

TECHNICAL MANUAL

OVERHAUL INSTRUCTIONS

(DEPOT)

**NOSE LANDING GEAR DOOR 48 DEGREE
REVERSAL GEARBOX ASSEMBLY**

177380-2

1680-01-159-9591

(ATOS)

F41608-82-G-0092

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INTRODUCTION

1. PURPOSE OF MANUAL.

This manual provides overhaul instructions for the Nose Landing Gear Door, 48 Degree Reversal Gearbox Assembly, part No. 177380-2, to enable personnel to perform the various tasks necessary to effect repair so that unit will meet new equipment standards of operation. This equipment is manufactured by Curtiss-Wright Flight Systems, Inc., Fairfield, NJ 07006.

2. CONTENTS OF MANUAL.

This manual consists of the following chapters:

Chapter 1	General Information
Chapter 2	Special Tools and Test Equipment
Chapter 3	Disassembly
Chapter 4	Cleaning
Chapter 5	Inspection, Repair, and Replacement
Chapter 6	Assembly
Chapter 7	Testing
Chapter 8	Table of Limits

3. USE OF MANUAL.

A table of contents when provided indicates chapter, paragraph, title, and page numbers to facilitate location of information. Illustrations, tables, and diagrams, when applicable, are located throughout the publication to supplement the text material. A list of illustrations and tables when provided indicates the number, title, and location. Abbreviations, phrases, and words which are on a decal, a placard, or an engraving are set forth in the text exactly as they appear on the decal, the placard, or the engraving.

4. REPAIR KITS.

Some repair parts for the component covered in this manual may be provided in the form of a kit. The Illustrated Parts Breakdown Manual identifies these parts. Activities shall replace all parts, regardless of condition, which are removed in the process of disassembly with all like parts furnished in the kit. Therefore, instructions for cleaning, inspecting, and reworking such used parts have been omitted. If any parts in the kit must be cleaned, inspected, or tested prior to installation, instructions for performing these requirements are included in this manual. Naturally, all defective parts are to be replaced, but a part unnecessary to be removed in the process of disassembly shall not be removed solely for the purpose of replacement by a corresponding kitted part. Refer to T.O. 00-25-195 regarding residue from kits and removed parts in this category.

5. LIST OF RELATED PUBLICATIONS.

The following list identifies publications related to this technical manual.

List of Related Publications

<u>Publication Number</u>	<u>Publication Title</u>
A-A-59105B	Nitric Acid
ANSI B74.18	Grading of Certain Abrasive Grain on Coated Abrasive Products

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<u>Publication Number</u>	<u>Publication Title</u>
ASME Y14.38M	Abbreviations for Use on Drawings, and in Specifications, Standards, and Technical Documents
ASTM D 329	Acetone, Technical
ASTM D 740	Methyl Ethyl Ketone (MEK)
ASTM E 1417	Standard Practice for Liquid Penetrant Examination
ASTM E 1444	Standard Practice for Magnetic Particle Examination
FED-STD-595B	Colors for Government Procurement
MIL-A-46106B	Adhesive-Sealants, Silicone, RTV, One-Component
MIL-DTL-81706A	Chemical Conversion Coatings on Aluminum and Aluminum Alloys
MIL-PRF-23377H	Grease, General Purpose
MIL-PRF-23827A	Grease, General Purpose
MIL-PRF-680A	Dry Cleaning and Degreasing Solvent
MIL-PRF-85285D	Coating, Urethane, Aliphatic Isocyanate, for Aerospace Applications
MIL-PRF-85582D	Primer Coatings: Epoxy, Waterborne
MIL-PRF-87937D	Cleaning Compound, Aerospace Equipment
MIL-T-81772B	Thinner, Aircraft Coating
SAE AMS-QQ-P-416A	Plating, Cadmium (Electrodeposited)
SAE AMS-S-8802A	Sealing Compound, Temperature Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion
T.O. 00-20-195	AF Technical Order System, Source, Maintenance, and Recoverability Coding of Air Force Weapons, Systems, and Equipments
T.O. 16G1-164-4	Nose Landing Gear Door 48 Degree Reversal Gearbox Assembly, Part No. 177380-2, Illustrated Parts Breakdown

6. LIST OF SYMBOLS AND ABBREVIATIONS.

The following symbols and abbreviations used in this technical manual comply with Military Specification ASME Y14.38M.

&	ampersand
°	degree
–	minus
%	percent
+	plus
Assy	Assembly
F	Fahrenheit
lb.	pound
in.	inch
max	maximum
min	minimum
No.	Number
psi	pounds per square inch
psig	pounds per square inch gauge
/	slash
T.O.	Technical Order

SAFETY SUMMARY

1. GENERAL SAFETY INSTRUCTIONS.

This safety summary includes general safety precautions and instructions that must be understood and applied during operation and maintenance to ensure personnel safety and protection of equipment. Prior to performing any task, the WARNINGS, CAUTIONS and NOTES included in that task shall be reviewed and understood.

2. WARNINGS, CAUTIONS, AND NOTES.

WARNINGS and CAUTIONS are used in this manual to highlight operating or maintenance procedures, practices, conditions or statements which are considered essential to protection of personnel (WARNING) or equipment (CAUTION). WARNINGS and CAUTIONS immediately precede the step or procedure to which they apply. WARNINGS and CAUTIONS consist of four parts: heading (WARNING, CAUTION or Icon [see HAZARDOUS MATERIALS WARNINGS]), a statement of the hazard, minimum precautions, and possible result if disregarded. NOTES are used in this manual to highlight operating or maintenance procedures, practices, conditions or statements which are not essential to protection of personnel or equipment. NOTES may precede or follow the step or procedure, depending upon the information to be highlighted. The headings used and their definitions are as follows.

**WARNING**

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc, which if not strictly observed, could result in injury to, or death of, personnel or long term health hazards.

**CAUTION**

Highlights an essential operating or maintenance procedure, practice, condition, statement, etc, which if not strictly observed, could result in damage to, or destruction of equipment or loss of mission effectiveness.

NOTE

Highlights an essential operating or maintenance procedure, condition, or statement.

CHAPTER 1 GENERAL INFORMATION

1.1 GENERAL INFORMATION.

The gearbox (Figure 1-1), is part of an aircraft nose landing gear door actuation mechanism. The gearbox provides a 48 degree change in direction of torque required to operate the nose landing gear doors.

1.2 FUNCTIONAL DESCRIPTION.

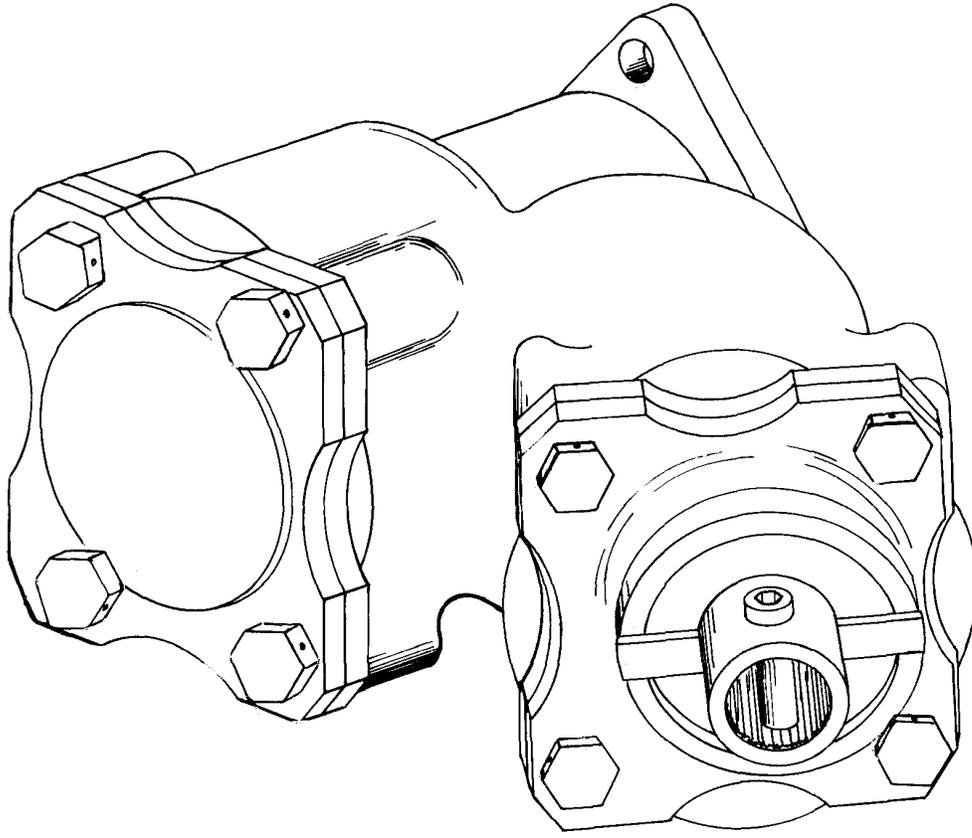
The gearbox consists of a housing containing two bevel gear/plug assemblies mounted on ball bearings, and two seal assemblies.

