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COMPONENT MAINTENANCE MANUAL WITH ILLUSTRATED PARTS LIST

DC STARTER-GENERATOR 23065 SERIES

List of Part Numbers

23065-001	**23065-008**	**23065-015-2**
23065-004	**23065-009**	**23065-015-3**
23065-004M	**23065-013**	**23065-018**
23065-004T	**23065-013-1**	**23065-018-1**
23065-004TM	**23065-015**	**23065-018-2**
23065-006	**23065-015-1**	**23065-020**

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.labinal-power.com/?lang=en and Click on the “Customer Portal” link.

HIGHLIGHTS

TO: Holders of Component Maintenance Manual with IPL for DC Starter-Generator Models 23065-001, -004, -004M, -004T, -004TM, -006, -008, -009, -016, -017, -018, -020, -021, -022, -023, -027, -028 and -046.

Attached to this transmittal letter is Revision No. 21 of the Component Maintenance Manual with IPL (original issue dated December 15, 1964).

REVISION 21, DATED MARCH 11, 2016

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

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

Key items included in this revision:

- Copyright information date changed to 2016.
- Revised the Figure 13 - Outline Drawing of 23065-020.
- Re-structured the Table 1001.
- Incorporated the changes from ACM204392.
- Design change from “finned” to “ribbed” style for the ADE End Bell (10001-270) in:
  - Figure 3003,
  - Figure 5015,
  - Figure 7003,
  - Figure 7004,
  - Figure 7006,
  - Figure 7007.
- Added the Customer Oriented Changes (COC) in CMM.

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

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RECORD OF REVISIONS

Revision Number	Date Issued	Date Inserted into CMM	Initials
Original Issue	Dec 15/64	Dec 15/64	SP
1	Nov 01/67	Nov 01/67	SP
2	Jun 01/68	Jun 01/68	SP
3	Sep 20/68	Sep 20/68	SP
4	Nov 01/68	Nov 01/68	SP
5	Oct 01/70	Oct 01/70	SP
6	Sep 01/71	Sep 01/71	SP
7	Dec 01/72	Dec 01/72	SP
8	Mar 01/73	Mar 01/73	SP
9	Jun 30/75	Jun 30/75	SP
10	Sep 30/75	Sep 30/75	SP
11	Apr 01/77	Apr 01/77	SP
12	May 01/78	May 01/78	SP
13	Jan 28/81	Jan 28/81	SP
14	May 09/83	May 09/83	SP
15	Mar 01/85	Mar 01/85	SP
16	Dec 15/00	Dec 15/00	SP
17	May 9/08	May 9/08	SP
18	Mar 30/09	Mar 30/09	SP
19	Jan 7/10	Jan 7/10	SP
20	Nov 14/14	Nov 14/14	SP
21	Mar 11/16	Mar 11/16	SP

Revision Number	Date Issued	Date Inserted into CMM	Initials

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

RECORD OF TEMPORARY REVISIONS

Temporary Revision Number	Page Number	Date Issued	Date Inserted	Initials	Date Removed	Initials
24-01	5012	April 24/03	April 24/03	SP	May 09/08	SP
24-02	Various	May 04/07	May 04/07	SP	May 09/08	SP
24-03	1021	May 03/13	May 03/13	SP	Nov 14/14	SP
24-04	1022	May 03/13	May 03/13	SP	Nov 14/14	SP
24-05	6008	May 03/13	May 03/13	SP	Nov 14/14	SP
24-06	10006	May 03/13	May 03/13	SP	Nov 14/14	SP
24-07	10008	May 03/13	May 03/13	SP	Nov 14/14	SP
24-08	10011	May 03/13	May 03/13	SP	Nov 14/14	SP
24-09	10012	May 03/13	May 03/13	SP	Nov 14/14	SP
24-10	10016	May 03/13	May 03/13	SP	Nov 14/14	SP
24-11	10018	May 03/13	May 03/13	SP	Nov 14/14	SP
24-12	10019	May 03/13	May 03/13	SP	Nov 14/14	SP
24-13	10020	May 03/13	May 03/13	SP	Nov 14/14	SP
24-14	10012	Jul 02/13	Jul 02/13	SP	Nov 14/14	SP

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

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SERVICE BULLETIN LIST

Service Bulletin Number	Status	Rev	Date Issued	Service Bulletin Number	Status	Rev	Date Issued
23065-06	Incorporated	-	Apr 20/81				
23065-07	Incorporated	-	Jul 17/84				
23065-0XX-24-01	Superseded	1	Apr 29/94				
23065-0XX-24-02	Incorporated	-	Apr 12/94				
23065-0XX-24-03	Incorporated	2	Sep 19/03				
SB-132	Incorporated	-	Jun 01/67				
SB-141	Incorporated	-	Jun 15/68				
SB-144	Incorporated	-	Sep 05/68				
SB-169-1	Incorporated	1	Jun 01/73				
23065-004-24-01	Incorporated	-	Oct 11/07				
23065-02X-24-01	Incorporated	-	Oct 11/07				
23065-020-24-01	Limited Distribution	-	Mar 20/09				
23064-1180-24-01	Valid	-	Oct 26/12				
23065-0XX-24-04	Incorporated	-	Aug 30/12				
SB-166	Out of Distribution	-	Mar 01/70				
SB-167-1	Incorporated	1	Mar 10/71				
SB-180-1	Out of Distribution	1	Sep 25/72				

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SERVICE INFORMATION LETTER LIST

Service Information Letter Number	Status	Rev	Date Issued	Service Information Letter Number	Status	Rev	Date Issued
02-5600-03	Incorporated	3	Apr 25/13				
03-6010-XX-01	Incorporated	-	May 02/95				
23701	Incorporated	1	Jun 19/00				
23703	Incorporated	-	Jan 24/97				
23704	Cancelled	1	Sep 05/08				
GSIL 2009-01	Valid	-	Oct 23/09				
GSIL 2006-01	Incorporated	-	Sep 26/06				
GSIL 2006-02	Incorporated	1	Feb 10/09				
GSIL 2011-01	Incorporated	-	Dec 16/11				
GSIL 2004-01	Limited Distribution	-	Jun 26/04				

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INTRODUCTION

1. Purpose

This Component Maintenance Manual (CMM) provides detailed instructions for overhaul and service repair of Safran Power 23065 Series of DC Starter-Generators. Line maintenance is supported by Maintenance Manual (MM) 23700. A DC Starter-Generator overhaul includes:

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

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

- Reconditioning of surface finishes as required.
- Repair/rework of parts as required.
- Re-certification including final assembly, records, and release tags.

Only an overhaul and an acceptance test authorize 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 a repair procedure, become thoroughly familiar with capabilities and limitations of equipment. Make sure all necessary safety equipment, test equipment, repair materials, special tools, and fixtures are available before starting the task.

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

Publications can be obtained by contacting the Safran Power, Monroe, NC distribution center. Contact the distribution administrator by e-mail at https://techpubsdistribution.labinal-power.com.

2. User Qualification and Certification Requirements

The information contained in this manual is intended for use by persons properly trained and certified in the repair and service of aircraft electrical accessories. Eligibility and certification of service technicians must be in accordance with 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 must be as indicated in the cited standard. Strictly follow the detailed requirements of all cited 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 will also be responsible for maintaining all necessary test, inspection, and maintenance records for each unit received for service.

All instrumentation and inspection equipment used must be calibrated and controlled in accordance with ISO 10012-1, with all standards traceable to the National Bureau of Standards or an equivalent standards regulatory authority.

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

The quality assurance activity must maintain documented evidence that specifications applicable to special processes such as soldering, non-destructive testing, plating, etc.; have been complied with during servicing and/or repair of the generator.

4. Safety Advisory

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

The user of this manual should obtain material safety data sheets and Occupational Safety and Health Act (OSHA) Form 20 or equivalent from the manufacturers or suppliers of materials to be used. The user must become completely familiar with and follow all manufacturer/supplier procedures, recommendations, warnings, and cautions for the safe use, handling, storage, and disposal of the materials. User of this manual are also advised to refer to applicable safety information contained in the "NIOSH Occupational Guideline for Chemical Hazards" published by the United States Department of Labor.

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

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

5. Hazardous Materials List

The materials listed in this paragraph are required for processes throughout this manual. Warnings and/or cautions will precede the use of the materials listed in Table i.

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

Material	Used in…
Acrylic Coating	CHECK, REPAIR, ASSEMBLY
Corrosion Preventative	CLEANING
Cleaning Solvent	CLEANING, ASSEMBLY
Detergent	CLEANING
Enamel Paint	REPAIR
Isopropyl Alcohol	DISASSEMBLY, CLEANING, CHECK, ASSEMBLY
Insulating Enamel	REPAIR, ASSEMBLY
Enamel Paint	REPAIR
Loctite Grade D	REPAIR, ASSEMBLY
Lubricating Oil	ASSEMBLY
Thread Locking Compound	REPAIR, ASSEMBLY
Zinc Chromate Primer	REPAIR, ASSEMBLY
Silicon Adhesive Primer	ASSEMBLY

Table i - Hazardous Materials

6. Non-Safran Power Authorized Components and Processes Policy

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

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

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

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

7. Abbreviations and Acronyms

The following is a list of the abbreviations and acronyms used in this document.

A	Ampere
AC	Alternating Current
AR	As Required
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
AWG	American Wire Gauge
C	Centigrade
CMM	Component Maintenance Manual
DC	Direct Current
F	Fahrenheit
ft.	feet
FAA	Federal Aviation Administration
Hz	Hertz
in-lbs	Inch pounds
IPL	Illustrated Parts List
ISO	International Organization for Standardization
IAW	In Accordance With

kg	Kilograms
km	Kilometers
kPa	Kilopascals
L	Liter
lbs	Pounds
MIL	Military Specification
mm	Millimeter
MS	Military Standard
NA	Not Applicable
NAS	National Aerospace Standard
N·m	Newton-meters
NPT	National Pipe Thread
OSHA	Occupational Safety and Health Administration
P/N	Part Number
psig	Pounds per Square Inch Gauge
QAD	Quick-Attach-Detach
REF	Reference
rms	Root Mean Square
rpm	Revolutions Per Minute
SI	Systeme Internationale
SP	Safran Power
SPD	Standard Practice Document
STD	Standard
TSO	Time Since Overhaul
V	Volt or Voltage
Ω	Ohms

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DESCRIPTION AND OPERATION

1. Equipment Description

The 23065 series of DC Starter-Generators are designed to provide torque for engine starting and to generate 30 VDC electrical power. Refer to the ILLUSTRATED PARTS LIST section for an illustration and parts breakdown of the DC Starter-Generator.

The 23065 DC Starter-Generator is an air-cooled, self-excited, brush-type unit that consists of a stator and housing assembly incorporating four main poles and four interpoles, an armature assembly attached to a dampening type drive shaft, end bell bearing supports, brush assembly, fan assembly, and terminal block assembly.

The drive shaft is splined on both ends; at the drive end for engaging the engine gearbox, and at the anti-drive end for coupling to the armature shaft. The anti-drive end also contains a mounting surface and threaded end for attaching the fan assembly. The drive shaft is provided in either dry or wet spline styles depending on the DC Starter-Generator model; the wet spline style uses a preformed packing on the drive end spline. The drive shaft and attached armature assembly are supported by bearings mounted in the drive and anti-drive end bells. At the drive end of the drive shaft is a clutch-type dampener assembly that absorbs torsional vibration generated by changes in engine gearbox speed and electrical load conditions.

Electrical connection to the DC Starter-Generator is made at the terminal block assembly. The terminal block, and in some cases the bearing and brush support assembly, have built-in radio noise filters which reduces electrical noise created by current passing through the armature and the stator.

Unit cooling at all rated conditions is achieved by either of two methods: (1) by air blast with supplemental air provided by the fan assembly at the anti-drive end, or (2) by self-cooling with the air provided by its own integral fan assembly. The fan is protected by a screen cover on self-cooled models.

The DC Starter-Generator is mounted on the engine mounting pad by using an appropriate Quick-Attach-Detach (QAD) kit, as specified in the ILLUSTRATED PARTS LIST. The QAD kit, which consists of a drive-end pad end-bell and a rim clenching clamp, is only supplied with certain models of the DC Starter-Generator. For all other models, the QAD kit must be ordered separately.

2. Operation

CAUTION: THE STARTER FUNCTION SHOULD NOT BE ACTIVATED FOR MORE THAN THE FEW SECONDS WHEN IN THE LOCKED ROTOR MODE. LARGE START CURRENTS AND LONG START TIMES CREATE VERY HIGH TEMPERATURES THAT CAN DAMAGE THE DC STARTER-GENERATOR.

When used as an engine starter, the DC Starter-Generator can be energized either by batteries or by ground-power units. The DC Starter-Generator uses a series starting field or a shunt field, or in combination. For the models in this CMM, only the series field will be used for starting. During this time, the shunt field should be open.

When operating as a generator, the DC Starter-Generator provides rated DC output at a rotational speeds within the rated speed range.

The generator will operate satisfactorily with either a carbon-pile or static type regulator. A reverse-current relay is normally used for automatically disconnecting the generator from the load bus if generator voltage drops below a pre-determined minimum.

Electrical and mechanical characteristics of the 23065 series of DC Starter-Generators are provided in Table 1 and Table 2.

Characteristics	Specification
Rated Power Output	6.0 kW (200 A models), 7.5 kW (250 A models)
Rated Voltage	30 VDC nominal; 26 to 30 VDC over speed range
Speed Range:	See Table 2.
Continuous Load in Speed Range	See Table 2.
Operating Altitude	35,000 ft. (10,668 km) maximum
Cooling	Self-cooled (fan is an integral part of starter-generator) (Models - 23065-004, -004T, -004M, -004TM, 008, -009 and -046)
	Combination cooled (Blast air with fan supplement) (All models except self-cooled)
Air Opening (Diameter)	3.0 inch (76 mm) (Models - 23065-001, -006, -017, -020, -022)
	5.2 inch (132 mm) (All models except those mentioned above for 3.0 inch (76 mm))
Direction of Rotation	Counterclockwise (viewing drive-end)
Weight (Less QAD kit)	See Table 2.
Overhung Moment	See Table 2.
Mounting Pad	AS 962-1P, AND 10261 XI-B, AND 10262 Type XII-A, or MS3331-1. See IPL for appropriate QAD mounting kit.
Drive Spline	12 Teeth; 0.600 inch pitch diameter (all, but 23065-018) 16 Teeth; 0.800 inch pitch diameter (23065-018 only)
Terminal Designations: B + E – A + D C +	Positive Negative Positive field Equalizer Starting

Table 1 - Equipment Specifications

Characteristics	Specification
External Start Power	28 VDC, 800 A max. - (All, but 1000 A models) 28 VDC, 1000 A max. -(23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2)
Overall Length (Less spline drive)	See Table 2.
Housing Diameter (over clamp)	6.22 inch (158,0 mm).

Table 1 - Equipment Specifications (Continued)

23065 Model (*QAD Kit included)	Speed Range	Load	Overhung Moment In-Lb (N·m)	Overall Length Inch (mm) Less spline	Weight Lbs (Kg)
23065-001	5800-12000	200	150 (16.95)	11.65 (295,9)	33.0 (14.97)
23065-004 (All)	5800-12000	200	138 (15.59)	10.26 (260,6)	30.5 (13.83)
23065-006	5800-12000	200	150 (16.95)	11.65 (296,0)	31.9 (14.47)
23065-008	5800-12000	200	138 (15.59)	10.26 (260,6)	30.5 (13.83)
23065-009	5800-12000	200	144 (16.27)	10.32 (262,1)	30.5 (13.83)
23065-013	6200-12000	250	150 (16.95)	10.55 (268,0)	31.2 (14.15)
23065-013-1	6200-12000	250	158.7 (17.93)	11.65 (296,0)	32.1 (14.56)
23065-015	6200-12000	250	148 (16.72)	10.55 (268,0)	31.1 (14.11)
23065-015-1	6200-12000	250	159.7 (18.05)	11.65 (296,0)	32.1 (14.56)
23065-015-2	6200-12000	250	154 (17.40)	10.55 (268,0)	31.2 (14.15)
23065-015-3	6200-12000	250	150 (16.95)	11.65 (296,0)	33.0 (14.97)
23065-018	6200-12000	250	148 (16.72)	10.55 (268,0)	31.2 (14.15)
23065-018-1*	6200-12000	250	154 (17.40)	10.55 (268,0)	31.2 (14.15)
23065-018-2	6200-12000	250	154 (17.40)	10.55 (268,0)	31.2 (14.15)
23065-020	6500-12000	200	150 (16,95)	10.40 (264,2)	31.2 (14,15)

Table 2 - Equipment Specification Details

3. MOD Status

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

Model(s)	MOD	Part Number	Description
23065-001, -006, -008, -009, -017, -022	A	03-6010-15	Bearings
	B	03-6010-18	Bearings
23065-013, -018, -020, -021, -023	A	03-6010-15	Bearings
	B	03-6010-18	Bearings
	C	23093-1307	Brushes
23065-004, -004M, -004T, -004TM	A	03-6010-15	Bearings
	B	03-6010-18	Bearings
	C	23065-1680	Brushes
23065-018-1, -028	A	03-6010-18	Bearings
	B	23093-1300	Brushes
23065-020	A	23065-1490	Fan
		23065-1220	Fan Cover Assembly
		23046-1111	Bearing Retainer
		MS24694-S3	Screws

Table 3 - MOD Status

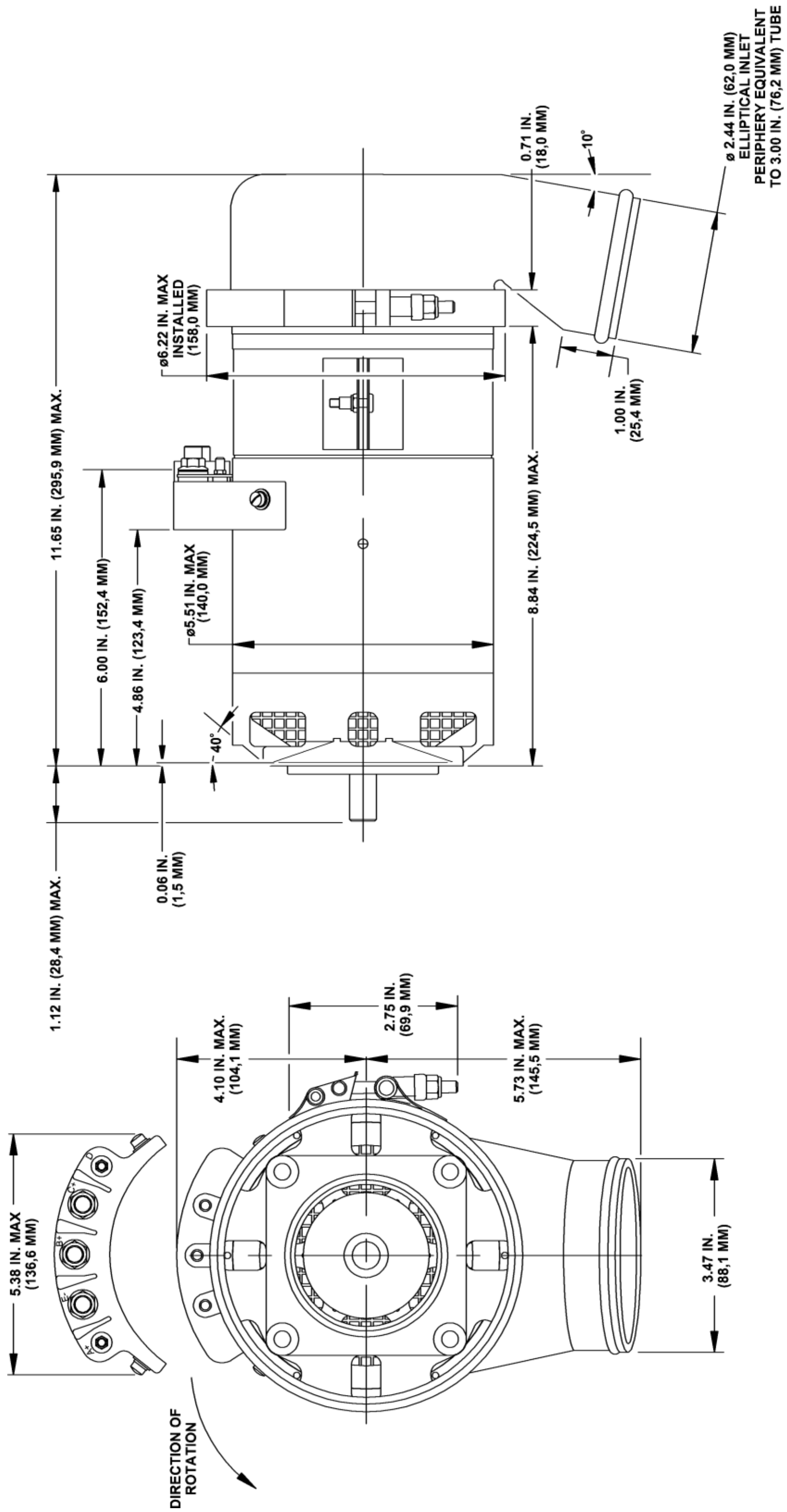


Figure 1 - Model 23065-001 Outline Drawing

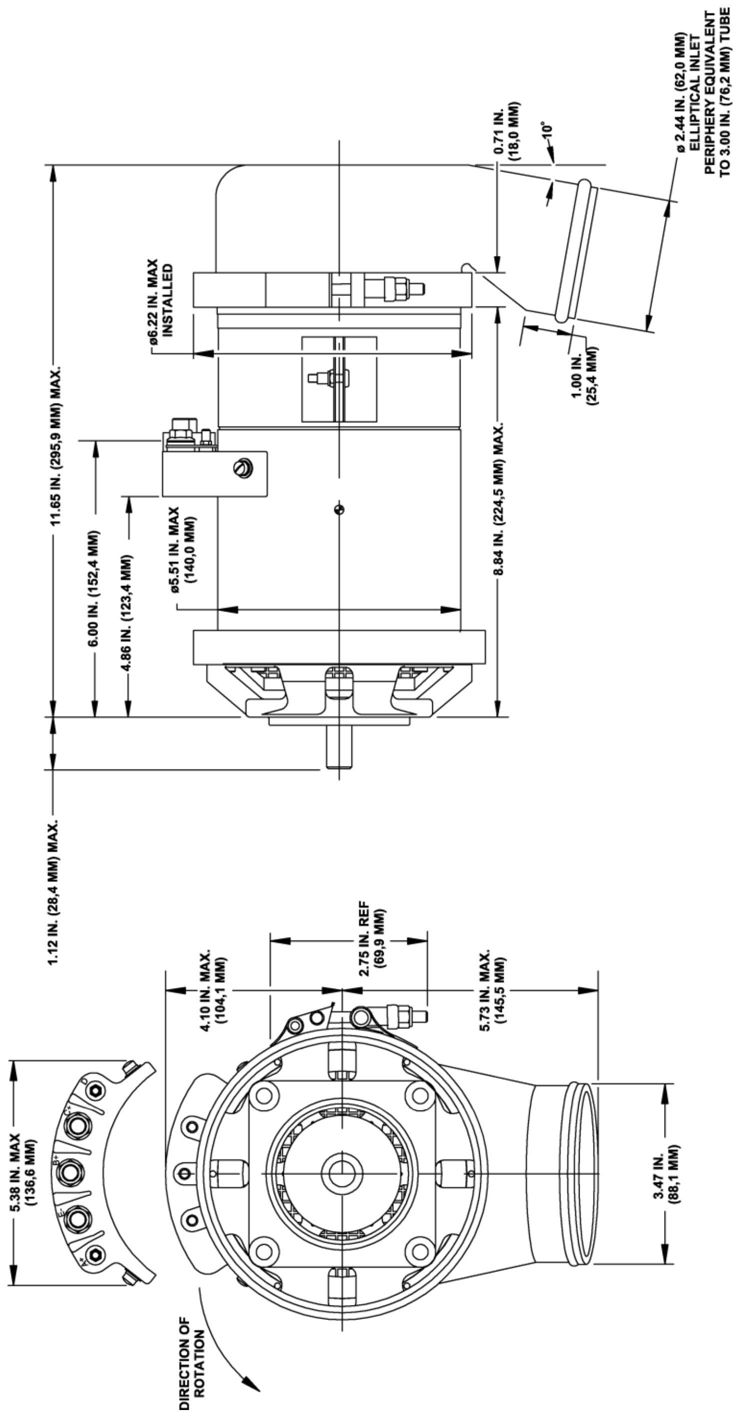


Figure 2 - Model 23048-006 Outline Drawing

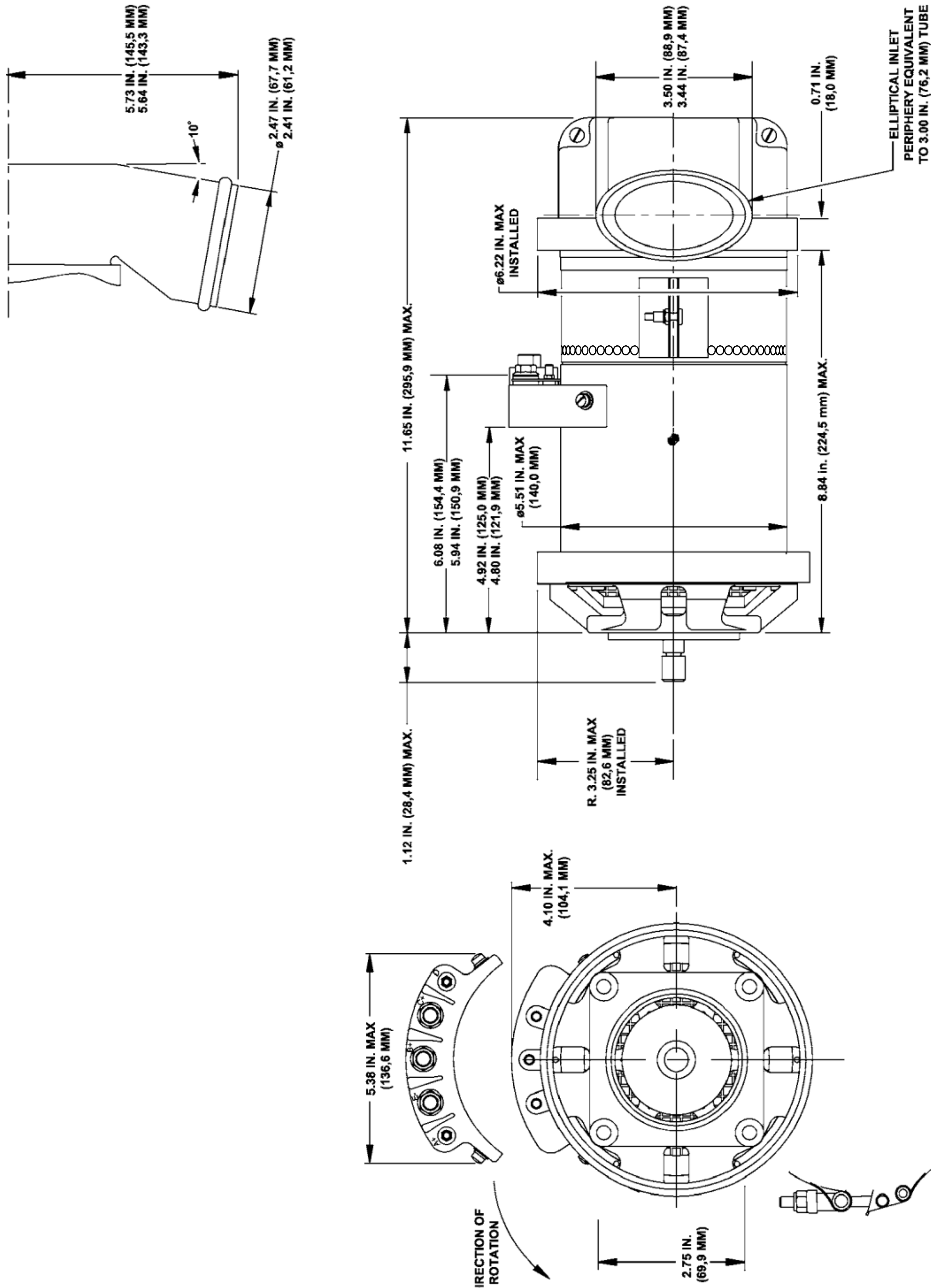


Figure 3 - Model 23048-017 Outline Drawing

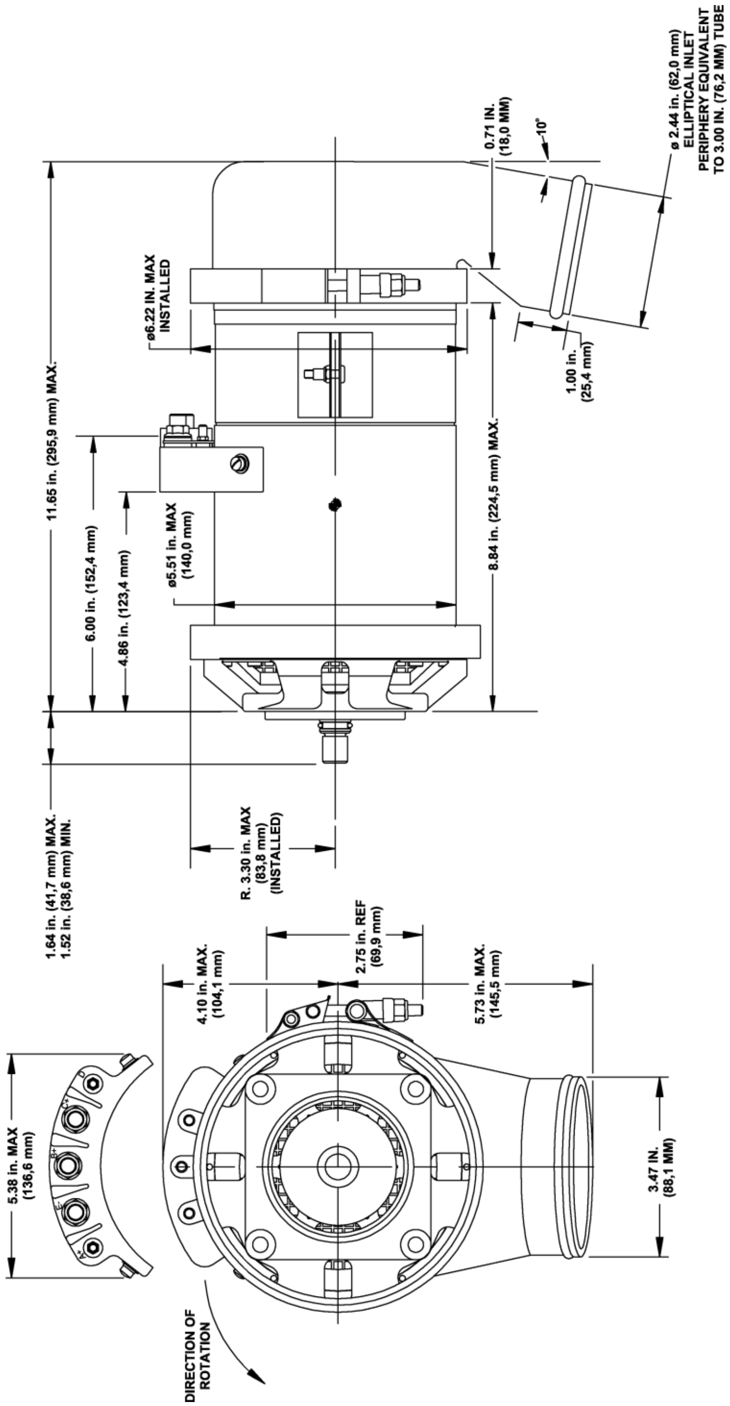


Figure 4 - Model 23048-020 Outline Drawing

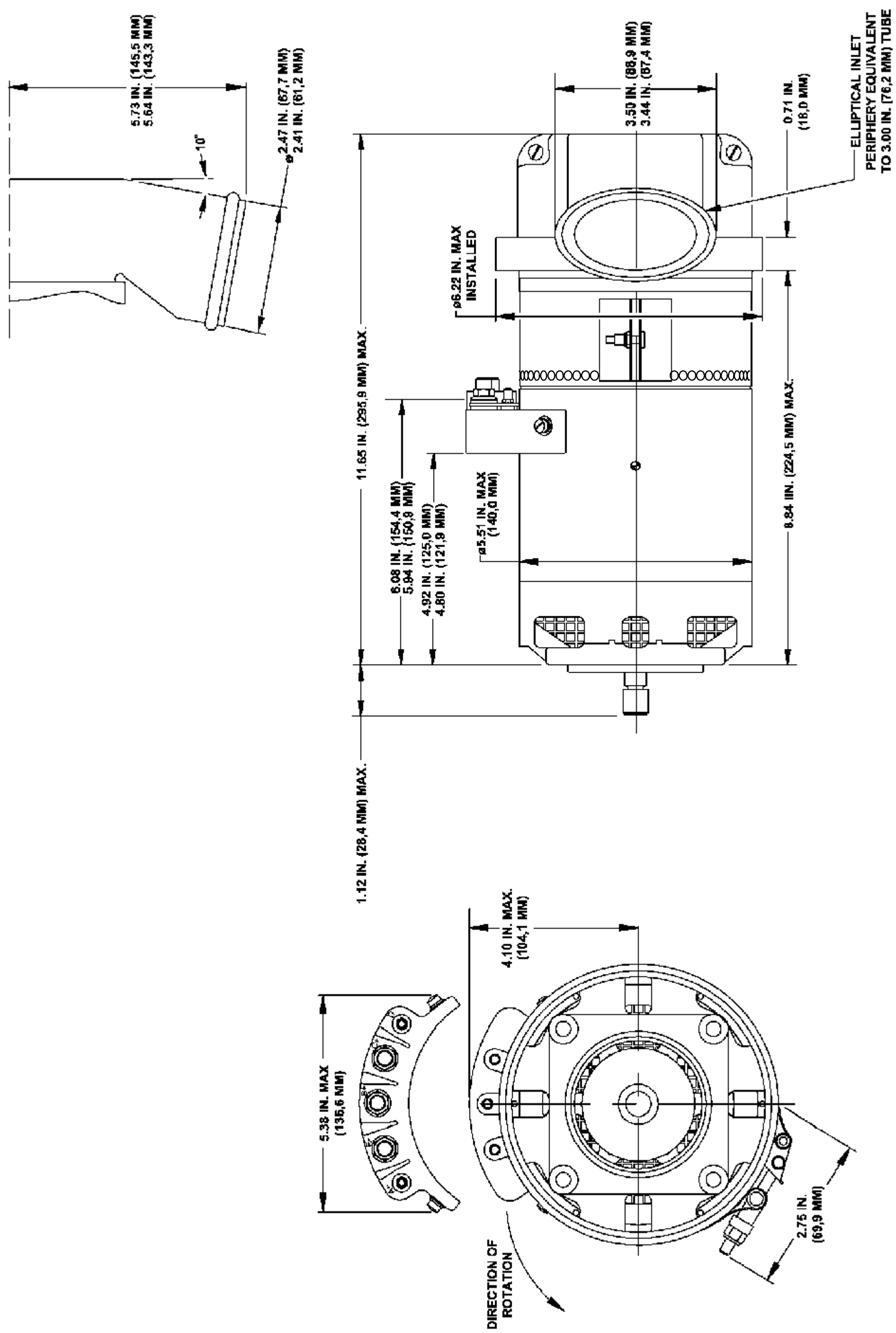
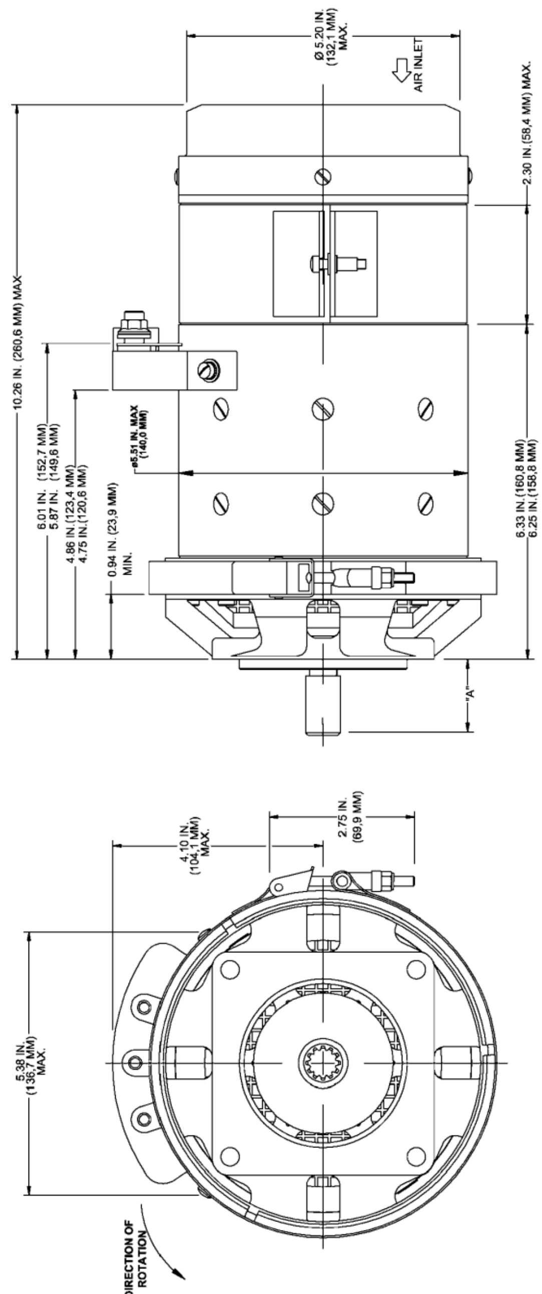


Figure 5 - Model 23048-022 Outline Drawing



MODEL	DIM "A" IN. (MM)
230048-004	0.97 (24,6) MAX.
230048-004T	0.97 (24,6) MAX.
230048-004M	1.18 (30,0) MAX.
230048-004TM	1.18 (30,0) MAX.
230048-008	0.97 (24,6) MAX.

