

DMWR 55-1650-312

**DEPOT MAINTENANCE WORK REQUIREMENT
FOR
HYDRAULIC SERVOCYLINDER
PART NO.
1660 SERIES**

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**U.S. ARMY AVIATION
SYSTEMS COMMAND
1 AUGUST 1979**



WARNING

PRECAUTIONARY DATA

Personnel performing instructions involving operations, procedures, and practices which are included or implied in this technical manual shall observe the following instructions. Disregard of these warnings and precautionary information can cause serious injury, death, or an aborted mission.

CLEANING AREA

When using cleaning solvents for cleaning operation, use area with adequate ventilation and no open flames or excessive high temperatures. Solvent flash point must not be less than 100°F.

BREATHING TOXIC VAPORS

Avoid prolonged or repeated breathing of solvent vapors.

COMPRESSED AIR

Do not direct compressed air in close proximity to or directly against skin. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi and only then with an effective chip guarding and personnel protection equipment.

PRESSURE TESTS

Test procedures require application of hydraulic pressures to 2250 psi. Use safety shields at all times while performing tests.

USING TOXIC/FLAMMABLE MATERIALS

Due to the toxicity and flammability of the solvents and solutions used in the cleaning procedures, adequate ventilation shall be provided. Avoid prolonged contact with solutions and chemicals. Do not use drycleaning solvent or flammable cleaners near open flame or in areas where high temperatures prevail.

CHANGE }
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U.S. ARMY AVIATION
SYSTEMS COMMAND
31 August 1992

DEPOT MAINTENANCE
WORK REQUIREMENT

FOR

HYDRAULIC SERVO CYLINDER
PART NUMBER
1660 SERIES

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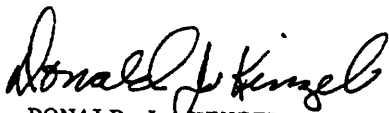
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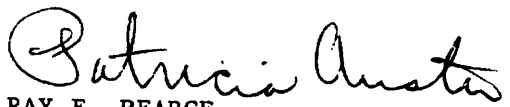
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Depot Maintenance
Work Requirement
No. 55-1650-312

U.S. ARMY AVIATION
SYSTEMS COMMAND
1 AUGUST 1979

DEPOT MAINTENANCE WORK REQUIREMENT
FOR
HYDRAULIC SERVOCYLINDER
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REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this DMWR. If you find any errors or if you know of a way to improve this DMWR, please let us know. Mail your letter, DA Form 2828 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this DMWR direct to: Commander, U.S. Army Aviation Systems Command, ATTN: AMSAV-MC, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished to you.

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CHAPTER 1 INTRODUCTION

Section I. GENERAL

1-1. Scope. These instructions are for use by depot/contractor personnel. They apply to hydraulic servocylinder, 1660 series (fig. 1-1). used on AH-1 and UH-1 series helicopters, and in case of conflict, take precedence over all other documents pertinent to their overhaul and inspection.

1-2. Deviations and Exceptions. When any work segment as set forth in this DMWR cannot be accomplished, or can be accomplished only in a manner other than specified, the contractor shall submit a Request for Action form, AMSAV-M Form 1379, through the Contracting Officer to AMSAV-MC with a copy to AMSAV-MD. If the problem is publications related or requires a change to a publication, a DA Form 2028 shall also accompany the Request for Action. The request for action shall state the problems, the reasons for urgency, and the following specifics:

- a. Serial number (if applicable), part number, and NSN of affected equipment.
- b. Work elements which will not be completed or which will not be accomplished exactly as specified herein.
- c. Reason for nonaccomplishment or deviation.

d. Action taken to correct condition causing nonaccomplishment or need for deviation.

e. Data relative to availability of parts required, if applicable.

f. Estimated man hours.

g. Instructions and inspection required to maintain the integrity of the end item because of such omission or deviation.

1-3. Maintenance Forms and Records. Maintenance forms, records, and reports which are to be used by depot maintenance personnel are listed in and prescribed by DA Pam 738-751.

1-4. Reporting Equipment Improvement Recommendations (EIRs). EIRs can and must be submitted by anyone who is aware of an unsatisfactory condition with the equipment design or use. It is not necessary to show a new design or list a better way to perform a procedure, just simply tell why the design is unfavorable or why a procedure is difficult. EIRs may be submitted on SF Form 368 (Quality Deficiency Report). Instructions for preparing EIRs are provided in DA Pam 738-751. Mail directly to Commander, U.S. Army Aviation Systems Command, ATTN: AMSAV-QRF, 4300 Goodfellow Blvd., St. Louis, MO 63120-1798. A reply will be furnished directly to you.

Section II. DESCRIPTION, DATA PLATES, AND TABULATED DATA

1-5. Description. The hydraulic servo-cylinder consists of a piston, cylinder, and a servo valve body with a fixed end. Both pressure and return ports located in the servo valve body are for standard AND fittings. The hydraulic servo cylinder is used to reduce the manual effort required for control of the variable pitch tail rotor of a helicopter by converting hydraulic pressure to mechanical force.

1-6. Data Plates. Stamping and/or replacement of data plate when applicable is necessary to provide convenient record of overhaul or modification and operating time that will at all times accompany equipment (fig. 1-2).

1-7. Tabulated Data. The major characteristics of the hydraulic servocylinder are listed in table 1-1.

1-8. Modification Criteria. The hydraulic servocylinder, part no. 1660-9 will be modified to a -17 configuration and part no. 1660-11 and 1660-15 will be modified to a -23 configuration after disassembly, inspection and lubrication procedures. Modification will take place as follows:

a. Refer to parts list (fig. 3-1) Usable on Code column for parts applicable.

b. Build up hydraulic servocylinder using only components parts showing applicable usable on code.

c. Reidentify applicable hydraulic servocylinder to part no. 1660-17 or -23 configuration.