1.3 LEADING PARTICULARS.

See Table 1-1 for the leading particulars.

Table 1-1. Leading Particulars

Angle Between Input and Output Shafts	48 degrees
Height	6.2 inches
Width	3.8125 inches
Length	7.15 inches
Weight	5.1 pounds
Gear Ratio	1:1



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Figure 1-1. Nose Landing Gear Door, 48 Degree Reversal Gearbox Assembly

CHAPTER 2

SPECIAL TOOLS, TEST EQUIPMENT, AND CONSUMABLE MATERIALS

2.1 INTRODUCTION.

Special tools and test equipment required for maintenance of the gearbox are presented in this chapter. Equivalent items may be used if the recommended tool/test equipment is not available.

2.2 SPECIAL TOOLS AND TEST EQUIPMENT.

Special tools and test equipment required for maintenance of the gearbox are listed in Table 2-1, standard tools and test equipment are listed in Table 2-2, and consumable materials are listed in Table 2-3.

Table 2-1. Special Tools and Test Equipment List

Tool/Equipment Number	Figure 2-1 Index No.	Nomenclature	Use and Application
ST5803 (in Kit ST792)	1	Plate	Used to support retainer during seal and protector installation and removal. (paragraph 3.3 and paragraph 6.4)
ST5804 (in Kit ST792)	2	Insertor/Remover	Used to install and remove seal and protector into/from retainer. (paragraph 3.3 and paragraph 6.4)
ST5808 5120-00-121-3684	3	Adapter	Adapts torque wrench to gear/plug assembly splines. (paragraph 3.3, paragraph 6.3.1, paragraph 6.3.2, and paragraph 7.2)
ST5817 5120-00-121-3683	4	Driver Plug, Bearing and Bushing	Used to install bearings. (paragraph 6.4)
ST5823 (in Kit ST792)	5	Wrench	Used to remove and install locknut (12). (paragraph 3.3 and paragraph 6.3.2)
ST5896 4920-00-132-1597	6	Adapter	Used for measuring backlash of gearbox. (paragraph 6.4)
ST5898 (in Kit ST823)	7	Driver Plug	Used to disassemble/assemble retainer (14). (paragraph 3.3 and paragraph 6.3.1)
ST5916 4920-00-486-4724	8	Plate, Bearing removal	Used to support retainer and bearing when removing from gear/plug assembly. (paragraph 3.3)
ST5917 5120-00-119-2490	9	Driver Plug	Used to remove bearing from gear/plug assembly. (paragraph 3.3)
ST5999 5120-00-520-3905	10	Removal Tool	Used to remove/install seal assembly (4), (5), (6). (paragraph 3.3)
ST6278 (in Kit ST799)	11	Gage	Used to measure internal splines. (paragraph 5.1)
ST6297 (in Kit ST823)	12	Insertor	Used to install lockwasher (34). (paragraph 6.3.1 and paragraph 6.3.2)
ST6300 (in Kit ST823)	13	Puller	Used to remove lockwasher (11). (paragraph 3.3)
ST6366 (in Kit ST799)	14	Setmaster, Internal	Used for internal spline measurement. (paragraph 5.1).

Table 2-1. Special Tools and Test Equipment List - Continued

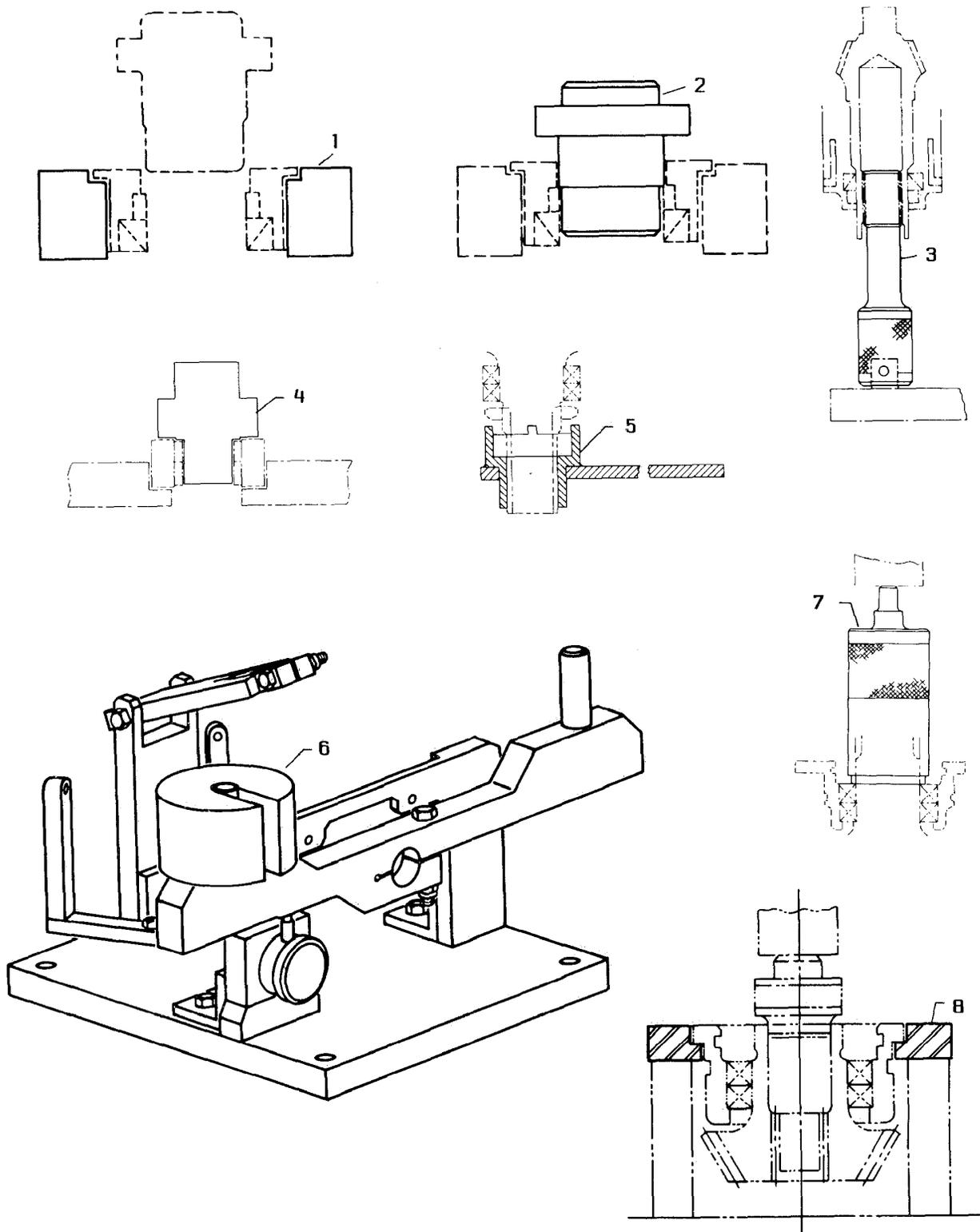
Tool/Equipment Number	Figure 2-1 Index No.	Nomenclature	Use and Application
ST799 5280-00-420-7093	15	Gage Kit, Actuator Drive Components	Used to measure internal and external spline wear. (paragraph 5.1)
3695-4 (5120-00-793-1077)	16	Tang Breakoff Tool	Used to remove heli-coil insert tangs. (paragraph 5.3)
1227-6 (5120-00-723-6833)	17	Extracting Tool	Used for extracting heli-coil inserts. (paragraph 5.3)
7552-4 (5120-00-710-7435)	18	Installing Tool	Used for installing heli-coil inserts. (paragraph 5.3)

