TM 55-1520-220-23-2

TECHNICAL MANUAL

AVIATION UNIT AND INTERMEDIATE MAINTENANCE INSTRUCTIONS ARMY MODEL UH-1C/M HELICOPTERS

This copy is a reprint which includes current pages from Changes 1 through 5.

This manual, together with TM 55-1520-220-23-1, 17 September 1980, and TM 55-1520-220-23-3, 17 September 1980, supersedes TM 55-1520-220-20, 30 April 1973, and TM 55-1520-220-34, 30 April 1973, including all changes.

HEADQUARTERS, DEPARTMENT OF THE ARMY

17 SEPTEMBER 1980

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TM 55-1520-220-23-2
C 10

CHANGE
No. 10

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ARMY MODEL UH-1C/M HELICOPTERS

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Remove pages	Insert pages
8-19 through 8-24	8-19 through 8-24
8-27 and 8-28	8-27 and 8-28
- - -	8-28.1 through 8-28.5/8-28.6

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TM 55-1520-220-23-2
C 9

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1. Remove and insert pages as indicated below.

	Remove pages	Insert pages
Chapter 7	7-9 and 7-10	7-9 thru 7-10.1/7-10.2
	7-25 thru 7-32	7-25 thru 7-32
Chapter 8	8-19 and 8-20	8-19 and 8-20

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C 8

CHANGE NO. 8

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	Remove pages	Insert pages
Warning	a and b	a and b
Chapter 7	7-3 and 7-4	7-3 and 7-4
	7-97 and 7-98	7-97 and 7-98
	7-111 and 7-112	7-111 and 7-112
	7-115 and 7-116	7-115 thru 7-116.1/7-116.2
Chapter 11	11-111 and 11-112	11-111 and 11-112

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NOTICE: Change No. 7 is being printed prior to Change No. 6 because of priority, Change No. 6 will be forthcoming. TM changes must be inserted in numerical sequence.

TM 55-1520-220-23-2
C7

CHANGE
No. 7

HEADQUARTERS
DEPARTMENT OF THE ARMY
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DS and GS Maintenance Manual

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TM 55-1520-220-23-2, 17 September 1980, is changed as follows:

1. Remove and insert pages as indicated below.

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Chapter 7	7-7 and 7-8	7-7 thru 7-8.1/7-8.2
	7-15 and 7-16	7-15 and 7-16
	7-19 and 7-20	7-19 thru 7-20.1/7-20.2
	7-21 thru 7-26	7-21 thru 7-26
	7-35 thru 7-38	7-35 thru 7-38
	7-41 and 7-42	7-41 and 7-42
	7-45 and 7-46	7-45 and 7-46
	7-105 thru 7-108	7-105 thru 7-108
	7-111 and 7-112	7-111 and 7-112
	7-117 and 7-118	7-117 and 7-118
Chapter 8	8-13 and 8-14	8-13 and 8-14
Chapter 10	10-19 and 10-20	10-19 and 10-20
Chapter 11	11-17 thru 11-20	11-17 thru 11-20
	11-67 and 11-68	11-67 and 11-68
	11-109 and 11-110	11-109 and 11-110

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C 5

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TM 55-1520-220-23-2, 17 September 1980 is changed as follows:

1. Remove and insert pages as indicated below.

	Remove pages	Insert pages
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	7-41 and 7-42	7-41 and 7-42
Chapter 8	8-33 thru 8-36	8-33 thru 8-36
	8-37 and 8-38	8-37 and 8-38
Chapter 11	11-29 and 11-30	11-29 and 11-30
Chapter 13	13-13 and 13-14	13-13 and 13-14

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1. Remove and insert pages as indicated below.

	Remove pages	Insert pages
Chapter 9	9-49 and 9-50	9-49 and 9-50
Chapter 11	11-25 and 11-26	11-25 and 11-26
	11-29 and 11-30	11-29 and 11-30
	11-73 and 11-74	11-73 and 11-74
	11-85 and 11-86	11-85 thru 11-86.2
Chapter 12	12-7 and 12-8	12-7 and 12-8

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TM 55-1520-220-23-2
C 2

CHANGE
No. 2

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Chapter 7	7-41 and 7-42	7-41 and 7-42
	7-77 thru 7-86	7-77 thru 7-86
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ARMY MODEL UH-1C/M HELICOPTER

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Chapter 7	7-92.1/7-92.2	7-92.1/7-92.2
	7-93 and 7-94	7-93 and 7-94
	7-117 and 7-118	7-117 and 7-118
Chapter 9	9-17 and 9-18	9-17 and 9-18
Chapter 11	11-19 and 11-20	11-19 and 11-20
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	11-27 and 11-28	11-27 and 11-28
	11-73 and 11-74	11-73 and 11-74
	11-83 and 11-84	11-83 and 11-84
	11-111 and 11-112	11-111 and 11-112
	11-115 and 11-116	11-115 and 11-116
Chapter 12	12-19 and 12-20	12-19 and 12-20
Alphabetical Index	Index 1 and Index 2	Index 1 and Index 2
	Index 21 and Index 22	Index 21 and Index 22
	Index 29 and Index 30	Index 29 and Index 30

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WARNING

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

Warnings, cautions, and notes are used to emphasize important and critical instructions and are used for the following conditions:

WARNING

An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury or loss of life.

CAUTION

An operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

NOTE

An operating procedure, condition, etc., which it is essential to highlight.

NOISE

Sound pressure levels in this helicopter during some operating conditions exceed the Surgeon General hearing conservation criteria, as defined in TB MED 501. Hearing protection devices, such as aviator helmet or ear plugs are required to be worn by all personnel in and around the helicopter during its operation.

DANGEROUS CHEMICALS ARE USED IN NICKEL-CADMIUM BATTERIES

The electrolyte used in nickel-cadmium batteries contains potassium hydroxide (KOH), which is a caustic chemical agent. Serious and deep burns of body tissue will result if the electrolyte comes in contact with the eyes or any part of the body. Use rubber gloves, rubber apron, and protective eye covering when handling the battery. If accidental contact with the electrolyte is made, use ONLY clean water and immediately (seconds count) flush contaminated areas. Continue flushing with large quantities of clean water. Seek medical attention immediately. Before removing or installing the battery, insure that the battery switch is off and the battery has cooled down if overheated. Removal or installation of the battery connector while the battery is under load may result in explosion, electrical arcing, and possible severe burns to personnel.

HANDLING HYDRAULIC FLUID (MIL-H-83282)

Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

TOXIC POISONS

Turbine fuels and lubricating oils contain additives which are poisonous and readily absorbed through the skin. Do not allow them to remain on skin longer than necessary.

STARTING HELICOPTER

Starting and operation of the helicopter will be performed only by authorized personnel in accordance with AR95-1.

GROUNDING HELICOPTER

The helicopter should be electrically grounded when parked. Turn off all power switches before making electrical connections or disconnections. Serious burns and electrical shock can result from contact with exposed electrical wires or connectors.

Before removing any engine ignition system component, ground the leads to dissipate any stored voltage in ignition unit.

FIRE EXTINGUISHER

Exposure to high concentrations of monobromotrifluoromethane (CF3BR) extinguishing agent or decomposition products should be avoided. The liquid should not be allowed to come into contact with the skin, as it may cause frost bite or low temperature burns.

ARMAMENT

Loaded weapons, or weapons being loaded or unloaded, shall be pointed in a direction which offers the least exposure to personnel or property in the event of accidental firing. Personnel shall remain clear of hazardous area of all loaded weapons.

ANY ROTATION OF THE GUN ARMAMENT SUBSYSTEM BARRELS WILL CAUSE THE GUN TO FIRE. Upon landing, immediately alert personnel to probable presence of live rounds in the gun. Summon armament repairman to clear weapon.

FUELING AND DEFUELING

When refueling helicopter, the refueling vehicle or forward air refueling unit must be parked a minimum of 20 feet from the helicopter. Before starting the fueling operation, always insert fueling nozzle grounding chain of fuel truck ground wire into GROUND HERE receptacle located on the right side of the helicopter aft of the cabin area. Refer to TM 10-1101.

When defueling, turn off all electrical switches and disconnect external power from the helicopter. The helicopter must be electrically grounded prior to defueling.

RADIOACTIVE MATERIALS

Self-luminous dials and ignition units may contain radioactive materials. If such an instrument or unit is broken or becomes unsealed, avoid personal contact. Use forceps or gloves made of rubber or polyethylene to pick up contaminated material. Place materials and gloves in a plastic bag. Seal bag and dispose of it as radioactive waste in accordance with AR755-15 and TM 3-261 (Refer to TB 43-0108). Repair procedures shall conform to requirements in AR700-52.

CLEANING SOLVENTS

Cleaning solvents may be flamable and toxic. Use only in well ventilated areas. Avoid inhalation of vapor and skin contact. Do not use solvents near open flame or in areas where very high temperatures prevail.

ROTOR BLADES

Personnel will stay clear of rotor blades during operation. Refer to Chapter 1 for rotor blade dimensions and clearances.

TECHNICAL MANUAL

No. 55-1520-220-23-2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *17 September 1980*

Aviation Unit and Intermediate
Maintenance Instructions

ARMY MODEL UH-1C/M HELICOPTERS

NOTE:

This manual is printed in three volumes as follows:

TM 55-1520-220-23-1, consisting of Table of Contents, Preface, Chapter 1 through Chapter 6, and Index.

TM 55-1520-220-23-2, consisting of Table of Contents, Chapter 7 through Chapter 17 and Index.

TM 55-1520-220-23-3, consisting of Table of Contents, Appendix A through Appendix F and Index.

The Appendices are applicable to all volumes.

TECHNICAL MANUAL

No. 55-1520-220-23-2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC 17 September 1980

AVIATION UNIT AND INTERMEDIATE MAINTENANCE INSTRUCTIONS

ARMY MODEL UH-1C/M HELICOPTERS

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this manual. If you find any mistake or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, U.S. Army Troop Support & Aviation Materiel Readiness Command, ATTN: DRSTS-MTT, 4300 Goodfellow Boulevard, St. Louis, MO 63120. A reply will be furnished directly to you.

TABLE OF CONTENTS

CHAPTER 7

HYDRAULIC AND PNEUMATIC SYSTEMS

SECTION I — HYDRAULIC SYSTEM

7-1. HYDRAULIC SYSTEM.

NOTE

All preformed packings and threads will have a light film of hydraulic fluid (C112 or C112.1) applied prior to assembly. Ensure that parts are clean.

7-2. Description — Hydraulic System. a. A dual hydraulic system (figure 7-1) is used to reduce the operational loads required to activate the cyclic, collective, and directional control systems. The dual system used in these aircraft provides greater safety of flight. Failure of one system leaves hydraulic power available through the other system. Each system consists of a reservoir; variable-delivery pressure-compensated pump; module assembly containing a solenoid valve, relief valve, pressure switch, pressure and return filters; magnetic type differential pressure indicators; servocontrol assemblies consisting of control cylinders and control valves which incorporate irreversible features; and necessary attaching hardware. See figure 7-2 for hydraulic system schematic diagram.

