 0.070 inch (1,78 mm) max. Width: 0.040 inch (1,02 mm) to 0.050 inch (1,27 mm)

Table 8001 - Acceptance Limits (Continued)

Ref.	Nomenclature	Inspection	Part Number	Acceptance Limits
9.S.	Armature	Commutator bar to bar acceptance test values	All Models	Bar to bar: 0.0002 inch (0,005 mm) max. TIR: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar (Before refinishing)		Bar to Bar: 0.0008 inch (0,020 mm) max.
		Commutator bar to bar and total indicated runout (After refinishing)		Bar to Bar: 0.0001 inch (0,0025 mm) max. TIR: 0.0005 inch (0,0127 mm) max.
		Balance		5 grain inch (8.2 gram mm) Max each end.
9.W.	Terminal Block	Capacitance values B+ to E-: C to Ground B+ to Ground	23032-1509	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%.
		Capacitance values: B to E and B to ground	23069-1370, 23081-1312	1.8 to 2.2 µF Tested @ 110 to 130 Hz, 77° F (25° C) ± 10%.
		Capacitance Values B and E Capacitance Values B and Ground	23069-1238	5.1 to 10.5 µF Tested @ 115 to 125 Hz, 77° F (25° C) ± 5%. 0.0176 to 0.0264 µF Tested @ 90 to 110 Hz, 77° F (25° C) ± 5%.

Table 8001 - Acceptance Limits (Continued)

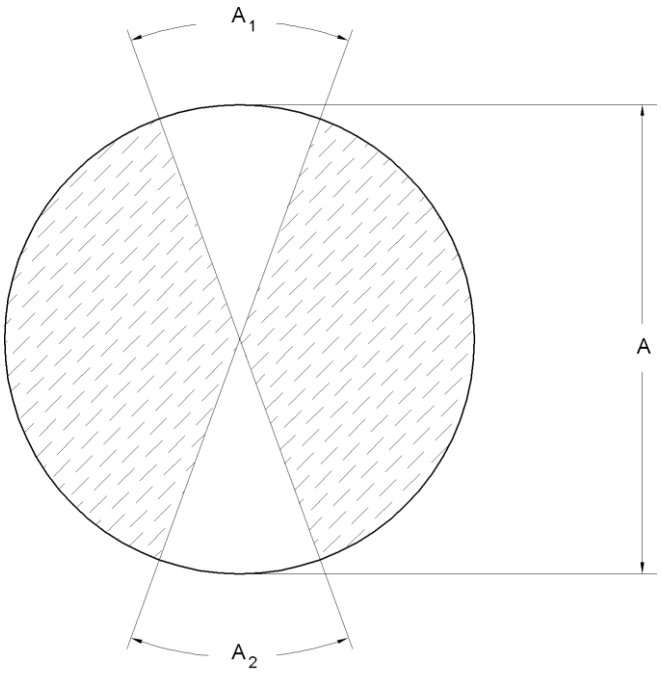


Figure 8001 - Measuring Armature Bearing Journal Diameters

NOTE: During overhaul/service inspection, diameter of bearing journal is considered to be acceptable if not more than 25% of circumference is below the minimum diameter limit (See Figure 8001). When the starter-generator is to be repaired and returned to service on a “continued time” basis, the minimum diameter limit of bearing journal diameter “A” is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) below minimum diameter limit.

NOTE: Acceptance criteria for used journals, not new or repaired journals.

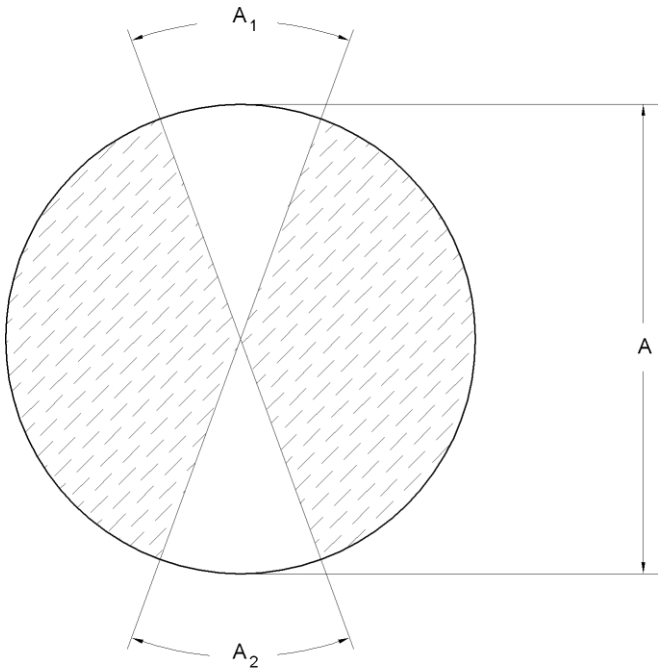


Figure 8002 - Measuring Bearing Liner Diameters

NOTE: During overhaul/service inspection, diameter of bearing liner is considered to be acceptable if not more than 25% of circumference is above the maximum diameter limit (See Figure 8002). When the starter-generator is to be repaired and returned to service on a “continued time” basis, the maximum diameter limit of bearing liner diameter “A” is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) above maximum diameter limit.

NOTE: Acceptance criteria for used liners, not new or repaired liners.

3. Torque Limits

The following torque limits are used to maintain the DC Starter-Generator.

Figure Item No.	Nomenclature	Torque (Newton Meters)
10001-10	Coupling, V-Retainer	Shown on outer edge of band
10001-60	Screw	7.7 to 10.3 lbf.in. (0,87 to 1,16 Nm)
10001-70	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10001-85	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10001-100	Screw	20 to 30 lbf.in. (2,26 to 3,4 Nm)
10001-110	Screw	25 to 35 lbf.in. (2,8 to 3,9 Nm)
10001-120	Nut, Self-Locking	100 to 120 lbf.in. (11,3 to 13,5 Nm)
10001-170	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10001-172	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10001-181	Screw	7.7 to 10.3 lbf.in. (0,87 to 1,16 Nm)
10001-195	Screw	4.2 to 5.5 lbf.in. (0,47 to 0,62 Nm)
10001-205	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10001-205A	Screw	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)
10001-225	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10001-	Nut, Jam, Hex on (230)	15 to 25 lbf.in. (1,7 to 2,8 Nm)
10001-260	Screw	13.5 to 18.0 lbf.in. (1,5 to 2,0 Nm)
10002-15	Nut, Blind Rivet	25 lbf.in. (2,82 Nm)
10002-25	Bolt, Machine	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)
10004-10	Nut, Self-Locking	220 to 235 lbf.in (24,86 to 26,55 Nm)
10004-25	Nut, Self-Locking	22.7 to 35 lbf.in (2,6 to 3,9 Nm)
10004-35	Terminal Stud	300 to 325 lbf.in (33,9 to 36,7 Nm)
10004-45	Screws	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)
10004-45A	Screws	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)
10004-45B	Bolts	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)
10004-45C	Bolts	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)
10004-60	Bolts	22.7 to 35.0 lbf.in. (2,6 to 3,9 Nm)

Table 8002 - Torque Limits

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Introduction

Table 9001 lists items that are approved for use during repair and overhaul of all 23069 Series DC Starter-Generators.

Reference Standard Practice Document (SPD) 1004 for the 23069 Series Brush Holder Alignment Fixtures.

Item	Figure No.
Adapters, Armature Shaft (Drive End, Anti-drive End)	Figure 9001
Adapter, Commutation Viewing	Figure 9002
Brush Holder, Alignment Fixture	SPD 1004
Drivers, Bearing (Inner Race And Outer Race)	Figure 9003
Driver, Liner	Figure 9004
Fixture, Commutator Turning	Figure 9005
Fixtures, Rivet Alignment And Rivet Press	Figure 9006
Plug, Adjustment, Speed Pickup	Figure 9007
Support, Armature	Figure 9008
Support, Anti-drive End, Bearing Support Assembly	Figure 9009
Supports, Hub, (Drive End And Anti-drive End)	Figure 9010
Support, Stator, Horizontal	Figure 9011
Support, Stator, Vertical	Figure 9012
Driver, Dampener Hub	Figure 9013
Driver, Dampener Plate	Figure 9014
Wrench, Spline	Figure 9015
Fastener Header, Plusnut®	Figure 9016
Hammer, Slide	Figure 9017

Table 9001 - Special Tools, Fixtures, and Equipment

2. Illustrated Description of Tools

Drawings in this section provide material and fabrication instructions for making tools or fixtures listed in Table 9001. Where dimensions and fabrication instructions are provided, the tool or fixture is approved for local manufacture. Unless otherwise specified, all dimensions are in inches.

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 Adapter (Anti-Drive End and Drive End)

Machine ends to be parallel to within ± 0.001 inch (0,0254 mm) and square with sidewalls to within ± 0.05 degree.

Material:	Brass, CD-260
Stock Size:	0.75 inch (19,1 mm) diameter
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

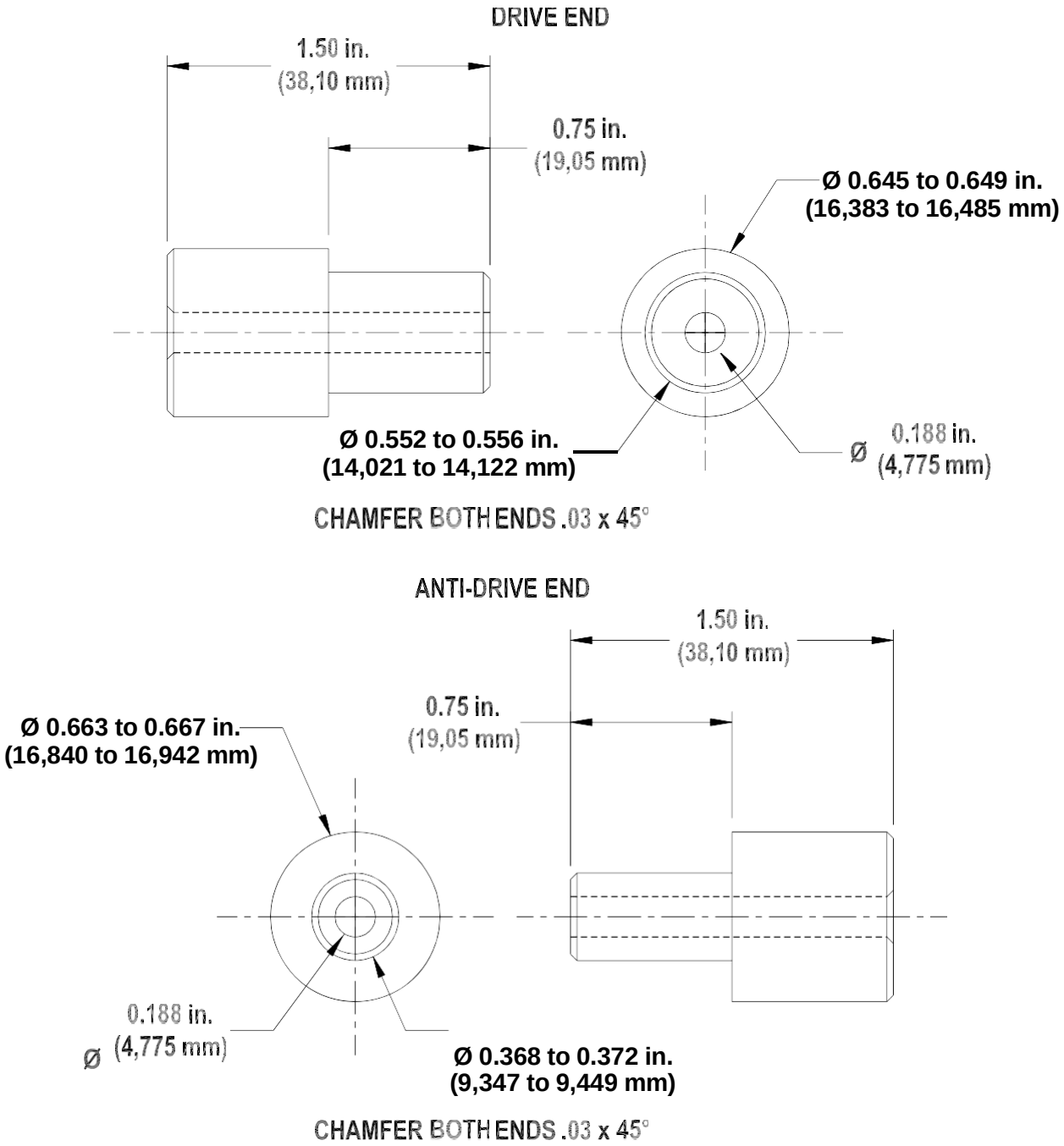


Figure 9001 - Armature Shaft Adapters

B. Commutation Viewing Adapters

(1) To make adapter model (on left) in Figure 9002:

Material	Used brush access cover
Clear Acrylic:	4 pieces 2.00 inch (50,9 mm) high 2.00 inch (50,8 mm) width 0.024 inch (0,61 mm) thick

(a) Cut four holes in brush access cover. Each hole must be positioned above one of the four brush holder assemblies to allow for viewing of brushes as they make contact with commutator during test.

(b) Cut four pieces of clear acrylic to be larger than brush access holes in stator and housing assembly.

(c) Apply adhesive on inside surface of viewing adapter to frame of cut-out viewing windows.

(d) Attach four pieces of acrylic to viewing windows on inner surface of viewing adapter using four pop rivets.

(2) To make adapter model (on right) in Figure 9002:

Material	
Clear Acrylic:	1 piece 18.18 inch (461,8 mm) long 2.38 inch (60,4 mm) width 0.024 inch (0,61 mm) thick

(a) Remove brackets from used brush access cover.

(b) Attach brackets to a piece of clear acrylic.

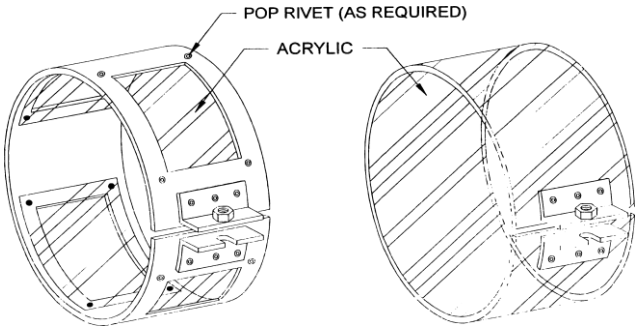
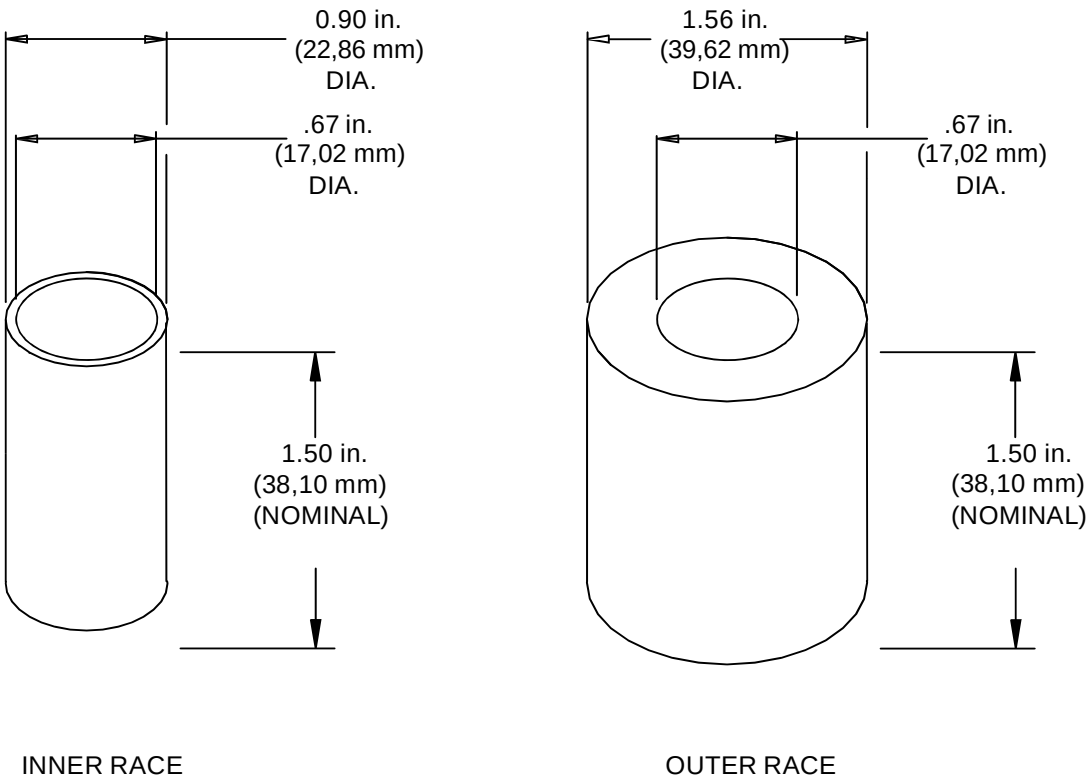


Figure 9002 - Commutation Viewing Adapter

C. Bearing Drivers (Inner Race and Outer Race)

Material:	O1 tool steel or equivalent
Stock Size:	2.00 diameter (50,8 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees



INNER RACE

OUTER RACE

Figure 9003 - Bearing Drivers

D. Liner Driver

Harden to Rockwell C 35-40

Material:	O1 tool steel or equivalent
Stock Size:	2.00 diameter (50,8 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

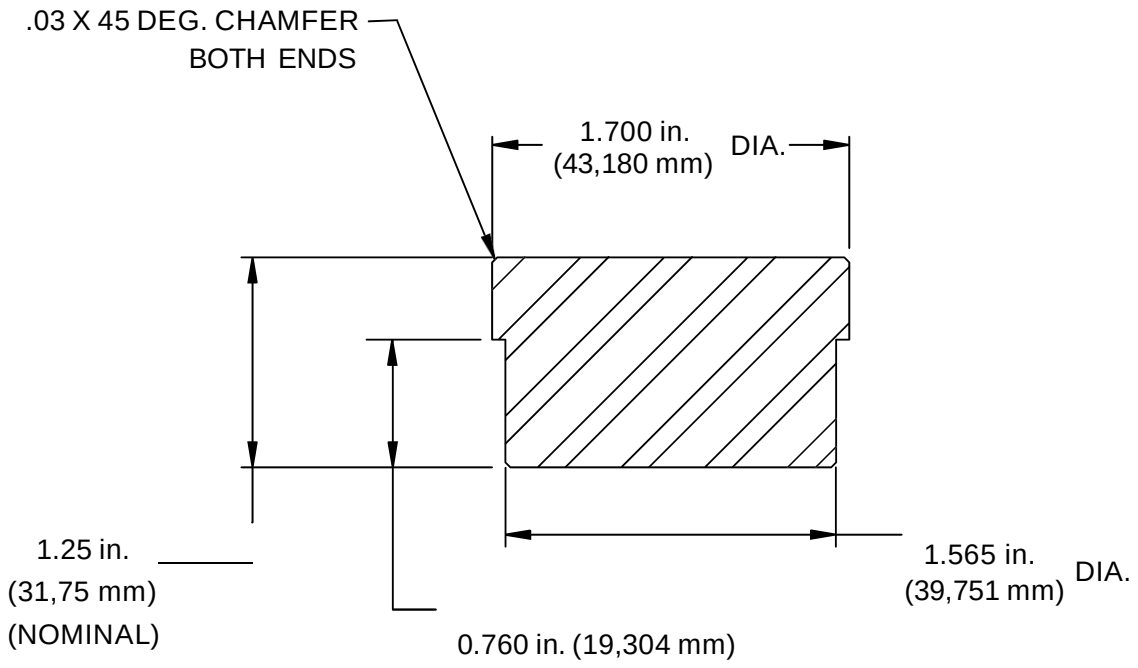


Figure 9004 - Lining Driver

E. Commutator Turning Fixture

(1) Harden to Rockwell C 35-40

(2) Install a ball bearing.

