



# VERTICAL DRILLING MOTOR MODEL GEB20

## CONTENTS

<b>INTRODUCTION</b> .....	1
<b>ATEX CERTIFICATION</b> .....	1
INSTRUCTIONS .....	1
5GEB20 .....	2
<b>DESCRIPTION</b> .....	3
<b>DATA</b> .....	4
<b>TORQUE VALUES</b> .....	5
<b>SPECIAL TOOLS AND EQUIPMENT</b> .....	5
<b>GROUNDING INSTRUCTIONS</b> .....	6
GROUNDING PROCEDURES .....	6
<b>LUBRICATION</b> .....	6
<b>INSPECTION</b> .....	7
MONTHLY .....	7
<b>CLEANING</b> .....	7
<b>LOCKING THE ROTOR FOR SHIPMENT</b> .....	8
<b>SHIPPING</b> .....	9
HANDLING .....	9
CLEANING AND SLUSHING .....	9
SKIDDING .....	9
PROTECTION .....	9
<b>STORAGE</b> .....	9
PLACING INTO STORAGE .....	9
REMOVING FROM STORAGE .....	10
<b>OVERHAUL</b> .....	13
<b>CLEANING</b> .....	13
<b>DEFECT RECORDS</b> .....	13
<b>VISUAL INSPECTION</b> .....	13
<b>STATIC ELECTRICAL TESTS</b> .....	13
MEGOHMMETER ("MEGGER") TESTS .....	13
HIGH-POTENTIAL ("HI-POT") TESTS .....	14
<b>HUB REMOVAL</b> .....	14
<b>ROTOR DISASSEMBLY PROCEDURES</b> .....	14
ROTOR REMOVAL .....	14
BEARING ASSEMBLIES REMOVAL .....	15
ROTOR SHAFT INSPECTION .....	16
<b>STATOR COILS AND BUS RINGS</b> .....	16
CONNECTION-END FRAME HEAD REMOVAL .....	16
CLEANING AND INSPECTION .....	16
STRIPPING INSULATED CONNECTIONS .....	17

CONNECTION-END FRAME HEAD INSTALLATION .....	17
<b>ROTOR ASSEMBLY PROCEDURES</b> .....	17
ROTOR BALANCING .....	17
ROTOR BEARING ASSEMBLIES .....	18
ROTOR INSTALLATION INTO FRAME .....	21
ROTOR BEARING ASSEMBLIES CHECKS .....	22
ROTOR SHAFT END-PLAY CHECK .....	22
FINAL ASSEMBLY OF ROTOR DRIVE-END .....	22
FINAL ASSEMBLY OF ROTOR CONNECTION-END .....	23
<b>CABLE LEADS AND CONNECTIONS</b> .....	23
INSPECTION .....	23
CABLE TERMINAL REPLACEMENT .....	23
<b>COVERS</b> .....	24
<b>ELECTRICAL RUNNING TEST</b> .....	25
<b>HUB MOUNTING</b> .....	25

## INTRODUCTION

This publication provides basic instructions for general preventive maintenance, i.e., inspection and lubrication of the Model 5GEB20 drilling motor.

## ATEX CERTIFICATION

### INSTRUCTIONS

**WARNING:** *Installation should be in accordance with the instruction as defined in EN 60079-14:1997 "Electrical apparatus for explosive gas atmospheres, Part 14. Electrical installations in hazardous areas (other than mines)". Couplings, belts and chain guards should be installed as needed to protect against accidental contact with moving parts. Machines accessible to the public should be further guarded by screening, guard rails, etc., to prevent the public from coming in contact with the equipment. Failure to observe these precautions may result in personal injury.*

Revisions are indicated by margin bars.

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FIG. 1. 5GEB20 VERTICAL DRILLING MOTOR. E-43082.

1. This machine is suitable for operation in typical oil well drilling industry rig environments including offshore platforms and mobile drilling units. For other types of applications and environments, please contact your GE representative to determine suitability.
2. Periodic lubrication is required on all 5GEB20 vertical drilling motors between scheduled overhaul periods. Every six months or 2500 hours, apply approximately 2 oz. of grease (D6A2C10, Cyprina RA) to both bearings. See Fig. 6 for lubrication locations. Motor bearings MUST be replaced after 25,000 hours of operation which is 90 percent of calculated bearing life. This is in accordance with the requirements of EN 13463-5:2000. All maintenance must be carried out in accordance with:

**EN 60019-17:1997** – Electrical apparatus for explosive gas atmospheres, Part 17. Inspection and maintenance of electrical installations in hazardous areas (other than mines);

**IEC 60079-19:1993** – Electrical apparatus for explosive gas atmospheres, Part 19. Repair and overhaul for apparatus used in explosive atmospheres (other than mines or explosives).

## GE Drilling Drives

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DRILLING MOTOR MODEL NO. – GEB 20 \_\_\_\_\_  
 SERIAL NO. \_\_\_\_\_ ABS

OPEN COOLING-2800 SCFM OF MAX. 45° C AMBIENT  
 AIR SUPPLIED BY TOP-MOUNTED BLOWER UNIT

RATINGS	CONTINUOUS
PHASE	3
AC VOLTS (L-L)	587
AMPS AC	1120
RATED RPM	800
SHAFT HP	1150
MAX. FREQUENCY. HERTZ	117
MAX OPERATING RPM	2300
CONSTANT HP 800-1800 RPM (600 VOLT L-L SUPPLY) WITH 600 VOLTS MAINTAINED ABOVE 820 RPM	
CONSTANT HP 800-2300 RPM (690 VOLT L-L SUPPLY) WITH 690 VOLTS MAINTAINED ABOVE 940 RPM	
INSULATION CLASS	H
CONNECTION	WYE
INGRESS PROTECTION	IP44 (OPEN)

GE Transportation Systems  
 Erie, Pa. Made in U.S.A.

FIG. 2. SAFE ELECTRICAL PARAMETERS FOR 5GEB20. E-45043.

3. Figure 2 defines the safe electrical parameters and Figure 3 defines the safe environmental parameters for the 5GEB20. The motor may be operated in the presence of typical vibration levels encountered on land and offshore drilling rigs.

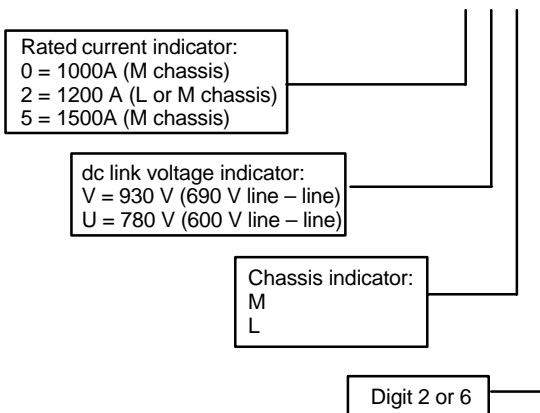
### GEB20

1. The cable fitted to the equipment must be capable of withstanding maximum temperatures of 108.5° C at the cable entry point.
2. The equipment must be supplied continuously with at least 2800 CFM of cooling air. The cooling arrangements must be suitable for the area in which it is installed. When fitted to the equipment, the cooling arrangements must ensure that the equipment satisfies a degree of protection of at least IP24.

3. The 5GEB20 motor shall be used with one of the drives indicated in the following table. The drive outputs shall be limited to 1500 amps max.

GE	GE AC2000AW Variable Speed Drive
Cegelec Bauteil	Type GD3000E AC Drive System
Unico, Inc.	Type 2400 Series (Part No. 109341) with or without a smoothing inductor
Siemens	See following illustration for range of applicable drives

Siemens drive identification 6SE704 1- \* \* \* \*



4. This equipment must be supplied via a time/current dependent device to monitor and limit the  $t_E$  time to 37 seconds, or a thermal protective device that limits the stator windings to 170° C. In both cases above the devices must be suitably certified as compliant with European Directive 94/9/EC as a Safety Related Device.

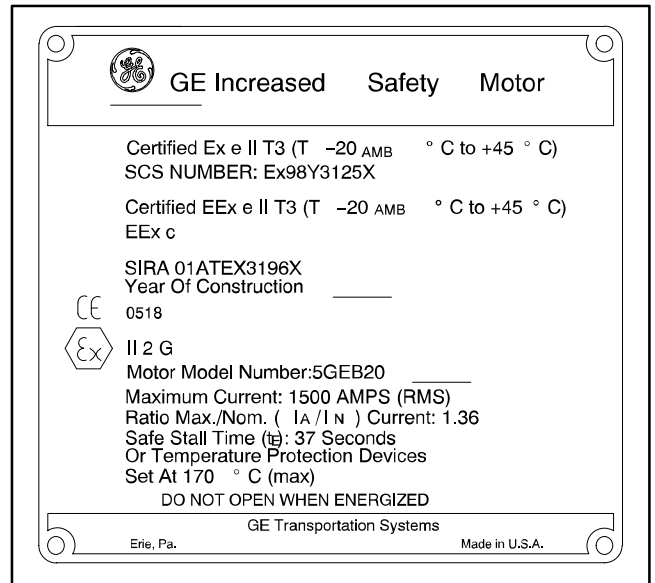


FIG. 3. SAFE ENVIRONMENTAL PARAMETERS FOR 5GEB20. E-45044.

5. RTD's supplied with the motor are to be connected to intrinsically safe circuits to meet compliance of the EEx c certification for operation in hazardous locations.

### DESCRIPTION

The 5GEB20 drilling motor (Fig. 1) is used by the oil and gas industry to power offshore and land-based drilling rigs. Designed for vertical operation, they provide more power, reliability, and easier maintenance than their DC predecessors.

Physically, the 5GEB20 is interchangeable with the GE752US2 drilling motor. Motor speed is controlled by varying the frequency of the alternating current in the motor stator windings.

**DATA**

**Model** ..... **GEB20-A1**  
**GEB20-B1**  
**GEB20-B2**

**Application Motor Rating**

<u>Speed</u> <u>(rpm)</u>	<u>Torque</u> <u>(lb.-ft)</u>	<u>Horsepower</u>	<u>Ventilation</u> <u>(scfm)</u>	<u>I<sub>PH</sub></u> <u>Amps</u>	<u>Time</u>
0	10,600	0	2,800	1,470	15 seconds
800	7,547	1,150	2,800	1,100	Continuous
1,600	3,773	1,150	2,800	1,100	Continuous

**Weight (lbs):**

Complete ..... A1-5960 (2703kg) B1-6043 (2741kg) B2-6087 (2761kg)  
Rotor Only ..... A1-1700 (771kg) B1-1699 (771kg) B2-1701 (772kg)

**Max. Permissible Speed (rpm)** ..... 2300

**Max. Permissible Vibration (Opposite Pinion End) (in./sec.)** ..... 0.44 (.01118m/s)

**Resistance at 25°C (Ohms)** ..... Min. ..... Max.  
Each pair of terminals ..... 0.0088 ..... 0.0108

**RTD's** ..... A1-10Ω Copper B1, B2-100Ω Platinum

**Rotor Bearings**

Diametral Clearance, Assembled (in.)  
Pinion End ..... 0.005 (0.127mm) ..... 0.009 (0.229mm)  
Opposite Pinion End ..... 0.0005 (0.0127mm) ..... 0.0035 (0.089mm)

**Rotor Balance**

Pinion End ..... 50-gram-inches  
Opposite Pinion End ..... 50-gram-inches

**Runout Measured from Shaft to Outer Race (in.)**

Pinion End ..... A1-0.004 (0.102mm) B1, B2-0.001(0.0254mm)  
Opposite Pinion End ..... A1-0.003 (0.076mm) B1, B2-0.001(0.0254mm)

**Lubrication**

Rotor Bearing Grease Capacities (oz)  
Pinion End ..... 39.1  
Opposite Pinion End ..... 31.8  
Lubricant ..... GE-D6A2C10

**Grease Specification**

D6A2C10 grease is a lithium soap base grease with added antioxidant. It contains an oil of heavy viscosity and is especially suitable for high speed, high temperature open or shielded bearings in drilling motors.