Table 2-2. Standard Tools and Test Equipment

Tool/Equipment Number	Nomenclature	Use and Application
TQ50 Snap-On Tools Corp. Kenosha, WI	Torque wrench	Used to measure torque when tightening parts. (paragraph 6.3.1, paragraph 6.3.2, paragraph 6.4)
RCQ-1086 NSN6635-01-575-4642	Magnetic particle inspection stand	Used to perform magnetic particle inspection. (Table 5-1)
Zygló Model ZA-28E Magna-flux Corp. Chicago, IL	Fluorescent penetrant inspection stand	Used to perform fluorescent penetrant inspection. (Table 5-1)
LFM1A NSN6650-01-967-8316	Lamp Magnifier	Used to perform visual inspection. (paragraph 5.1)

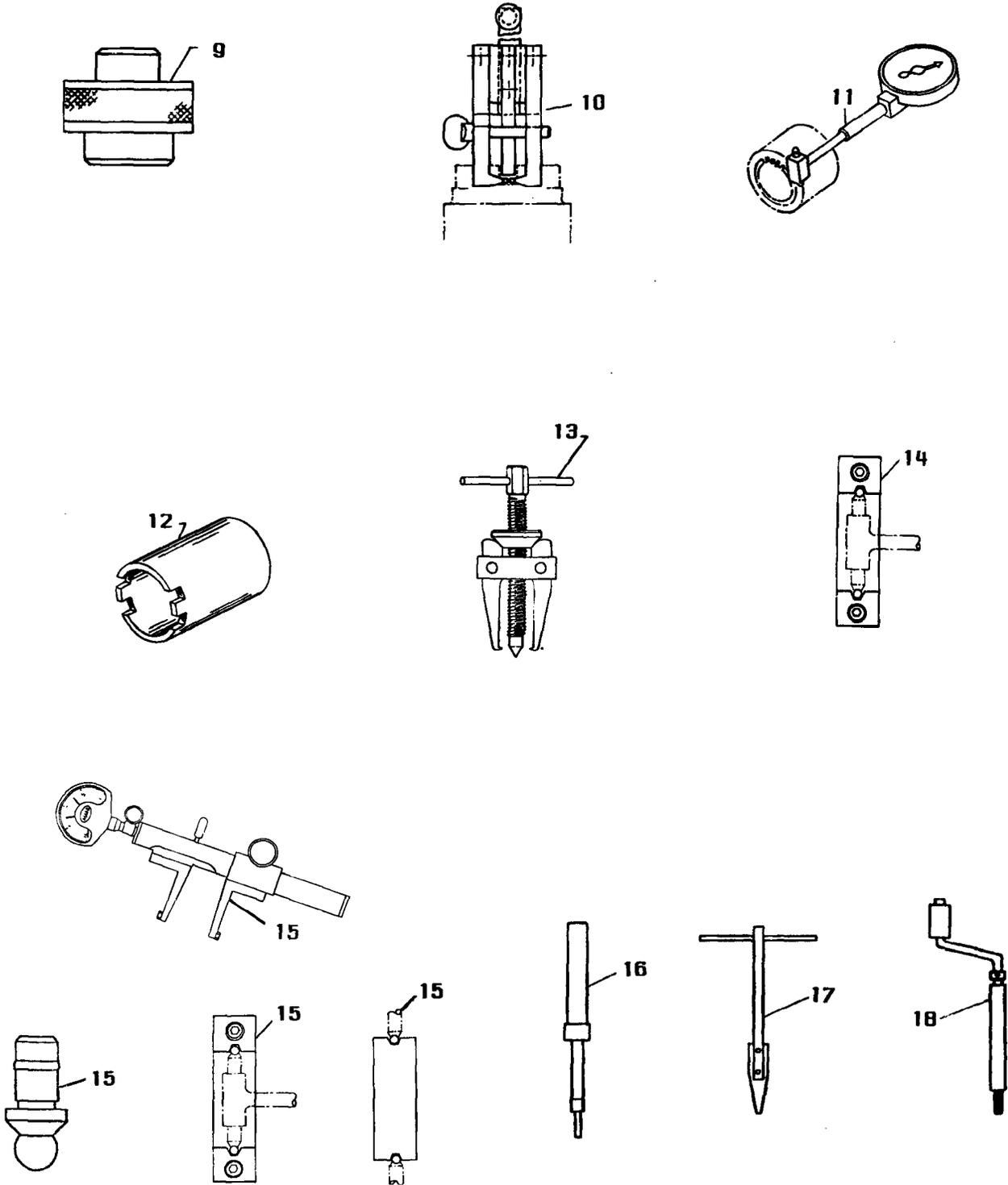
Table 2-3. Consumable Materials

Nomenclature	Specification or Part No. (mfr code)	Quantity
Crocus Cloth	ANSI B74.18	As Required
Grease	MIL-PRF-23827A	As Required
No. 320 Silicon Carbide Abrasive Cloth	Federal Specification ANSI B74.18	As Required
Methyl ethyl ketone	Federal Specification ASTM D 740	As Required
Iridite No. 14-2	MIL-DTL-81706A	As Required
Iridite 8P	SAE AMS-QQ-P-416A, Type 2, Class 2	As Required
Primer	MIL-PRF-23377H, Type I, Class 2 or MIL-PRF-85582D, Type I, Class 2	As Required
Polyurethane Enamel	MIL-PRF-85285D Color, No. 17925 of FED-STD-595B	As Required
Enamel Stripper Turco Products, Inc. Wilmington, CA	T-5003	As Required
Sealing Compound	SAE AMS-S-8802A	As Required
Silastic Compound	MIL-A-46106B	As Required
Thinner	MIL-T-81772B	As Required
Acetone	ASTM D 329	
Dry cleaning solvent	MIL-PRF-680A, Type II or III	As Required



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Figure 2-1. Special Tools and Test Equipment (Sheet 1 of 2)



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Figure 2-1. Special Tools and Test Equipment (Sheet 2)

CHAPTER 3

DISASSEMBLY

3.1 GENERAL.

This chapter covers unpacking and disassembly of the gearbox assembly. The extent of disassembly required should be determined by preliminary visual inspection and test. No part should be disassembled unless it requires replacement or servicing or unless it must be removed to allow access to other parts requiring replacement or servicing. The disassembly procedures are described in detail unless self-evident upon inspection. Figure 3-1 reflects the general order of disassembly.

3.2 UNPACKING.

No special unpacking instructions are required for unpacking the gearbox. Save and store all packing material for reuse for shipment or storage purposes.

3.3 DISASSEMBLY OF GEARBOX.

Disassembly instructions for the gearbox are provided in the following paragraphs. Figure 3-1 shall be used as a reference for removal of all subassemblies and parts for the gearbox. Note that attaching parts immediately follow the parts they attach. Observe the following procedures and tool applications and proceed as follows:

CAUTION

Do not allow any parts to come in contact with dirt or grit after they have been removed.

- a. Install gearbox assembly in a padded vise and disassemble.
- b. Remove bolt (1) and nut (2) from gear/plug assembly (17).
- c. Compress spring (3) and remove seal assembly (4, 5, and 6) with Removal Tool part No. ST5999. Discard seal assembly (4, 5, and 6).
- d. Remove bolt (9) and washer (10) securing the retainer (8) to housing (44). Remove retainer (8) and packing (7). Discard packing (7).
- e. Remove lockwasher (11) using Puller, part No. ST6300. Remove locknut (12) by holding gear with Adapter, part No. ST5808, using Wrench, part No. ST5823, and a vise.
- f. Remove shim (13) and hold for reassembly if same parts are used. Measure and record thickness of shims as disassembled.