Material:	O1 tool steel or equivalent
Stock Size:	2.00 diameter (50,8 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

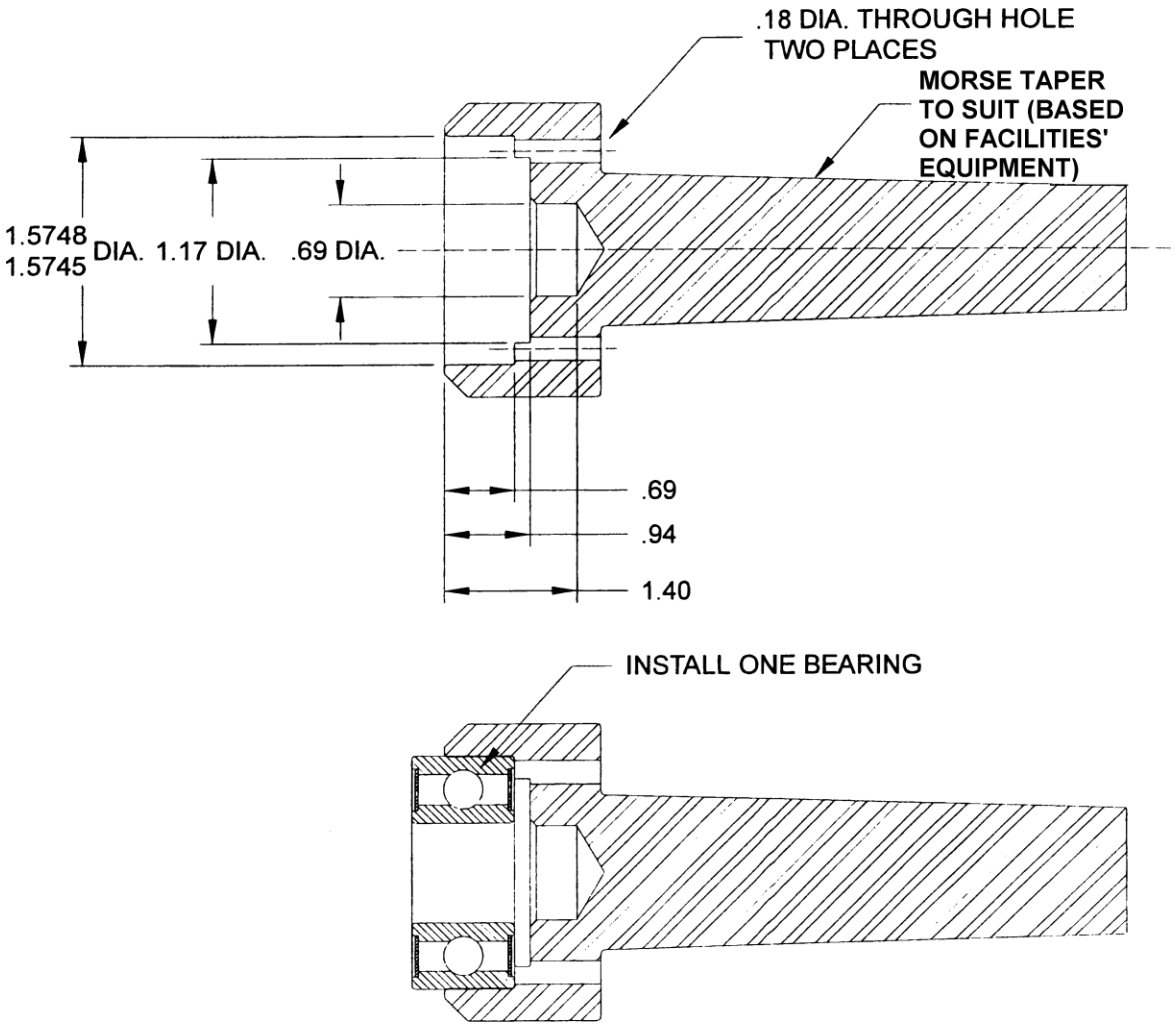
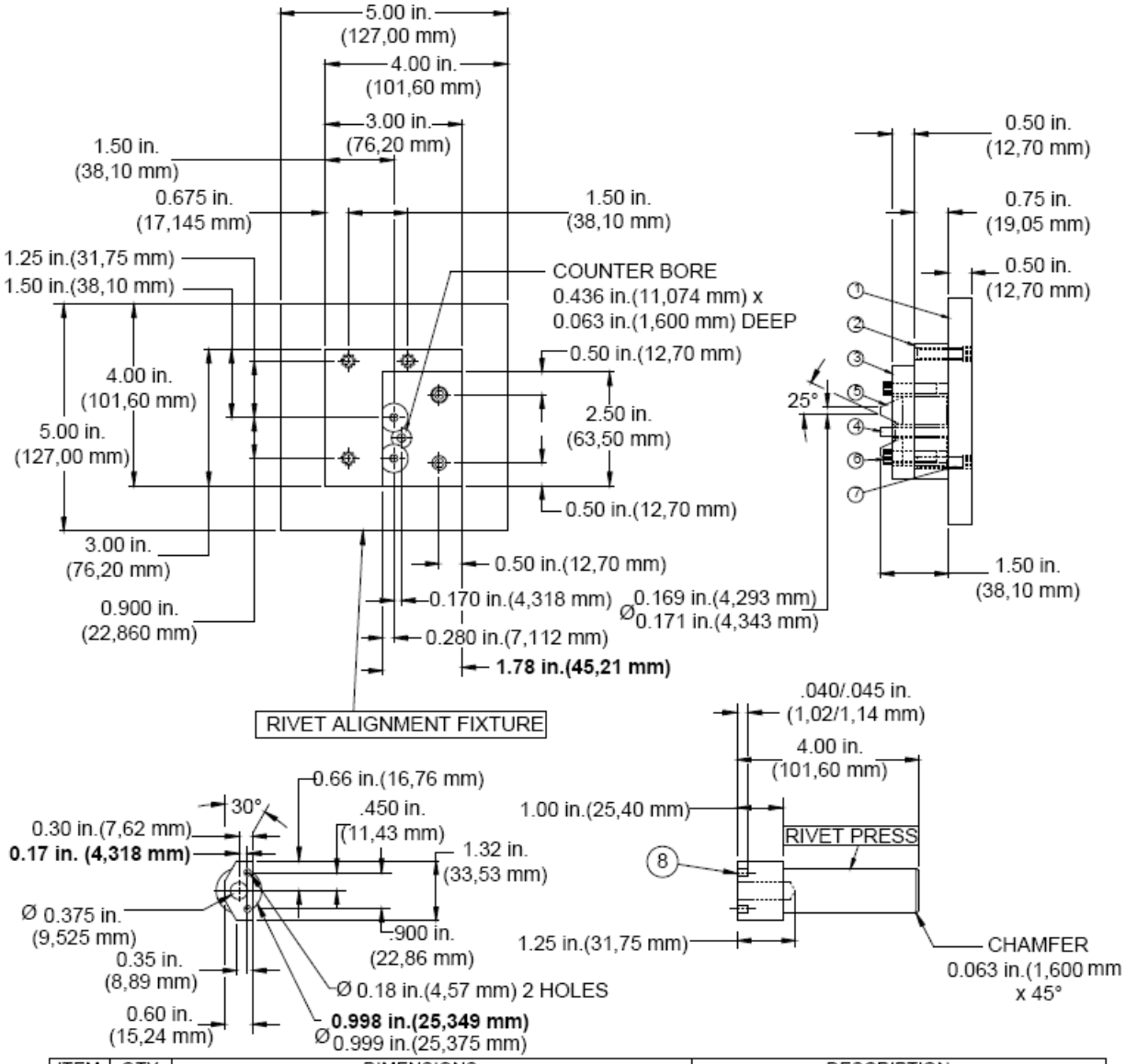


Figure 9005 - Commutator Turning Fixture

F. Rivet Alignment Fixture and Rivet Press - See Chart below.

Tolerances on: Decimals 0.XX ± 0.01
0.XXX ± 0.005

Angles ± 5 Degrees



ITEM	QTY.	DIMENSIONS	DESCRIPTION
8	1	1 1/2 DIA. (38,10 mm) DIA X 4 1/8 in (104,78 mm) LONG	A2 TOOL STEEL, HARDEN Rc 55-60
7	3	.250 in (6,35 mm)-20	SCREW, CAP SOCKET HEAD, COUNTER SUNK
6	2	.190 in (4,83 mm)-24	SCREW, CAP SOCKET HEAD
5	2	5/8 in (15,86 mm) DIA. X 1 3/4 in (44,45 mm) LONG	01 TOOL STEEL, DRILL ROD
4	1	3/16 in (4,76 mm) DIA. X 1 3/4 in (44,45 mm) LONG	01 TOOL STEEL, DRILL ROD
3	1	1/2 in (12,70 mm) X 2 1/2 in (63,50 mm) X 2 1/2 in (63,50 mm)	1010 COLD ROLL STEEL
2	1	3/4 in (19,05 mm) X 3 in (76,20 mm) X 3 in (76,20 mm)	1010 COLD ROLL STEEL
1	1	1/2 in (12,70 mm) X 5 in (127,00 mm) X 5 in (127,00 mm)	1010 COLD ROLL STEEL

Figure 9006 - Rivet Alignment and Rivet Press Fixtures

G. Speed Pickup Adjustment Plugs

Harden to Rockwell C 55-60

NOTE: Ground diameters must be concentric to within 0.0005 TIR

Material:	O1 tool steel or equivalent
Stock Size:	2.50 inch diameter (63,5 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

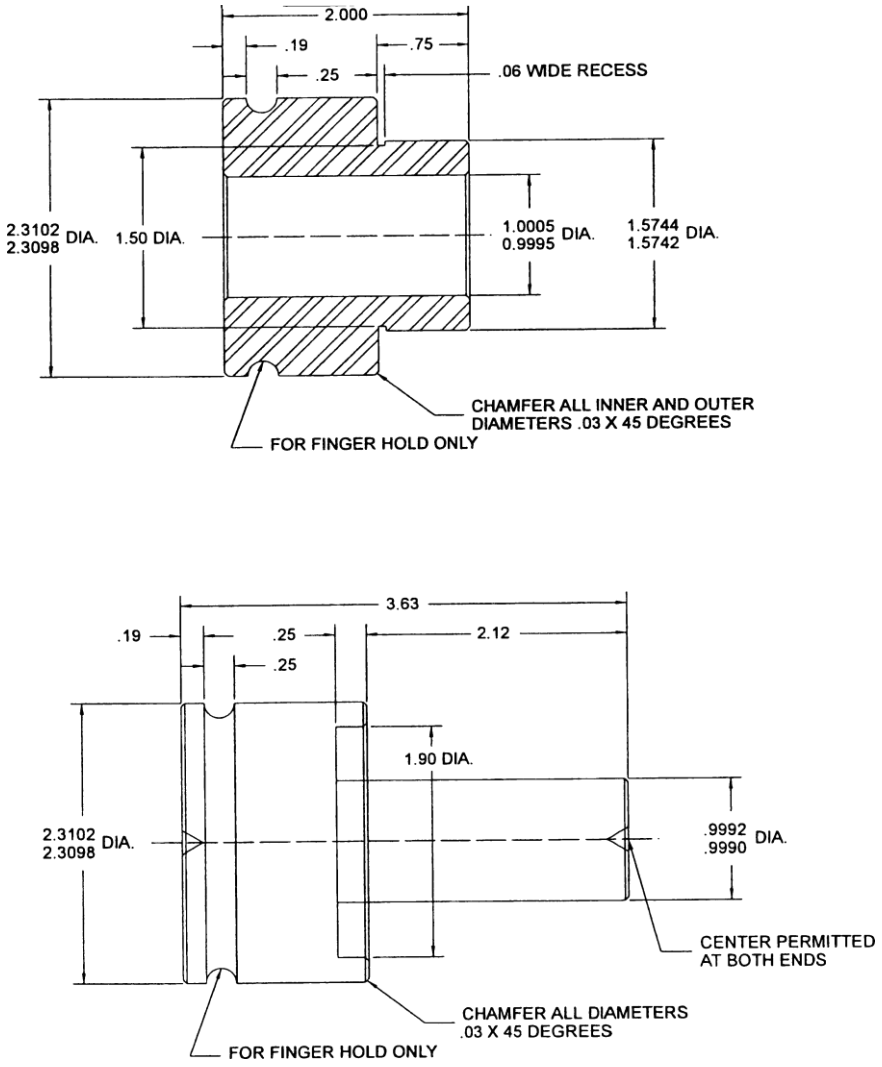


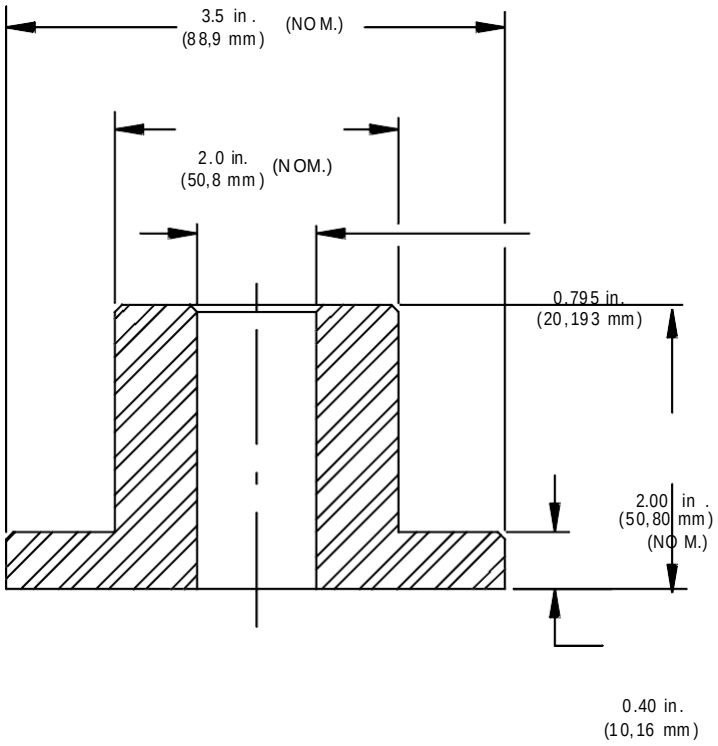
Figure 9007 - Speed Pickup Adjustment Plug

H. Armature Support

(1) Machine ends to be parallel within 0.001 inch (0,0254 mm) and square with the bore hole to within ± 0.05 degrees.

(2) Harden to Rockwell C 35-40.