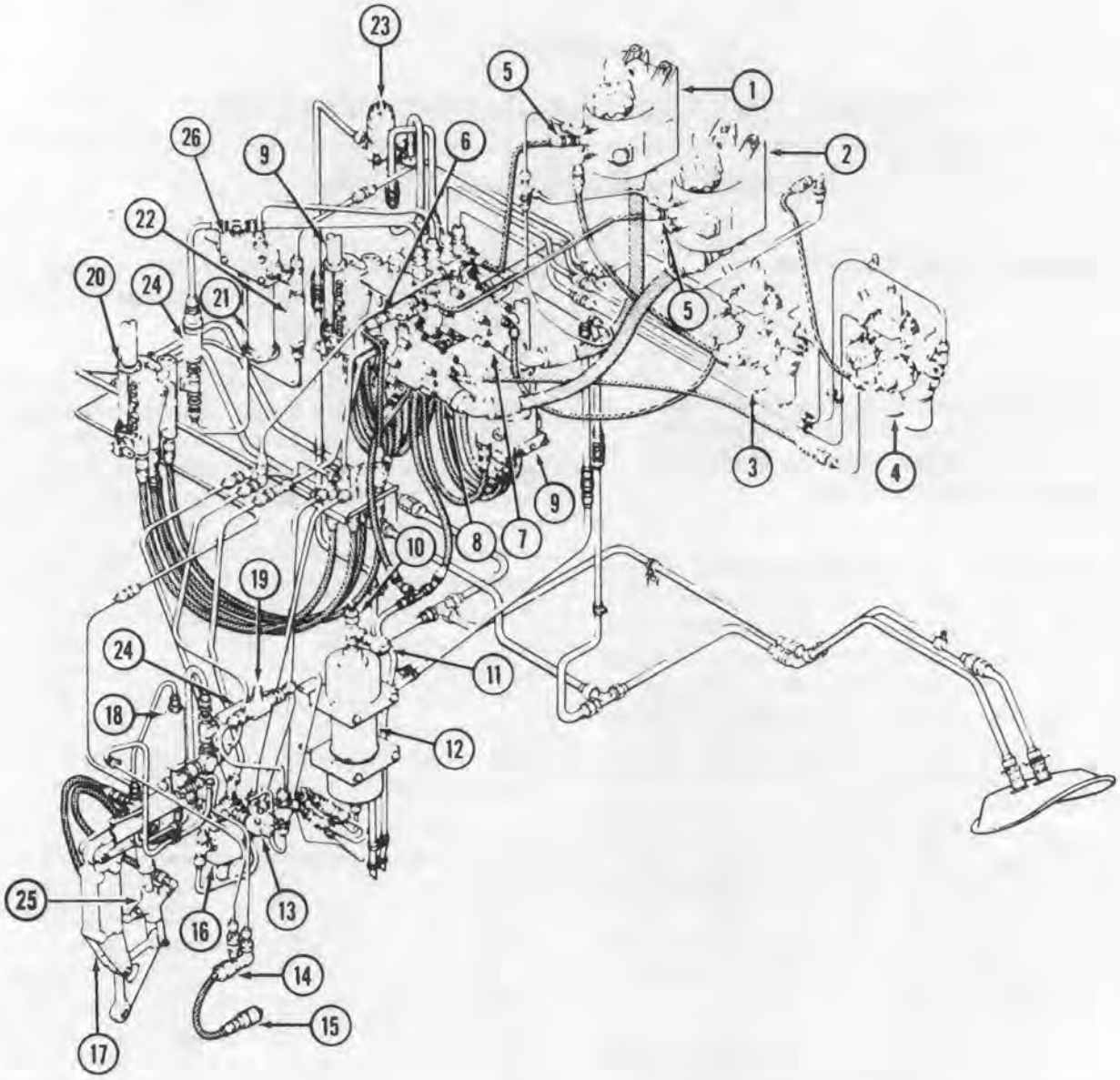
b. The reservoirs are mounted on the cabin aft bulkhead just to the right of aircraft centerline. The pumps are mounted on the transmission lower case and furnish hydraulic pressure to the servocontrol valves through the module assemblies, which are attached to the right side of the cabin aft bulkhead. Pressure required for system operation is provided by each pump, which supplies flow on demand.

7-3. Operation — Hydraulic System. a. Two variable delivery pumps furnish fluid, under 1500 psi pressure, to their respective module assemblies. Operation of both module assemblies is the same. Fluid passes through the module pressure filter to the solenoid valve which is open when de-energized. A check valve (pressure relief) limits system pressure, cracking at 1626 psi, with a full flow pressure of 2140 psi. Pressure and return line filters both have differential pressure indicators which sense pressure on both sides of the filter. An indicator pin extends, if inlet pressure exceeds outlet pressure by more than 70-psi differential (figure 7-2).

b. Fluid pressure from the solenoid valve energizes a pressure switch which is set to break the circuit to the pressure warning light on the caution panel at **800 ±100** psi increasing pressure and make the circuit at **500 ±100** psi on decreasing pressure. Fluid is furnished to the cyclic and collective servocontrol valves from both sub-systems. Pressure fluid to the tail rotor servocontrol valve (directional) is furnished only from the hydraulic System No. 1 solenoid valve. Return fluid from the servocontrol valves passes through the module assembly return filters. With the solenoid valve energized the return fluid passage is connected to the system passage. With pressure blocked, pump operates at system pressure with no flow.

c. Armament hydraulic power is supplied from System No. 2, and is isolated from the power control system by a solenoid valve in the pressure line and a check valve in the return line. Hydraulic pressure to the armament circuit is provided by energizing the solenoid valve (figure 7-1). On helicopters with provisions for externally mounted armament, pressure is supplied to a normally-open solenoid valve which is controlled by a switch on an armament control panel. When the valve is open, hydraulic fluid is supplied to the external couplings on each side of the helicopter. When external hydraulic equipment is connected, fluid used to operate the equipment is returned through a filter and check valve to the hydraulic reservoir.

d. Hydraulic System No. 1 incorporates the added feature of an emergency collective (accumulator) system. This added system maintains collective control hydraulic pressure for four control strokes, minimum, in the event both hydraulic systems fail. This emergency collective system also adds total irreversibility to the collective control system. An accumulator, pressure operated lockout valve, nitrogen charging valve, pressure gage, drain valve, drain hose and plug assembly, and drain valve



1. Reservoir, System No. 1
2. Reservoir, System No. 2
3. Module Assembly, System No. 1
4. Module Assembly, System No. 2
5. Check Valve
6. Check Valve
7. Pump, System No. 1
8. Pump, System No. 2
9. Cyclic Servo Control Valve
10. Charging Valve, Nitrogen
11. Pressure Gauge, Nitrogen
12. Accumulator, Collective
13. Drain Valve
14. Drain Valve Coupling Half and Pressure Cap Assembly
15. Drain Hose with Coupling Half and Plug Assembly
16. Accumulator Lockout Valve, Collective
17. Support and Bellcrank Assemblies
18. Relief Valve
19. Solenoid Valve
20. Collective Servo Control Valve
21. Accumulator, Cyclic
22. Relief Valve
23. Solenoid Valve, Armament
24. Relief Valve
25. Tail Rotor Servocylinder assembly
26. Accumulator Lockout Valve, Cyclic