**Specifications:**

Worked Consistency, 77°F, MM/10 ..... 220-240  
Dropping Point, Degrees °F (Min) ..... 380  
Mineral Oil Viscosity at 100°F, SSU ..... 475-525  
Free Alkali, Percent (Max) ..... 0.50  
Free Acid, Percent (Max) ..... Nil  
Color ..... Amber  
Base (With Antioxidant) ..... Lithium  
Oxidation Resistance Time to Reach 20 psi Drop at 210°F, Hr. (Min) ..... 1000  
Corrosion ..... Must Pass  
Approved Vendor ..... Shell Oil  
Brand Name ..... Cyprina RA

**Megger Test** ..... min. 2 megohms

**HI-Pot** ..... 3500 Vrms, 60 Hz for 1 Minute

### TORQUE VALUES

<b>Bolt torque values:</b>	<u>lb.-ft.</u>	<u>N-m</u>
Cover, top (connection end) .....	22-24	30-33
Frame head, connection-end .....	448-496	607-672
Frame head, drive-end .....	448-496	607-672
Motor cover, lead entry .....	56-60	76-81
Rotor bearing cap, connection-end .....	111-123	149-163
Rotor bearing cap insert, drive-end .....	111-123	149-163
Rotor bearing housing, connection-end .....	111-123	149-163
Rotor bearing nut, connection-end .....	500-520	678-705
Rotor bearing nut set screws, connection-end .....	38-42	52-57
Speed sensor assembly (if provided) .....	18-21	24-28
Speed sensor clamp bolts (if provided) .....	22-24	30-33

### SPECIAL TOOLS AND EQUIPMENT

Rotor shaft lifting eyebolt (1 in.-8 steel) .....	N672P39
Rotor dummy drive-end bearing cap .....	6796493P3
Rotor drive-end bearing pilot .....	8849499P7
Rotor bearing nut spanner wrench .....	9945228
Rotor dummy connection-end bearing cap .....	41C689896
Bearing assembly pullers .....	41D736059G1
Digital pyrometer kit .....	2X3430
Megohmmeter (Megger) .....	111X910 (or equivalent)
Long guide studs (2 required) .....	N/A
Hub assembly gauge .....	41D790941G1
Hub puller (less pump) .....	41B535703G1
Pump (for hub puller) .....	8843947G1
Megohmmeter (or "Megger" <sup>™</sup> ) .....	600 volts 111X910 or equivalent
Voltmeter .....	Simpson Multimeter, Model 260 or equivalent

## GROUNDING INSTRUCTIONS

Grounding motor frames is required to safeguard personnel from electric shock in event of an insulation failure in the machine.

**WARNING: Failure to properly ground electrical equipment may expose personnel to a potentially hazardous condition in which serious or fatal injury from electrical shock is possible.**

Grounding conductors must be provided between the machine frame and the supporting structure to avoid hazardous potential difference between the machine frame and the adjacent surface on which a person may be standing while touching the machine.

**NOTE: This type of ground connection is referred to in electrical standards as “equipment grounding” or “enclosure grounding” which is not to be confused with “system” or “circuit” grounding. Drilling drive systems normally do not have intentional circuit ground connections, except through high impedance detectors.**

Grounding conductors must be provided on drilling units on which the construction of the unit and/or the installation of the machines do not inherently insure positive grounding of the equipment. Examples are those portable (modular) platform rigs and land rigs which do

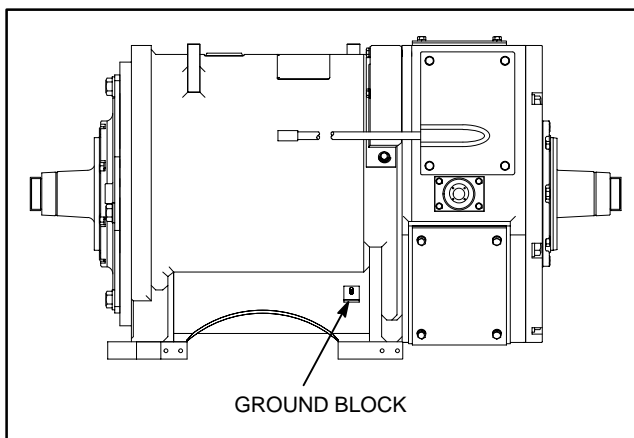


FIG. 4. DRILLING MOTOR – FRAME GROUNDING CABLE CONNECTIONS. E-43083.

not already have ground cables to all machinery structures. Offshore rigs with equipment fastened to the decks by bolting or welding should not require additional grounding. (References: ABS Rules for Building and Classing Steel Vessels, Section 35.9.6, and IEEE Standard 45-1977, Recommended Practice for Electrical Installations on Shipboard, Section 21.4.)

## GROUNDING PROCEDURES

The GEB20 has a ground block attached to the frame as shown in Fig. 4. The mounting stud is 3/8-16 thread.

1. To attach a ground cable to the ground block, obtain a 3/8-16 nut and a lockwasher. Also obtain a cable lug to fit the ground cable and large enough for the 0.375 diameter bolt.
2. Prepare a ground conductor\* long enough to run from the motor frame to an existing ground conductor system or to a suitable equipment ground point as defined by the National Electrical Code Article 250 or other applicable regulation. Check that the system ground detector is also connected to the Common ground point for the rig and make connection if necessary.
3. Install terminal lugs on cable. Remove paint, rust and oil from **all** surfaces to which the cables are to be attached and bolt the lugs securely to these surfaces (torque to 25 ft.lbs.)

## LUBRICATION

### ROTOR BEARINGS

Periodic lubrication is required on all GEB20 vertical drilling motors between scheduled overhaul periods. Every 6 months or 2500 hours apply approximately 2 ounces of grease (D6A2C10, Cyprina RA ) at each end. See Fig. 6 for lubrication locations

\*Use 4/0 size or larger copper cable for GEB20 machines. (Reference: National Electrical Code, 1978 Edition, Table 250-95.)

™ Tradename of James G. Biddle Co.

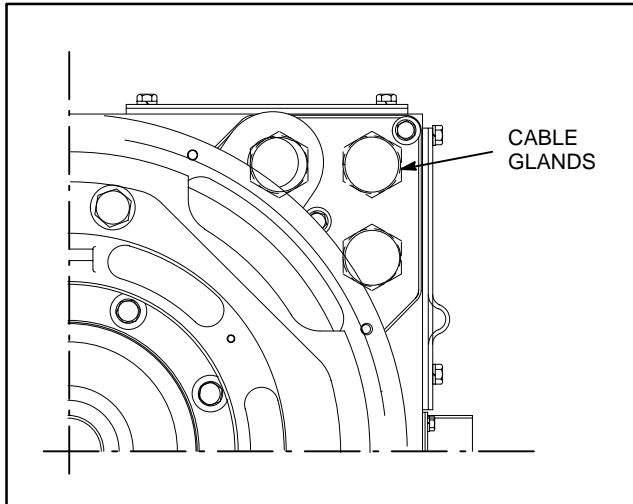


FIG. 5. CABLE GLAND LOCATION. E-43087.

## INSPECTION

### MONTHLY

Inspect the exterior of the motor, including cables, for damage. Inspect cable glands (Fig. 5) for tightness as well.

### Covers, Seals, Latches

Clean the outside of the machine and remove the inspection covers. Use clean, dry compressed air and blow the dirt and dust from the interior of the machine.

**WARNING: When using compressed air for cleaning purposes, flying debris and particles may present a hazard to personnel in the immediate area. Personnel should be provided with, and trained in the use of, personal protective equipment as specified by applicable federal or state safety regulations.**

Check exterior covers to be sure felt seals are intact. If seals are missing or covers are damaged, replace seals or covers as necessary. Make sure covers fit properly and are bolted securely.

### Power Cables

Inspect the power cables and terminals for signs of excessive heating, poor insulation, chafing, or mechanical damage. Verify that all cable connections are tight,

and that cables are secured. Check for damaged cable bushings, loose or missing cable cleat hardware, etc.

### Insulation

Measure the insulation resistance with a megohmmeter (Megger) to determine the condition of the insulation. If reading is low, make a further inspection to determine if insulation failure or excessive moisture is causing the low megohmmeter reading. Correct the cause of low readings before returning the motor to service.

Megohmmeter tests will determine the condition of the insulation to ground or between windings by testing for high resistance paths. Megohmmeter readings are most affected by moisture, dirt build-up, or carbon tracking. When a low megohmmeter reading is obtained, the reading may be raised by cleaning and baking the components. If the reading does not rise, disassembly is required.

Apply a 500-volt megohmmeter test between the traction motor TA lead and the cleaned ground connection on the cable cleat of the stator frame to determine the condition of the stator coil insulation. Ohmic values less than 2 megohms indicate a dirt and/or moisture problem. Refer to **CLEANING** section of this publication.

### Ground Cable

Ensure that the ground cable is bolted securely to the drilling motor and base equipment mounting surface.

### Mounting Bolts

Check all mounting bolts to assure tightness. Observe for cracking, deformities, looseness, or other obvious damage.

### Speed Sensor Gap (if supplied)

Ensure the gap between the speed sensor assembly and the speed sensor gear is 0.036 to 0.20 in. (0.91 to 0.51mm). Tighten the sensor mounting bolts to the torque given in the **Torque Values** section of this publication.

## CLEANING

It is essential that the drilling motor be kept as clean as possible, both inside and outside. When the drilling

## GEK-91694C, Vertical Drilling Motor, Type GEB20

motor assembly has been removed from its machinery base, any accumulation of oil or grease-soaked dirt should be removed from both inside and outside.

Clean the drilling motor as follows:

**WARNING: Personnel performing cleaning operations must wear protective clothing, gloves and eye protection to avoid injury. To prevent personal injury when cleaning with compressed air, observe all railroad and Government regulations.**

1. Cover the air inlet and outlet openings in the motor frame with heavy plastic and tape.

**CAUTION: Alkali and chlorinated hydrocarbon cleaning solutions are not recommended for cleaning traction motors due to their adverse effect on the motor insulation system.**

2. Steam clean the exterior surfaces. Avoid forcing moisture inside the motor. Recommended cleaning compounds are: CHEMICAL METHODS, INC., 809 OR 809-NP:DuBois U.S.A., Jectac or Dusqueeze.