Figure 6 - Models 23065-004, -004M, -004T, -004TM Outline Drawing

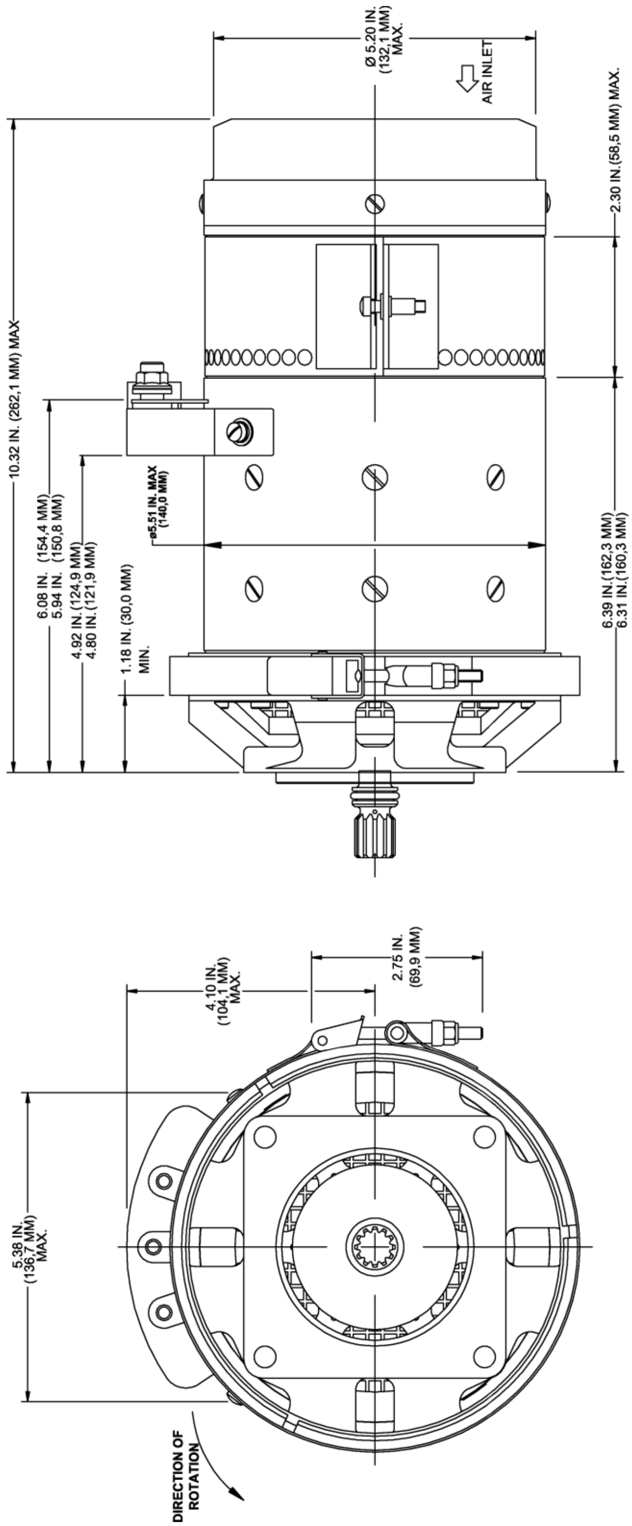


Figure 7 - Models 23065-008 Outline Drawing

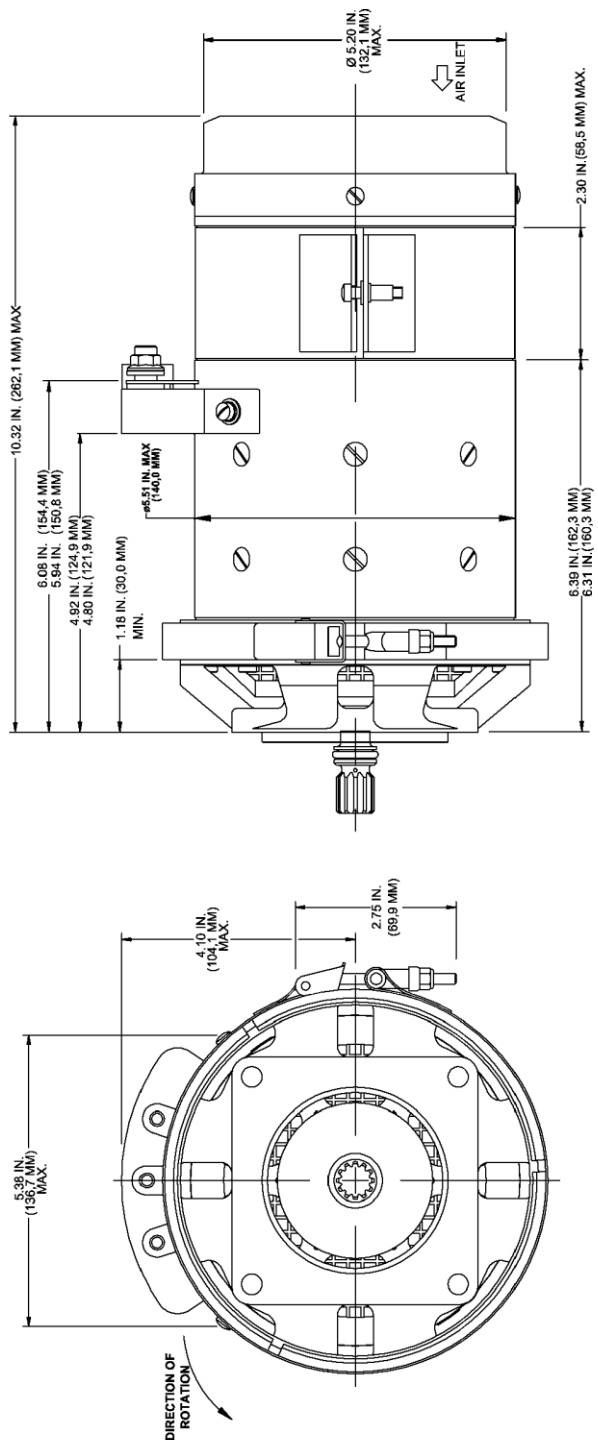


Figure 8 - Model 23065-009 Outline Drawing

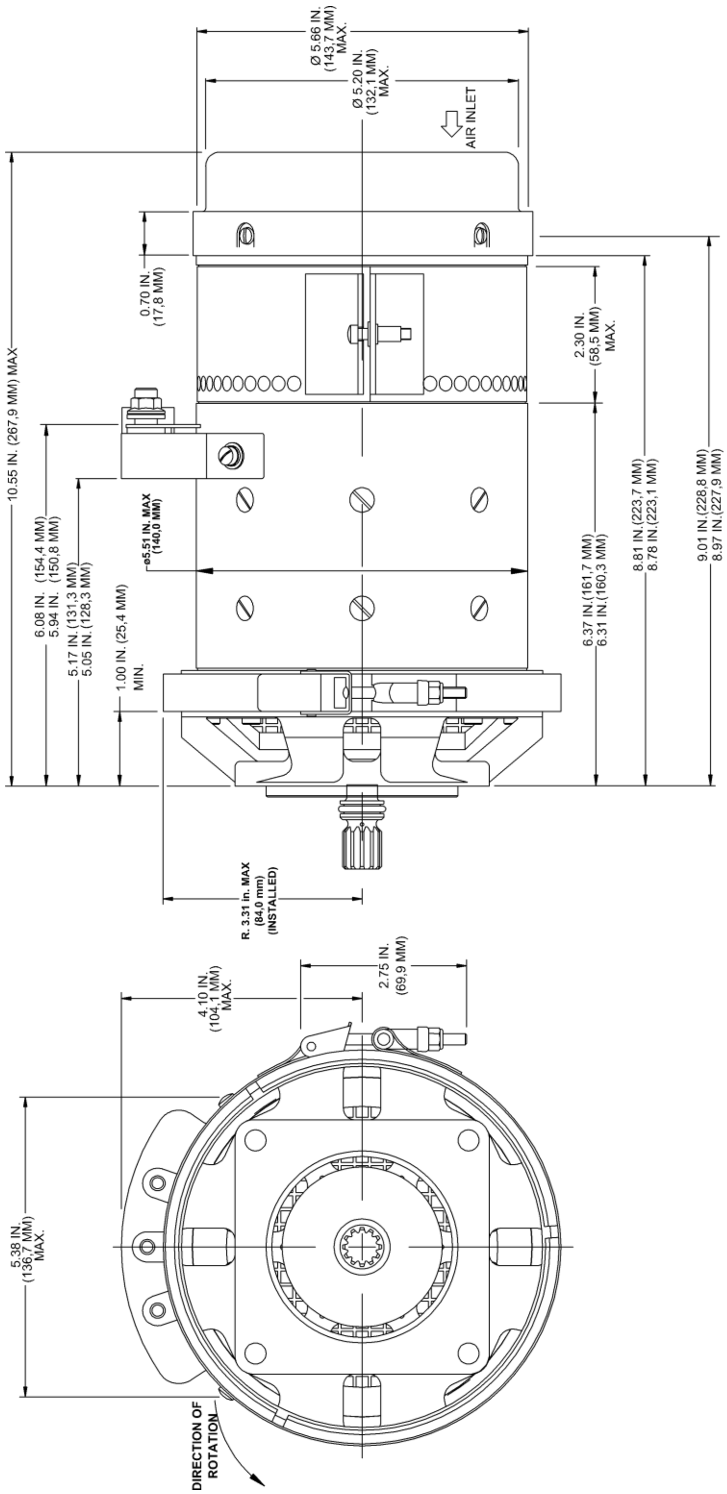


Figure 9 - Model 23065-013 Outline Drawing

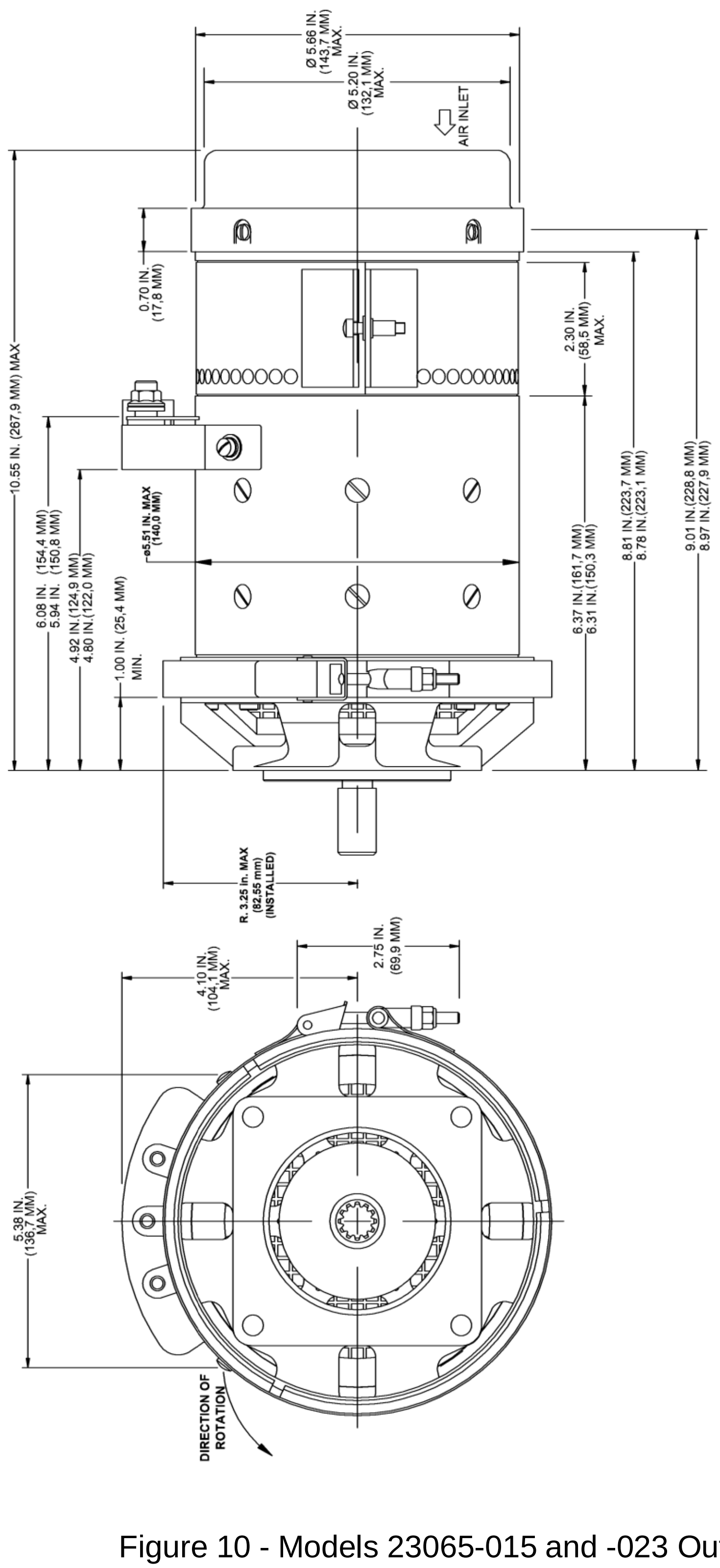


Figure 10 - Models 23065-015 and -023 Outline Drawing

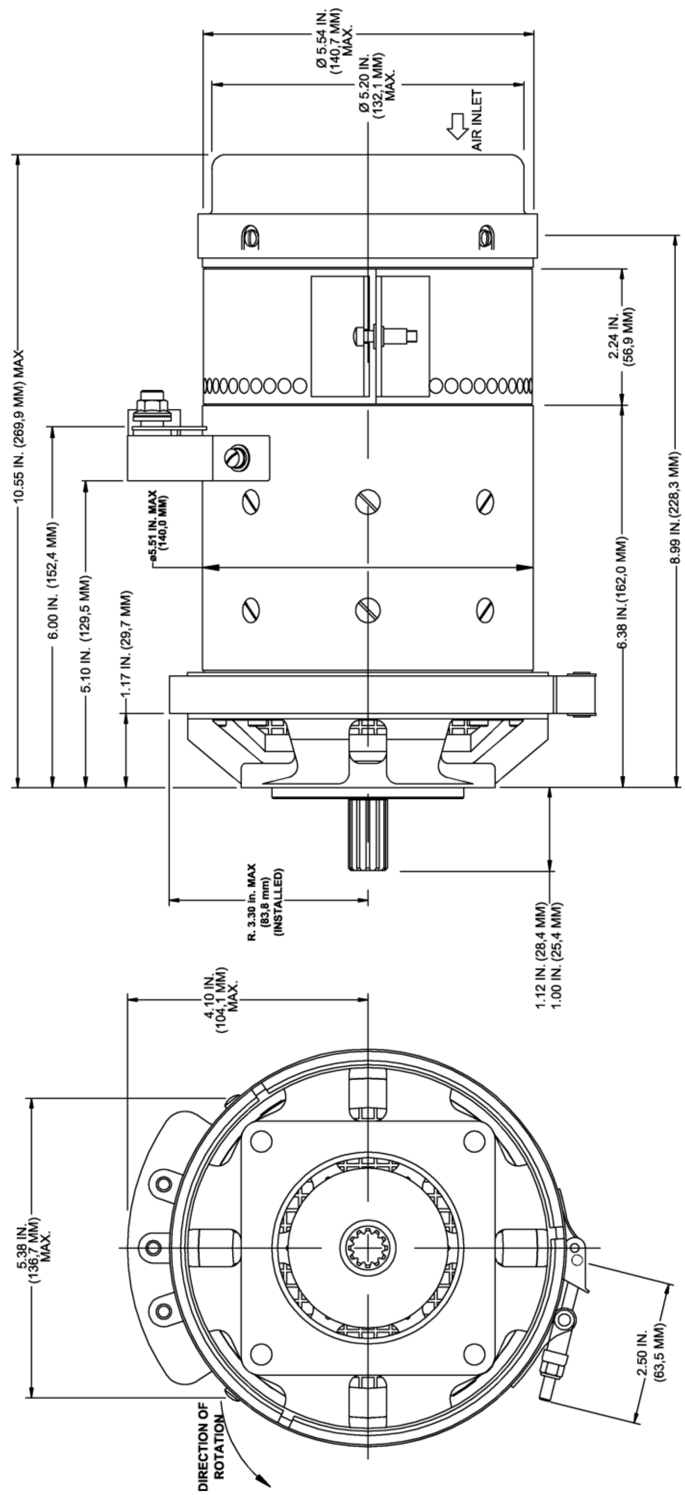


Figure 11 - Model 23065-015-2 Outline Drawing

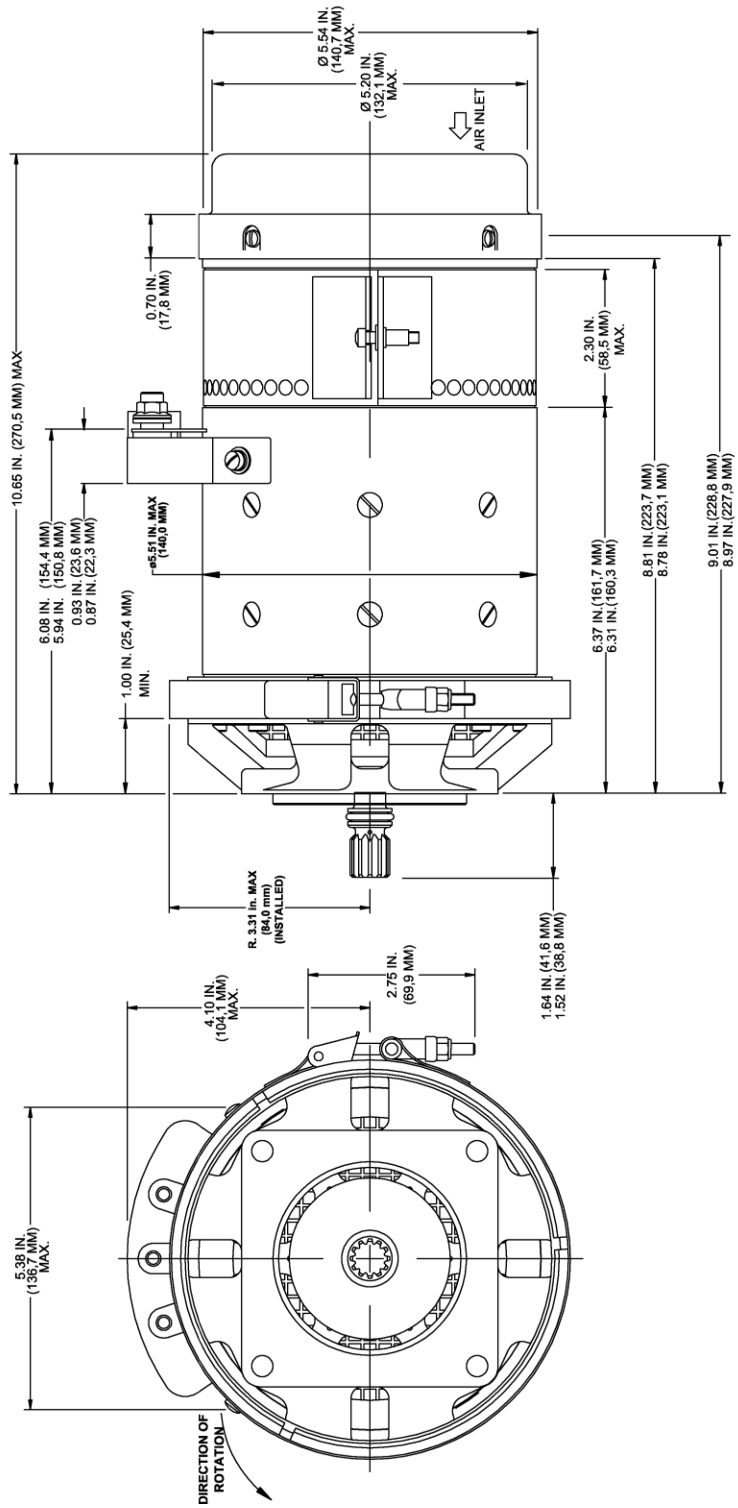


Figure 12 - Models 23065-018-1 and -028 Outline Drawing

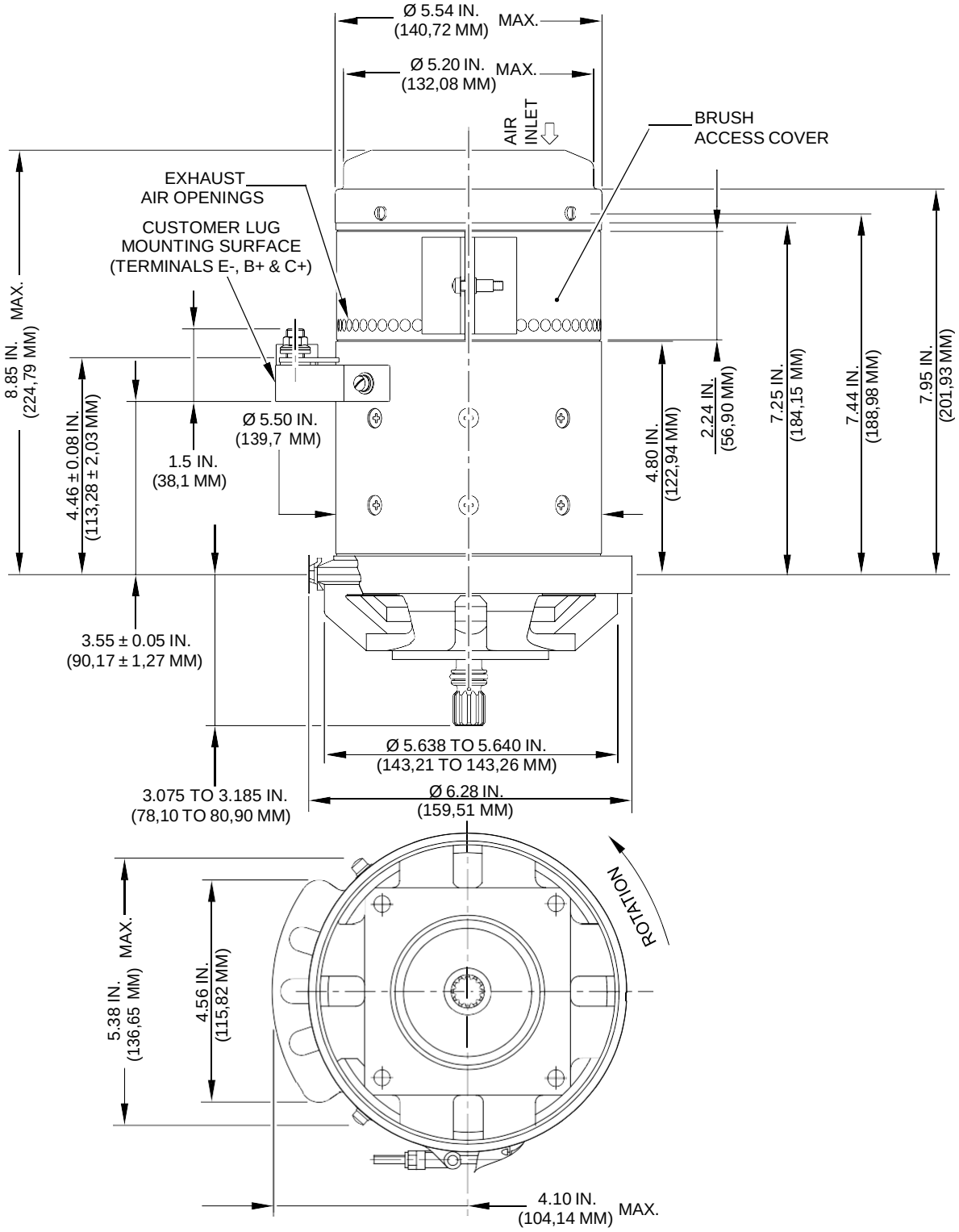


Figure 13 - Outline Drawing of 23065-020

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TESTING AND FAULT ISOLATION

1. Introduction

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

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

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

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

2. Test Conditions

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

Parameter	Operating Condition
Ambient Temperature	50° to 104° F (10° to 40° C)
Barometric Pressure	27 to 33 inch (914 to 1117 millibar) of mercury
Mounting	Drive shaft (rotational axis) horizontal

Table 1001 - Performance Test Conditions

Parameter	Operating Condition	
Forced Air Cooling is required for models:	23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2	Cooling air must be supplied through a tube that is straight for a length of 3 ft. (0,9 m) and has an inner diameter of 5.2 inch (132 mm)
		A static pressure of 6.0 in/H_2O, measured 12 inch (305 mm) upstream from the air inlet, is required for all models.
	23065-001, 23065-006	Cooling air must be supplied through a tube that is straight for a length of 3 ft. (0,9 m) and has an inner diameter of 3.0 inch (76 mm)
		A static pressure of 0.5 in/H_2O, measured 12 inch (305 mm) upstream from the air inlet, is required for all models.
	23065-013-1, 23065-015-1, 23065-015-3	Cooling air must be supplied through a tube that is straight for a length of 3 ft. (0,9 m) and has an inner diameter of 3.0 inch (76 mm)
		A total pressure of 6.0 in/H_2O, measured 12 inch (305 mm) upstream from the air inlet, is required for all models.
Self-cooled models:	23065-004, 23065-004M, 23065-004T, 23065-004TM, 23065-008, 23065-009, 23065-020	Cooling air is supplied by its own integral fan assembly through an air inlet, inner diameter of 5.2 inch (132 mm).
Brush Seating NOTE: Refer to SPD-1006	Before test measurements are made: For all models, brushes must be seated 100% in the direction of rotation. For all models, but 23065 -017, 23065-015-1, and 23065-015-3, brushes must be seated at least 90% in the axial direction. For models 23065-013-1, 23065-015-1, and 23065-015-3, brushes must be seated at least 75% in the axial direction.	

Table 1001 - Performance Test Conditions (Continued)

3. Required Test Equipment

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

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 Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Wiring Diagram Reference
Ammeter, DC (1)	0 to 500 A	DC Ammeter
Drive Test Stand	Capable of driving starter-generator 5500 to 14,000 rpm, and suitable metering to measure speed, voltage, current, and temperature	---
High Potential (Dielectric) Tester	250 VAC rms, 50/60 Hz	---
Load Bank, Variable	30 V, 0 to 160 A	Load Bank
Load Bank, Variable	30 V, 0 to 300 A	Load Bank
Ohmmeter (1)	---	---
Power Supply, DC, Variable (1)	0 to 30 VDC	Power Supply
QAD Mounting Kit	See IPL for appropriate kit no.	---
Regulator	---	---
Resistor	1.25 Ω	---
Shunt, Precision (1)	1000 A ± 5%	---
Starter Test Stand	Capable of measuring a locked rotor torque of 20 lb-ft (27 N·m) and having a power supply capacity of not less than 500 A at 13 VDC.	---
Voltmeter, DC (1)	0 to 3 V	DC Voltmeter, 0 to 3

Table 1002 - Test Equipment Requirements and Specifications

Equipment Type (Quantity)	Range and Accuracy or Equipment Rating	Generator Test Wiring Diagram Reference
Voltmeter, DC (1)	0 to 30 V	DC Voltmeter, 0 to 30
Commutation Viewing Adapter	---	Figure 9007
Resilient Cradle or Wooden Cradle or V-block support	-	Not illustrated
Dial Indicator with ball or mushroom indicator tip. Optional: Magnetic Base to fit dial indicator	Accuracy: 0.0001 inch	Not illustrated

Table 1002 - Test Equipment Requirements and Specifications (Continued)

4. Test Preparation

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

A. Perform an initial inspection.

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

B. Check brush seating.

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

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

(1) Make sure all brushes (60) are correctly seated according to procedures in SPD 1006.

C. Clean the starter-generator.

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

(1) Refer to CLEANING section for details.

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

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

CAUTION: ACCEPTANCE TESTING CAN DAMAGE FILTER CAPACITORS INSIDE UNIT'S TERMINAL BLOCK.

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

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

E. Install commutation viewing adapter.

(1) Remove brush access cover (50). 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: THE STARTER-GENERATOR MUST BE SUPPORTED AT ALL TIMES DURING INSTALLATION AND REMOVAL. DO NOT ALLOW THE UNIT TO HANG UNSUPPORTED. TOO MUCH BENDING LOADS ON THE DRIVE SHAFT CAN DAMAGE THE SHEAR SECTION.

(2) Put commutation viewing adapter on stator and housing assembly (275).

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

(3) Center brackets of commutation viewing adapter over one rib of stator and housing assembly (275).

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

F. Install the DC Starter-Generator onto the drive stand.

(1) Turn off all power to the drive stand.

(2) Install the appropriate QAD kit mounting adapter onto the drive stand. Refer to the ILLUSTRATED PARTS LIST for the kit number required.

(3) While supporting the anti-drive end of the DC Starter-Generator, align and install the drive end to the mounting adapter.

(4) Make sure that the drive stand and the DC Starter-Generator mating splines are correctly engaged.

(5) Install the rim clenching clamp and tighten the self-locking hex nut (375) to 50 in.-lbs. (5,6 N·m).

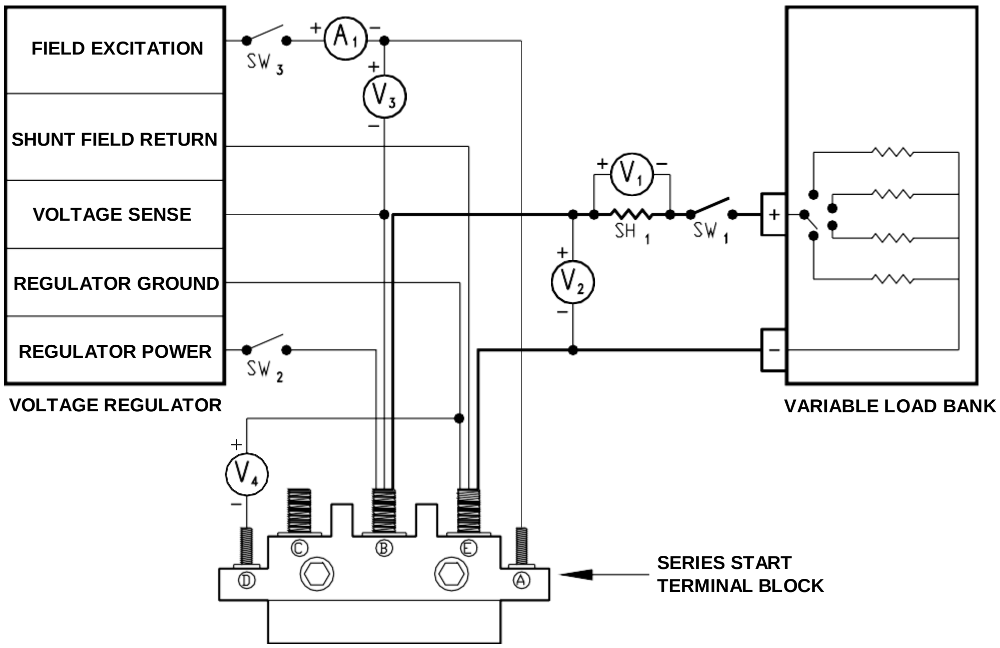

Figure 1001 - 23065 Series DC Starter-Generator Test Set-Up

(6) Connect cooling equipment for all models requiring external cooling. See Table 1001.

(7) Connect the DC Starter-Generator to the test circuit as shown in Figure 1001.

(8) Figure 1002 shows, in schematic diagram form, the electrical connections to the DC Starter-Generator.

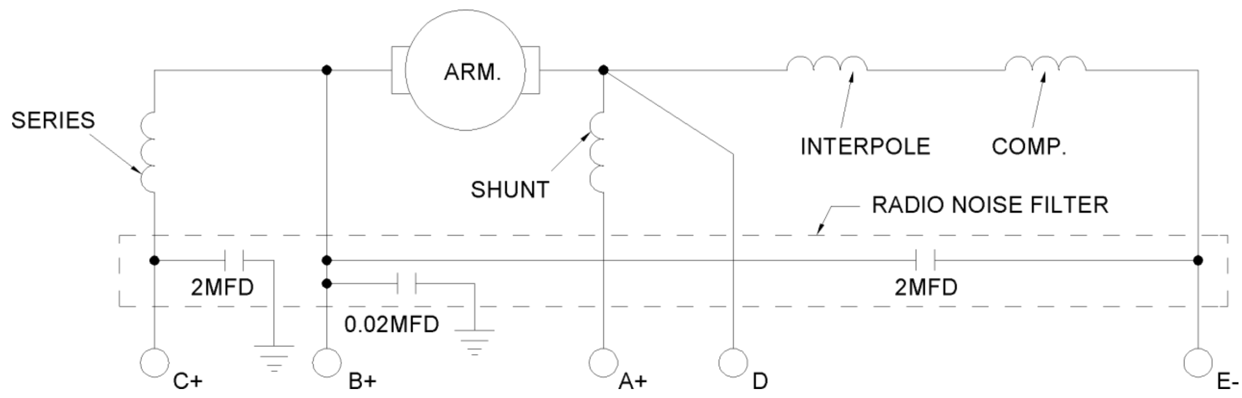

Figure 1002 - Electrical Connections

5. Test Procedures

This paragraph contains the required performance tests and the sequence in which they are to be accomplished.

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

A. Maximum Speed for Regulation (All models, but 23065-013-1, 23065-015-1,23065-015-3, 23065-020).

NOTE: Perform this test without operational warm-up.

(1) With regulator connected to the DC Starter-Generator, operate the DC Starter-Generator self-excited with no load, at 13,000 rpm and 30 VDC.

(2) Record the following:

- field current, A_1
- commutation (models 23065-004, -004M, -004T, -004TM, -008 and -009 only)
- frame temperature

(3) Acceptance Limits:

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

(b) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush (60) and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

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

B. Maximum Speed for Regulation (Models 23065-013-1, 23065-015-1, 23065-015-3 only).

NOTE: Perform this test without operational warm-up.

(1) With regulator connected to the DC Starter-Generator, operate the DC Starter-Generator self-excited with no load, at 13,000 rpm and 30 VDC.

(2) Record the following:

- field current, A_1
- B to A voltage

(3) Calculate resistance between terminals B and A.

$$\text{B to A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

(4) Acceptance Limits:

(a) B to A resistance must not be more than 35 Ω.

C. Continuous Operating Speed and Equalizing Voltage.

(1) For all models except 23065-015-3: with regulator connected to the DC Starter-Generator, operate the DC Starter-Generator self-excited, at the rpm, voltage, and ampere load given in Table 1003, until stabilized or until the frame temperature shows no more than 2° F (1,1° C) rise in 5 minutes.

(2) For model 23065-015-3: with regulator connected to the DC Starter-Generator, operate the DC Starter-Generator self-excited, at the rpm, voltage, and ampereload given in Table 1003, until stabilized or for a maximum of 15 minutes beforerecording details.

23065 Model	rpm	VDC	Amp Load	D-E Max.
23065-001, 23065-006	12,000	30	200	Figure 1003
23065 -004/-004M/ -004T/-004TM, -008, -009	12,000	30	200	Figure 1004

Table 1003 - Continuous Operating Values

23065 Model	rpm	VDC	Amp Load	D-E Max.
23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2	12,000	30	250	Figure 1005
23065-013-1	12,000	30	250	Figure 1006
23065-015-1	12,000	30	250	Figure 1007
23065-015-3	12,000	30	250	Figure 1008
23065-020	12,000	30	200	Figure 1009

Table 1003 - Continuous Operating Values (Continued)

(3) Record the following

- equalizing voltage (V_4) between terminals D and E,
- field current,
- commutation,
- air inlet temperature,
- winding or frame temperature.

(4) Acceptance Limits:

(a) The equalizing voltage (V_4) between terminals D and E must be a value between lines in figures referenced in Table 1003.

NOTE: In Figure 1003 through Figure 1009, the left-most graph line is minimum range and the right-most line is maximum range. An acceptable voltage falls between the two lines on the graph. If voltage is not within the limits, refer to Table 1008, Fault Isolation Chart, for possible remedies.

(b) Frame temperature must not be more than air inlet temperature by more than 175° F (79,4° C) for Models 23065-001, -004, -004M, -004T, -004TM, -006, -008, -009 only.

(c) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush (60) 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.

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

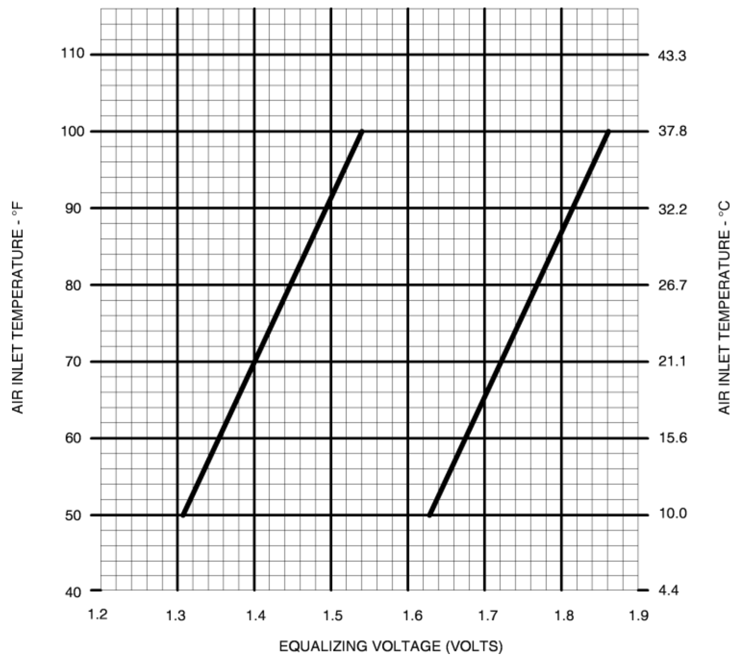

Figure 1003 - Equalizing Voltage (Models 23065-001, 23065-006)

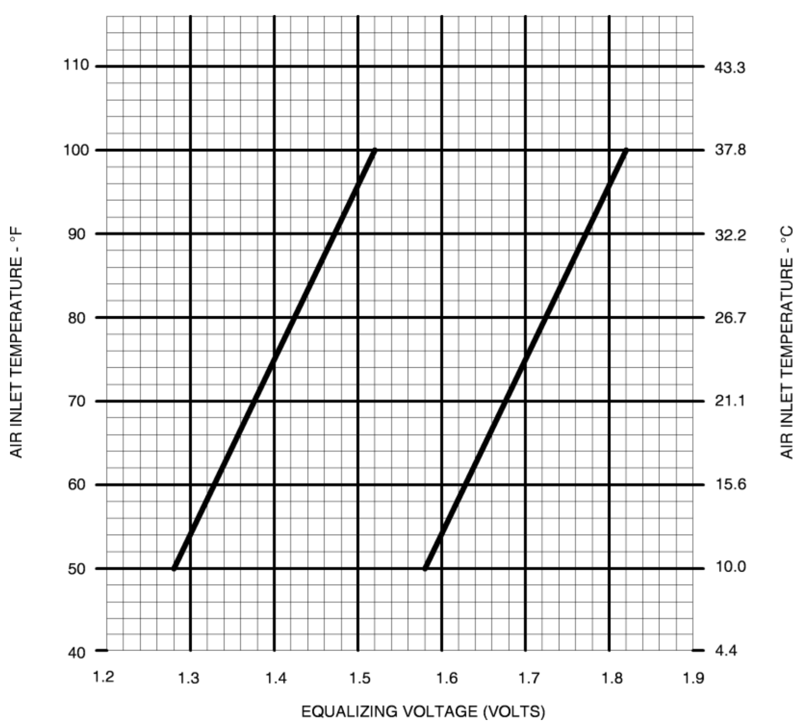

Figure 1004 - Equalizing Voltage (Models 23065-004/-004M/-004T/-004TM, 23065-008, 23065-009)

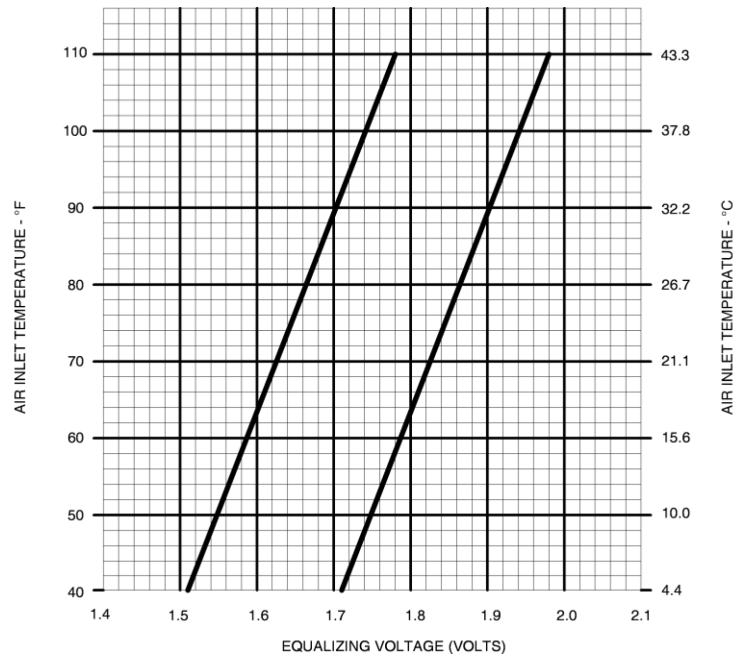

Figure 1005 - Equalizing Voltage (Models 23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2)

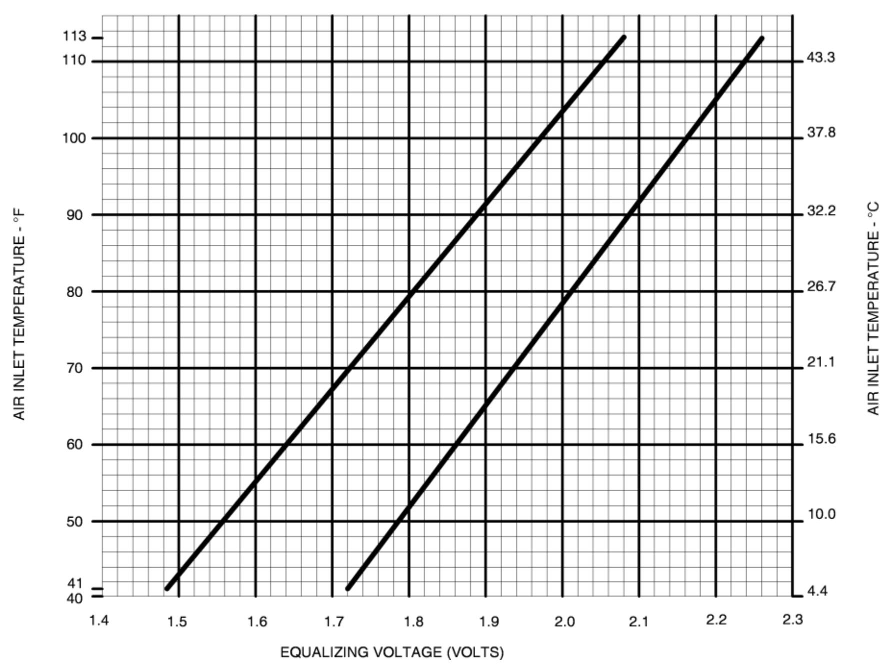

Figure 1006 - Equalizing Voltage (Model 23065-013-1)

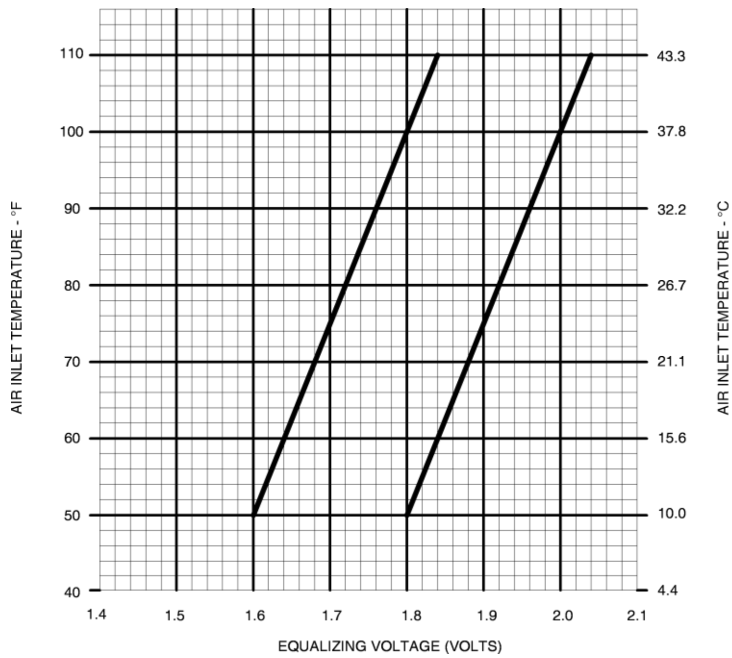

Figure 1007 - Equalizing Voltage (Model 23065-015-1)

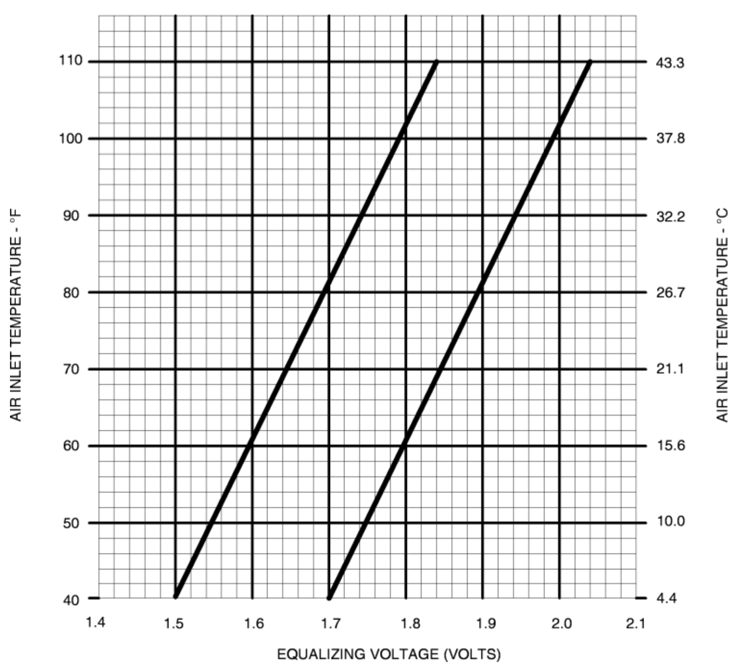

Figure 1008 - Equalizing Voltage (Model 23065-015-3)

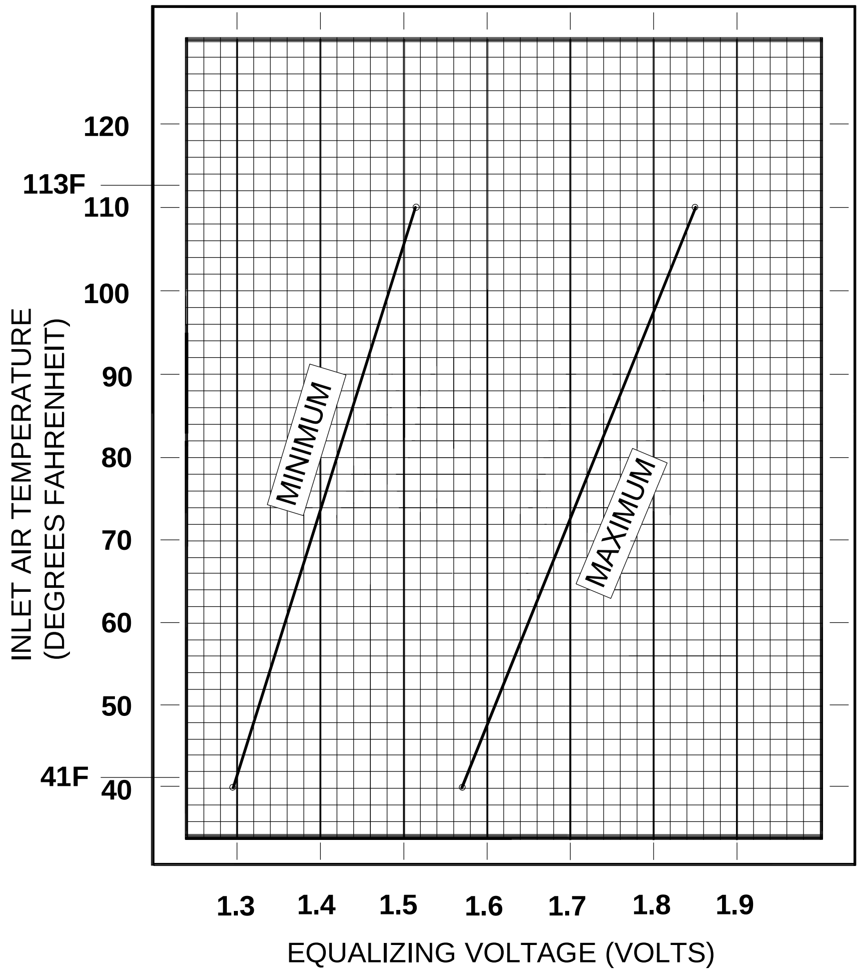

Figure 1009 - Equalizing Voltage (Model 23065-020)

D. Compounding (For models 23065-001, 23065-004/-004M/-004T/-004TM, 23065-006, 23065-008, 23065-009, 23065-013-1, 23065-015-1 and 23065-015-3).