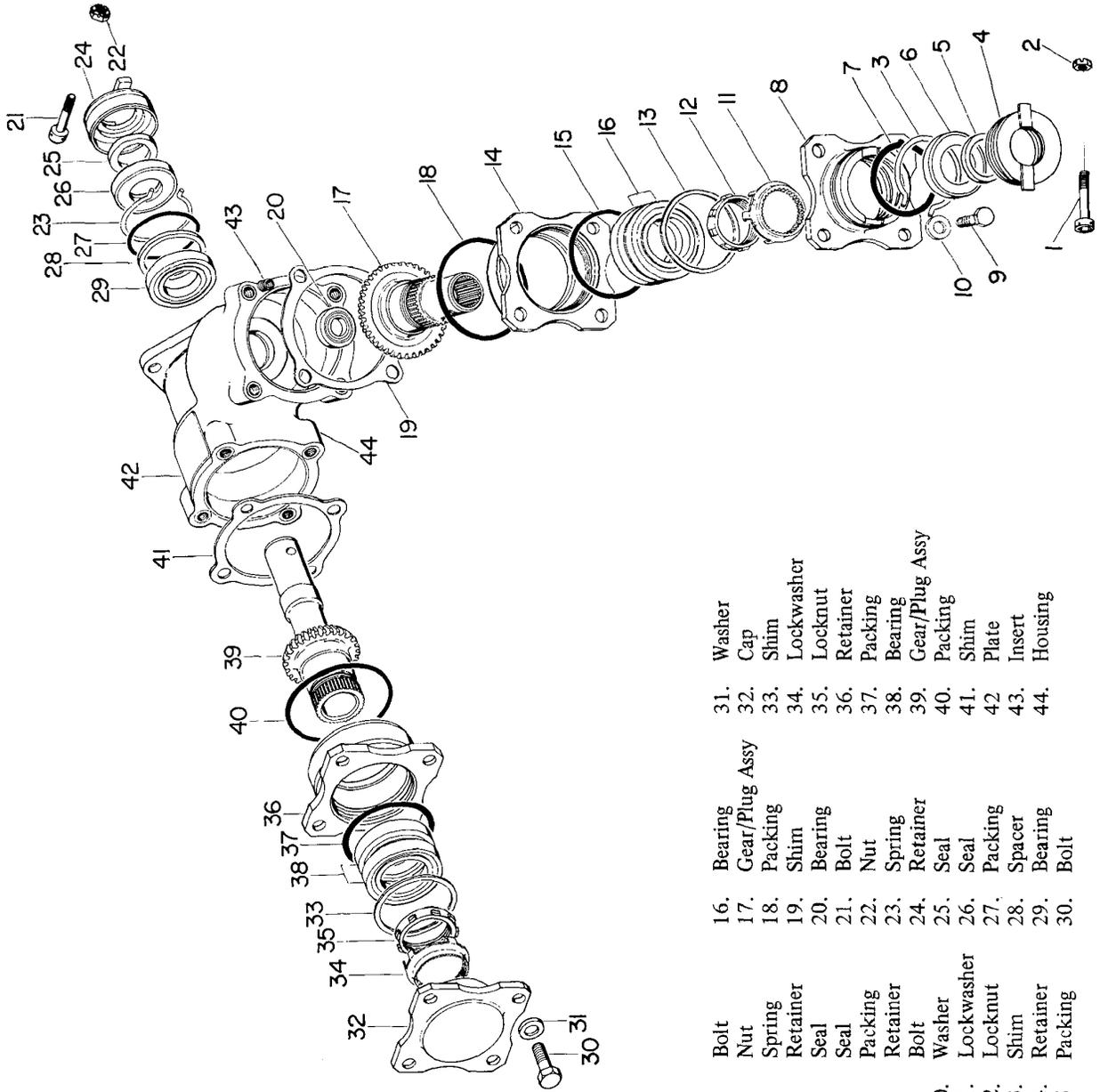
CAUTION

During the pressing operation, protect gears with soft stock such as aluminum.

- g. Remove retainer (14) with gear (17) from housing. Remove retainer and bearing (16) from bevel gear (17) using Driver Plug, part No. ST5898, and an arbor press. Support end of retainer (14) with Plate, part No. ST5916 and push out the gear. Remove packings (15 and 18) from retainer (14) and discard. Remove bearings (16) from retainer (17).
- h. Remove shim (19) from housing and hold for reassembly if same parts are used. Measure and record thickness of shim.
- i. Remove bearing (20) from housing (44) using a standard bearing puller.
- j. Remove bolt (21) and nut (22) from gear/plug assembly (39).

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- k. Compress spring (23) and remove seal assembly (24, 25, and 26) with Removal Tool part No. ST5999. Discard seal assembly. Remove spacer (28).
- l. Remove bolt (30) and washer (31) securing cap (32) to housing (44). Remove cap (32).
- m. Remove shim (33) and hold for reassembly if same parts are used. Measure and record thickness of shim.
- n. Remove lockwasher (34) using Puller, part No. ST6300. Remove locknut (35) by holding gear with Adapter, part No. ST5808, and using Wrench, part No. ST5823 and a vise. Pull gear and retainer from housing. Remove packing (27) and bearing (29). Discard packing.
- o. Remove packings (37, 40) from retainer (36). Discard packings. Remove retainer and bearing (38) from gear/plug assembly (39) using Driver Plug, part No. ST5917, and an arbor press. Support end of retainer with Plate, part No. ST5916, or equivalent, and push out the gear.
- p. Remove shim (41) and hold for reassembly if same parts are used. Measure and record shim (41).



- | | | | |
|-----|----------------|-----|----------------|
| 1. | Bolt | 31. | Washer |
| 2. | Nut | 32. | Cap |
| 3. | Spring | 33. | Shim |
| 4. | Retainer | 34. | Lockwasher |
| 5. | Seal | 35. | Locknut |
| 6. | Seal | 36. | Retainer |
| 7. | Packing | 37. | Packing |
| 8. | Retainer | 38. | Bearing |
| 9. | Bolt | 39. | Gear/Plug Assy |
| 10. | Washer | 40. | Packing |
| 11. | Lockwasher | 41. | Shim |
| 12. | Locknut | 42. | Plate |
| 13. | Shim | 43. | Insert |
| 14. | Retainer | 44. | Housing |
| 15. | Packing | | |
| 16. | Bearing | | |
| 17. | Gear/Plug Assy | | |
| 18. | Packing | | |
| 19. | Shim | | |
| 20. | Bearing | | |
| 21. | Bolt | | |
| 22. | Nut | | |
| 23. | Spring | | |
| 24. | Retainer | | |
| 25. | Seal | | |
| 26. | Seal | | |
| 27. | Packing | | |
| 28. | Retainer | | |
| 29. | Bolt | | |
| 30. | Nut | | |

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Figure 3-1. Gearbox Assembly, Exploded View

CHAPTER 4

CLEANING

4.1 GENERAL.

Cleaning instructions for the gearbox are provided in this chapter. All dust, dirt, corrosion, rust, and moisture must be removed, as these destructive agents may eventually cause equipment failure. As soon as possible after disassembly, thoroughly clean all parts of the gearbox in accordance with the instructions given in step a and step b.

WARNING

- MIL-PRF-680A, Type II or III, may affect skin, eyes, and respiratory tract. Use in a well-ventilated area. Avoid prolonged breathing of vapors. Avoid eye and repeated skin contact. Keep away from sparks and flames.
 - Acetone is flammable and may affect skin, eyes, and respiratory tract. Use in a well-ventilated area. Avoid prolonged breathing of vapors. Chemical goggles and neoprene gloves are required. Keep away from sparks and flames.
 - Compressed air used for cleaning can create airborne particles that may enter the eyes. Pressure will not exceed 30 psig. Eye protection is required.
- a. Clean all metal parts in a solvent such as dry cleaning solvent, MIL-PRF-680A, Type II or III and rinse afterwards with acetone, ASTM D 329 if necessary.
 - b. Do not dip the parts into the solvent. Spray cleaning is recommended. Use only fresh, clean solvent. A false bottom screen in the cleaning container is suggested so that parts dropped into the container will not fall into the sludge at the bottom of the container. A stiff, fiber brush will aid in cleaning. Use filtered shop air to blow the parts dry. Inspect the parts as soon as possible after cleaning. Do not allow parts to remain unprotected. Store parts in clean plastic containers until ready for reinstallation.

CHAPTER 5

INSPECTIONS, REPAIR AND REPLACEMENT

5.1 INSPECTION.

Inspect the gearbox in accordance with the following instructions:

5.1.1 Visual Inspection. Perform a visual inspection of disassembled parts immediately after cleaning. Proceed as follows:

- a. Inspect all components for corrosion, contamination, and obvious damage that would affect operation and integrity of the gearbox.
- b. Inspect all parts for wear, cracks, burrs, and scoring.
- c. Check for damaged threads, worn or chipped gear teeth, breaks and dents.
- d. Refer to Table 5-1 for inspection procedures.

5.1.2 Spline Inspection. Perform the spline inspection as follows:

NOTE

When measuring spline wear, special dial indicator gages and ball anvil sets are required. The available gages are designed for specific internal and external spline inspection application, and are parts of Kit, part No. ST799.