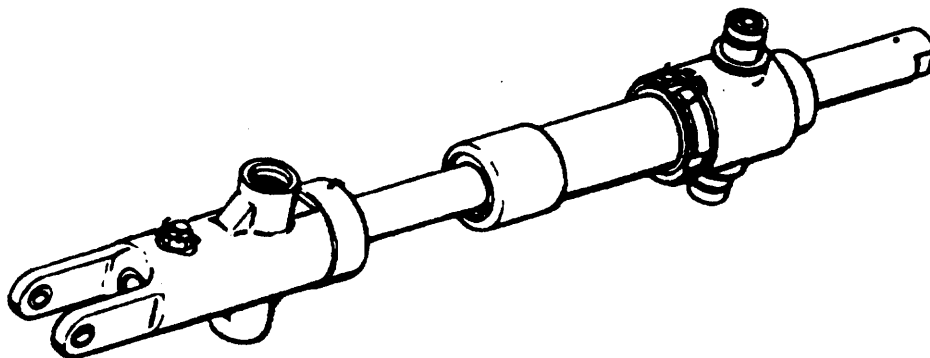
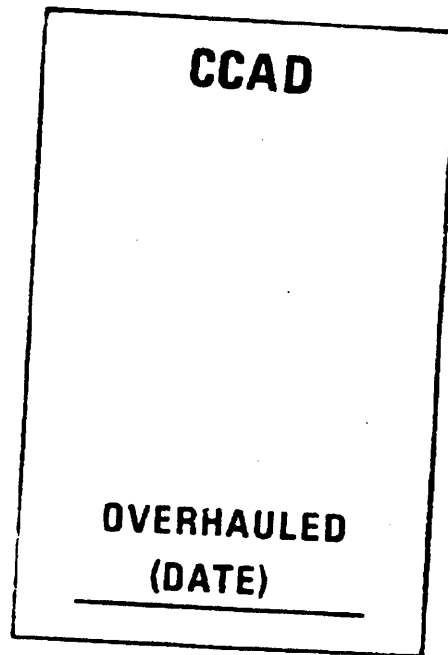


Figure 1-1. Hydraulic Servocylinder, Part No. 1660 Series (Typical).



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Figure 1-2. Stamping and/or Replacement of Data Plate

Table 1-1. Loading Particulars

Pressure Data:	
Operating	1500 psig (105.6 kg/sq cm)
Proof	2250 psig (158.3 kg/sq cm)
Burst	3750 psig (263.9 kg/sq cm)
Cylinder Stroke	3.500 to 3.540 in. (8.89 to 8.992 cm)
Effective Area	0.38 in. ² (2.45 sq/cm)
Port Data:	
PRESS	per AND 10050-4 for 1/4 in. tube
RET	per AND 10050-5 for 5/16 in. tube
Servo Valve Data:	
Servo Valve Stroke from Neutral	±0.035 in. (±0.089 cm)
CYL 1 and CYL 2 to RET	0.004 to 0.006 in. (0.010 to 0.015 cm) overlap
PRESS to CYL 1 and CYL 2	0.001 to 0.002 in. (0.003 to 0.005 cm) underlap
Pilot Input Force (after static for 5 minutes and 1500 psi) (105.6 kg/sq cm)	2.5 lb (1.14 kg) (max.)
Pilot Load on Valve	1000 lb (454 kg) (max.)
Breakout Force (Ports Open)	5.0 lb (2.27 kg) (max.) (P/N1660-9,11,-15) 10.0 lb (4.54 kg) (max.) (P/N1660-17,-23)
Over-all Dimensions (approx):	
Length	14 in. (35.6 cm)
Width	1.5 in. (3.8 cm)
Height	2.56 in. (6.50 cm)
Weight (Dry)	1.75 lb (max.) (0.79 kg)
Operating Medium	Hydraulic fluid, MIL-H-83282A
Operating Temperature Range	-53.9° C to +82.2° C (-65° F to +180° F)

CHAPTER 2
REQUIREMENTS

Section I. GENERAL

2-1. Facilities. The contractor's facilities shall be equipped to perform all phases of overhaul and retest as specified in this DMWR.

2-2. Special Tools. No special tools are required.

2-3. Test Equipment. Test equipment will be required which meets specifications outlined in paragraph 4-1.

2-4. Expendable Supplies and Consumable Materials List. The supplies and materials required to repair or overhaul the hydraulic servocylinder are listed in table 2-1. The latest revision including

amendments, changes to specifications that are in effect on date work is initiated on hydraulic servocylinder are applicable.

2-5. Repair Parts. Repair parts and replacement parts as needed for overhaul appear in Chapter 3, Section II of this DMWR.

NOTE

The component parts will include a Usable on Code to indicate the items that are used on certain hydraulic servocylinders. The absence of a Usable on Code indicates the item is applicable to all hydraulic servocylinder configurations.

Section II. STANDARDS

2-6. Quality of Materials. Parts and materials used for replacement, repair, or modification shall meet equipment drawings and specifications.

2-7. Wear Limits, Fits, and Tolerances. Wear limits, fits, and tolerances listed in table 3-1 and

throughout this DMWR shall be complied with unless otherwise stated in the contract/work directive.

2-8. Flight Safety Parts Program. This DMWR is not impacted by the Flight Safety Parts Program.