Material:	O1 tool steel or equivalent
Stock Size:	3.50 inch diameter (88,9 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees



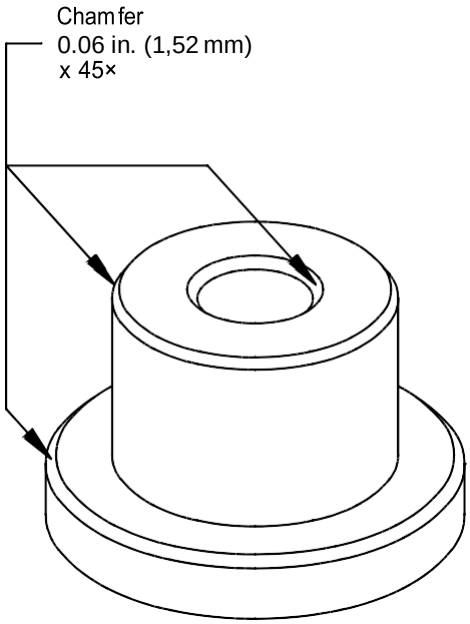


Figure 9008 - Armature Support

I. Bearing and Brush Support Assembly Support

Material:	O1 tool steel or equivalent
Stock Size:	6.0 inch diameter (152,4 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

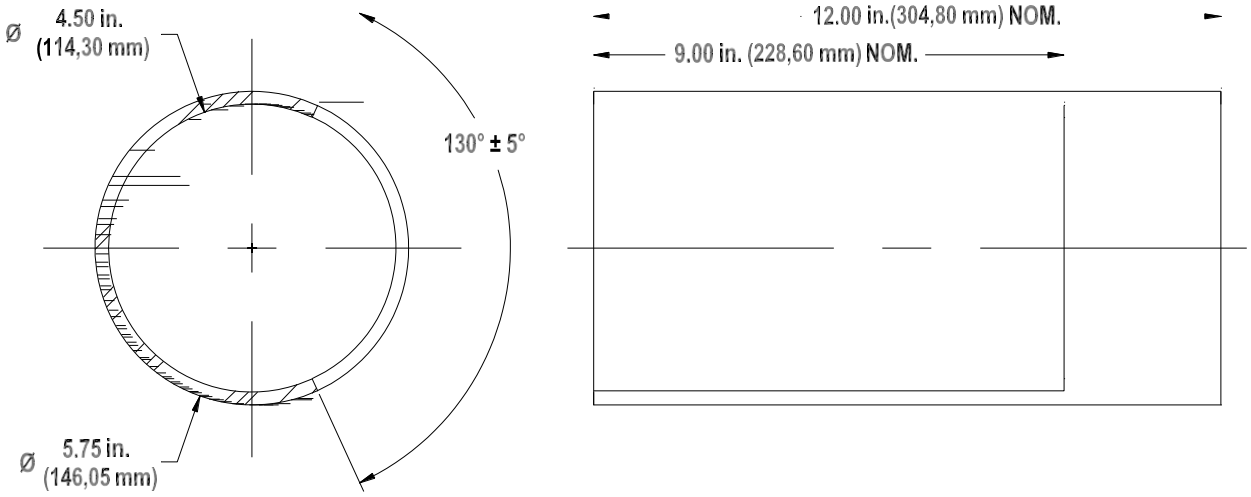


Figure 9009 - Bearing and Brush Support Assembly Support

J. Hub Supports (Drive End and Anti-Drive End)

Harden to Rockwell C 35-40.

Material:	O1 tool steel or equivalent
Stock Size:	2.0 inch diameter (50,8 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

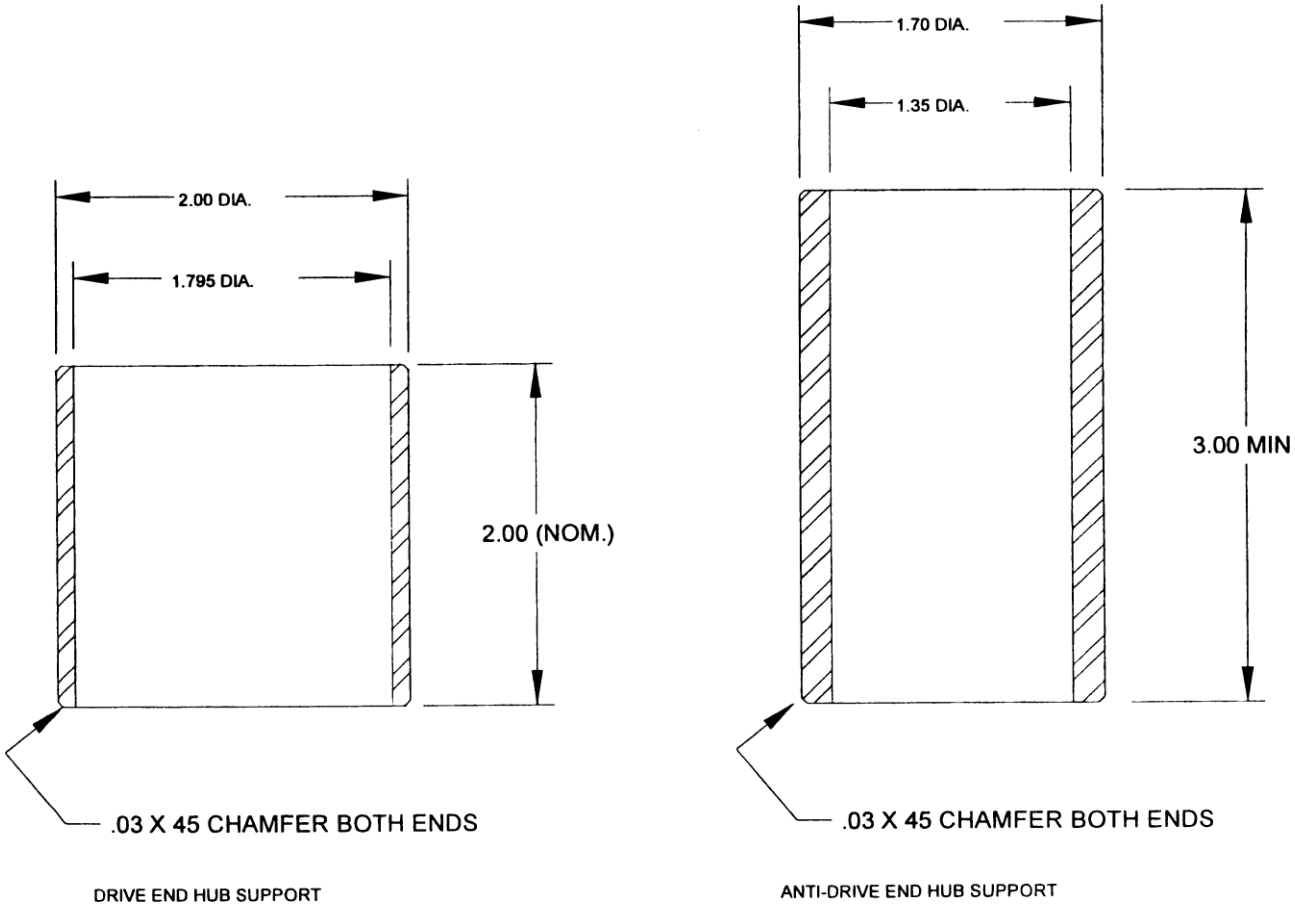


Figure 9010 - Drive End and Anti-Drive End Hub Supports

K. Horizontal Stator Support

Material	Hardwood
Stock Size:	8 X 5 X 4 inch (203 X 127 X 102 mm)

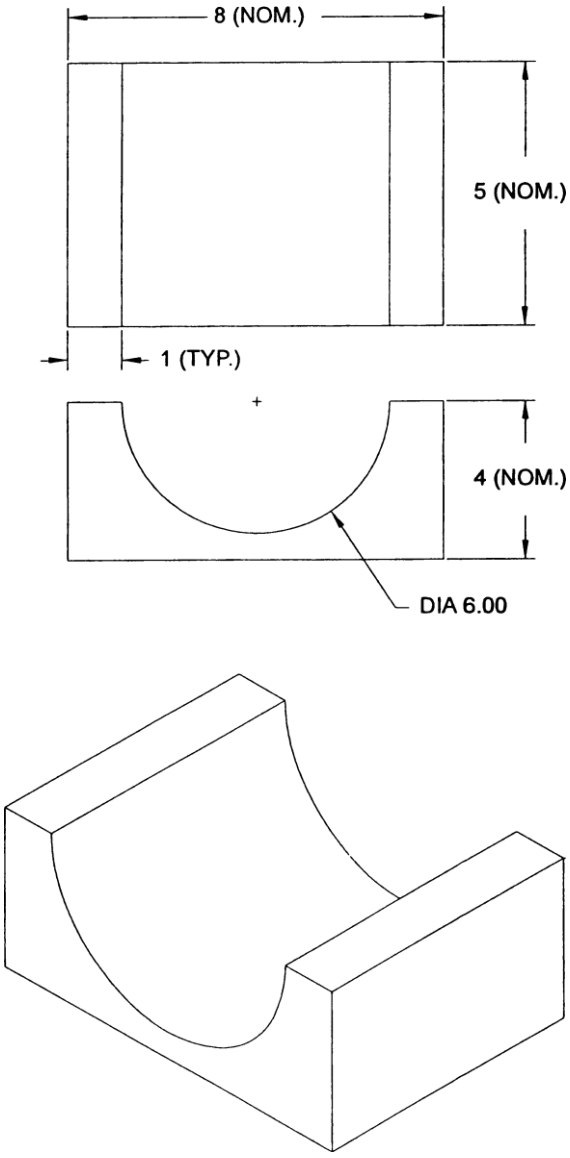


Figure 9011 - Horizontal Stator Support

L. Vertical Stator Support

Material	Hardwood
Stock Size:	9 X 9 X 3 inch (229 X 229 X 102 mm)

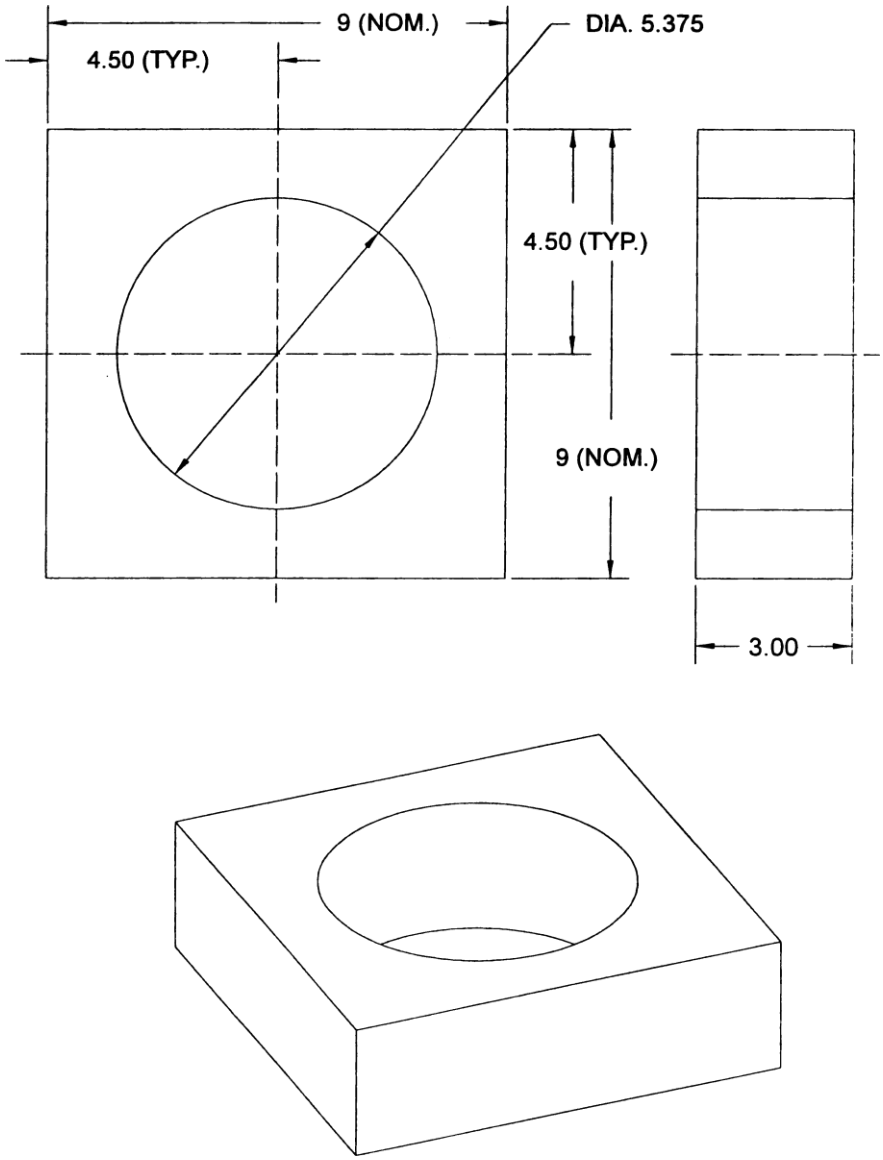


Figure 9012 - Vertical Stator Support

M. Dampener Hub Driver

Material:	O1 tool steel or equivalent
Stock Size:	3.0 X 3.0 X 0.25 inch (76,2 X 76,2 X 6,35 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 5 Degrees

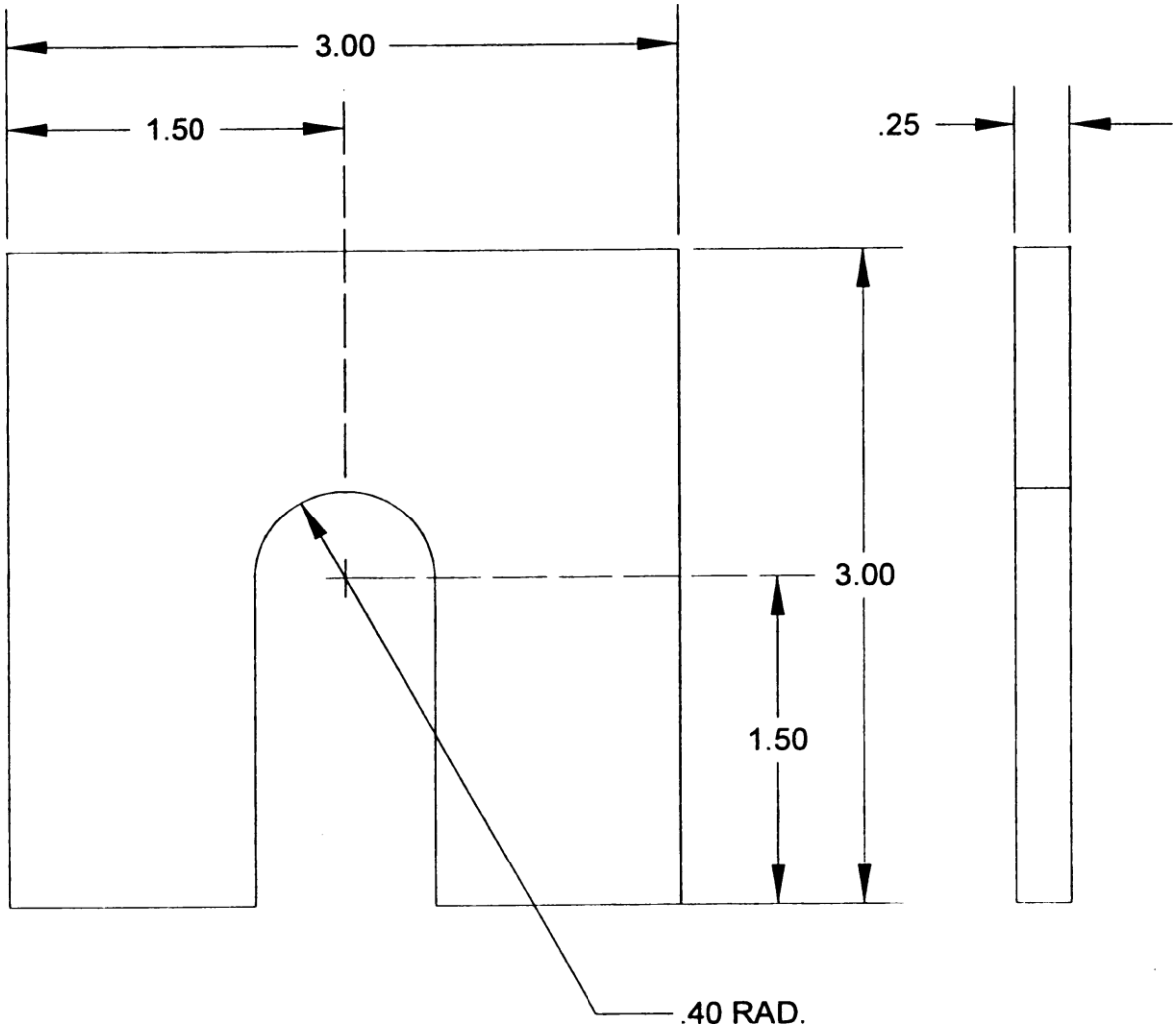
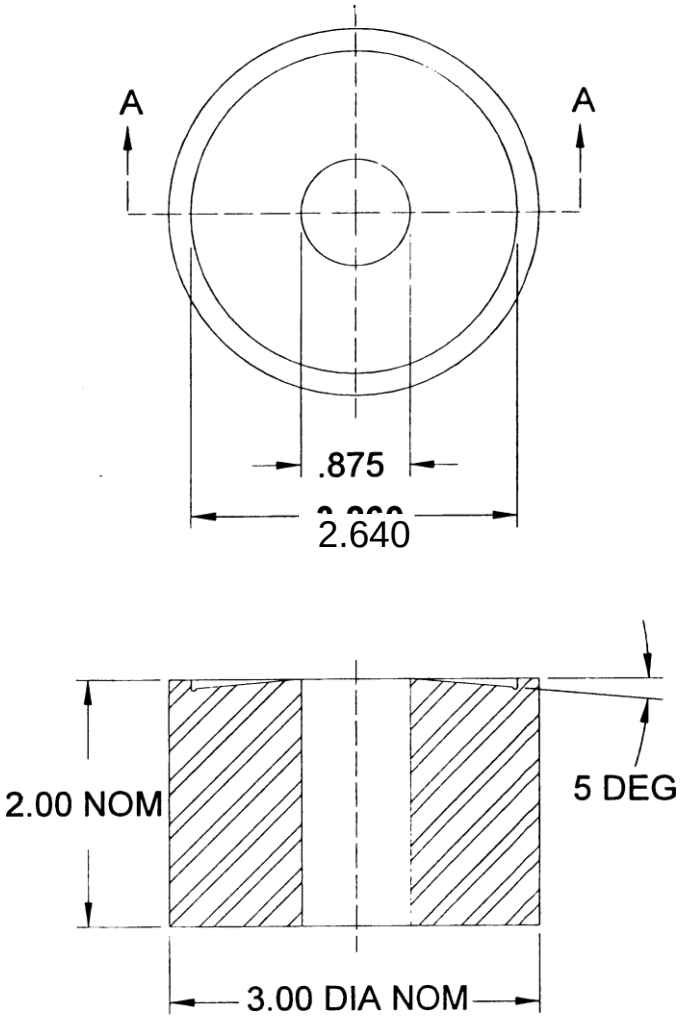


Figure 9013 - Dampener Hub Driver

N. Dampener Plate Driver

Harden to Rockwell C 55-60.