- a. Prior to use of gage, set it to measure the proper spline diameter, which is accomplished with the appropriate Setmaster.
- b. Gage, part No. ST6278 is used to measure internal spline wear on pitch diameters from 0.600-1.125 inch. Two ball sizes, 0.07217 and 0.05774 inch are utilized with this gage. Applicable Setmasters, part No. ST6366 are available through the required range of pitch diameters.
- c. When measuring gage pitch diameter of 0.6875 inch, use gage head with ball size of 0.05774 inch. Assemble short extension of gage ball with head, tighten small lock ring securely. If gage dial deflection adjustment is required, loosen set screw with Allen wrench. Reposition gage by moving gage dial in or out of holder. Tighten set screw.
- d. Tighten all threaded parts by hand except the Allen screw.
- e. With the gage positioned on the proper Setmaster, set the dial indicator of the gage to read zero.
- f. Determine spline wear over entire length of splines. Refer to Figure 8-1 for wear tolerances. The dial indicator reading is the actual wear on the splines. Replace part if worn beyond tolerances.

5.1.3 Gear Inspection. Inspect all gears using an illuminated magnifier (part No. LFM1A). If a bevel gear is replaced for apparent wear, the mating gear must also be replaced. Replace gears exhibiting any of the following conditions:

NOTE

Wear may be visually detected on some gears by a wear step or a visible change in tooth profile. Visual comparison can be readily made between the loaded and unloaded sides of teeth, or between teeth of a used gear and a new gear. Normal tooth polishing, indicated by a shiny pattern, should not be considered wear.

- a. Any displaced metal, horizontal and/or vertical indentations or pitting in the face or flank area. See Figure 5-1, wear pattern A.
- b. Wear which tends to wear the top edge of a tooth, decreasing the top land thickness and the face area. See Figure 5-1, wear pattern B.
- c. Any tooth edge breakage or chipping.

Table 5-1. Inspection Data

Nomenclature	Figure No.	Index No.	Inspection Procedure	Acceptable Dimensions (inches)		
				Min	Max	
Retainer, Bearing	Figure 3-1	8	Check IDs for nicks and burrs. Inspect four mounting holes for elongation and cracks.			
Retainer, Bearing	Figure 3-1	14 & 36	Check ID of bearing (16) retaining surface		1.8513	
			Check surfaces for nicks and burrs. Inspect four mounting holes for cracks and elongation.			
Gear/Plug Assembly	Figure 3-1	17	Check OD of bearing (16) mounting surface.	1.1810		
			Check OD of bearing (20) mounting surface.	0.9993		
			Check spline wear between three 0.05774 inch diameter pins.			0.6033
Cap, Bearing	Figure 3-1	32	Check ID and OD for nicks and burrs. Inspect four mounting holes for cracks and elongation.			
Gear/Plug Assembly	Figure 3-1	39	Check OD of bearing (38) mounting surface.	1.1810		
			Check OD of bearing (29) mounting surface.	0.9832		
			Check spline wear between three 0.05774 inch diameter pins.			0.6033
			Check for cracks, nicks and scratches.			
			Perform fluorescent penetrant inspection per ASTM E 1417.			
Housing	Figure 3-1	44	Check ID of bearing (20) seating surface.		1.2510	
			Check ID of bearing (29) seating surface.		1.6544	
			Check for damaged threads, burrs and damage to ID and OD that would prevent proper seating of bearings or installation of housing.			
			Perform fluorescent penetrant inspection per ASTM E 1444.			

5.2 REPAIR.

Perform the following repair procedures as needed:

5.2.1 Minor Repairs. Perform minor repairs as follows:

- a. Remove minor scratches, burrs, and corrosion from steel parts by polishing lightly with crocus cloth, Federal Specification ANSI B74.18.

CAUTION

Do not use crocus cloth on aluminum parts. Its abrasive is a ferric oxide which causes aluminum to corrode rapidly.

- b. Remove minor defects from aluminum parts by polishing lightly with aluminum oxide or silicon carbide abrasive cloth, Federal Specification ANSI B74.18. After repair, clean parts thoroughly; refer to Chapter 4, Cleaning.

5.2.2 Repair of Painted Surfaces. Repair painted surfaces as follows:

5.2.2.1 Surface Preparation.

WARNING

Conduct all preparation and painting operations as directed throughout this chapter in a well-ventilated area or in an approved spray booth equipped with adequate ventilation and exhaust.

Prepare surface of various materials as follows:

5.2.2.1.1 Aluminum Alloys.

NOTE

Repair refers to a condition in which the base metal is exposed through the paint.

Perform the following procedure:

WARNING

Acetone is flammable and may affect skin, eyes, and respiratory tract. Use in a well-ventilated area. Avoid prolonged breathing of vapors. Chemical goggles and neoprene gloves are required. Keep away from sparks and flames.

- a. Feather-edge the film adjacent to the damaged area using No. 320 silicon carbide abrasive cloth, Federal Specification ANSI B74.18, or equivalent. Wipe surface clean with a cloth wetted with acetone, Federal Specification ASTM D 329, and wipe dry.

WARNING

Iridite is toxic to skin, eyes and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.

- b. Apply Iridite No. 14-2 solution (MIL-DTL-81706A), four ounces of Iridite per gallon of water at room temperature with a brush or swab to the exposed area. A contact time of 15 to 30 seconds will usually produce a golden yellow color. Rinse thoroughly with water and dry.

5.2.2.1.2 Cadmium-Titanium Plated Steel or Cadmium Plated Steel. Perform the following procedure:

- a. Feather-edge the film adjacent to the damaged area using No. 320 silicon carbide abrasive cloth, Federal Specification ANSI B74.18, or equivalent.
- b. With a brush or swab, clean the affected area with an approved alkaline cleaner until it is completely wetted and shows no water breaks. Rinse thoroughly.

WARNING

Nitric acid is highly toxic to skin, eyes and respiratory tract. Avoid all contact. Skin and eye protection and exhaust hood are required.

- c. Prepare a solution of one ounce of Iridite 8P, manufactured by Allied Research Products, Inc. 4004 E. Monument Street, Baltimore, MD 21204 (or equivalent), 0.406 fluid ounces (12 milliliters) of concentrated nitric acid, Federal Specification A-A-59105B and sufficient water to make one gallon of solution. Apply the solution to the affected area. When Iridite 8P is used as specified, the requirements of SAE AMS-QQ-P-416A, Type II, Class 2 are met. If an equivalent is selected, consideration must be given to assure that it also meets the requirements of SAE AMS-QQ-P-416A, Type II, Class 2.
- d. Keep the surface wet with the mixed solution until the desired color is obtained. Rinse thoroughly with water and dry.

5.2.2.2 Touch-Up Painting Procedure. Prepare surfaces for minor repair as follows:

NOTE

Repair refers to a condition in which one or more of the paint films has been damaged without exposing the base metal.

- a. Feather-edge the film adjacent to the damaged area using No. 320 silicon carbide abrasive cloth, Federal Specification ANSI B74.18, or equivalent, being careful not to expose the base metal.
- b. Wipe area with precoating surface cleaner, MIL-PRF-87937D, diluted in accordance with manufacturer's instruction. Rinse afterwards with clean cloth dampened with clean water and wipe dry with clean cloth.

WARNING

- Polyurethane enamel is flammable and toxic to eyes, skin and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate. Keep away from open flames or other sources of ignition.
- Epoxy primer is highly toxic to eyes, skin and respiratory tract. Avoid all contact. Skin and eye protection required. Use only with adequate ventilation.

5.2.2.2.1 Apply one coat of epoxy primer (MIL-PRF-23377H, Type I, Class 2) or waterborne epoxy primer (MIL-PRF-85582D, Type I, Class 2) and two coats of polyurethane enamel (MIL-PRF-85285D) per paragraphs titled Application of Epoxy Primer and Preparation of Enamel.

5.2.2.3 Repainting. The affected area shall be repainted with the following: one coat of epoxy, primer, MIL-PRF-23377H, Type I, Class 2 or water borne epoxy primer, MIL-PRF-85582D, Type I, Class 2 and two coats of polyurethane enamel, MIL-PRF-85285D Color No. 17925 per FED-STD-595B.

5.2.2.4 Application of Epoxy Primer. Prior to expose the base metal applying epoxy primer, mix and thin primer as follows:

NOTE

The surfaces to be painted shall be clean, dry and free from dust, dirt, oil, or other foreign matter. The epoxy primer (MIL-PRF-23377H, Type I, Class 2) or waterborne epoxy primer (MIL-PRF-85582D, Type I, Class 2) shall be applied to the prepared surface within eight hours from the time of initial mixing. Primer not used within this period shall be discarded.

- a. Prepare the epoxy primer (MIL-PRF-23377H, Type I, Class 2) or waterborne epoxy primer (MIL-PRF-85582D, Type I, Class 2) in accordance with the manufacturer's recommendations under clean conditions and with clean equipment.
- b. Mix the components at room temperature. Remove skins if present.