Table 2-1. Expendable Supplies and Consumable Materials

ITEM NO.	MATERIAL	TYPE OR GRADE	GOVERNMENT SPECIFICATION
1	Hydraulic Fluid		MIL-H-83282A
2	Hydraulic Fluid (Preservative)		MIL-H-6083D
3	Drycleaning Solvent		P-D-680 (2)
4	Crocus Cloth	No. 600	P-C-458C
5	Polishing Cloth	No. 7/0	P-C-451E
6	Waterproof Paper	Type 1, Grade A	MIL-B-121E
7	Technical Petrolatum		VV-P-236A
8	Primer, Zinc Chromate		MIL-P-8585A
9	Paint, Aluminum		MIL-P-14276

CHAPTER 3 MAINTENANCE, OVERHAUL AND REPAIR

Section I. PRESHOP ANALYSIS

3-1. Purpose. Preshop analysis instructions are provided as a guide to examination of the incoming hydraulic servocylinder. Information obtained from this examination should be used by the overhaul facility in preparing estimates needed to determine extent of repair, modification and replacement needed to perform overhaul of the hydraulic servocylinder in order to make it a completely serviceable item. Detailed cleaning and corrosion treatment methods appear in this DMWR. Items pending performance of maintenance shall be preserved to prevent damage or deterioration.

3-2. Unpacking. Remove hydraulic servocylinder from shipping container. Physically check all tags and forms to determine reason for removal from service. Also determine what modifications have not been accomplished.

NOTE

Tags and forms received with the hydraulic servocylinder should not be removed.

a. General Disassembly Procedures. Disassembly and a physical check are required when the hydraulic servocylinder to be overhauled was removed from service for any of the following reasons:

- (1) Internal failure.
- (2) Expiration of approved operating time interval; or time unknown or estimated.

(3) Visible physical damage.

b. Required Disassembly Procedures. When it has been determined that the hydraulic servocylinder will need disassembly, proceed as follows:

(1) Refer to Notes, Cautions, and Warnings in DMWR.

(2) Parts of the hydraulic servocylinder should be tagged and/or kept together so that wear condition of parts can be evaluated during inspection. Matched parts shall be tagged, handled, and stored together to preclude damage and to ensure reassembly and installation in their matched position.

(3) Record and tag parts that are defective with the reason for rejection.

NOTE

Exclude parts which are normally replaced at every overhaul such as packing, gaskets and seals.

(4) Used components and refinished parts recovered as products of disassembly will be examined 100% by the contractor to determine serviceability.

c. Refer to paragraph 3-5 for disassembly procedures.

3-3. In-Process Inspection. The inspection procedures are contained in paragraph 3-7.