(1) Operate DC Starter-Generator with the regulator connected, at the following rpm and voltage.

Model	rpm	VDC	Ampere Loads
23065-001, 23065-004/-004M/-004T/-004TM, 23065-006, 23065-008, 23065-009	12,000	30	0, 50, 100, 150, 200
23065-013-1, 23065-015-1, 23065-015-3	12,000	30	0, 62.5, 125, 187.5, 250

Table 1004 - Compounding

(2) Apply ampere loads as noted in Table 1004.

(3) Record field current for each load.

(4) Acceptance Limits:

(a) Field current must rise with increasing load.

E. Minimum Speed for Regulation.

(1) Disconnect the forced air supply tube on models 23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1 and 23065-018-2 only.

(2) Operate the DC Starter-Generator at the following rpm, voltage, and ampere load (stabilization not required).

NOTE: Operate models 23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1 and 23065-018-2 for 15 minutes before recording details.

Model	rpm	VDC	Ampere Loads
23065-001, 23065-004/-004M/-004T/-004TM, 23065-006, 23065-008, 23065-009, 23065-020	6500	30	200
23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2 **NOTE:** Run for 15 Minutes	6900	30	250
23065-013-1, 23065-015-1	6900	30	250
23065-015-3	6200	26	250

Table 1005 - Minimum Speed for Regulation

(3) Record the following:

- field current,
- frame temperature (for all models except 23065-013-1, 23065-015-1, 23065-015-3and 23065-020),
- voltage between B and A.
- residual voltage (for model 23065-020)

(4) Calculate resistance between terminals B and A.

$$\text{B to A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

(5) Acceptance limits:

(a) Field current must not be more than 8 A.

(b) Frame temperature must not be more than air inlet temperature by more than 280° F (137,8° C) for models 23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2.

(c) Residual Voltage: Must not be less than 0.5 V, for model 23065-020.

(d) B to A resistance must be a minimum of 1.25 Ω.

F. Minimum Speed Test.

(1) Disconnect forced air supply tube, if used.

(2) With regulator connected to the starter-generator, operate the starter-generator self-cooled at the following rpm, voltage and ampere load.

NOTE: Operate models 23065-001, 23065-006, 23065-013-1, 23065-015-1 and 23065-020 for 15 minutes before recording details.

Model	rpm	VDC	Ampere Loads
23065-001, 23065-004/-004M/-004T/-004TM, 23065-006, 23065-008, 23065-009, 23065-015-1, 23065-020	5800	26	200
23065-013-1	6200	26	200
23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2	6200	26	250

Table 1006 - Minimum Speed

(3) Record the following:

- field current
- frame temperature (for all models except 23065-013-1, 23065-015-1, 23065-015-3and 23065-020)
- voltage between B and A

(4) Calculate resistance between terminals B and A.

$$\text{B to A Resistance} = \frac{\text{B to A Voltage}}{\text{Field Current}}$$

(5) Acceptance limits:

(a) Field current must not be more than 8 A.

(b) B to A resistance must be a minimum of 1.25 Ω.

NOTE: With the generator still hot immediately proceed to overspeed test.

G. Overspeed Test (Models 23065-001, -004/-004M/-004T/-004TM, -006, -008, -009, -046).

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

(2) Acceptance limits:

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

H. Commutation check (Models 23065-001, -004/-004M/-004T/-004TM, -006, -008, -009, -046).

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

(2) Record the following (Models 23065-001, -004/-004M/-004T/-004TM, -006, -008, -009):

- field current (for models 23065-001, -004/-004M/-004T/-004TM, -006, -008, -009).
- frame temperature (for models 23065-001, -004/-004M/-004T/-004TM, -006, -008, -009).
- commutation

(3) Acceptance limits:

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

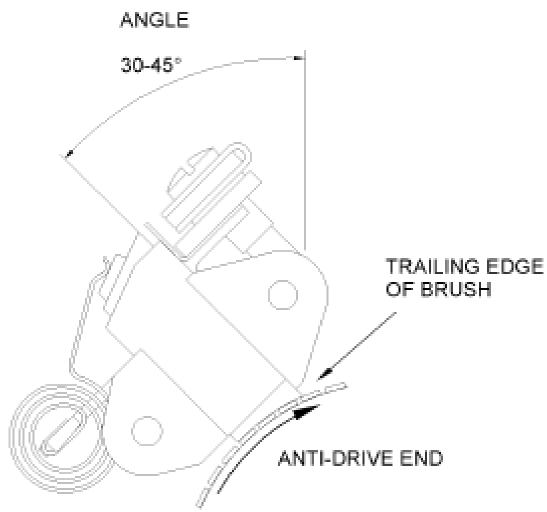

Figure 1010 - Correct Viewing Angles

I. Overspeed Test (Models 23065-013, 23065-015, 23065-015-2, 23065-018, 23065-018-1, 23065-018-2)

(1) With DC Starter-Generator hot and field circuit open, operate at 14,000 rpm for five (5) minutes.

(2) Reduce speed to 12,000 rpm.

(3) Close the field circuit switch and adjust generator output to supply 30 VDC and 250 A to the load.

J. Overspeed Test (Models 23065-013-1, 23065-015-1, 23065-015-3)

(1) With DC Starter-Generator hot and field circuit open, operate at 14,000 rpm for five minutes.

(2) Acceptance limits:

(a) There should be no indication of failure.

K. Commutation Test (Models 23065-013-1, 23065-015-1, 23065-015-3)

(1) With forced air supply and regulator connected, operate the generator at 30 VDC for speeds of 6500, 10,000, and 12,000 rpm, and at the following loads.

(a) 0.0 A, 125 A, and 250 A.

(2) Record the worst condition for commutation.

(3) Acceptance limits:

(a) Acceptable (pin point) commutation must be interpreted to permit continuous sparking that extends 0.12 inch (3,0 mm) beyond the edge of the brush (60) and occasional (no more than 10 per minute) single sparks that extend up to 0.25 inch (6,4 mm) beyond the edge of the brush.

Unacceptable commutation is considered to be continuous sparking or "arcing" beyond 0.25 inch (6,4 mm).

L. 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: CAPACITORS EMBEDDED IN RADIO NOISE FILTERS IN TERMINAL BLOCK WILL BE DAMAGED IF SUBJECTED TO DIELECTRIC TEST. ALWAYS DISCONNECT STATOR LEADS FROM TERMINAL BLOCK WHEN CONDUCTING DIELECTRIC TEST.

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

(1) Remove power from tester and remove DC Starter-Generator from test stand.

(2) Remove commutation viewing adapter.

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

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

(5) 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 V PER SECOND, MAXIMUM). INCREASING OR DECREASING THE VOLTAGE TOO QUICKLY CAN CAUSE SERIOUS DAMAGE TO THE STARTER-GENERATOR.

(6) 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.

(7) Slowly decrease voltage to zero.

(8) Turn the power supply OFF.

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

(10) Acceptance Limits:

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

M. No Load Starter Tests

For all models, except model 23065-020.

(1) Place starter-generator onto resilient cradle. Secure the starter-generator with strap.

(2) Install starter-generator and resilient cradle assembly onto starter test stand.

(3) Remove power from tester.

(4) Connect DC Starter-Generator as shown in Figure 1011 for models 23065-013, -017, -018, -020, -021, -022, -023, -027 and -028.

(5) Connect DC Starter-Generator as shown in Figure 1012 for models 23065-001, 004/ -004M/ -004T/ -004TM, -006, -008, -009.

NOTE: Make sure DC Starter-Generator is properly mounted by its flange.

(6) If applicable in Table 1007, connect a 1.25 Ω resistor between terminals A and B refer to Figure 1012, otherwise the A terminal is left open.

(7) Before turning power supply to ON, set power supply output to minimum.

(8) Turn ON power supply.

(9) With no load, gradually increase starter voltage between terminals C and E until voltage reaches values in Table 1007.

(10) Acceptance limits:

(a) At voltage specified, no-load speed must be equal to or more than associated rpm value.

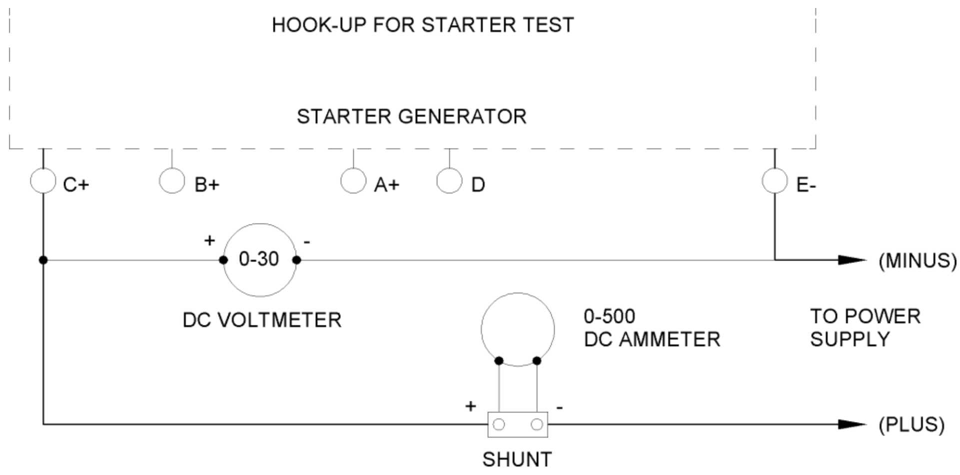

Figure 1011 - Starter Test Set-Up

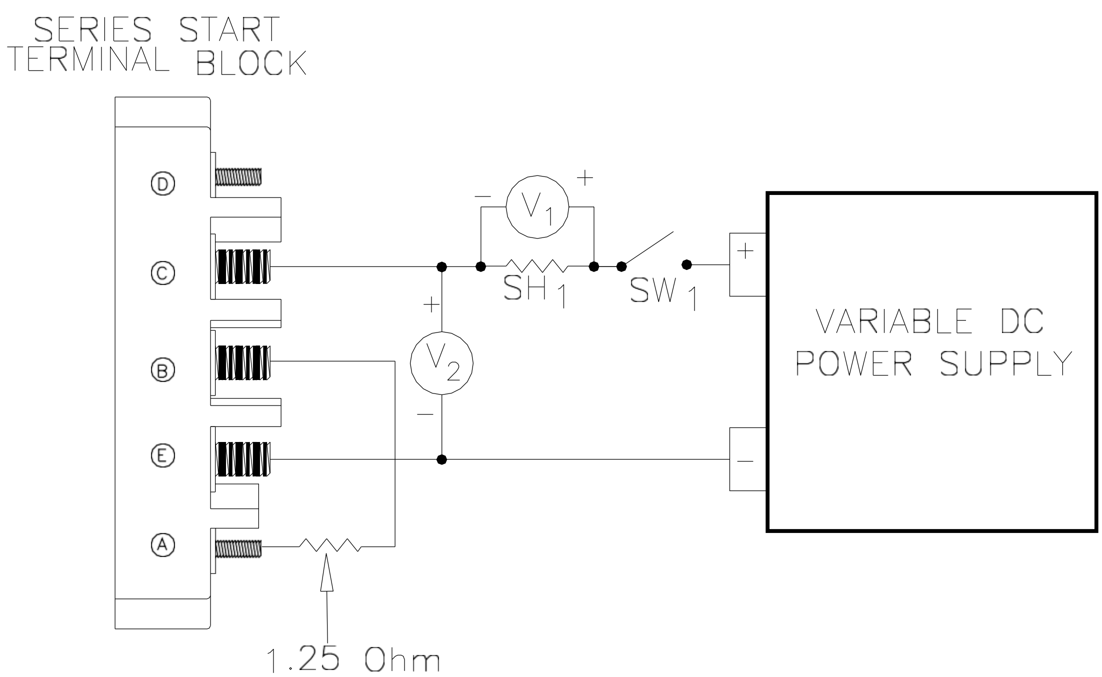

Figure 1012 - Starter Test Set-up for Models 23065-001, 23065-004/-004M/-004T/-004TM,
23065-006, 23065-008, 23065-009

Model	A to B Load Resistor	VDC	Minimum rpm
23065-001, 23065-004/-004M/-004T/-004TM, 23065-006, 23065-008, 23065-009	1.25 Ω	24	3500
23065-013, 23065-013-1, 23065-015, 23065-015-1, 23065-015-2, 23065-015-3, 23065-018, 23065-018-1, 23065-018-2,	None	15	4800

Table 1007 - Starter Tests

N. **Locked Rotor Test**

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

(1) Remove power from tester.

(2) Make sure the DC Starter-Generator is securely mounted on the test stand and the rotor is locked.

(3) Remove the 1.25 Ω resistor from models 23065-004, -004M, -004T, -004TM, -008 and -009 that was used in the previous “No Load Starter Tests”.

NOTE: Shunt field (A+) must be open (no connection) for this test for all models but models 23065-001 and -006 which require a 1.25 Ω resistor be placed between the A and B terminals.

(4) If testing models 23065-001 and -006 install a 1.25 Ω resistor between the A and B terminals.

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

(6) Turn ON power supply.

CAUTION: DO NOT ENERGIZE GENERATOR FOR MORE THAN FIVE SECONDS FOR ALL MODELS BUT 23065-001 AND -006. FOR MODELS 23065-001 AND -006 DO NOT ENERGIZE GENERATOR FOR MORE THAN TWO SECONDS.

(7) With no load, gradually increase voltage between terminals C and E until the output torque is 20 ft-lb. (27 N·m).

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

(9) Measure and record voltage between terminals C and E (V_2).

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

(10) Turn the power supply OFF.

(11) Disconnect the electrical test leads and remove the Starter-Generator from the test stand.

(12) Acceptance limits:

(a) At 20 ft-lb (27 N·m) of torque, C-to-E voltage must not be more than 13 VDC and current must not be more than 500 A.

(13) If testing models 23065-001 and -006 remove the 1.25 Ω resistor between the A and B terminals and repeat Paragraph 5.N.(7) through Paragraph 5.N.(11) with the A terminal open. The test results must be the same.

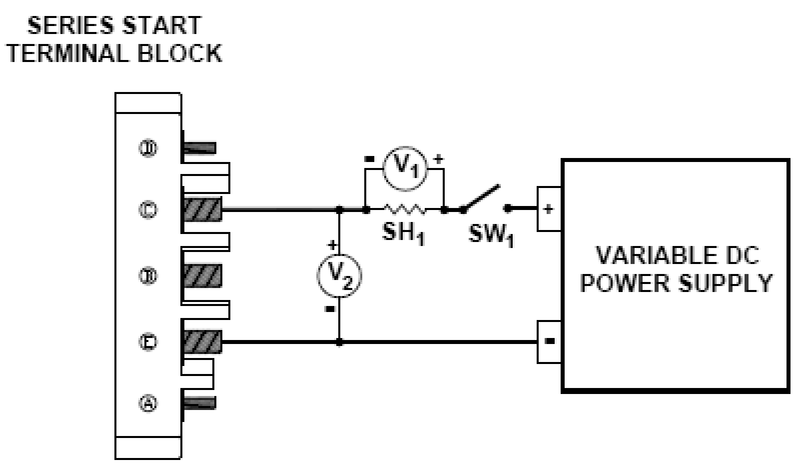

Figure 1013 - Series Start Locked Armature Test Connection Diagram

O. Commutator Run-Out.

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

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

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

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

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

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

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

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

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

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

(8) Acceptance Limits:

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

(b) Total Runout:

- For all models but models 23065-013-1 and -020: 0.0008 inch (0,020 mm)Maximum.
- For models 23065-013-1 and -020: 0.0007 inch (0,015 mm) Maximum.

6. Fault Isolation Chart

Table 1008 lists faults that can occur during acceptance testing, performance testing, or while in service. For each fault, probable causes are listed along with related corrective actions. When a fault is detected, perform the corrective actions necessary to return the DC Starter-Generator to a serviceable condition. A complete acceptance test is required after the corrective action is accomplished.

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
A. Maximum Speed for Regulation Test		
The field current limit is exceeded (A_1).	Too much load was applied during testing.	Check applied load at load bank. Apply correct load.
	Stator windings are shorted or grounded.	Clean stator and housing assembly, refer to procedure in CLEANING section.
		Dielectric test stator and housing assembly, refer to CHECK section.
		Replace stator and housing assembly if it fails the dielectric test.
	Armature is shorted or grounded.	Clean armature, refer to procedure in CLEANING section
		Dielectric test components of the armature, refer to the CHECK section.
		Replace armature if fails dielectric test.

Table 1008 - Fault Isolation Chart

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Too much sparking with no load.	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	One or more complete brush holders are loose.	Check attaching hardware. If damage is found, Repair bearing and brush support assembly as necessary. Do dielectric test on bearing and brush support assembly according to procedure in CHECK section. Do brush run-in procedure. Refer to SPD 1006.
	Brush spring pressure below limit.	Check brush spring pressure. Refer to SPD 1006. Replace brush springs that do not meet limits in FITS AND CLEARANCES section.
	An armature winding is partially or completely open.	Replace armature.
	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Do brush run-in procedure. Refer to SPD 1006.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, Replace stator and housing assembly.
	Armature is out of balance.	Check armature balance. Refer to SPD 1000. Repair or replace armature as necessary.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
B. Continuous Operating Speed, Equalizing Voltage and Minimum Speed Test		
High Equalizing Voltage (V_4).	Cooling air flow is low.	Check air flow path for obstructions. Clear all obstructions.
	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	Loose brush lead(s).	Inspect all brush leads for loose connections. If loose brush lead is found and no evidence of arcing is present, secure brush lead to complete brush holder. If loose brush is found and evidence of arcing is present, Replace brush.
	Brush circuit(s) open.	Inspect all brush leads for an open circuit. If open circuit found, overhaul or repair starter-generator as necessary.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Do dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
Field current (A_1) limit is exceeded.	Too much load applied during testing.	Check and adjust applied load at load bank, as necessary.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Low external field resistance.	Cooling air flow is low.	Check air flow path for obstructions. Clear all obstructions.
	Brushes are not properly seated.	Do brush run-in procedure. Refer to SPD 1006.
	Brushes hung up in complete brush holder.	Inspect for proper positioning.
	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Do brush run-in procedure. Refer to SPD 1006.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Do dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Too much sparking with no load.	Brushes are not properly seated.	Do brush run-in procedure. Refer to SPD 1006.
	One or more complete brush holders are loose.	Check attaching hardware. If damage is found, REPAIR bearing and brush support assembly as necessary. Do dielectric test on bearing and brush support assembly according to procedure in CHECK section. Do brush run-in procedure. Refer to SPD 1006.
	Brush spring pressure below limit.	Check brush spring pressure. Refer to SPD 1006. Replace brush springs that do not meet limits in FITS AND CLEARANCES section.
	An armature winding is partially or completely open.	Replace armature.
	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Do brush run-in procedure. Refer to SPD 1006.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, Replace stator and housing assembly.
	Armature is out of balance.	Check armature balance. Refer to SPD 1000. Repair or Replace armature as necessary.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
C. Compounding Test		
Shunt field current does not increase with load.	Stator compensating windings bad.	Replace stator and housing assembly.
D. Minimum Speed for Regulation Test		
Field current (A_1) limit is exceeded.	Too much load applied during testing.	Check and adjust applied load at load bank, as necessary.
Low external field resistance.	Cooling air flow is low.	Check air flow path for obstructions. Clear all obstructions.
	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	Brushes hung up in complete brush holder.	Inspect for proper positioning.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Do brush run-in procedure. Refer to SPD 1006.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Perform dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
E. Overspeed Test		
Noisy Operation.	Bearings are defective and/or installed incorrectly.	Replace bearings.
	Cooling fan blades rubbing or are out of balance.	Check fan blades and air inlet for damage. Replace cooling fan if damaged. Repair or replace air inlet if damaged. NOTE: There are no authorized repair procedures to balance cooling fans.
	Drive shaft spline is worn.	Disassemble drive shaft from starter-generator. Inspect drive shaft IAW to the CHECK section. Repair or replace drive shaft as necessary.
	Armature striking against the stator and housing assembly.	Disassemble starter-generator. Check both parts for physical damage. Repair or replace damaged parts as necessary.
Starter-Generator vibrates.	Bearings are defective and/or installed incorrectly.	Visually inspect bearings. Disassemble starter-generator and replace bearings as necessary.
	Armature is out of balance.	Disassemble starter-generator. Check armature balance. Refer to SPD 1000. Repair or replace armature as necessary in accordance with SPD 1000.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Too much sparking with no load.	Brushes are not properly seated.	Perform brush run-in procedure. Refer to SPD 1006.
	One or more complete brush holders are loose.	Check attaching hardware. If damage is found, Repair bearing and brush support assembly as necessary. Do dielectric test on bearing and brush support assembly according to procedure in CHECK section. Do brush run-in procedure. Refer to SPD 1006.
	Brush spring pressure below limit.	Check brush spring pressure. Refer to SPD 1006. Replace brush springs that do not meet limits in FITS AND CLEARANCES section.
	An armature winding is partially or completely open.	Replace armature.
	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Do brush run-in procedure. Refer to SPD 1006.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, Replace stator and housing assembly.
	Armature is out of balance.	Check armature balance. Refer to SPD 1000. Repair or Replace armature as necessary.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
F. Commutation Test		
Too much sparking with no load.	Brushes are not properly seated.	Do brush run-in procedure. Refer to SPD 1006.
	One or more complete brush holders are loose.	Check attaching hardware. If damage is found, REPAIR bearing and brush support assembly as necessary. Do dielectric test on bearing and brush support assembly according to procedure in CHECK section. Do brush run-in procedure. Refer to SPD 1006.
	Brush spring pressure below limit.	Check brush spring pressure. Refer to SPD 1006. Replace brush springs that do not meet limits in FITS AND CLEARANCES section.
	An armature winding is partially or completely open.	Replace armature.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Too much sparking with no load. (Continued)	Commutator surface incorrectly filmed or irregular.	Check armature. Refer to CHECK section. Repair commutator surface or replace armature. Refer to REPAIR section. Do brush run-in procedure. Refer to SPD 1006.
	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
	Armature is out of balance.	Check armature balance. Refer to SPD 1000. Repair or replace armature as necessary.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
G. Starter-Generator Dielectric Test		
Starter-Generator insulation breakdown.	Bearing and brush support assembly is grounded.	Disassemble the starter-generator. Clean bearing and brush support assembly. Refer to CLEANING section. Do dielectric test on bearing and brush support assembly according to procedure in CHECK section. If bearing and brush support assembly fails dielectric test, replace insulating sleeves and washers, according to the procedures in the disassembly and assembly section.
	Armature is grounded.	Disassemble the starter-generator. Clean armature. Refer to CLEANING section. Do dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Stator and housing assembly is grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do 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.
H. Starter Test		
Low no-load speed	Open circuit in armature.	Replace armature.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
I. Locked Rotor Test		
Low or no torque.	Stator and housing assembly is shorted or grounded.	Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
	Armature is shorted or grounded.	Clean armature. Refer to CLEANING section. Do dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
	Brushes incorrectly seated or installed.	Remove the brush cover. Using a wire hook tool, pull brush sets away from commutator surface. Check commutator surface for damage. Repair, if limits are not exceeded in FITS AND CLEARANCES section. Do brush run-in procedure. Refer to SPD 1006. Re-test starter-generator.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Low or no torque. (Continued)	Open brush circuit.	Remove the brush cover. Inspect all brush leads for an open circuit. If an open circuit is found, replace brush (new brush only). Do brush run-in procedure. Refer to SPD 1006. Re-test starter-generator.
Calculated efficiency is below minimum limit.	Windings hot from testing.	Allow the windings to cool. Repeat test.
	Field current is low.	Check field circuit for high resistance.
	Brushes are incorrectly seated or installed.	Refer to SPD 1006 for brush installation, seating, and run-in procedures.
Time to reach specified rpm exceeds minimum limit.	Windings hot from testing.	Allow the windings to cool. Repeat test.
	Field current is low.	Check field circuit for high resistance.
	Brushes are incorrectly seated or installed.	Refer to SPD 1006 for brush installation, seating, and run-in procedures.

Table 1008 - Fault Isolation Chart (Continued)

FAULT	PROBABLE CAUSE	CORRECTIVE ACTION
Line current (V_1/SH_1) or voltage between terminals B and E (V_2) exceeded.	Stator and housing assembly is shorted or grounded.	Disassemble the starter-generator. Clean stator and housing assembly. Refer to CLEANING section. Do dielectric test on stator and housing assembly according to procedure in CHECK section. If stator and housing assembly fails dielectric tests, replace stator and housing assembly.
	Armature is shorted or grounded.	Disassemble the starter-generator. Clean armature. Refer to CLEANING section. Do dielectric test on armature according to procedure in CHECK section. If armature fails dielectric tests, check armature for a short with a growler. Refer to the CHECK section. If armature fails growler check, replace armature.
J. Commutator Runout Check		
Bar-to-bar runout or total indicated runout exceeded.	Shifted commutator bars.	Repair commutator surface. Replace armature if not repairable.

Table 1008 - Fault Isolation Chart (Continued)

7. Component Testing Fault Isolation Chart

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

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

Table 1009 - Component Testing Fault Isolation Chart

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

Table 1009 - Component Testing Fault Isolation Chart (Continued)

Verification/Final Acceptance Data Sheet

Model Number: **23065-** ______ Inspected by: ______

Serial Number: ______ Date: ______

Inspection/Test	Requirements/Limits	Measurement	Accept	Reject
Visual Inspection	Check for physical damage			
Brush Seating	Brushes must be seated 100% in the direction of rotation, and at least the percentage (75% or 90%) specified in Table 1001 in the axial direction.			
Max. Speed for Regulation Test (All models, but not for 23065-013-1, 23065-015-1, 23065-015-3, 23065-020)	Shunt field current must not be less than 0.81 A.	A		
	Commutation must not be more than pinpoint sparking.			
Max. Speed for Regulation Test (Only 23065-013-1, 23065-015-1, 23065-015-3)	B-to-A resistance must not be more than 35 Ω.	Ω		
	Commutation must not be more than pinpoint sparking.			
Continuous Operating Speed and Equalizing Voltage Test	Frame temperature must not be more than air inlet temperature by more than 175° F (79,4° C).	° F (°C)		
	Equalizing voltage must be within the limits specified in Paragraph 5.C.(4).	V T		
	Commutation must not be more than pinpoint sparking.			
Compounding	Field current rises as load increases.	A		
Residual Voltage Test (for model 23065-020)	B to E residual voltage (0.5 VDC Min) (V_2)	VDC		

Inspection/Test	Requirements/Limits	Measurement	Accept	Reject
Min. Speed for Regulation Test (* For all models except 23065-013-1, 23065-015-1, 23065-015-3, 23065-020)	Field current must not be more than 8.0 A.	A		
	* Frame temperature must not be more than air inlet temperature by more than 280° F (137,8° C).	° F (°C)		
	(B to A) resistance must be a minimum of 1.25 Ω.	Ω		
Min. Speed Test	Field current must not be more than 8.0 A.	A		
	Voltage between terminals B and A (V3)	VDC		
	(B to A) resistance must be a minimum of 1.25 Ω.	Ω		
Commutation Test	Field Current	A		
	Frame Temperature	° F (°C)		
	Commutation must not be more than pinpoints at all test speeds and loads.			
Overspeed Test	No sign of electrical or mechanical failure			
Dielectric Test	No evidence of insulation breakdown. Leakage (5mA Max)	mA		
Starter Test (* Models 23065-001, -004, -004M, -004T, -004TM, -006, -008, or -009 only)	* At 24 VDC, no load starter speed must not be less than 3500 rpm.	rpm		
	At 15 VDC, no load starter speed must not be less than 4800 rpm.	rpm		
Locked Rotor Test	At 20 ft-lb (27 N·m) of torque, C-to-E voltage must not be more than 13 VDC and current must not be more than 500 A.	V A		

Inspection/Test	Requirements/Limits	Measurement	Accept	Reject
Commutator Run-out	Total indicated runout must not be more than 0.0007 inch (0,015 mm) (models 23065-013-1 and -020) or 0.0008 inch (0,020 mm) (all other models)	inch (mm)		
	Bar-to-bar run-out must not be more than 0.0002 inch (0,005 mm)	inch (mm)		

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SCHEMATICS AND WIRING DIAGRAMS

1. Introduction

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DISASSEMBLY

1. Introduction

This section gives the disassembly instructions for Model 23065 Series of DC Starter-Generators. Additional disassembly of major components is not necessary unless further disassembly is indicated in the CHECK or TESTING AND FAULT ISOLATION sections. Do not open or desolder permanent connections unless worn, damaged or defective parts need to be replaced.

- Do not remove threaded inserts. Refer to CHECK section for details.
- Do not disassemble riveted parts. Refer to REPAIR section to determine whether part(s) can be replaced.
- Do not open or desolder permanent connections unless replacement of worn, damaged, or defective parts is necessary. Use ANSI/IPC J-STD-001 for soldering/desoldering. Tag electrical wires before removal.
- When a starter-generator is removed for service, the QAD kit usually stays on the aircraft.

2. Disassembly Tools

In addition to normal shop tools, the tools and materials listed in Table 3001 are needed for generator disassembly.

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

Tool Description	Reference
Arbor press	Not illustrated
Dampener hub driver	Figure 9003
Inner race bearing driver	Figure 9006
Leather or plastic mallet	Commercially available
Retaining ring pliers	Commercially available
Bearing puller	Commercially available
Spline wrench	Figure 9001
Drive end armature shaft adapter	Figure 9004
Anti-drive end armature shaft adapter	Figure 9005
Support, Anti-Drive End Hub	Figure 9002

Table 3001 - Disassembly Tools

Tool Description	Reference
Support, Bearing and Brush Support Assembly	Figure 9013
Support, Drive End Hub (Outboard)	Figure 9015
Support, Horizontal Stator	Figure 9012
Support, Vertical Stator	Figure 9011
Tweezers	Commercially Available
Wire Hook Tool	Commercially Available

Table 3001 - Disassembly Tools (Continued)

3. Disassembly Materials

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

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

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

Item	Description/Specification	Source (CAGE Code)
Foam Cushion	N/A	Commercially Available
Isopropyl Alcohol See **WARNING** before using this material.	TT-I-735, Grade A Flash Point: 53° F (11,7° 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

The following procedures detail the basic disassembly of the DC Starter-Generator.

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

(1) Do not remove the identification plate (345), instruction decal (335), FAA/PMA label (336), or MOD Status label (340) unless damaged or unreadable.

(2) Do not disassemble the following components unless they are damaged:

- Drive end bearing support assembly (115)
- Bearing and brush support assembly (200)
- Stator and housing assembly (275)

(3) During disassembly, inspect component parts in accordance with procedures in the CHECK section of this manual.

A. If used, remove preformed packing (90) from drive shaft (85) and discard.

B. If used, remove air inlet assembly (5) and fan cover (25).

(1) Loosen and remove rim clenching clamp (10) and remove air inlet from bearing and brush support assembly (200).

(2) Twist fan cover (25) to unlock and remove from bearing and brush support assembly (200).

NOTE: Do not disassemble air inlet unless damaged. Screws (15) and washers (20) allow disassembly of the air inlet.

C. If used, remove fan cover assembly (25A).

(1) Loosen and remove four screws (40) and remove fan cover from bearing and brush support assembly (200).

D. Remove brush cover (50) from stator and housing assembly (275).

(1) Remove screw (55) from self-locking blind rivet nut (56) that secures brush cover (50) around stator and housing assembly (275).

(2) Slide brush cover (50) off of anti-drive end of unit.

E. Remove brushes (60) from brush holders (255).

(1) Remove four screws (65) that secure brush and field leads.

(2) Remove four brushes (60) from brush holders.

F. Remove fan assembly (70) from drive shaft (85).

(1) Use a suitable spline wrench (Figure 9001) to hold drive shaft (85).

(2) Remove nut (75) and washer (80).

(3) Remove fan assembly (70) from drive shaft (85).

G. Remove drive shaft (85) and associated dampener parts.

(1) Tap drive shaft (85) out of driven end of stator and housing assembly by using a plastic or leather hammer.

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

(2) Remove dampener plate (95) and friction ring (105). See Figure 3001.

NOTE: Remove dampener hub (100) from drive shaft (85) only if damaged and replacement is necessary.

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

(a) Put a foam cushion and an anti-drive end hub support (Figure 9002) on the table of an arbor press.

(b) Position a dampener hub driver (Figure 9003) on the flat side of the dampener hub (100).

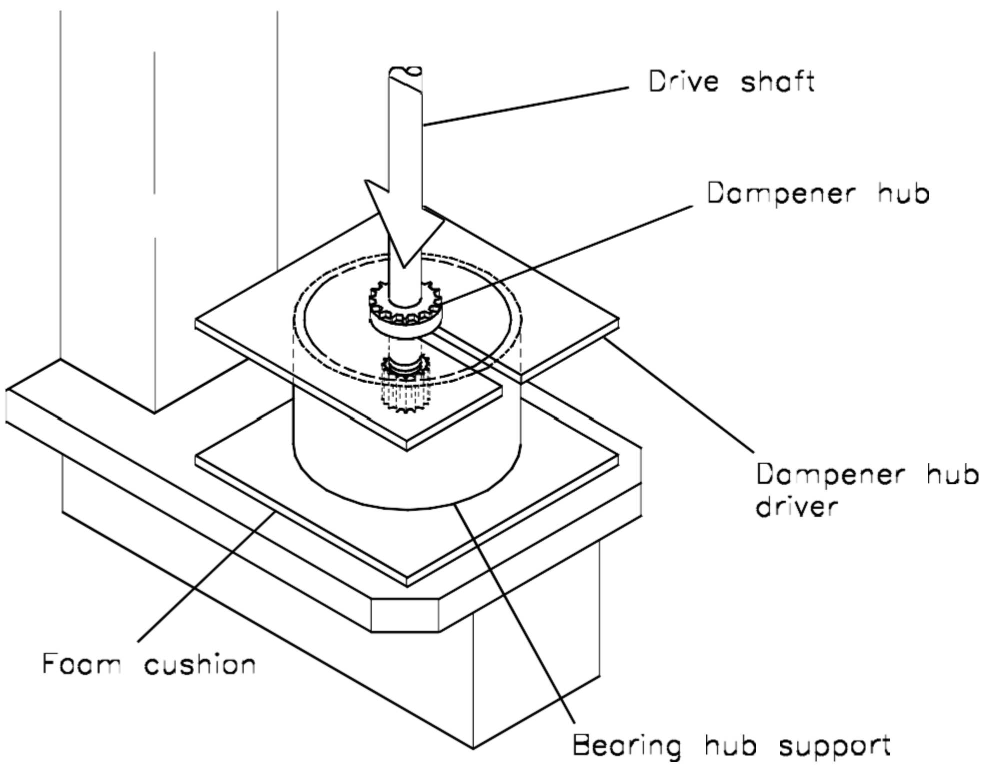

Figure 3001 - Dampener Hub Removal

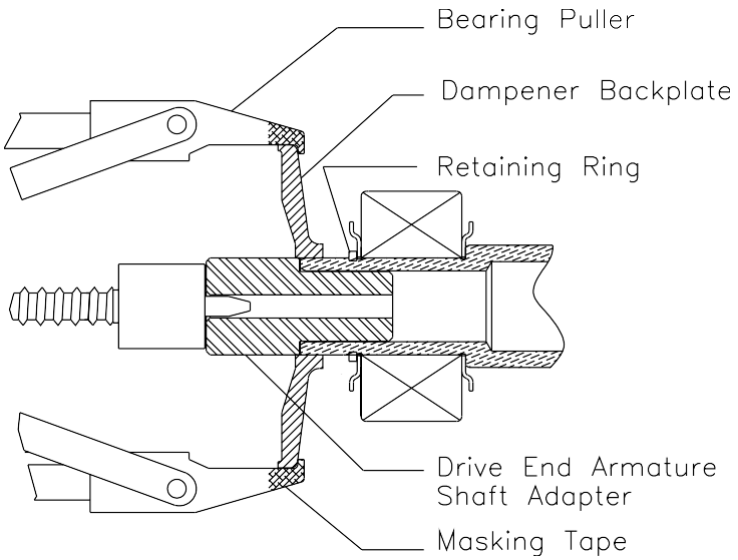

Figure 3002 - Dampener Backplate Removal

(c) Insert the drive spline through the center of the bearing hub support until the dampener hub driver rests on the bearing hub support.