Material:	O1 tool steel or equivalent
Stock Size:	3.0 inch diameter (76,2 mm)
Tolerances on:	Decimals 0.XX ± 0.01 0.XXX ± 0.005
Angles	± 1 Degrees



SECTION A-A

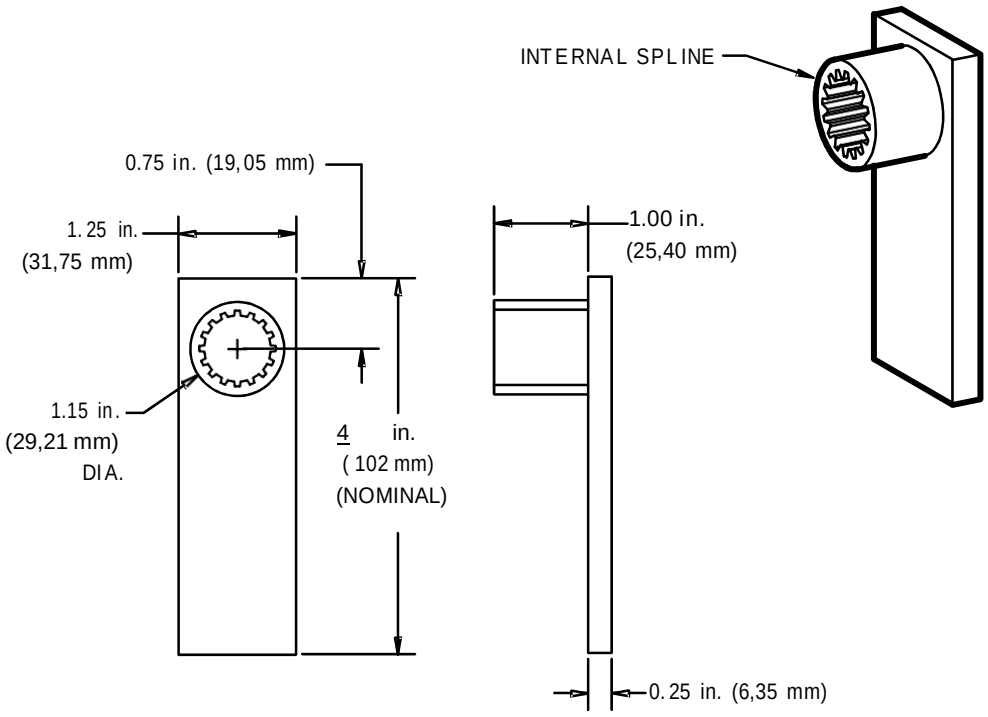
Figure 9014 - Dampener Plate Driver

O. Spline Wrench

NOTE: For internal spline details - Reference Table 3 – Mounting Flange and Drive Shaft Specifications in DESCRIPTION AND OPERATION.

Harden to Rockwell C 55-60.

Material:	O1 tool steel or equivalent
Stock Size:	1.0 inch diameter, 4.00 X 1.25 inch length (25.4 dia., 101,6 X 31,75 mm)
Tolerances on:	Decimals 0.XX ±.01, 0.XXX ± 0.005
Angles:	± 5 Degrees
No. Teeth:	12
Diametral Pitch:	20 / 40
Pitch Diameter:	0.6000 inch (15,24 mm)
Pressure Angle:	30°



12 TOOTH SPLINES

Internal Involute Spline Data Fillet Root Side Fit	inch	mm
Number of Teeth	12	
Diametral Pitch	20/40	
Pressure Angle	30 DEG.	
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	1,854
Pin Diameter	0.0720	1,829
Between three .072 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 DEG.	
Pitch Diameter	0.8000	20,320
Minor Diameter (min.)	0.7270	18,466
Major Diameter (min.)	0.8640	21,946
Chord Space (min.)	0.0728	1,849
Pin Diameter	0.0720	1,829
Between three .072 Pins (min.)	0.7096	18,024

Figure 9015 - Spline Wrench

P. PlusNut® Fastener Header

NOTE: For rivet nut replacement - Reference REPAIR.

P/N: C1000-832

Vendor Cage Code (V0ZVN9)

Reference ILLUSTRATED PARTS LIST for Vendor Cage Code name and address for tool procurement.

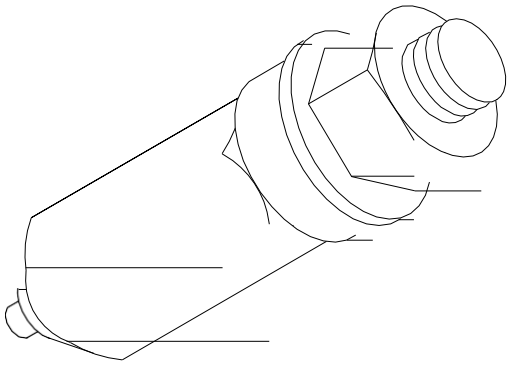


Figure 9016 - Plusnut® Fastener Header

Q. Hammer, Slide

(1) Tolerances on decimals 0.XX ± 0.01 inch (0,25 mm), 0.XXX ± 0.005 inch (0,127 mm). The machine cut ends to be parallel within ± 0.001 inch (0,025 mm). The machine cut ends must be square with sidewall within ± 0.05 degree. Angles ± 2°0'. The material is 1040 Steel.

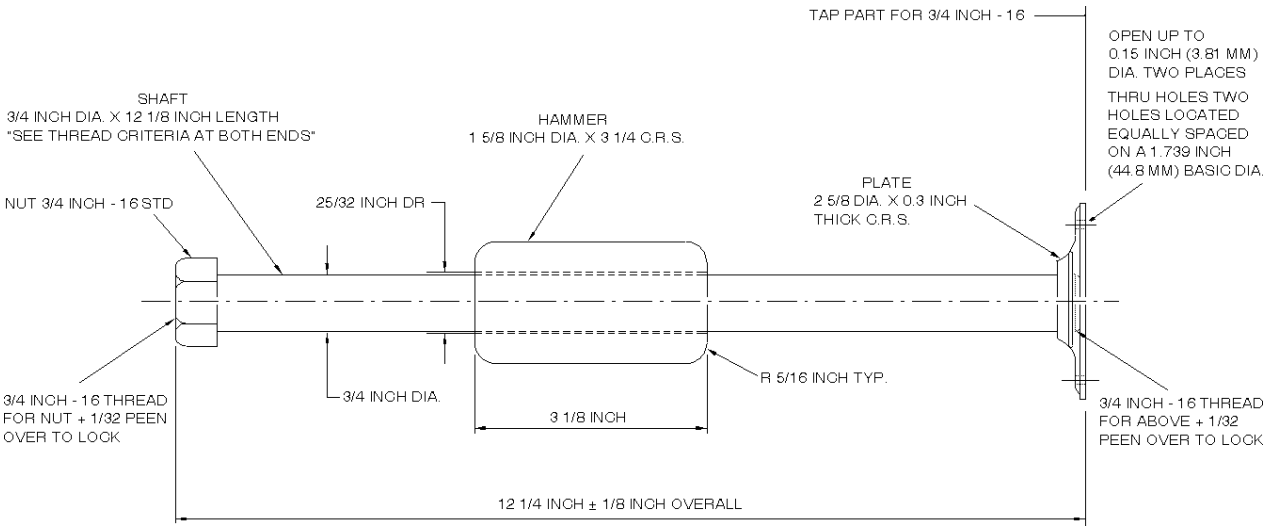


Figure 9017 - Hammer, Slide

THIS PAGE INTENTIONALLY LEFT BLANK

SPECIAL PROCEDURES

1. Introduction

This section is unassigned.

THIS PAGE INTENTIONALLY LEFT BLANK

REMOVAL

1. Introduction

This section is unassigned.

THIS PAGE INTENTIONALLY LEFT BLANK

INSTALLATION

1. Introduction

This section is unassigned.

THIS PAGE INTENTIONALLY LEFT BLANK

SERVICING

1. Introduction

This section is unassigned.

THIS PAGE INTENTIONALLY LEFT BLANK

STORAGE

1. Storage

Materials recommended for packaging rotating machines containing grease-lubricated bearings for storage or shipment are listed below in Table 15001.

Description	Specification	Quantity
Bag, waterproof, vapor-proof	Commercially available. Bag must totally enclose instructions for installation and then be sealed.	1
Bag, waterproof, vapor-proof	Kraft-foil or suitable equivalent. Bag must totally enclose generator and then be sealed.	1
Tag	Commercially available	1 (domestic) 2 (overseas)
Grease	MIL-PRF-81322	AR
Chemically Neutral Protective Paper	Commercially available	AR
Desiccant	MIL-D-3464E Type II, Kraft bag, 4 unit bag size Englehard Corporation Desiccate 25 or equivalent	AR
Polyethylene (Plastic) Wrap	Commercially available	AR
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam (Safran Power's recommended method: 3 in. (76,2 mm) thick minimum expanded foam surrounding machine on all sides).	Commercially available	AR
Small Plastic Bag	Commercially available	AR
O-Ring (for applicable models)	Check Illustrated Parts List for current p/n	1 each
Cardboard Tubing	Commercially available	AR
Tape - waterproof, pressure sensitive	Commercially available	AR

Table 15001 - Packaging Material

Description	Specification	Quantity
Original shipping box or alternate	PPP-B-636 (or equivalent)	1 each
Box - WC5 overseas shipping container	PPP-B-636 (or equivalent)	1 each

Table 15001 - Packaging Material (Continued)

A. General Information

CAUTION: IF MACHINE STORAGE TIME IS MORE THAN 24 MONTHS WITH NO USE, IT IS RECOMMENDED THAT ITS BEARINGS BE REPLACED. IT MUST THEN BE RE-TESTED ACCORDING TO TESTING AND FAULT ISOLATION SECTION BEFORE BEING PLACED INTO SERVICE.

(1) Unit must have successfully completed tests specified in TESTING AND FAULT ISOLATION section of this manual before preparing unit for shipment or storage.

(2) Verify that safety wire are in place.

(3) Record following information to tag(s):

- Model Number
- Serial Number
- Mod Status
- Test Date (PASSED)
- Packing date

(4) Use packaging materials as specified in Table 15001.

B. Documentation

Include all applicable documentation with unit:

- Testing Records
- Repair Reports
- Final Inspection/Check Records
- Packing List and Certificate of Conformance

C. Domestic Packaging

(1) If machine includes drive shaft with O-ring/oil sealing provision, place O-ring into a small plastic bag, include instructions to lubricate and install the O-ring on drive end of shaft prior to installation on aircraft, seal bag, and attach it to the machine.

(2) Apply lubricating grease to drive spline according to MIL-PRF-81322 and wrap it in protective paper according to MIL-B-121A, Grade A, Type II.

(3) Place unit and desiccant into a waterproof and vapor-proof heat-seal bag and partially heat-seal it while forcing as much air as possible from bag.

(4) Insert vacuum tube into bag to draw remaining air out of bag.

(5) Withdraw vacuum tube quickly and complete heat-sealing of bag.

(6) Using machine's original shipping container if possible, place bagged machine into box surrounded with a minimum of three (3) inch thick shock absorbing, cushioning material on all six sides.

(7) Securely and completely seal all flapped openings of box with tape.

(8) Tape tag to exterior surface of box. Make sure all information is visible.

D. Overseas Shipment On Surface Vessels

(1) Accomplish domestic packaging of machine in accordance with Para. C.

(2) Place domestically packaged generator or starter-generator into WC5 shipping container.

(3) Securely and completely, seal all flapped openings of shipping container with tape.

(4) Tape tag to exterior surface of shipping container. Make sure all information is visible.

THIS PAGE INTENTIONALLY LEFT BLANK

REWORK

1. Introduction

This section is unassigned.

THIS PAGE INTENTIONALLY LEFT BLANK

ILLUSTRATED PARTS LIST

1. Introduction

This section provides a listing of assemblies and detail parts for the 23069 Series of DC Starter-Generators. Each list is arranged in disassembly sequence, but attaching parts which are listed immediately after the parts they attach.

All replacement parts are manufactured or source-controlled by Safran Power, USA with the exception of those parts assigned a military standard (MIL, MS, etc.), a National Aerospace Standard (NAS), Army Navy (AN) standard, or an industry standard (ANSI, ASME, ISO, etc.) part number.

WARNING: 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 Spares Portal.

2. Arrangement of Parts List

A. Figure and Item Number

The figure number indicates the figure where the part is illustrated. Each item number corresponds to a part illustrated in the applicable figure. Several item numbers can have a letter following a number (e.g. 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 NUMBER column of the Detailed Parts List gives the part number for each detail part. Use the part number as shown in this column to sequence parts unless specified differently in the NOMENCLATURE column. If the part number contains the characters that do not agree with the Air Transport Association (ATA) rules, differences are shown as follows:

(1) When the part number contains the characters that are different from the Air Transport Association (ATA) specification rules, differences are shown in the NOMENCLATURE column.

(2) When the part number is more than 15 characters, the part number shown in the IPL as follows:

PART NUMBER	NOMENCLATURE
M55302-60-20C10	. WASHER (M55302-60-20C10 is reference for complete P/N M55302-60-20C100)

(3) When the part number contains a dash (-) between a number and a letter, the part number shown in the IPL as follows:

PART NUMBER	NOMENCLATURE
BACR12BM223	. BACKUP RING (BACR12BM223 is reference for complete P/N BACR12BM-223)

(4) When the part number contains a slash (/), the part number shown in the IPL as follows:

PART NUMBER	NOMENCLATURE
M25988-1-009	. PACKING (M25988-1-009 is reference for complete P/N M25988/1-009)

C. Nomenclature

The proper name and type of each part is provided in this column. The description of each item is indented by columns to indicate the relationship to the next higher assembly. The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

1 2 3 4 5
Assembly, level 1, no bullets
  Detail Parts for Assembly, level 2, 1 bullet
    Sub-Assembly, level 3, 2 bullets
      Attaching Parts for Sub-Assembly, level 4, 3 bullets
        Detail Parts for Sub-Assembly, level 5, 4 bullets

The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. A list of the terms used to show interchangeability and their definition is as follows:

Term	Parts List Abbreviation	Definition
Alternate	ALT.	The part fully agrees with the functional and structural specifications, but is different in external dimensions, connection, installation and/or assembly. Rework or possible modifications can be necessary.
Modification	MOD	Modification (Mod) status details information about the effectivity of parts in regard to upgrades and modifications. Alpha variants (A through Y) (but I, O, Q, S, X and Z) are assigned to existing model numbers when necessary. Includes details of SB applicability.
Superseded	SUPSD BY	The 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	The part number listed is discontinued and must be replaced by the new part number. The original part can 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.

D. Effect Code

Part variations between generator models are indicated by letter symbols placed in this column. When parts are used on all models, the column is left blank.

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”.

F. Vendors

In the case of an item supplied by a vendor and not listed under the prime manufacturer's part number, a vendor code is prefixed by the capital letter V appearing in the nomenclature column. This code number designates the original manufacturer, and is in accordance with Cataloging Hand Books H4-1, H4-2, and H4-3. The Customer Support division in your region is to be contacted for parts dispatch.

The following is an index of the vendors names, addresses, and cage codes as referenced in this CMM.

VENDOR CODE	NAME AND ADDRESS
80205	National Aircraft Standard (prefix NAS)
81349	Military Specifications (prefix M)
88044	Army/Navy Standard (prefix AN)
96906	Military Standard (prefix MS)
3CPE0	Safran Power, USA 8380 Darrow Road Twinsburg, OH 44087 USA

Table 10001 - Vendor Name, Address and CAGE Code

Spec 200/2000, automated ordering users, refer to the Exclusive Distributors Section in the front of this manual when ordering parts identified with V3CPE0, Safran Power, USA for proper region to contact.

Note 1: Models 23069-013, -009, -015 and -025 are not supplied with a QAD kit. QAD kit 23069-500 is required for installation and can be ordered separately.

Note 2: Model 23069-013-1 is not supplied with a QAD kit. QAD kit 23069-501 is requiredfor installation and can be ordered separately.

Note 3: Model 23069-015 is not supplied with a QAD kit. QAD kits 23069-502 and 23069-509 are application specific. QAD kit is required for installation and can be ordered separately.

Note 4: DELETED

Note 5: DELETED

Note 6: Model 23069-020 is not supplied with a QAD kit. QAD kit is required for installation and furnished by the customer.

Note 7: Model 23069-020-1 and -024 is not supplied with a QAD kit. QAD kit 23069-507is required for installation and can be ordered separately.

Note 8: Model 23069-016-1 is not supplied with an air inlet. Air inlet's 23069-1430 and 23069-1740 are application specific. Air inlet is required for installation and can be ordered separately.

Note 9: Model 23069-015-1 = "D" Mod status with armature 23069-1503 and drive end bearing support assembly, 23069-1551. Both parts must be installed as a set.

Note 10: Model 23069-015-1 = "K" Mod status with armature 23069-1500 and drive end bearing support assembly 23069-1552.
Note: If starter-generator has armature 23069-1503 and drive end bearing support assembly 23069-1552, the Mod status is "J."

Note 11: Models 23069-016-1 and -014 change from bearing 03-6009-19 with no Mod status to bearing 03-6009-23 with Mod status: -009 = "B" and -014 = "D." Mod status "A" was never incorporated into production units.

Note 12: Baffle disc 23032-1143 is changed from quantity of two to quantity of one. Spacer 23032-1144 replaces one of the two baffle discs.