3. Remove the protective coverings from the motor openings.

**CAUTION: When applying heat to the motor, do NOT expose the speed sensor to heat above 176° F (80° C).**

4. Using compressed air, blow out the interior of the motor to remove all dirt and moisture. Apply heat if necessary to dry the motor thoroughly.

### LOCKING THE ROTOR FOR SHIPMENT

#### LOCKING SEQUENCE

1. Remove the 2 bolts diametrically opposite on the 13.50" dia. bolt circle of the pinion end frame head.
2. Replace with locking bolt(2) and nut(1) (Fig. 7).
3. Torque locking bolt(1) to 30ft.lbs., then tighten nut(2).
4. Paint bolt heads yellow.

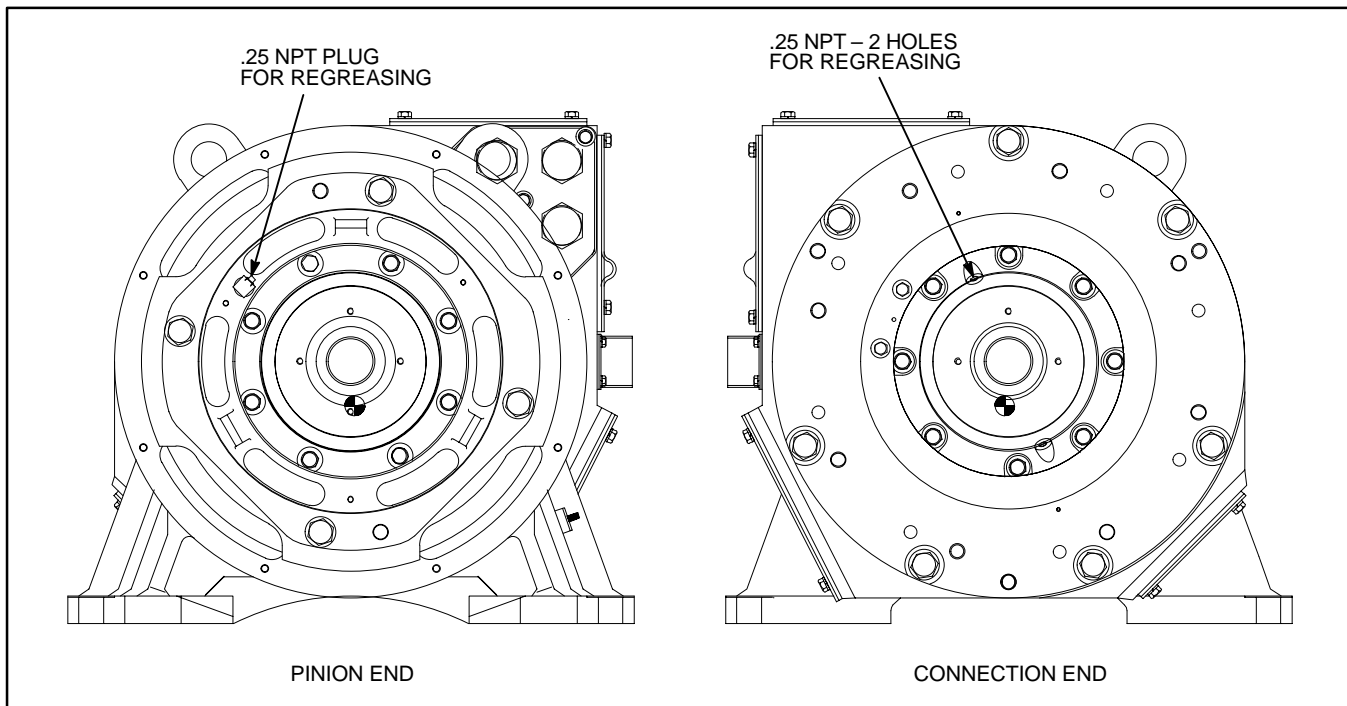


FIG 6. LUBRICATION LOCATIONS, PINION AND CONNECTION ENDS. E-43086

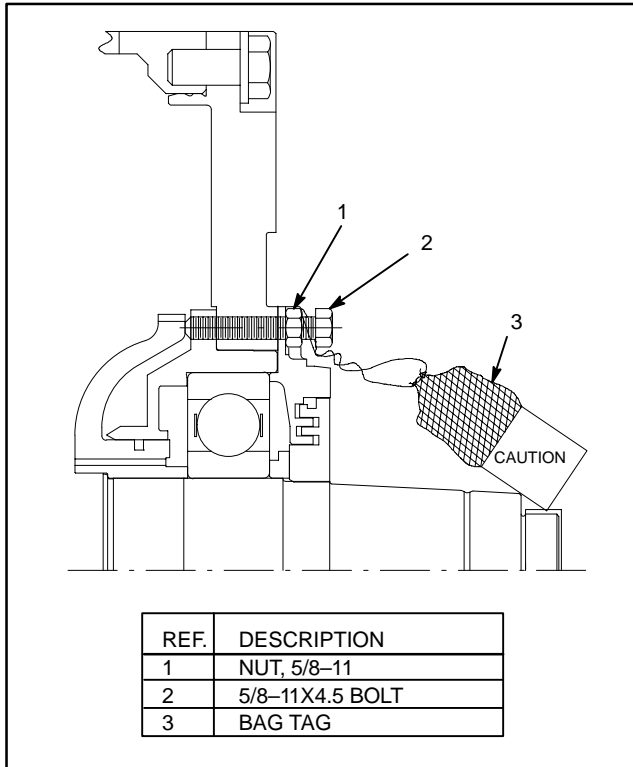


FIG. 7. ROTOR LOCKING SEQUENCE. E-43081

- Place bolts and washers removed in bag(3) and attach as shown (Fig. 7).
- When motor reaches final destination, replace p16 and p17 with bolts and washer in bag.

### SHIPPING

Whenever drilling motors are to be shipped, they must be properly skidded and secured to prevent any damage in transit. The drawing that follows (Fig. 8) illustrates a proven method of skidding these machines for handling and shipment.

### HANDLING

To avoid damage to the machine during handling, review the following cautionary statements:

- Do not lift motors by the shaft extension of the Rotor.
- Do not allow the rotor to bump another object.

- Do not tighten coupling assembly bolts with an air wrench or by pounding.
- Do not remove rotor end-play by any other means than axial blocking.
- Do not load the rotor radially (strap down) for shipment.

### CLEANING AND SLUSHING

Before skidding the machine for shipment, all exposed finished surfaces not already painted should be cleaned and slushed as follows:

- Remove all corrosion.
- Wipe off the surface with clean rags and wet with petroleum spirits GE-D5B8.
- Follow with a clean rag wet with methanol, then wipe dry. **DO NOT** touch the cleaned surface with bare hands.
- Slush immediately after cleaning with GE-D6C6A1 slushing compound.

### SKIDDING

Use yellow pine timbers large enough to support the weight of the machine. The recommended size is illustrated in Fig. 8.

### PROTECTION

When any apparatus is shipped in the open, it should be fully protected from rain, snow, dirt, etc., by covering with some suitable weatherproof material.

### STORAGE

#### PLACING INTO STORAGE

When placing GE drilling motors into storage, the following preparations should be performed to prevent damage to the equipment as a result of the storage.

Machines should be placed on a pallet and stored indoors if possible. A clean, dry ambient of 60° F is preferred. In a high humidity environment, an ambient of 70° F is recommended. Every attempt should be made to avoid widely varying temperatures and high humidity.

## REMOVING FROM STORAGE

Before placing a stored motor in service, perform the following:

1. Blow dust and dirt accumulation out of the stator coil with clean, dry air.
2. Visually inspect for corrosion and general defects.

3. Check stator coil insulation continuity to ground with a 500 volt megger. If the megger reading is less than 2 megohms, the stator should be baked or dried until the moisture content is sufficiently reduced to raise the megger reading to 2 megohms.
4. An electrical source of heat is best for drying as it can be easily regulated and is clean. Proceed as follows:

**NOTE: Before drying stator coils, consideration must be given to bearings and lubricants. Not only can bearing lubricants be damaged by heat, but they can also deteriorate with age. For this reason, it is usually best to remove bearings before drying and repack with new grease before reassembly.**

- a. Remove the rotor from the frame and remove bearings from the rotor shaft.
- b. Heat the frame and rotor until dried sufficiently to obtain the 2 megohm reading.
- c. Pack bearings with new grease. Refer to the DATA table for the proper grease. Refer to the appropriate bearing illustration for the proper amount of grease.
- d. Reassemble the motor.
- e. If facilities are available, give the reassembled machine a running test to check the bearings.

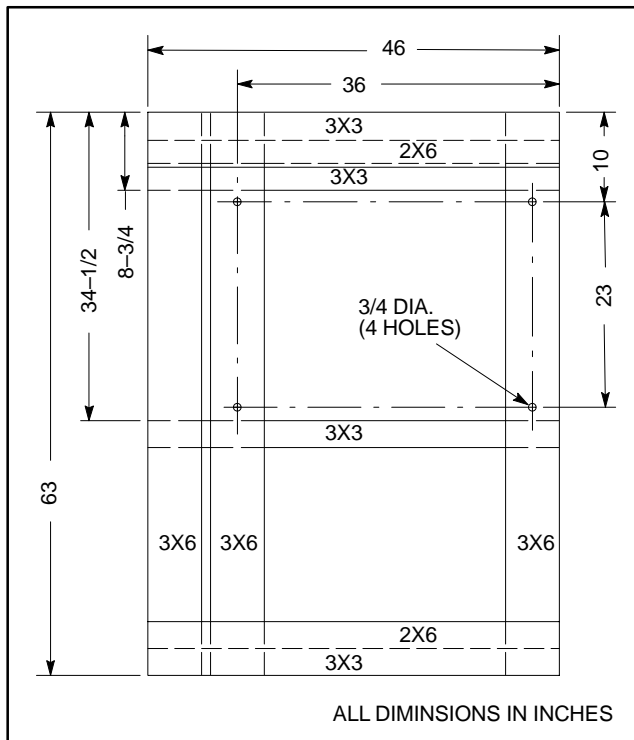
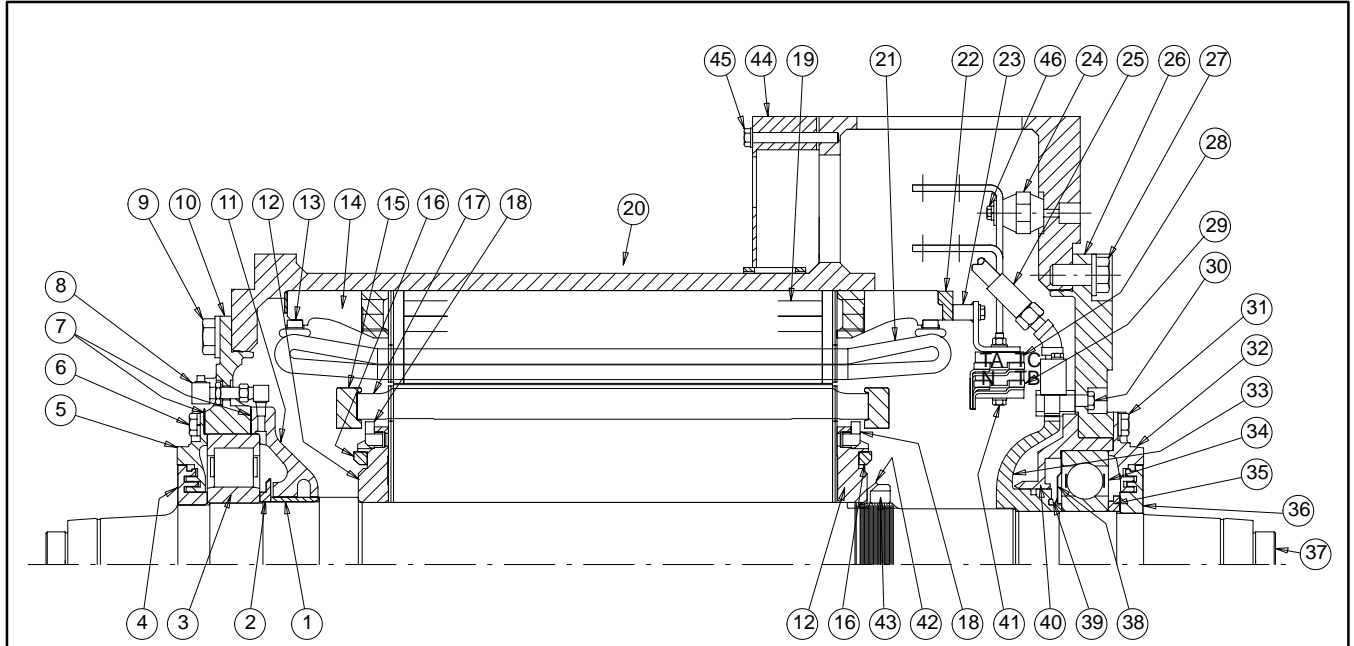