(d) Press down gently on the anti-drive end of the drive shaft (85) with the arbor press until the dampener hub (100) disengages from the drive shaft (85).

CAUTION: TAPE JAWS OF BEARING PULLER TO PREVENT DAMAGE TO CHAMFERED FACE OF BACK PLATE DURING REMOVAL.

(3) Using a suitable bearing puller and drive end armature shaft adapter (See Figure 9004), carefully remove dampener back plate (110) from armature (175) shaft. See Figure 3002.

H. Remove drive end bearing support assembly (115), P/N 23046-1171.

(1) Remove eight screws (120), washers (125), and lock washers (130) and carefully remove drive end bearing support assembly (115) from stator and housing assembly (275).

(2) If repair of drive end end bell (150) is necessary, remove four drive screws (140), washers (145), and screen (135) from drive end bearing support assembly.

I. Remove drive end bearing support assembly (115), P/Ns 23065-1470 and 23046-1670.

(1) Remove 12 screws (120) and carefully remove drive end bearing support assembly (115) from stator and housing assembly (275).

(2) If repair of drive end end bell (155) is necessary, remove six drive screws (140), washers (145), and screen (135) from drive end bearing support assembly.

J. Remove bearing and brush support assembly (200).

(1) Remove eight screws (205), washers (210), and lock washers (215).

(2) With armature (175) attached, carefully remove armature and bearing and brush support assembly from stator and housing assembly.

K. Separate and remove bearing and brush support assembly (200) from armature (175). See Figure 3003.

(1) Using a hub support, place armature, drive end down, into support until bearing and brush support rest on top of support.

(2) Using an anti-drive end armature shaft adapter, (Figure 9005) press armature (175) out of bearing (190).

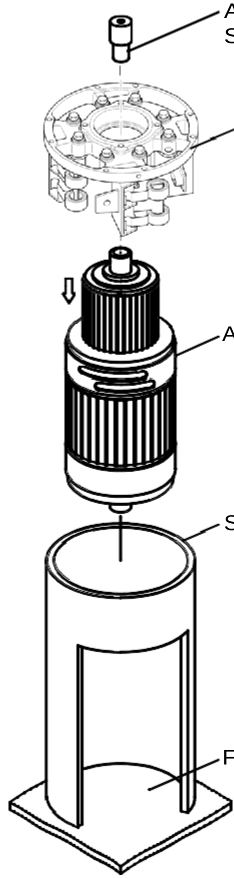

Figure 3003 - Removing Armature from Bearing and Brush Support Assembly

L. Disassemble bearing from armature (175).

(1) At drive end of armature, remove retaining ring (160) and baffle disc (165) from armature shaft.

(2) Using a suitable bearing puller and drive end armature shaft adapter, remove bearing (170) from armature shaft.

(3) Remove remaining baffle disc (165) from armature shaft.

M. Disassemble bearing and brush support assembly (200).

(1) Remove four screws (185) and remove bearing retainer (180).

(2) Using hub support (Figure 9002) and an inner race bearing driver (Figure 9006), press ball bearing (190) out of bearing and brush support assembly (200).

(3) Do not remove brush holder assemblies (220) and springs (245) from bearing and brush support assembly unless inspection reveals that replacement of parts is required. If necessary, disassembly is performed as follows.

NOTE: There are studded and studless styles of brush holder. The studded type contains threaded studs (250) that go through the end bell (270) and are secured with a nut (230) on the fan side of the end bell. The studless type uses a mounting bolt (225) that screws into the brush holder (255) through the end bell.

(a) Remove brush holder assemblies (220) by removing bolts (225) or nuts (230), washers (235), non-metallic washers (240), insulation sleeves (260), and insulation plates (265).

(b) Unclip and remove brush springs (245) from brush holder (255).

N. Disassemble stator and housing assembly (275).

NOTE: Do not disassemble stator and housing assembly beyond removing the terminal block (280).

(1) If removal of terminal block (280) is necessary, proceed as follows:

(a) Remove large terminal stud nuts (300) and washers (305) from terminal studs B, C, and E.

(b) Remove small terminal stud nuts (310) and washers (315) from terminal studs A and D.

(c) Remove two terminal block mounting screws (285), washers (290), and lock-washers (295).

(d) Carefully disconnect stator lead wires from the terminal block studs and reposition to allow removal of the terminal block (280).

(2) If isolation of terminal block grounding lead is necessary, proceed as follow:

(a) Remove screw (285) and flat washer (290) and remove terminal block grounding lead.

O. If used and if they are damaged then, remove instruction decal (335), FAA-PMA label (336), information plate (337), modification status label (340) or identification plate (345).

NOTE: The removal procedure is identical for instruction decal (335), FAA-PMA label (336), information plate (337) and modification status label (340). The procedure to remove instruction decal (335) is given in Paragraph 4.O.(2).

(1) Remove the identification plate (345) from the DC Starter-Generator as follows:

(a) 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 (350) that hold it in place to dislodge the plate from the housing.

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

NOTE: Discard the old identification plate, after its manufacturing information has been transferred to the new replacement ID nameplate.

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

(c) 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.

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

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.

(2) Remove instruction decal (335) using an appropriate scraper and cleaning gum residue with isopropyl alcohol.

CLEANING

1. Introduction

This section provides cleaning procedures for the 23065 Series DC Starter-Generators.

2. Cleaning Materials

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

Table 4001 lists the materials required to clean the generator.

Material	Description/Specification	Source
Brush	Non-metallic, soft bristle	Commercially available
Cleaning pads/Wiping cloths	Lint-free, soft fabric	Commercially available
Detergent Refer to the material technical data sheet for recommended dilution and application temperature. The detergent used must not be destructive to the finish or material of the part.	Formula 815 GD or GD-NF Applications: (1) Hot tanks - aluminum safe (2) Steam cleaning (3) Pressure sprayers (4) Ultrasonic cleaning (5) Formula 1990 GD Application: (1) Spray wash cleaning	The Brulin Corporation Indianapolis, IN The Brulin Corporation Indianapolis, IN
Isopropyl alcohol	TT-I-735, Grade A See the **WARNING** above before using this material. Flash point: 53° F (11,7° C), flammable Refer to the material safety data sheet for additional safety information.	Commercially available

Table 4001 - Cleaning Materials

Material	Description/Specification	Source
Cleaning solvent	MIL-PRF-680 Type I - Stoddard Solvent Type II - 140° F (60° C) Solvent See the **WARNING** above before using this material. Refer to the material safety data sheet for additional safety information.	Commercially available
Corrosion Preventive Cold application	Water displacing soft film MIL-C-16173, Grade 3.	Commercially available

Table 4001 - Cleaning Materials (Continued)

3. Cleaning Procedures

Before performing the check, repair, assembly, acceptance testing, and final inspection procedures, the components of the generator 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 DC Starter-Generator according to the following procedures.

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

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

A. Blow out dirt particles.

(1) Put the air inlet, metal dampener components, drive shaft, armature assembly, drive end bearing support assembly, bearing and brush support assembly, and the stator and housing assembly into a ventilated air spray booth.

(2) Blow away all evidence of dirt with clean and dry compressed air.

B. Clean parts and assemblies.

CAUTION: DO NOT SOAK ALUMINUM OR IVD COATED PARTS FOR MORE THAN 30 MINUTES. A CHEMICAL REACTION CAN RESULT THAT WILL LEAVE THE PART IN AN UNSERVICEABLE CONDITION.

(1) With the exception of the armature and the stator and housing, wash parts using one or more of the approved cleaning procedures outlined in Table 4002.

NOTE: Remove brushes before cleaning.

Procedure	Instruction
Spray	**CAUTION:** MAKE SURE TO LIMIT THE PRESSURE USED TO CLEAN PARTS. HIGH PRESSURE CAN REMOVE OR DAMAGE SURFACE COATINGS, CONNECTIONS, AND INSULATION.
	(1) Put parts into a high pressure spray wash booth.
	(2) Spray parts with a solution of detergent and water. Refer to the material technical data sheet for the recommended dilution of water and detergent and solution temperature.
Ultrasonic	**CAUTION:** DO NOT PUT ALUMINUM PARTS INTO AN ULTRASONIC TANK. PLATING, BLACK OXIDE COATINGS, AND DIMENSIONAL TOLERANCES CAN BE DAMAGED BY ULTRASONIC CLEANING.
	(1) Put parts into the ultrasonic cleaning tank.
	(2) Allow parts to soak for 15 to 20 minutes maximum. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(3) Remove all evidence of dirt with a soft bristle brush or cleaning rag.
Agitation	(1) Put all parts in an agitation tank. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(2) Agitate until all evidence of dirt can be removed from parts with a soft bristle brush or cleaning rag.
Soak	(1) Put all parts into a soaking tank. NOTE: Restrict immersion time of armature and stator to 10 minutes.
	(2) Soak parts until all evidence of dirt can be removed with a soft bristle brush or cleaning rag.

Table 4002 - Cleaning Procedures

(2) Rinse parts.

NOTE: Use minimal pressure to rinse parts.

(a) Put parts into a pressure spray wash booth.

(b) Use soft bristle brush to clean foreign material from slots between commutator bars.

(c) Flush parts using hot water or steam.

(3) Repeat the applicable cleaning procedure as necessary until parts are clean and free of dirt.

(4) 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.

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

(b) 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.

(c) 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.

C. Clean the armature and stator and housing.

(1) Use isopropyl alcohol with a soft bristle brush to remove oily film from the armature and stator and housing components. A spray mist application is acceptable if immediately followed by wiping and drying.

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

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

(2) Dry parts with cleaning cloths or clean, dry, low velocity, filtered compressed air, 29 psig (200 kPa) maximum pressure.

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

4. Corrosion Preventive

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

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

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

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

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

5. Cleaning After Liquid Penetrant Inspection

A. Description

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

B. Procedure

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

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

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

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

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

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

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

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

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

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

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

(b) Use compressed air to remove rinse water.

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

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

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

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

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

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

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

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

CHECK

1. Introduction

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

This section provides figures and tables with information that is needed to perform a satisfactory inspection of the unit components. During an overhaul of the unit, all primary components must be examined to find out if they are serviceable.

A part must be rejected if wear or damage is outside acceptance limits or if the part is not serviceable.

2. Inspection Tools and Materials

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

The following tools and materials are needed to examine the unit. Equivalent substitutes can be used for the tools and materials listed.

Tool/Material Description	Reference
Alcohol, Isopropyl	Table 4001
Brush, non-metallic, soft bristle	Commercially Available
Cleaning pads/wiping cloths, lint-free, soft fabric	Commercially Available
Dial Indicator	Commercially Available
Dynamic Balancer	Safran Power SPD1001
V-Block	Commercially Available
Growler	Commercially Available
High Potential (Dielectric) Tester	Table 1002
Magnifier, 7X to 10X	Commercially Available
Ohmmeter	Table 1002
Pull Scale	Commercially Available
Surface Plate	Commercially Available

Table 5001 - Inspection Tools

A. Use of Growler

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

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

3. General Information

Check acceptance limits for individual components are found in the FITS AND CLEARANCES section. Parts that do not meet the acceptance limits are to be discarded. Use the following procedures for all inspections.

A. Inspect the dc starter-generator and it's components for:

- signs of corrosion
- chipped-off enamel
- nicks, cracks, dents, scratches
- gouging, scoring or glazing mating surfaces
- fretting corrosion on mating surfaces
- loose or defective attaching parts
- distortion
- discoloration due to heat or friction
- crossed or stripped threads
- condensation at drain holes
- torn or cracked seals
- galling or glazing of friction lining residue
- bent or distorted springs
- rounding, stripping or uneven wear of drive shaft spline

B. Inspect electrical connections and wiring for:

- loose or defective attaching parts

- damage caused by very high heat
- signs of electrical arcing
- corroded contacts or terminals
- chafing, cracking, or burning of wire insulation
- loose or defective electrical connector, contacts or terminals
- bent connector pins
- loose, broken or shorted terminations

4. Initial Inspection

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

A. Visually inspect the unit in a brightly lit work area. Refer to Paragraph 3.A. **and** Paragraph 3.B.

(1) If shipping or handling damage is evident, stop inspection immediately and notify supervisor.

(2) If operational damage is found, record which components need to be repaired or replaced and continue inspection.

B. Clean the exterior of the unit.

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

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

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

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

E. While facing the drive end, turn the drive shaft counterclockwise.

(1) The armature assembly should rotate with no scraping or bearing noise.

(2) If armature assembly will not turn, or if indications of internal damage can be heard, discontinue inspection and proceed to DISASSEMBLY.

F. Examine the installation between the housing and the brush support and drive-end end bell.

(1) Make sure that the brush support and end bell are fully installed with the housing and stator assembly.

(2) Make sure that all attaching hardware is in place and tight.

5. Non-Destructive Test (NDT) Inspections.

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

B. Unless otherwise specified, do liquid penetrant inspections IAW ASTM-E1417-99, type 1 Method A or B, sensitivity 2 or higher. Unless otherwise specified, acceptance criteria must be IAW MIL-STD-1907 Table II, Grade C.

6. Replacing Service Parts and Common Hardware

A. Examine service parts and common hardware.

(1) During overhaul, all bearings, brushes, insulating parts, retaining rings, self-locking nuts, and lock washers must be discarded regardless of their condition.

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

7. Inspection of Generator Parts and Assemblies

A. Overhaul Inspection

At overhaul, examine all primary components of the unit.

B. Repair Inspection

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

C. The following terms are referenced in this section.

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

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

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

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

D. Dimensions and Points

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

E. Surfaces

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

8. Inspection of Parts and Assemblies

The following procedures are the basic instructions for examining parts and assemblies of the unit. Perform visual inspections under high-intensity lighting and 7 to 10 power magnification. Refer to FITS AND CLEARANCES for applicable component wear tolerances.

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

Qualify individual parts and subassemblies according to the following procedures.

- Repair or replace defective components as instructed.
- Inspect only those components that are products of disassembly for repair.
- Do not perform disassembly for inspection, unless further disassembly is indicated through testing, troubleshooting, and fault isolation.

A. Identification plate (345)

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

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

If damage exists or the information is faded or unreadable:

(a) Retain the original identification plate.

(b) Transfer the information from the original identification plate to a replacement identification plate (345).

(c) Discard the original identification plate.

(2) Make sure that the drive screws (350) are tight and in place.

(a) Discard loose drive screws (350).

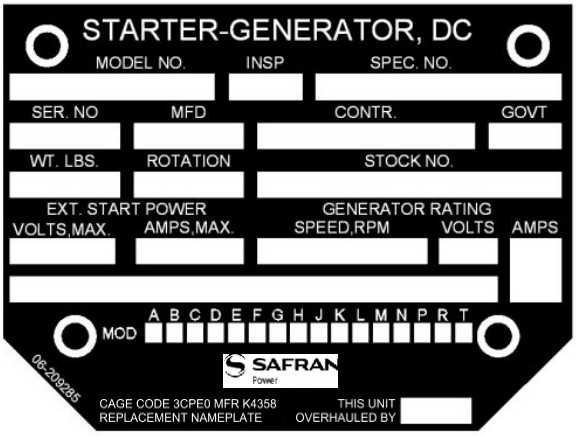


Figure 5001 - Replacement Identification Plate

B. Fan Covers (25) or Fan Cover Assembly (25A) and Brush Cover (50)

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

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

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

(4) (Models 23065-013, 23065-015, 23065-018 only) Make sure that gasket (30) in fan cover assembly (25A) is not damaged or missing. Replace gasket if necessary. Refer to instructions in the REPAIR section.

C. Brush cover (50). See Figure 5002.

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

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

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

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

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

(3) Examine the screw (55) threads IAW the procedures found in Paragraph 3.A.

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

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

(4) Make sure that the blind rivet nut (56) on the bracket is tightly attached.

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

(5) Examine the blind rivet nut (56) threads IAW the procedures found in Paragraph 3.A.

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

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

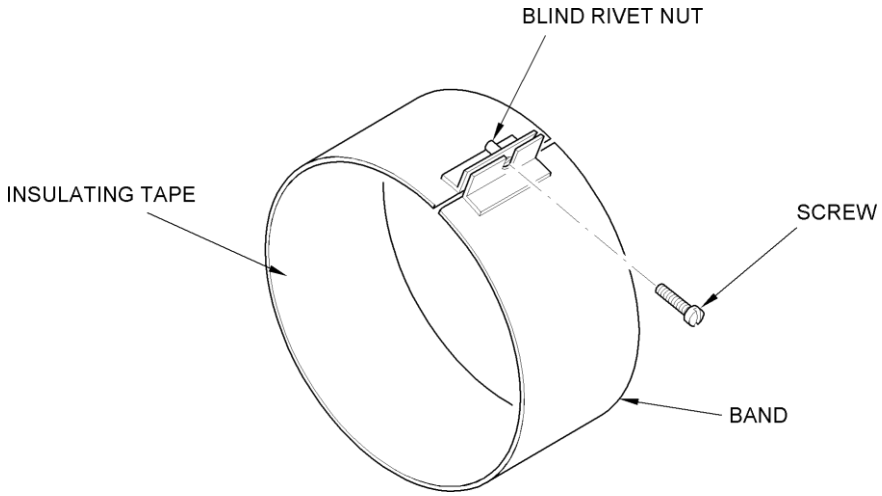


Figure 5002 - Brush Cover

D. Brushes (60) and Brush Holder Assemblies (220)

(1) Visually examine brush holders for cracks, warpage, and broken brush springs.

(a) Replace broken brush springs and damaged brush holders.

(2) Visually examine brushes for cracks, chips, frayed leads, and loose rivets or loose connections. Discard brushes if damaged.

(3) Replace brushes if remaining allowable wear will be achieved before the next overhaul (See Figure 5003). Seat new brushes in accordance with instructions in SPD 1006.

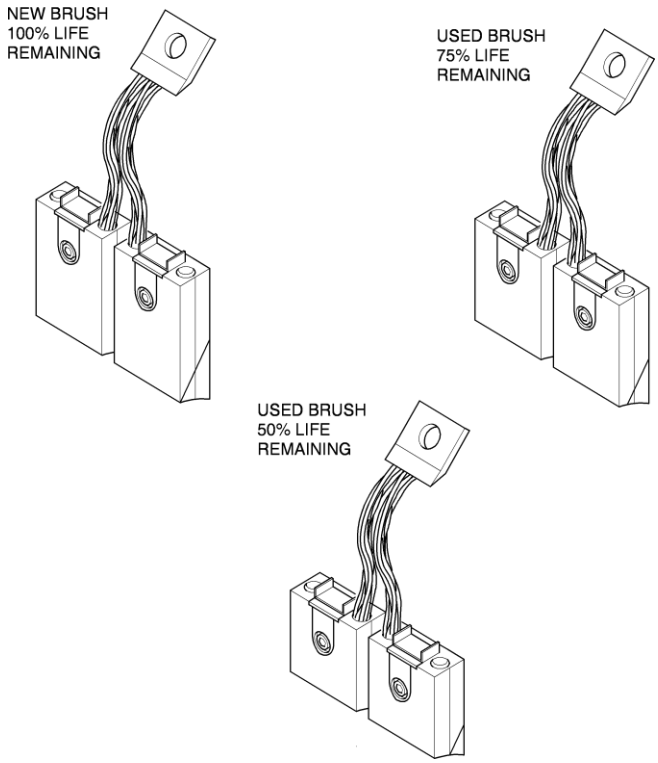


Figure 5003 - Brush Wear Check

(4) Measure brush spring (245) pressure using a pull scale with harness. See Figure 5004.

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

(a) Take six measurements.

(b) Calculate an average from the measurements.

(c) DISCARD any spring not within limits of FITS AND CLEARANCES section.

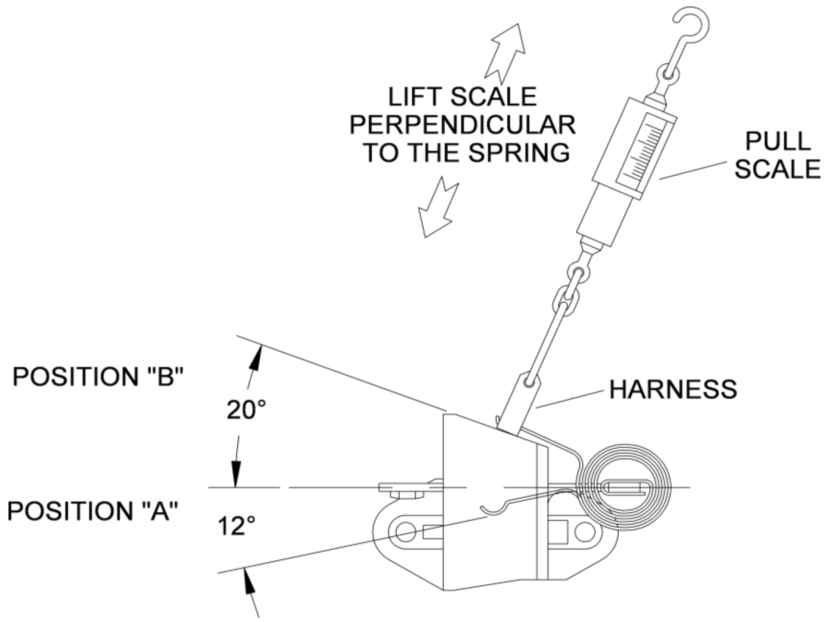


Figure 5004 - Brush Spring Tension Check

E. Air Inlet Assembly (5)

(1) Visually examine all surfaces for dents, nicks, and scratches that reduce clearance between the sidewall and fan cover (25).

(a) Repair air inlet assembly if damage is found.

(b) Discard air inlet assembly if damage extends to the mounting or inlet flanges.

(2) Visually examine mounting and inlet flanges for gouging, scoring, or glazing.

(a) Repair flange(s) if damage is found.

(b) Discard air inlet assembly if damage cannot be repaired.

F. Fan (70). See Figure 5005.

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

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

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

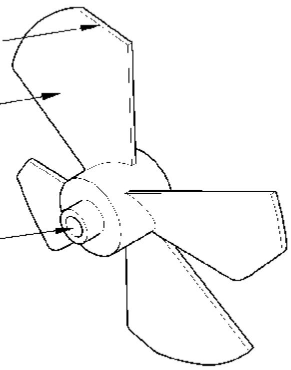


Figure 5005 - Fan

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

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

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

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

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

(a) Repair if damage is found.

G. Two part fan, P/N 23046-1020

(1) Dimensionally inspect the fan assembly as follows. Refer to Figure 5006**.**

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

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

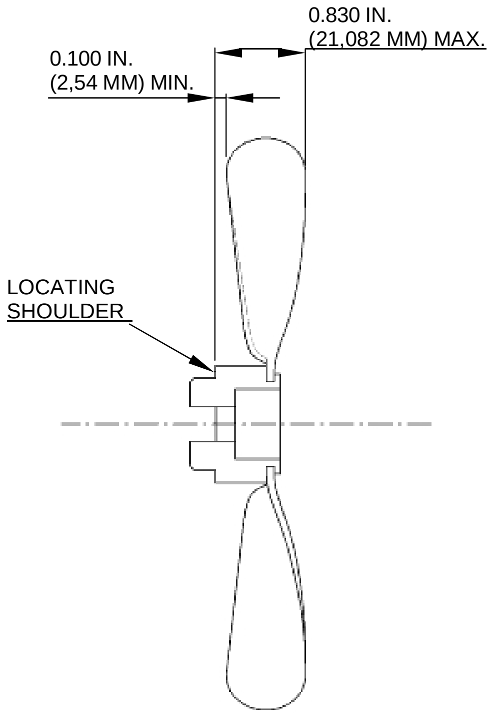


Figure 5006 - Two Part Fan (P/N 23046-1020)

H. Two part fan, P/N 23065-1240

(1) Dimensionally inspect the fan assembly as follows. Refer to Figure 5007**.**

(a) Back edge of blade must be 0.040 inch (1,02 mm) Min. to 0.050 inch (1,27 mm) Max. below the locating shoulder of the hub.

(b) Forward edge of blade must not be more than 0.62 inch (15,75 mm) Min. to 0.63 inch (16,002 mm) Max. from the locating shoulder of the hub.

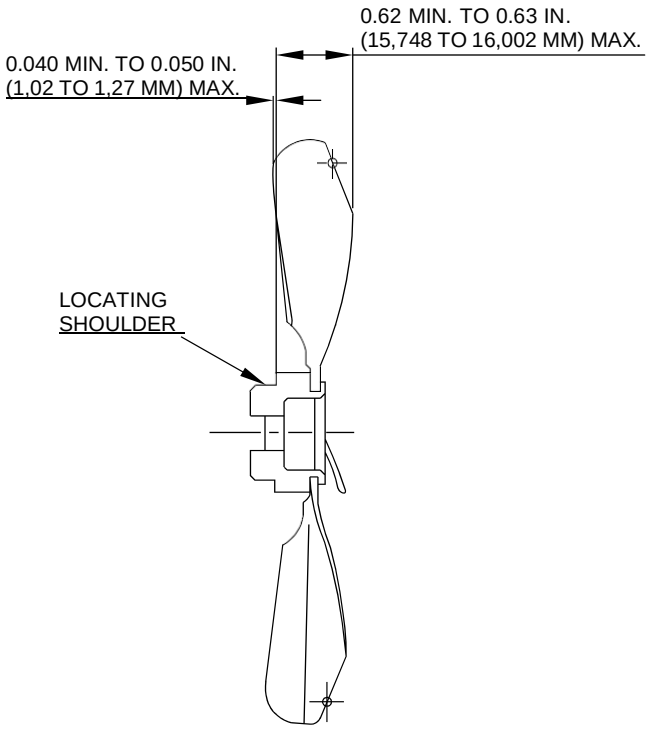


Figure 5007 - Two Part Fan (P/N 23065-1240)

I. Drive shaft (85) and Dampener hub (100)

(1) Visually examine all surfaces for cracks.

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

(b) Discard damaged part(s).

(2) Visually examine all surfaces for dents, nicks, and scratches.

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

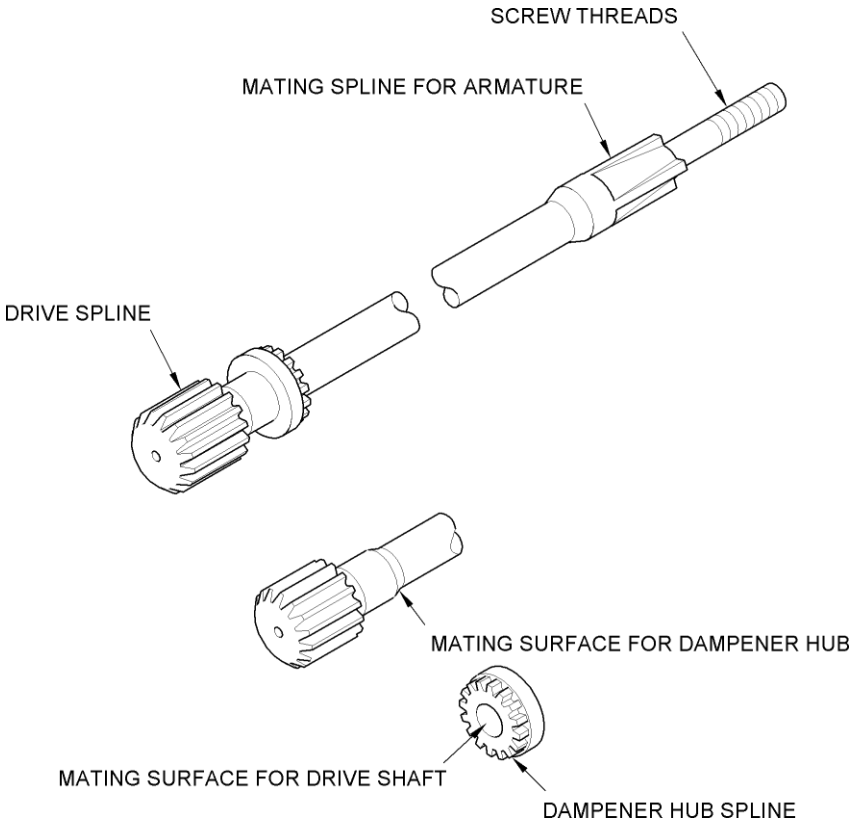


Figure 5008 - Drive Shaft and Dampener Hub

(3) Visually examine drive spline and the dampener hub for rounding, stripping, or uneven wear (Figure 5008).

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

(b) Discard damaged part(s).

(4) Visually examine screw threads for crossed or stripped threads.

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

(b) Disassemble drive shaft and dampener hub if two or more threads are damaged and discard drive shaft.

(5) Measure drive spline diameter over two gauge pins. Disassemble drive shaft and dampener hub if diameter is not within limits in the FITS AND CLEARANCES section. Discard drive shaft.

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

(a) Discard the drive shaft (85) and dampener hub (100) if damage is found.

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

J. Friction Ring (105)

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 ABOUT PROPER HANDLING AND DISPOSAL PROCEDURES.

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

(2) Visually examine all surfaces for cracks.

(a) Discard friction ring if damage is found.

(3) Measure friction ring (Figure 5009).

(a) Discard friction ring if the thickness is not within limits in the FITS AND CLEARANCES section.

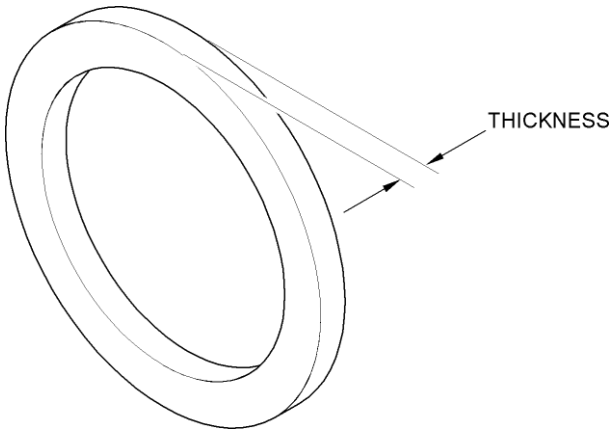


Figure 5009 - Friction Ring Thickness Check

K. Dampener Plate (95)

(1) See Figure 5010. Visually examine all surfaces for cracks or warpage.

(a) Discard dampener plate if damage is found.

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) Repair dampener plate if minor damage is found.

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

(a) Repair dampener plate if minor damage is found.

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

(a) Discard dampener plate if damage is found.

(5) Measure dampener plate thickness.

(a) Discard dampener plate if it is not within acceptance limits in the FITS AND CLEARANCES section.

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

(a) Discard dampener plate if the distance between pins is more than acceptance limits in the FITS AND CLEARANCES section.

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

(a) Discard the part if it is damaged.

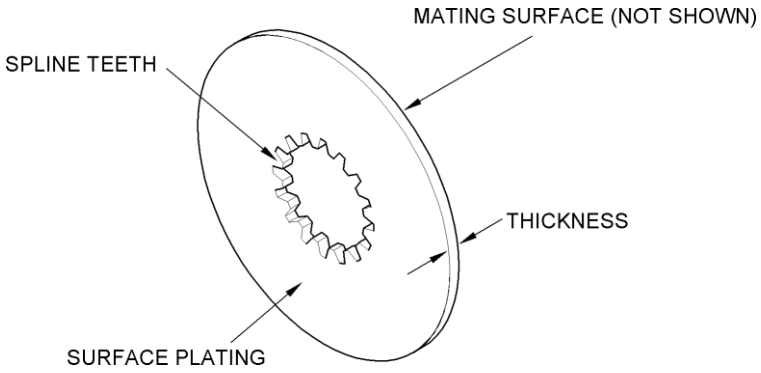


Figure 5010 - Dampener Plate Checks

L. Dampener Back Plate (110)

(1) See Figure 5011. Visually examine all surfaces for cracks.

(a) Discard dampener back plate if damage is found.

(2) Visually examine all surfaces for dents, nicks, and scratches.

(a) Repair dampener back plate if minor damage is found.

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

(a) Discard dampener back plate if damage is found.

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

(a) Discard if damage is found.

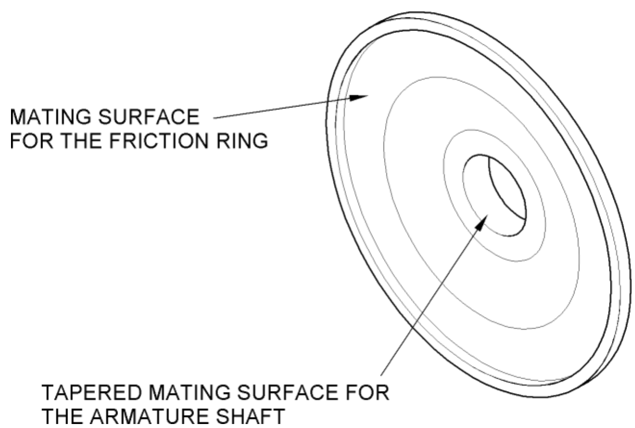


Figure 5011 - Dampener Backplate Checks

M. Drive end bearing support assembly (115). See Figure 5012.

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

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

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

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

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

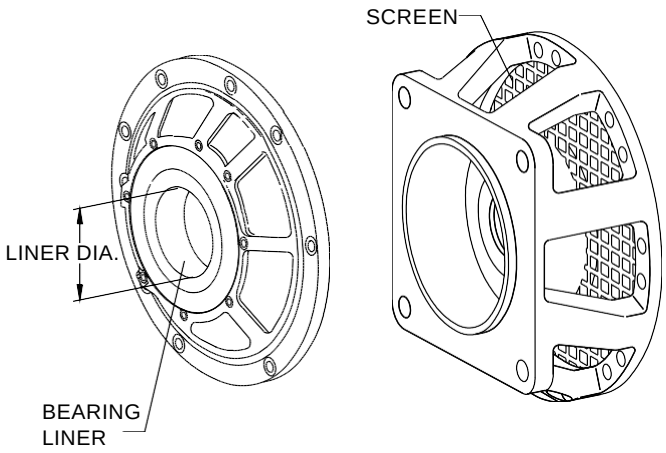


Figure 5012 - Drive End Bearing Support Assembly

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

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

(a) Replace if damage is found.

(4) Measure the bearing liner diameter using a gage and equipment with an accuracy of ± 0.00004 inch (0.0010 mm). See Figure 5012.

(a) Repair the bearing liner if the measurements are not in the limits given in FITS AND CLEARANCES section.

N. Baffle Discs (165)

(1) Visually examine all surfaces for dents, nicks, and scratches.

(a) Repair baffle disc if minor damage is found.

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

(a) Discard baffle disc if damage is found.

O. Armature (175) See Figure 5013.

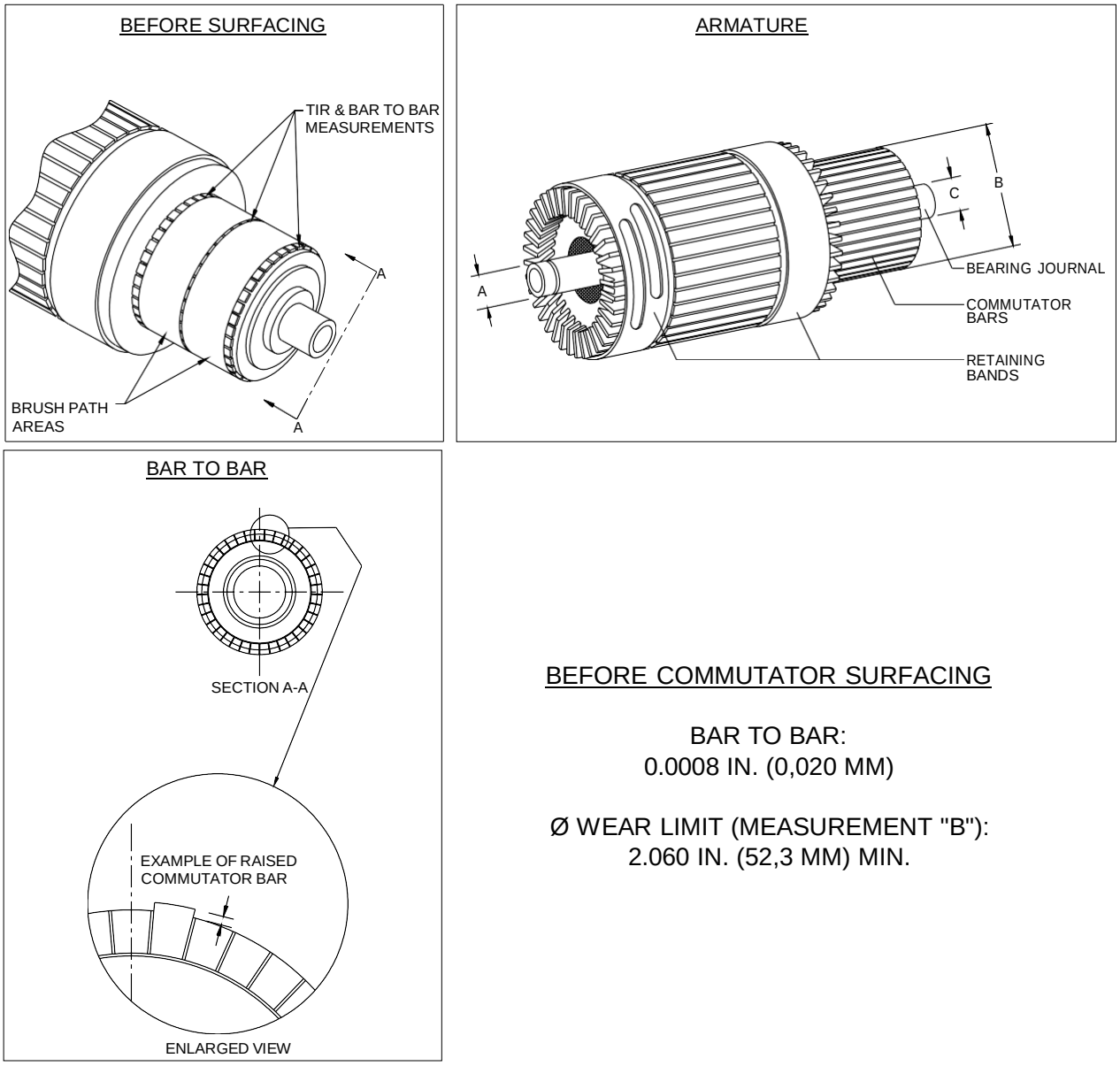
CAUTION: INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) IS NOT APPROVED ON THE ARMATURE WINDINGS. THE ARMATURE MUST BE REPLACED IF YOU FIND INSULATING ENAMEL (GLYPTAL OR EQUIVALENT) ON THE ARMATURE WINDINGS.

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

(a) Replace armature if bar-to-bar run-out is more than the limits of the FITS AND CLEARANCES section before refinishing the armature. No repair is permitted.

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

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



BEFORE COMMUTATOR SURFACING

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

Ø WEAR LIMIT (MEASUREMENT "B"):
2.060 IN. (52,3 MM) MIN.

Figure 5013 - Armature Check

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

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

(a) Repair bearing journals if damaged.

(b) Replace armature if damage is not repairable.

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

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

(b) Replace armature if damage is not repairable.

(5) Measure commutator (before recut) diameter B, as shown in Figure 5013.

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

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

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

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

(b) Replace armature if damaged.

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

(a) Replace armature if damaged.

(8) Examine commutator bars for burning and discoloration.

(a) Repair commutator if damaged.

(b) Replace armature if damage is not repairable.

(9) Measure commutator undercut.

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

(b) Replace armature if damage is not repairable.

(10) After the commutator is refinished, measure commutator bar-to-bar and total indicator reading (TIR) run-out in a full circumference. Support the armature (175) on two “V” blocks.

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

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

(b) Measure commutator TIR run-out.

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

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

(a) Replace the armature (175) if a short exists.

(12) Perform a dielectric test.

NOTE: Armature (175) must be thoroughly clean before performing a dielectric test.

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

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

(a) With power OFF, connect positive test lead of high potential tester to armature (175) shaft.

(b) Put negative test lead on commutator bar.

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

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

(e) Turn high potential tester power OFF.

(f) Remove negative test lead.

(g) Connect negative lead to retaining band.

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

(i) Acceptance Limits:

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

If armature (175) fails dielectric test, clean armature and repeat dielectric test.

2 If armature (175) fails dielectric test after cleaning, replace armature.

P. Stator and Housing Assembly (275)

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) Visually inspect exposed housing surfaces for cracks, chips, and dents.

(a) Replace assembly if cracks, chips, or dents cause loss or permanent deformation of base material.

(2) Visually inspect for the following indications of overheating:

- varnish coating of exposed windings is cracked or flaking;
- missing, melted, or damaged insulators.

(a) Replace assembly if indications of overheating are found.

(3) Check for tight fit of pole shoes and damage to windings in housing.

(a) Replace assembly if stator parts are loose or windings are damaged.

(4) Perform a dielectric test.

NOTE: Stator and housing assembly must be thoroughly clean before performing a dielectric check.

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

CAUTION: BEFORE YOU CONNECT OR DISCONNECT THE ELECTRICAL LEADS, TURN OFF THE POWER TO THE HIGH POTENTIAL TESTER. DAMAGE TO THE ARMATURE CAN OCCUR.

(a) Jumper all stator leads together.

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

(c) Connect negative test lead to uncoated surface of housing.