Note 13: Protrusion dimensions for Mounting Adapter Pins are as follows:
P/N 02-4412-03 = 0.12 inch, P/N 02-4412-06 = 0.15 inch
P/N 05-180108 = 0.15 to 0.19 inch

Note 14: Electrical contact brushes P/N 23088-1321 have been superseded by P/N 30300-1413 in models 23069-020-1 and 23069-021. For removal of MOD C frommodel 23069-020-1, reference SB 23069-020-1-24-01. For removal of MOD B frommodel 23069-021, reference SB 23069-021-24-02 and SB 23069-0XX-24-05.
MOD B and MOD C must be removed.

Note 15: New production models do not get an FAA/PMA label applied. This was when production was located in the USA. If the unit has an FAA/PMA label and it needs replaced, then replace. Otherwise, if no label is installed for these units, do not install one because they are not FAA/PMA certified.

Note 16: The part number 23069-359 (ADE Bearing and Brush Support Assembly) has been replaced by the 23069-355 w/some build standard.

3. Numerical Index

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
AN3-11A		10004	45B	2
		10004	-45E	2
AN3-12A		10004	45C	2
		10004	-45F	2
AN3-5A		10004	60	1
AN3-7A		10002	25	8
AN502-10-14		10001	100	1
		10001	-100B	1
AN502-10-18		10001	-100A	1
AN960-10L		10002	35	8
		10004	55	2
AN960-416		10001	125	1
AN960-4L		10003	35	6
		10003	-35A	4
AN960-8		10001	75	4
AN960B10		10004	-30A	2
AN960B616		10004	-15F	2
AN960C10		10004	30	2
		10004	-30B	2
AN960C10L		10004	70	1
		10004	-55A	2
		10004	-55B	2
AN960C616		10004	-15A	3
		10004	-15B	3
		10004	15D	2
		10004	-15E	2
		10004	-15G	2
AN960C616L		10004	15	3
		10004	-15C	2
G25-157		10004	50A	2
G25-171		10004	55C	2
M83248-1-113		10001	-135A	1
		10001	-135B	1
M83248-1-210		10001	-135C	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
MS16624-1066		10001	160	1
MS16998-31		10001	205A	8
MS16998-32		10004	-45D	2
MS20364B624C		10004	-10B	RF
MS20426AD3-5		10002	55	2
MS21042-3		10004	25	2
MS21042-4		10001	-120A	1
		10001	-120B	1
MS21042-6		10004	10	3
		10004	10A	2
		10004	-10C	RF
MS21045-4		10001	-15A	1
MS21045L4		10001	15	1
MS21209C0815		10002	10	4
		10003	-15	2
MS21318-13		10001	-35A	4
		10001	-35B	4
MS21318-14		10001	-35	4
MS21318-15		10003	30	6
		10003	-30A	4
MS24693S47		10001	205	3
MS29561-113		10001	135	1
MS3112E8-3P		10001	185	1
MS3367-4-9		10002	-65	RF
MS35206-227		10001	-181	4
MS35206-241		10001	-70D	4
MS35206-242		10001	-225A	2
MS35206-243		10001	-70E	4
		10001	-70G	4
		10001	-70K	RF
MS35206-246		10001	-70F	4
		10001	-70H	4
		10001	-70J	4
MS35265-19		10001	195	4
MS35265-41		10001	70	4
MS35265-42		10001	225	2

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
MS35265-45		10001	85	4
		10001	260	4
		10001	-260A	4
		10001	-70A	4
		10001	-70B	4
MS35266-64		10004	45	2
MS35266-65		10004	45A	2
MS35338-41		10001	-182	4
MS35338-42		10001	175	8
		10001	265	4
MS35338-43		10001	210	8
		10004	50	2
		10004	65	1
MS35338-46		10004	15H	2
		10004	-15J	2
MS35489-1		10001	235	1
NAS1130-06-15		10002	10A	4
NAS1130-08L15D		10002	12	4
NAS1149C0332R		10004	-70A	1
NAS1149C0363R		10004	30C	2
NAS1149C0663R		10004	20	2
NAS1149F0332P		10002	-35A	8
NAS1189-06P12L		10001	60	2
		10001	-60A	2
NAS1189-06P14L		10001	-60B	2
NAS1329H08K120L		10002	15	4
NAS1329H3K130L		10001	-101B	1
NAS1329H3K80L		10001	-101A	1
NAS1352-08-14P		10001	-170A	8
		10001	-170B	8
		10001	-170D	6
NAS1801-08-11		10001	-70L	4
NAS620-10L		10001	215	8
NAS620-8		10001	90	RF
		10001	-75A	4
		10001	-75B	4

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
02-2001-27		10002	40	8
02-4007-02		10001	110	4
02-4022-02		10001	-260B	4
02-4082-07		10004	35	2
		10004	-35B	2
02-4089-07		10004	-35C	2
02-4107-01		10001	120	RF
02-4160-03		10004	10D	2
		10004	-10E	2
02-4231-03		10001	240	1
		10001	-240A	1
02-4250-13		10001	245	AR
		10001	-245A	AR
02-4250-14		10001	-245B	AR
		10001	-245C	AR
02-4250-15		10001	-245D	AR
		10001	-245E	AR
02-4412-03		10001	26	3
		10001	-26B	3
02-4412-06		10001	-26A	3
		10001	-26C	3
02-5600-05		10001	150	RF
		10001	-150B	RF
02-5600-11		10001	-150C	RF
		10001	-150F	RF
02-5600-13		10001	-150A	1
		10001	-150E	1
02-5600-15		10001	-150D	1
		10001	-150G	1
		10001	-150H	1
03-6009-07		10001	270	RF
		10001	-270A	2
		10001	-270E	RF
03-6009-18		10001	-270B	2
		10001	-270F	2
		10001	-270J	RF

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
03-6009-19		10001	-270C	2
03-6009-23		10001	-270D	2
		10001	-270H	2
		10001	-270K	2
05-180108		10001	-26D	3
05-321002		10001	-101	1
05-340209		10001	-110A	4
		10001	-110B	4
05-341303		10001	-172	2
05-341306		10001	170	RF
		10001	-170C	RF
05-346370		10001	-70C	4
05-360065		10004	-35A	2
05-370232		10001	180	8
05-374094		10002	30	8
05-374095		10002	-30A	8
05-652015		10004	-31	2
06-123301		10001	-52	1
06-200001		10001	-50	1
06-201020		10001	-45	1
06-201100		10001	-40	1
06-209285		10001	-30	1
06-2301-10		10001	-30A	1
15-014021		10004	-32	AR
23032-1143		10001	-276	1
		10001	275	1
		10001	-275A	1
23032-1144		10001	280	1
		10001	-280A	1
23032-1509		10004	40A	1
		10004	-40B	1
23032-1901		10001	140	1
23032-1910		10001	145	1
23032-2711		10001	-155A	1
		10001	-155B	1
		10001	-155D	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23032-2802		10001	20	1
23032-3210		10001	-155C	1
23032-3212		10001	-155E	1
23033-2840		10002	70	8
23048-1125		10001	95	1
		10001	-95A	1
23048-1127		10001	-95B	1
		10001	-95D	1
		10001	-95H	1
		10001	-95L	1
23065-1772		10001	115	1
23065-1872		10001	-115A	1
		10001	-115C	1
23065-1873		10001	-115B	1
		10001	-115D	1
23069-1235		10004	-40D	1
23069-1238		10004	40E	1
		10004	-40F	1
23069-1241		10001	-55A	1
23069-1371		10001	155	1
23072-1128		10001	10	1
23072-1280		10001	230	1
23072-1281		10001	-230A	1
23072-1313		10001	190	1
23072-1400		10001	-230B	1
		10001	-230C	1
23075-1193		10002	42	1
23075-1203		10002	20	4
23075-1230		10002	50	1
23075-1400		10002	45	1
23075-351		10001	165	1
23075-353		10001	-165A	1
23076-1200		10001	-55B	1
23076-1200-1		10001	-55C	1
23079-1060		10001	55	1
23080-332		10002	-60C	4
23081-1080		10001	255	1

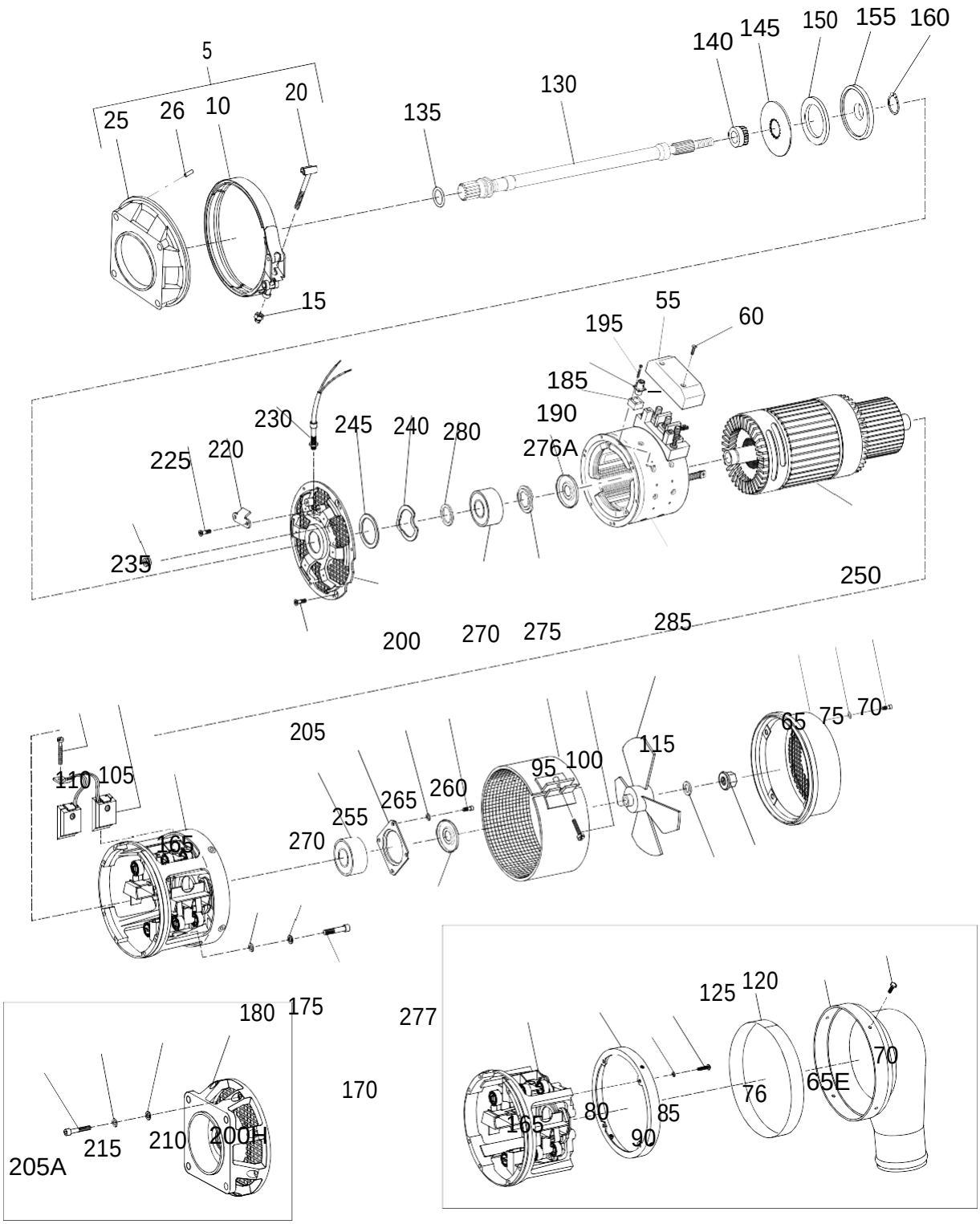
PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23081-1312		10004	40G	1
23069-013		10001	-1	RF
23069-013-1		10001	-1A	RF
23069-015		10001	-1B	RF
23069-015-1		10001	-1C	RF
23069-16		10001	-1D	RF
23069-016-1		10001	-1F	RF
23069-020		10001	-1G	RF
23069-020-1		10001	-1H	RF
23069-021		10001	-1J	RF
23069-024		10001	-1K	RF
23069-025		10001	-1L	RF
23069-1020		10001	25	1
23069-1060		10002	5	1
23069-1070		10001	250	1
		10001	-250D	1
23069-1080		10001	285	1
		10001	-285C	1
		10004	-1	RF
23069-1081		10001	-285D	1
		10004	-1A	RF
23069-1140		10001	76	1
23069-1150		10001	65	1
23069-1340		10004	-40	1
23069-1350		10001	130	1
23069-1351		10001	-130B	1
		10001	-130E	1
23069-1354		10001	-130D	1
23069-1355		10001	-130A	1
		10001	-130J	1
23069-1356		10001	-130C	1
23069-1357		10001	-130F	1
		10001	-130G	1
23069-1358		10001	-130L	1
23069-1370		10004	40C	1
23069-1380		10001	-285A	1
		10001	-285E	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
		10004	-1B	RF
23069-1382		10001	-285B	1
		10001	-285F	1
		10001	-285M	1
		10004	-1C	RF
23069-1400		10001	-25B	1
23069-1405		10001	-25D	1
23069-1420		10001	80	RF
23069-1430		10001	-65A	1
23069-1450		10001	-25C	1
23069-1480		10003	-5D	1
23069-1481		10003	-5E	1
23069-1482		10003	5F	1
23069-1500		10001	-250A	1
		10001	-250E	1
		10001	-250G	1
23069-1503		10001	-250B	1
		10001	-250C	1
		10001	-250F	1
		10001	-250H	1
23069-1530		10001	-285G	1
		10004	-1D	RF
23069-1532		10001	-285J	1
		10004	-1F	RF
23069-1535		10001	-285K	1
		10004	-1E	RF
23069-1536		10001	-285L	1
		10004	-1G	RF
23069-1540		10003	-25A	1
23069-1541		10003	-25B	1
		10003	-25C	1
23069-1550		10001	-200F	1
		10003	-1D	RF
23069-1551		10001	-200G	1
23069-1552		10001	200H	1
		10001	-200J	1
		10003	-1E	RF

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23069-1570		10001	-155F	1
		10001	-155G	1
23069-1630		10001	-95J	1
23069-1690		10001	-130K	1
23069-1740		10001	-65C	1
23069-1743		10001	65D	1
23069-1810		10002	5A	1
23069-1812		10002	-5B	1
23069-1830		10001	-25E	1
23069-350		10001	-165B	1
		10001	-165D	1
		10001	-165H	1
		10001	-165M	1
		10002	-1	RF
23069-355		10001	-165E	1
		10001	-165G	1
		10001	-165P	1
		10002	-1A	RF
23069-356		10001	-165C	1
		10001	-165J	1
		10001	-165N	1
		10002	-1B	RF
23069-359		10001	-165F	1
		10002	-1D	RF
23069-360		10002	60	4
23069-363		10002	-60A	4
		10002	-60D	4
23069-366		10002	-60B	4
		10002	-60E	4
		10002	-60G	4
23069-500		10001	5	1
23069-501		10001	-5A	1
23069-502		10001	-5B	1
23069-507		10001	-5E	1
23069-509		10001	-5C	1
23088-1020		10003	-5	1
23088-1021		10003	-5A	1

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
23088-1022		10003	5B	1
23088-1023		10003	5C	1
23088-1070		10001	200	1
		10001	-200D	1
		10003	-1	RF
23088-1071		10001	-200B	1
		10003	-1A	RF
23088-1072		10001	-200A	1
		10001	-200E	1
		10001	-200K	1
		10003	-1B	RF
23088-1073		10001	-200C	1
		10003	-1C	RF
23088-1140		10003	25	1
23088-1150		10001	220	1
23088-1310		10001	-95C	1
		10001	-95E	1
		10001	-95F	1
		10001	-95K	1
23088-1320		10001	-105M	RF
23088-1321		10001	-105J	4
		10001	-105F	4
		10001	-105G	RF
		10001	-105N	RF
23088-1340		10001	276A	1
23088-1342		10001	277	1
23088-1346		10001	-276B	1
23088-1350		10001	-115E	1
23093-1304		10001	-105R	4
23093-1301		10001	-105S	4
		10001	-105T	4
30059-1029		10004	75	1
30300-1410		10001	105	4
		10001	-105A	RF
30300-1413		10001	-105K	4
		10001	-105D	4

PART NUMBER	AIRLINE STOCK NUMBER	FIGURE	ITEM	TOTAL REQ'D
		10001	-105B	4
		10001	-105C	4
		10001	-105E	RF
		10001	-105L	RF
		10001	-105Q	4
		10001	-105H	4
		10001	-105P	4