WARNING

Thinner is flammable and toxic to eyes, skin and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate. Keep away from open flames or other sources of ignition.

- c. Thin the mixed primer to a viscosity of 17 to 19 seconds in a No. 2 Zahn cup by the addition of approximately three volumes of thinner to four volumes of mixed primer. The thinner shall be per MIL-T-81772B.
- d. Thoroughly stir the mixed primer while thinning. Strain the primer after thinning and allow to stand in a closed container for one hour prior to use.
- e. The primer is to be applied in a single wet pass by spraying; when necessary, the fill-and-drain method may be used for inaccessible surfaces. This method consists of wetting the inaccessible surfaces by pour-filling with primer. A prime coating is thus left on the surfaces.
- f. The average dry film thickness of each coat of epoxy primer shall be 0.0006 to 0.0009 inch.
- g. A minimum air drying time of one hour and a maximum of eight hours shall elapse before applying the polyurethane enamel. When these maximum time limits have been exceeded, the epoxy primed surface shall be scuff-sanded using No. 320 silicon carbide abrasive cloth, Federal Specification ANSI B74.18, or equivalent, and reactivate with methyl ethyl ketone, Federal Specification ASTM D 740, and then cleaned and dried prior to applying enamel. No oven drying processes shall be used.
- h. Full closed containers of both components have a storage life of one year from date of manufacture when stored at temperature of 70° to 90° F.

5.2.2.5 Preparation of Enamel. Prior to applying enamel, prepare the enamel as follows:

- a. The components to be mixed shall be at room temperature (70° F min) and the mixing shall be done with clean equipment.
- b. The polyurethane enamel shall be vigorously shaken on a "Red Devil" shaker, or equivalent, before mixing with the isocyanate/thinner (supplied).
- c. The enamel shall be prepared by mixing the two components in a 1:1 volume ratio, stirring thoroughly, straining, and allowed to stand for one hour before use. Thinning up to 10%, by volume, may be accomplished using MIL-T-81772B, Type I Thinner.
- d. The mixing of paints supplied by different manufacturers is prohibited to avoid any possibility of incompatibility.
- e. The viscosity of freshly mixed material shall be 17 to 23 seconds in a No. 2 Zahn cup.

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5.2.2.6 Application of Enamel. Apply two coats of polyurethane enamel.

- a. The polyurethane enamel shall be applied by spray or brush to properly prepared surfaces within six hours from the time of initial mixing. Enamel shall be discarded.
- b. When using the spraying method, a high air atomization pressure (40 to 60 psi) has been found to produce a coating with good leveling properties and without causing "orange peel." Grounding the tables or racks holding the parts has been found advantageous, since it prevents a build-up of a static charge which could attract airborne dust particles.
- c. The epoxy-primed surfaces to be overcoated shall be clean and dry. Any surfaces which require repair shall be prepared in accordance with paragraph 5.2.2.1 and paragraph 5.2.2.2 prior to applying enamel. If more than eight hours time has elapsed since the application of the epoxy primer (MIL-PRF-23377H, Type I, Class 2) or waterborne epoxy primer (MIL-PRF-85582D, Type I, Class 2) the primer coat shall be scuff sanded and solvent activated with methyl ethyl ketone, Federal Specification ASTM D 740, or both, then cleaned and dried just prior to applying enamel.
- d. Drying time to be one hour before handling and dry hard in not more than five hours. Full cure will be achieved in seven days. Oven dry process is to bake dry for 12 hours at 125° to 135° F.
- e. After mixing, pot life is six hours at 70° to 90° F.
- f. All markings applied over the polyurethane enamel shall be made with a gloss black polyurethane stencil enamel per MIL-PRF-85285D.

WARNING

Enamel Stripper is toxic to skin, eyes and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.

- g. Removal of polyurethane enamel, when necessary, can be made using stripper part No. T-5003, a product of Turco Products, Inc. Wilmington, CA, or equivalent.

5.3 REPLACEMENT.

Follow replacement instructions shown below:

5.3.1 General. Replace all parts that do not meet inspection requirements or that cannot be repaired using the repair procedures.

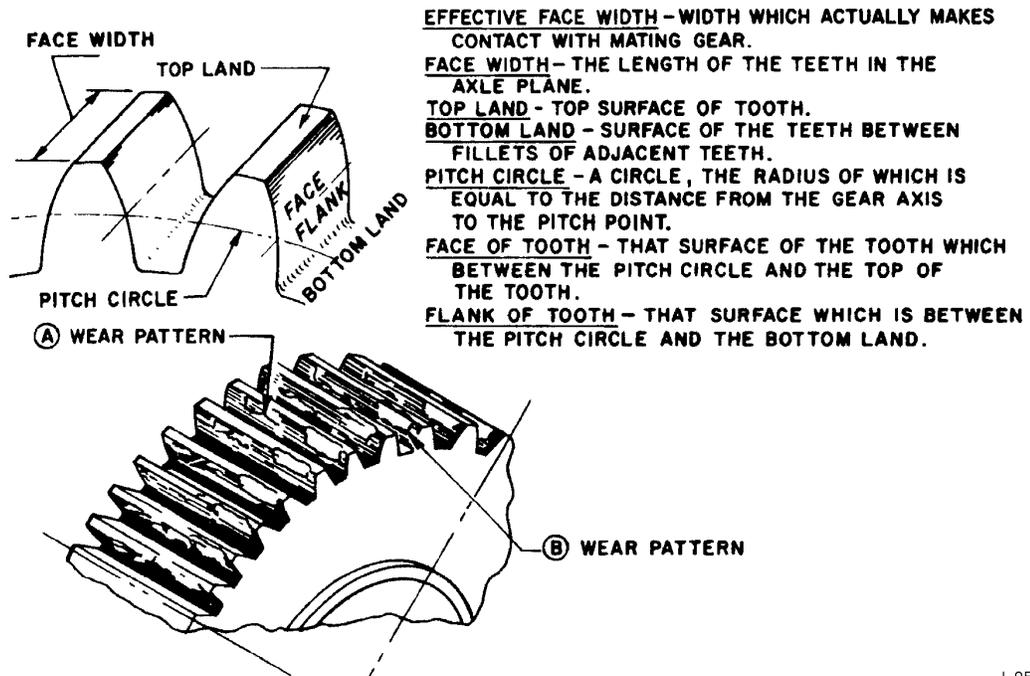
5.3.2 Heli-Coil Insert Replacement. See Figure 3-1, 43.

- a. Remove the defective insert with Extracting Tool, No. 1227-6, or equivalent.
- b. Clean and dry the female thread from which the defective insert was removed.

WARNING

Wet primer is toxic to skin, eyes and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.

- c. Apply primer, MIL-PRF-23377H, Type I, Class 2, sparingly to the cleaned female thread.
- d. Before the primer dries, install new insert using installing tool, No. 7552-4 (1/4-28 thread) or equivalent. Top end of insert shall be 3/4 to 1-1/2 threads below the surface.
- e. Remove the insert driving tang with Tang Break off Tool, No. 3695-4 (1/4-28 thread) or equivalent.
- f. Inspect the insert to ensure that the tang broke off clean and the insert ends are firmly seated.



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Figure 5-1. Typical Gear Tooth Nomenclature and Wear Pattern

CHAPTER 6 ASSEMBLY

6.1 GENERAL.



- Wet primer is toxic to skin, eyes and respiratory tract. Skin and eye protection required. Avoid repeated or prolonged contact. Good general ventilation is normally adequate.
- For reassembly of the gearbox, use Figure 3-1 and its callouts as a guide. During assembly use only new packings, preformed O-rings, gaskets, seals and lubricate as required. Assemble bolts, nuts and threaded fasteners with Federal Specification MIL-PRF-23377H, Type I, Class 2, wet primer. When pressing bearings or gears on shafts, check for proper seating against shoulders. Ensure that all running parts such as shafts and bearings turn freely after assembly.

6.2 LUBRICATION.

Pack bearings and seals, and butter gears, splines and O-rings with a mixture of one part MIL-PRF-7808L lubricating oil and three parts MIL-PRF-23827A grease.

6.3 CALCULATION FOR SHIM THICKNESS.

Figure 6-1 and Figure 6-2 are provided to show proper way of determining shim thickness required. All assembly requirements are to be accomplished per detailed instructions of paragraph 6.4. Make all measurements to the nearest 0.0001 inch. Compare dimensions with stacked gage blocks or equivalent, built up to the nearest 0.0001 inch. After calculating keep affected parts mated.