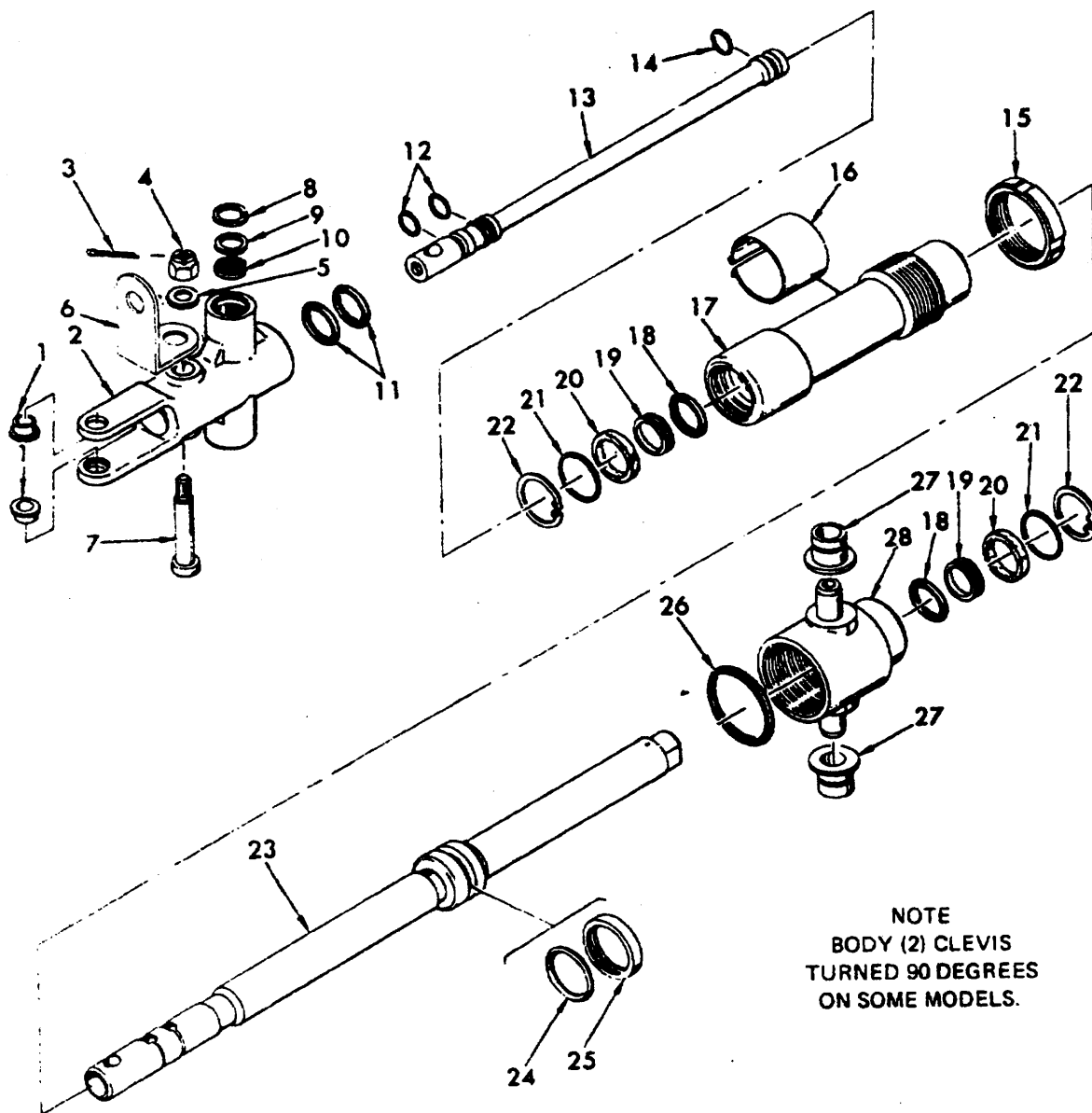
Section II. DISASSEMBLY

3-4. General. The following instructions are issued with the understanding that all lockwire will be removed where necessary, and parts such as bushings which are not normally removed at overhaul, but are removed on condition as deemed necessary by inspection, are classified as repairs and are covered under the repair and replacement section. Figure 3-1 is an exploded view illustration with an associated group parts list used for disassembly of the hydraulic servocylinder.

3-5. Disassembly Procedures.

NOTE

Use a clean working area for disassembly. As parts are removed, place in a clean container for protection against dirt and rough handling. If unit is to remain disassembled for a considerable length of time, protect parts from moisture by immersing in preservative hydraulic fluid (item 2, table 2-1).



TS 1650-312/3-1

Figure 3-1. Hydraulic Servocylinder, Part No. 1650 Series (Typical), Exploded View

Parts list for figure 3-1.

FIGURE & INDEX NO.	PART NUMBER								DESCRIPTION	UNITS PER ASSY	USABLE ON CODE
		1	2	3	4	5	6	7			
3-1	1660-9								Hydraulic Servocylinder Assy		A
	1660-11								Hydraulic Servocylinder Assy		B
	1660-15								Hydraulic Servocylinder Assy		C
	1660-17								Hydraulic Servocylinder Assy		D
	1660-23								Hydraulic Servocylinder Assy		E
	No Number								Shaft and Body	1	ABC
	8941								Shaft and Body	1	D
	8951								Shaft and Body	1	E
-1	8382								Bushing	1	
-2	8304-1								Body	2	
	8938								Body	1	ABC
	8948								Body	1	D
-3	MS24665-151								Pin, Cotter	1	E
-4	AN310-3								Nut	1	
-5	AN960C10								Washer	1	
	AN960C10L								Washer	1	AD
-6	20-032-1								Bracket	1	BCE
-7	1238								Bolt	1	BCE
-8	MS16629-37								Ring, Retaining	1	
-9	8314								Washer	1	
-10	8452								Filter	1	
-11	MS28775-016								Packing, Preformed	1	
	8907								Packing, Preformed	2	ABC
-12	MS28775-011								Packing, Preformed	2	DE
-13	8309								Tube Assembly	2	
	8937								Tube Assembly	1	ABC
N/S	8908								Tube	1	DE
N/S	187001								Lee Plug	1	DE
-14	MS28775-010								Packing, Preformed	1	DE
-15	1235								Jam Nut	1	
-16	1665-9								Name Plate	1	
	1665-11								Name Plate	1	A
	1665-15								Name Plate	1	B
	1665-17								Name Plate	1	C
	1665-23								Name Plate	1	D
-17	1364								Barrel	1	E
-18	MS28775-114								Packing, Preformed	1	
-19	9025-114								Channel Seal	2	
-20	S110065-3T								Scraper Ring	2	DE
-21	1207								Washer	2	
-22	MS16625-93								Ring, Retaining	2	
-23	8318								Shaft	2	
	8939								Shaft	1	ABC
-24	8258								Ring Seal	1	DE
	8258-19								Packing, Preformed	1	ABC
-25	8266-19								Cap Seal	1	DE
-26	AN6227-20								Packing, Preformed	1	
	MS28775-215								Packing, Preformed	1	ABC
-27	1289								Bushing	1	DE
-28	1329								Head	2	
										1	

N/S - Not Shown

a. Disassemble hydraulic servo-cylinder as shown in figure 3-1. Discard all packings, cotter pin, scraper rings, retaining rings and seals during each overhaul.

NOTE

Bracket (6) is not used on P/N 1660-17.

b. Remove cotter pin (3), nut (4), washer (5) and bracket (6). Remove bolt (7) from body (2).

CAUTION

Shaft and body assembly (23 and 2, fig. 3-1) are select-fit, matched, and precision lapped parts. If either part is damaged, the complete assembly must be replaced as a single unit. Use extreme caution when handling to prevent damage to grooves and adjacent surfaces. Wrap parts after disassembly for protection and retain in set.

c. Slide body (2) off of shaft (23).

NOTE

If filter (10) is damaged, remove retaining ring (8), washer (9) and filter.

d. Remove preformed packings (11) from body (2).

e. Cut lockwire and loosen jam nut (15) from barrel (17) and separate barrel from head (28).

f. Remove packing (26) from head (28).

g. Remove shaft (23) and tube assembly (13) from shaft. Remove preformed packings (12 and 14).

h. Remove cap seal (25) and preformed packing or ring seal (24).

i. Remove retaining rings (22), washers (21), scraper rings (20), channel seals (19) and preformed packings (18) from both barrel (17) and head (28).

NOTE

Channel seals (19) are not used on P/N 1660-9, -11, and -15.

NOTE

Do not remove bushings (1) from body (2), bushings (27) from head (28), or name plate (16) unless replacement is necessary.