204076-1038A

Figure 7-1. Hydraulic system

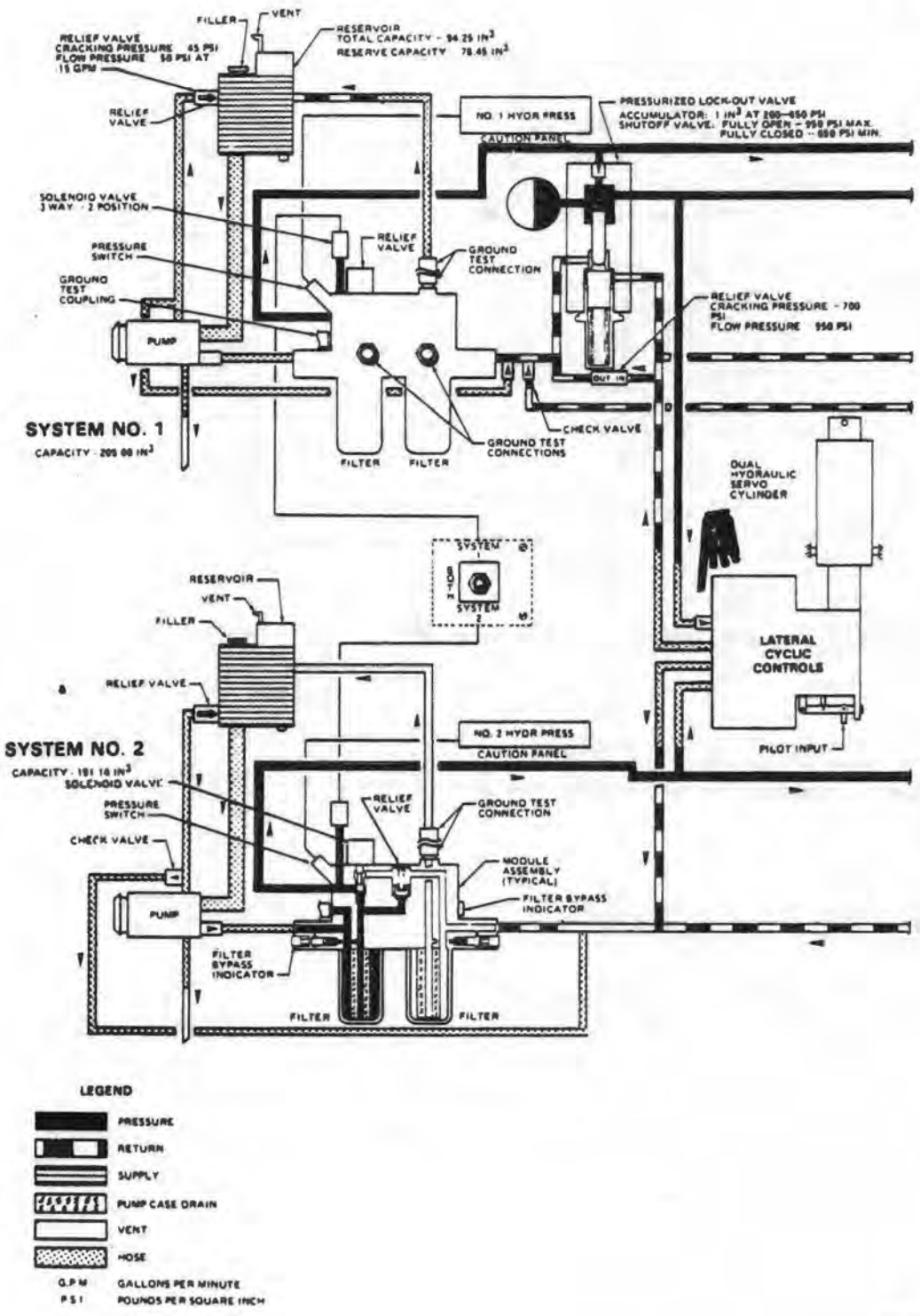


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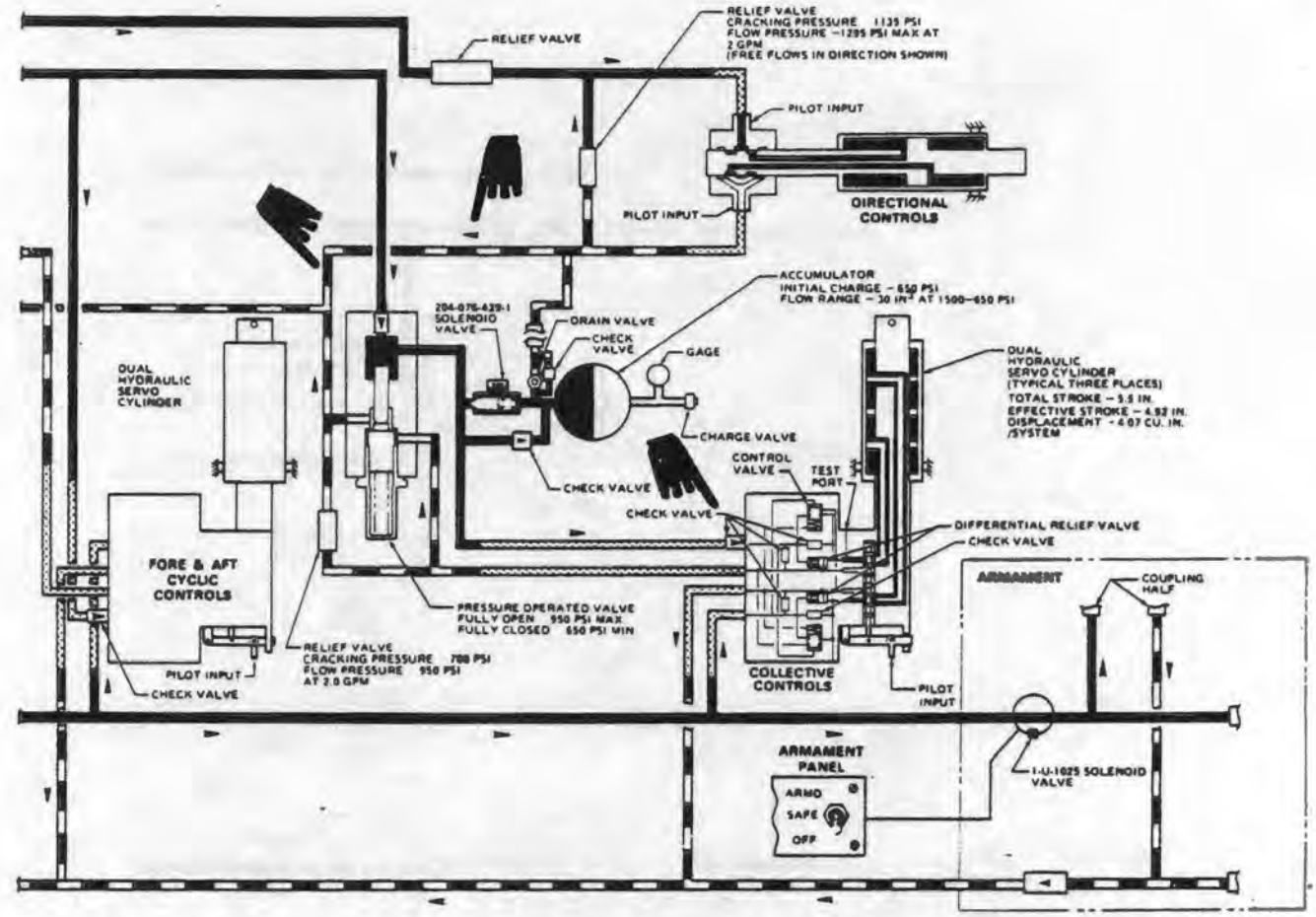
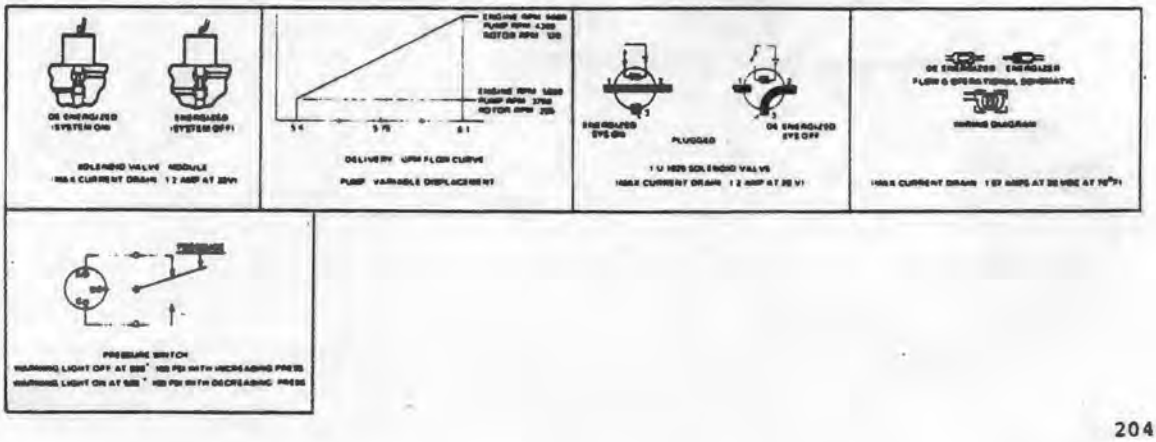
Figure 7-2. Hydraulic system schematic (Sheet 1 of 2)





204476-1000-2A

Figure 7-2. Hydraulic system schematic (Sheet 2 of 2)

coupling halves with necessary tubes and fitting, constitute the added equipment required to obtain the above characteristics.

e. System No. 1 also includes a pressurized lockout valve which serves to pressurize and lock out the cyclic actuators, as well as increase the amount of irreversibility in the cyclic system, if both hydraulic systems should fail. Components of this cyclic emergency system include a pressure operated lockout valve and a small, spring-loaded accumulator with necessary fittings, tubing, and check valves (figure 7-1).

f. The following provides guide lines for allowable external leakage of in-service hydraulic system components, and some methods of measuring such leakage (table 7-1).

(1) Scope — Limits described are only for components in service in helicopter hydraulic systems. Intent is to minimize replacement of hydraulic components which are still serviceable.

(a) These limits may differ from those contained in various military specifications for

Table 7-1. Allowable Leakage for In-service Hydraulic Components

COMPONENT	FUNCTION	LEAK TYPE	LEAKAGE RATE (Max.)
FLIGHT CONTROLS ACTUATORS	Rod Seal	D	1 drop/20 full stroke cycles
		S-D	1 drop/15 min.
	End Cap	S	2 drops/day
	Valve Input	D	1 drop/5 cycles
		S-D	1 drop/5 min.
	Valve Body (Weep Hole)	S-D	1 drop/5 min.
PUMP	Output Shaft	D	8 drops/min.
		S-D	1 drop/min.
	Housing (Mating Surfaces)	S	2 drops/day
SWIVELS	Low Pressure	S	1 drop/15 min.
	High Pressure	D	1 drop/5 cycles
		S	1 drop/15 min.
VALVES	Body (Weep Hole)	S	2 drops/day
	Manual Stem	D	1 drop/5 cycles
		S-D	1 drop/15 min.
	Dump Valve	S	2 drops/day
	Pressure Switch	S-D	1 drop/5 min.
FITTINGS	Flares or Flareless	S	None
	Compression Seals	S	1 drop/30 min. (less if readily accessible)

NOTES: 1. Leak Types: D = Dynamic
S = Static
S-D = Static leakage through dynamic seals.
2. Approx. 20 drops — 1 cubic centimeter.
3. Components in static condition, as in parked aircraft, are allowed maximum leakage of two drops per seal or packing per day.

components, which are intended to control quality, assembly, and proper functioning of the components for procurement. Components in service sometimes develop leakage rates in excess of specification limits, without necessarily becoming detrimental to the system or failing to provide reliable operation.

(b) These limits are not to be used as basis for acceptance or rejection of components of any bench functional test or systems on new helicopters.

(c) These limits are not applicable to self-contained closed-compartment hydraulic units such as viscous dampers, liquid springs, or oleo struts.

(2) Causes of Leakage — Some seepage is normally present, since static or dynamic seals are not functionally perfect, due to such causes as follows:

(a) A film of hydraulic fluid being retained by metal surfaces, such as piston rods, and thus carried past seals. This film is necessary for seal lubrication.

(b) Pressure and temperature variations affecting seals.

(c) Seals tend to take a permanent set after a period of time.

(3) Classification of Leakage — External leakages of hydraulic fluid can be broadly classified as excessive or allowable.

(a) Excessive Leakage: Fluid leakage such that hydraulic reservoir level may be dangerously lowered or depleted during normal operation, or a fire hazard may be created, or air-worthiness of helicopter may be otherwise compromised.

(b) Allowable Leakage: Fluid leakage such that quantity lost is insignificent, will have no detrimental effect on helicopter operation, and correction does not warrant maintenance time involved.

(c) General: Leakage usually shows as a seepage, stain, or wet area. It is possible for allowable leakage or seepage to collect in a cavity or depression in adjacent structure over a period of time and falsely indicate excessive leakage. Accumulation on a flat area or a white-painted surface often appears to be excessive, though actually being allowable. However, it is also possible to have enough components with allowable leakages that their combined leakage should be classified as excessive.

(4) Leakage Checks — Measurement of leakage rates, for classification according to table 7-1 can be performed as follows:

WARNING

The following procedure allows a possibility of air remaining in the system. The gravity feed system is self-bleeding. Therefore, before flight, the system must be bled by cycling tail rotor pedals and cyclic and collective controls a minimum of 10 times with main rotor turning at engine idle. Fill reservoir.

(a) When hydraulic systems have remained in static, unpressurized condition for an appreciable period of time, leakage checks should not be performed immediately after starting operation. Activate systems and operate components several times, then wipe off any leaked hydraulic fluid before making leakage checks.

(b) Where location of a component does not permit direct observation, it is posssible to measure leakage on a flat surface (either part of structure below or a panel temporarily positioned for that purpose). Wipe surface clean and place a drop of fluid on area, allow to stabilize, then outline area with soft lead pencil before wiping off fluid. Pressurize and cycle the component to observe leakage rate, comparing wetted surface to marked one-drop area.

(c) Where fluid dropping from a component can be directly observed, pressurize and cycle the component until a drop falls free. Continue operating, observing time until next drop to determine leakage rate.

(d) For tests requiring long periods of time and where fluid can drop, wipe surface clean and dry without using a solvent. Use a clean blotter or white cloth after system has operated or has been idle the required period of time.

g. The following provides guidelines for evaluating intersystem leakage:

(1) On shutdown, the lockout valve pressurizes the return lines in system No. 1. This causes the pressure to bleed off through the lap fits in the cyclic and collective actuator servo valves and results in a fluid leakage from system No. 1 to No. 2. The amount of fluid leakage per shutdown is limited to approximately one cubic inch, which is the capacity of the accumulator in system No. 1 return line. The fluid leakage requires 40 to 60 minutes to occur. The effect of this leakage is that after 20 to 30 flights the system No. 2 reservoir air volume is filled; No. 2 reservoir runs over, and system No. 1 reservoir requires refilling.

(2) No other intersystem leakage of significance occurs; however, improper system installation, i.e., crossing of lines or hoses, can cause intersystem fluid flow. This type of intersystem flow will be more severe when operating on a single system and would quickly drain the reservoir in the operating system. A defective actuator could also contribute to intersystem flow.

(3) Any intersystem fluid transfer other than that which occurs normally on shutdown should be investigated and corrected (paragraph 7-6). When checking for intersystem leakage, do not mistake the following for intersystem leakage:

(a) Filling system No. 1 reservoir with collective accumulation full will cause system No. 1 reservoir to overflow when the collective accumulator is discharged.

(b) When operating with pressure on system No. 2 and no pressure on system No. 1, rapid motion of the directional system will cause the directional servo actuator to cavitate and cause hydraulic oil level in system No. 1 reservoir to rise.

(4) When operating with pressure on system No. 1 and no pressure on system No. 2, rapid motion of cyclic or collective systems will cause the servo cylinder to cavitate and cause system No. 2 reservoir to overflow.

NOTE

When a cylinder cavitates, it pulls air in through its rod end seals, and the air displaces oil. The displaced oil returns to the reservoir. When the system is turned on and controls moved, oil replaces the air and reservoir returns to normal level. The cyclic and collective cylinders must be cycled full stroke or some air will remain in the cylinder.

7-4. Testing — Hydraulic System. Testing of the hydraulic system may be accomplished by attaching a hydraulic test stand to the test connectors (located on right side of helicopter, forward of engine) and auxiliary power unit in accordance with the following procedures. Premaintenance requirements for testing of hydraulic system are as follows:

Premaintenance requirements for testing of hydraulic system

Conditions	Requirements
Model	All
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	Two
Consumable Materials	(C112) (C112.1) (C127) (C145.1)
Special Environmental Conditions	Dust Free/ Well Ventilated Area

NOTE

The hydraulic test stand equipment shall be serviced to use hydraulic oil (C112 or C112.1). The test unit shall include a 10- micron filter to filter all oil leaving the test unit. The unit shall be capable of producing pressure to 2300 psi, and shall have a flow rate of at least 6-gpm. A calibrated pressure gage with a minimum of 2500 psi capacity shall be provided on the test unit. The test unit shall have provisions in the pressure and return lines for connecting to both hydraulic systems for simultaneous operation.

a. Preparation for Testing.