Component Maintenance Manual with Illustrated Parts List
DC Starter-Generator, 23069 Series
Figure 10001 - DC Starter-Generator Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-1	23069-013	STARTER-GENERATOR, DC.	A	RF
-1A	23069-013-1	STARTER-GENERATOR, DC.	B	RF
-1B	23069-015	STARTER-GENERATOR, DC.	C	RF
-1C	23069-015-1	STARTER-GENERATOR, DC.	D	RF
-1D	23069-16	STARTER-GENERATOR, DC.	E	RF
-1E	DELETED			
-1F	23069-016-1	STARTER-GENERATOR, DC.	H	RF
-1G	23069-020	STARTER-GENERATOR, DC. . . . . (See NOTE: 6)	K	RF
-1H	23069-020-1	STARTER-GENERATOR, DC.	L	RF
-1J	23069-021	STARTER-GENERATOR, DC.	M	RF
-1K	23069-024	STARTER-GENERATOR, DC.	N	RF
-1L	23069-025	STARTER-GENERATOR, DC.	P	RF
5	23069-500	• MOUNTING KIT, QAD. . . . . (See NOTE: 1)	A,H,M,P	1
-5A	23069-501	• MOUNTING KIT, QAD. . . . . (See NOTE: 2)	B	1
-5B	23069-502	• MOUNTING KIT, QAD. . . . . ALT: 23069-509 (See NOTE: 3)	C	1
-5C	23069-509	• MOUNTING KIT, QAD. . . . . ALT: 23069-502 (See NOTE: 3)	C	1
-5D	DELETED			
-5E	23069-507	• MOUNTING KIT, QAD. . . . . (See NOTE: 7)	L,N	1
10	23072-1128	• • COUPLING, V-Retainer . . . . . (ATTACHING PARTS)	A,B,C,H, L,M,N,P	1
15	MS21045L4	• • • NUT, Reduced Hex, Self-Locking. (MS21045L4 is reference for complete P/N MS21045-L4) REPLD BY MS21045-4	A,B,C,H, L,M,N,P	1
-15A	MS21045-4	• • • NUT, Reduced Hex, Self-Locking. REPLS MS21045L4	A,B,C,H, L,M,N,P	1
20	23032-2802	• • • T-BOLT. . . . . ---------- * ----------	A,B,C,H, L,M,N,P	1 I
25	23069-1020	• • ADAPTER, Mounting	A,H,M,P	1
-25A	DELETED			
-25B	23069-1400	• • ADAPTER, Mounting	B	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-25C	23069-1450	• • ADAPTER, Mounting . . . . . (Used with 23069-502)	C	1
-25D	23069-1405	• • ADAPTER, Mounting . . . . . (Used with 23069-509)	C	1
-25E	23069-1830	• • ADAPTER, Mounting	L,N	1
26	02-4412-03	• • • PIN, Grooved, Headless, Dowel . REPLD BY 02-4412-06 (See NOTE: 13)	A,B,H,M, P	3
-26A	02-4412-06	• • • PIN, Grooved, Headless, Dowel . REPLS 02-4412-03 (See NOTE: 13)	A,B,H,M, P	3
-26B	02-4412-03	• • • PIN, Grooved, Headless, Dowel . (Used with 23069-502) (See NOTE: 13)	C	3
-26C	02-4412-06	• • • PIN, Grooved, Headless, Dowel . (Used with 23069-509) (See NOTE: 13)	C	3
-26D	05-180108	• • • PIN, Spring, Coiled, Heavy Duty . (See NOTE: 13)	L,N	3
-30	06-209285	• PLATE, ID, Replacement	A,B,C,D, H,K,L,M, N,P	1
-30A	06-2301-10	• PLATE, ID, Replacement . . . . . (Cessna only) (ATTACHING PARTS)	D,E	1
-35	MS21318-14	• SCREW, Drive. . . . . REPLD BY MS21318-13	A,B,D,H, K,L	4
-35A	MS21318-13	• SCREW, Drive. . . . . REPLS MS21318-14	A,B,D,H, K,L	4
-35B	MS21318-13	• SCREW, Drive.	C,E,M,N, P	4
		*		
-40	06-201100	• LABEL, MOD Status . . . . . (Cessna only)	D	1
-45	06-201020	• LABEL, CAUTION.		1
-50	06-200001	• LABEL, Patent.		1
-52	06-123301	• LABEL, FAA-PMA . . . . . (See NOTE: 15)	A,B	1
		Deleted.	L,M	1
55	23079-1060	• COVER, Terminal Block	A,C,K,L, M,N,P	1
-55A	23069-1241	• COVER, Terminal Block	D,E	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-55B	23076-1200	• COVER, Terminal Block . . . . . ALT: 23076-1200-1	H	1
-55C	23076-1200-1	• COVER, Terminal Block . . . . . ALT: 23076-1200 (ATTACHING PARTS)	H	1
60	NAS1189-06P12L	• SCREW.	A,C,K	2
-60A	NAS1189-06P12L	• SCREW. . . . . ALT: 01-200346	L,M,N,P	2
-60B	NAS1189-06P14L	• SCREW.	D,E	2
		*		
65	23069-1150	• COVER, Air, Inlet.	A,C,K	1
-65A	23069-1430	• COVER, Air, Inlet. . . . . See Note 8	B,D,E H	1
-65B	DELETED			
-65C	23069-1740	• COVER, Air, Inlet. . . . . See Note 8	L,M,N,P, H	1
-65D	23069-1740	• COVER, Air, Inlet. . . . . REPLD BY 23069-1743	L,M,N,P	1
65E	23069-1743	• COVER, Air, Inlet. . . . . REPLS 23069-1740 (ATTACHING PARTS)	L,M,N,P	1
70	MS35265-41	• SCREW, Machine . . . . . REPLD BY MS35265-45	A	4
-70A	MS35265-45	• SCREW, Machine . . . . . REPLS MS35265-41	A	4
-70B	MS35265-45	• SCREW, Machine	C,K	4
-70C	05-346370	• SCREW, Pan Head . . . . . REPLD BY MS35206-241	B	4
-70D	MS35206-241	• SCREW, Pan Head . . . . . REPLS 05-346370 REPLD BY MS35206-243	B	4
-70E	MS35206-243	• SCREW, Pan Head . . . . . REPLS MS35206-241 REPLD BY MS35206-246 Pre SB 23069-0XX-24-03	B	4
-70F	MS35206-246	• SCREW, Pan Head . . . . . ALT: MS35206-247 REPLS MS35206-243 Post SB 23069-0XX-24-03	B	4

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-70G	MS35206-243	• SCREW, Pan Head . . . . . REPLD BY MS35206-246	L,M	4
		Pre SB 23069-0XX-24-03		
		Pre SB 23069-015-1-24-05.	D	4
-70H	MS35206-246	• SCREW, Pan Head . . . . . ALT: MS35206-247 REPLS MS35206-243	L,M	4
		Post SB 23069-0XX-24-03		
		Post SB 23069-015-1-24-05	D	4
-70J	MS35206-246	• SCREW, Pan Head . . . . . ALT: MS35206-247	E,N,P	4
-70K	MS35206-243	• SCREW, Pan Head . . . . . SUPSD BY NAS1801-08-11	H	RF
-70L	NAS1801-08-11	• SCREW, Hex Head . . . . . SUPSDS MS35206-243	H	4
75	AN960-8	• WASHER, Flat. . . . . REPLD BY NAS620-8	A	4
-75A	NAS620-8	• WASHER, Flat. . . . . REPLS AN960-8	A	4
-75B	NAS620-8	• WASHER, Flat.	C,K	4
		---------- * ----------		
76	23069-1140	• • GASKET, Rubber.	A,C,K	1
80	23069-1420	• RING, Air Inlet Support . . . . . REPLD BY 23069-1430,	B,H,L,M	RF
		Pre SB 23069-0XX-24-03	D	RF
		REPLD BY 23069-1430, Pre SB 23069-015-1-24-05. . . . . (ATTACHING PARTS)		
85	MS35265-45	• • SCREW, Machine Drilled, Fillister . . Head REPLD BY 23069-1430,	B,H,L,M	4
		Pre SB 23069-0XX-24-03 . . . . . REPLD BY 23069-1430,	D	4
		Pre SB 23069-015-1-24-05		
90	NAS620-8	• WASHER, Flat. . . . . REPLD BY 23069-1430,	B,H,L,M	RF
		Pre SB 23069-0XX-24-03	D	RF
		REPLD BY 23069-1430, Pre SB 23069-015-1-24-05.		
		---------- * ----------		
95	23048-1125	• COVER, Brush Access	A,C,K	1
-95A	23048-1125	• COVER, Brush Access . . . . . REPLD BY 23048-1127	B	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-95B	23048-1127	• COVER, Brush Access . . . . . REPLS 23048-1125 REPLD BY 23088-1310	B	1
-95C	23088-1310	• COVER, Brush Access . . . . . REPLS 23048-1127	B	1
-95D	23048-1127	• COVER, Brush Access . . . . . REPLD BY 23088-1310	D	1
-95E	23088-1310	• COVER, Brush Access . . . . . REPLS 23048-1127	D	1
-95F	23088-1310	• COVER, Brush Access	E	1
-95G	DELETED			
-95H	23048-1127	• COVER, Brush Access . . . . . REPLD BY 23069-1630	H	1
-95J	23069-1630	• COVER, Brush Access . . . . . REPLS 23048-1127 REPLD BY 23088-1310	H	1
-95K	23088-1310	• COVER, Brush Access . . . . . REPLS 23069-1630	H	1
-95L	23048-1127	• COVER, Brush Access . . . . . (ATTACHING PARTS)	L,M,N,P	1
100	AN502-10-14	• • SCREW, Machine Drilled, FH . . . . . REPLD BY AN502-10-18	A,C,K,L, M,N,P	1
-100A	AN502-10-18	• • SCREW, Machine Drilled, FH . . . . . REPLS AN502-10-14	A,C,K,L, M,N,P	1
-100B	AN502-10-14	• • SCREW, Machine Drilled, FH	B,D,E,H	1
-101	05-321002	• • NUT, Self-locking . . . . . REPLD BY NAS1329H3K80L		1
-101A	NAS1329H3K80L	• • RIVNUT® . . . . . REPLS 05-321002 REPLD BY NAS1329H3K130L		1
-101B	NAS1329H3K130L	• • RIVNUT® . . . . . ALT: 01-200376 REPLS NAS1329H3K80L		1
		*		
105	30300-1410	• BRUSH, Electrical Contact . . . . . SUPSD BY 23093-1304 SB 23069-013-1-24-01	B	RF
-105A	30300-1410	• BRUSH, Electrical Contact . . . . . SUPSD BY 30300-1413	A,C,K	RF
-105B	30300-1413	• BRUSH, Electrical Contact .....MOD A SUPSDS 30300-1410 SIL 23069-00X-02	A	4

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-105C	30300-1413	• BRUSH, Electrical Contact .....MOD A SUPSDS 30300-1410	C	4
-105D	30300-1413	• BRUSH, Electrical Contact . . . . . . SUPSDS 30300-1410	K	4
-105E	30300-1413	• BRUSH, Electrical Contact . . . . . . SUPSD BY 23088-1321	D,L	RF
-105F	23088-1321	• BRUSH, Electrical Contact .....MOD F SUPSDS 30300-1413 SB 23069-015-1-24-06	D	4
-105G	23088-1321	• BRUSH, Electrical Contact . . . MOD C SUPSDS 30300-1413 (See Note 14) SUPSD BY 23093-1301 SB 23069-0XX-24-07	L	RF
-105H	30300-1413	• BRUSH, Electrical Contact . . . . . . SUPSDS 23088-1321 SB 23069-020-1-24-01 (See Note 14) SUPSD BY 23093-1301 SB 23069-0XX-24-07	L	RF
-105J	23088-1321	• BRUSH, Electrical Contact	E	4
-105K	30300-1413	• BRUSH, Electrical Contact	H	4
-105L	30300-1413	• BRUSH, Electrical Contact . . . . . . SUPSD BY 23088-1320	M	RF
-105M	23088-1320	• BRUSH, Electrical Contact . . . . . . SUPSDS 30300-1413 SUPSD BY 23088-1321 SB 23069-021-24-01	M	RF
-105N	23088-1321	• BRUSH, Electrical Contact .....MOD B SUPSDS 23088-1320 (See Note 14) SUPSD BY 23093-1301 SB 23069-0XX-24-07	M	RF
-105P	30300-1413	• BRUSH, Electrical Contact . . . . . . SUPSDS 23088-1321 SB 23069-021-24-02 or SB 23069-0XX-24-05 (See Note 14) SUPSD BY 23093-1301 SB 23069-0XX-24-07	M	RF
-105Q	30300-1413	• BRUSH, Electrical Contact . . . . . . SB 23069-0XX-24-05 SUPSD BY 23093-1301 SB 23069-0XX-24-07	N,P	RF

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-105R	23093-1304	• BRUSH, Electrical Contact . . . MOD D SUPSDS 30300-1410 SB 23069-013-1-24-01	B	4
-105S	23093-1301	• BRUSH, Electrical Contact .....MOD E SUPSDS 23088-1321 and 30300-1413 SB 23069-0XX-24-07.	L, M	4
-105T	23093-1301	• BRUSH, Electrical Contact .....MOD A SUPSDS 30300-1413 SB 23069-0XX-24-07.	N, P	4
		(ATTACHING PARTS)		
110	02-4007-02	• SCREW, Machine . . . . . . REPLD BY 05-340209	A,B,D,H, K,L,M	4
-110A	05-340209	• SCREW, Pan Head . . . . . . REPLS 02-4007-02	A,B,D,H, K,L,M	4
-110B	05-340209	• SCREW, Pan Head	C,E,N,P	4
		*		
115	23065-1772	• FAN, Axial . . . . . . REPLD BY 23065-1872	A	1
-115A	23065-1872	• FAN, Axial . . . . . . REPLS 23065-1772	A	1
-115B	23065-1873	• FAN, Axial	B,H,L,M, N,P	1
-115C	23065-1872	• FAN, Axial	C,K	1
-115D	23065-1873	• FAN, Axial . . . . . . REPLD BY 23088-1350 Pre SB 23069-015-1-24-10.	D,E	1
-115E	23088-1350	• FAN, Axial		
		REPLS 23065-1873(MOD L) Post SB 23069-015-1-24-10	D	1
		REPLS 23065-1873.(MOD A) Post SB 23069-015-1-24-10	E	1
		(ATTACHING PARTS)		
120	02-4107-01	• NUT, Reduced Hex, Self-Locking . . . . SUPSD BY MS21042-4	A,B,D,H, K,L,M	RF
-120A	MS21042-4	• NUT, Reduced Hex, Self-Locking . . . . SUPSDS 02-4107-01	A,B,D,H, K,L,M	1
-120B	MS21042-4	• NUT, Reduced Hex, Self-Locking	C,E,N,P	1
125	AN960-416	• WASHER, Flat.		1
		*		
130	23069-1350	• SHAFT, Drive. . . . . . REPLD BY 23069-1355	A	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-130A	23069-1355	• SHAFT, Drive. . . . . REPLS 23069-1350	A	1
-130B	23069-1351	• SHAFT, Drive. . . . . REPLD BY 23069-1356	B	1
-130C	23069-1356	• SHAFT, Drive. . . . . REPLS 23069-1351	B	1
-130D	23069-1354	• SHAFT, Drive.	C	1
-130E	23069-1351	• SHAFT, Drive. . . . . REPLD BY 23069-1357	D	1
-130F	23069-1357	• SHAFT, Drive. . . . . REPLS 23069-1351	D	1
-130G	23069-1357	• SHAFT, Drive.	E	1
-130H	DELETED			
-130J	23069-1355	• SHAFT, Drive.	H,M,P	1
-130K	23069-1690	• SHAFT, Drive.	K	1
-130L	23069-1358	• SHAFT, Drive.	L,N	1
135	MS29561-113	• O-RING . . . . . REPLD BY M83248-1-113	A,B	1
-135A	M83248-1-113	• O-RING . . . . . (M83248-1-113 is reference for complete P/N M83248/1-113) REPLS MS29561-113	A,B	1
-135B	M83248-1-113	• O-RING . . . . . (M83248-1-113 is reference for complete P/N M83248/1-113)	D,E,H,L, M,N,P	1
-135C	M83248-1-210	• O-RING . . . . . (M83248-1-210 is reference for complete P/N M83248/1-210)	K	1
140	23032-1901	• HUB, Dampener		1
145	23032-1910	• PLATE, Dampener		1
150	02-5600-05	• RING, Friction . . . . . **WARNING; CONTAINS ASBESTOS** SUPSD BY 02-5600-13	A,K	RF
-150A	02-5600-13	• RING, Friction . . . . . SUPSDS 02-5600-05	A,K	1
-150B	02-5600-05	• RING, Friction . . . . . **WARNING; CONTAINS ASBESTOS** SUPSD BY 02-5600-11	B	RF
-150C	02-5600-11	• RING, Friction . . . . . SUPSDS 02-5600-05 SUPSD BY 02-5600-15	B	RF

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-150D	02-5600-15	• RING, Friction . . . . . SUPSDS 02-5600-11	B	1
-150E	02-5600-13	• RING, Friction	C,L,M,N, P	1
-150F	02-5600-11	• RING, Friction . . . . . SUPSD BY 02-5600-15	D,H	RF
-150G	02-5600-15	• RING, Friction . . . . . SUPSDS 02-5600-11	D,H	1
-150H	02-5600-15	• RING, Friction	E	1
155	23069-1371	• BACK PLATE, Dampener . . . . . REPLD BY 23032-2711	A	1
-155A	23032-2711	• BACK PLATE, Dampener . . . . . REPLS 23069-1371	A	1
-155B	23032-2711	• BACK PLATE, Dampener . . . . . REPLD BY 23032-3210	B	1
-155C	23032-3210	• BACK PLATE, Dampener . . . . . REPLS 23032-2711	B	1
-155D	23032-2711	• BACK PLATE, Dampener	C,K,L,M, N,P	1
-155E	23032-3212	• BACK PLATE, Dampener . . . . . REPLD BY 23069-1570	D	1
-155F	23069-1570	• BACK PLATE AND GEAR, Dampener REPLS 23032-3212	D	1
-155G	23069-1570	• BACK PLATE AND GEAR, Dampener	E,H	1
160	MS16624-1066	• RING, Retaining.		1
165	23075-351	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End REPLD BY 23075-353	A	1
-165A	23075-353	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End REPLS 23075-351 REPLD BY 23069-350	A	1
-165B	23069-350	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End REPLS 23075-353 REPLD BY 23069-356 Pre SB 23069-0XX-24-03	A	1
-165C	23069-356	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End REPLS 23069-350..... (MOD C) Post SB 23069-0XX-24-03	A	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-165D	23069-350	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End		
		REPLD BY 23069-355.	B,H,L,M	1
		Pre SB 23069-0XX-24-03		
		REPLD BY 23069-355.	D	1
		Pre SB 23069-015-1-24-05		
-165E	23069-355	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End		
		REPLS 23069-350..... (MOD B)	B,L	1
		Post SB 23069-0XX-24-03		
		REPLS 23069-350..... (MOD C)	H,M	1
		Post SB 23069-0XX-24-03		
		REPLS 23069-350.....(MOD G)	D	1
		Post SB 23069-015-1-24-05		
		REPLD BY 23069-359.	D,E	1
		Pre SB 23069-015-1-24-10		
-165F	23069-359	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End		
		REPLS 23069-355.....(MOD L)	D	1
		Post SB 23069-015-1-24-10		
		REPLS 23069-355..... (MOD A)	E	1
		Post SB 23069-015-1-24-10		
		REPLD BY 23069-355.	D,E	1
-165G	23069-355	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End	D,E	1
		REPLS 23069-359		
-165H	23069-350	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End	C	1
		REPLD BY 23069-356		
-165J	23069-356	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End	C	1
		REPLS 23069-350..... (MOD D)		
-165K	DELETED			
-165L	DELETED			
-165M	23069-350	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End	K	1
		REPLD BY 23069-356		
		Pre SB 23069-0XX-24-03		
-165N	23069-356	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End	K	1
		REPLS 23069-350.(MOD C)		
		Post SB 23069-0XX-24-03		