FIG. 8 SKID CONSTRUCTION DETAILS E-43112



REF.	DESCRIPTION	REF.	DESCRIPTION
1	D.E. SHAFT COLLAR	27	BOLT AND HARD WASHER
2	FLINGER	28	BUS RING CLAMP
3	ROLLER BEARING	29	BUS RINGS
4	SLEEVE	30	BOLT
5	BEARING CAP (OUTER)	31	BOLT AND LOCKWASHER
6	BOLT AND LOCKWASHER	32	C.E. BEARING CAP
7	GASKET	33	SPEED SENSOR GEAR
8	GREASE PIPING	34	BALL BEARING
9	BOLT AND HARD WASHER	35	SPACER
10	D.E. FRAME HEAD	36	C.E. SLEEVE (OUTER)
11	BEARING CAP (INNER)	37	ROTOR SHAFT
12	ROTOR END PLATE	38	NILOS RING
13	TIE RING	39	"V" RING SEAL
14	STATOR END PIECE	40	C.E. BEARING HOUSING
15	ROTOR END RING	41	BOLT, HARD WASHERS AND NUT
16	BALANCE WEIGHT	42	SHAFT WASHER
17	ROTOR BAR	43	SHAFT NUT
18	STOP PIN	44	CONNECTION COVER
19	STATOR CORE	45	BOLT, LOCKWASHER AND FLATWASHER
20	STATOR FRAME	46	BOLT, LOCKWASHER AND FLATWASHER
21	STATOR COIL	47	SPEED SENSOR COVER
22	CORE STIFFENING RING	48	COVER
23	CLAMP BRACKET	49	HAND HOLE COVER
24	INSULATOR	50	BOLT AND LOCKWASHER
25	SPEED SENSOR	51	CONNECTOR SUPPORT
26	C.E. FRAME HEAD	52	BOLT AND LOCKWASHER

FIG. 9. 5GEB20A1 LONGITUDINAL SECTION. E-43080

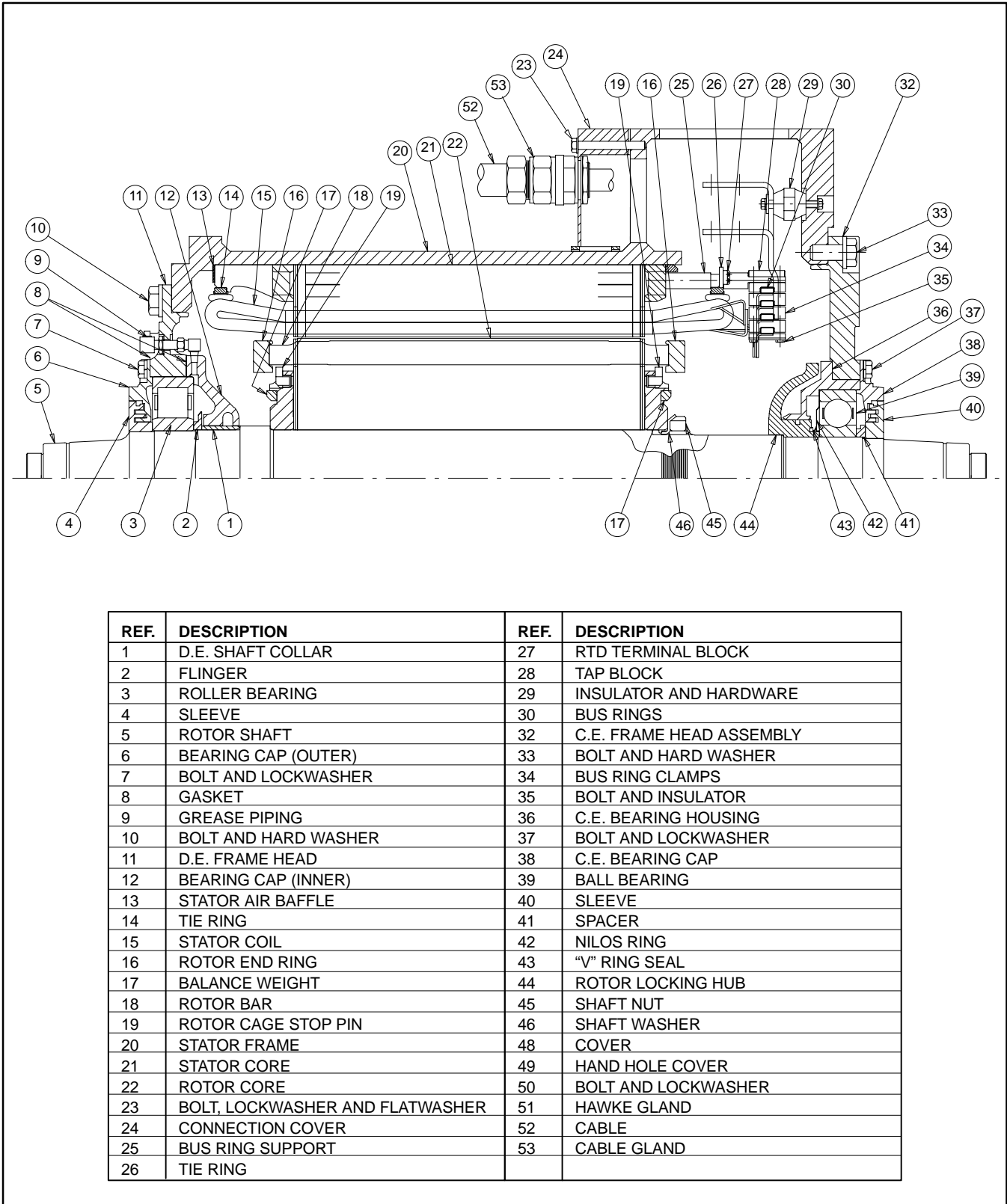


FIG. 10. 5GEB20B1 LONGITUDINAL SECTION. E-43611

## OVERHAUL

Overhaul intervals will depend on the severity of service seen by the machine. However, General Electric Co. recommends that an overhaul be performed every 25,000 hours on all machines subjected to normal operation.

The motor should be removed, disassembled, cleaned, inspected and reconditioned as necessary (including varnish treatment of rotor and stator, and fields). Motor bearings should be replaced.

## CLEANING

After the exterior of the drill motor has been cleaned, steam clean the internal metal and insulated parts as follows:

**WARNING: Personnel performing steam cleaning operations must wear protective clothing, gloves and eye protection to avoid injury.**

**CAUTION: Alkali and chlorinated hydrocarbon cleaning solutions are not recommended for cleaning traction motors due to their adverse effect on the motor insulation system.**

**NOTE: Do NOT exceed 30 to 40 psi (207 to 276 kPa) steam pressure.**

1. Use steam in combination with a commercial non-caustic cleaner, such as CHEMICAL METHODS, INC., 809S.
2. Suspend the motor in a position accessible from all directions to a direct flow of steam from the hose.
3. Rinse all residue from the motor with a mixture of clean steam and water.
4. Bake the motor for at least four hours at 302°F (150°C) to remove all moisture from insulated parts.

## DEFECT RECORDS

Prior to beginning an overhaul, record the following information to aid in tracking the drill motor and component parts and to determine the defects:

1. Log the motor frame serial number. After tear-down, record the rotor serial number also.
2. Visually inspect the motor for defects.
3. Test the motor as outlined in **STATIC ELECTRICAL TEST** section of this publication.
4. Fill out a defect sheet for the motor frame, and another defect sheet for the motor rotor. These sheets should list defects found in the electrical test, visual inspection, and inspections defined in specific sections of this publication. The defect sheets should travel through the shop with the frame or rotor. Defects should be added when found, and marked off when repaired.

## VISUAL INSPECTION

Visually inspect the drill motor as follows:

1. Examine the stator for damaged coils, insulation and wedges.
2. Inspect the stator for blistered, flaked or cracked coil-insulating varnish.
3. Examine the bus rings for loose or burnt connections and cables.

## STATIC ELECTRICAL TESTS

**WARNING: Electrical shock can cause serious or fatal injury. Proper precautions should be taken and observed by personnel performing testing to avoid such injury.**

## MEGOHMMETER (“MEGGER”) TESTS

Megohmmeter (“Megger”™) tests will determine the condition of the insulation to ground or between windings by testing for high resistance paths. Megohmmeter readings are most affected by moisture, dirt build-up, or carbon tracking. When a low megohmmeter reading is obtained, the reading may be raised by cleaning and baking the components. If the reading does not rise,

disassembly is required.

Apply a 500-volt megohmmeter test between the drill motor TA lead and a cleaned ground connection on the stator frame to determine the condition of the stator coil insulation. Ohmic values less than 2 megohms indicate a dirt and/or moisture problem. Refer to **CLEANING** section of this publication.

## HIGH-POTENTIAL (“HI-POT”) TESTS

**WARNING:** *High-potential (“HI-POT”) testing can cause serious injury or death. Strict safety regulations must be observed during such testing.*

High-potential (“HI-POT”) tests evaluate the insulation dielectric strength (ability to insulate) of motor components. A high-potential test set applies high voltage between the windings and ground or between windings.

**CAUTION:** *Always test with a megohmmeter first. High-potential test only after megohmmeter tests show two megohms resistance or higher. High-potential test only after the windings have been cleaned and baked dry. If a failure occurs as a result of a high-potential test, the motor will be permanently damaged.*

Apply an AC high-potential test at the voltage given in **DATA** section of this publication between the drill motor TA lead and the cleaned ground connection on the cable cleat of the stator frame. Ground one lead of each RTD during this test.