(1) Clean the complete system thoroughly.

(2) Fill both reservoirs to capacity.

b. Functional Test. Perform functional test by application of **1000 TO 1100** psi to hydraulic system. Maintain for **15** minutes. While pressure is maintained, check the following:

(1) **Leakage.** Observe all parts of system for evidence of leakage, and correct excessive external leakage. Irreversible valve accumulator bore weep hole shall not exceed the equivalent of **1** drop in **25** cycles during actuation or **1** drop in **24** hours during static condition.

(2) **Intersystem Leakage - Collective or Cyclic Servo-cylinder Assemblies (AVIM).** Intersystem leakage may occur in one or more servo-cylinder assemblies. If one system reservoir consistently overflows while the other reservoir shows low fluid level, intersystem leakage may be indicated.

To check for intersystem leakage and to isolate the faulty servo-cylinder assembly(s), do the steps below:

WARNING

Extreme caution must be exercised when doing the following. Damage to the aircraft or physical injury to maintenance personnel may result from improper action.

(a) Bleed all residual hydraulic pressure from system.

(b) Trace the return lines from overflowing system reservoirs to each servo-cylinder. Mark lines for subsequent removal.

(c) Connect hydraulic test unit hoses to system which shows low fluid level (opposite system of step b).

NOTE

Disconnect only one servo-cylinder at a time. Refer to figure 7-28 for cyclic servo-cylinders and figure 7-38 for collective servo-cylinder.

(d) Remove control tube from servo-cylinder (13 or 19, figure 7-28 or 11, figure 7-38).

(e) Remove cotterpin, nut, washer and bolt and disconnect hydraulic cylinder from swashplate horn (figure 7-28) or lever assembly (figure 7-38).

(f) Disconnect return lines marked in step b from servo-cylinder.

WARNING

Position servo-cylinder assembly so that extension/retraction of the cylinder will not result in damage to the swashplate, collective levers and control tubes or injury to personnel.

(g) Set hydraulic test unit for approximately 6 gpm flow at 1475 to 1525 psi pressure.

(h) Extend servo-cylinder assembly to full upward travel. Heavy leakage from control valve return part after the cylinder is fully extended indicates intersystem leakage.

(i) Stop flow from hydraulic test unit.

(j) Install servo-cylinder (cyclic controls, paragraph 7-167 or collective control, paragraph 7-180).

(k) Connect hydraulic return lines to servocontrol valve.

(l) Repeat steps b through k for each servocontrol valve until source of intersystem leakage is found. Make sure residual hydraulic pressure is depleted before opening hydraulic connections.

(3) **Clearance.** Slowly cycle all controls to limits and observe movement of servo cylinders. Clearance should be such that fouling cannot occur. Check flexible connections to ensure that pinching of hoses does not occur and that vibration does not loosen attaching fittings or cause chafing of lines.

(4) **Bleeding.** Cycle the cyclic controls, collective control, and tail rotor control pedals through full travel at least ten times to bleed air from system.

(5) **Warning Lights.** Apply pressure to the hydraulic system. Slowly increase pressure and check the warning light. The light should be off when pressure reaches **700 TO 900** psi. Slowly decrease the pressure. The light should be on when pressure decreases to **600 TO 400** psi.

(6) **Solenoid Valve.** Increase the system pressure to **1475 TO 1525** psi, place the solenoid valve switch OFF. The pressure warning light should come on. Operate the cyclic, collective, and tail rotor controls. (If the solenoid valve actuated properly, the controls should require more force to operate.)

NOTE

When testing System No. 2, tail rotor controls are not powered by hydraulic pressure and will require more force to operate.

c. **Relief Valve.** Connect System No. 1 to test unit and slowly increase pressure until relief valve on System No. 1 module assembly opens. Relief valve should open between **1626 AND 2140** psi.

(1) Repeat above step c. for System No. 2.

(2) Disconnect hydraulic systems from ground test unit and remove ground test unit.

d. **Solenoid Valve.** With accumulator switch OFF, attempt to move collective control stick. Stick should not move, indicating solenoid valve is closed.

e. **Accumulator.** With collective accumulator switch ON, bleed emergency collective (accumulator) system by moving control stick through approximately **6** strokes. When stick can no longer be moved, accumulator has been depleted.

(1) Return collective accumulator switch to OFF.

NOTE

Correct accumulator precharge is mandatory for proper operation of emergency collective system.

(2) Check collective accumulator (12, figure 7-1) for proper pressure as follows:

(a) Connect reservoir drain hose coupling half (15) to drain valve coupling half (14).

CAUTION

Do not press drain valve (13) with rotor running or with hydraulic pressure on the aircraft system. If coupling half connections cannot be made, refer to troubleshooting, paragraph 7-6, for corrective action.

(b) Press drain valve (13) to drain oil from accumulator. Hold for **30** seconds minimum.

(c) Check pressure gage (11). Indicator on dial should be in green area for correct accumulator nitrogen pressure.

(d) If indicator is in yellow area, below green area, accumulator must be charged with nitrogen (C145.1) to correct pressure, using **650 TO 850** psi supply pressure. (Refer to paragraph 7-107 for procedure for charging hydraulic accumulator).

(e) If indicator is in yellow area, above green area, release excess pressure until indicator is in green area.

(f) After correct pressure has been obtained, disconnect reservoir drain hose coupling half (15) from drain valve coupling half (14) and stow.

f. **Final System Check.** Test System pressure by connecting calibrated (0 TO 3000) gages to both hydraulic systems at pressure ground test fittings. With rotor turning at 285 TO 315 rpm, hydraulic pressure shall be 1475 TO 1525 psi on each system, with cyclic, collective, and tail rotor controls fixed.

g. **Final System Test.** Upon completion of the test, restore helicopter to flight status as follows:

(1) Remove gages and replace filter elements in both module assemblies.

(2) Refill hydraulic systems using hydraulic test stand.

(3) Bleed systems in accordance with above step b. (3).

(4) Disconnect and remove hydraulic test stand.

(5) Close all test ports on hydraulic test stand and on hydraulic systems.

(6) Connect hydraulic reservoirs to module assemblies and quick-disconnect couplings.

(7) Service reservoirs (paragraph 7-7).

7-5. Flushing — Hydraulic System. The complete system must be thoroughly flushed as follows:

WARNING

Prolonged contact with liquid or mist can irritate eyes and skin. After any prolonged contact with skin, immediately wash contacted area with soap and water. If liquid contacts eyes, flush immediately with clear water. If liquid is swallowed, do not induce vomiting; get immediate medical attention. Wear rubber gloves when handling liquid. If prolonged contact with mist is likely, wear an appropriate respirator. When fluid is decomposed by heating, toxic gases are released.

CAUTION

Do not service reservoir with accumulator charged hydraulically. Accumulator shall be bled down by connecting restrictor drain hose coupling half (15) to drain valve coupling half (14). Depress drain valve (13) to drain oil from accumulator. Hold minimum of 30 seconds, disconnect coupling half (15) from coupling half (14) and stow.

NOTE

Immediately after disconnecting hoses, fittings of cyclic and collective servo valves shall be capped to prevent contamination of system.

a. Disconnect hoses from cyclic and collective servo cylinders. Connect pressure and return hose ends of System No. 1 and System No. 2 together with MS21916D5-4 reducers. Install protective caps to fittings of irreversible valves to prevent entry of dirt.

b. Read above NOTE. Disconnect hoses from elbows of tail rotor control cylinder. Connect hose ends together with MS21916D5-4 reducer. Install protective caps to elbow fittings on control cylinder to prevent entry of dirt.

c. Visually inspect complete hydraulic system to ensure all components and lines are securely attached and appear capable of satisfactory operation.

d. Set test unit to a minimum flow rate of 6-gpm. Use test unit pressure setting sufficient to maintain 6-gpm flow through hydraulic system for at least 5 minutes. Use test unit reservoir for this flushing procedure.

CAUTION

Flush each hydraulic system separately.

e. Disconnect test unit hoses from System No. 1 and connect to System No. 2 through ground test fitting of filter module located on right side of helicopter. Repeat step d. above.

NOTE

Throughout performance of steps d. and e. above, observe all portions of system for external leakage. Appropriate action shall be taken to correct any cause of leakage.

f. Upon completion of steps d. and e. above, test unit shall be shut down and cyclic and collective hoses shall be reconnected to servo control valves.

g. Connect left and right hydraulic armament system pressure and return lines.

h. Set test unit to a minimum flow rate of at least 3-gpm. Use test unit pressure setting sufficient to maintain 3-gpm flow through system for at least 5 minutes. Activate test unit and flush system for at least 5 minutes.

NOTE

Throughout performance of above step h., observe all portions of system for external leakage. Appropriate action shall be taken to correct any cause of leakage.

i. Shut down test unit and disconnect left and right hydraulic armament system pressure and return lines. Cap lines.

j. Disconnect test unit hoses from System No. 2, and connect to System No. 1.

k. Accomplish above step h., including note.

l. Upon completion of above step m., test unit shall be shut down and hydraulic system hoses shall be reconnected to cyclic, collective, and tail rotor cylinder.

m. Set test unit pressure relief valve for a cracking pressure of **2100** psi and set pump so it is capable of at least **6**-gpm flow. Set pressure compensation at **1475 TO 1525** psi. System No. 1 and System No. 2 shall both be connected to the test unit at the ground test connections.

n. Throughout the operation, observe all portions of system for evidence of external leakage.

o. Shut down hydraulic test stand and reconnect hoses to valves and cylinders.

p. Inspect filter elements (two each in modules (3) and (4)) for cleanliness and install element to filter. Torque bowl **100 TO 125** inch-pounds and secure with lockwire (C127).

q. Bleed system (paragraph 7-4).

7-6. Troubleshooting — Hydraulic System. The following conditions, test and inspections, and corrective action is intended to aid in hydraulic system troubleshooting. This guide should be used with other sources of information, such as: (1) Hydraulic System Schematic Illustration; (2) Electrical diagrams; and (3) Operational Ground Test; and other detailed procedures in this section.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 7-2. Troubleshooting of Hydraulic System

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. No. 1 HYDR PRESS or No. 2 HYDR PRESS caution segment (either system) illuminated during normal operation.	STEP 1. Loss of fluid and pressure by leakage.	Locate and repair leaks; replace faulty lines, hoses, seals, or other parts. Service system as required (paragraph 7-135).
	STEP 2. Total loss of fluid in system.	Replace pump (paragraph 7-17).

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
STEP 3. Other malfunction in system.	**Perform operational check with hydraulic test stand (paragraph 7-4).**
STEP 4. System actuators operate normally on hydraulic test stand, but caution segment is illuminated, warning circuit may be faulty or pressure switch faulty.	**Replace pressure switch (figure 7-10) in system module (paragraph 7-60).**
STEP 5. If NO. 1 HYDR PRESS or NO. 2 HYDR PRESS caution segment illuminates and system operates normally with hydraulic test stand, trouble may be in pump circuit or defective pump.	**Replace pump (paragraph 7-17).**
STEP 6. Pump pressure line restricted or check valve reversed.	**Replace or correct installation of parts (paragraph 7-17).**
STEP 7. Electric circuit malfunction.	**Check and repair electrical circuit (paragraph 9-10).**
STEP 8. Caution panel is illuminated and system actuators do not operate normally with hydraulic test stand, trouble may be in the module or in system beyond module.	
STEP 9. System solenoid valve staying at OFF position or faulty hydraulic switch.	**Replace module, or repair electrical circuit, or replace switch (paragraph 7-53 or 9-10).**
STEP 10. System relief valve staying open or relieving at too low pressure.	**Replace system module (paragraph 7-53).**
STEP 11. Inernal leakage through a unit.	**Isolate and replace defective unit.**
2. No. 1 HYDR PRESS or No. 2 HYDR PRESS segment in caution panel fails to illuminate when hydraulic switch is at other system position.	
STEP 1. Caution panel lamp or panel segment failed.	**Replace lamp or panel (paragraph 9-171).**

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 2. Pressure switch or wiring faulty.