WARNING

Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100 degrees F to 138 degrees (38 degrees C to 59 degrees C).

CAUTION

Do not drop body (2) or shaft (23) into container of cleaning solvent. Hand hold to prevent damage to precision-machined surfaces.

3-6. Cleaning.

a. Immerse and wash all metallic parts in drycleaning solvent, (item 8, table 2-1). Pay particular attention to passages and threaded areas. Remove stubborn dirt with a stiff-bristled, nonmetallic brush moistened in solvent.

WARNING

Do not direct compressed air against skin.

b. Dry all parts with dry compressed air not in excess of 15 psig (1.06 kg/sq cm).

c. If components are not to be used immediately after cleaning, flush all parts with preservative hydraulic fluid (item 2, table 2-1) and place plastic bag and dust-free containers.

NOTE

"The use of any alcohol in cleaning components which contact hydraulic fluids is prohibited. Formation of polymeric residue can result, which could impair mechanical operation of the component."

3-7. Inspection.

a. Inspect all surfaces and threaded areas for damage, signs of wear, burrs, cross-threading, scoring, nicks, and/or corrosion. (Refer to table 3-1.)

NOTE

Excessive wear is defined as any obvious deformation or deterioration of parts which may render the unit inoperative. If doubt exists concerning the serviceability of a part, replace the part.

b. Mating surfaces and grooves on shaft (23, fig. 3-1) and body (2) must be smooth and free of scratches, scoring, feathered edges, and damage from corrosion.

Table 3-1. Inspection Criteria

FIG & INDEX NUMBER	NOMENCLATURE	INSPECT FOR	METHOD OF INSPECTION	REMARKS
3-1	Bushing	ID wear 0.252 inch maximum	SIE	Ref para 3-8c.
-1	Bushing	ID wear 0.252 inch maximum	SIE	Ref para 3-8c.
-2	Body	Thread damage	Visual	Ref para 3-8a.
		Superficial damage and corrosion	Visual	Ref para 3-8b.
		Cracks and distortion	Visual	Ref para 3-8c.
-7	Bolt	Damaged threads and corrosion	Visual	Ref para 3-8a. and b.
-13	Tube	Cracks, distortion superficial damage	Visual	Ref para 3-8b. and c.
-15	Jamnut	Thread damage	Visual	Ref para 3-8a.
		Crack distortion and superficial damage	Visual	Ref para 3-8c.
-17	Barrel	Major ID 0.9405 inch max	SIE	Ref para 3-8c.
		Minor ID 0.6275 inch max	SIE	

Table 3-1. Inspection Criteria (Continued)

FIG & INDEX NUMBER	NOMENCLATURE	INSPECT FOR	METHOD OF INSPECTION	REMARKS
-23	Shaft	Thread damage	Visual	Ref para 3-8a.
		Cracks, distortion and superficial damage	Visual	Ref para 3-8b. and c.
		Barrel and cap seal contact area diameter 0.6225 to 0.6235 inch	SIE	
		Thread damage	Visual	Ref para 3-8a.
		Cracks and distortion	Visual	Ref para 3-8b. and c.
-27	Bushing	OD 0.498 minimum	SIE	Ref para 3-8c.
-28	Head	ID 0.6275 maximum	SIE	Ref para 3-8c.
		Thread damage	Visual	Ref para 3-8a.
		Cracks, distortion and superficial damage	Visual	Ref para 3-8b. and c.

c. Check identification plate (16) for security of attachment and legibility.

d. Examine parts for wear in excess of allowable wear limits as specified in table 3-1.

NOTE

Wear on shaft (23) is acceptable if chrome plating is not worn through or is

chipped. Wear on body (2) is acceptable if cylinder assembly leakage is within limits as specified in final test procedures.

e. Make visual check, using 10-power glass, of all radii and corners.

Section III. REPAIR

3-8. Component Replacement and Repair.

a. Repair or replace all parts which are defective. Do not attempt to repair delicate parts or surfaces. Replace damaged parts rather than attempt difficult or extensive repairs.

b. Except for critical surfaces (lapped parts) on body (2, fig. 3-1)

and shaft (23), polish out minor scoring on nonsealing and nonbearing ferrous parts with crocus cloth, (item 4, table 2-1), or equivalent. Use polishing cloth, (item 5, table 2-1) or equivalent, to polish out minor scoring on aluminum parts. Thoroughly clean any polished parts. (Refer to paragraph 3-6.)

c. Replace any parts not repairable by minor polishing and any part worn beyond the allowable wear limits specified in table 3-1.

NOTE

Body (2, fig. 3-1) and shaft (23) are precision-matched parts. If

either body or shaft replacement, replace them as an assembly.

d. Replace all packings, cotter pin, scraper rings, and retaining rings whenever these parts are removed during assembly.

Section IV. ASSEMBLY

3-9. Lubrication. Lubricate all internal parts at final assembly in hydraulic fluid (item 1, table 2-1) and lubricate all preformed packings with technical petrolatum (item 7, table 2-1) prior to installation.

3-10. Reassembly and Testing of Assemblies. (Refer to Chapter 4.)

3-11. Painting Requirements. The hydraulic servocylinder is painted after all tests are complete and cylinder has been flushed with preservative hydraulic fluid. Wipe all surfaces to be painted with solvent (item 3, table 2-1) using a clean, lint-free cloth.

WARNING

Drycleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100 degrees F to 138 degrees F (38 degrees C to 59 degrees C).

Tape all exposed sliding surfaces and proceed as follows:

a. Spray paint with zinc chromate primer (item 8, table 2-1) and allow to dry.

b. Apply final spray coat of aluminum paint (item 9, table 2-1).

3-12. Reassembly Procedures.