## HUB REMOVAL

When removing a hub, use a suitable puller, similar to Part 41B535703G1, Fig. 11. This is a simple, efficient hydraulic puller employing the float method of removal. A complete unit consists of a pump kit, a backing plate, an adapter, a felt ring and a bolt.

**NOTE:** *Do not heat the hub before pulling it, and do not use steel wedges between the hub and bearing cap.*

1. Remove the set-screw plug from the tapped hole in the end of the shaft.

2. Screw the backing plate, with felt ring in place, to the end of the shaft as tight as possible by hand. Back off the backing plate to line up the slot with the tapped hole in the end of the shaft. This is to provide sufficient clearance for the hub to pop off.
  3. Screw the pressure-fitting adapter into the hole in the shaft until it seats at the bottom.
  4. Attach the pump by screwing the connector on one end of the pressure tube into the adapter, and the other end into the pump.
  5. Close the hand relief valve and work the pump handle to force oil into the groove in the armature shaft under the hub. When sufficient pressure has been built up, the hub will pop off the shaft and be stopped by the felt washer and backing plate.
- NOTE:** *Capacity of the pump is 40,000 psi. It holds sufficient oil to remove eight to ten hubs; check at each use. Periodically, remove the filling plug and refill with SAE-10 lubricating oil.*
6. Open the relief valve, disconnect the pump from adapter, remove the adapter and backing plate from the shaft, and lift off the hub. Reinsert the plug to prevent clogging the hole.

**CAUTION:** *Special precautions should be taken to avoid damage to the rotor, bearings, or bearing fits, when lifting the rotor in the vertical position or turning rotor to a horizontal position.*

## ROTOR DISASSEMBLY PROCEDURES

### ROTOR REMOVAL

Remove the drill motor rotor from the stator frame as follows:

**NOTE:** *For convenience, the numbers in parenthesis () refer to part numbers in Fig. 9 of this publication, unless otherwise noted. The bearing and frame head assemblies for all the GEB20 models are similar enough that assembly and disassembly procedures are the same.*

1. Place the drill motor in a horizontal position.
2. If supplied, remove the four bolts and washers holding the speed sensor cover to the connection end of the stator frame. Remove the two speed sensor mounting bolts (30) and place the speed sensor assembly in a secure place outside the stator frame.
3. Remove the eight bolts and flat washers (31) securing the connection-end bearing housing to the connection-end frame head. Remove the connection-end bearing cap (32) and sleeve (36).
4. Screw two long guide studs through the frame head and into the connection-end bearing housing in opposite holes of the six just emptied. These studs will help to guide the rotor out of the motor frame.
5. Place the motor on a heavy-duty stand with the drive-end up. Level the motor so that the rotor can be lifted vertically with a hoist without damaging the bearings or bus rings.
6. Remove the four bolts (9) and flat washers holding the drive-end frame head to the motor frame.
7. Screw a 1in.-8 steel lifting eyebolt (GE Tool N672P39) into the threaded hole in the drive-end of the rotor shaft (37).
8. Align the hoist cable with the centerline of the rotor, and attach the hoist hook to the lifting eye.

**NOTE:** The connection-end bearing and housing and the drive-end frame head, bearing and housing are removed with the rotor as an assembly.

**CAUTION:** Use extreme care when turning the rotor to the horizontal position to avoid damage to the core and the bearing and frame head fits. Use two hoists when positioning the rotor horizontally.

9. Carefully lift the rotor assembly out of the motor stator, and place the rotor in a horizontal position on a wooden cradle supporting the core assembly.
10. With the rotor in the horizontal position, remove the two long guide studs from the connection-end bearing housing.
11. Remove and service the rotor bearings according to instructions in **BEARING ASSEMBLIES REMOVAL** section of this publication

## BEARING ASSEMBLIES REMOVAL

### Connection-End Bearing

**NOTE:** Numbers in parenthesis () refer to part numbers in Fig. 12 of this publication, unless otherwise noted.

1. Assemble the bearing puller (GE Tool 41D736059G3), and use the hydraulic jack to pull the connection-end bearing housing (2) and bearing (4) from the rotor shaft.

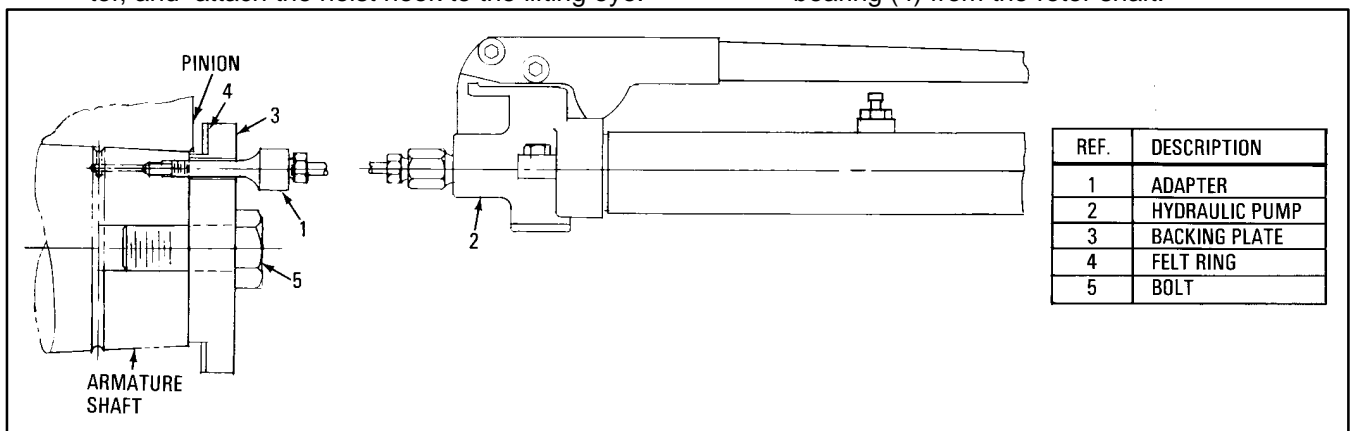


FIG. 11. HYDRAULIC COUPLING HUB PULLER. E-23829.

- Position the bearing housing – with the bearing down – on a flat surface. Reassemble the bearing puller (to GE Tool 41D736059G4), and use the hydraulic jack to push the bearing from the bearing housing.

### Drive-End Bearing

**NOTE: Numbers in parenthesis () refer to part numbers in Fig. 13 of this publication, unless otherwise noted.**

- Remove the eight bolts (6) and flat washers from the outer bearing cap insert (5).
- Support the weight of the drive-end frame head (10) with a hoist, taking care not to lift the rotor off its support. Assemble the bearing puller (GE Tool 41D736059G2); and use the hydraulic jack to pull the frame head, roller bearing (3), bearing flinger (2), outer bearing cap (5), outer sleeve (4), and inner bearing cap (11) from the rotor shaft.
- Use an arbor press and fixtures to separate the bearing assembly components.

**NOTE: Remove the collar (1) only if damaged, if outside of inspection limits, or if the shaft must be removed from the rotor. If necessary, use a puller tool to remove the collar.**

### ROTOR SHAFT INSPECTION

- Measure both rotor-shaft bearing mounting diameters. Ensure that the rotor shaft centers are not damaged.
- Place the rotor shaft and core on centers in a lathe, and measure the bearing fit surface runout on each end with a dial indicator. Runout must not exceed 0.001 in. (0.025 mm).
- Visually check the shaft for defects such as burrs, upset metal, damaged threads, etc.

**NOTE: If out-of-limit measurements or excessive damage are observed, the rotor must be replaced.**

## STATOR COILS AND BUS RINGS

### CONNECTION-END FRAME HEAD REMOVAL

**NOTE: Numbers in parenthesis () refer to part numbers in Fig. 9 of this publication, unless otherwise noted.**

Removal of the connection-end frame head (26) may be required to gain access to the bus rings and stator coil connections. Remove the eight bolts and flat washers (27) holding the frame head to the motor frame, and then remove the frame head.

### CLEANING AND INSPECTION

Prior to performing disassembly or repair operations, clean and inspect the stator as follows:

- Ensure that the motor is clean as specified in **CLEANING** section of this publication.

**WARNING: To prevent personal injury when cleaning parts with compressed air, observe all government safety regulations.**

- Blow out the inside of the stator with clean, dry compressed air. Dirt and dust tend to collect in

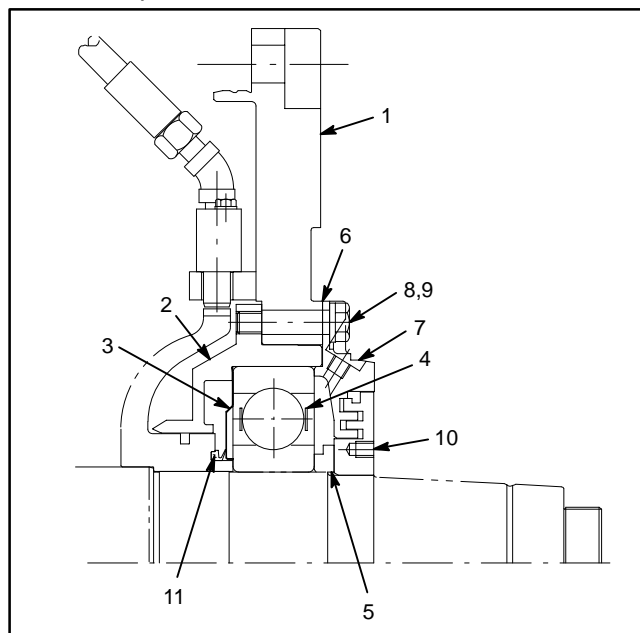


FIG. 12. CONNECTION-END BEARING DETAILS. E-43615.

the stator, and – if allowed to accumulate – can in time cause an electrical failure.

**WARNING: If commercial cleaning solvents are used, the precautions cited by the manufacturer regarding toxicity, flammability and ventilation MUST BE STRICTLY FOLLOWED to prevent serious or fatal injury to personnel.**

3. If oil or grease is on a coil or connection, wipe off with a cloth dipped in commercial cleaning solvent.

**CAUTION: Do NOT use too much solvent, as the solvent may soak into the insulation with damaging effects.**

4. Examine the bus rings for damaged or loose connections. Observe the condition of coil insulation and the varnish surface. Evidence of burned or charred insulation from an overheating condition usually indicates a defective coil.

## STRIPPING INSULATED CONNECTIONS

Insulation is removed from connections by cutting, requiring the use of a hammer, knife, chisel, screwdriver and Channel-Lock pliers.

1. Position the stator frame to obtain the best working position for the connections to be cleaned.

2. Use the chisel, knife and hammer to cut the insulation. Cut the insulation down to the copper the full length of the connection.
3. After cutting the insulation the full length, pry the insulation away from the connection using the knife or screwdriver.
4. Brazing tool heat can be used to soften the insulation for final cleaning. Alternately heat the insulation and scrape off all material until reaching bare copper.