Replace pressure switch or repair electrical circuit (figure 7-10) (paragraph 7-60 and 9-167).

STEP 3. System solenoid or electrical circuit faulty.

Replace module, or repair electrical circuit (figure 7-10) (paragraph 7-53 and 9-167).

STEP 4. Faulty hydraulic torque switch.

Replace switch (paragraph 9-5).

3. Filter bypass indicators tripped.

STEP 1. Low fluid temperature below **20** degrees F (**-6.6** degrees C).

Operate until fluid temperature is normal, then reset indicators by pushing buttons in. If not again tripped, no further action needed (figure 7-11).

STEP 2. Indicators tripped by unusual vibration or module being struck.

Check module for damage, reset indicators. If not again tripped, no further action needed (figure 7-11).

STEP 3. Clogged filters.

Inspect and clean or replace filter elements. Reset indicators (figure 7-11) (paragraph 7-46).

STEP 4. Defective indicator assembly.

Replace module assembly (paragraph 7-53).

4. Servo cylinders chatter when controls are moved. (Some chatter in tail rotor control cylinder is normal when using hydraulic test stand.

STEP 1. Air in system.

Cycle controls at least ten full strokes at normal operating pressure to work out air (paragraph 7-4).

5. Hydraulic power inadequate or lacking at couplings for armament (other indications normal).

STEP 1. Faulty circuit to armament couplings, or system No. 1 pressure is marginally low.

Check operation with hydraulic test stand (paragraph 7-4).

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
	STEP 2. No improvement when using hydraulic test stand for normal system pressure, or armament.	**Replace armament system solenoid valve or repair electrical circuit (paragraphs 7-67 and 9-5).**
	STEP 3. Restriction in couplings (figure 7-21) or lines.	**Replace defective parts.**
	STEP 4. Operation becomes normal on hydraulic test stand, or System No. 2 pump or lines defective.	**Replace pump or faulty lines (paragraph 7-17 or 7-135).**
6. System No. 2 reservoir overflows.	STEP 1. Repeated cyclic inputs with hydraulic system switch in System No. 1 position.	**Release hydraulic system test switch. Actuate cyclic stick approximately ten full cycles, to remove air from actuators. Replenish fluid in reservoir (paragraph 7-7).**
	STEP 2. Loose mounting bearing (13, figure 7-29 or 7-30) on dual hydraulic cylinder.	**Loosen and retorque nut (10, figure 7-29 or 7-30).**
	STEP 3. Any internal looseness in dual hydraulic cylinder assembly.	**Replace dual hydraulic cylinder assembly (paragraphs 7-173 and 7-180).**
7. Hydraulic oil leaks.	STEP 1. Low hydraulic pressure.	**Check for leaks (table 7-1).** **Replace solenoid valve (paragraph 7-67).** **Flush system (paragraph 7-5).** **Replace pump (paragraphs 7-19 and 7-23).**
	STEP 2. Solenoid valve not operating properly.	**Replace solenoid valve (paragraph 7-67).**
	STEP 3. Electrical wiring to warning light or solenoid valve not correct.	**Make proper hookup or replace wiring (Appendix F).**

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

Step 4. Check valve (located at hydraulic pump pressure port) installed backward.

Remove and install check valve properly (figure 7-2).

STEP 5. Worn gaskets, seals, or preformed packings.

Replace gaskets, seals, or preformed packings.

NOTE

Tighten fitting nut (table 7-3) with wrench until a sharp increase in torque is noted. Do not overtorque.

STEP 6. Leaking fittings.

Replace with new tube or hose assembly if nut, sleeve, tubing, or hose is defective.

STEP 7. Improper tightening, presence of foreign matter, or defective part.

Tighten tube and hose connectors in accordance with limits outlined in table 7-3. Clean and remove all foreign matter from threads of connector.

NOTE

Apply hydraulic fluid (C112 or C112.1) to threads of tube and hose connectors and fittings prior to torquing. Do not torque with threads dry.

NOTE

If there is any doubt that the point of sharp torque increase has been reached, rapidly loosen and tighten the nut several times (use light torque) until certain that increase in torque is due to the sleeve and tube touching the fitting seat, and is not due to thread friction.

Tighten nut an additional 1/6 of a turn (one hex flat), from point of sharp torque increase.

If leak is present, tighten nut additional 1/6 of a turn.

If leak still persists, remove tube or hose assembly and install new tube or hose assembly.

8. Hydraulic control switch ineffective.

STEP 1. Circuit breaker open.

Close circuit breaker.

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
STEP 2. Solenoid valve not connected.	**Connect wiring to solenoid valve (Appendix F).**
STEP 3. Improper electrical wiring.	**Repair or replace wiring (Appendix F).**
Step 4. Solenoid valve not functioning properly.	**Replace solenoid valve (paragraph 7-67).**
STEP 5. Check valve (located at hydraulic pump pressure port) installed backward.	**Remove and install check valve properly (figure 7-2).**
9. Excessive feedback to controls.	
STEP 1. Air in system.	**Bleed system (paragraph 7-4).**
STEP 2. Main rotor not properly adjusted.	**Track and adjust rotor (paragraph 5-132).**
STEP 3. Loose cylinder support bearing retaining nut or loose bushing set adjustment nut.	**Check torque on cyclic dual servo cylinder support retaining nut and bushing set adjustment nut (paragraph 7-167).** **Check torque on collective dual servo cylinder support retaining nut and bushing set adjustment nut (paragraph 7-180).**
STEP 4. Loose or worn dual servo cylinder bearing housing mounting studs.	**Tighten nuts and/or replace mounting studs (paragraph 7-153 or 7-169).**
10. Cyclic/collective servo cylinder binds or does not operate smoothly.	
STEP 1. Excessively tight cylinder support bearing.	**Lubricate bearing (figure 1-3).** **Check torque on bearing retaining nut (paragraph 7-153 or 7-169).**

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
STEP 2. Servo control valve requires more than 12 ounce force to operate.	**Replace dual servo cylinder (paragraphs 7-153 and 7-169).**
STEP 3. Collective stick binds at upstroke mid-travel during collective accumulator bleed-down.	**Inspect main rotor extension sleeves for binding and worn bearings (paragraph 5-83).**
11. Unusual cyclic or collective control buffeting, abnormal vibration or movement.	
STEP 1. Retainer nut loose or tang not bent properly.	**Replace dual servo cylinder assembly (paragraphs 7-153 and 7-169).**
12. Collective stick will not stay in position.	
STEP 1. Friction not properly adjusted.	**Adjust friction (paragraph 11-25).**
STEP 2. Springs on collective servo control valve are mislocated, weak, or improperly adjusted.	**See figure 7-27 for proper spring and washer assembly. Replace weak springs. Refer to adjustment instructions in paragraph 7-171.**
13. Controls do not operate smoothly.	
STEP 1. Sticky servo control valve.	**Replace faulty dual servo cylinder (paragraphs 7-153 and 7-169).**
STEP 2. Servo control valve requires more than 12 ounces to operate.	**Check to ensure all bolts at servo control valve lever are free to rotate by finger pressure. Replace servo control valve (paragraphs 7-153 and 7-169).**
STEP 3. Servo control valve motoring.	**Adjust in accordance with instructions in paragraphs 7-155 and 7-171.**
STEP 4. Incorrect bolts inserted in servo control valve lever.	**Check valve lever bolts. Install correct bolts.**

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

14. Hydraulic system too hot.

STEP 1. Relief valve cracking pressure set lower than system pressure.

Replace defective relief valve (paragraph 7-39).

Flush hydraulic system (paragraph 7-5).

STEP 2. Pump generates pressure higher than relief valve cracking pressure.

Replace pump (paragraphs 7-17).

STEP 3. Relief valve stuck open.

Replace relief valve (paragraph 7-39).

STEP 4. Pump case drain incorrectly installed.

Install properly (paragraph 7-17).

15. Using ground hydraulic test stand, fluid flows from top of reservoir through vent filter when controls are operated.

STEP 1. Using helicopter reservoir instead of test stand reservoir.

Use test stand reservoir.

16. Dual servo cylinders chatter when moving controls.

STEP 1. Air in dual servo cylinders.

Cycle controls, through full stroke, 10 times with more than 850 psi pressure applied to eliminate air. Some chatter is normal in the directional servo actuator when rotor is not turning.

STEP 2. Dual servo cylinder mounting bearings loose.

Adjust bearings (paragraph 7-153 or 7-169).

STEP 3. Any looseness in dual servo cylinders.

Replace dual servo cylinder (paragraph 7-153 or 7-169).

17. Tail rotor control pedals creeping.

STEP 1. Tail rotor control hydraulic servo actuator hoses misaligned, causing unequal pressure.

Readjust and align hoses until pedals hold position (paragraph 7-141).

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

18. Four full strokes, minimum, still not obtainable on collective control.

STEP 1. Faulty nitrogen precharge.

Service nitrogen system (paragraph 1-12) (C145.1).

STEP 1. Faulty collective accumulator.

Replace accumulator and charge with nitrogen and hydraulic fluid (paragraph 7-107).

19. Hydraulic pressure available (warning light on).

STEP 1. Module pressure switch inoperative.

Replace pressure switch (paragraph 7-60).

STEP 2. Electrical wiring in pressure switch circuit faulty.

Check electrical wire circuitry for proper hookup and continuity. Repair or replace wiring as required (paragraph 9-264).

20. Check valve cracking pressure set lower than system pressure.

STEP 1. Check with hydraulic test stand.

Replace check valve (paragraph 7-25).

21. Cyclic stick will not stay in position.

STEP 1. Springs on cyclic servo control valves are mislocated, weak, or improperly adjusted.

See figures 7-27, 7-29 or 7-39 for proper spring and washer assembly. Replace weak springs. Adjust springs (paragraphs 7-155 or 7-171).

22. Hydraulic fluid transfers from one system to the other.

STEP 1. Inter-system leakage.

Refer to paragraph 7-3.

23. Coupling halves in drain circuit cannot be connected.

STEP 1. Drain valve button has been depressed prematurely (before coupling halves were connected).

Open bleed valve in line between drain valve and drain valve coupling half to relieve pressure.

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

24. Collective accumulator will not hold pressure in green band of gage.

STEP 1. Accumulator piston seal leaking.

Replace accumulator (paragraph 7-97).

25. Less than four full strokes of collective control available.

STEP 1. Improper nitrogen precharge in accumulator.

Properly charge accumulator with nitrogen (C145.1) (paragraph 7-107).

STEP 2. Improper hydraulic fluid charge in accumulator.

Use hydraulic test stand to charge accumulator.

STEP 3. Internal leakage in the collective servo control valve.

Replace hydraulic servo cylinder assembly (paragraphs 7-153 or 7-169).

NOTE

If hydraulic test stand is not available, qualified personnel may run-up helicopter to provide necessary hydraulic power.

STEP 4. Defective pressure relief valve.

Replace the valve.

STEP 5. Accumulator lockout valve defective.

Replace accumulator lockout valve (paragraph 7-74).

26. Low hydraulic pressure.

STEP 1. Module relief valve malfunctioning.

Replace module assembly (paragraph 7-53).

STEP 2. Filter indicator(s) extended.

Replace filters (paragraph 7-46).

STEP 3. Faulty hydraulic pump.

If pump readings not within tolerance, replace pump (paragraph 7-17).