NOTE

Coat all internal parts with clean hydraulic fluid (item 1, table 2-1), to facilitate reassembly.

a. If removed, press new bushings (1, fig. 3-1) into body (2) and bushings (27) onto head (28).

b. When installing packings:

(1) Visually inspect new packings for cuts nicks or flaws and discard when any evidence of these defects are present.

(2) Ensure that packings are of proper size. Uniform pressure on packings when installed is necessary for satisfactory operation of servocylinder and to prevent leakage.

(3) Lubricate preformed packings with petrolatum, (item 7, table 2-1) prior to installation.

(4) When installing packings, extreme care must be exercised to prevent packing from being cut or scratched on threads or sharp corners. Carefully roll or rotate packings within their grooves to remove twisting.

NOTE

Ensure retaining ring is installed with flat side outboard.

c. Install preformed packings (18), channel seals (19), scraper rings (20) and washers (21) and secure with retaining ring (22); in both head (28) and barrel (17).

NOTE

Channel seals (19) are not used on P/N 1660-9, -11, and -15.

d. Install preformed packing (26) into head (28).

e. Assemble ring seal on preformed packing (24) and cap seal (25) onto shaft (23).

f. Install preformed packings (12 and 14) on tube assembly (13) and insert tube into shaft (23).

CAUTION

Use care when torquing jam nut to preclude damage to barrel (17) and head (28).

g. Install barrel (17) and head (28) on shaft (23) and fasten together with jam nut (15). Torque jam nut to 200-250 in-lb. Lockwire after testing.

h. Install preformed packings (11) in body (2) and, if removed, install filter (10), washer (9) and retaining ring (8).

i. Install body (2) on shaft (23). Insert shoulder bolt (7) through body and shaft and install bracket (6), washer (5), nut (4) and cotter pin (3).

NOTE

Bracket (6) is not used on P/N 1660-17.

j. Install new nameplate (16) if necessary, after testing and painting.

CHAPTER 4

FINAL ASSEMBLY AND TESTING

Section I. GENERAL

4-1. Pretest Conditions and Procedures.

a. Pretest Conditions. Pretest condition shall be as follows:

(1) Hydraulic fluid (item 1, table 2-1) conforms to MIL-H-83282.

(2) Hydraulic fluid continuously filtered to

10 microns at pressures up to 2250 psig (158.3 kg/sq cm) at 26.7°C to 43.0°C (80°F to 110°F) as test medium.

b. Test Equipment. Hydraulic test stand capable of delivering hydraulic fluid continuously filtered to 10 microns, at pressures up to 2250 psig (158.3kg/sq cm) at 26.7°C to 43.0°C (80°F to 110°F).

Section II. FINAL PERFORMANCE CHECK

4-2. Test Procedures.

a. Install cylinder assembly in hydraulic test stand and flush all air from cylinder before testing.

b. There shall be no external leakage with the cylinder at midstroke and with the servo valve in neutral position with 2250 psig applied to the pressure port and 0 psig at return port for a period of 3 minutes.

c. Observe cylinder assembly for any evidence of loosening or permanent deformation of parts of unit.

d. Reduce hydraulic pressure to 1500 psi (105.5 kg/sq cm) for the optional test.

e. Actuate the cylinder through 25 cycles by operating the servo valve body and observe that there is no leakage from any joint or boss.

f. Check that leakage at external packings is no greater than one drop during the 25 cycles.

g. Using a 0-5 pound (0-2.3 kg) spring scale, check that the force required to move the servo valve body does not exceed 2.5 pounds (1.1 kg).

h. For leakage test, apply 1500 psi (105.5 kg/sq cm) hydraulic pressure to the pressure port and measure leakage from the return port under the following conditions:

(1) With cylinder at midstroke and the servo valve in neutral, check that leakage from the return port does exceed 100 cc/min.

(2) With the servo valve in full extend position and the cylinder fully extended, check that leakage from the return port does not exceed 100 cc/min.

(3) With the servo valve in full retract position and the cylinder fully retracted, check that leakage from the return port does not exceed 100 cc/min.

(4) Reverse line connections to remove pressure from the pressure port. Apply 50 psi (3.5 kg/sq cm). pressure to the return port.

(5) Check that combined leakage from the servo valve ends does not exceed one drop in 20 minutes.

4-3. Trouble Analysis. If any malfunction or leakage is observed during tests, refer to table 4-1, troubleshooting chart, for probable cause and remedy. Replace parts if required and repeat all test procedures.

4-4. Post Test Procedures.

a. After satisfactory completion of all tests drain hydraulic fluid from assembly.

b. Cap all ports.

Table 4-1. Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	REMEDY
Leakage during test procedure step h (1).	Faulty shaft and/or body	Replace shaft (23, fig. 3-1) and body (2).
Leakage during test procedure, steps h (2) and h (3).	Faulty shaft and/or body	Replace shaft (23) and body (2).
	Tube packings (12) or packing (24) nicked	Replace packings as required.
Leakage from either end piston	Faulty packings	Replace packings as required.
Excessive force required to move barrel	Shaft in barrel binding	Replace barrel (17) and/or shaft (23) and body (2) and/or head (28).
Valve travel check out of limits	Faulty shaft and/or body	Replace shaft (23, fig. 3-1) and body (2) and retest.