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

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

(f) Turn high potential tester power OFF.

(g) Disconnect test leads.

(h) Disconnect jumper from stator leads.

(i) Acceptance Limits:

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

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

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

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

(a) Replace the stator and housing assembly (275) if an open circuit exists.

Q. Terminal Block (280)

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

(1) Visually examine all surfaces for cracks, nicks, and scratches.

Discard terminal block if damaged.

(2) Visually examine terminal studs for crossed or stripped threads.

(a) Repair terminal block studs if thread damage is two or less thread turns.

NOTE: The measurement of capacitance values is not necessary during servicing or overhaul unless a suspected fault causing EMI has been reported.

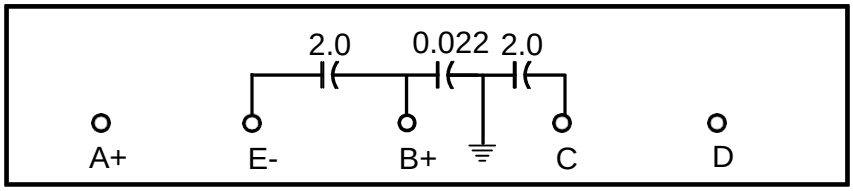


Figure 5014 - Terminal Block Schematic

(3) Using an LCR (inductance, capacitance and resistance) meter, measure the capacitance values between terminals B and E, between B and the ground and between C and the ground.

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

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

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

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

a Discard the part if there is more than 1 A of leakage.

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

(d) Repeat steps (a) thru (c) for B to Ground and C to Ground.

R. Bearing and brush support assembly (200). See Figure 5015 and Figure 5016.

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

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

(b) Repair if minor dents, scratches and nicks or gouging scoring or glazing on the mating surfaces (marked 1, 2, 3, and 6 on Figure 5015) are found.

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

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

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

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

(a) Replace if damage is found.

(4) Measure bearing liner diameter “A.” Using a gage with an accuracy of ± 0.00004 inch (0,0010 mm). See Figure 5015.

(a) Disassemble the bearing and brush support assembly (200) if damage exists.

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

(5) Examine the Heli-coil® inserts (marked 4 and 5 on Figure 5015) for damage.

(a) Repair Heli-coil® if damage is found.

(b) Repair any damaged parts.

(6) Hand tighten a machine screw into the blind rivet nut in each complete brush holder (220) to assure that the self-locking feature is functional. The machine screw should bind in the blind rivet nut before it is fully engaged.

(a) Repair the complete brush holder (220) if the blind rivet nut is damaged.

(b) Repair the complete brush holder (220) if the self-locking feature does not function properly.

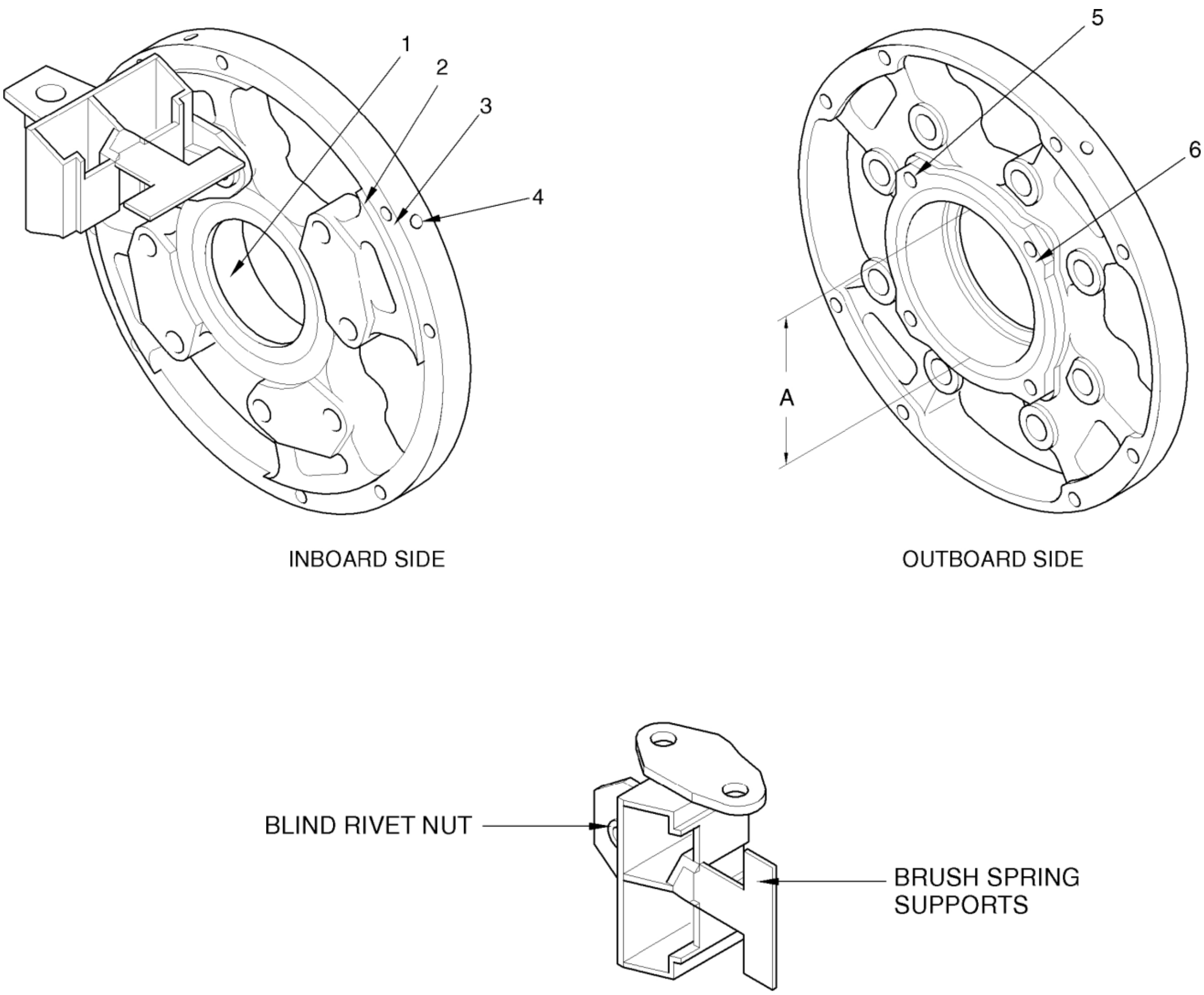


Figure 5015 - Bearing and Brush Support Assembly, Inboard and Outboard Side

(7) Examine the brush holders (255), including the brush spring supports and center supports for cracks, warping, and discoloration caused by electrical arcing.

(a) Discard the complete brush holder (220) if damage exists.

(8) Perform a dielectric test.

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

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

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

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

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

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

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

(e) Turn high potential tester power OFF.

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

(g) Acceptance Limits:

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

a If bearing and brush support assembly (200) fails dielectric test, clean bearing and brush support assembly, and repeat dielectric test.

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

a If bearing and brush support assembly (200) fails dielectric test, replace bearing and brush support assembly.

S. Bearing Retainer (180)

(1) Visually inspect bearing retainer for cracks, chips, and dents.

(a) Discard retainer if cracks, chips, or dents cause permanent deformation.

(2) Place bearing retainer on surface plate to check for warping.

(a) Discard retainer if warpage is indicated.

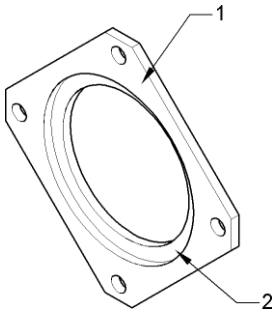


Figure 5016 - Bearing Retainer

T. Drive End Pad End Bell (365)

(1) Measure the height of the three locating dowels.

(a) Replace pin if not to the height in FITS AND CLEARANCES section.

9. Terminology

Table 5002 lists the definitions of terms used to describe damage conditions.

Term	Definition	Probable Cause
Corrosion	The chemical or electrochemical reaction between a material, usually a metal, and its environment.	Environmental condition that causes deterioration.
Fretting	Wear that occurs between tight-fitting surfaces subjected to cyclical relative motion of extremely small amplitude.	Vibration between mating surfaces.
Crack	A break in material	Severe stress from overloading or shock; possible extension of a scratch
Dent	A small, smoothly-rounded depression	A sharp blow or too much pressure

Table 5002 - Terminology

Term	Definition	Probable Cause
Fretting/ Corrosion	Surface chemical reaction that results in discoloration, a layer of oxide, or rust	Vibration between mating surfaces
Galling	Transfer of metal from one surface to another	Result of localized lubrication breakdown between sliding surfaces
Glazing	Smoothing and creep of a surface	Result of localized lubrication breakdown between sliding surfaces
Gouging	Removal of surface metal, typified by rough and deep depressions	Protruding objects, incorrectly aligned
Nick	A sharp bottomed depression that can have rough outer edges	Dropping, banging
Rounding	Removal of surface metal at corners or dulling of edges	Result of abrasion, vibration, or incorrect tolerances
Scoring	Deep scratch following a path of part travel	Result of localized lubrication breakdown between sliding surfaces
Scratch	A very shallow furrow or irregularity, usually longer than wide	Movement of a sharp object across the surface
Short	Evidence of sparking, arcing, or high current	The result when two current-carrying conductors are connected by a path of negligible resistance
Stripped Thread	Thread of a nut, stud, bolt, or screw damaged by tearing away parts of the thread	Incorrect installation of thread pitch or size
Tear	Parting of material	Too much tension, caused by an external force
Wear	Slow removal of parent material, wear is not visible to the unaided eye	Result of abrasive substances contacting rolling surfaces and acting as a lapping compound

Table 5002 - Terminology (Continued)

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REPAIR

1. Introduction

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

This section provides authorized repair instructions for the 23065 Series of DC Starter-Generators. Repairs are limited to:

- Repairing damaged surfaces
- Restoring surface coatings of parts and assemblies
- Repairing damaged threads
- Replacing Heli-coil® inserts
- Restoring bearing liners and journals
- Repairing and refinishing the armature commutator
- Balancing armature
- Brush seating
- Repairing brush holder assembly
- Replacing fan cover gasket
- Correcting output voltage polarity
- Replacing brush access cover self-locking blind rivet nut
- Replacing brush band insulating tape

Authorized repairs also include approved procedures by reference. Repair operations not referring to instructions given in this section are not authorized by Safran Power.

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

- Selective (Brush Plating), Electrodeposition - Refer to SPD 1000.
- Armature Balancing for DC Starter-Generators - Refer to SPD 1001.
- Surface Repair and Coating - Refer to SPD 1002.
- Plastic Media Blasting - Refer to SPD 1003.

- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Repair Tools

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

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

CAUTION: STEEL WOOL AND ABRASIVES CONTAINING IRON OR IRON OXIDE MUST NOT BE USED DURING REPAIR OPERATIONS.

Tool Description	Reference
Commutator Turning Fixture	Figure 9008
Dynamic balancer	Safran Power, SPD 1001
End mill [0.25 inch (6,4 mm) diameter]	Commercially available
Heli-coil® Insert Removal and Installation Tool	Commercially Available
India stone	Commercially available
PlusNut® Fastener Header P/N C1000-832	Commercially available
Rivet Alignment and Press Fixture	Figure 9014
Six Volt Battery or Equivalent DC Power Source	Commercially Available
Thread chasers	Commercially available

Table 6001 - Repair Tools

3. Repair Materials

Materials used for repair are listed in Table 6002. Equivalent materials can be used.

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

Item	Description/Specification	Source
Alcohol, Isopropyl	TT-I-735, Grade A	Commercially available
Brush, Soft Bristle	N/A	Commercially available

Table 6002 - Repair Materials

Item	Description/Specification	Source
Coating, Acrylic	MIL-I-406058/HumiSeal 1B31, Type AR	Chase Corporation Woodside, NY 11377 Ph: (718) 932-0800 FAX: (718) 932-4345 www.humiseal.com V0SR97
Coating, Conversion	MIL-C-5541, Class 3 Alodine 1200 or equivalent	Commercially available
Compound, Thread Locking	Loctite, Grade D (MIL-S-22473).	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com V7V827
Enamel, Red Insulating, Baking	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
Oil, Lubricating	MIL-L-6085	Commercially available
Pads, Cleaning	Lint-free cotton	Commercially available
Paint, Gloss Enamel	Urethane (MIL-C-85285B) Amendment 2 Type 1	Commercially available
Primer, Zinc Chromate	TT-P-1757, Composition G, Color Y	Commercially available
Sandpaper	5/0 or finer	Commercially available
Sandpaper	400/600 grit	Commercially available
Sealing Compound, Pipe Joint and Thread, Lead Free	Gasoila, Soft Set	Federal Process Co. 4620 Richmond Rd. Beachwood, OH 44128 GSA Supply on-line www.gsasupplyco.com/
Solvent, Cleaning	MIL-PRF-680 Type I - Stoddard Solvent Type II - 140° F (60° C) Solvent	Commercially available
Solvent, Cleaning	Ensolv Cleaning Solvent	Enviro Tech International, Inc. Alameda, CA 94501 www.ensolv.com V0S8S8

Table 6002 - Repair Materials (Continued)

Item	Description/Specification	Source
Tape, Insulating	P/N SG13-06R 8 mil, PTFE coated fiberglass, acrylic adhesive	Saint Gobain New Haven, CT Ph: 1-203-777-3631 www.saint-gobain.com/us V1DS07

Table 6002 - Repair Materials (Continued)

4. Surface Repair

A. Repair metal components that have surface damage or corrosion and that qualify for repair according to the CHECK section inspection guidelines.

(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 the surface of the part.

(2) Remove small raised edges, burrs, nicks, or scratches on polished or load-bearing surfaces. Remove only material that is above the polished surface. Make sure that dimensional tolerances are in limits.

5. Restoring the Surface Coatings of Parts and Assemblies

A. Removal of Surface Coatings

Remove the surface coatings of parts and assemblies that have been damaged using plastic blasting equipment and procedures as given in Safran Power SPD 1003.

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

B. Restoration of Surface Coatings

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

Clean all parts per CLEANING section of this CMM.

6. Thread Repair

A. Repair damaged threads as follows:

CAUTION: DO NOT USE A THREAD CUTTING DIE. IRREPARABLE DAMAGE CAN RESULT FROM USING A THREAD CUTTING DIE.

(1) Repair damaged threads with a thread chaser.

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

WARNING: LUBRICATING OIL IS FLAMMABLE AND CAN BE HARMFUL IF SWALLOWED. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

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

7. Heli-coil® Insert Replacement

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

A. Remove and replace damaged Heli-coil® inserts (257) in brush holder (255) as needed.

(1) Remove damaged Heli-coil® insert with a Heli-coil® insertion/removal tool.

(2) Clean hole for new Heli-coil® insert. Refer to the CLEANING section.

(3) Install Heli-coil® insert in brush holder to the depth shown in Figure 6002 below part surface.

(4) Break off Heli-coil® insert installation tang.

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

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

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

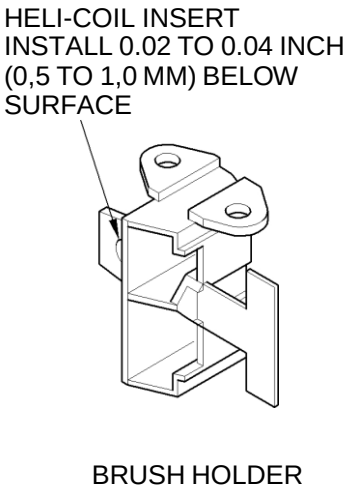


Figure 6001 - Heli-coil® Insert Replacement

8. Bearing Liner and Journal Restoration

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

NOTE: The drive end end bell P/N 23046-1670 cannot have the bearing liner repaired by SPD 1000 because the liner exceeds the maximum repairable hardness limits.

A. Restoration

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

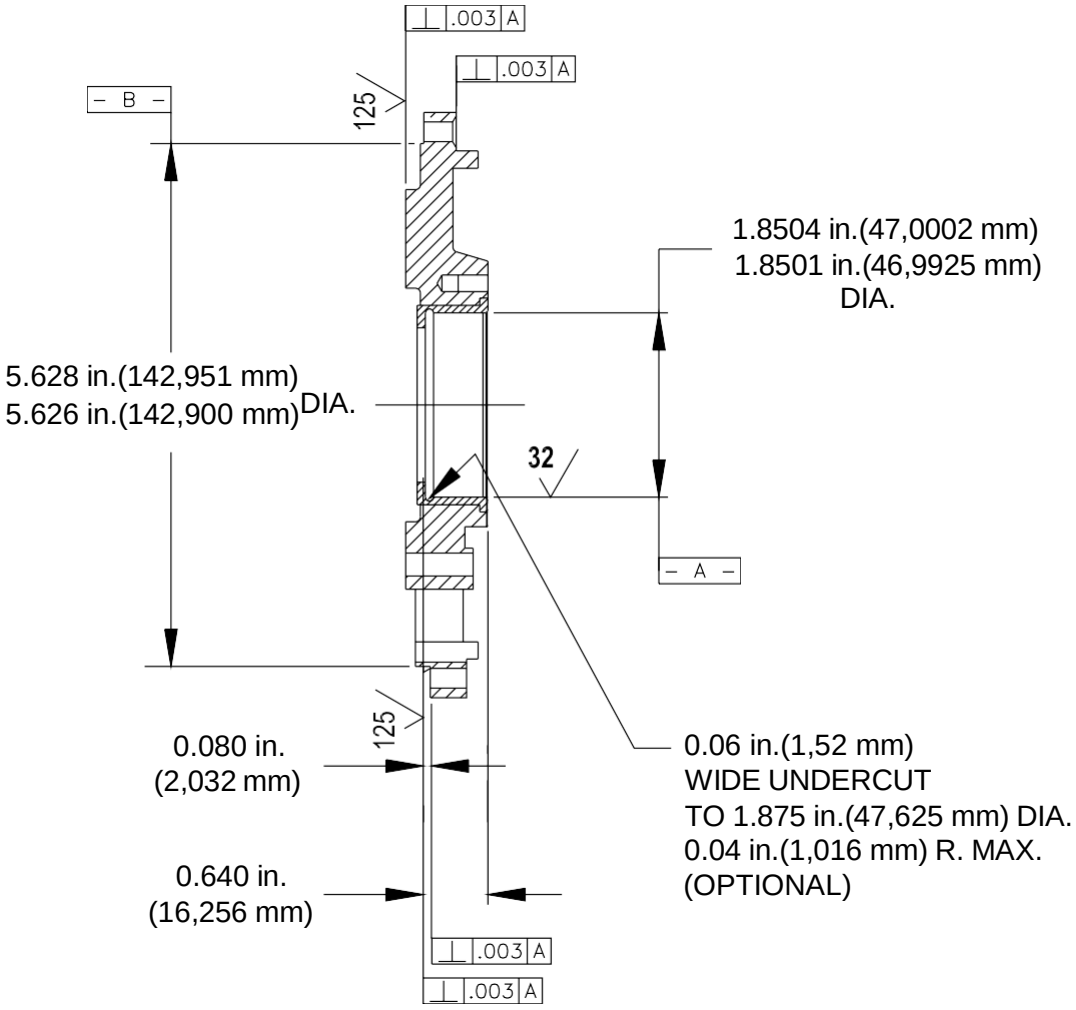
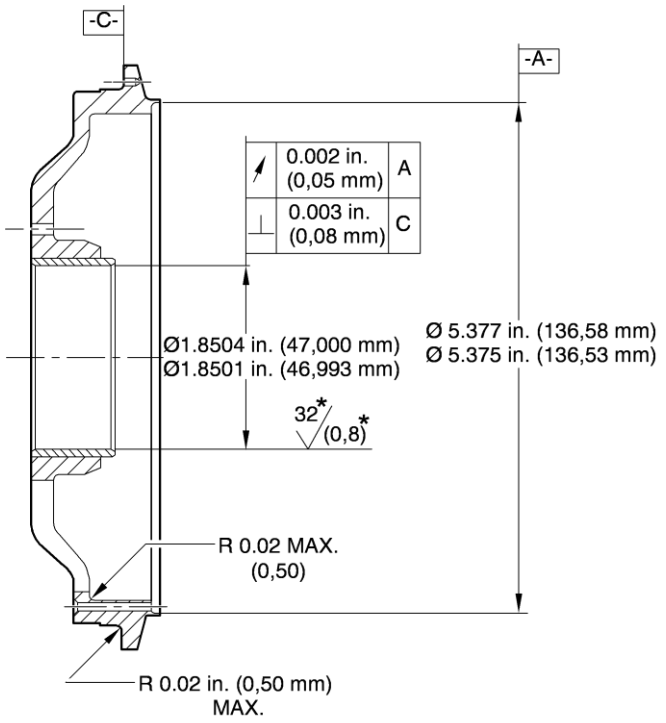


Figure 6002 - Anti-Drive End End Bell Bearing Liner Machining Specifications for all Models



UNLESS OTHERWISE SPECIFIED,
ALL DIMENSIONS ARE IN INCHES
FOLLOWED BY MILLIMETERS
IN PARENTHESIS.

* MICRO-FINISH IS ONLY APPLICABLE TO NEW END BELLS OR LINERS THAT WERE REPAIRED PER SPD 1000.

Figure 6003 - Drive End End Bell Bearing Liner Machining Specifications for P/N 23065-1470

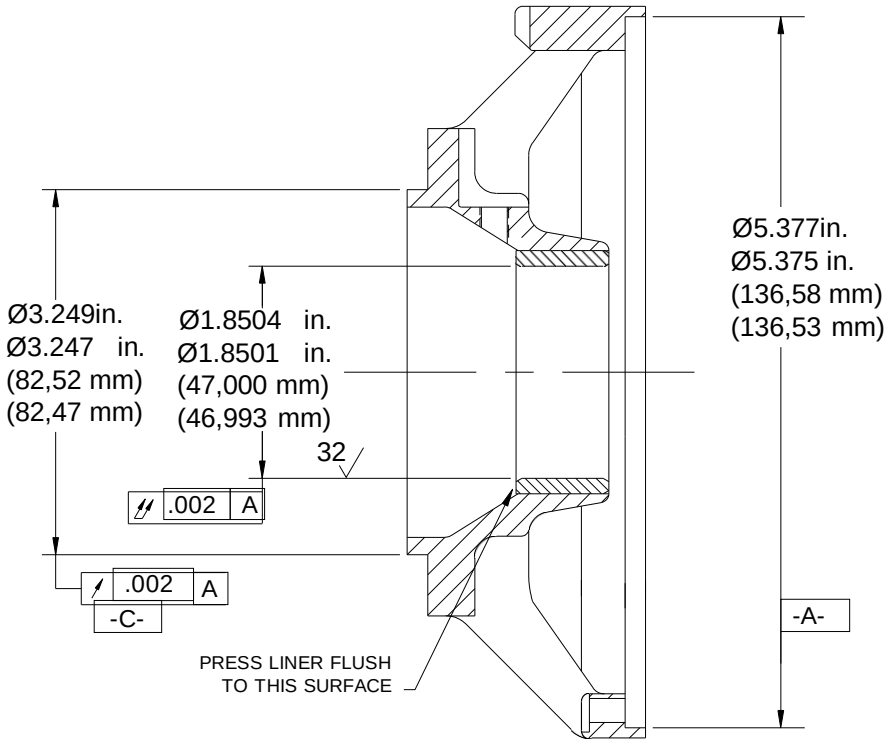


Figure 6004 - Drive End End Bell Bearing Liner Machining Specifications for P/N 23046-1191

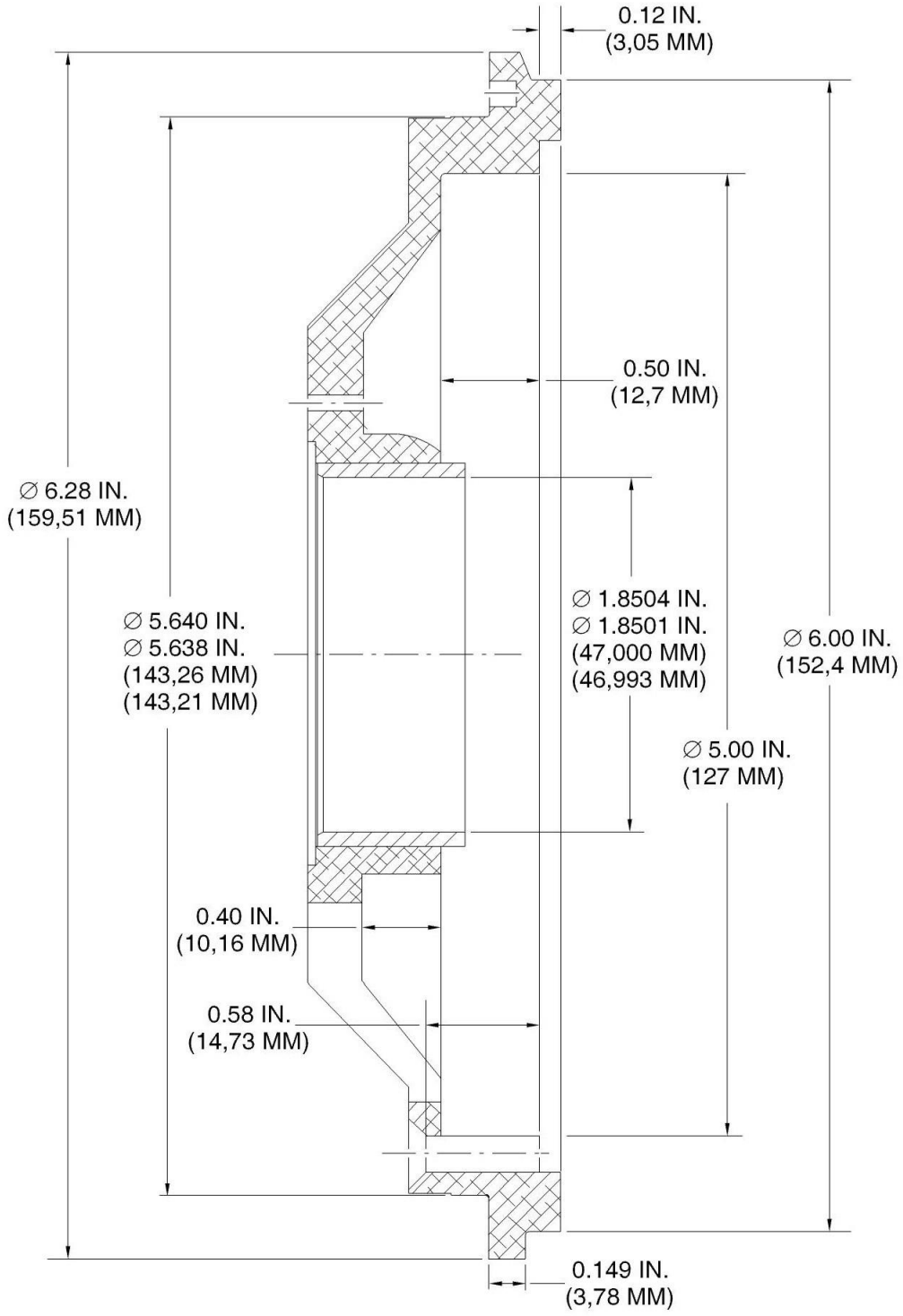


Figure 6005 - Drive End End Bell Bearing Liner Machining Specifications for P/N 23046-2322

9. Commutator Refinishing

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

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

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

A. Setup

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

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

(2) Position the drive end of the armature (175) shaft at the lathe chuck head and the commutator turning fixture in the tail stock.

B. Repair procedure

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

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

(1) Cut the commutator to a surface finish of 64 to 100 microinches (1,6 to 2,5 microns) RMS. The finish surface must extend from the end of the full undercut to within 0 to 0.060 inches (0 to 1,5 mm) of the outboard end of the commutator. See Figure 6006.

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

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

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

(2) Clean the armature (175) surfaces with compressed air, 29 psig (200 kPa) max.

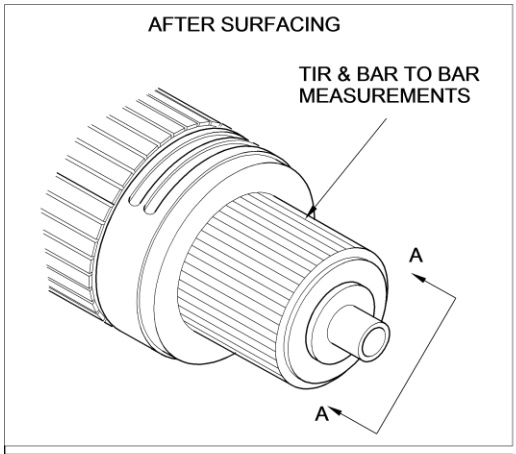
(3) Measure the depth of the mica undercut between the commutator bars. Refer to the FITS AND CLEARANCES section for the limits.

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

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

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

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



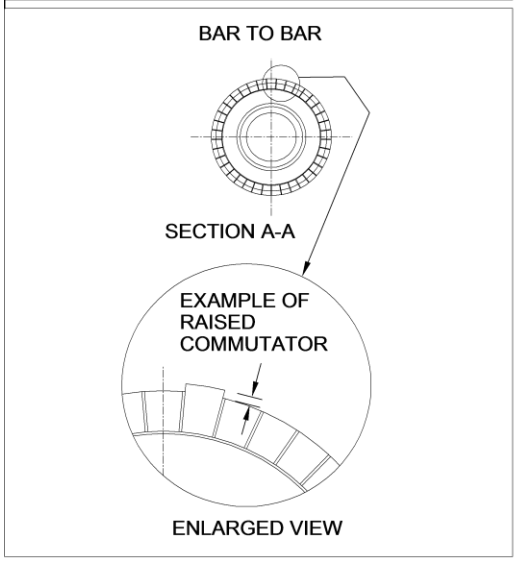
AFTER COMMUTATOR SURFACING

BAR TO BAR:
0.0001 IN. (0.003 MM)

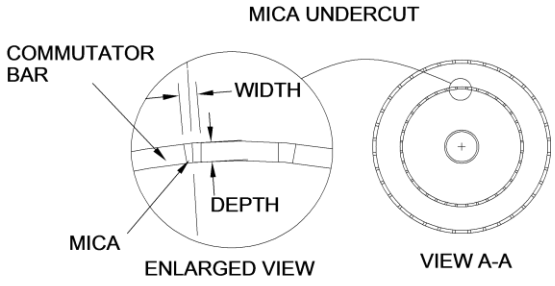
T.I.R. (1 REV):
0.0005 IN. (0.013 MM)

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.



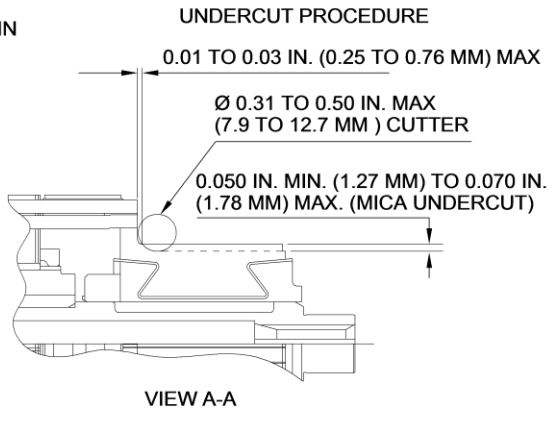


Figure 6006 - Armature Repair

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

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

(7) Clean the armature (175) surfaces with compressed air, 29 psi (200 kPa) max.

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

(a) Replace the armature if the damage cannot be repaired.

10. Balancing the Armature

Balance the armature (10001-175) to the limits given in FITS AND CLEARANCES and using the procedure in Safran Power Standard Practice Document (SPD) 1001.

11. Repair Procedures

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

A. Repair of the complete brush holder (220).

(1) Disassemble the complete brush holder (220) IAW Paragraph 4.M.(3) of the DISASSEMBLY section.

(2) Touch up any damage to the surface of the complete brush holder (220), as required, per Standard Practice Document (SPD) 1002.

(3) Assemble the complete brush holder (220) IAW Paragraph 5.A. of the ASSEMBLY section.

B. Brush Seating.

New brushes must be properly seated on the commutator surface before starting the performance tests. Failure to properly seat the brushes can affect the results obtained during test after overhaul. Refer to SPD 1006 for instructions.

C. Flashing the Field.

DC Starter-Generators with reversed polarity in the output voltage can be corrected by flashing the field as outlined below.

CAUTION: DO NOT FLASH THE FIELD WHILE UNIT IS IN OPERATION.

(1) Disconnect leads to external voltage regulator.

(2) Connect negative terminal of a 1.5 to 6.0 VDC battery to terminal “E”.

(3) Connect positive terminal of battery to one side of a knife switch.

(4) Connect other side of knife switch to terminal “A”.

(5) Close knife switch for 5 seconds.

(6) Open switch and disconnect it from battery.

NOTE: If flashing the field fails to correct generator polarity, check for incorrect connections or defective field circuit.

D. Replacing Fan Cover Gasket (30).

NOTE: In this procedure, all surfaces to be bonded must be clean and free of grease, oil, and other contaminants. All solvent must be completely evaporated before applying adhesives or primers.

(1) Remove old gasket bonding residue from fan cover assembly (25A) using a stiff wire brush.

WARNING: BEFORE YOU USE CLEANING SOLVENT, PUT ON A RESPIRATOR, RUBBER APRON, RUBBER GLOVES AND EYE PROTECTION. THIS WILL PREVENT INJURY FROM SPILLS AND FROM THE FUMES. IF YOU GET SOME ON YOUR SKIN OR IN YOUR EYES, FLUSH WITH CLEAN WATER AND GET MEDICAL AID.

(2) Clean gasket area on fan cover using cleaning solvent and a lint-free cloth.

(3) Apply a thin coat of silicone adhesive primer to gasket area of fan cover. Allow to dry for 30 to 45 minutes at room temperature.

(4) Lightly coat mounting surface of gasket with silicone rubber sealant.

(5) Place gasket on fan cover.

NOTE: Only contact pressure between the gasket and fan cover is required for bonding. Best adhesion is obtained with a glue line of 0.56 inch (15 mm) (approximately).

(6) Clean excess sealant from fan cover before curing, using cleaning solvent and a lint-free cloth.

(7) Allow sealant to cure for 24 hours at room temperature with a minimum of 20% relative humidity.

E. Replace the insulating tape.

(1) Remove all signs of the insulating tape and clean the inside surface of the brush cover (50). Refer to the CLEANING section.

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

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

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

(5) Apply the fiberglass tape directly from the roll to the inner surfaces of the brush cover band. Installed tape must be 0.06 inch (1.5 mm) from the brush cover band edges and ends. The tape can overlap the brush cover band edges by 0.2 inch (0.5 mm) on one side only. However, overlap is not permitted at the cover band ends.

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

F. Replace self-locking blind rivet nut (56). See Figure 6007**.**

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

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

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

(3) Put the fastener header tool into the hole in the brush access cover (50).

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

NOTE: Do not tighten the rivet nut too much. The threads can be damaged.

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

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

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

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

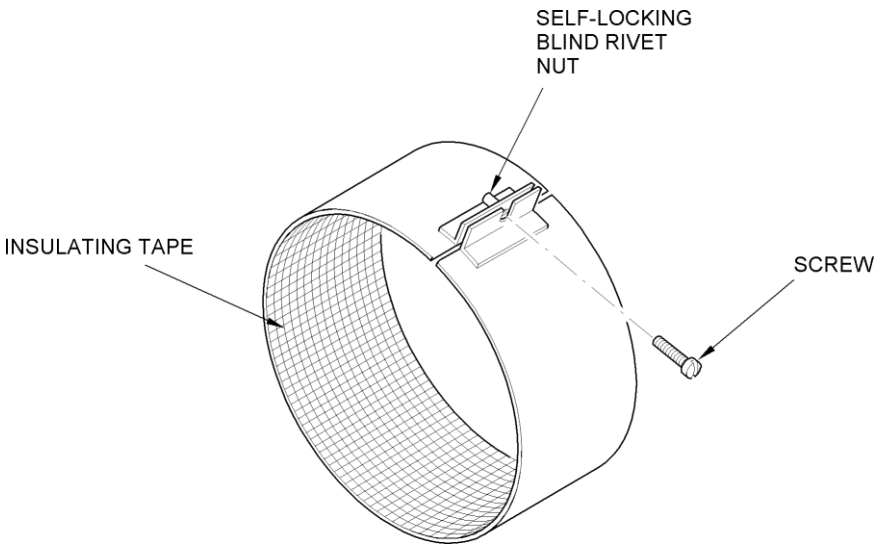


Figure 6007 - Brush Cover

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ASSEMBLY

1. Introduction

This section gives assembly instructions for 23065 Series DC Starter-Generators. Assemble the unit in a clean work area away from machining or other metal removing operations. Clean all parts as given in the CLEANING section before final assembly.

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

- Surface Repair and Coating - Refer to SPD 1002.
- Brush Holder Alignment Fixtures - Refer to SPD 1004.
- Brush Installation, Seating, and Run-In - Refer to SPD 1006.

2. Assembly Tools

In addition to normal shop tools, tools listed in Table 7001 are needed for unit assembly.

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

Tool Descriptions	Reference
Arbor press	Not illustrated
Brush Holder Alignment Fixture	SPD 1004
Support, anti-drive end end bell	Figure 9002
Dampener plate driver	Figure 9010
Inner race bearing driver	Figure 9006
Outer race bearing driver	Figure 9006
Leather or plastic mallet	Commercially available
Retaining ring pliers	Commercially available
Spline wrench	Figure 9001
Armature support	Figure 9009
Driver, dampener backplate	Figure 9010
Support stator, vertical	Figure 9011
Support stator, horizontal	Figure 9012
Terminal block - unserviceable (optional)	None

Table 7001 - Assembly Tools

3. Assembly Materials

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

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

Item	Description/Specification	Source
Solvent, Cleaning	EnSolv Solvent	Enviro Tech International Inc. Alameda, CA 94501 www.ensolv.com V0S8S8
Alcohol, Isopropyl	TT-I-735, Grade A Flash point: 53° F (11,7° C) **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.	Commercially Available
Coating, Acrylic	MIL-I-406058/HumiSeal 1B31, Type AR	Chase Corp. Woodside, NY
Coating, Conversion	Alodine 1200 or equivalent MIL-C-5541, Class 3	Commercially Available
Compound, Thread Locking	Loctite, Grade D (MIL-S-22473).	Loctite Corporation Aurora, IL Ph: (860) 571-5100 www.loctite.com V7V827
Anti-Seize Compound	Never-Seez or, Lubricant, Solid Film, Heat Cured MIL-46010 Type 1 Lube-LOK 5306-40%	Never-Seez Compound Corp. or E/M Corporation Dayton, Ohio 45432 Ph: (313) 254-8481

Table 7002 - Assembly Materials

Item	Description/Specification	Source
Enamel, Red Insulating, Baking	Synthite ER-41	John C. Dolph Co. Box 41 Monmouth, NJ 08852
Paper	Protective/MIL-B-121A, grade A, type II, class I	National Paper Walton Hills, OH
Lubricating and Assembly Paste	Altemp QNB50 **FLAMMABLE.** Read the **WARNING** before using this material. Refer to the applicable MSDS for additional safety information	Kluber Lubrication 54 Wentworth Avenue Londonderry, NH 03053 Cage Code: 04PK1 Ph: 888-455-8237
Primer, Zinc Chromate	TT-P-1757, Composition G, Color Y	Commercially Available
Primer, Silicone Adhesive	A-4094	Dow Corning Corporation PO Box 994 Midland, MI 48686-0994 Ph: (989) 496 4400 FAX: (989) 496 6731 www.dowcorning.com V71984I
Sealant, Silicone Rubber	Silastic RTV 732, Black	
Sealing Compound, Pipe Joint and Thread, Lead Free	Gasoila, Soft Set	Federal Process Co. 4620 Richmond Rd. Beachwood, OH 44128 GSA Supply on-line www.gsasupplyco.com/

Table 7002 - Assembly Materials (Continued)

4. Assemble Stator and Housing Assembly (275)

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

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

A. Install terminal block (280) if removed at disassembly.

NOTE: Applicable if the terminal block (280) was removed during acceptance testing.

(1) Position terminal block on stator housing (275) with stator leads positioned on terminal block studs.

(2) Install two screws (285), lock washers (295) and washers (290) to secure terminal block to stator housing. Tighten screws from 22.7 to 35 in-lbs (2,5 to 3,9 N·m).

(3) Secure stator leads B, C, and E to large terminals with washers (305) and nuts (300).

(4) Secure stator leads A and D to small terminals with washers (315) and nuts (310).

B. Connect terminal block grounding lead if isolated during disassembly.

(1) If the terminal block grounding lead was disconnected and taped, remove the tape and secure the grounding lead with screw (285) and flat washer (290).

5. Assemble Bearing and Brush Support Assembly (200)

The following procedure details assembly of the bearing and brush support assembly.

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

A. Install brush holder (255) on end bell (270).

NOTE: There are studded and studless styles of brush holder. The studded type contains threaded studs (250) that go through the end bell and are secured with a nut (230) on the fan side of the end bell. The studless type uses a mounting bolt (225) that screws into the brush holder through the end bell.