Table 7-2. Troubleshooting of Hydraulic System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
27. Collective stick binds.	
STEP 1. Collective stick binds during collective accumulator bleed-down.	Inspect main rotor feather bearing for binding or evidence of teflon dust.

7-7. Servicing — Hydraulic System. Fill reservoirs (1 and 2, figure 7-1) to overflow with hydraulic fluid (C112 or C112.1)

7-8. HYDRAULIC RESERVOIRS.

7-9. Description — Hydraulic Reservoirs. Two reservoirs are mounted on the cabin aft bulkhead just to the right of helicopter centerline. Access to these units is gained by opening the right transmission cowling. The outboard reservoir supplies System No. 2, and the inboard reservoir supplies System No. 1. Each reservoir has a total capacity of 3.2 U.S. pints and is equipped with a sight gage which is visible when the reservoir right transmission cowling is open. Drain valves are located in the bottom of each reservoir, and a screened vent is located at the top of each unit (figures 7-1 and 7-3).

CAUTION

Careful inspection shall be made of fluid level sight gages to be sure they are not stained internally and giving erroneous indications of fluid level. Faulty or stained glasses shall be cleaned or replaced. Protective covers shall be installed on all open ports and lines.

7-10. Removal — Hydraulic Reservoirs.

CAUTION

Install protective covers on all open ports and lines.

a. Open right transmission cowling (3, figure 2-19).

b. Remove System No. 2 reservoir assembly as follows:

(1) Place a container under drain valve (35, figure 7-3) and open valve.

(2) Deleted.

(3) Disconnect tube (21, figure 7-3) from fitting (22). Install protective plug on tube.

(4) Disconnect hose (20) from relief valve (19). Install protective plug on hose connector.

(5) Disconnect hose (10) from fitting (9). Install protective plug on hose connector.

(6) Remove bolts (1) and washers (2) attaching reservoir (3) to bulkhead and remove reservoir. Place reservoir on clean work bench.

c. Disassemble System No. 2 reservoir assembly as follows:

(1) Loosen nut (23) and remove fitting (22) from reservoir. Remove packing (25), backup ring (24), and nut (23) from fitting (22). Discard packing.

(2) Remove relief valve (19) from bushing (17). Remove packing (18) from relief valve and discard packing.

(3) Remove bushing (17) from reservoir (3). Remove packing (16) from bushing and discard packing.

(4) Loosen nut (13) and remove baffle (12) from reservoir (3). Remove packing (15), backup ring (14), and nut (13) from baffle and discard packing.

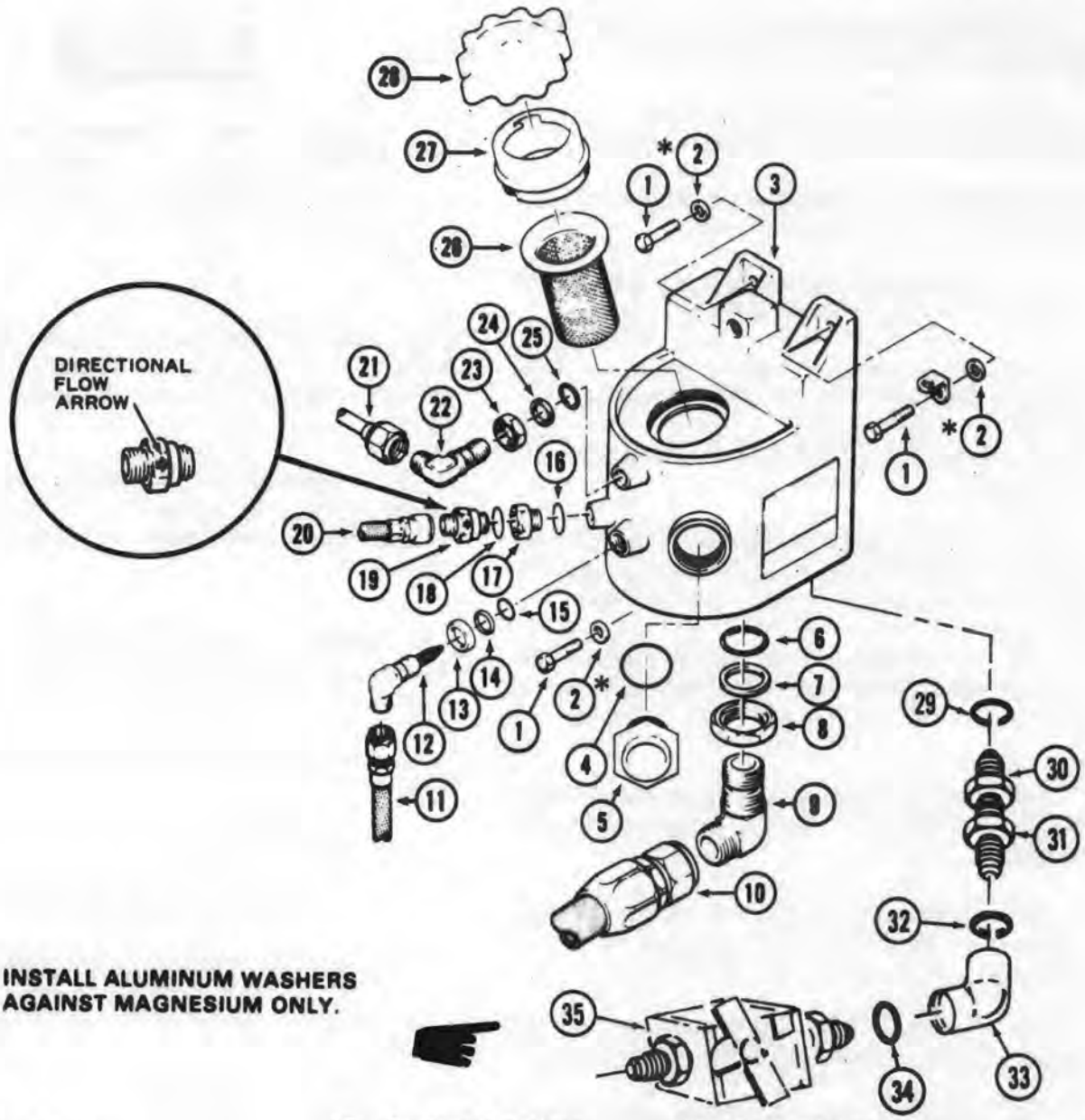
(5) Loosen nut (8) and remove fitting (9) from reservoir (3). Remove packing (6), backup ring (7), and nut (8) from fitting and discard packing.

(6) Disconnect chain from reservoir and remove cap assembly (28). Remove adapter (27) and strainer (26) from reservoir (3).

(7) Remove lockwire from level sight gage (5) and remove level sight gage from reservoir (3). Remove packing (4) from level sight gage and discard packing.

d. Remove System No. 1 reservoir assembly as follows:

(1) Place a container under drain valve (34, figure 7-4) and open valve.



1. Bolt
* 2. Washer
3. Reservoir
4. Preformed packing
5. Level sight gage
6. Preformed packing
7. Backup ring
8. Nut
9. Fitting (Elbow)
10. Hose
11. Tube
12. Baffle
13. Nut
14. Backup ring
15. Preformed packing
16. Preformed packing
17. Bushing
18. Preformed packing
19. Relief valve
20. Hose
21. Tube
22. Fitting (Elbow)
23. Nut
24. Backup ring
25. Preformed packing
26. Strainer
27. Adapter
28. Cap assembly
29. Preformed packing
30. Nut
31. Nipple
32. Packing
33. Elbow
34. Packing
35. Valve

Figure 7-3. Reservoir and sight glass replacement — system No. 2

(2) Disconnect tube (24, figure 7-4) from fitting (23). Install protective plug to connector.

(3) Disconnect hose (19) from relief valve (18). Install protective plug to connector of hose.

(4) Disconnect hose (10) from baffle (11). Install protective plug to connector of hose.

(5) Disconnect hose (9) from fitting (8). Install protective plug to connector of hose.

(6) Remove bolts (1), and washers (2) from brackets (3) and reservoir (4). Remove reservoir.

e. Disassemble System No. 1 reservoir assembly as follows:

(1) Loosen nut (22) and remove fitting (23) from reservoir (4). Remove packing (20), backup ring (21), and nut (22) from fitting and discard packing.

(2) Remove relief valve (18) from bushing (16). Remove packing (17) from relief valve and discard packing.

(3) Remove bushing (16) from reservoir (4). Remove packing (15) from bushing and discard packing.

(4) Loosen nut (12) and remove baffle (11) from reservoir (4). Remove packing (14), backup ring (13), and nut (12) from baffle and discard packing.

(5) Remove fitting (8) from reservoir (4). Remove packing from fitting and discard packing.

(6) Remove lockwire from level sight gage (6). Remove level sight gage (6) from reservoir (4). Remove packing (5) from level sight age and discard packing.

(7) Disconnect chain from reservoir (4) and remove cap assembly (27). Remove adapter (26), and strainer (25) from reservoir (4).

7-11. Level Sight Gage Replacement — Hydraulic Reservoir. (Paragraph 7-8).

7-12. Cleaning — Hydraulic Reservoir. a. Flush reservoir (3, figure 7-3 or 4, figure 7-4) with clean hydraulic fluid (C112 or C112.1).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Clean strainer (26, figure 7-3 or 25, figure 7-4), baffle (12, figure 7-3 or 11, figure 7-4), external surface of reservoir, fittings, and nuts with solvent (C205).

7-13. Inspection — Hydraulic Reservoirs. a. Inspect strainer (26, figure 7-3 or 25, figure 7-4) for rust, corrosion, and breaks. No tears allowed in screen.

b. Inspect level sight gage (5, figure 7-3 or 6, figure 7-4) for scratches, cracks, crazing, or damage that would impair indication.

c. Damage limits for each boss, port, or fitting are as follows:

(1) Depth: one-third of thread.

(2) Length: one-third of pitch diameter.

(3) Number of repairs: two per segment.

d. Inspect mating parts for damage and crossed threads.

e. No cracks allowed.