CHAPTER 5

QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Section I. GENERAL

- 5-1. **Responsibility.** The contractor/depot quality assurance activity is responsible for the performance of the inspections specified in the DMWR. The contractor/depot may utilize their own facilities or any commercial laboratory acceptable to the procuring activity/commodity manager (PA/CM). The PA/CM reserves the right to perform any of the inspections specified in the DMWR, when such inspections are necessary to assure that supplies or services conform to the prescribed requirements.
- 5-2. **Quality Assurance Terms and Definitions.** For quality assurance terms and definitions refer to MIL-STD-109 and the glossary in the DMWR.
- 5-3. **Inspection and Test Equipment.** The overhaul facility is responsible for acquisitions, maintenance, calibration, and disposition of all inspection and test equipment. Test equipment to be used by AMC (Army) elements will be acquired in accordance with AR 750-43 and AMC Supplement 1 to AR 750-43. All instrumentation and inspection equipment used in compliance with this DMWR shall be calibrated and controlled in accordance with MIL-I-45607B and MIL-STD-45662 (Commercial facility) or DESCOM-R-702-1, Depot Quality System (Army facility), with all standards traceable to the National Bureau of Standards. Descriptions of inspecting and measuring equipment are left to the discretion of the overhauling facility to be considered as good shop practice.
- 5-4. **Certification of Personnel, Materials, and Processes.** The contractor/depot QA activity shall be responsible for ascertaining and certifying personnel skills, equipment, and materiel meet the requirements of the work to be accomplished. Unless otherwise specified in the contractor or by PA/CM representative, the contractor/depot QA activity shall provide the PA/CM with statements or other evidence that specifications for such special processes as welding, nondestructive testing, plating, and the like, have been complied with. Personnel performing magnetic particle and penetrant tests shall be certified in accordance with MIL-STD-410.
- 5-5. **Quality Assurance Plan.** The contractor/depot Quality Assurance activity shall insure compliance with Quality Assurance planning as applicable to the Quality program/system in use at the overhaul activity.

Section II. INSPECTION REQUIREMENTS

- 5-6. **General.**
- a. Quality Inspectors (QI) are required to witness all tests and those inspections which are marked "QI" or otherwise designated by the PA/CM.
 - b. The Maintenance Technicians shall inspect, check, and determine the conditions of all other areas to insure compliance with the DMWR.
- 5-7. **Comparison Test.** The first item overhauled shall be inspected for conformance to the DMWR. If the contractor/depot has overhauled this type item for the Government within the last two years, this requirement may be waived by a written request to PA/CM.

5-8. In-Process and Acceptance Inspections.

a. Used components and refinished parts recovered as products of disassembly shall be examined 100% by the contractor/depot, to determine serviceability. A copy of this log shall be submitted to the PA/CM as a part of the overhaul contract. The log shall contain the Maintenance Technician's comments for all parts removed; such as, parts inspected, replaced, repaired, inspected by QI, tested by NDI, modified by MWO, or other notes or actions.

b. Diagnostic and nondestructive tests such as magnetic particle, penetrant, radiographic, and ultrasonic inspections as required by this DMWR shall be in accordance with referenced military specifications, and AVSCOM AA-STD-1 and AA-STD-2. A qualified QI shall either perform or witness these tests.

c. A list of inspection definitions, Table 5-1, are included at the end of this chapter. Accept and reject criteria for these inspections and unique repair methods are found in applicable areas of this DMWR.

5-9. Test Check List. A check list indicating each required test shall be included as a part of this DMWR. The list shall show name of test and test set-up (per figure if applicable). List the input readings, such as position of valves, switches, etc. List the required readings, such as time, meter readings, etc. List the accept/reject criteria for each test as applicable.

Table 5-1. Inspection Definitions

TERM	DEFINITION	PROBABLE CAUSE
Abrasion	Roughened surface, varying from light to severe	Foreign material present between moving parts
Bend	Any change in the intended configuration	Application of severe or excessive force
Break	Separation of part	Severe force, pressure or overload
Burn	Loss of metal	Excessive heat
Burnishing	The smoothing of a metal surface by mechanical action, but without loss of material. Generally found on plain bearing surfaces. Surface discoloration is sometimes present around outer edges of burnished area.	Excessive heat
NOTE		
Normal burnishing from operational service is not detrimental if coverage approximates the carrying load and if there is no evidence of burns.		
Burr	A rough edge or sharp projection	Impact from foreign object, or poor machining
Chipping	Breaking away of small metallic particles	Heavy impact of foreign object
Corrosion	Surface chemical action that results in surface discoloration, a layer of oxide, rust, and removal of surface metal	Improper corrosion preventive procedures and excessive moisture

Table 5-1. Inspection Definitions (continued)

TERM	DEFINITION	PROBABLE CAUSE
Crack	A break in material	Severe stress from overloading or shock; possible extension of a scratch
Dent	A small smoothly rounded depression	A sharp blow or excessive pressure
Distortion	A change from original shape	Application of severe heat or irregular forces
Erosion	Wearing away of metal	Hot gases, corrosive liquids, or grit
Fatigue failure	Sharp indentions, cracks, toolmarks, and inclusions that result in progressive yielding of one or more local areas	Cyclic stress. As stress is repeated, cracks develop, then spread, usually from surfaces (or near surface) of the particular section. Finally, so little sound material remains that normal stress on part exceeds strength of the remaining material. This type of failure is not caused by metal crystalization. This condition can easily be determined by visual inspection of part. Striations will be evidence by several lines, more or less concentric. The center (or focus) of lines indicates origin of the failure
Flaking	Loose particles of metal or evidence of surface covering removal	Imperfect bond or severe load
Fracture	See break	
Gouging	Removal of surface metal. Typified by rough and deep depressions	Protruding objects, misalignment
Heat oxidizing	Characterized by a discoloring film. Color varies from yellow to brown and blue to purple	High temperature operation
Indenting	Cavities with smooth bottoms and sides. Occurs on rolling contact surfaces of bearing components	Loose or foreign particles rolling between rotating elements of a bearing
Nick	A sharp-bottomed depression that may have rough outer edges	Dropping, banging