CAUTION: DO NOT WIND SPRING FURTHER THAN NECESSARY TO INSTALL IN POSITION, OR SPRING CAN TAKE A PERMANENT SET, AND PRODUCE INSUFFICIENT PRESSURE ON BRUSH.

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

(1) Install two brush springs (245) on brush holder (255). Each spring must be wound approximately 3/4 turn before installation on brush holder spring support bar.

(2) Insert insulation sleeve (260) into each of two brush holder mounting holes in end bell (270).

(3) If using the studless brush holder, place a flat washer (235) and non-metallic washer (240) on each of two bolts (225) and insert bolts through insulation sleeves in end bell (270).

(4) Install insulation plate (265).

(a) For studded brush holders, position insulation plate (265) on brush holder studs and position brush holder studs in insulation sleeves in end bell. Place a non-metallic washer (240) and flat washer (235) on each of the studs and secure brush holder with nut (230). Tighten nuts 22.7 to 35 in-lbs (2,5 to 3,9 N·m).

(b) For studless brush holders, position insulation plate on mounting bolts (225) coming through the end bell.

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

(5) Coat threads of bolts (225) with thread-locking compound.

(6) Position brush holder (255) against insulation plate (265) and thread bolts (225) into brush holder.

(7) Align (rotate) bearing and brush support assembly in alignment fixture. Refer to SPD 1004.

(8) Tighten bolts 22.7 to 35 in-lbs (2,5 to 3,9 N·m) for P/N AN3-7A or 25 to 30 in-lbs (2.83 to 3.39 N·m) for P/N AN3-10A.

B. Perform a dielectric test.

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

6. Final Assembly of DC Starter-Generator

The following procedure details final assembly of the DC Starter-Generator.

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

A. Install baffle discs (165), bearing (170),and retaining ring (160) on armature shaft (175).

(1) Install baffle disc (165) on drive end of armature shaft, with recessed area of baffle disc facing the armature.

(2) Support armature in an arbor press using an armature support (Figure 9009).

NOTE: In the following paragraph, make sure the bearing part mark on the outer race faces toward the armature windings and apply lubricating and assembly paste to the inside liner of the anti-drive end end bell assembly.

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

(3) Using an armature support (Figure 9009) and inner race bearing driver (see Figure 9006), press a new bearing (170) onto drive end of armature shaft. Bearing must be fully engaged against baffle disc (165). See Figure 7001.

(4) Install remaining baffle disc (165) on drive end of armature shaft, with recessed area of baffle disc facing away from armature.

(5) Install and fully seat retaining ring (160) into groove on armature shaft. See Figure 7002.

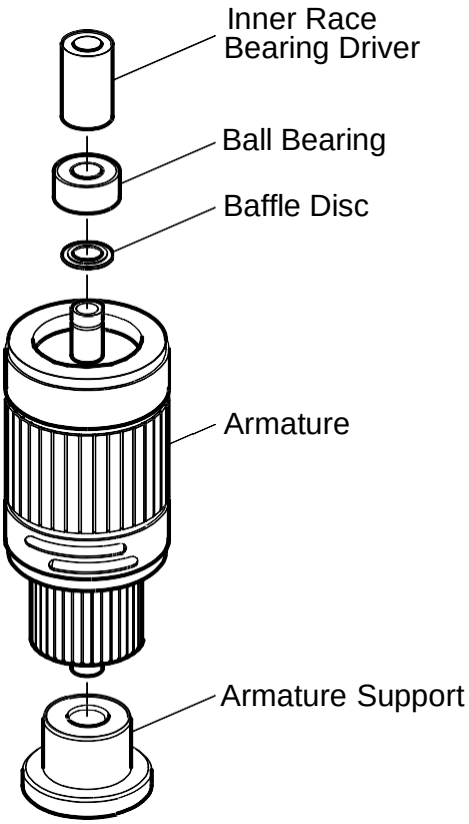

Figure 7001 - Baffle Disc and Ball Bearing Installation

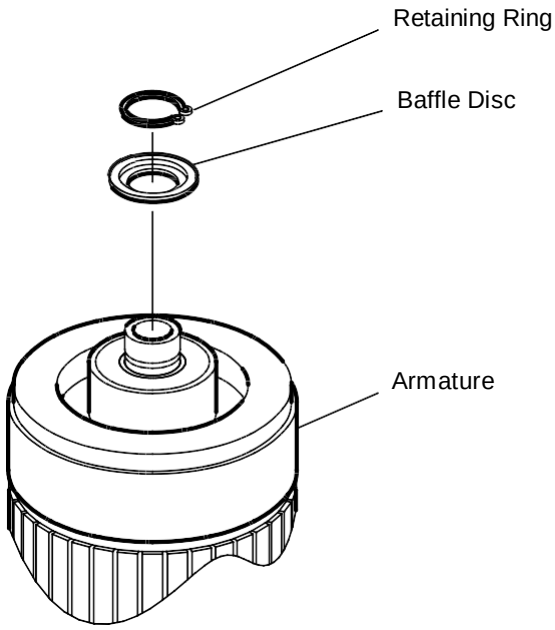

Figure 7002 - Baffle Disc, Spacer, Retaining Ring Installation

B. Press a ball bearing (190) into the bearing and brush support assembly (200).

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

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

(3) Set a ball bearing onto bearing liner of bearing and brush support assembly.

NOTE: Make sure that part marking on the ball bearing must be facing towards the inside of the unit.

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

(5) Press ball bearing into bearing liner of bearing and brush support assembly.

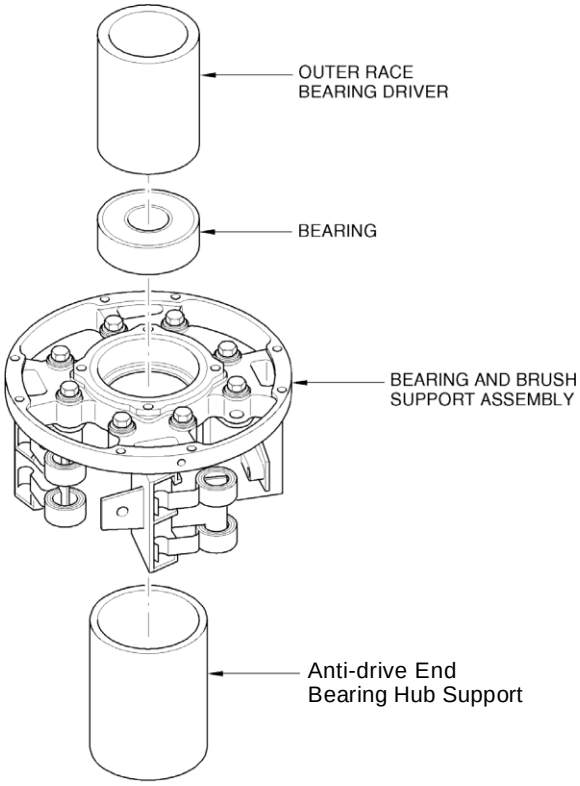

Figure 7003 - Install Bearing in Bearing and Brush Support Assembly

(6) Make sure that ball bearing is fully installed against inner lip of bearing liner.

C. Attach the bearing retainer (180) to the bearing and brush support assembly (200).

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

(1) Apply sealing compound to threads of screws (185).

(2) Attach bearing retainer to bearing and brush support assembly using attaching screws. See Figure 7004. Torque screws (185) to 13.5 to 18.0 in.-lbs (1,5 to 2,0 N·m).

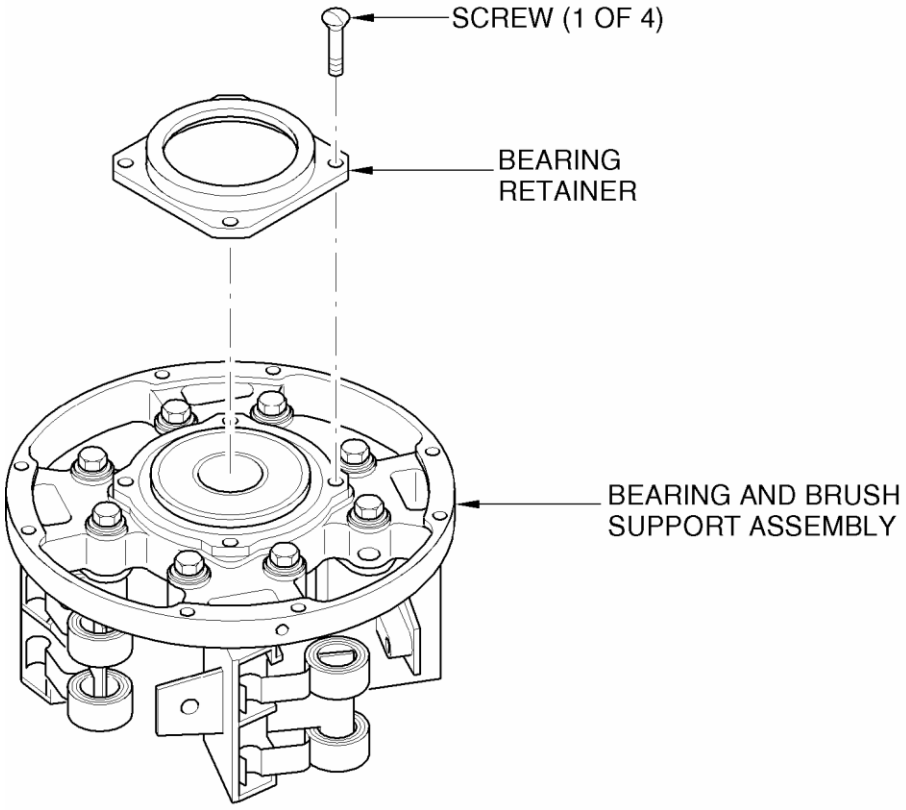

Figure 7004 - Attach Bearing Retainer to Bearing and Brush Support Assembly

D. Prepare armature (175) 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 7005.

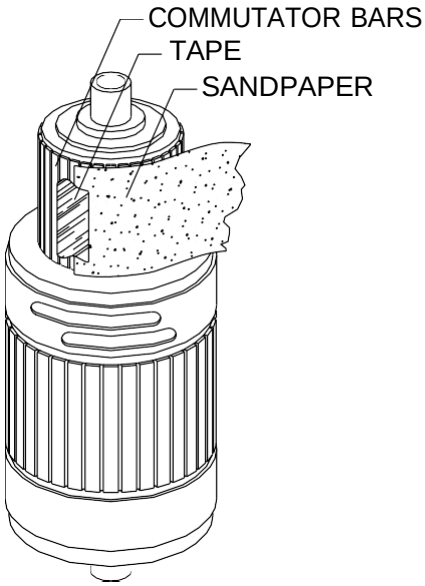

Figure 7005 - Preparing Armature for Rough Seating

E. Attach the bearing and brush support assembly (200) to the armature (175).

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 an armature support on the arbor press table. See Figure 7006.

(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 an inner race bearing driver onto anti-drive end ball bearing installed in bearing and brush support assembly.

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

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

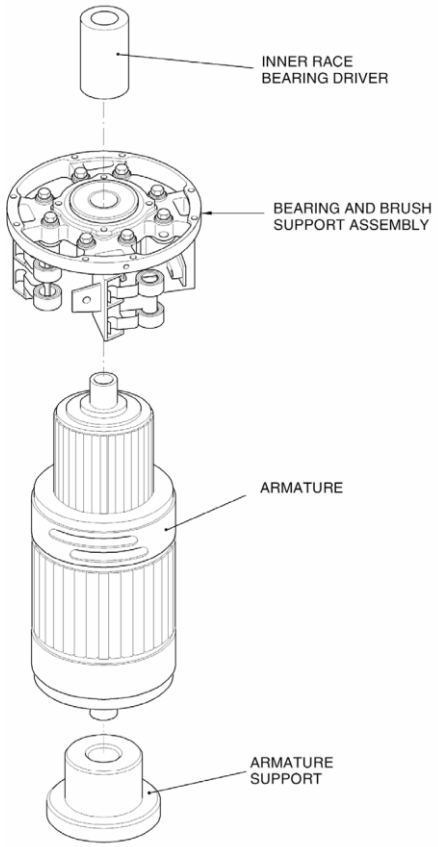

Figure 7006 - Attach Bearing and Brush Support Assembly to Armature

F. Install drive end bearing support assembly (115) on stator and housing assembly (275).

(1) Set stator and housing assembly with armature (175) and bearing and brush support assembly (200) on a horizontal stator support.

(2) Position drive end bearing support assembly (115) on stator assembly Figure 9012.

NOTE: On the following models with the rounded drive end end bell configuration (155), a dowel pin hole in the end bell must be aligned with the terminal block in a specific way for proper installation.

NOTE: (Models 23065-004/-004T/-004M/-004TM, 23065-006, 23065-008, 23065-009) Looking from the drive end, a dowel pin hole must be positioned 180 degrees away (directly opposite) from the terminal block.

NOTE: (Models 23065-013, 23065-013-1, 23065-015, 23065-015-2, 23065-018,

23065-018-1, 23065-018-2, 23065-020) Looking from the drive end, a dowelpin hole must be positioned directly in line with the terminal block.

(3) Make sure that end bell assembly is fully installed on bearing (170).

WARNING: THREAD-SEALING COMPOUND IS FLAMMABLE. DO NOT USE NEAR OPEN FLAMES OR SPARKS. USE IN A WELL-VENTILATED AREA.

(4) Apply thread-sealing compound to threads of screws (120).

(5) For models 23065-001 and -022 only: Attach drive end bearing support assembly (115) to stator and housing assembly (275) using eight screws (120), lock washers (130) and flat washers (125). Tighten the screws to a torque of 13.5 to 18.0 lbf.in. (1.5 to 2.0 N·m).

(6) For all models except 23065-001 and -022: Attach drive end bearing support assembly (115) to stator and housing assembly (275) using twelve screws (120). Tighten the screws to a torque of 13.5 to 18.0 lbf.in. (1,5 to 2,0 N·m).

G. Install armature (175) and bearing and brush support assembly (200) into stator and housing assembly (275).

(1) Set stator and housing assembly stator end down on a vertical stator support. See Figure 7007.

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

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

(3) Set bearing and brush support assembly (200) with its attached armature (175) into stator and housing assembly lining up the eight screw holes for attachment with screws.

(4) Apply thread-sealing compound on each of the eight screws (205).

(5) Place a lock washer (210) and flat washer (215) on each of the eight screws (205) and attach them through bearing and brush support assembly to stator and housing assembly.

(6) Torque screws to 13.5 to 18.0 in.-lbs (1,5 to 2,0 N·m).

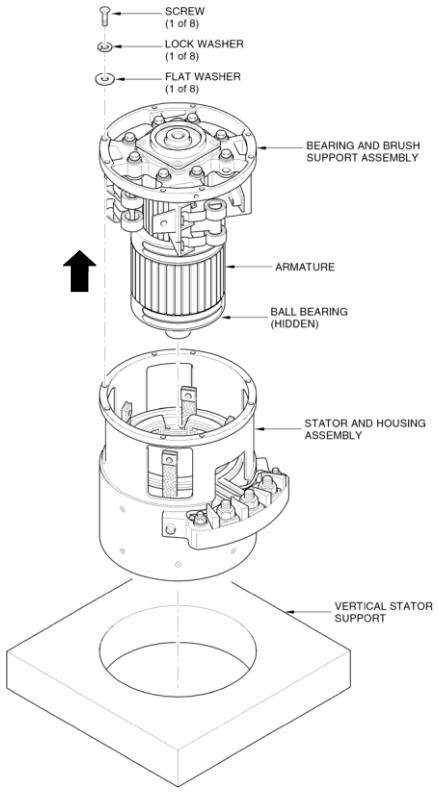

Figure 7007 - Install Armature and Bearing and Brush Support Assembly

H. Place dampener backplate (110) and friction ring (105) onto armature shaft.

CAUTION: DO NOT USE THE ARBOR PRESS TO FORCE DAMPENER BACKPLATE ONTO ARMATURE SHAFT.

(1) Hand twist dampener backplate (110) onto drive end of armature shaft until it is fully installed on shaft taper. See Figure 7008.

(2) Check runout of backplate radial surface while rotating armature on its bearings. Runout must not be more than 0.003 inch (0,08 mm) T.I.R.

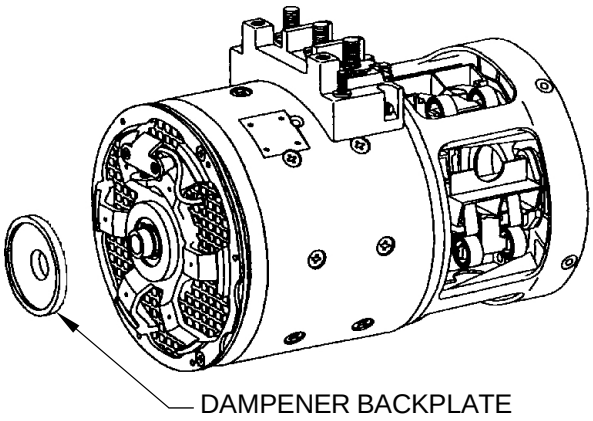

Figure 7008 - Installing Dampener Backplate

I. Assemble the dampener hub (100) and dampener plate (95) onto the drive shaft (85).

CAUTION: DO NOT FORCE DAMPENER HUB ONTO MATING TAPER OF DRIVE SHAFT. THE HUB CAN FRACTURE IF TOO MUCH PRESSURE IS USED.

(1) If dampener hub (100) was removed from drive shaft, hand twist dampener hub onto drive shaft taper and make sure it is fully installed.

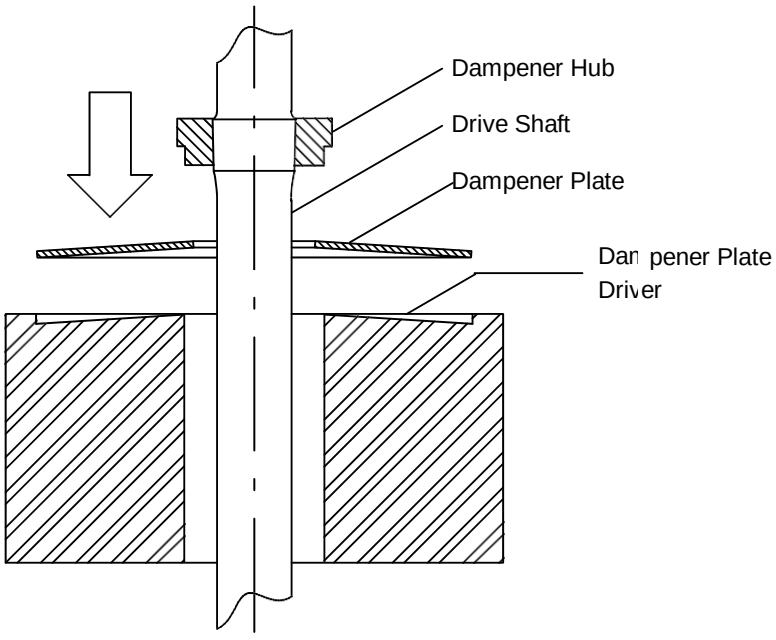

Figure 7009 - Assembling Dampener Hub and Plate

(2) Put Dampener Plate into dampener plate driver, Figure 9010. See Figure 7009.

(3) Insert drive shaft (85) through dampener plate, while aligning dampener plate and dampener hub splines.

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

(5) Make certain that spline on plate engages with spline on hub and fully bottoms on shoulder of hub.

J. Install drive shaft (85) and fan assembly (70).

(1) Hand press friction ring (105) into recess of dampener backplate.

(2) Place friction ring in dampener backplate.

(3) Insert drive shaft (85) through drive end of armature, making certain that drive shaft splines fully engage armature shaft splines. See Figure 7010.

(4) Position fan assembly (70) on drive shaft and secure with washer (80) and self-locking nut (75). See Figure 7011.

(5) Use a suitable spline wrench to hold drive shaft (85) and tighten nut (75) from 100 to 120 in-lbs (11.3 to 13.6 N·m).

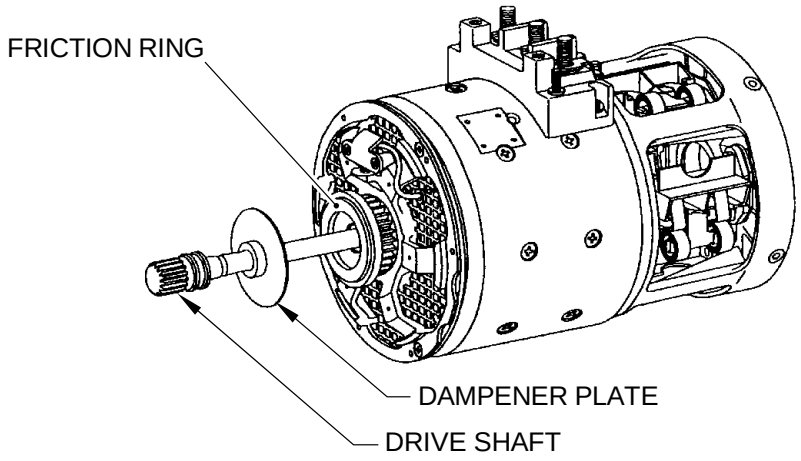

Figure 7010 - Inserting Drive Shaft into Armature Shaft

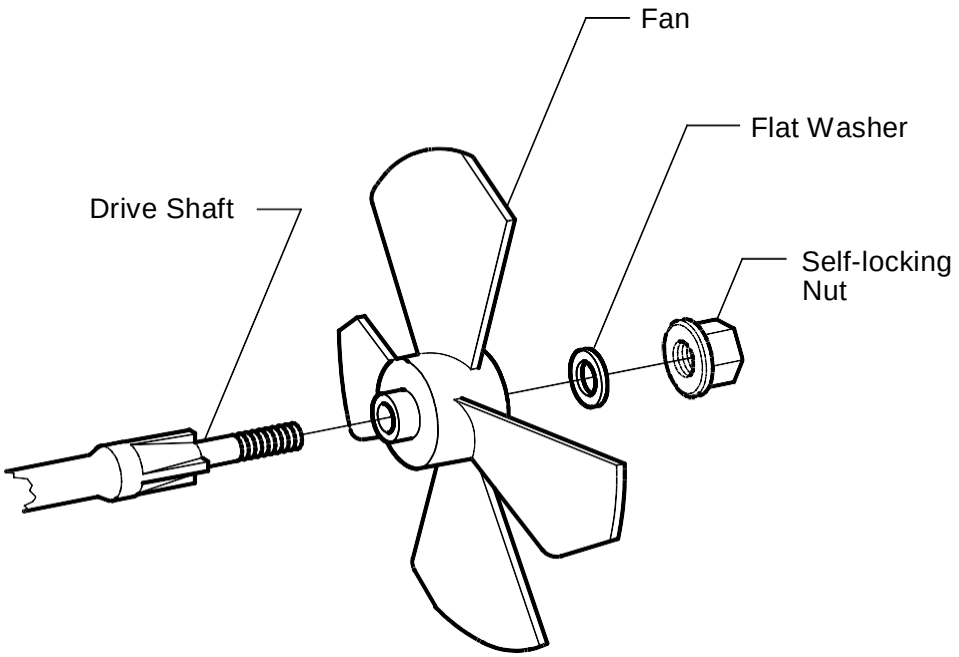

Figure 7011 - Attaching Fan to Drive Shaft

K. Install four brushes (60) and brush access cover (50).

NOTE: See REPAIR section for correct position of brush wire leads and for proper seating of brushes.

(1) Install brushes (60) into brush holders and secure brush and field leads with four screws (65). Torque screws to 22.7 to 35 in.-lb. (2.5 to 3.9 N·m).

(2) Looking from fan end, position brush access cover (50) on housing with clamp screw (55) located 90 degrees counterclockwise from center terminal on terminal block. Secure cover with screw (55).

NOTE: Make sure that brush access cover must be assembled with the air ventilation holes towards the terminal block.

NOTE: Anti-seize compound must be applied to the screw (55) after acceptance test is finished during final assembly per Paragraph 8..

L. Install fan cover (25) or fan cover assembly (25A).

(1) Fan cover (25) Installation.

(a) Position fan cover on support assembly in a manner that allows grooves in cover to accomplish a locking effect.

(b) Rotate cover either clockwise or counterclockwise to lock in place.

(2) Fan cover assembly (25A) Installation.

NOTE: If installing fan cover assembly that uses a gasket, check that gasket (30) is in place, secure, and undamaged. If missing, loose, or damaged, replace gasket. Refer to instruction in the REPAIR section.

(a) Position fan cover assembly on bearing and brush support assembly and align screw holes in cover with screw holes in support assembly.

(3) Install four screws (40) to secure fan cover assembly. Torque screws to 7.7 to 10.3 in.-lb. (0.9 to 1.2 N·m).

M. Attach air inlet assembly (5), if used.

(1) Position air inlet assembly (5) on stator and housing assembly (275) in the correct orientation.

(2) Install rim clenching clamp (10) on air inlet assembly and tighten nut to a torque of 50 in-lb (5.6 N·m).

N. If removed, attach the instruction decal (335), FAA-PMA label (336), information plate (337), modification status label (340) and identification plate (345), as applicable.

NOTE: The replacement procedure is identical for instruction decal (335), FAA-PMA label (336) and information plate (337). The procedure to replace instruction decal (335) is shown below.

(1) If instruction decal (335) was damaged:

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.

(a) Clean stator and housing assembly (275) surface where decal is to be applied using isopropyl alcohol and a clean, lint-free cloth.

(b) Allow the alcohol to dry.

(c) Remove the protective backing on the instruction decal (335) and install decal on stator and housing assembly (275).

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

(2) If the DC Starter-Generator has been modified:

NOTE: Full re-identification instructions are given in the applicable service bulletins.

(a) Put a blank modification status label on a wooden work surface.

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

(c) Apply the modification status label to the stator and housing assembly next to the identification plate.

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

(3) If original identification plate was damaged:

(a) Put a replacement identification plate on a wooden work surface.

(b) Transfer all information from the original identification plate to the replacement identification plate using a 1/8 inch (3,18 mm) letter punch set and a light hammer.

(c) Attach identification plate with 4 drive screws (350) to stator and housing assembly.

NOTE: If the drive screw holes have become elongated, or if the drive screw head breaks off or damages the screw hole, the housing cannot be field repaired.

(d) Coat the replacement identification plate with acrylic coating and let the coating air dry.

7. Mandatory Acceptance Testing

Test DC Starter-Generator according to procedures in the TESTING AND FAULT ISOLATION section before it is returned to service or stored.

8. Final Assembly

After mandatory acceptance testing is completed, apply anti-seize compound as follows:

(1) Remove the screw (55) securing the brush access cover (50).

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

(2) Apply anti-seize compound to the threads of self-locking blind rivet nut (56).

(3) Re-install screw (55) into self-locking blind rivet nut (56). Tighten screw to a torque of 20 to 30 lbf.in. (2,3 to 3,4 Nm).

9. Preparation for Shipment/Storage

Prepare DC Starter-Generator for shipment or storage.

A. Package the generator for shipment or storage.

(1) Wrap the drive spline with protective paper according to MIL-B-121A, Grade A, Type II, Class 1.

(2) For shipment or storage, seal DC Starter-Generator unit in suitable plastic container to protect against corrosion and airborne contaminants. Refer to STORAGE section in this manual for packing materials.

(3) For shipment, package the unit in its original shipping container if possible. Include applicable inspection, test, repair, and installation documents. Otherwise, package sealed unit in accordance with best commercial practices. Refer to STORAGE section in this manual for packing materials.

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FITS AND CLEARANCES

1. Introduction

A. The following paragraphs provide information for determining the acceptability of fits and clearances of the starter-generator.

B. Examine the parts for damage. Refer to CHECK section, for details.

C. Repair the parts before assembly. Refer to REPAIR section, for details.

D. The required torque values to be used during repair and assembly of starter-generator components and attaching parts are listed in Paragraph 2.

E. The acceptance limits for starter-generator components and subassemblies are listed in Paragraph 3.

2. Torque Values

Refer to Table 8001 for torque values to be used during repair and assembly.

IPL Figure and Item Number	Item	Torque lb-in (N·m)
10001-40	Screw	7.7 to 10.3 (0,9 to 1,2)
10001-65	Screw	22.7 to 35.0 (2,5 to 3,9)
10001-75	Nut	100.0 to 120.0 (11,3 to 13,6)
10001-120	Screws	13.5 to 18.0 (1,5 to 2,0)
10001-185	Screws	13.5 to 18.0 (1,5 to 2,0)
10001-205	Screws	13.5 to 18.0 (1,5 to 2,0)
10001-225	Bolt	P/N AN3-7A: 22.7 to 35.0 (2,5 to 3,9) P/N AN3-10A: 25.0 to 30.0 (2,8 to 3,4)
10001-230	Nut	22.7 to 35.0 (2,5 to 3,9)
10001-285	Screw	22.7 to 35.0 (2,5 to 3,9)

Table 8001 - Torque Values

3. Component Acceptance Limits

Refer to Table 8002 for acceptance limits applicable to DC Starter-Generator components and subassemblies. Paragraph designations in the CHECK column refer to the applicable inspection procedures found in the CHECK section, but where noted.

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

CHECK Section	Item Description	Inspect for…	Acceptance Limits
8.D.(4)(c)	Brush holder assembly (220)	Brush spring tension	Position “A”: 2.6 lbs. (11.1 N) Min.
			Position “B”: 3.4 lbs. (15.3 N) Max.
8.I.(5)	Drive shaft - 12 tooth (85) used on all models, but Model 23065-018	Drive end spline dia. over two 0.1094 inch (2,779 mm) dia. pins	0.757 inch (19,23 mm) minimum
	Drive shaft - 16 tooth (85) used on model 23065-018	Drive end spline dia. over two 0.096 inch (2,44 mm) dia. pins	0.921 inch (23,39 mm) minimum
8.J.	Friction ring (105)	Thickness	0.060 inch (1,52 mm) minimum
8.K.	Dampener plate (95)	Thickness	0.038 inch (0,97 mm) minimum
		Internal spline dia. over two 0.090 inch (2,28 mm) dia. pins	0.6550 inch (16,637 mm) maximum
8.M.(4)(a)	Drive end bearing support assembly (115)	Bearing liner diameter	1.8501 inch (46,993 mm) min. 1.8504 inch (47,001 mm) max.

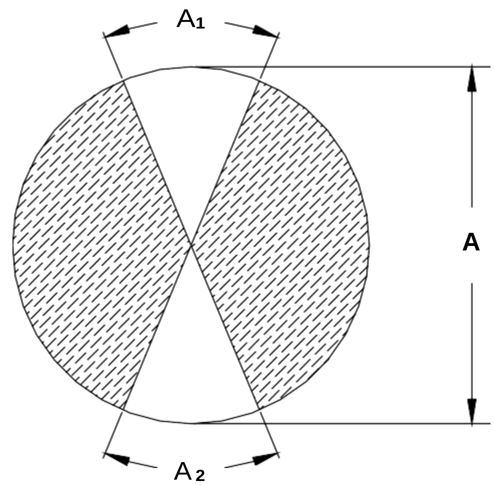
Table 8002 - Acceptance Limits

CHECK Section	Item Description	Inspect for…	Acceptance Limits
8.O.	Armature (175)	Bearing Journal Diameter (A, C)	0.7872 to 0.7875 inch (19,994 to 20,003 mm)
		Commutator Diameter (B)	2.060 inch (52,324 mm) Min.
		Commutator Bar to Bar Acceptance Test Values	Bar to Bar: 0.0002 inch (0,005 mm) Max. T.I.R.: 0.0008 inch (0,020 mm) Max.
		Commutator Bar to Bar (Before Refinishing)	Bar to Bar: 0.0008 inch (0,020 mm) Max.
		Commutator Bar to Bar and Concentricity (After Refinishing)	Bar to Bar: 0.0001 inch (0,0025 mm) Max. T.I.R.: 0.0005 inch (0,0127 mm) Max.
		Mica Undercut (Before Re-cut)	Depth: 0.045 inch (1,14 mm) Min. to 0.070 inch (1,78 mm) Max. Width: 0.035 to 0.045 inch (0,89 to 1,14 mm) Max.
		Mica Undercut (After Re-cut)	Depth: 0.050 inch (1,27 mm) Min. to 0.070 inch (1,78 mm) Max. Width: 0.035 to 0.045 inch (0,89 to 1,14 mm) Max.
		Balance	5 grain inch (8,23 gram mm) Max. each end

Table 8002 - Acceptance Limits (Continued)

CHECK Section	Item Description	Inspect for…	Acceptance Limits
8.Q.	Terminal block (280)	Capacitor tolerance: Capacitance Values B and E Capacitance Values B and Ground Capacitance Values C and Ground	 2.0 µFd +50%/-20% 1.0 µA @ 50 VDC 0.022 µFd +50%/-20% 1.0 µA @ 50 VDC 2.0 µFd +50%/-20% 1.0 µA @ 50 VDC
8.R.(4)(b)	Anti-drive end end bell (270)	Bearing liner diameter	1.8501 inch (46,993 mm) min. 1.8504 inch (47,001 mm) max.
8.T.(1)	QAD kit end bell (365)	Dowel Pin Projection (366)	0.115 inch (2,92 mm) minimum
REPAIR 9.B.(3).	Armature (175)	Mica Undercut (After Re-cut)	Depth: 0.050 inch (1,27 mm) Min. to 0.070 inch (1,78 mm) Max. Width: 0.035 to 0.045 inch (0,89 to 1,14 mm) Max.
REPAIR Paragraph 10.	Armature (175)	Armature balance	5 grain inches (8,2 gr. mm) max. (each end)

Table 8002 - Acceptance Limits (Continued)

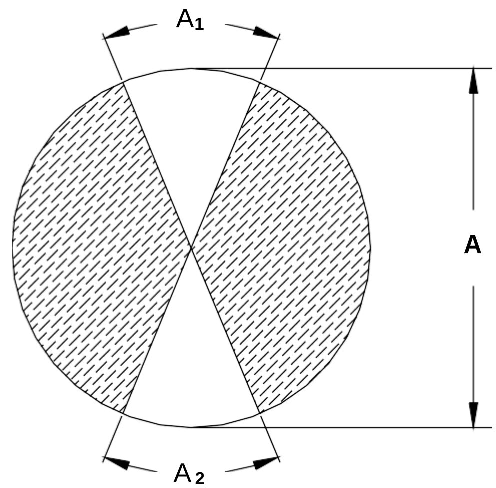


A1 + A2 < 25% of Diameter A Minimum

Figure 8001 - Measuring Armature Bearing Journal Diameters

NOTE: During overhaul/service inspection, diameter of bearing journal is considered to be acceptable if not more than 25% of circumference is below the minimum diameter limit (See Figure 8001). When the starter-generator is to be repaired and returned to service on a "continued time" basis, the minimum diameter limit of bearing journal diameter "A" is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) below maximum diameter limit.

NOTE: Acceptance criteria for used journals, not new or repaired journals.



A1 + A2 < 25% of Diameter A Maximum

Figure 8002 - Measuring Bearing Liner Diameters

NOTE: During overhaul/service inspection, diameter of bearing liner is considered to be acceptable if not more than 25% of circumference is above the maximum diameter limit (See Figure 8002). When the starter-generator is to be repaired and returned to service on a "continued time" basis, the maximum diameter limit of bearing liner diameter "A" is acceptable if up to 25% of the circumference is not more than 0.0001 inch (0,0025 mm) above maximum diameter limit.

NOTE: Acceptance criteria for used liners, not new or repaired liners.

SPECIAL TOOLS, FIXTURES, AND EQUIPMENT

1. Introduction

Table 9001 lists items that are approved for use during repair and overhaul of all 23065 Series DC Starter-Generators.

Reference Standard Practice Document (SPD) 1004 for 23065 Series Brush Holder Alignment Fixtures.

Item	Figure No.
Wrench, Spline	Figure 9001
Support, Anti-Drive End Hub	Figure 9002
Driver, Dampener Hub	Figure 9003
Adapter, Armature Shaft (Drive End)	Figure 9004
Adapter, Armature Shaft (Anti-Drive End)	Figure 9005
Drivers, Bearing (Inner Race and Outer Race)	Figure 9006
Adapter, Commutator Viewing	Figure 9007
Fixture, Commutator Turning	Figure 9008
Support, Armature	Figure 9009
Driver, Dampener Plate	Figure 9010
Support, Stator, Vertical	Figure 9011
Support, Stator, Horizontal	Figure 9012
Support, Bearing and Brush Support Assembly	Figure 9013
Fixture, Rivet Alignment	Figure 9014
Support, Drive End Hub	Figure 9015
Brush Holder, Alignment Fixture	SPD 1004

Table 9001 - Special Tools, Fixtures, and Equipment

2. Illustrated Description of Tools

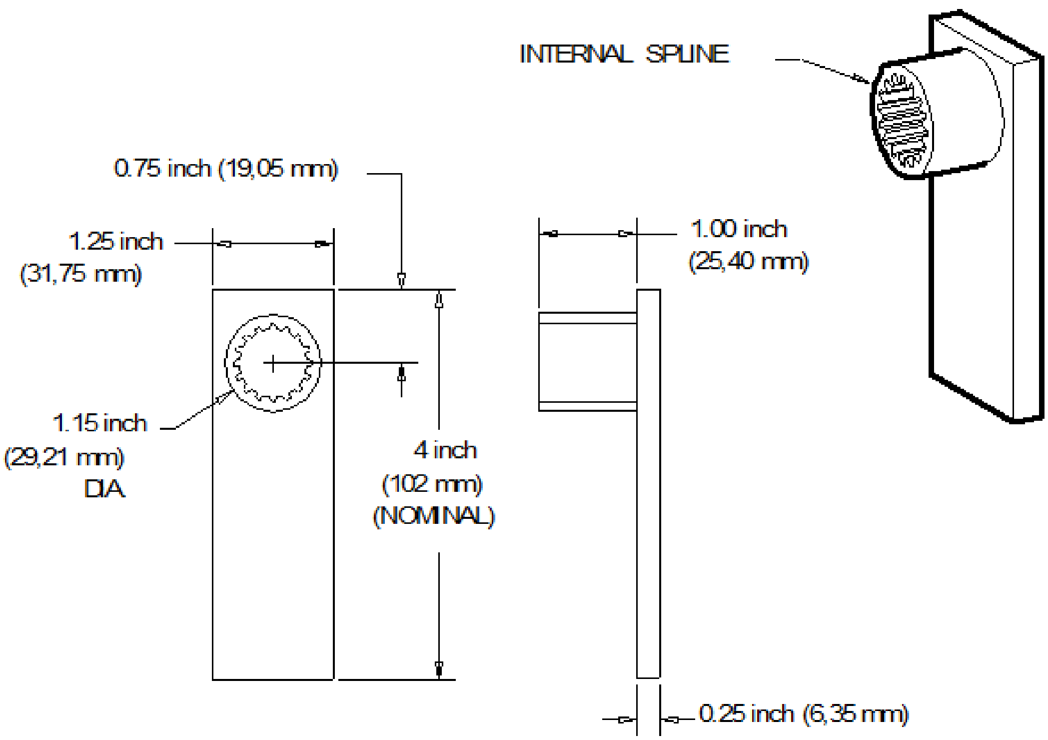
Drawings in this section provide material and fabrication instructions for making tools or fixtures listed in Table 9001. Where dimensions and fabrication instructions are provided, the tool or fixture is approved for local manufacture. Unless otherwise specified, all dimensions are in inches.

The tools and fixtures cannot be procured from Safran Power. Equivalent tooling and fixture requirements meeting with Safran Power specifications can be used.

A. Spline Wrench

Material: Spline socket - AISI-01 tool steel or equivalent.
Hardened to Rockwell C 55-60
Handle: C.R.S.