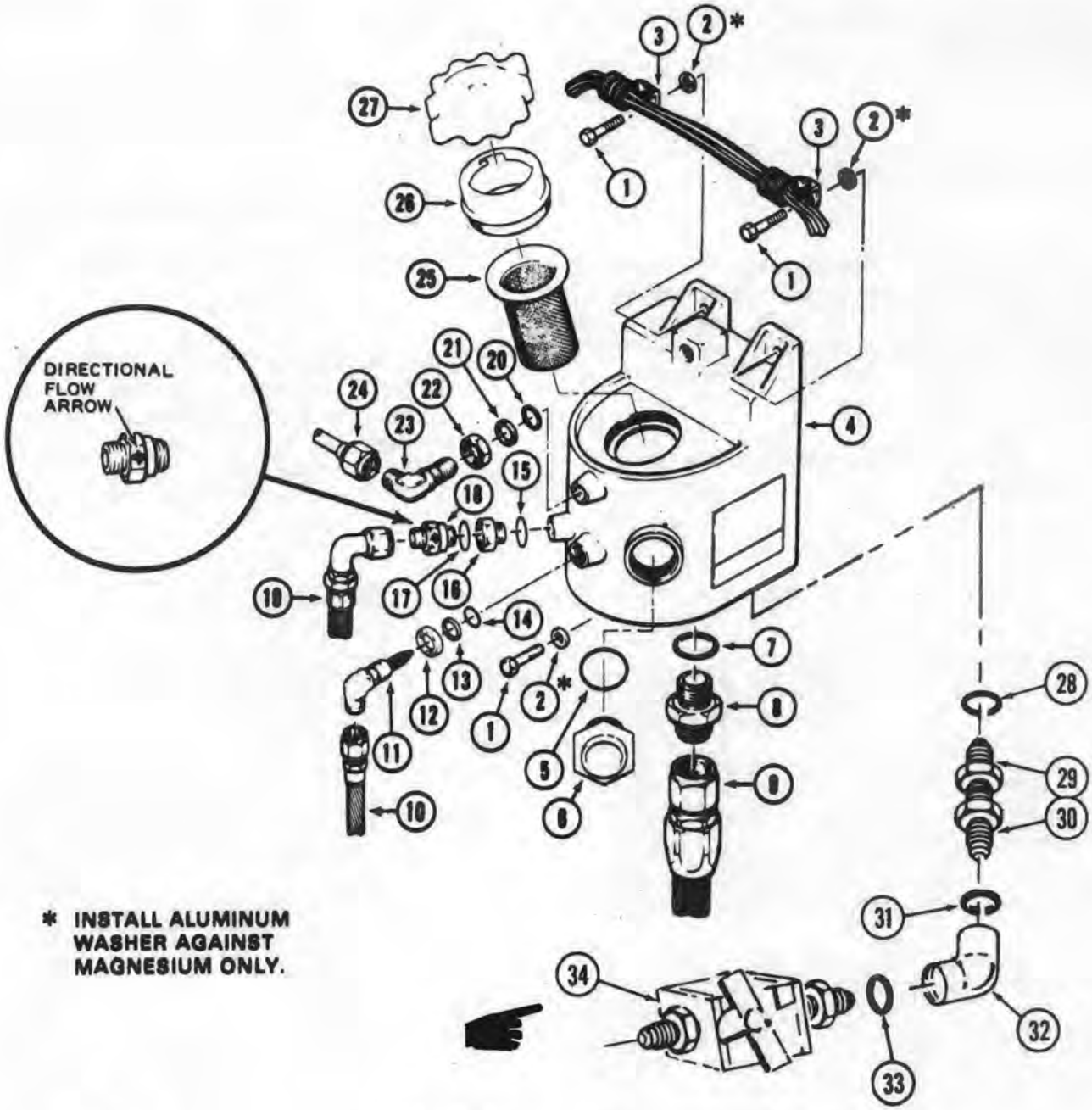
f. Maximum depth of reparable mechanical damage (reference nicks, scratches, gouges, dents, etc.) to the reservoir is **0.040** inch deep after cleanup.

g. Corrosion damage to reservoir shall not exceed **0.020** inch in depth prior to cleanup and **0.040** inch depth after cleanup.

h. Inspect system for leaks.

i. Inspect drain plug, level sight gage (5, figure 7-3 or 6, figure 7-4) and cap assembly (28, figure 7-3 or 27, figure 7-4) for proper locking and safetying.

j. Inspect drain lines for obstructions.



1. Bolt
* 2. Washer
3. Bracket
4. Reservoir
5. Preformed packing
6. Level sight gage
7. Preformed packing
8. Fitting (union)
9. Hose
10. Hose
11. Baffle
12. Nut
13. Backup ring
14. Preformed packing
15. Preformed packing
16. Bushing
17. Preformed packing
18. Relief valve
19. Hose
20. Preformed packing
21. Backup ring
22. Nut
23. Fitting (elbow)
24. Tube
25. Strainer
26. Adapter
27. Cap assembly
28. Preformed packing
29. Nut
30. Nipple
31. Packing
32. Elbow
33. Packing
34. Valve

Figure 7-4. Reservoir and sight glass replacement — system No. 1

k. Drain a small quantity of hydraulic fluid from bottom of reservoir and inspect for contaminants. If contaminants are evident, flush system (paragraph 7-5).

l. Inspect reservoir and attaching components for cleanliness and proper security.

7-14. Repair or Replacement — Hydraulic Reservoirs (AVIM). a. Any part that fails inspection requirements outlined in above paragraph 7-13 requires part to be replaced without repair. For repairs of corrosion damage to parts, refer to TM 43-0105.

b. Parts containing cracks require replacement without repair.

c. Replace level sight gage (5, figure 7-3 or 6, figure 7-4) if discolored.

d. Replace backup rings (7, 14, and 24, figure 7-3 or 13 and 21, figure 7-4) when damaged beyond serviceability.

e. Replace all preformed packings.

7-15. Installation — Hydraulic Reservoirs.

NOTE

Apply a coat of hydraulic fluid (C112 or C112.1) to all fluid connections prior to installation. All fluid connections will be torqued in accordance with limits outlined in table 7-3.

Table 7-3. Torque Values for Fluid Connections

*TORQUE VALUES FOR AIRFRAME FLUID CONNECTIONS

Dash Number Reference	Tubing OD (Inches)	WRENCH TORQUES FOR TIGHTENING AN 818 NUT (inch/pounds) Al. Tubing (Flare MS33583 or MS33584) Min.	Al. Tubing (Flare MS33583 or MS33584) Max.	Steel Tubing (Flare MS33584) Min.	Steel Tubing (Flare MS33584) Max.	Hose End Fittings and Hose Assemblies (MS28740) (MS38759) Min.	Hose End Fittings and Hose Assemblies (MS28740) (MS38759) Max.
	1/8	—	—	—	—	—	—
-3	3/16	—	—	90	100	70	100
-4	1/4	40	65	135	150	70	120
-5	5/16	60	80	180	200	85	180
-6	3/8	75	125	270	300	100	250
-8	1/2	150	250	450	500	210	420
-10	5/8	200	350	650	700	300	480
-12	3/4	300	500	900	1000	500	850
-16	1	500	700	1200	1400	700	1150
-20	1 1/4	600	900	—	—	—	—
-24	1 1/2	600	900	—	—	—	—
-28	1 3/4	—	—	—	—	—	—
-32	2	—	—	—	—	—	—

*Flareless tubing connections shall be tightened as follows: Tighten the MS21921 nut 1/6 to 1/3 turns (1/2 HEX flats) past the point of sharp torque rise on all sizes and materials for all types of fittings or tubes.

NOTE: The 1/6 to 1/3 turns (performed after the presetting operation) is the final installation torque.

a. Assemble System No. 1 reservoir assembly as follows:

NOTE

Hydraulic fluid (C112 or C112.1) shall be applied to all threads and packings prior to installation, with the exception of adapter (26, figure 7-4). Assembly of reservoir must be accomplished on a clean work bench.

(1) Close drain valve (34).

(2) Install packing (5) on level sight gage (6) and install level sight gage to reservoir (4). Secure level sight gage to reservoir with lockwire (C127).

(3) Install packing (7) on fitting (8) and install fitting in bottom SUCTION port of reservoir (4).

(4) Install nut (12), backup ring (13), and packing (14) on baffle (11). Position and install baffle as shown to RETURN port of reservoir and tighten nut (12) against reservoir.

(5) Install packing (15) on bushing (16) and install bushing in PRESSURE port of reservoir.

(6) Install packing (17) on relief valve (18). Position relief valve (with arrow pointing toward reservoir) and install relief valve in bushing (16).

(7) Install nut (22), backup ring (21), and packing (20) on fitting (23). Position and install fitting as shown to CASE DRAIN port and tighten nut (22) against reservoir.

(8) Install strainer (25) in reservoir.

(9) Apply primer (C167) to threads of adapter (26) and install adapter to reservoir (4).

(10) Install cap assembly (27) to reservoir (4) and secure chain to reservoir.

b. Install System No. 1 reservoir assembly as follows:

(1) Apply primer (C167) to shank of bolts (1). Position reservoir (4) to cabin bulkhead, place brackets (3) on reservoir, and install bolts (1) and (aluminum) washers (2).

NOTE

For proper torque requirements for tube and hose fluid connectors, refer to table 7-3.

(2) Install tube (24) to fitting (23).

(3) Install hose (19) to relief valve (18).

(4) Install hose (10) to baffle (11).

(5) Install hose (9) to fitting (8).

c. Service System No. 1 reservoir (paragraph 1-12).

d. Using helicopter power (TM 55-1520-220-10), bleed air from System No. 1 (paragraph 7-4). Shut down engine (TM 55-1520-220-10).

e. Assemble System No. 2 reservoir assembly as follows:

NOTE

Hydraulic fluid (C112 or C112.1) shall be applied to all threads of relief valve, fittings, level sight gage, bushing, and tube and hose connectors, and packings prior to installation with the exception of adapter (27, figure 7-3). Assembly of reservoir must be accomplished on a clean work bench.

(1) Close drain valve (35).

(2) Install packing (4) on level sight gage (5) and install level sight gage to reservoir (3). Secure level sight gage to reservoir with lockwire (C127).

(3) Install strainer (26) into reservoir (3).

(4) Apply primer (C167) to threads of adapter (27) and install adapter into reservoir (3).

(5) Install cap assembly (28) and secure chain to reservoir (3).

(6) Install packing (6) and backup ring (7) on fitting (9). Thread and position fitting (9), as shown, into SUCTION port on bottom of reservoir and tighten against reservoir.

(7) Install nut (13), backup ring (14), and packing (15) on baffle (12). Thread and position baffle (12), as shown, into RETURN port of reservoir (3) and tighten nut (13) against reservoir.

(8) Install packing (16) on bushing (17) and install bushing in PRESS port of reservoir (3).

(9) Install packing (18) on relief valve (19) and install relief valve (with arrow pointing toward reservoir) to bushing (17).

(10) Install nut (23), backup ring (24), and packing (25) on fitting (22). Thread and position fitting in CASE DRAIN port of reservoir and tighten nut (23) against reservoir.

f. Install System No. 2 reservoir assembly as follows:

(1) Apply primer (C167) to shank of bolts (1, figure 7-3). Position reservoir to cabin bulkhead; install bolts (1) and washers (aluminum) (2).

NOTE

For proper torque requirements for tube and hose fluid connectors, refer to table 7-3.

(2) Install tube (21) to fitting (22).

(3) Install tube (11) to baffle (12).

(4) Install hose (10) to fitting (9).

(5) Install hose (20) to relief valve (19).

g. Service System No. 2 reservoir (paragraph 1-12).

h. Using helicopter power (TM 55-1520-220-10), bleed air from System No. 2 (paragraph 7-4). Shut down engine.

i. Close right transmission cowling (3, figure 2-19).

7-16. Painting — Hydraulic Reservoirs. Repairs to external surfaces of reservoir after properly treated may be touched-up with primer (C167).

7-17. HYDRAULIC PUMPS.

7-18. Description — Hydraulic Pumps. Each system consists of a variable delivery, pressure-compensated pump (figure 7-1). The pumps are mounted on the transmission lower case and furnish hydraulic pressure to the servo control assemblies through the module assemblies, which are attached to the right side of the cabin aft bulkhead. Pressure required for system operation is pre-set on each pump, which supplies flow on demand.