6.3.1 Shims (3) and (19). Determine thickness of shims (3) and (19) to be used in and under retainers (8 and 14) Figure 6-1, as follows:

- a. Measure dimension A on retainer (8).
- b. To obtain C dimension subtract C_1 from C_2 .
- c. Assemble gear/plug assembly (17) by inserting bearings (16) into retainer (14). Using Driver Plug, part No. ST5898, press bearings onto gear/plug assembly.
- d. Install locknut (12) by holding gear/plug assembly (17) with torque wrench and Adapter, part No. ST5808. Tighten locknut using wrench part No. ST5823, to torque per Figure 6-1. Install lockwasher (11) using Inserter, part No. ST6297.
- e. Measure dimension B on retainer (14).
- f. Calculate shim thickness according to the following formulas:

$$\text{Shim (13)} = (B - A) \quad +0.002/-0.000 \text{ inch}$$

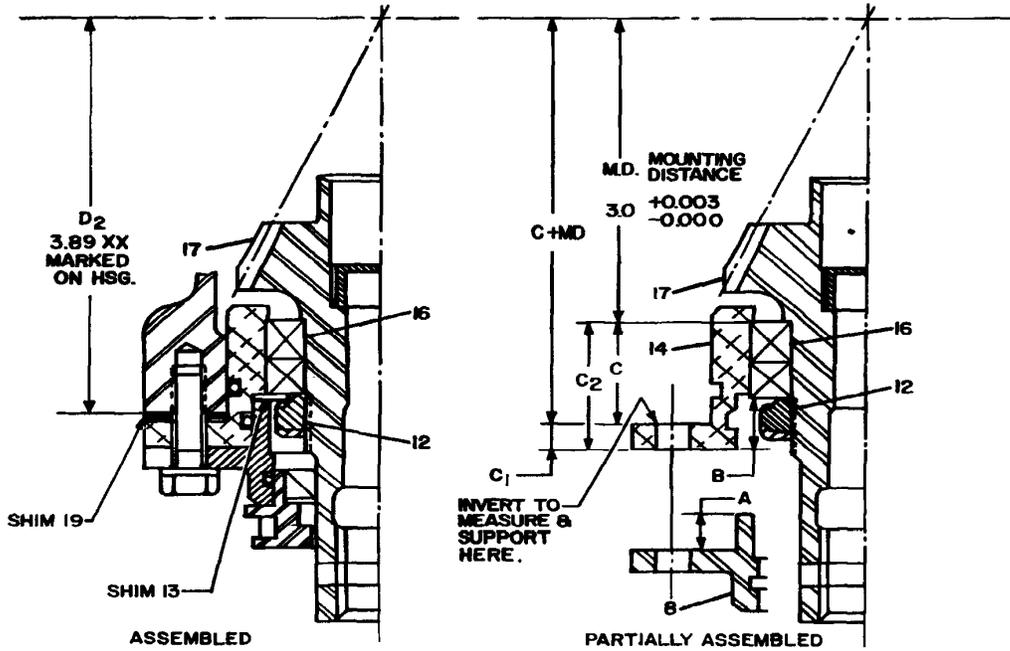
$$\text{Shim (19)} =$$

$$(MC + C - D_2) \quad +0.002/-0.000 \text{ inch}$$

A, B, C = Dimension shown in Figure 6-1

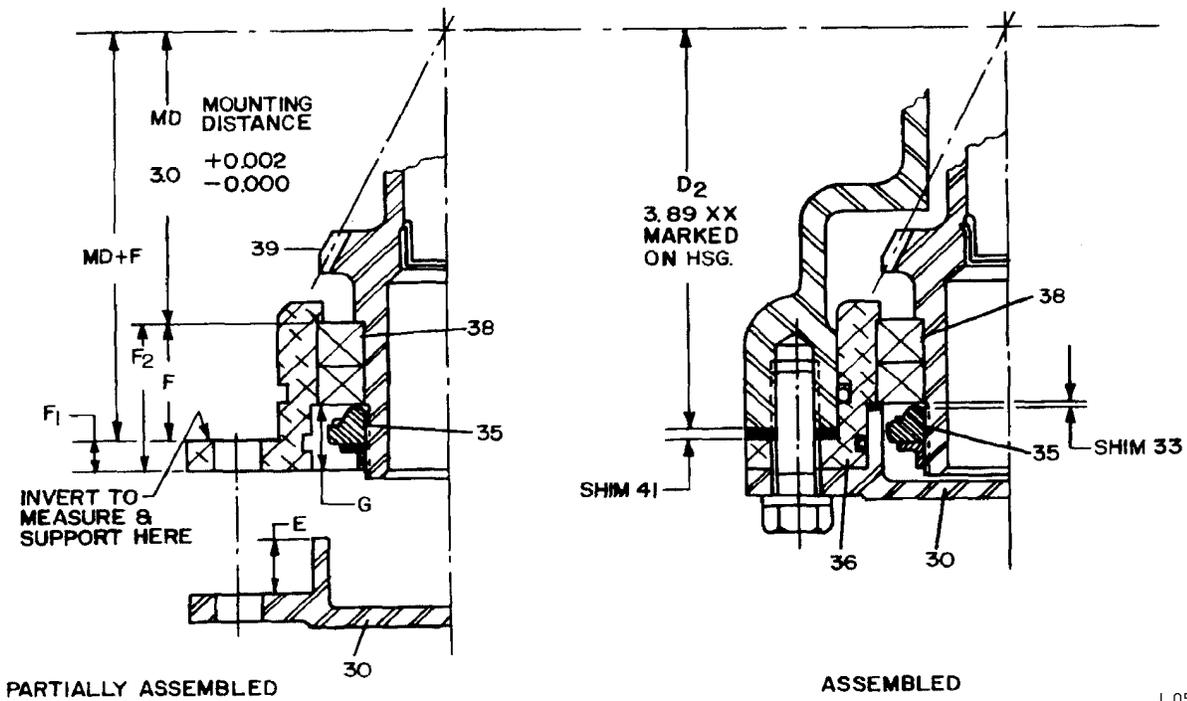
$$MD = \text{Mounting Distance} \quad 3.0 \quad +0.003/-0.000 \text{ inch}$$

D_2 = Dimension marked on housing



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Figure 6-1. Shim Determination for Shims (13) and (19)



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Figure 6-2. Shim Determination for Shims (33) and (41)

6.3.2 Shims (33) and (41). Determine thickness of shims (33) and (41) to be used in and under retainer (Figure 6-2, 36) as follows:

- a. Measure dimension E on cover (30).
- b. Obtain $(F = F_2 - F_1)$ dimension on retainer (36).
- c. Assemble gear/plug assembly (39) by inserting bearings (38) into retainer (36). Using Driver Plug, part No. ST5898, press bearings onto gear/plug assembly.
- d. Install locknut (35) by holding gear/plug assembly (39) with torque wrench and Adapter part No. ST5808. Tighten locknut using wrench part No. ST5823, to torque per Figure 5-1. Install lockwasher (34) using Inserter, part No. ST6297.
- e. Measure dimension G.
- f. Calculate shim thickness according to the following formulas:

Shim (33) = $(G - E)$	+0.002/0.000 inch
Shim (41) = $(MD + F - D_2)$	+0.003/-0.000 inch
F.G.E = Dimensions shown in Figure 6-2	
MD = Mounting distance	3.0 -0.002/-0.000 inch
D_2 = Dimension marked on housing	

6.4 GEARBOX ASSEMBLY.

Assemble gearbox in accordance with the following procedures:

CAUTION

Avoid undue pressure or shock loads on ends of shafts when gears and bearings are installed as this may result in jammed bevel gears.

- a. Install housing (Figure 3-1, 44) in padded vise.
- b. Insert packing (40) onto retainer (36).
- c. Install bearing (29), spacer (28), and packing (27) into housing (44). Install shim (41) and assembled gear/plug assembly (39) in housing (44), through bearing (29).
- d. Install shim (33).
- e. Install packing (37) and cap (32) using washers (31), bolts (30) and torque per Figure 8-1. Lockwire (MS20995C32) bolts together.
- f. Insert packings (15, 18) onto retainer (14).
- g. Press bearings (20) into housing (44), using Driver Plug, part No. ST5817.
- h. Install shim (19) and assembled gear/plug assembly (17) into housing (44).
- i. Install shim (13).
- j. Install packing (7) into retainer (8) and install into housing (44). Using washers (10) and bolts (9), secure retainer and torque per Figure 8-1.
- k. Fill cavity between seals (5,6) and between lips of seal (6) with grease (refer to paragraph 6.2). Install seal assembly with packing (7) and spring (3), into retainer (8).