Tolerances on: Decimals 0.XX ± 0.010 inch (0,25 mm)
0.XXX ± 0.005 inch (0,13 mm)



Internal Involute Spline Data Fillet Root Side Fit	inch	mm
Number of Teeth	16	
Diametral Pitch	20 / 40	
Pressure Angle	30 DEG.	
Pitch Diameter	0.8000	20,320
Minor Diameter (min.)	0.7270	18,590
Major Diameter (min.)	0.8640	21,946
Chord Space (min.)	0.0728	1,849
Pin Diameter	0.0720	1,829
Between three.072 Pins (min.)	0.7096	18,024

Figure 9001 - Spline Wrench

B. Anti-Drive End Hub Support

Material: AISI-01 tool steel or equivalent
Harden to Rockwell C 35-40

Tolerances on: Decimals 0.XX ± 0.010 inch (0,25 mm)
0.XXX ± 0.005 inch (0,13 mm)

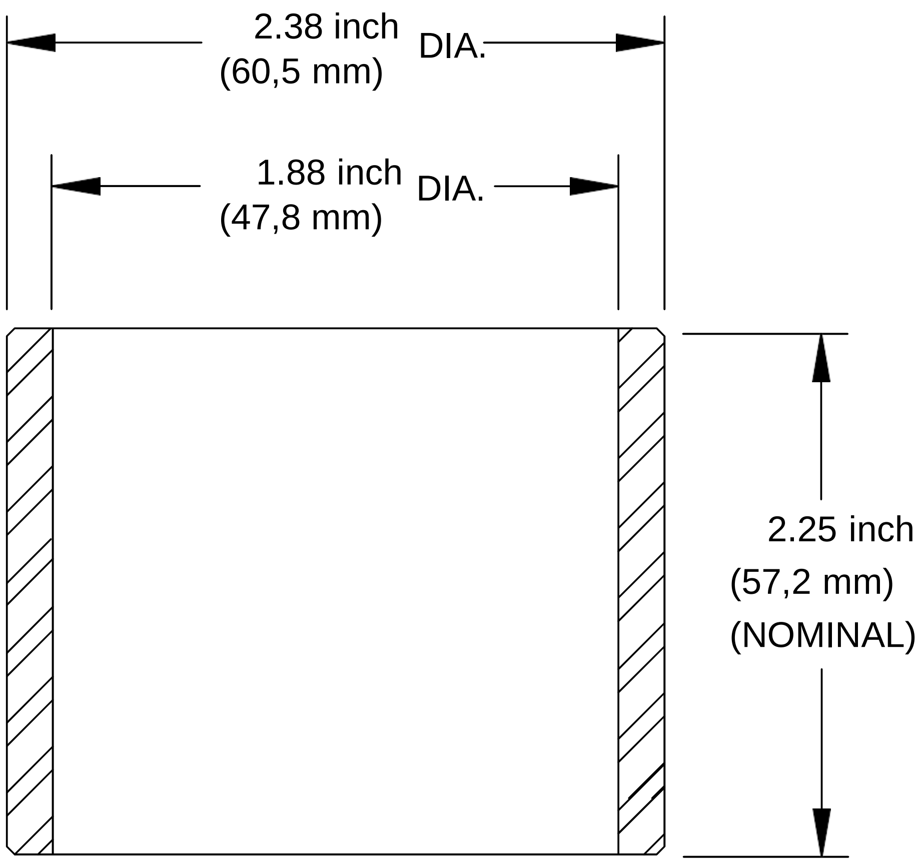


Figure 9002 - Anti-Drive End Hub Support

C. Dampener Hub Driver

Material: AISI-01 tool steel or equivalent

Tolerances on: Decimals 0.XX ± 0.010 inch (0,25 mm)
0.XXX ± 0.005 inch (0,13 mm)

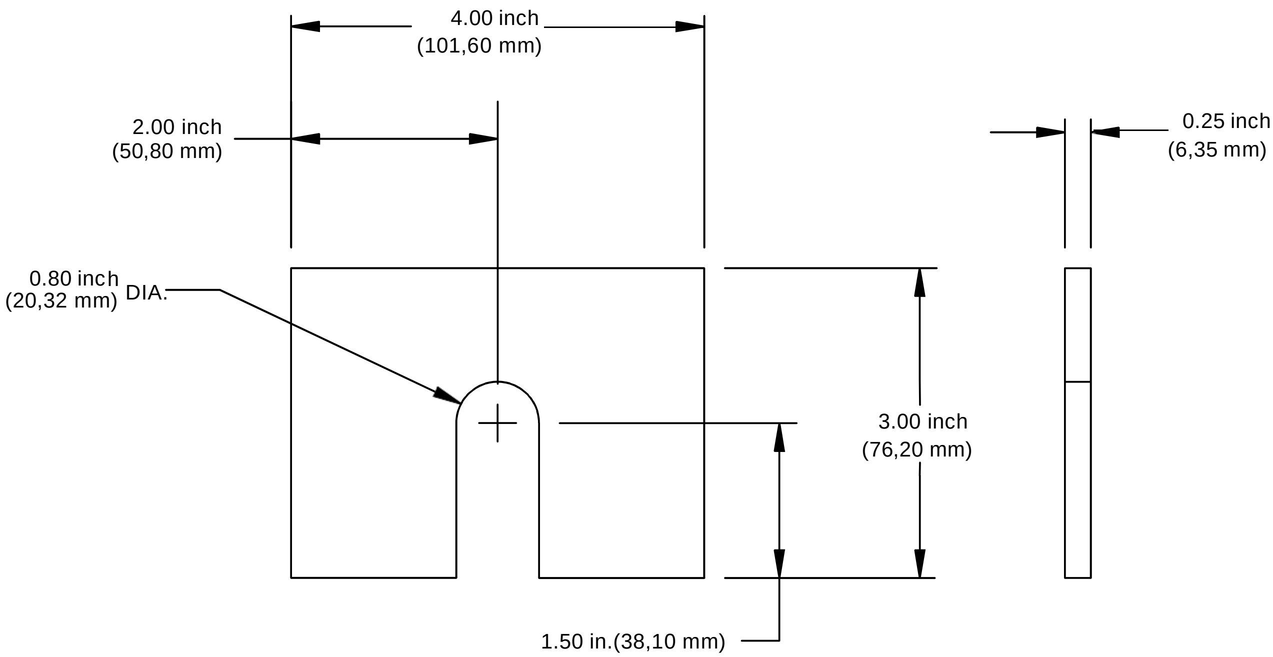


Figure 9003 - Dampener Hub Driver

D. Armature Shaft Adapter

Tolerances on decimals 0.XX ± 0.010 inch (0,25 mm), 0.XXX ± 0.005 inch (0,13 mm). Machined ends to be parallel to within 0.001 inch (0,03 mm) and square with sidewalls within ±0.05 degree.
Materials: Brass CD-260

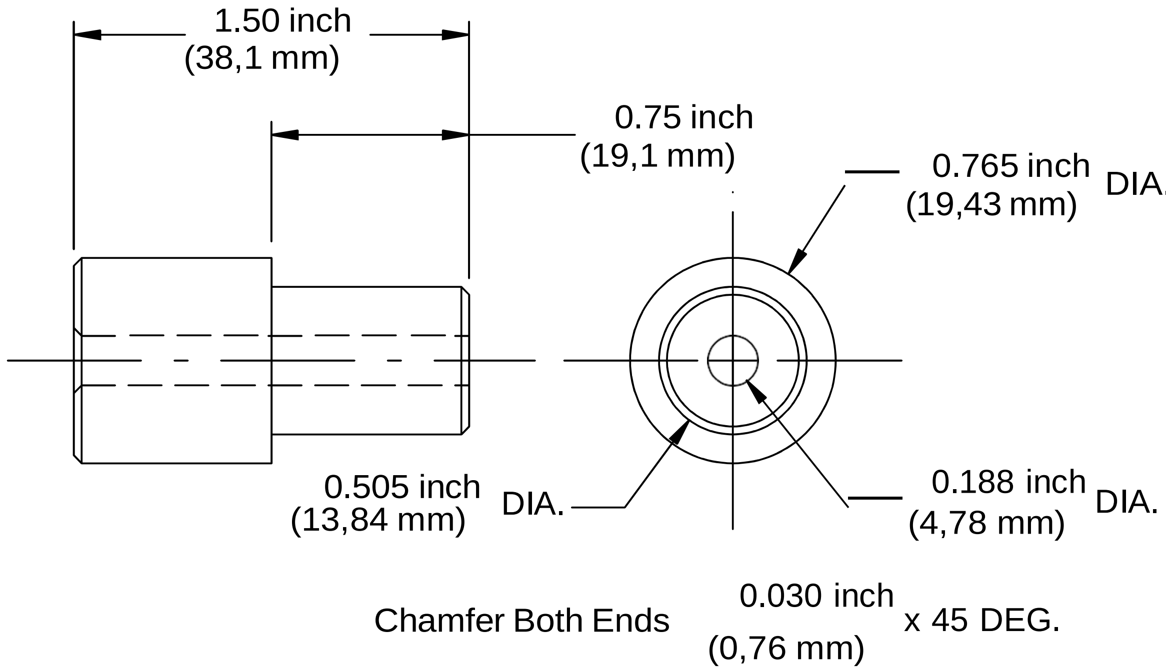


Figure 9004 - Drive End Armature Shaft Adapter

E. Anti-Drive End Armature Shaft Adapters

Tolerances on decimals 0.XX ± 0.010 inch (0,25 mm), 0.XXX ± 0.005 inch (0,13 mm). Machined ends to be parallel to within 0.001 inch (0,03 mm) and square with sidewalls within ±0.05 degree.
Materials: Brass, CD-260

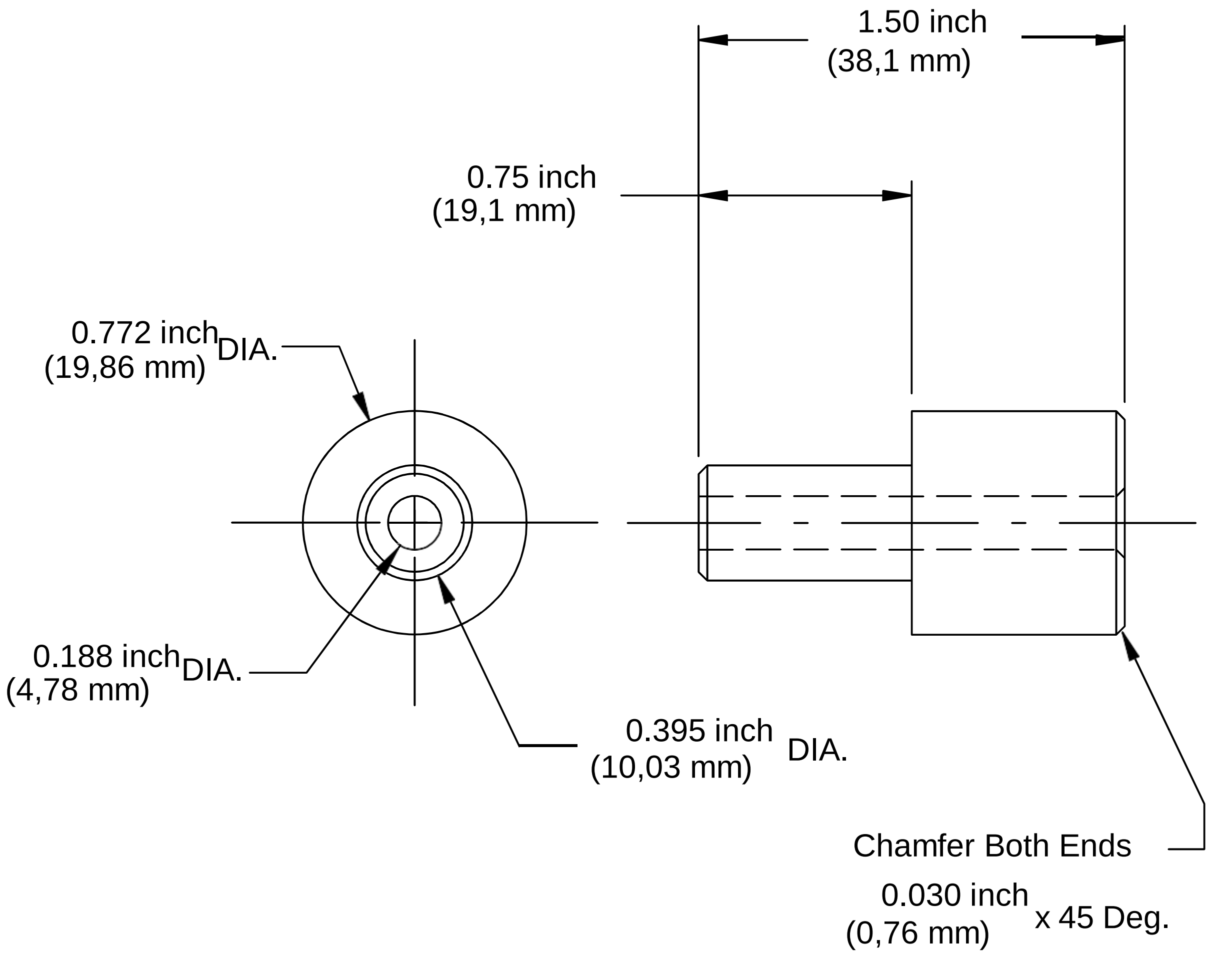


Figure 9005 - Anti-Drive End Armature Shaft Adapter

F. Bearing Drivers (Inner Race and Outer Race)

Material:	O1 tool steel or equivalent	
Stock Size:	2.00 inch diameter (50,8 mm)	
Tolerances on:	Decimals	0.XX ± 0.010 inch (0,25 mm) 0.XXX ± 0.005 inch (0,13 mm)
Angles:	±5°	

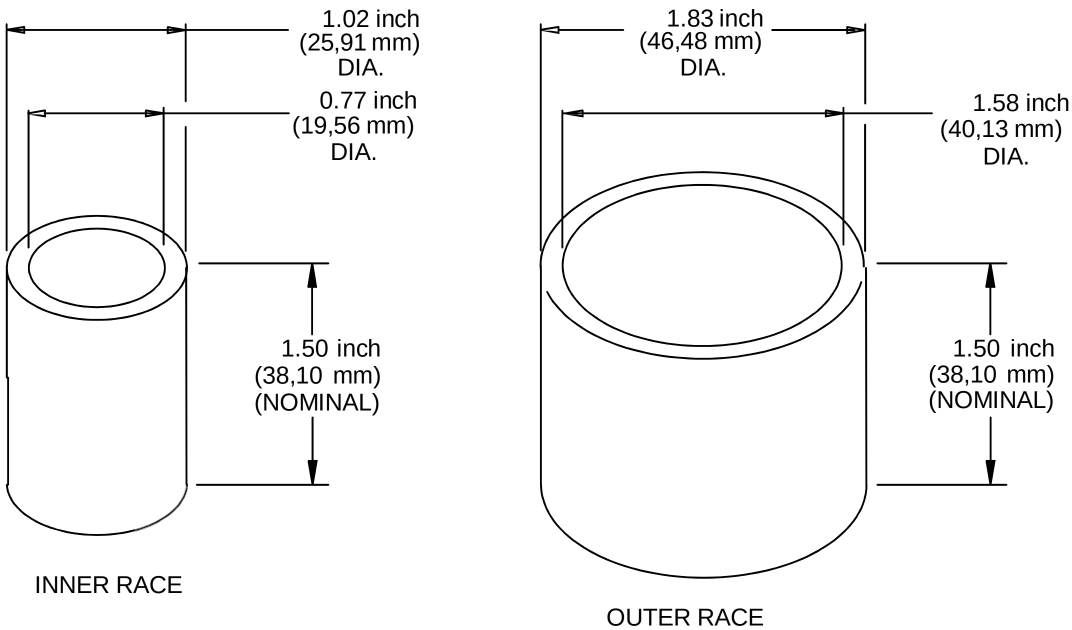


Figure 9006 - Bearing Drivers

G. Commutator Viewing Adapter (Figure 9007)

Clear acrylic viewing adapter fabrication

Required Materials: Clear acrylic, 0.125 inch (3,18 mm) thick, A dummy brush access cover, Adhesive

(1) Cut acrylic to size, 19.0 x 2.6 inch (483 x 66 mm)

(2) Remove brackets from a dummy brush access cover.

(3) Apply adhesive to ends of acrylic.

(4) Attach brackets to acrylic.

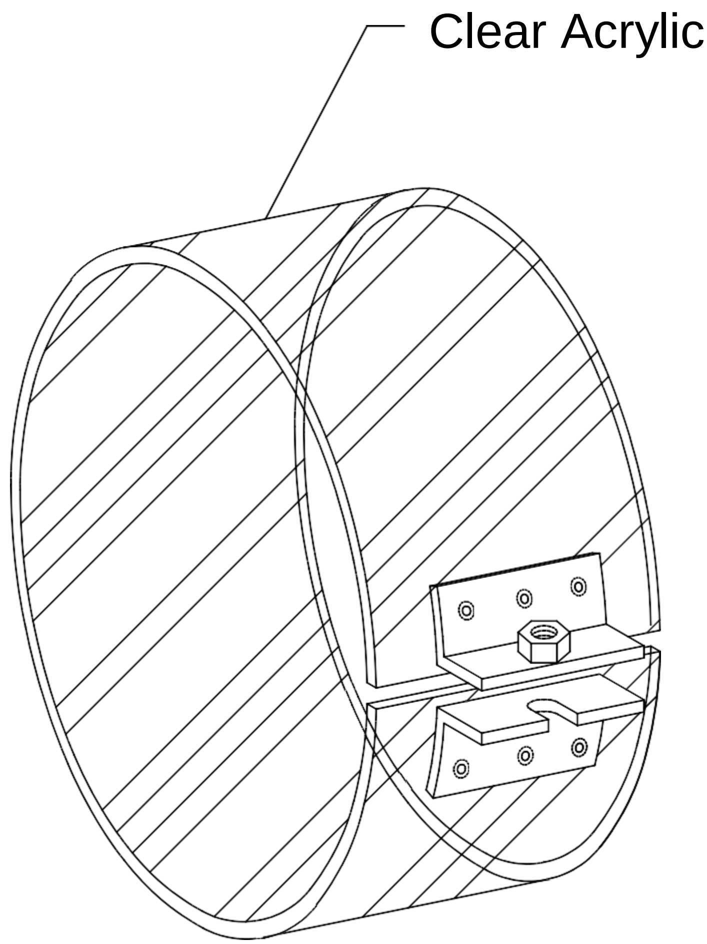


Figure 9007 - Commutator Viewing Adapter

H. Commutator Turning Fixture (Figure 9008)

Tolerances on decimals 0.XX ± 0.010 inch (0,25 mm), 0.XXX ± 0.005 inch (0,13 mm). Machined ends to be parallel to within 0.001 inch (0,03 mm) and square with sidewalls within ±0.05 degree. Harden steel to Rockwell C 35-40.
Material: 1040 Steel, Stock size: 2.50 inch (63,5 mm) diameter

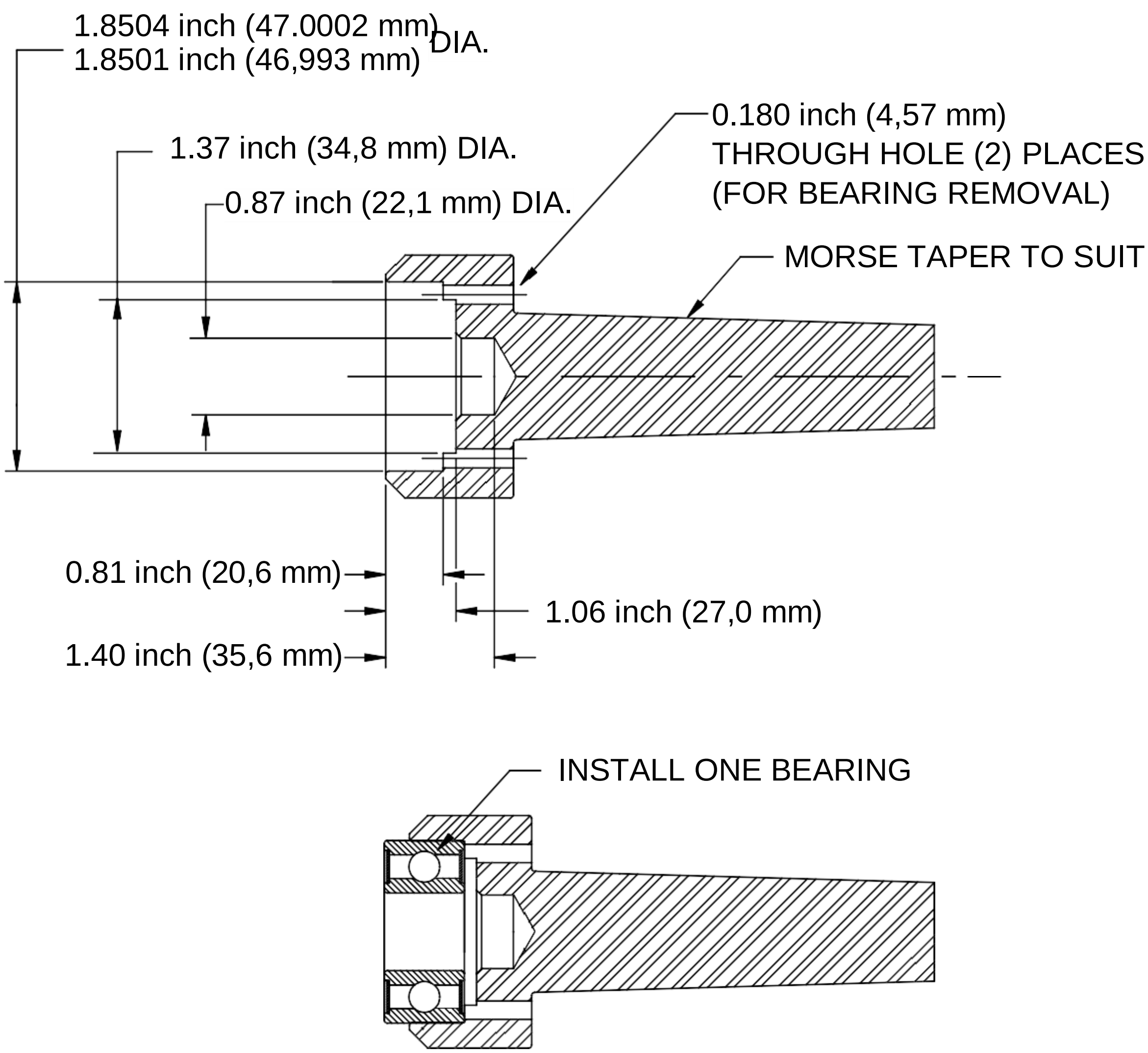


Figure 9008 - Commutator Turning Fixture

I. Armature Support

Material: O-1 tool steel, 35-40

Tolerances on: Decimals 0.XX ± 0.010 inch (0,25 mm)
0.XXX ± 0.005 inch (0,13 mm)

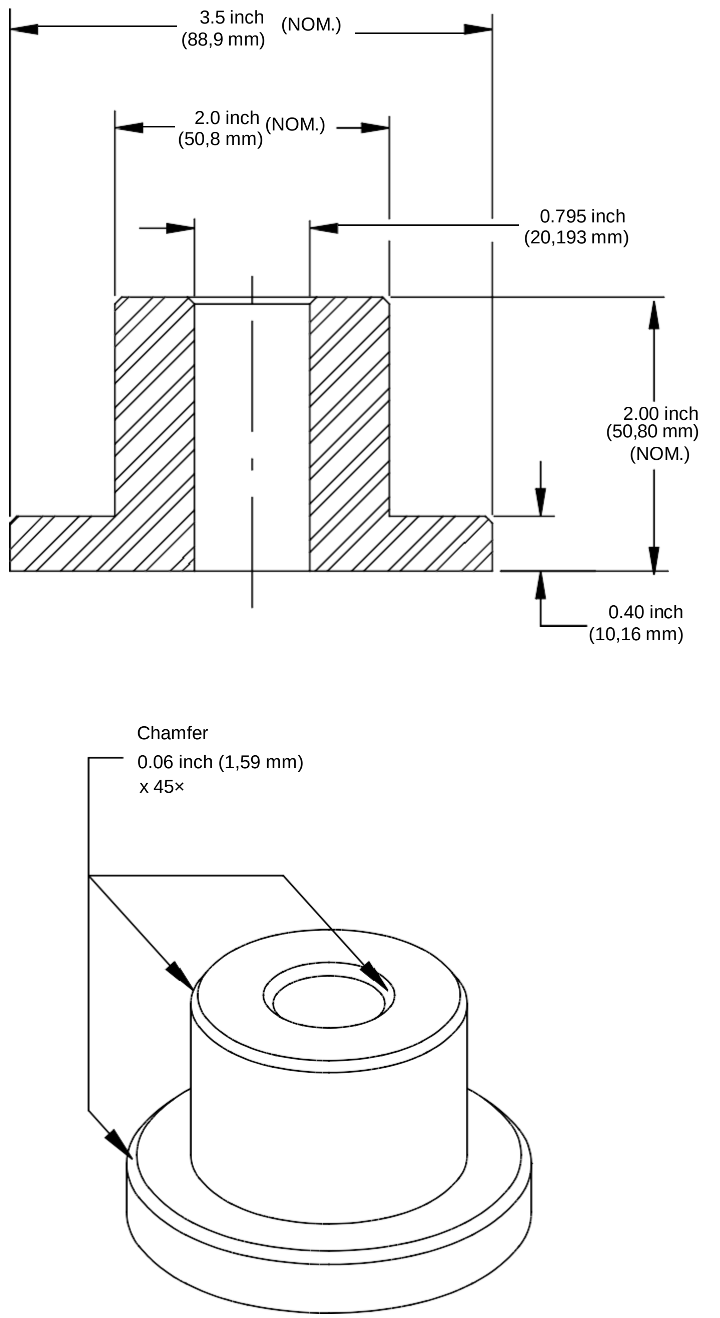


Figure 9009 - Armature Support

J. Dampener Plate Driver

Material:	O1 tool steel or equivalent Harden to Rockwell C 55-60.
Stock Size:	3.0 inch (76 mm) diameter
Tolerances on:	0.XX ± 0.010 inch (0,25 mm) 0.XXX ± 0.005 inch (0,13 mm)
Angles:	±1°

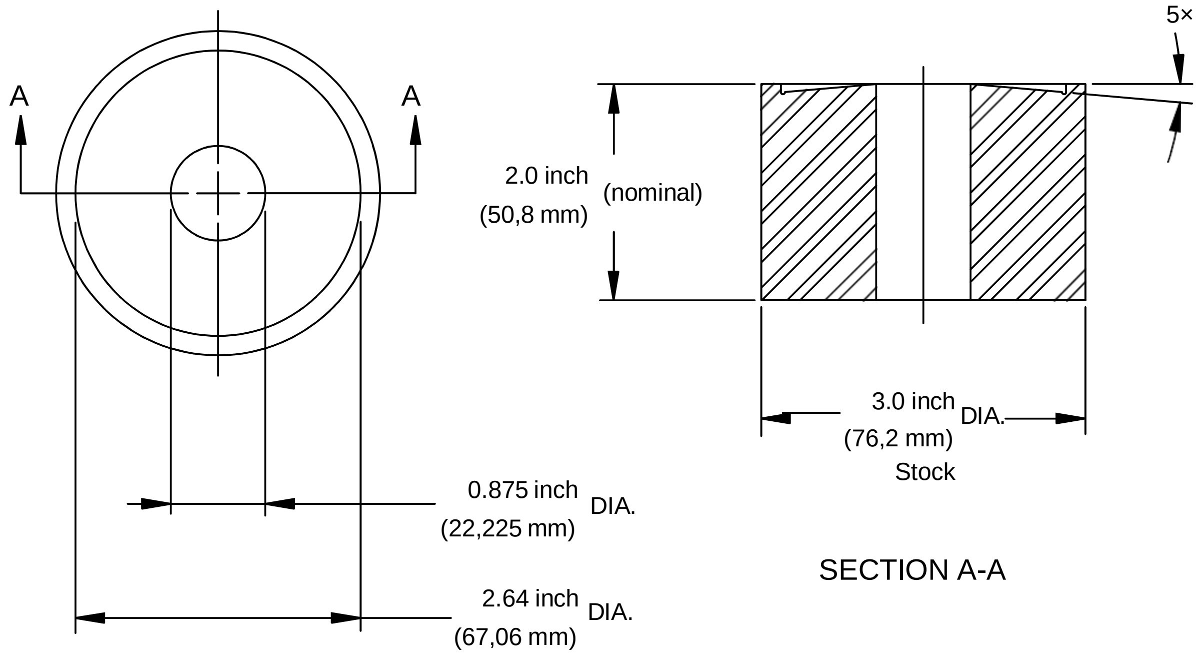


Figure 9010 - Dampener Plate Driver

K. Vertical Stator Support

All dimensions are nominal. The material is a suitable hardwood.

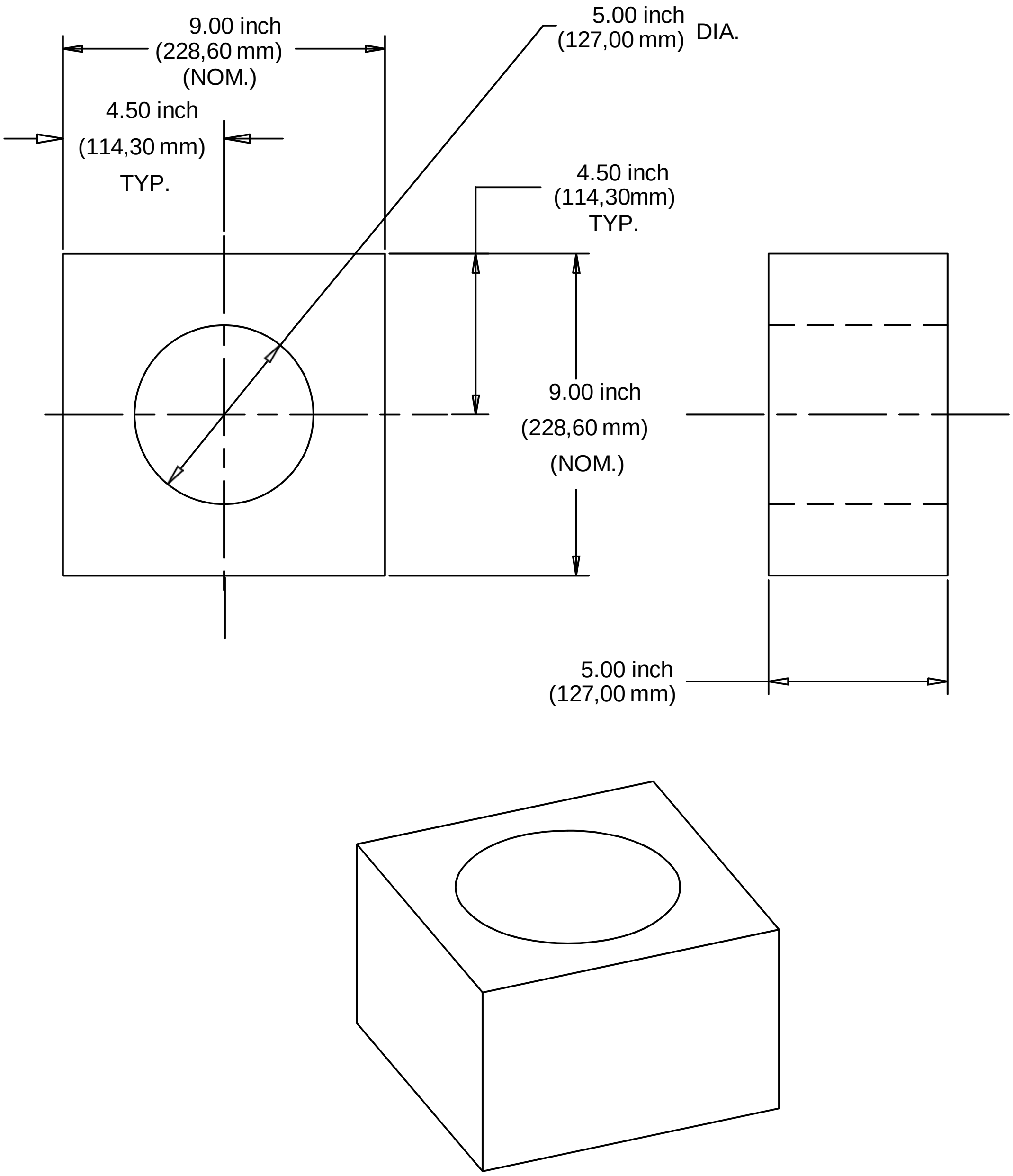


Figure 9011 - Vertical Stator Support

L. Horizontal Stator Support

Material:	Hardwood	
Stock Size:	7 x 4 x 6 inch (178 x 102 x 152 mm)	
Tolerances on:	Decimals	0.XX ± 0.010 inch (0,25 mm) 0.XXX ± 0.005 inch (0,13 mm)
Angles:	±5°	

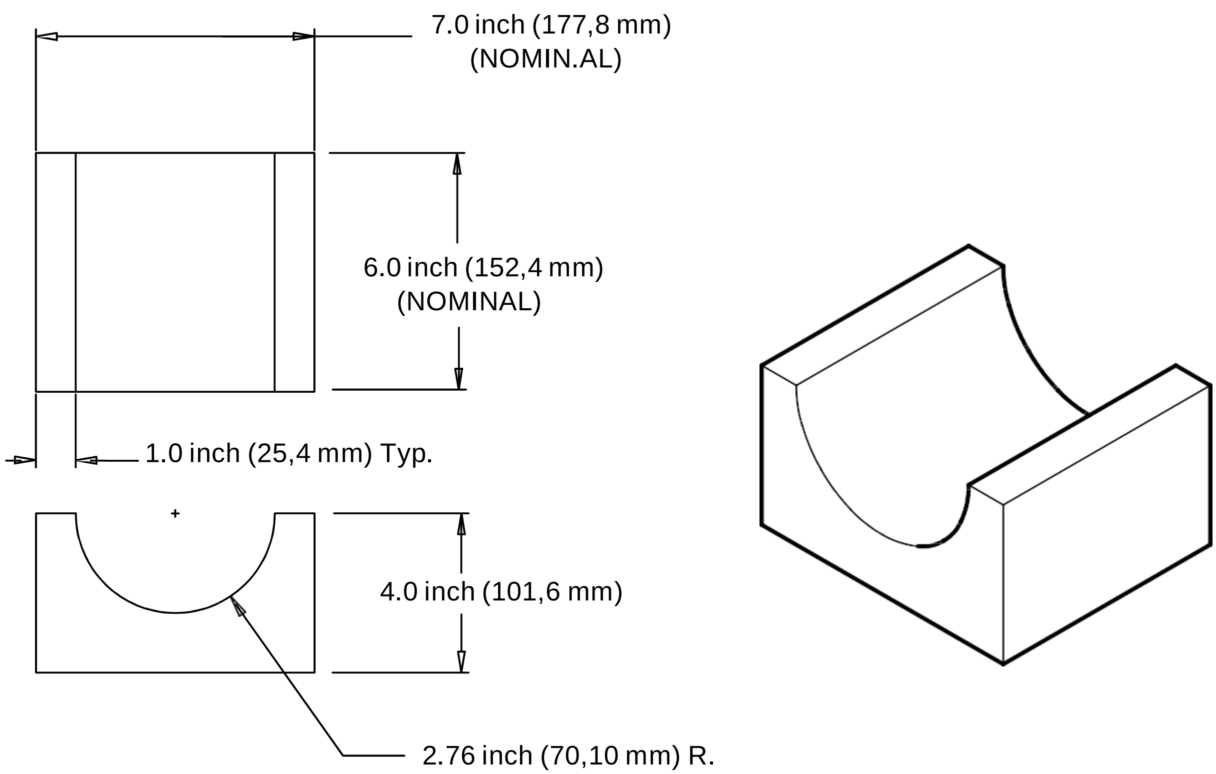


Figure 9012 - Horizontal Stator Support

M. Bearing and Brush Support Assembly Support

Material:	O1 tool steel or equivalent	
Stock Size:	6.0 inch (152 mm) diameter	
Tolerances on:	Decimals	0.XX ± 0.010 inch (0,25 mm) 0.XXX ± 0.005 inch (0,13 mm)
Angles:	±5°	

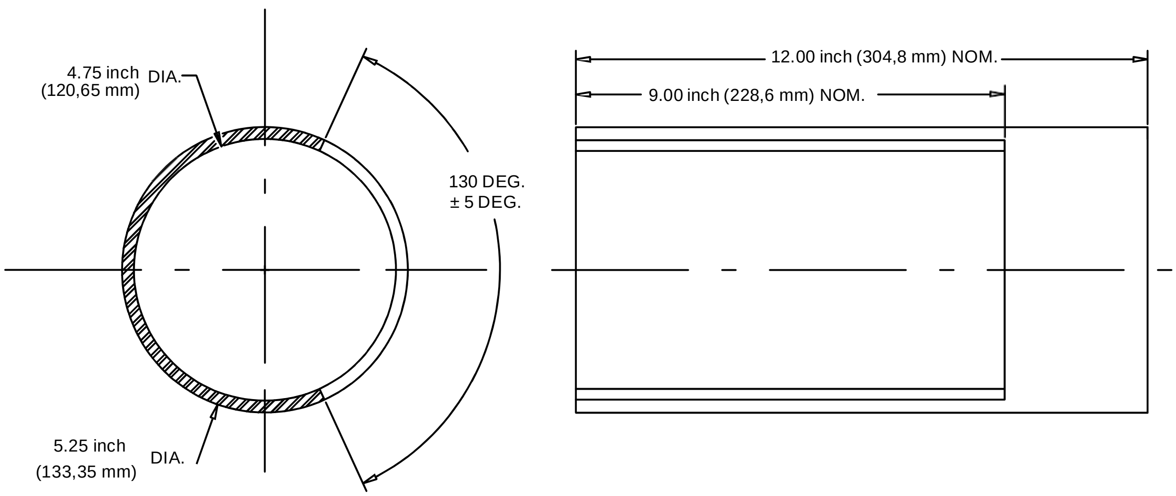
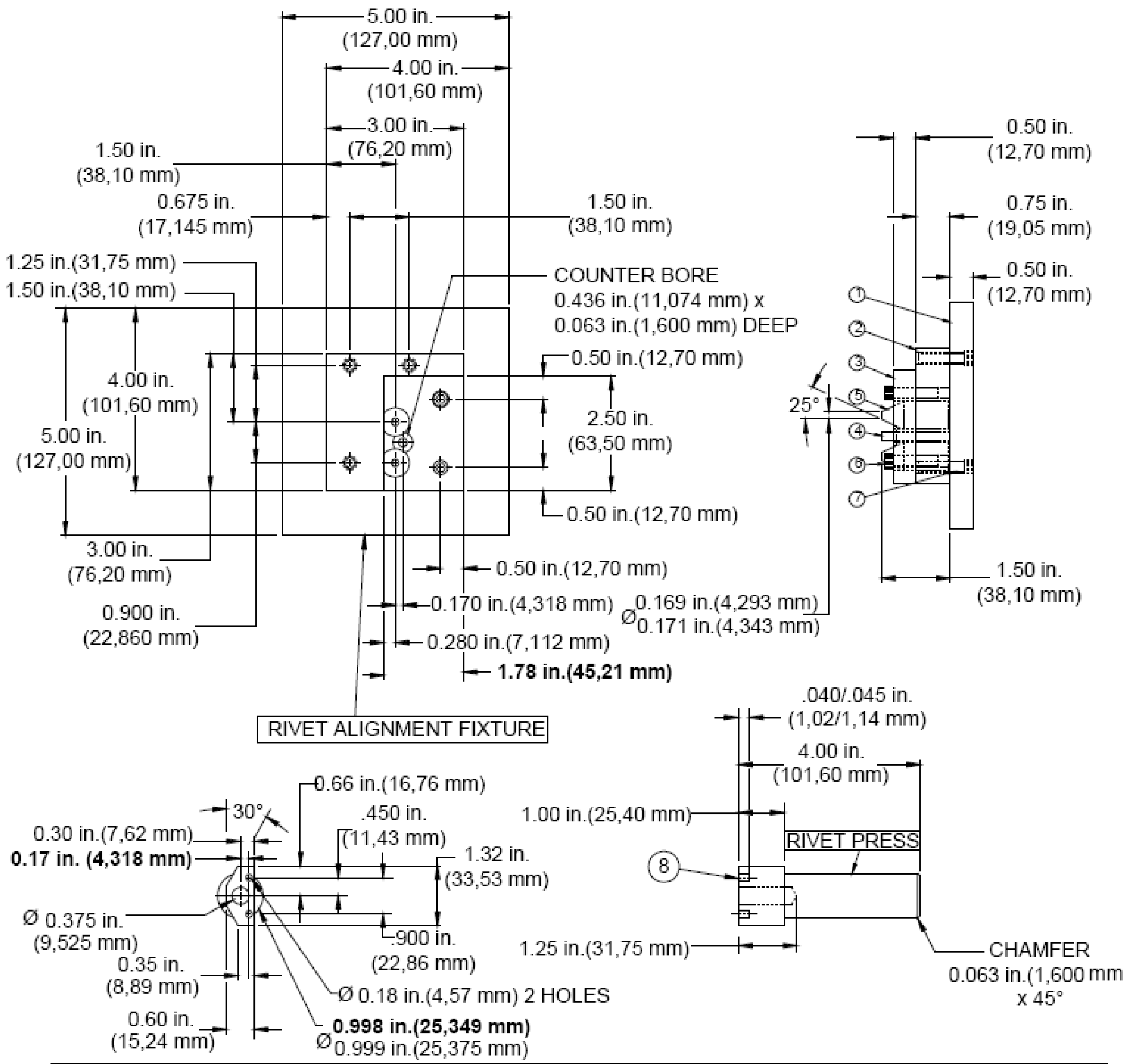


Figure 9013 - Bearing and Brush Support Assembly Support

N. Rivet alignment and press fixture. See Figure 9014.

Unless otherwise specified, tolerances on decimals are: 0.XX±0.01 inch, 0.XXX±0.005 inch, angles are ±5°0'. Machined ends to be parallel within 0.001 inch and square with sidewalls to ±0.05 degrees. See drawing for Rockwell (Rc) hardness requirements.



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 9014 - Rivet Alignment and Press Fixture

O. Drive End Hub Support. See Figure 9015.

Tolerances on decimals 0.XX ± 0.010 inch (0,25 mm), 0.XXX ± 0.005 inch (0,13 mm). Machined ends to be parallel to within 0.001 inch (0,025 mm) and square with sidewalls within ±0.05 degree.
Materials: 1040 Tool Steel hardened to Rc 35 - 40, Stock size: 2.50 inch (63,5 mm) diameter.