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-165P	23069-355	• SUPPORT ASSEMBLY, Bearing and . Brush, Anti-Drive End (ATTACHING PARTS)	N,P	1
170	05-341306	• SCREW, Cap SH. . . . . REPLD BY NAS1352-08-14P	A,B,C,D, K,L,M	RF
-170A	NAS1352-08-14P	• SCREW, Cap SH. . . . . REPLS 05-341306 ALT: 01-200892	A,B,C,D, K L,M	8 8
-170B	NAS1352-08-14P	• SCREW, Cap SH. . . . . ALT: 01-200892	E,N,P	8
-170C	05-341306	• SCREW, Cap SH. . . . . REPLD BY NAS1352-08-14P	H	RF
-170D	NAS1352-08-14P	• SCREW, Cap SH. . . . . REPLS 05-341306	H	6
-172	05-341303	• SCREW, Cap SH.	H	2
175	MS35338-42	• WASHER, Spring Lock		8
180	05-370232	• WASHER, Flat.		8
		*		
-181	MS35206-227	• SCREW, Pan Head . . . . . (MOD L) . . . . . (MOD A).	 D E	4
-182	MS35338-41	• WASHER, Lock	D,E	4
185	MS3112E8-3P	• CONNECTOR, Electrical, Three Pin . . .	B,D,E,H	1
190	23072-1313	• SPACER, Electrical . . . . . (ATTACHING PARTS)	B,D,E,H	1
195	MS35265-19	• SCREW, Machine-Drilled, FH	B,D,E,H	4
		*		
200	23088-1070	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLD BY 23088-1072 Pre SB 23069-0XX-24-04	A,K,L,M	1
-200A	23088-1072	• SUPPORT ASSEMBLY, Bearing, ... Drive End		
		REPLS 23088-1070..... (MOD F) Post SB 23069-0XX-24-04	A	1
		REPLS 23088-1070.....(MOD D) Post SB 23069-0XX-24-04	K,M	1
		REPLS 23088-1070..... (MOD A) Post SB 23069-0XX-24-04 SB 23088-107X-24-01	L	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-200B	23088-1071	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLD BY 23088-1073 Pre SB 23088-0XX-24-04	B,H	1
-200C	23088-1073	• SUPPORT ASSEMBLY, Bearing, ... Drive End		
		REPLS 23088-1071.....(MOD C) Post SB 23069-0XX-24-04	B	1
		REPLS 23088-1071.....(MOD D) Post SB 23069-0XX-24-04 SB 23088-107X-24-01	H	1
-200D	23088-1070	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLD BY 23088-1072	C	1
-200E	23088-1072	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLS 23088-1070.....(MOD E) SB 23088-107X-24-01	C	1
-200F	23069-1550	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLD BY 23069-1551 Pre SB 23069-015-1-24-03	D	1
-200G	23069-1551	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLS 23069-1550.....(MOD D) Post SB 23069-015-1-24-03 REPLD BY 23069-1552 Pre SB 23069-015-1-24-07 (See Note 9)	D	1
200H	23069-1552	• SUPPORT ASSEMBLY, Bearing, ... Drive End REPLS 23069-1551.....(MOD J) Post SB 23069-015-1-24-07 (See Note 10)	D	1
-200J	23069-1552	• SUPPORT ASSEMBLY, Bearing, ... Drive End	E	1
-200K	23088-1072	• SUPPORT ASSEMBLY, Bearing, ... Drive End SB 23088-107X-24-01 (ATTACHING PARTS)	N,P	1
205	MS24693S47	• SCREW, Mach, Flat HD . . . . . (MS24693S47 is reference for complete P/N MS24693-S47)	A,B,C, H,K,L,M, N,P	3
205A	MS16998-31	• SCREW, Cap, SH	D,E	8
210	MS35338-43	• WASHER, Spring Lock	D,E	8

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
215	NAS620-10L	• WASHER, Flat.	D,E	8
		*		
220	23088-1150	• GUARD, Speed Pickup . . . . . (ATTACHING PARTS)	B,H	1
225	MS35265-42	• SCREW, Machine	B	2
-225A	MS35206-242	• SCREW, Pan HD.	H	2
		*		
230	23072-1280	• PICKUP, Speed . . . . . REPLD BY 23072-1281 Pre SIL 23072-1400-01	B,D,H	1
-230A	23072-1281	• PICKUP, Speed . . . . . ALT: 23072-1280 REPLS 23072-1280 Pre SIL 23072-1400-01 REPLD BY 23072-1400	B,D,H	1
-230B	23072-1400	• PICKUP, Speed . . . . . REPLS 23072-1281 Post SIL 23072-1400-01	B,D,H	1
-230C	23072-1400	• PICKUP, Speed	E	1
235	MS35489-1	• GROMMET, Rubber	D,E,H	1
240	02-4231-03	• WASHER, Spring Wave		
		Post SB 23069-0XX-24-04	A,B,H,K, L,M	1
		Post SB 23069-015-1-24-07	D	1
-240A	02-4231-03	• WASHER, Spring Wave	C,E,N,P	1
245	02-4250-13	• SHIM, Steel, 0.002” (0,05 mm) thick . .		
		Post SB 23069-0XX-24-04	A,B,H,K, L,M	AR
		Post SB 23069-015-1-24-07	D	AR
-245A	02-4250-13	• SHIM, Steel, 0.002” (0,05 mm) thick . .	C,E,N,P	AR
-245B	02-4250-14	• SHIM, Steel, 0.005” (0,127 mm) thick .		
		Post SB 23069-0XX-24-04	A,B,H,K, L,M	AR
		Post SB 23069-015-1-24-07	D	AR
-245C	02-4250-14	• SHIM, Steel, 0.005” (0,127 mm) thick .	C,E,N,P	AR
-245D	02-4250-15	• SHIM, Steel, 0.010” (0,254 mm) thick .		
		Post SB 23069-0XX-24-04	A,B,H,K, L,M	AR
		Post SB 23069-015-1-24-07	D	AR

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-245E	02-4250-15	• SHIM, Steel, 0.010” (0,254 mm) thick .	C,E,N,P	AR
250	23069-1070	• ARMATURE . . . . . REPLD BY 23069-1500	A,B	1
-250A	23069-1500	• ARMATURE . . . . . REPLS 23069-1070 REPLD BY 23069-1503	A,B	1
-250B	23069-1503	• ARMATURE . . . . . REPLS 23069-1500	A,B	1
-250C	23069-1503	• ARMATURE	C,E,N,P	1
-250D	23069-1070	• ARMATURE . . . . . REPLD BY 23069-1500	D	1
-250E	23069-1500	• ARMATURE . . . . . REPLS 23069-1070 REPLD BY 23069-1503 Pre SB 23069-015-1-24-03 Pre SB 23069-015-1-24-07	D	1
-250F	23069-1503	• ARMATURE . . . . . REPLS 23069-1500 Post SB 23069-015-1-24-03 . (MOD D) Post SB 23069-015-1-24-07(MOD J and K) (See Note 9 and 10)	D	1
-250G	23069-1500	• ARMATURE . . . . . REPLD BY 23069-1503	H,K,L,M	1
-250H	23069-1503	• ARMATURE . . . . . REPLS 23069-1500	H,K,L,M	1
255	23081-1080	• RETAINER, Bearing . . . . . (ATTACHING PARTS)		1
260	MS35265-45	• SCREW, Machine, Filister Head	A,B,C, H,K,L,M, N,P	4
-260A	MS35265-45	• SCREW, Machine, Filister Head . . . . . REPLD BY 02-4022-02	D,E	4
-260B	02-4022-02	• SCREW, Machine, Filister Head . . . . . REPLS MS35265-45	D,E	4
265	MS35338-42	• WASHER, Spring Lock	A,B,C, H,K,L,M, N,P	4
		---------- * ----------		
270	03-6009-07	• BEARING, Ball. . . . . SUPSD BY 03-6009-07 Pre SIL 23069-00X-01	A,C,D	RF

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-270A	03-6009-07 (Code 1111)	• BEARING, Ball.		
		SUPSDS 03-6009-07 ..... (MOD A) Post SIL 23069-00X-01	A,C,D	2
		SUPSD BY 03-6009-18 . . . . . Pre SB 23069-013-24-01	A	RF
		SUPSD BY 03-6009-18 . . . . . Pre SB 23069-00X-24-01	C	RF
		SUPSD BY 03-6009-18 . . . . . Pre SB 23069-015-1-24-01	D	RF
		SUPSD BY 03-6009-18 . . . . . Pre SB 23069-016-1-24-01	H	RF
		SUPSD BY 03-6009-18 . . . . . Pre SB 23069-0XX-24-01	K	RF
-270B	03-6009-18	• BEARING, Ball.		
		SUPSDS 03-6009-07 ..... (MOD B) Post SB 23069-013-24-01	A	2
		SUPSDS 03-6009-07 ..... (MOD B) Post SB 23069-00X-24-01	C	2
		SUPSD BY 03-6009-23	C	RF
		SUPSDS 03-6009-07 ..... (MOD B) Post SB 23069-015-1-24-01	D	2
		SUPSD BY 03-6009-19 . . . . . Pre SB 23069-015-1-24-02	D	RF
		SUPSDS 03-6009-07 ..... (MOD A) Post SB 23069-016-1-24-01	H	2
		SUPSD BY 03-6009-23 . . . . . Pre SB 23069-0XX-24-02	H,K	RF
		SUPSDS 03-6009-07 ..... (MOD A) Post SB 23069-0XX-24-01	K	2
-270C	03-6009-19	• BEARING, Ball.		
		SUPSDS 03-6009-18 ..... (MOD C) Post SB 23069-015-1-24-02	D	2
		SUPSD BY 03-6009-23 . . . . . Pre SB 23069-015-1-24-04	D	RF
		SUPSD BY 03-6009-23 . . . . . Pre SB 23069-0XX-24-02	M	RF
-270D	03-6009-23	• BEARING, Ball.		
		SUPSDS 03-6009-18 ..... (MOD C)	C	2
		SUPSDS 03-6009-19 ..... (MOD E) Post SB 23069-015-1-24-04	D	2
		SUPSDS 03-6009-18 ..... (MOD B) Post SB 23069-0XX-24-02	H,K	2
		SUPSDS 03-6009-19 ..... (MOD A) Post SB 23069-0XX-24-02	M	2
-270E	03-6009-07	• BEARING, Ball.		
		SUPSD BY 03-6009-18 Pre SB 23069-0XX-24-01	B	RF

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-270F	03-6009-18	• BEARING, Ball. . . . . SUPSDS 03-6009-07 ..... (MOD A) Post SB 23069-0XX-24-01	B	2
-270G	DELETED			
-270H	03-6009-23	• BEARING, Ball.	E,N,P	2
-270J	03-6009-18	• BEARING, Ball. . . . . SUPSD BY 03-6009-23	L	RF
-270K	03-6009-23	• BEARING, Ball. . . . . SUPSDS 03-6009-18 ..... (MOD D)	L	2
275	23032-1143	• DISC, Baffle. . . . . (See Note 12)	A,B,C,H, K,L,M	1
-275A	23032-1143	• DISC, Baffle.	N,P	1
-276	23032-1143	• DISC, Baffle. . . . . REPLD BY 23088-1340 Pre SB 23069-015-1-24-10	D,E	1
276A	23088-1340	• SHIELD, Bearing, DE. . . . . REPLS 23032-1143		
		Post SB 23069-015-1-24-10 . .(MOD L)REPLD BY 23088-1346	D	1
		Pre SB 23069-015-1-24-11 REPLS 23032-1143	D	1
		Post SB 23069-015-1-24-10 . (MOD A)REPLD BY 23088-1346	E	1
		Pre SB 23069-015-1-24-11	E	1
-276B	23088-1346	• SHIELD, Bearing, DE. . . . . REPLS 23088-1340		
		Post SB 23069-015-1-24-11 . (MOD M)REPLS 23088-1340	D	1
		Post SB 23069-015-1-24-11 . (MOD B)	E	1
277	23088-1342	• SHIELD, Bearing, ADE		
		Post SB 23069-015-1-24-10 . .(MOD L)Post SB 23069-015-1-24-10 . (MOD A)	D E	1 1
280	23032-1144	• SPACER (See Note 12)		
		Post SB 23069-0XX-24-04	A,B,H,K, L,M	1
		Post SB 23069-015-1-24-07	D	1
-280A	23032-1144	• SPACER . . . . . (See Note 12)	C,E,N,P	1
285	23069-1080	• STATOR AND HOUSING ASSEMBLY REPLD BY 23069-1380	A	1
-285A	23069-1380	• STATOR AND HOUSING ASSEMBLY REPLS 23069-1080 REPLD BY 23069-1382	A	1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-285B	23069-1382	• STATOR AND HOUSING ASSEMBLY REPLS 23069-1380	A	1
-285C	23069-1080	• STATOR AND HOUSING ASSEMBLY REPLD BY 23069-1081	B	1
-285D	23069-1081	• STATOR AND HOUSING ASSEMBLY REPLS 23069-1080	B	1
-285E	23069-1380	• STATOR AND HOUSING ASSEMBLY REPLD BY 23069-1382	C,K,L,M	1
-285F	23069-1382	• STATOR AND HOUSING ASSEMBLY REPLS 23069-1380	C,K,L,M	1
-285G	23069-1530	• STATOR AND HOUSING ASSEMBLY REPLD BY 23069-1532	D	1
-285H	23069-1532	• STATOR AND HOUSING ASSEMBLY REPLS 23069-1530	D	1
-285J	23069-1532	• STATOR AND HOUSING ASSEMBLY	E	1
-285K	23069-1535	• STATOR AND HOUSING ASSEMBLY REPLD BY 23069-1536	H	1
-285L	23069-1536	• STATOR AND HOUSING ASSEMBLY REPLS 23069-1535	H	1
-285M	23069-1382	• STATOR AND HOUSING ASSEMBLY	N,P	1

- NOT ILLUSTRATED

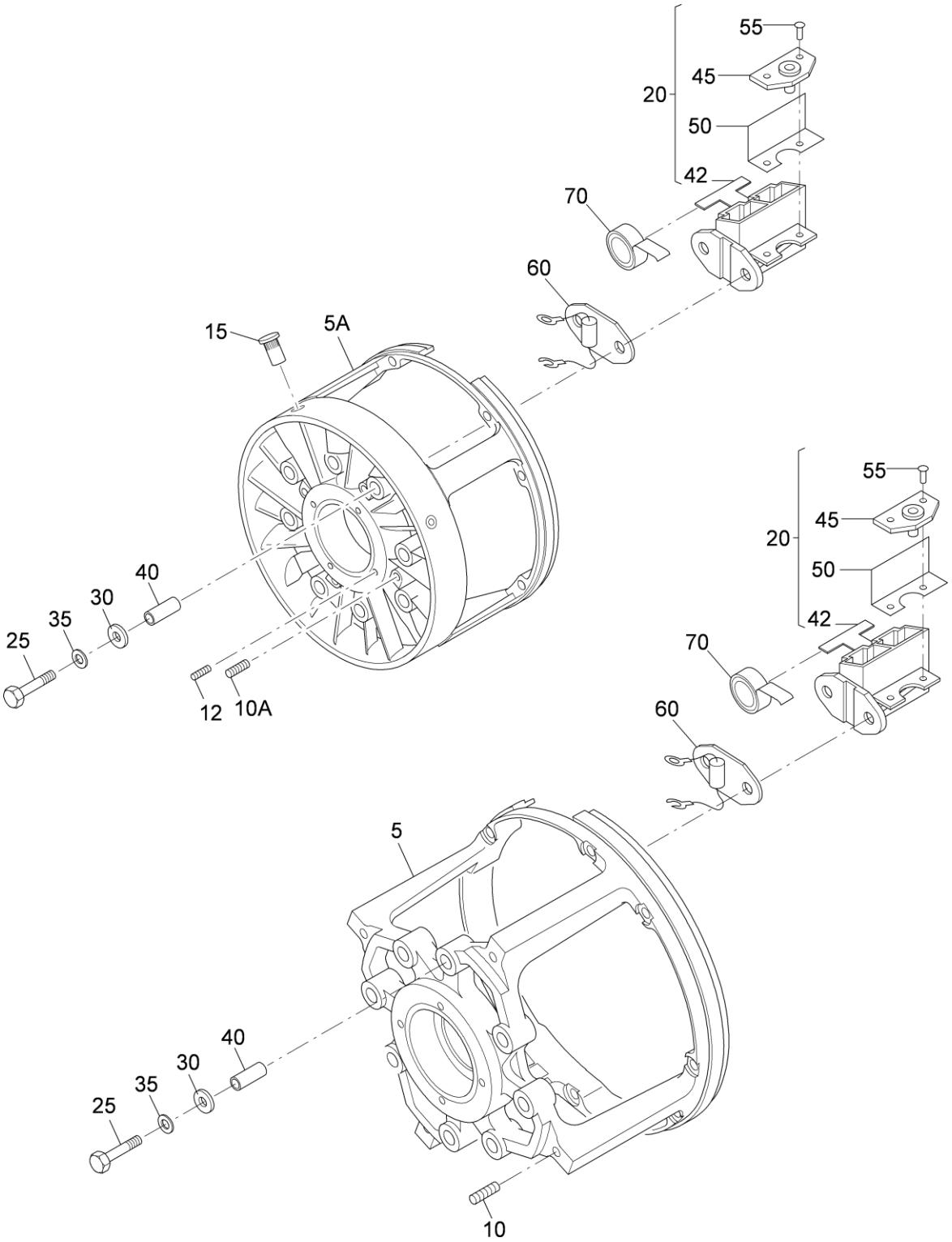


Figure 10002 - Bearing and Brush Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10002-				
-1	23069-350	SUPPORT ASSEMBLY, Bearing and Brush	A	RF
-1A	23069-355	SUPPORT ASSEMBLY, Bearing and Brush	B	RF
-1B	23069-356	SUPPORT ASSEMBLY, Bearing and Brush	C	RF
-1C	DELETED			
-1D	23069-359	SUPPORT ASSEMBLY, Bearing and Brush (See Note 16)	E	RF
5	23069-1060	• END BELL, Anti-Drive End	A	1
5A	23069-1810	• END BELL, Anti-Drive End . . . . . Note: Must be Modified Per SB 23069-015-1-24-10 to be used on 23069-015-1 Post 'MOD L' and 23069-16 Post 'MOD A'	B,E	1
-5B	23069-1812	• END BELL, Anti-Drive End	C	1
5C	DELETED			
10	MS21209C0815	• • INSERT, Helicoil	A,C	4
10A	NAS1130-06-15	• • INSERT, Helicoil	B,E	4
12	NAS1130-08L15D	• • INSERT, Helicoil . . . . . ALT: MS21209C0815	B,E	4
15	NAS1329H08K120L	• • RIVNUT®. . . . . ALT: 01-200796	B,E	4
20	23075-1203	• BRUSH HOLDER, Complete . . . . . (ATTACHING PARTS)		4
25	AN3-7A	• BOLT, Machine, Hex Head		8
30	05-374094	• WASHER, Non metallic.	A	8
-30A	05-374095	• WASHER, Non metallic.	B,C,E	8
35	AN960-10L	• WASHER, Flat	A	8
-35A	NAS1149F0332P	• WASHER, Flat	B,C,E	8
-35B	DELETED			
40	02-2001-27	• SLEEVING, Insulation		8
		*		
42	23075-1193	• • BRUSH HOLDER		1
45	23075-1400	• • TERMINAL BOARD, ... Brush Lead		1