## CONNECTION-END FRAME HEAD INSTALLATION

**NOTE: Numbers in parenthesis () refer to part numbers in Fig. 9 of this publication, unless otherwise noted.**

To assemble the connection-end frame head (26), install and hand-tighten the eight bolts and flat washers (27) holding the frame head to the motor frame. Then torque the bolts evenly in a diametrically opposite sequence to  $468 \pm 28$  ft.lbs.

## ROTOR ASSEMBLY PROCEDURES

### ROTOR BALANCING

Dynamic balance of the rotor assembly is required for smooth operation and low vibration. If not corrected, an out-of-balance rotor will lead to complete motor failure.

The rotor must be balanced to within 50 gram-in. at both ends of the rotor.

**NOTE: For best results, dynamic balancing should be done with the drive-end bearing collar (item 1 in Fig. 9) in place. See BEARING ASSEMBLIES, DRIVE-END BEARING section of this publication for spacer and collar assembly instructions.**

These instructions pertain only to the location and method of attaching the balance weights. The set-up, fixtures to hold components in the balance machine, and the procedures required to obtain a balance within specified limits is dependent on the type of balance machine. Therefore, follow the operating procedures for

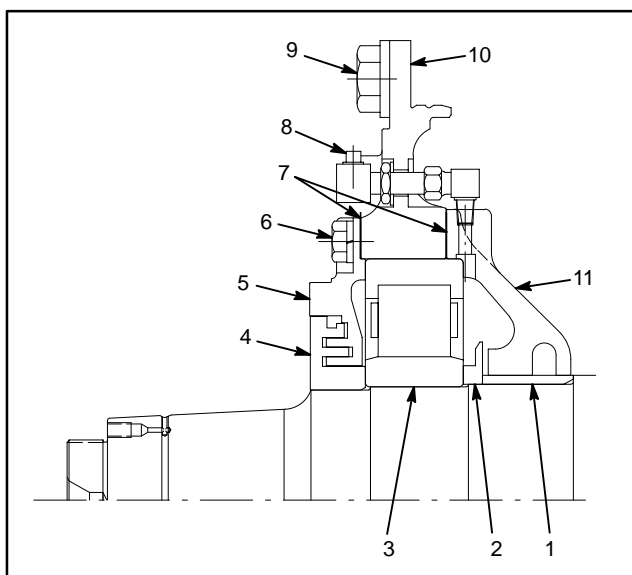


FIG. 13. DRIVE-END BEARING DETAILS.  
E-43616.

the balance machine used.

**CAUTION:** Use ONLY the specified welding rod. Use of other types may result in poor welds leading to motor failure.

**NOTE:** Keep weld splatter out of the rotor core vent holes when welding balance weights to the end plates.

Attach the balance weights as needed by welding to the rotor end plates at a diameter of 10.90 in. (276.9 mm). Use welding rod GE Spec. B50E37, BRONZE (AWS-E-Cu-Sn-C).

## ROTOR BEARING ASSEMBLIES

### Drive-End Bearing

**NOTE:** Numbers in parenthesis () refer to part numbers in Fig. 13 of this publication, unless otherwise noted.

1. Inspect to ensure that all mating surfaces of the rotor drive-end bearing assembly parts are clean and free of nicks and burrs.
2. If removed, heat the rotor drive-end collar (1) to 212°F (100°C) in an oven. With the rotor in the horizontal position, apply the heated collar to the rotor shaft, seating tightly against the rotor shaft shoulder, and secure the collar in position until cooled.
3. Smear the inside diameter of the rotor drive-end inner bearing cap (11) with GE Specification D6A2C10 grease (Fig. 14), and pack the inner cavity of the bearing cap with 4.8 oz. (136 g) of the grease (Fig. 15). Install the inner bearing cap over the collar.
4. Heat the rotor drive-end bearing flinger (2) to 212°F (100°C) in an oven. Apply the heated flinger to the rotor shaft, seating tightly against the collar (1), and secure the flinger in position until cooled.
5. Heat the inner race of the rotor drive-end roller bearing (3) to 212°F (100°C) in an oven. Apply the bearing inner race to the rotor shaft, seating

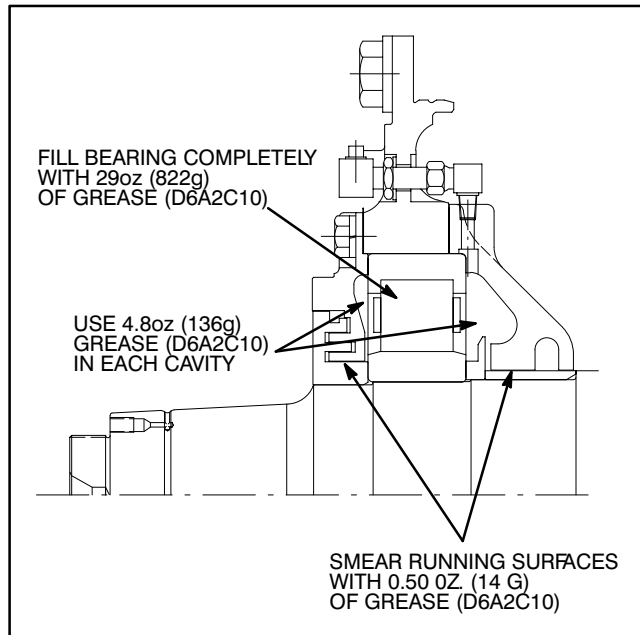


FIG. 14. DRIVE-END BEARING GREASE DISTRIBUTION. E-45100.

6. Pack the outer race (Fig. 17) and bearing rollers of the rotor drive-end roller bearing (3) with 29 oz. (822 g) of GE Specification D6A2C10 grease (Fig. 18).

**NOTE:** If proper press equipment is available, cold pressing of the rotor drive-end roller bear-

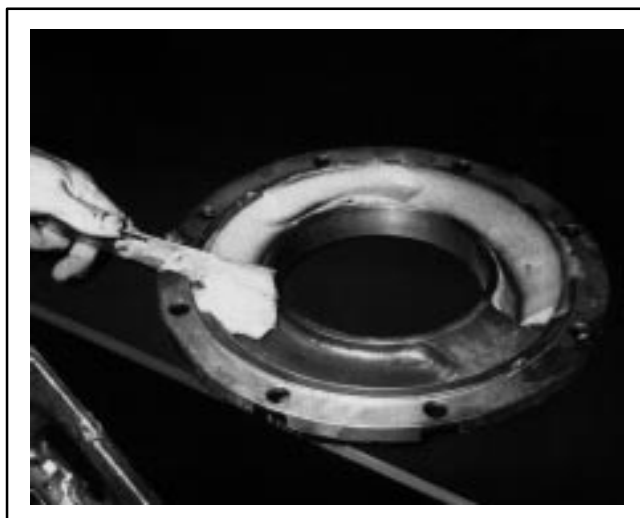


FIG. 15. APPLYING GREASE TO DRIVE-END INNER BEARING CAP. E-27156.

ing outer race (3) into the frame head (11) is preferred. If proper equipment is NOT available, heat the frame head to 212° F (100° C) in an oven, and install the bearing outer race in the heated frame head.

7. Cold-press the rotor drive-end bearing outer race and rollers (3) into the drive-end frame head (11). Refer to Fig. 14 for the approximate bearing race position in the frame head.

**NOTE:** Without the use of a rotor drive-end bearing pilot, the upper-most rollers will drop toward the center, making the assembly of rollers over the inner race difficult. Refer to SPECIAL TOOLS AND EQUIPMENT section of this publication for the bearing pilot, guide stud and dummy bearing cap part numbers.

8. Install the drive-end bearing pilot on the rotor shaft (Fig. 19). Screw a guide stud into one of the threaded holes in the inner bearing cap (11).

**CAUTION:** Ensure that the vent hole in the rotor pinion-end bearing cap, gasket and framehead all line up when assembled.

9. Apply the gasket (7) over the guide stud to the rotor drive-end inner bearing cap (11).



FIG. 16. DRIVE-END INNER BEARING CAP, FLINGER AND BEARING INNER RACE INSTALLED. E-27157.



FIG. 17. GREASE IN DRIVE-END BEARING OUTER RACE. E-27158.



FIG. 18. GREASE IN DRIVE-END BEARING ROLLERS AND OUTER RACE. E-27159.

10. Supporting the weight of the frame head (10) with a hoist, slide the frame head, drive-end bearing outer race and rollers assembly over the bearing pilot and guide stud onto the rotor shaft (37), seating tightly against the drive-end inner bearing cap (11) and gasket (Fig. 20). Hold the frame head and bearing in place until the frame head is bolted to the inner bearing cap in Step 11.
11. Remove the bearing pilot. Apply the gasket over the guide stud to the drive-end frame head (10). After removing the guide stud, secure the dummy drive-end bearing cap and frame head to the inner bearing cap with eight bolts and flat washers (6).

**NOTE:** Do **NOT** assemble the additional rotor drive-end bearing assembly parts until the rotor has been assembled into the frame, and bearing clearance and runout checks have been completed.

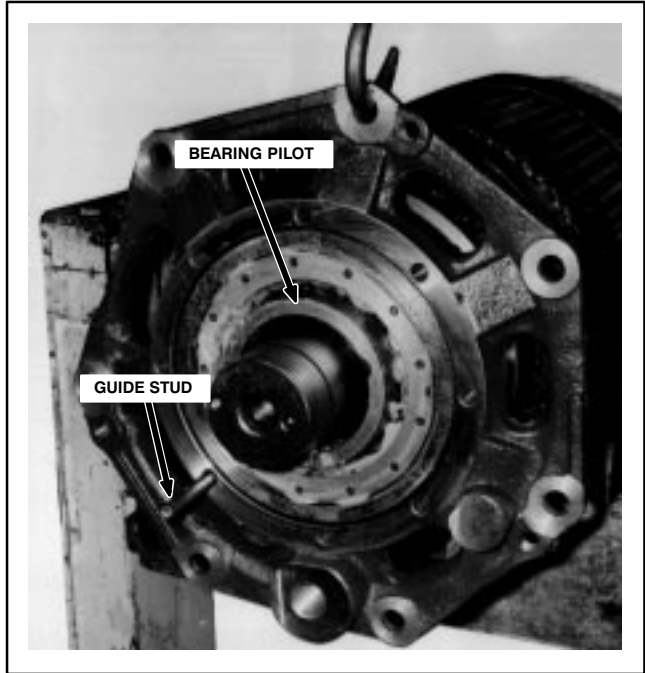


FIG. 20. DRIVE-END FRAME HEAD AND BEARING ASSEMBLY. E-27166.

### Connection-End Bearing

**NOTE:** Numbers in parenthesis () refer to part numbers in Figs. 12 and 21 of this publication, unless otherwise noted.

1. Inspect the rotor connection-end bearing housing (2) to ensure that both inside bores are clean and free of nicks and burrs.