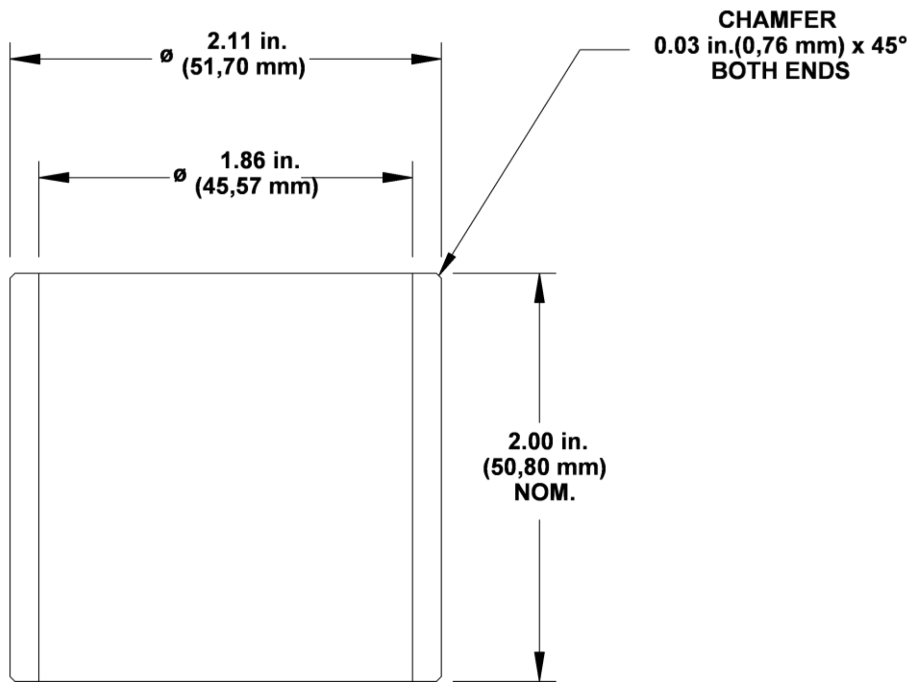


Figure 9015 - Drive End Hub Support

SPECIAL PROCEDURES

1. Introduction

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REMOVAL

1. Introduction

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INSTALLATION

1. Introduction

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SERVICING

1. Introduction

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STORAGE

1. Introduction

Materials required to pack the generator for storage or shipment are listed in Table 15001.

Description	Specification	Quantity
Bag, waterproof, vapor-proof	Commercially available. Bag must totally enclose instructions for installation and then be sealed.	1
Bag, waterproof, vapor-proof	Kraft-foil or suitable equivalent. Bag must totally enclose generator and then be sealed.	1
Box - domestic class, single wall, corrugated cardboard.	PPP-B-636 or suitable equivalent. Box must be large enough to totally enclose and restrain bagged and cushioned generator.	1
Box - WC5 overseas shipping container.	PPP-B-636 or suitable equivalent. Box must be large enough to completely enclose domestic class packaging.	1
Cardboard Tubing	Commercially available	AR
Chemically Neutral Protective Paper	Commercially available	AR
Desiccant - MIL-D-3464E Type II, Kraft bag, 4 unit bag size Englehard Corporation Desiccate 25 or equivalent	Commercially available	AR
Grease	MIL-PRF-81322	AR
Packing Material - shock absorbing foam rubber, styrofoam, bubble wrap, or expanded foam. (Safran Power's recommended method: 3 inch (76,2 mm) thick minimum expanded foam surrounding machine on all sides.)	Commercially available	AR
Polyethylene (Plastic) Wrap	Commercially available	AR

Table 15001 - Packaging Material

Description	Specification	Quantity
Small Plastic Bag	Commercially available	AR
O-Ring (for applicable models)	Check Illustrated Parts List for current p/n	1 each
Tag	Commercially available.	1 (Domestic) 2 (Internat'l)
Tape - waterproof, pressure sensitive.	Commercially available.	AR

Table 15001 - Packaging Material (Continued)

A. General information

CAUTION: IF MACHINE STORAGE TIME IS MORE THAN 24 MONTHS WITH NO USE, IT IS RECOMMENDED THAT ITS BEARINGS BE REPLACED. IT MUST THEN BE RE-TESTED ACCORDING TO TESTING AND FAULT ISOLATION SECTION BEFORE BEING PLACED INTO SERVICE.

(1) Unit must have successfully completed tests specified in TESTING AND FAULT ISOLATION section of this manual before preparing unit for shipment or storage.

(2) Record following information to tag(s):

- Model Number
- Serial Number
- Mod Status
- Test Date (PASSED)
- Packing date

(3) Use packaging materials as specified in Table 15001.

B. Documentation

Include all applicable documentation with unit:

- Testing Records
- Repair Reports
- Final Inspection/Check Records
- Packing List and Certificate of Conformance

C. Domestic Packaging

(1) If machine includes drive shaft with O-ring (10001-90)/oil sealing provision, place O-ring into a small plastic bag and attach to machine.

(2) Apply lubricating grease to drive spline according to MIL-PRF-81322 and wrap it in protective paper according to MIL-B-121A, Grade A, Type II.

(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 3 inch (76,2 mm) thick shock absorbing, cushioning material on all six sides.

(7) Securely and completely seal all flapped openings of box with tape.

(8) Tape tag to exterior surface of box. Make sure all information is visible.

D. Overseas Shipment On Surface Vessels

(1) Accomplish domestic packaging of machine in accordance with Paragraph 1.C.

(2) Place domestically packaged 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.

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REWORK

1. Introduction

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ILLUSTRATED PARTS LIST

1. Introduction

This section contains a listing of assemblies and detail parts for 23065 Series DC Starter-Generator. Each list is arranged in disassembly sequence, but the attaching parts are listed immediately after the parts they attach, under the heading of (ATTACHING PARTS).

All replacement parts are manufactured or source-controlled by Safran Power with the exception of those parts given an MS, AN, NAS, ANSI, ASME or ISO, etc. part number. (See Paragraph 2.B. below).

WARNING: USE OF PARTS, MATERIALS OR PROCEDURES NOT AUTHORIZED BY SAFRAN POWER FOR MAINTENANCE OR OVERHAUL OF UNIT(S) CAN AFFECT CONTINUED AIR WORTHINESS OR INVALIDATE CERTIFICATION.

To order authorized Safran Power parts, contact your regional Safran Power Customer Service Center.

2. Arrangement of the Parts List

A. Figure and Item Number

The figure number indicates the figure where the part is illustrated. Each item number corresponds to a part illustrated in the applicable figure. Several item numbers can have a letter following a number (e.g. 10 A). This indicates that the part has the same function and location as the base number (e.g. 10), but can be different in form and material. An item number that is preceded by a dash (e.g. -30) is not illustrated in the applicable figure.

B. Part Number

The part numbers listed in this column are the only authorized parts for replacement and overhaul of the starter-generator. Part numbers in this IPL consists mainly of Safran Power part numbers, and does include Military Standard (MS), Army Navy (AN), National Aerospace Standard (NAS) and industry standard (ANSI, ASME, ISO, etc.) part numbers unless a Commercial and Government Entity (CAGE) code appears in the Nomenclature column. Refer to Paragraph 2.F. for details.

C. Nomenclature

The proper name and type of each part is provided in this column. The description of each item is indented by columns to indicate the relationship to the next higher assembly (NHA). Each listed item is placed in the NOMENCLATURE column one indenture (one dot) to the right of the assembly to which it belongs. Items at equal indentures are all components of a single assembly or subassembly. The number of indentures and bullets depicts the relationship of the item to the associated next higher assembly as follows:

1 2 3 4 5
Assembly, level 1, no bullets
  Detail Parts for Assembly, level 2, 1 bullet
    Sub-Assembly, level 3, 2 bullets
      Attaching Parts for Sub-Assembly, level 4, 3 bullets
        Detail Parts for Sub-Assembly, level 5, 4 bullets

The interchangeability relationship between parts is identified in the NOMENCLATURE column of the parts list. A list of the terms used to show interchangeability and their definition is as follows:

Term	Parts List Abbreviation	Definition
Alternate	ALT:	One of the two part numbers can be used. If the part number in the Nomenclature Column is NOT specified as 'ALT:', it can not be used as an alternate. The information is for reference only or as a way to help identify the part.
Modification	MOD	Modification (MOD) status details information about 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.
Replaced by	REPLD BY	Part number listed is discontinued and should 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.
Superseded	SUPSD BY	Part number listed is obsolete and must be replaced by new part listed at the next overhaul or repair. The superseded part is not to be installed or reinstalled.
Supersedes	SUPSDS	The part number listed must replace the obsolete part number at the next overhaul or repair.

This column establishes part relationships with starter-generator models, which are essentially the same, but have minor variations. These starter-generator models are the end items on the detailed parts list and are assigned reference letters such as A, B, C, D, etc. Subassemblies or detail parts, which are not common to all configurations, but are associated with one or more of the coded end items, carry the letter or letters assigned to the end item(s) with which they are associated. When parts are used on all models, the column is left blank. Effectivity codes are redefined for each major subassembly figure.

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”. The abbreviation NP indicates non-procurable and refers to items which are not procurable and can not be ordered. The abbreviation REF indicates that the item is listed for “Reference Only”.

F. Vendors

In the case of an item supplied by a vendor and not listed under the prime manufacturer's part number, a vendor CAGE code is prefixed by the capital letter V appearing in the nomenclature column. This CAGE code number designates the original manufacturer of non-Safran Power components, and is in accordance with Cataloging Hand Books H4-1, H4-2, and H4-3. CAGE codes are listed in the NOMENCLATURE column, except for the government codes below, which are not listed:

V80205	National Aircraft Standard (prefix NAS)
V81349	Military Specifications (prefix M)
V88044	Army/Navy Standard (prefix AN)
V96906	Military Standard (prefix MS)

The Customer Support division in your region is to be contacted for parts dispatch.

Vendor Code	Manufacturer’s Name and Address

NOTE: Spec 200/2000, automated ordering users, refers to the EXCLUSIVE DISTRIBUTOR section in the front of this manual when ordering parts identified with V19527, Safran Power.

3CPE0	Safran Power USA Twinsburg, Ohio, 44087

G. Notes

Note #	QAD Kit	Information	Order Kit Separately
1	None	Direct Mount	----
2	23046-511	----	[redacted]
3	23046-520	----	[redacted]
4	23046-521	ALT: 23046-513	[redacted]
5	23046-512	----	[redacted]
6	23046-520	ALT: 23046-512	[redacted]
7	23046-521	----	[redacted]
8	23046-510	----	[redacted]
9	23046-521	Provided (ALT: 23046-513)	----
10	23046-513	----	[redacted]

Table 10001 - QAD Kit Information Notes

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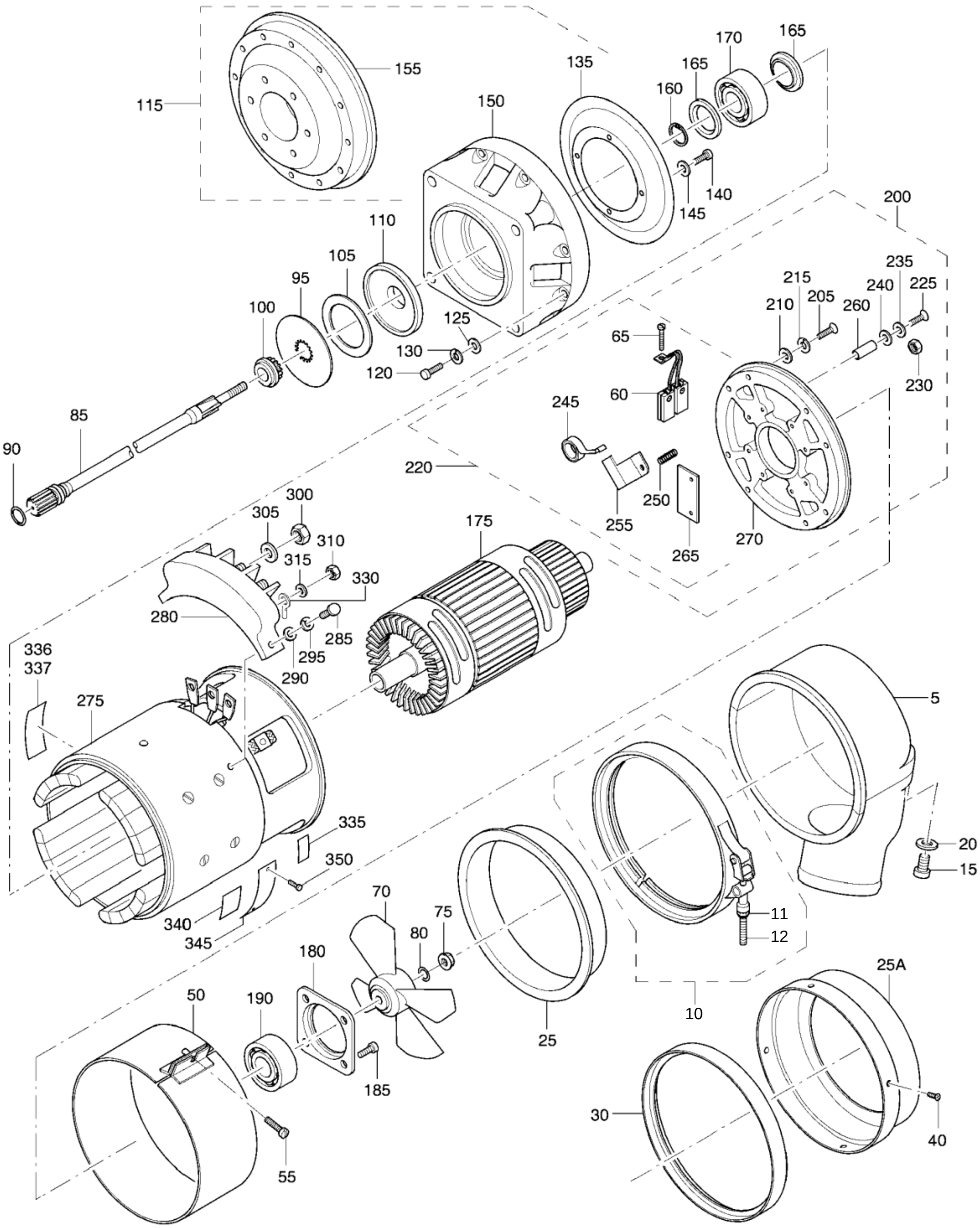

Figure 10001 - DC Starter-Generator

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
	23065-001	STARTER-GENERATOR, DC . . . . See NOTE: 1	A	RF
	23065-004	STARTER-GENERATOR, DC . . . . See NOTE: 2	B	RF
	23065-006	STARTER-GENERATOR, DC . . . . See NOTE: 3	C	RF
	23065-008	STARTER-GENERATOR, DC . . . . See NOTE: 2	D	RF
	23065-009	STARTER-GENERATOR, DC . . . . See NOTE: 10	E	RF
	23065-012	DELETED		
	23065-014	DELETED		
	23065-015	DELETED		
	23065-013	STARTER-GENERATOR, DC . . . . See NOTE: 4	F	RF
	23065-013-1	STARTER-GENERATOR, DC . . . . See NOTE: 5	G	RF
	23065-015	STARTER-GENERATOR, DC . . . . See NOTE: 6	H	RF
	23065-015-1	STARTER-GENERATOR, DC . . . . See NOTE: 7	I	RF
	23065-015-2	STARTER-GENERATOR, DC . . . . See NOTE: 5	J	RF
	23065-018	STARTER-GENERATOR, DC . . . . See NOTE: 8	K	RF
	23065-015-3	STARTER-GENERATOR, DC . . . . See NOTE: 1	L	RF
	23065-004T	STARTER-GENERATOR, DC . . . . See NOTE: 2	M	RF
	23065-004M	STARTER-GENERATOR, DC . . . . See NOTE: 2	N	RF
	23065-004TM	STARTER-GENERATOR, DC . . . . See NOTE: 2	O	RF
	23065-018-1	STARTER-GENERATOR, DC . . . . See NOTE: 9	Q	RF
	23065-018-2	STARTER-GENERATOR, DC . . . . See NOTE: 7	R	RF
	23065-020	STARTER-GENERATOR, DC . . . . See NOTE: 7	S	RF

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
5	23065-1040	• INLET ASSEMBLY, Air . . . . (Matched Set)	ACGIL	1
10	23032-1580	• CLAMP, Rim Clenching . . . . ALT: 23032-1586	AC	1
-10A	23032-1586	• CLAMP, Rim Clenching . . . . ALT: 23032-1580	GIL	1
		(ATTACHING PARTS)		
11	MS21045L3	• • NUT . . . . (MS21045L3 is reference for complete P/N MS21045-L3) Used on 23032-1580	AC	1
-11A	MS21045L3	• • NUT . . . . REPLD BY MS21045-3 (MS21045L3 is reference for complete P/N MS21045-L3) Used on 23032-1586	GIL	1
11B	MS21045-3	• • NUT . . . . REPLS MS21045L3 Used on 23032-1586	GIL	1
12	23032-2800	• • T-BOLT . . . . Used on 23032-1580 and 23032-1586	ACGIL	1
		.... *		
15	AN501A10-12	• SCREW	AC	2
-15A	MS35266-65	• SCREW	GIL	2
20	AN960-10	• WASHER	ACGIL	2
25	23065-1000	• COVER, Fan	ACGIL	1
25A	23065-1220	• COVER ASSEMBLY, Fan.	BDEMNO	1
	23065-1220	• COVER ASSEMBLY, Fan...........MOD A SUPSDS 23046-1090	S	1
	23046-1090	• COVER ASSEMBLY, Fan. . . . . REPLD BY 23065-1250	F	1
	23046-1090	• COVER ASSEMBLY, Fan. . . . . SUPSD BY 23065-1220	S	RF
	23046-1090	• COVER ASSEMBLY, Fan.	JQR	1
	23065-1250	• COVER ASSEMBLY, Fan. . . . . REPLS 23046-1090	F	1
	23065-1250	• COVER ASSEMBLY, Fan.	HK	1
30	23065-1260	• • GASKET, Fan Cover	FHK	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		(ATTACHING PARTS)		
40	05-340122	• SCREW	BDEFHJ KMNOQ RS	4
		------------ * ------------		
50	23065-1121	• COVER, Brush	ABCEIM NO	1
	23065-1270	• COVER, Brush	D	1
	23065-1360	• COVER, Brush	FGHJKL QRS	1
		(ATTACHING PARTS)		
55	AN502-10-14	• • SCREW . . . . REPLD BY AN502-10-18	ABCEIM NO	1
	AN502-10-14	• • SCREW	DFGHJK LQRS	1
	AN502-10-18	• • SCREW . . . . REPLS AN502-10-14	ABCEIM NO	1
-56	05-321002	• • NUT, Self-Locking . . . . REPLD BY NAS1329H3K80L	ABCEFG HIJKLMN OQR	1
	05-321002	• • NUT, Self-Locking	D	1
	NAS1329H3K80L	• • NUT, Blind Rivet, Self-Locking . . . . REPLS 05-321002 REPLD BY NAS1329H3K130L	ABCEFG HIJKLMN OQR	1
	NAS1329H3K130L	• • NUT, Blind Rivet, Self-Locking . . . . (Same as P/N 01-200376) REPLS NAS1329H3K80L	ABCEFG HIJKLMN OQR	1
	NAS1329H3K130L	• • NUT, Blind Rivet, Self-Locking	S	1
		------------ * ------------		
60	30010-1026	• BRUSH.	ACDE	4
	30010-1026	• BRUSH. . . . . SUPSD BY 23065-1680	BMNO	RF
	30300-1282	• BRUSH.	GL	4
	30300-1282	• BRUSH. . . . . SUPSD BY 30300-1284	F	RF
	30300-1284	• BRUSH, SUPSDS 30300-1282,. . . . . SUPSD BY 30300-1286	F	RF
	30300-1284	• BRUSH. . . . . SUPSD BY 30300-1286	H	RF

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
60 (Contd)	30300-1286	• BRUSH. . . . . SUPSDS 30300-1284 SUPSD BY 23093-1307	FH	RF
	30300-1286	• BRUSH. . . . . SUPSD BY 23093-1307	IJK	RF
	30300-1286	• BRUSH. . . . . SUPSD BY 23093-1300	QR	RF
	23065-1680	• BRUSH...................................... MOD C SUPSDS 30010-1026, Refer to SB 23065-004-24-01	BMNO	4
	23093-1300	• BRUSH..................................... MOD B SUPSDS 30300-1286, Refer to SB 23065-02X-24-01	QR	4
	23093-1300	• BRUSH.	S	4
	23093-1307	• BRUSH.................................... MOD C SUPSDS 30300-1286, Refer to SB 23065-0XX-24-04	FHIJK	4
		(ATTACHING PARTS)		
65	05-340201	• SCREW		4
		.... *		
70	23046-1020	• FAN ASSEMBLY . . . . REPLD BY 23065-1480	ACFGHIJ	1
	23065-1480	• FAN, Axial . . . . REPLS 23046-1020	ACFGHIJ	1
	23065-1480	• FAN, Axial	KLQR	1
	23065-1480	• FAN, Axial . . . . SUPSD BY 23065-1490	S	RF
	23065-1490	• FAN, Axial. . . . . ALT: 23065-1240	BDEMN O	1
	23065-1490	• FAN, Axial.................................MOD A SUPSDS 23065-1480	S	1
		(ATTACHING PARTS)		
75	02-4107-01	• NUT, Self-Locking. . . . . REPLD BY MS21042-4	ABCDEF GHIJKLM NOQR	1
	MS21042-4	• NUT, Self-Locking. . . . . REPLS 02-4107-01	ABCDEF GHIJKLM NOQR	1
	MS21042-4	• NUT, Self-Locking.	S	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
80	AN960-416L	• WASHER, Flat . . . . Use with Axial Fan 23065-1480 and 23065-1490, REPLD BY AN960-416	ABCDEF GHIJKLM NOQR	1
	AN960-416	• WASHER, Flat . . . . REPLS AN960-416L	ABCDEF GHIJKLM NOQR	1
	AN960-416	• WASHER, Flat	S	1
		------------ * ------------		
85	23046-1121	• SHAFT, Drive	ACGHJL	1
	23046-1125	• SHAFT, Drive	BDM	1
	02-6100-07	• SHAFT, Drive	E	1
	02-6100-02	• SHAFT, Drive	FIQRS	1
	23046-1129	• SHAFT, Drive	K	1
	23046-2153	• SHAFT, Drive	NO	1
90	MS29561-113	• PACKING, Preformed . . . . SUPSD BY M83248/1-113	EFIQR	RF
	M83248/1-113	• PACKING, Preformed . . . . SUPSDS MS29561-113	EFIQR	1
	M83248/1-113	• PACKING, Preformed	S	1
95	23032-1240	• CLUTCH, Dampener . . . . REPLD BY 23032-1900 and 23032-1910, Refer to SB 169-1	ABCDFH	1
	23032-1910	• PLATE, Dampener . . . . REPLS 23032-1240	ABCDFH	1
	23032-1910	• PLATE, Dampener	EGIJKLM NOQRS	1
100	23032-1900	• HUB, Dampener . . . . REPLS 23032-1240	ABCDFH	1
	23032-1900	• HUB, Dampener	EGIJKLM NOQRS	1
105	02-5600-05	• RING, Friction . . . . **WARNING: CAN CONTAIN ASBESTOS** SUPSD BY 02-5600-13	ABCDEF GHIJKLM NOQR	RF
	02-5600-13	• RING, Friction . . . . SUPSDS 02-5600-05	ABCDEF GHIJKLM NOQR	1
	02-5600-13	• RING, Friction	S	1
110	23032-1281	• BACK PLATE, Dampener. . . . . REPLD BY 23032-2710, Refer to SB 169-1	ABCDFH	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
		NOTE: This part did not include a friction ring.		
-110A	23032-2710	• BACK PLATE, Dampener. . . . . REPLS 23032-1281	ABCDFH	1
-110B	23032-2710	• BACK PLATE, Dampener.	EGIJKLM NOQRS	1
115	23046-1171	• BEARING SUPPORT ASSEMBLY, ... Drive End	AL	1
-115A	23065-1470	• BEARING SUPPORT ASSEMBLY, ... Drive End ALT: 23046-1670 REPLD BY 23046-1678	BCDEFG HIJKMN OQR	1
-115B	23046-1678	• BEARING SUPPORT ASSEMBLY, ... Drive End REPLS 23046-1470	BCDEFG HIJKMN OQR	1
-115C	23046-1670	• BEARING SUPPORT ASSEMBLY, ... Drive End REPLD BY 23046-1678	S	1
-115D	23046-1678	• BEARING SUPPORT ASSEMBLY, ... Drive End REPLS 23046-1670	S	1
		(ATTACHING PARTS)		
120	05-341309	• SCREW	AL	8
-120A	05-350208	• SCREW	BCDEFH JKMNOQ RS	12
-120B	NAS1189-08P16KW	• SCREW	GI	12
125	05-370176	• WASHER, Flat	AL	8
130	AN935-8L	• WASHER, Lock . . . . SUPSD BY MS35338-42	A	RF
	MS35338-42	• WASHER, Lock . . . . SUPSDS AN935-8L	A	8
	MS35338-42	• WASHER, Lock	L	8
		------------ * ------------		
135	23046-1180	• • SCREEN.		1
		(ATTACHING PARTS)		
140	MS21318-15	• • SCREW, Drive	AL	4
	MS21318-15	• • SCREW, Drive	BCDEFG HIJKMN OQRS	6

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
145	AN960-4L	• • WASHER	AL	4
	AN960-4L	• • WASHER	BCDEFG HIJKMN OQRS	6
		------------ * ------------		
150	23046-1191	• • END BELL, Drive End.	AL	1
155	23065-1460	• • END BELL, Drive End. . . . . Used on 23065-1470	BCDEFG HIJKMN OQR	1
-155A	23046-1630	• • END BELL, Drive End. . . . . Used on 23046-1670	BCDEFG HIJKMN OQRS	1
-155B	23046-2322	• • END BELL, Drive End. . . . . Used on 23046-1678	BCDEFG HIJKMN OQRS	1
160	MS16628-1078	• RING, Retaining		1
165	G128-178	• DISC, Baffle		2
170	07-111253	• BEARING, Ball . . . . ALT: 03-6010-08, SUPSD BY 03-6010-15	ABCDEM NO	RF
	03-6010-08	• BEARING, Ball . . . . SUPSD BY 03-6010-15	FGHIJKL	RF
	03-6010-15	• BEARING, Ball............................ MOD A SUPSDS 07-111253, SUPSD BY 03-6010-18	ABCDEM NO	RF
	03-6010-15	• BEARING, Ball . . . . SUPSDS 03-6010-08 SUPSD BY 03-6010-18	FGHIJKL	RF
	03-6010-15	• BEARING, Ball . . . . SUPSD BY 03-6010-18	QR	RF
	03-6010-18	• BEARING, Ball............................ MOD B SUPSDS 03-6010-15, Refer to SB 23065-0XX-24-02	ABCDEF GHIJKLM NO	1
	03-6010-18	• BEARING, Ball...........................MOD A SUPSDS 03-6010-15	QR	1
	03-6010-18	• BEARING, Ball	S	1
175	23065-1031	• ARMATURE . . . . ALT: 23065-1030, REPLD BY 23065-1032	ABCDEF HIJKMN OQR	1
	23065-1031	• ARMATURE . . . . REPLD BY 23065-1032	GL	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
175 (Contd)	23065-1032	• ARMATURE . . . . REPLS 23065-1031 and 23065-1030, Refer to SB 23065-0XX-24-03	ABCDEF HIJKMN OQR	1
	23065-1032	• ARMATURE . . . . REPLS 23065-1031	GL	1
	23065-1032	• ARMATURE	S	1
180	23046-1110	• RETAINER, Bearing	ACFGHIJ KLQR	1
	23046-1110	• RETAINER, Bearing . . . . SUPSD BY 23046-1111	S	RF
	23046-1111	• RETAINER, Bearing	BDEMN O	1
	23046-1111	• RETAINER, Bearing ....MOD A SUPSDS 23046-1110	S	1
		(ATTACHING PARTS)		
185	AN500A8-6	• SCREW	AC	4
	AN509-8R6	• SCREW . . . . REPLD BY MS24694-S3	BDEMN O	4
	MS24694-S3	• SCREW . . . . REPLS AN509-8R6	BDEMN O	4
	MS24694-S3	• SCREW....................................MOD A SUPSDS MS35265-43	S	4
	MS35265-43	• SCREW	FGHIJKL QR	4
	MS35265-43	• SCREW . . . . SUPSD BY MS24694-S3	S	RF
		.... *		
190	07-111253	• BEARING, Ball . . . . ALT: 03-6010-08, SUPSD BY 03-6010-15	ABCDEM NO	RF
	03-6010-08	• BEARING, Ball . . . . SUPSD BY 03-6010-15	FGHIJKL	RF
	03-6010-15	• BEARING, Ball............................ MOD A SUPSDS 07-111253, SUPSD BY 03-6010-18	ABCDEM NO	RF
	03-6010-15	• BEARING, Ball . . . . SUPSDS 03-6010-08 SUPSD BY 03-6010-18	FGHIJKL	RF
	03-6010-15	• BEARING, Ball . . . . SUPSD BY 03-6010-18	QR	RF

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
190 (Contd)	03-6010-18	• BEARING, Ball............................ MOD B SUPSDS 03-6010-15, Refer to SB 23065-0XX-24-02	ABCDEF GHIJKLM NO	1
	03-6010-18	• BEARING, Ball............................ MOD A SUPSDS 03-6010-15	QR	1
	03-6010-18	• BEARING, Ball	S	1
200	23046-364	• ASSEMBLY, Bearing and Brush. . . . . . . Support, REPLD BY 23046-301/23046-372	AC	1
	23046-372	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-301, REPLS 23046-364	AC	1
	23046-308	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-378	BDEMN O	1
	23065-1440	• ASSEMBLY, Bearing and Brush. . . . . . . Support, REPLD BY 23046-370	FH	1
	23046-370	• ASSEMBLY, Bearing and Brush. . . . . . . Support, REPLS 23065-1440	FH	1
	23046-370	• ASSEMBLY, Bearing and Brush. . . . . . . Support	JKQRS	1
	23046-307	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-370	FHJKQR	1
	23046-304	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-370	FHJKQR	1
	23046-377	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-370	FHJKQR	1
	23046-376	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-370	FHKQR	1
	23046-366	• ASSEMBLY, Bearing and Brush. . . . . . . Support	GL	1
	23046-371	• ASSEMBLY, Bearing and Brush. . . . . . . Support	I	1
	23046-340	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-366 and 23046-371	GIL	1
	23046-379	• ASSEMBLY, Bearing and Brush. . . . . . . Support, ALT: 23046-366 and 23046-371	GIL	1
		(ATTACHING PARTS)		
205	05-350206	• SCREW	ACGIL	8

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
205 (Contd)	05-341303	• SCREW	BDEFHJ KMNOQ RS	8
210	05-370232	• WASHER, Flat	BDEFHJ KMNOQ RS	8
215	MS35338-42	• WASHER, Lock	BDEFHJ KMNOQ RS	8
		------------ * ------------		
220	23046-1130	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-301, REPLD BY 23046-1132	AC	4
	23046-1132	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-301, REPLS 23046-1130	AC	4
	23046-1133	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-308, 23046-364, 23046-372 and 23046-378	ABCDEM NO	4
	23065-1420	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-370, 23046-371, 23046-376 and 23065-1440	FHIJKQR S	4
	23064-1281	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-304, REPLD BY 23064-1283	FHJKQR	4
	23064-1283	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-304, REPLS 23064-1281	FHJKQR	4
	23064-1283	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-377 REPLD BY 23064-1284	FHJK	4
	23064-1284	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-307, 23046-340 and 23046-366	FGHIJKL QR	4
	23064-1284	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-377 REPLS 23064-1283	FHJK	4
	23064-1284	• • BRUSH HOLDER ASSEMBLY . . . . . . Used on 23046-379	GIL	4
		(ATTACHING PARTS)		

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
225	AN3-7A	• • BOLT. . . . . Used on 23046-307, 23046-308, 23046-364, 23046-366 and 23065-1440	ABCDEF GHJKLM NOQR	8
	AN3-10A	• • BOLT. . . . . Used on 23046-340, 23046-370, 23046-371, 23046-372, 23046-376, 23046-377, 23046-378, and 23046-379	ABCDEF GHIJKLM NOQRS	8
230	MS20364-1032C	• • NUT . . . . Used on 23046-301 and 23046-304	ACFHJK QR	8
235	AN960-10L	• • WASHER, Flat		8
240	05-374094	• • WASHER, Non-Metallic		8
		------------ * ------------		
245	23033-1120	• • • SPRING, Brush . . . . Used on 23046-1130 and 23064-1281 REPLD BY 23033-1121	AC	8
-245A	23033-1121	• • • SPRING, Brush . . . . Used on 23046-1130 and 23062-1281 REPLS 23033-1120	AC	8
-245B	23033-1121	• • • SPRING, Brush . . . . Used on 23046-1133, 23046-1132, 23065-1420, 23064-1284, 23064-1283, 23065-1420	BDEFG HIJKLM NOQRS	8
250	05-360013	• • • STUD, Lock-Thread . . . . Used on 23046-1132 and 23046-1283	ACFGHIJ KLQR	8
255	30010-1025	• • • HOLDER, Brush . . . . Used on 23046-1130, 23046-1132 and 23046-1133	ABCDEM NO	4
	23064-1180	• • • HOLDER, Brush . . . . Used on 23064-1281, 23064-1283 and 23064-1284 Refer to SB 23064-1180-24-01	FGHIJKL QR	4
	23064-1180	• • • HOLDER, Brush . . . . Refer to SB 23064-1180-24-01	S	4
	23065-1380	• • • HOLDER, Brush . . . . Used on 23065-1420	FHIJKQR	4

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-257	MS21209F1-15L	• • • • INSERT, Heli-coil® Locking . . . . . Used on 23064-1180 Refer to SB 23064-1180-24-01	FGHIJKL QRS	1
260	05-631145	• • SLEEVE, Insulation		8
265	23014-1039	• • PLATE, Insulation		4
270	23065-1010	• • END BELL, Anti-Drive End . . . . Used on 23046-301, 23046-340, 23046-364 and 23046-366	ACGIL	1
	23065-1410	• • END BELL, Anti-Drive End . . . . Used on 23046-370, 23046-377 and 23046-378, REPLD BY 23046-1141	BDEFHJ KMNOQ R	1
	23046-1141	• • END BELL, Anti-Drive End . . . . Used on 23046-370, 23046-377 and 23046-378, REPLS 23065-1410	BDEFHJ KMNOQ R	1
	23046-1141	• • END BELL, Anti-Drive End . . . . Used on 23046-370, 23046-377 and 23046-378	S	1
	23046-1141	• • END BELL, Anti-Drive End . . . . Used on 23046-304, 23046-307 23046-308 and 23046-376	BDEFHJ KMNOQ R	1
	23065-1430	• • END BELL, Anti-Drive End . . . . Used on 23046-371, 23046-372 and 23046-379	ACGIL	1
275	23046-311	• STATOR AND HOUSING ASSEMBLY. .	ABCDEF GHIJKLN QRS	1
	23046-318	• STATOR AND HOUSING ASSEMBLY. .	MO	1
-276	3BT-F3-64	• • SWITCH, Thermal. . . . . **NOTE**: Not a Safran Power part, installed by Beech Aircraft.	F	1
280	23032-1512	• • BLOCK, Terminal		1
		(ATTACHING PARTS)		
285	AN501A10-12	• • SCREW, ALT: 01-098011 . . . . SUPSD BY MS35266-65		RF
	MS35265-65	• • SCREW . . . . SUPSD BY MS35266-65		RF
	MS35266-65	• • SCREW . . . . SUPSDS MS35265-65		2
290	AN960-10L	• • WASHER, Flat, ... REPLD BY AN960C10L		2

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
290 (Contd)	AN960C10L	• • WASHER, Flat . . . . REPLS AN960-10L		2
295	MS35338-43	• • WASHER, Lock.		2
		------------ * ------------		
300	MS21042-6	• • NUT, Terminal, Large		3
305	AN960C616	• • WASHER, Flat		3
310	MS21042-3	• • NUT, Terminal, Small		2
315	AN960C10	• • WASHER, Flat		2
-320	23046-1360	• • LUG, Terminal		NP
-325	23046-1310	• • LUG, Terminal		NP
330	05-652015	• • LUG, Terminal . . . . 3 ea. used on older model Stator and Housing Assemblies		2
335	06-201020	• DECAL, Instruction.		1
-336	06-123301	• LABEL, FAA-PMA	FGHIJK	1
-337	23065-9904	• PLATE, Information	QR	1
340	06-201100	• LABEL, Modification Status	ABCDEF GHIJKLM NOQR	AR
345	06-209285	• PLATE, Identification, Replacement. . . .	ACDEFG HIJKLMN OQRS	1
-345A	06-209286	• PLATE, Identification, Replacement. . . .	B	1
		(ATTACHING PARTS)		
350	MS21318-14	• SCREW, Drive . . . . REPLD BY MS21318-13	ABCDEF GHJKLM NOQR	4
-350A	MS21318-14	• SCREW, Drive	I	4
-350B	MS21318-13	• SCREW, Drive . . . . REPLS MS21318-14	ABCDEF GHJKLM NOQR	4
-350C	MS21318-13	• SCREW, Drive	S	4
		------------ * ------------		
-360	23046-510	• KIT, Quick-Attach-Detach	K	1
-360A	23046-511	• KIT, Quick-Attach-Detach	BDMNO	1
-360B	23046-512	• KIT, Quick-Attach-Detach	GJ	1
-360C	23046-513	• KIT, Quick-Attach-Detach	E	1
-360D	23046-520	• KIT, Quick-Attach-Detach	C	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-360E	23046-520	• KIT, Quick-Attach-Detach . . . . . ALT: 23046-512	H	1
-360F	23046-521	• KIT, Quick-Attach-Detach . . . . . Kit is provided with model 23065-018-1	IQRS	1
-360G	23046-521	• KIT, Quick-Attach-Detach . . . . . ALT: 23046-513	F	1
-365	23046-1760	• • END BELL, Drive End Pad . . . . . Used on 23046-511	BDMNO	1
-365A	23046-1764	• • END BELL, Drive End Pad . . . . . Used on 23046-520, REPLD BY 23046-1761	CH	1
-365B	23046-1761	• • END BELL, Drive End Pad . . . . . Used on 23046-520, REPLS 23046-1764	CH	1
-365C	23046-1761	• • END BELL, Drive End Pad . . . . . Used on 23046-512	GJ	1
-365D	23046-1762	• • END BELL, Drive End Pad . . . . . Used on 23046-513 REPLD BY 23046-1763	E	1
-365E	23046-1765	• • END BELL, Drive End Pad . . . . . Used on 23046-513 and 23046-521, REPLD BY 23046-1763	FIQR	1
-365F	23046-1763	• • END BELL, Drive End Pad . . . . . Used on 23046-521, REPLS 23046-1765	FIQR	1
-365G	23046-1763	• • END BELL, Drive End Pad . . . . . Used on 23046-521	S	1
-365H	23046-1763	• • END BELL, Drive End Pad . . . . . Used on 23046-513 REPLS 23046-1762	E	1
-365J	23046-1660	• • END BELL, Drive End Pad . . . . . ALT: 23046-1661, Used on 23046-510	K	1
		(ATTACHING PARTS)		
-366	02-4412-03	• • • PIN, Grooved, Headless, Dowel . . .	BCDEFG HIJKMN OQRS	3
		*		
-370	23032-1585	• • CLAMP, Rim Clenching. . . . . Used on 23046-510, 23046-511, 23046-512 and 23046-513, ALT: 23032-1581	BDEFGH JKMNO	1

- ITEM NOT ILLUSTRATED

FIGURE AND ITEM	PART NUMBER	NOMENCLATURE 1 2 3 4 5	EFFECT CODE	UNITS PER ASSY
10001-				
-370A	23072-1125	• • CLAMP, Rim Clenching. . . . . Used on 23046-520 and 23046-521, ALT: 23072-1325	CFHIQR S	1
		(ATTACHING PARTS)		
-375	MS21045L3	• • • NUT. . . . . (MS21045L3 is reference for complete P/N MS21045-L3) Used on 23032-1581 and 23032-1585	BDEFGH JKMNO	1
-375A	MS21045L4	• • • NUT. . . . . (MS21045L4 is reference for complete P/N MS21045-L4) Used on 23072-1325	CFHIQR S	1
-375B	MS21045L4	• • • NUT. . . . . (MS21045L4 is reference for complete P/N MS21045-L4) Used on 23072-1125, REPLD BY MS21045-4	CFHIQR	1
-375C	MS21045-4	• • • NUT. . . . . Used on 23072-1125, REPLS MS21045-L4	CFHIQR	1
-375D	MS21045-4	• • • NUT.	S	1
-380	23032-2800	• • • T-BOLT . . . . Used on 23032-1581 and 23032-1585	BDEFGH JKMNO	1
-380A	23032-2802	• • • T-BOLT . . . . Used on 23072-1125	CFHIQR S	1
-380B	23032-2803	• • • T-BOLT . . . . Used on 23072-1325	CFHIQR S	1
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- ITEM NOT ILLUSTRATED

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