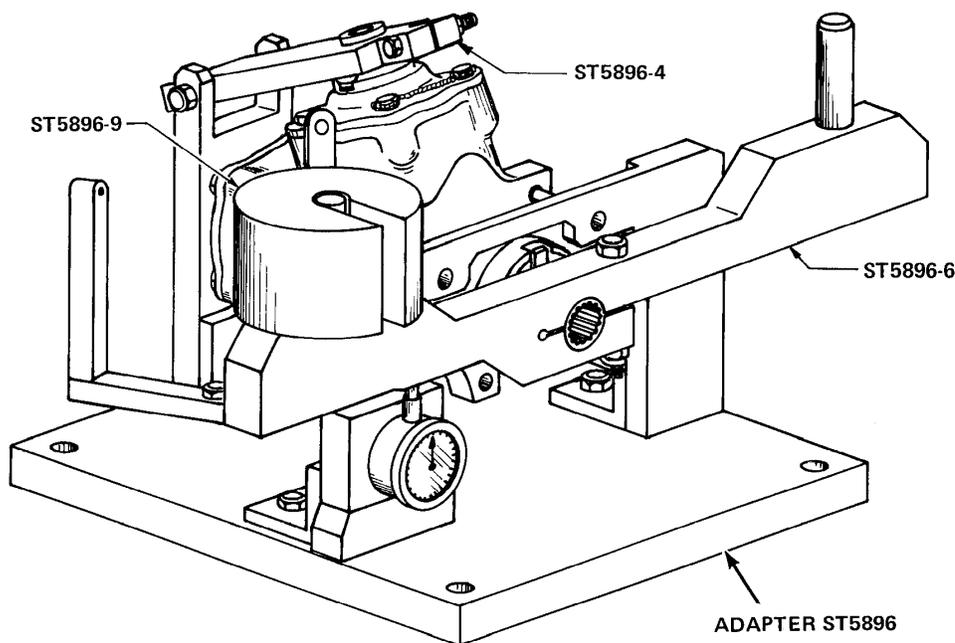
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- l. Fill cavity between seals (25, 26) and between lips of seal (26) with grease. Install packing (27), seal assembly, and spring (23) into housing (44).
- m. Measure gearbox backlash, (Figure 6-3).
 - (1) Install the assembled gearbox on Adapter, part No. ST5896.
 - (2) Lock the output shaft with the Clamping Arm, part No. ST5896-4. Attach the Test Arm, ST5896-6, in a horizontal position, to the input shaft, using the supplied bolts, washers and nuts.
 - (3) Place the Weight, part No. ST5896-9, over the locating pin on the end of the Test Arm opposite the dial indicator.
 - (4) Zero the indicator.
 - (5) Move the weight to the indicator end of the Test Arm, placing it over the locating pin.
- n. Read indicator. The backlash is acceptable if indicator reads between 0.020 and 0.055 inch. If less than 0.020 or more than 0.055 inch, disassemble and recheck all of the measurements to determine the cause of the error.

NOTE

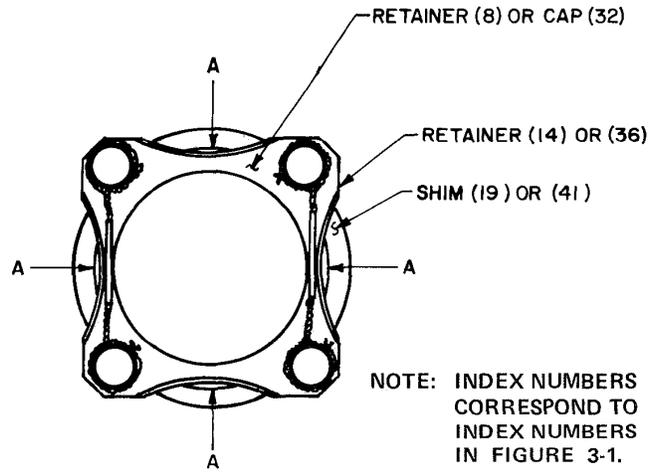
If backlash is not acceptable, the shim measurement procedures must be repeated for accuracy and the shims checked for correct thickness.

- o. Insert bolt (1) into gear/plug assembly (17) and secure with nut (2). Insert bolt (21) in gear/plug assembly (39) and secure with nut (22).
- p. Fill gaps between retainer (14) and shim (19), four places, and between retainer (36) and shim (41), four places, as shown in Figure 6-4, with Adhesive-Sealant, Silicone per MIL-A-46106B.
- q. Test the gearbox to assure serviceability. Refer to Chapter 7, Testing.



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Figure 6-3. Checking Backlash



A - FILL GAPS WITH ADHESIVE-SEALANT SILICONE MIL-A-46106B
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Figure 6-4. Adhesive-Sealant, Silicone Application Areas

CHAPTER 7 TESTING

7.1 FUNCTIONAL TEST.

Functional testing of the gearbox consists of friction torque measurement.

7.2 FRICTION TORQUE TEST.

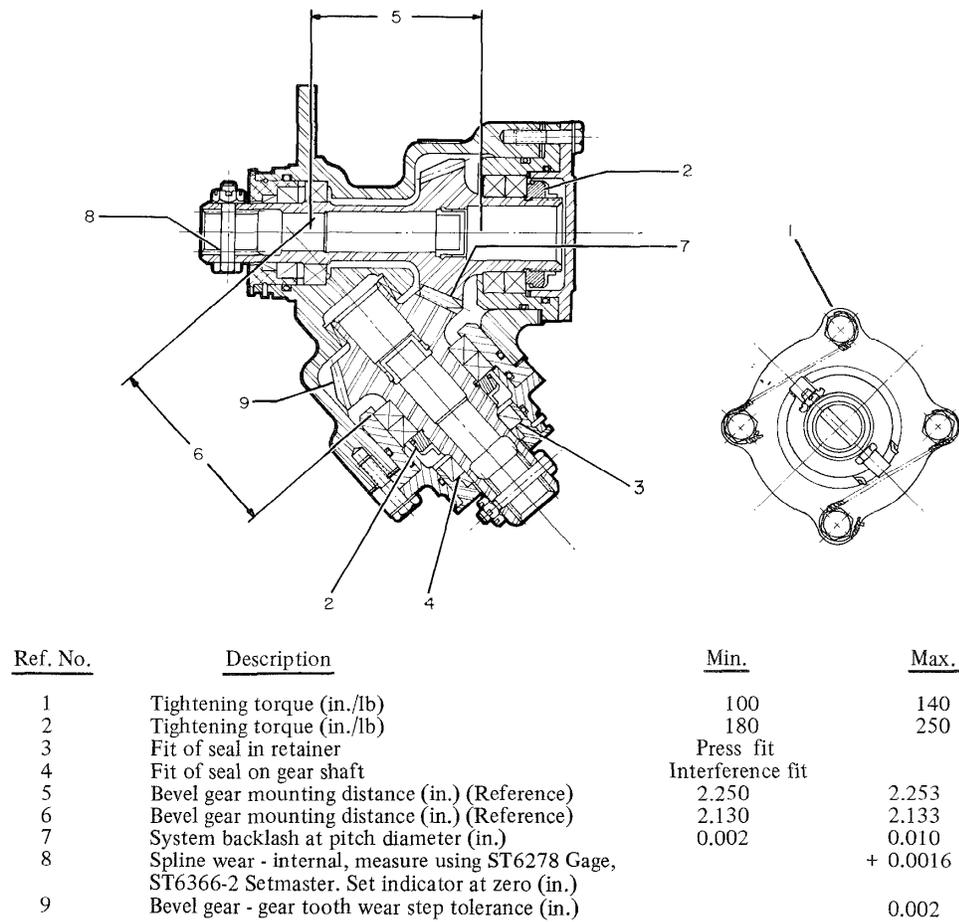
Test the assembled gearbox for friction torque. Conduct test at room temperature.

- a. With both gears free, rotate input shaft five turns clockwise and counter-clockwise using Adapter, part No. ST5808, and a 0 to 25 inch-pound torque wrench.
- b. The force to turn the gears shall not exceed ten inch-pounds torque at any location.

CHAPTER 8 TABLE OF LIMITS

8.1 INTRODUCTION.

This chapter provides information for wear/service tolerance limits which may be used in determining if an item requires replacement. The table of limits, part of Figure 8-1 also contains torque values to be used.



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Figure 8-1. Service Tolerances