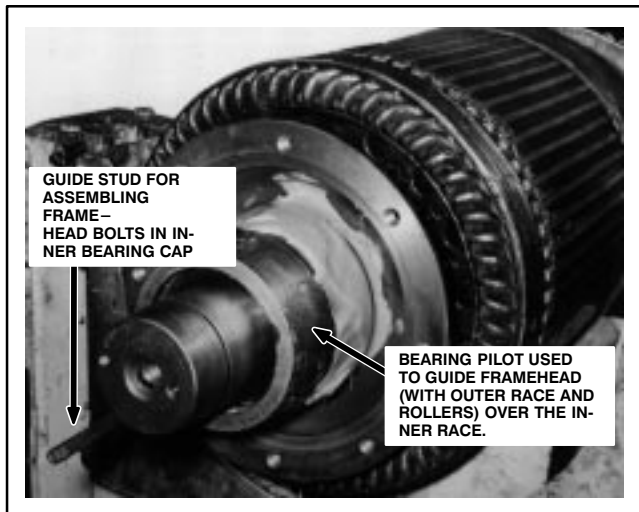


FIG. 19. DRIVE-END BEARING PILOT AND GUIDE STUD INSTALLED. E-27165.

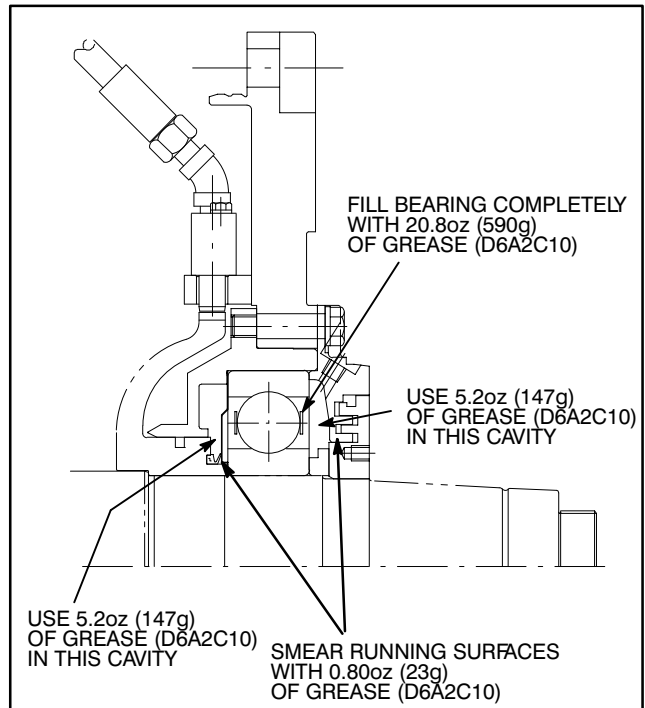


FIG. 21. CONNECTION-END BEARING GREASE DISTRIBUTION. E-45099.

2. Fill the cavity of the rotor connection-end bearing housing (2) with 5.2 oz. (147 g) of GE Specification D6A2C10 grease.
  3. Fully pack the rotor connection-end ball bearing (4) with 20.8 oz. (590 g) of GE Specification D6A2C17 grease.
  4. Evenly heat the rotor connection-end bearing housing (35) to 212°F (100°C) in an oven. Place the heated bearing housing on a flat surface, exposing the bearing cavity. Immediately slip the rotor connection-end ball bearing (4) into the bore of the bearing housing.
  5. Smear the running surfaces of the connection-end of the rotor shaft with 0.8 oz. (23 g) of GE Specification D6A2C10 grease.
  6. Heat the rotor connection-end bearing and bearing housing assembly to 212°F (100°C) in an oven. Remove the heated assembly from the oven, and immediately slide the assembly onto the rotor shaft, seated tightly against the rotor shaft shoulder, and secure the assembly in position until cooled.
  7. Apply the gasket, and assemble the dummy connection-end bearing cap with the six bolts (8) and flat washers.
1. Inspect to ensure that all mating surfaces are clean and free of nicks and burrs.
  2. Place the motor frame (20) on a heavy-duty stand with the drive-end up. Level the motor frame so that the rotor can be lowered vertically into the frame with a hoist without damaging the bearings or bus rings.
  3. Screw two long guide studs into the connection-end bearing housing (40) in opposite holes. These studs will help to guide the rotor into the motor frame.
  4. Screw a 1 in.-8 steel lifting eyebolt (GE Tool N672P39) into the threaded hole in the drive-end of the rotor shaft (37).

**CAUTION: Exercise extreme care when turning the rotor from the horizontal position to avoid damage to the core and the bearing and frame head fits. A suitable turning fixture or two hoists should be used to position the rotor vertically.**

**NOTE: The rotor connection-end bearing assembly is completed as part of the rotor installation.**

## ROTOR INSTALLATION INTO FRAME

**NOTE: The connection-end bearing and housing and the drive-end frame head, bearing and housing are installed with the rotor as an assembly.**

**NOTE: Numbers in parenthesis () refer to part numbers in Fig. 9 of this publication, unless otherwise noted.**

5. Carefully lift the rotor assembly from the horizontal position, attaching a hoist hook to the lifting eye. Align the hoist cable with the centerline of the motor frame (20), and slowly lower the rotor into the motor frame, guiding the long studs through the appropriate connection-end frame head (26) holes.
6. Install and hand-tighten the four bolts and flat washers (9) holding the drive-end frame head (10) to the motor frame (20). Then tighten the bolts evenly in a diametrically opposite sequence to the torque given in **TORQUE VALUES** section of this publication.
7. Remove the motor from the stand, placing the motor in its normal horizontal position
8. Force the rotor as far toward the connection end as possible. Remove the two long guide studs from the connection-end bearing housing (40). Install the six bolts and flat washers (31) securing the connection-end bearing housing (40) to the connection-end frame head (26), and tighten the bolts to the torque given in **TORQUE VALUES** section of this publication.

## ROTOR BEARING ASSEMBLIES CHECKS

### Connection-End Bearing Runout

1. Raise the connection end of the motor 4 to 6 in. (102 to 152 mm), and force the rotor toward the pinion end.
2. Clamp a dial indicator to the face of the rotor shaft at the connection end.
3. Zero the indicator ball on the face of the connection-end rotor bearing outer race. Then rotate the rotor to determine the bearing runout. If the bearing runout exceeds the runout given in **DATA** section of this publication, retighten the connection-end bearing housing and frame head bolts; and repeat the runout check. If necessary, disassemble the bearing assembly and check for burrs or dirt. Replace the connection-end bearing housing if the runout is still excessive.

### Drive-End Bearing Runout

1. Raise the drive end of the motor 4 to 6 in. (102 to 152 mm), and force the rotor toward the connection end.
2. Clamp a dial indicator to the face of the rotor shaft at the drive end.
3. Zero the indicator ball on the face of the pinion-end rotor bearing outer race. Then rotate the rotor to determine the bearing runout. If the bearing runout exceeds the runout given in **DATA** section of this publication, retighten the drive-end bearing housing and frame head bolts; and repeat the runout check. If necessary, disassemble the bearing assembly and check for burrs or dirt. Replace the drive-end bearing housing if the runout is still excessive.

### Drive-End Bearing Radial Clearance

1. With drive end of the motor raised 4 to 6 in. (102 to 152 mm), force the rotor toward the connection end.

2. Select a feeler gage thickness equal to the minimum radial clearance given in **DATA** section of this publication for the drive-end rotor bearing.
3. Place the feeler gage flat against the rolling surface of the inner race of the drive-end rotor bearing, just in front of the uppermost bearing roller. Hand-turn the rotor shaft just enough to roll the top bearing roller over the minimum radial clearance feeler gage.
4. Repeat the minimum clearance check for each bearing roller in the drive-end rotor bearing. Reject the bearing if one or more bearing rollers will not roll over the minimum radial clearance feeler gage.
5. Select a feeler gage thickness equal to the maximum radial clearance given in **DATA** section of this publication for the drive-end rotor bearing. Place the feeler gage flat against the rolling surface of the inner race of the drive-end rotor bearing. Hand turn the rotor shaft to check that none of the bearing rollers will roll over the maximum radial clearance feeler gage. Reject the bearing if one or more bearing rollers will roll over the maximum radial clearance feeler gage.

## ROTOR SHAFT END-PLAY CHECK

1. With the motor horizontal, force the rotor to seat at the drive end.
2. Clamp a dial indicator to the motor frame at the connection end or the dummy connection-end bearing cap. Zero the indicator ball on the face of the rotor bearing nut.
3. Force the rotor back to seat at the connection end. The amount of rotor shaft end-play indicated must not exceed the end-play given in **DATA** section of this publication.

## FINAL ASSEMBLY OF ROTOR DRIVE-END

If the rotor bearings pass the bearing runout and radial clearance checks, install the remaining drive-end assembly parts as follows:

**NOTE: Numbers in parenthesis () refer to part numbers in Figs. 13 and 14 of this publication.**

1. Remove the dummy drive-end bearing cap.
2. Pack the drive-end outer bearing cap insert (5) with 4.8 oz. (136 g) of GE Specification D6A2C10 grease. Assemble the bearing cap insert to the drive-end frame head (10) and inner bearing cap (11) with eight bolts and flat washers (6), and tighten the bolts to the torque given in **TORQUE VALUES** section of this publication.
3. Heat the outer sleeve (4) to 110\_ C (230\_ F) and shrink it onto the shaft until it is tight against the inner race of the bearing.

## FINAL ASSEMBLY OF ROTOR CONNECTION-END

**NOTE: Numbers in parenthesis () refer to part numbers in Fig. 9 and 21 of this publication.**

1. Remove the dummy connection-end bearing cap.
2. Apply 5.2 oz. (147 g) of GE Specification D6A2C10 grease to the connection-end bearing cap (32). Assemble the connection-end bearing cap using six bolts and flat washers (31), and tighten the bolts to the torque given in **TORQUE VALUES** section of this publication.
3. If supplied, replace the speed sensor and two speed sensor mounting bolts (30) and torque the bolts to the torque given in the **TORQUE VALUES** section. Ensure the gap between the speed sensor assembly and the speed sensor gear is 0.036 to 0.20 in. (0.91 to 0.51mm). Replace the speed sensor cover and four bolts and washers holding the cover to the connection end of the stator frame.

## CABLE LEADS AND CONNECTIONS

### INSPECTION

Inspect and clean the motor cable leads and connections as follows:

1. The cable insulation near the terminal should be free of splits, brittleness and charring. These conditions indicate excessive heat in the area of the terminal, which may be caused by a poor

crimp or loose or excessively tight assembly bolts.

2. The tongue or tang of the terminal should be checked for deformed assembly bolt holes or indentations at or around the holes caused by over-tightening of the bolts. Do **NOT** attempt to smooth the surface with a file, as this will remove the necessary plating on the tongue.
3. See that the mating surface of the terminal is flat, and has no contaminants (dirt, grease or other materials) that could interfere with the electrical contact between the terminal and the surface to which it is bolted.
4. Measure the external cable length between the tip of the connector and the end of the clamp. All cable leads must be within 0.5 in. (13 mm) in length of each other.
5. Cable insulation should not be damaged, frayed or worn. Carefully check areas where cables are clamped or subjected to abrasion.

Inspect the ground cable connection on the cable cleat on the motor frame to assure that the connection is clean.