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10002-				
50	23075-1230	• • SHEET, Insulation . . . . . (ATTACHING PARTS)		1
55	MS20426AD3-5	• • RIVET, Solid, Precision Head, ... Countersunk		2
		*		
60	23069-360	• FILTER ASSEMBLY	A	4
-60A	23069-363	• FILTER ASSEMBLY . . . . . REPLD BY 23069-366	B	4
-60B	23069-366	• FILTER ASSEMBLY . . . . . REPLS 23069-363	B	4
-60C	23080-332	• FILTER ASSEMBLY . . . . . REPLD BY 23069-363	C	4
-60D	23069-363	• FILTER ASSEMBLY . . . . . REPLS 23080-332 REPLD BY 23069-366	C	4
-60E	23069-366	• FILTER ASSEMBLY . . . . . REPLS 23069-363	C	4
-60F	DELETED			
-60G	23069-366	• FILTER ASSEMBLY . . . . . (ATTACHING PARTS)	E	4
-65	MS3367-4-9	• • TIE, Nylon . . . . . (Used with 23080-332)	B,C	RF
		*		
70	23033-2840	• SPRING, Brush		8

- NOT ILLUSTRATED

THIS PAGE INTENTIONALLY LEFT BLANK

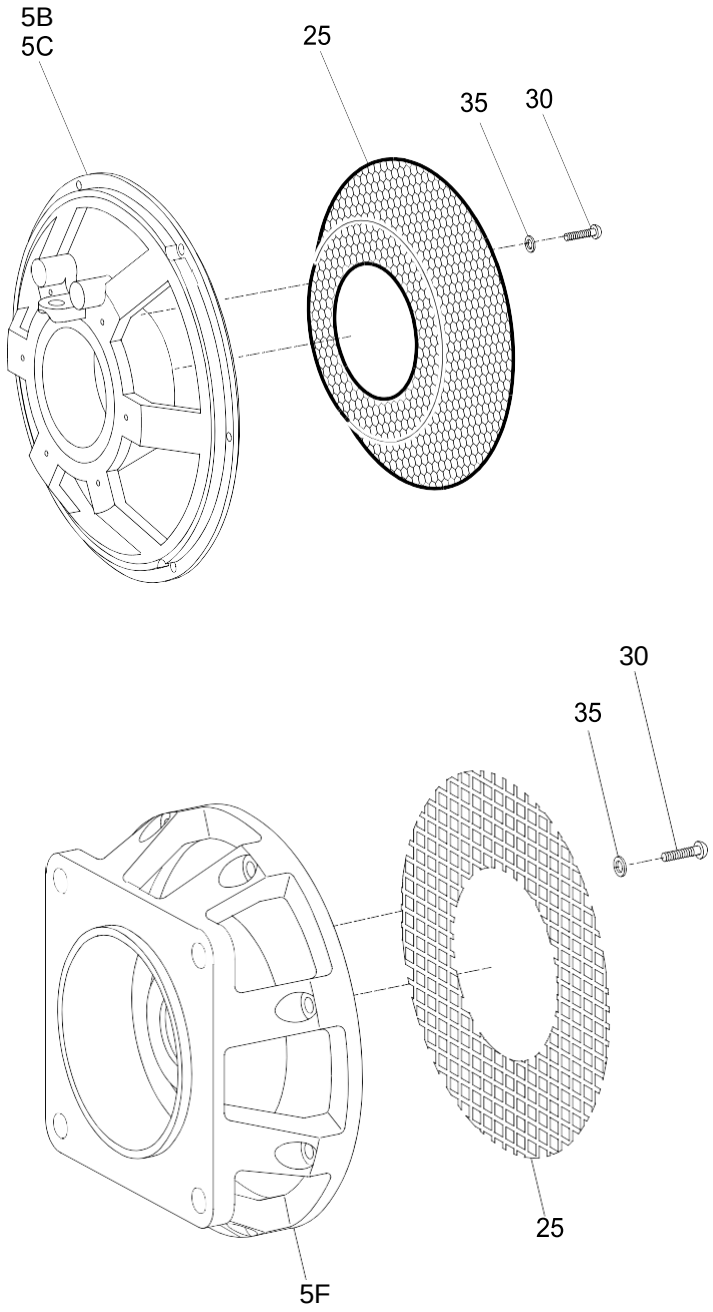
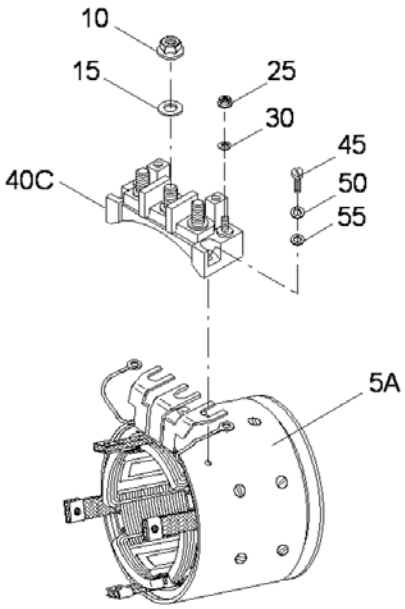


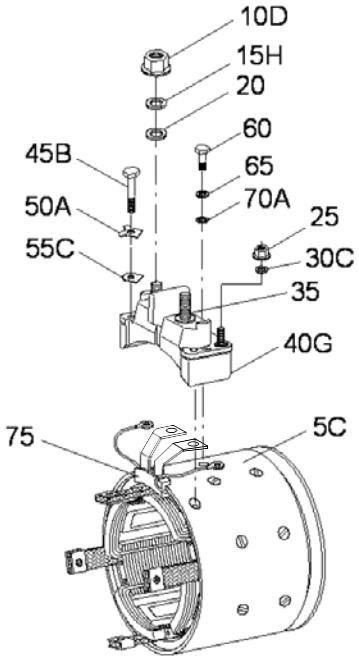
Figure 10003 - Drive End Bearing Support Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10003-				
-1	23088-1070	SUPPORT ASSEMBLY, Bearing, Drive End	A	RF
-1A	23088-1071	SUPPORT ASSEMBLY, Bearing, Drive End	B	RF
-1B	23088-1072	SUPPORT ASSEMBLY, Bearing, Drive End	C	RF
-1C	23088-1073	SUPPORT ASSEMBLY, Bearing, Drive End	D	RF
-1D	23069-1550	SUPPORT ASSEMBLY, Bearing, Drive End	E	RF
-1E	23069-1552	SUPPORT ASSEMBLY, Bearing, Drive End	F	RF
5	23088-1020	• SUPPORT, BEARING, Drive End	A	1
-5A	23088-1021	• SUPPORT, BEARING, Drive End	B	1
-5B	23088-1022	• SUPPORT, BEARING, Drive End	C	1
-5C	23088-1023	• SUPPORT, BEARING, Drive End	D	1
-5D	23069-1480	• SUPPORT, BEARING, Drive End . . . . . REPLD BY 23069-1481	E	1
-5E	23069-1481	• SUPPORT, BEARING, Drive End . . . . . REPLS 23069-1480	E	1
-5F	23069-1482	• SUPPORT, BEARING, Drive End	F	1
-10	DELETED			
-15	MS21209C0815	• • INSERT, Helicoil	B,D	2
25	23088-1140	• SCREEN	A,B,C,D	1
-25A	23069-1540	• SCREEN . . . . . REPLD BY 23069-1541	E	1
-25B	23069-1541	• SCREEN . . . . . REPLS 23069-1540	E	1
-25C	23069-1541	• SCREEN	F	1
		(ATTACHING PARTS)		
30	MS21318-15	• SCREW, Drive.	A,B,C,D	6
-30A	MS21318-15	• SCREW, Drive.	E,F	4
35	AN960-4L	• WASHER, Flat	A,B,C,D	6
-35A	AN960-4L	• WASHER, Flat	E,F	4
		*		

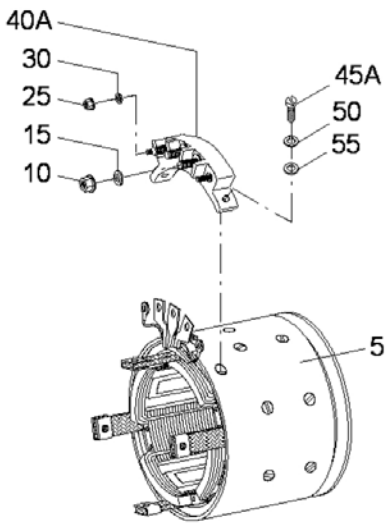
- NOT ILLUSTRATED



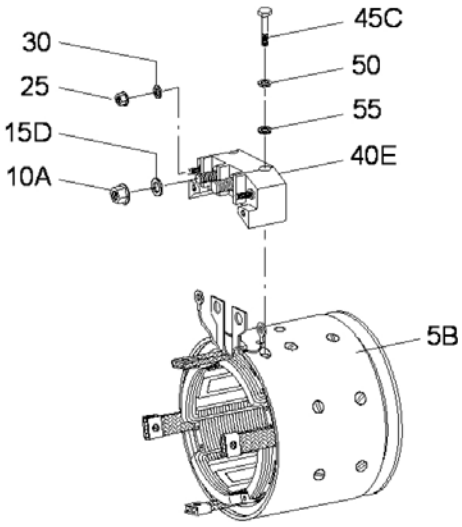
23069-1380
23069-1382



23069-1535
23069-1536



23069-1080
23069-1081



23069-1530
23069-1532

Figure 10004 - Stator and Housing Assembly

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10004-				
-1	23069-1080	STATOR AND HOUSING ASSEMBLY	A	RF
-1A	23069-1081	STATOR AND HOUSING ASSEMBLY	B	RF
-1B	23069-1380	STATOR AND HOUSING ASSEMBLY	C	RF
-1C	23069-1382	STATOR AND HOUSING ASSEMBLY	D	RF
-1D	23069-1530	STATOR AND HOUSING ASSEMBLY	E	RF
-1E	23069-1535	STATOR AND HOUSING ASSEMBLY	F	RF
-1F	23069-1532	STATOR AND HOUSING ASSEMBLY	G	RF
-1G	23069-1536	STATOR AND HOUSING ASSEMBLY	H	RF
5 5A 5B 5C	(not procurable)	• HOUSING, Stator	A,B C,D E,G F,H	NP NP NP NP
10	MS21042-6	• NUT, Reduced Hex, Self-Locking	A,B,C,D	3
10A	MS21042-6	• NUT, Reduced Hex, Self-Locking	E,G	2
-10B	MS20364B624C	• NUT, Self-Locking . . . . . SUPSD BY MS21042-6	F	RF
-10C	MS21042-6	• NUT, Reduced Hex, Self-Locking . . . . . SUPSDS MS20364B624C SUPSD BY 02-4160-03	F	RF
10D	02-4160-03	• NUT, Spiralock, Flanged . . . . . SUPSDS MS21042-6	F	2
-10E	02-4160-03	• NUT, Spiralock, Flanged	H	2
15	AN960C616L	• WASHER, Flat . . . . . REPLD BY AN960C616	A,C	3
-15A	AN960C616	• WASHER, Flat . . . . . REPLS AN960C616L	A,C	3
-15B	AN960C616	• WASHER, Flat	B,D	3
-15C	AN960C616L	• WASHER, Flat . . . . . REPLD BY AN960C616	E	2
15D	AN960C616	• WASHER, Flat . . . . . REPLS AN960C616L	E	2
-15E	AN960C616	• WASHER, Flat	G	2
-15F	AN960B616	• WASHER, Flat . . . . . REPLD BY AN960C616	F	2
-15G	AN960C616	• WASHER, Flat . . . . . REPLS AN960B616 REPLD BY MS35338-46	F	2
15H	MS35338-46	• WASHER, Lock. . . . . REPLS AN960C616	F	2
-15J	MS35338-46	• WASHER, Lock.	H	2

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10004-				
20	NAS1149C0663R	• WASHER, Flat . . . . . ALT: AN960C616	F,H	2
25	MS21042-3	• NUT, Reduced Hex, Self-Locking		2
30	AN960C10	• WASHER, Flat	A,B,C,D, E,G	2
-30A	AN960B10	• WASHER, Flat . . . . . REPLD BY AN960C10	F	2
-30B	AN960C10	• WASHER, Flat . . . . . REPLS AN960B10	F	2
30C	NAS1149C0363R	• WASHER, Flat . . . . . ALT: AN960C10	H	2
-31	05-652015	• LUG, Terminal		2
-32	15-014021	• SLEEVING, Insulation		AR
35	02-4082-07	• STUD, Lock. . . . . REPLD BY 02-4089-07	H	2
-35A	05-360065	• STUD, Lock. . . . . REPLD BY 02-4082-07	F	2
-35B	02-4082-07	• STUD, Lock. . . . . REPLS 05-360065	F	2
-35C	02-4089-07	• STUD, Lock. . . . . REPLS 02-4082-07	H	2
-40	23069-1340	• TERMINAL BLOCK. . . . . REPLD BY 23032-1509	A	1
40A	23032-1509	• TERMINAL BLOCK. . . . . REPLS 23069-1340	A	1
-40B	23032-1509	• TERMINAL BLOCK.	B	1
40C	23069-1370	• TERMINAL BLOCK.	C,D	1
-40D	23069-1235	• TERMINAL BLOCK. . . . . REPLD BY 23069-1238	E	1
40E	23069-1238	• TERMINAL BLOCK. . . . . REPLS 23069-1235	E	1
-40F	23069-1238	• TERMINAL BLOCK.	G	1
40G	23081-1312	• TERMINAL BLOCK. . . . . (ATTACHING PARTS)	F,H	1
45	MS35266-64	• SCREW, Machine, FH.	C,D	2
45A	MS35266-65	• SCREW, Machine, FH.	A,B	2
45B	AN3-11A	• BOLT, Machine	F,H	2
45C	AN3-12A	• BOLT, Machine	G	2
-45D	MS16998-32	• SCREW, Machine, FH. . . . . REPLD BY AN3-11A	E	2

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10004-				
-45E	AN3-11A	• BOLT, Machine . . . . . REPLS MS16998-32 REPLD BY AN3-12A	E	2
-45F	AN3-12A	• BOLT, Machine . . . . . REPLS AN3-11A	E	2
50	MS35338-43	• WASHER, Spring Lock	A,B,C,D, E,G	2
50A	G25-157	• WASHER, Tab Lock	F,H	2
55	AN960-10L	• WASHER, Flat . . . . . REPLD BY AN960C10L	A,C,E	2
-55A	AN960C10L	• WASHER, Flat . . . . . REPLS AN960-10L	A,C,E	2
-55B	AN960C10L	• WASHER, Flat	B,D,G	2
55C	G25-171	• WASHER, Insulating	F,H	2
		*		
60	AN3-5A	• BOLT, Machine, Hex Head	F,H	1
65	MS35338-43	• WASHER, Spring Lock	F,H	1
-70	AN960C10L	• WASHER, Flat	F	1
70A	NAS1149C0332R	• WASHER, Flat . . . . . ALT: AN960C10L	H	1
75	30059-1029	• GROMMET	F,H	1

- NOT ILLUSTRATED

THIS PAGE INTENTIONALLY LEFT BLANK

TECHNICAL PUBLICATIONS COMMENT FORM

If you have any comments or concerns with this publication, please fill out the Comments Form. Click Below button to open the form.

COMMENT FORM