Table 5-1. Inspection Definitions (continued)

TERM	DEFINITION	PROBABLE CAUSE
Off-square or mis-alignment of Anti-Friction Bearing	Indicated by retainer deterioration, retainer bore erosion, and gouged retainer rolling element pockets of the inner and outer race. Two distinct rolling element paths may be seen on the race where off-square conditions exist	Caused by rolling element speed variation, which jams rolling elements into separator pockets
Pitting	Small indentions in a surface	Chemical pitting: Oxidation of surface or electrolytic action. Mechanical pitting: Chipping of loaded surfaces caused by improper clearances and over-loading, and by pressure of foreign material
Scoring	Deep scratch following path of part travel	Result of localized lubrication breakdown between sliding surfaces
Scraping	A furrow	Rubbing with any hard, or rough pointed object
Scratch	A very shallow furrow or irregularity, usually longer than wide	Movement of a sharp object across the surface
Seizure	Fusion or binding of two adjacent surfaces preventing continued movement	Improper lubrication or wear
Stripped thread	Thread of a nut, stud, bolt, or screw damaged by tearing away part of thread	Improper installation or thread pitch or size
Tear	Parting of parent material	Excess tension, caused by an external force
Wear	Slow removal of parent material Frequently, wear is not visible to the naked eye	Result of abrasive substances contacting rolling surfaces, and acting as a lapping compound

CHAPTER 6

PACKAGING

6-1. Components will be preserved, packed, and marked in accordance with the Delivery Order/Contract, Depot Maintenance Interservice Support Agreement (DMISA), Statement of Work (SOW) including AMSAV Form 6525(J), Memorandum of Agreement, or other authorized document.

6-2. Organic Depot shall contact AVSCOM Packaging and Transportability Branch, HQ AVSCOM, AMSAV-SDP, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798 for preservation and packaging requirements.

6-3. For further information, contact AVSCOM Packaging and Transportability Branch, HQ AVSCOM, AMSAV-SDP, 4300 Goodfellow Boulevard, St. Louis, MO 63120-1798. All contracts or inquiries shall be through the Contracting Officer (KO).

Page 6-2 including Figure 6-1 have been deleted

APPENDIX A
REFERENCES

A-1. Military Specifications

MIL-P-116	Preservation, Methods of
MIL-I-45208A	Inspection System Requirements
MIL-I-45607	Inspection Equipment, Acquisition, Maintenance, and Disposition of
MIL-C-45662	Calibration Systems Requirements

A-2. Military Standards.

MIL-STD-109	Quality Assurance Terms and Definitions
MIL-STD-120	Gage Inspection
MIL-STD-129	Marking for Shipment and Storage
MS33540	Safety Wiring, General Practice for

A-3. Technical Manuals.

TB 746-93-2	Painting and Marking of Army Aircraft
TM 55-405-3	Army Aviation Maintenance Engineering Manual, Maintenance of Aircraft Systems
TM 55-1500-204-25/1	General Aircraft Maintenance

A-4. Regulations.

AMCR 702-7	Product Assurance, Depot Quality Assurance Program
DA PAM 738-751	Functional Users Manual for the Army Maintenance Management System - Aviation (TAMMS-A)

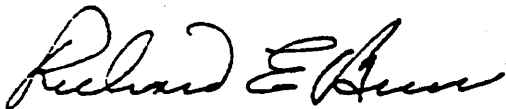
APPENDIX B

REPAIR PARTS AND SPECIAL TOOLS LIST

Refer to TM 55-1520-210-23P.

FOR THE COMMANDER:

OFFICIAL:

A handwritten signature in cursive script, appearing to read "Richard E. Bruce".

RICHARD E. BRUCE
USAAVSCOM Publications Control Officer

ROBERT A. WAGG, JR
Colonel, GS
Chief of Staff

The Metric System and Equivalents

Linear Measure

- 1 centimeter = 10 millimeters = .39 inch
- 1 decimeter = 10 centimeters = 3.94 inches
- 1 meter = 10 decimeters = 39.37 inches
- 1 dekameter = 10 meters = 32.8 feet
- 1 hectometer = 10 dekameters = 328.08 feet
- 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

- 1 centigram = 10 milligrams = .15 grain
- 1 decigram = 10 centigrams = 1.54 grains
- 1 gram = 10 decigrams = .035 ounce
- 1 dekegram = 10 grams = .35 ounce
- 1 hectogram = 10 dekagrams = 3.52 ounces
- 1 kilogram = 10 hectograms = 2.2 pounds
- 1 quintal = 100 kilograms = 220.46 pounds
- 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

- 1 centiliter = 10 milliliters = .34 fl. ounce
- 1 deciliter = 10 centiliters = 3.38 fl. ounces
- 1 liter = 10 deciliters = 33.81 fl. ounces
- 1 dekaliter = 10 liters = 2.64 gallons
- 1 hectoliter = 10 dekaliters = 27.42 gallons
- 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

- 1 sq centimeter = 100 sq. millimeters = .155 sq. inch
- 1 sq decimeter = 100 sq. centimeters = 125.5 sq. inches
- 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
- 1 sq. dekameter (are) = 100 sq. dekameters = 1,076.4 sq. feet
- 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
- 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

- 1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
- 1 cu. decimeter = 1000 cu. decimeters = 61.02 cu. inches
- 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	To	Multiply by	To change	To	Multiply by
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	Inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-foot	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

° F Fahrenheit Temperature
5/9 (after subtracting 32)
Celsius Temperature
° C