## CABLE TERMINAL REPLACEMENT

Terminal crimping requires a hydraulic pump with hose. The proper power cable crimping head and crimping die also are required, depending on the terminal type and cable size. Proceed as follows:

1. Remove the old terminal by cutting the cable as close to the barrel of the terminal as possible.

**NOTE: The knife or stripping tool must not nick or score the outer strands of the cable. Nicked or scored wires will break with vibration or flexing of the cable.**

2. Carefully remove the insulation from a length of the copper cable equal to the depth of the new terminal barrel.
3. Coat the inside of the new copper terminal barrel with a thin protective coating of an oxidation inhibitor such as T&B M-53 (GE Part 41A204944P1) to reduce oxidation and corrosion.

**TABLE 1. COPPER CABLE CRIMPING DIE AND HEAD CATALOG NUMBERS.**

Cable Size	Tube Terminal		Cast Terminal		
	AMP Die	AMP Head	Die Code	GE Die	GE Head
225/24			54	2X5079	2X4945
375/24	46767-2	69099	60	2X5080	2X4945
450/24	46749-2	69099	60	2X5080	2X4945
550/24	46750-2	69099	76	2X4946	2X4945
650/24			76	2X4946	2X4945
775/24	46752-2	69099	76	2X4946	2X4945
925/24	46753-2	69099	87	2X4947	2X4945
1100/24	69653	69082	107	2X4950	2X4945
	46754-2	69082			
1325/24	59872-1	68073-2	107	2X4950	2X4945
	46755-2	69082			
1600/24	59873-1	68073-2	112	2X4952	2X4945
	46756-2	69082			
1925/24	59869-1*	68073-2	112	1X8087	2X4133
			112	2X4952	2X4945
2000/24			112	1X8087	2X4133
2300/24			125	2X4143	2X4133
2750/24			130	2X4144	2X4133
			150	2X4146	2X4133

\* Double crimp die.

- Carefully insert the bare cable into the new terminal until the cable bottoms. Avoid unravelling the outside strands of the bare cable. If the cable strands unravel, retwist the strands as close to their original shape as possible.

**CAUTION: Tube terminal crimping dies must be used ONLY with tube terminals; cast terminal crimping dies must be used ONLY with cast terminals. Intermixing types of crimping dies and terminals will cause terminal and cable failures.**

- Crimp the terminal barrel with the proper die (Table 1). Ensure the die code indicated on the barrel of cast terminals is the code for the die that is used.

**NOTE: Tube terminals and cast terminals may be bolted to like terminal types or to each other without restriction.**

- Inspect the crimp of the terminal barrel to the cable for a proper fit.

**NOTE: Copper terminals may be soldered to copper cables if the proper flux and solder is available.**

- Apply two layers of GE All-Weather tape (GE Part 41A216477P4) for 2 in. from the joint on both the cable and terminal.
- Slip shrinkable plastic tubing over the end of the cable and the terminal barrel. Apply heat to shrink the plastic tubing in place (Fig. 22).

## COVERS

Assemble the covers to the motor frame, and check for proper cover fit.

**ELECTRICAL RUNNING TEST**

**WARNING: Electrical shock can cause serious or fatal injury. Proper precautions should be taken and observed by personnel performing testing to avoid such injury.**

After the motor has been reconditioned and reassembled, make the following tests to ensure that the motor will operate satisfactorily.

1. Use Duxseal<sup>™</sup> putty to hold thermometers on the pinion-end and connection-end outer bearing caps. Thermometers should contact the bearing caps for best results.
2. Run the motor at NO LOAD in the order listed in Table 2. The applied waveform shall be sinusoidal. Bearing temperature rise should not exceed 122°F (55°C) above the room or enclosure temperature during the conduct of these tests.

**TABLE 2 – Motor No Load Testing Parameters**

Time in Minutes	Freq in HZ	RMS Volts Line-to-Line	Avg Line Current Amps	Motor Speed in RPM
2	41	572	435–490	800
2	82	572	118–137	1600
40	61	572		1220

3. Overspeed test: Run the motor for 2 minutes at approximately 155 Hz, not exceeding 572 volt rms line-to-line. Motor speed should be



FIG. 22. COMPLETED POWER CABLE TERMINAL. E-16355.

<sup>™</sup> Duxseal is a trademark of Johns-Manville Company.

3080–3090 rpm. Observe any unusual noise or vibration.

4. Vibration test: With the motor running at 137 Hz, 1080 volts rms line-to-line and 2750 rpm, measure the vibration at the drive-end and connection-end bearings. Vibration should not exceed 0.44 in/sec. (11,2 mm/sec) peak-to-peak. If vibration exceeds this amount, re-balance the armature.
5. Bearing noise: Check the pinion-end and opposite pinion-end bearings for unusual noise. The maximum noise reading with the shock pulse meter set for each bearing is 20dB<sub>n</sub> at 1200 rpm at the pinion-end and 1400 rpm at the opposite pinion-end. This reading should be taken when operating the motor at 1080 volts rms line-to-line.

**WARNING: High-potential (hi-pot) testing can cause serious injury or death. Strict safety regulations must be observed during such testing.**

6. Dielectric test: Apply a high-potential (hi-pot) test to ground with all terminals connected together at the voltage given in **DATA** section of this publication. See **STATIC ELECTRICAL TESTS** section of this publication.

**HUB MOUNTING**

**Hub Fitting**

To prevent a hub from slipping, it should have at least 75 percent fit on the shaft; i.e., at least 75 percent of the tapered bore of the hub should be in contact with the tapered fit on the shaft. Before mounting a hub, check and correct the fit as follows:

1. Lightly cover the bore of the hub with a blueing compound such as Prussian Blue.
2. Snap the cold hub forcefully onto the shaft.
3. Mark the relative angular position of hub with respect to the shaft.
4. Remove the hub from the shaft. A convenient method of removal is by the use of two finely tapered steel wedges (hardened and ground)

which are carefully driven between the hub and the bearing outer sleeve on the shaft.

5. **IMPORTANT! Inspect the taper fit of the shaft; blueing of the hub bore should now show on the shaft.** If at least 75 percent of shaft surface shows traces of blueing, the fit is satisfactory. If, however, only a few spots of blueing show on the shaft, the fit is not satisfactory.
6. Dress down the blue spots on the shaft very lightly with a fine emery cloth such as No. 400A Triemite.
7. Blue the hub bore again (see Step 1) and repeat Steps 2, 4, 5 and 6. Be sure to place the hub onto the shaft in the same position as marked.

Generally, the fit will be improved, but the foregoing procedure may have to be repeated several times to obtain a 75 percent fit.

Under no circumstances use a lapping compound since lapping will produce a shoulder at the large end of the tapered fit. A shoulder will prevent a perfect fit when the hub is mounted hot; i.e., when it is mounted in the advanced position.

8. After a good fit has been obtained, thoroughly clean the shaft and the hub bore to remove all blueing, oil or grease. Then mount the hub.

### Hub Mounting

1. Thoroughly clean the hub fit on the shaft and bore of the hub (see the procedure in the Cleaning section). Remove any scoring on the shaft or hub bore.
2. Spot the cold hub on the shaft by hand and check for at least 75 percent fit. See the "Hub Fitting" section. If necessary, dress the shaft to obtain this fit.
3. Trial mount the cold hub onto the shaft. Measure and record the position of the hub with respect to the end of the shaft. Take measurements with a micrometer advance gauge similar to that shown in Fig. 23. Zero the gauge.

Mark points of measurement, and mark across the end of shaft and hub face so that the hub, when heated, can be mounted in exactly the same angular position, and so the advance measurement can be made from the same point.

**CAUTION: Zero settings of advance gauge must not be disturbed until all readings on the hub are completed.**

4. Mount the hub hot onto the shaft so as to secure an advance from the cold position to the hot position along the axis of the shaft as indicated in this section. The ESTIMATED difference between shaft temperature and hub temperature (temperature rise) which will provide this advance is also given. The temperature difference is only an estimate and should be adjusted (if necessary) to provide the advance within prescribed limits.

**CAUTION: The temperature of the hub must not exceed 250° C (482° F); otherwise, the hub may become annealed.**

Part No. of Hub	Advance (in.)	Degrees Rise Above Shaft Temp.
493A471	0.120–0.130	215° C (419° F)
41A237799	0.120–0.130	215° C (419° F)

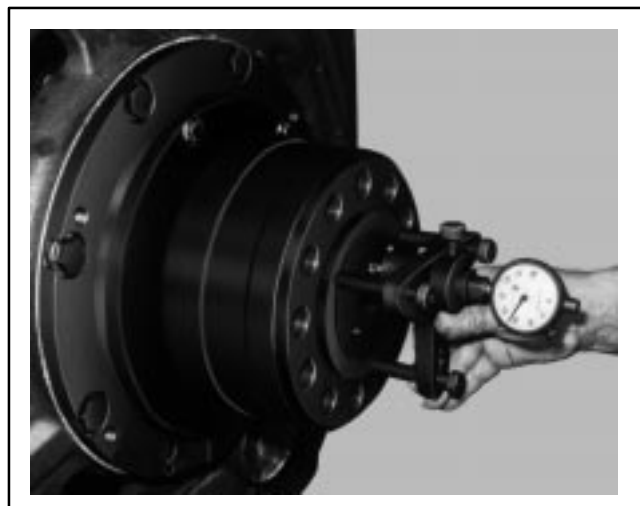


FIG. 23. METHOD OF USING ADVANCE GAUGE. E-5975A.

Heat the hub in an oven until it has reached a uniform temperature (the desired number of degrees above shaft temperature). For example, if shaft temperature is 25\_ C (77\_ F), heat hub to 25°C (77°F) +215°C (419°F) = 240°C (464°F).

An accurate method must be provided for measuring hub and shaft temperatures quickly before mounting the hub. This can best be done with a hand pyrometer. In using the pyrometer, place points of the gauge inside the bore of the hub, Fig. 24.

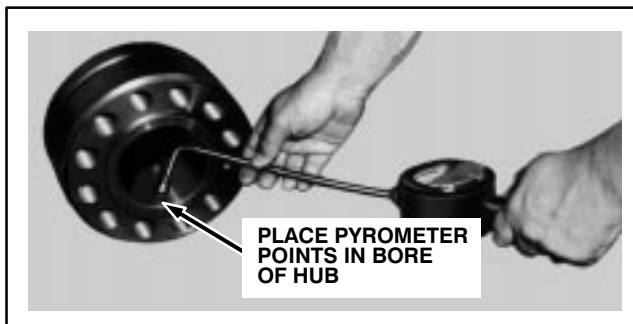


FIG. 24. MEASURING TEMPERATURE OF COUPLING HUB WITH PYROMETER. E-5976.

**NOTE: The part must be left in the oven long enough for the heat to penetrate throughout the part.**

Measure the temperature of the shaft and the hub with the same instrument.

5. Insure that the hub bore and the shaft taper are clean. Then, using adequate hand protection, quickly mount the hot hub on the shaft in the same angular position as when cold. When the hub is nearly in engagement with the taper fit (not in actual contact), snap it forcibly into place with a quick push. It is important that the hot hub be instantly snapped into position before it has cooled; otherwise, it will freeze to the shaft and cannot be adjusted further.
6. Check the hot or shrunk-on position of the hub on the shaft. The advance from cold to hot position along the axis of the shaft must be held within the limits indicated. Check the actual advance with an indicator gauge, located in the same relative position as used to measure the cold position in Step 3, Fig. 23.

If the advance is not within specified limits, remove the hub and repeat the assembly procedure.



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