NOTE

Maximum allowable leakage for in-service components of the hydraulic pump is as follows:

Output Shaft — dynamic — 8 drops/minute

Output Shaft — static (through seal) — 1 drop/minute

Housing (mating surfaces) — static — 2 drops/day

7-19. Removal — Hydraulic Pumps. a. Open right transmission cowling (3, 7, figure 2-19).

b. System No. 1 Pump Assembly. Remove System No. 1 pump assembly (7, figure 7-6) as follows:

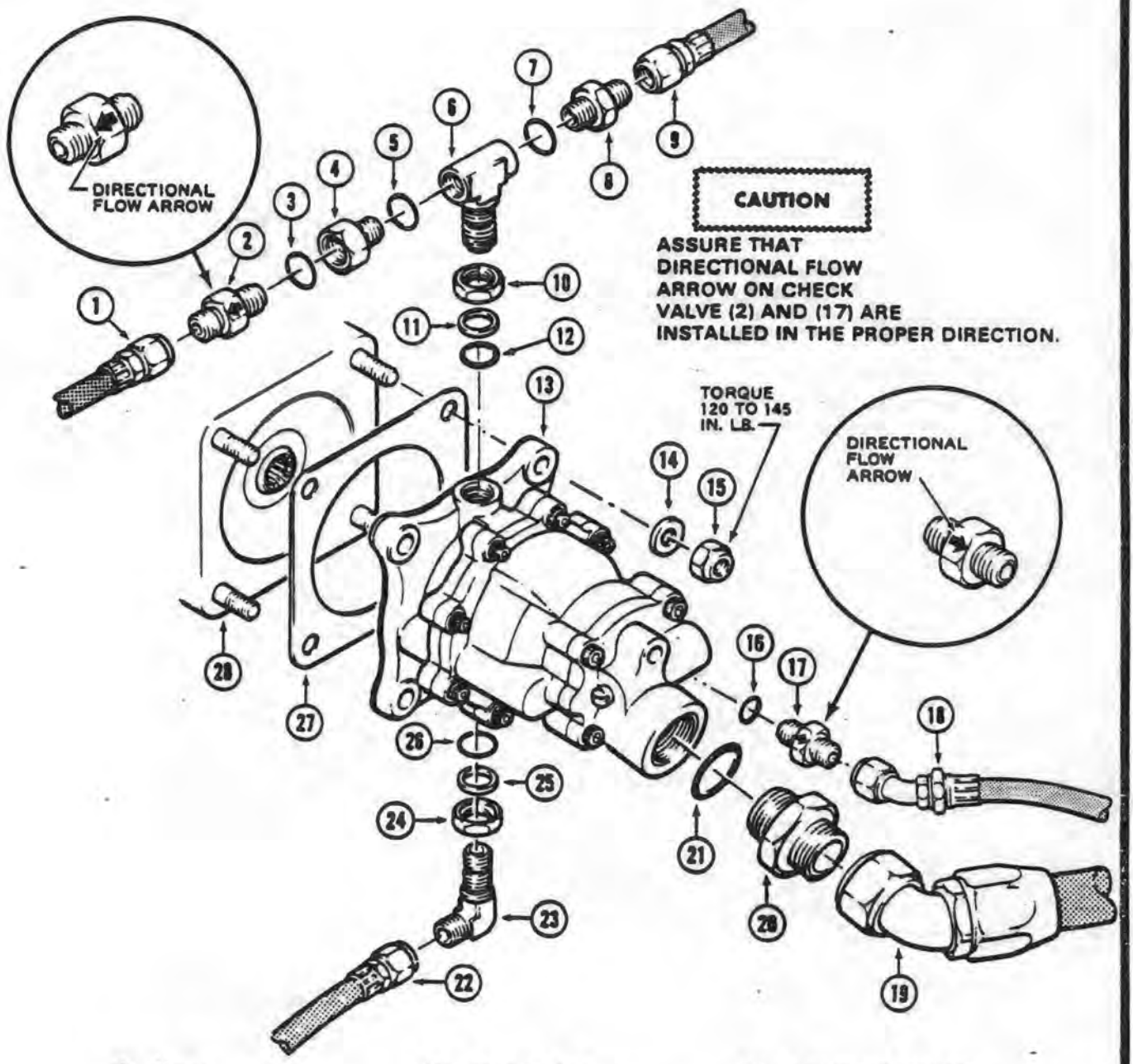
(1) Drain hydraulic fluid from System No. 1 reservoir (4, figure 7-4) (paragraph 7-10).

(2) Place shop towels or container under pump (7, figure 7-6), loosen hose (13) connector slowly and drain fluid from hose. Remove hose. Install protective plug to hose connector to prevent entry of dirt.

(3) Loosen hose (10) connector slowly and remove hose. Install protective plug to connector to prevent entry of dirt.

(4) Remove hoses (1 and 3) from fitting (2). Install protective plugs to hose connectors.

(5) Remove hose (16) from fitting (17). Install protective plug to hose connector.



1. Hose
2. Check valve
3. Preformed packing
4. Bushing
5. Preformed packing
6. Fitting (Tee)
7. Preformed packing
8. Fitting (Union)
9. Hose
10. Nut
11. Backup ring
12. Preformed packing
13. Pump
14. Washer (4)
15. Nut (4)
16. Preformed packing
17. Check valve
18. Hose
19. Hose
20. Fitting (Union)
21. Preformed packing
22. Hose
23. Fitting (Elbow)
24. Nut
25. Backup ring
26. Preformed packing
27. Gasket
28. Accessory drive quill pad

Figure 7-5. Hydraulic pump assembly (system No. 2) — removal and installation

(6) Remove nuts (12) and washers (11) from studs of accessory drive quill pad (22) and remove pump (7) and gasket (21). Drain fluid from pump. Discard gasket.

(7) Remove check valve (9) from pump (7) and remove packing (8) from check valve. Discard packing.

(8) Remove fitting (14) from pump (7). Remove packing (15) from fitting. Discard packing.

(9) Loosen nut (18) and remove fitting (17). Remove packing (20), backup ring (19), and nut (18) from fitting. Discard packing and backup ring.

(10) Loosen nut (4) and remove fitting (2) from pump (7). Remove packing (6), backup ring (5), and nut (4) from fitting. Discard packing and backup ring.

(11) Install protective plugs to all open ports of pump (7) with exception of CASE DRAIN port.

(12) Fill pump (7) with preservative hydraulic fluid (C113) through CASE DRAIN port and install protective plug into port. Tag and forward pump to Depot for repairs.

c. System No. 2 Pump Assembly. Remove System No. 2 pump assembly (13, figure 7-5) as follows:

(1) Drain hydraulic fluid from System No. 2 reservoir (3, figure 7-3) (paragraph 7-10).

(2) Place shop towels or container under pump (13, figure 7-5), loosen hose (19) connector slowly and drain fluid from hose. Remove hose. Install protective plug to hose connector.

(3) Loosen hose (18) connector slowly and remove hose. Install protective plug.

(4) Remove hoses (1 and 9) from check valve (2) and fitting (8). Install protective plugs to hose connectors to prevent entry of dirt.

(5) Remove hose (22) from fitting (23). Install protective plug to hose connector.

(6) Remove nuts (15) and washers (14) from studs of accessory drive quill pad (28) and remove pump (13) and gasket (27). Discard gasket. Drain fluid from pump.

(7) Remove check valve (2) from bushing (4). Remove packing (3) from check valve (2) and discard packing.

(8) Remove bushing (4) from fitting (6). Remove packing (5) from bushing (4) and discard packing.

(9) Remove fitting (8) from fitting (6). Remove packing (7) from fitting (8) and discard packing.

(10) Loosen nut (10) and remove fitting (6) from pump (13). Remove packing (12), backup ring (11), and nut (10) from fitting. Discard packing and backup ring.

(11) Remove check valve (17) from pump (13). Remove packing (16) from check valve (17) and discard packing.

(12) Remove fitting (20) from pump (13). Remove packing (21) from fitting (20) and discard packing.

(13) Loosen nut (24) and remove fitting (23) from pump (13). Remove packing (26), backup ring (25), and nut (24) from fitting (23). Discard packing and backup ring.

(14) Install protective plugs to all open ports of pump (13) with exception of CASE DRAIN port.

(15) Fill pump (13) with preservative hydraulic fluid (C113) through CASE DRAIN port and install protective plug into port. Tag and forward pump to Depot for repairs.

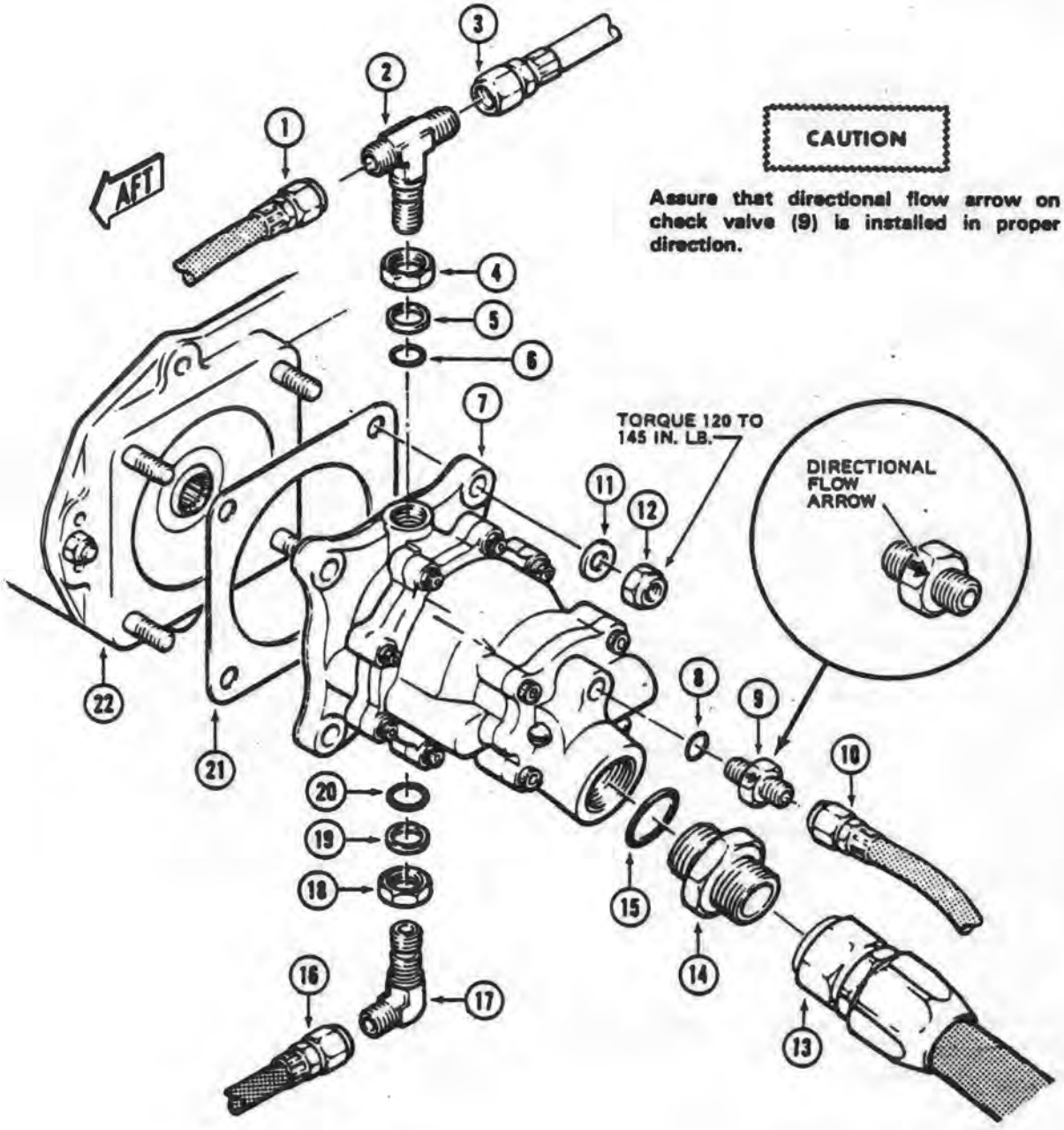
7-20. Cleaning — Hydraulic Pumps.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not submerge pump in dry cleaning solvent as it might cause internal damage.



1. Hose
2. Fitting (Tee)
3. Hose
4. Nut
5. Backup ring
6. Preformed packing
7. Pump
8. Preformed packing
9. Check valve
10. Hose
11. Washer (4)
12. Nut (4)
13. Hose
14. Fitting (Union)
15. Preformed packing
16. Hose
17. Fitting (Elbow)
18. Nut
19. Backup ring
20. Preformed packing
21. Gasket
22. Accessory drive quill pad

Figure 7-6. Hydraulic pump assembly (system No. 1) — removal and installation

a. Clean external surfaces of hydraulic pump (13, figure 7-5) with a soft bristle brush (C32) and solvent (C205).

WARNING

Goggles will be worn when using compressed air. Do not allow more than 5 psi air pressure to come in contact with skin.

b. Blow dry pump with clean, filtered, compressed air.

7-21. Inspection—Hydraulic Pumps. a. Inspect hydraulic pump (13, figure 7-5) for evidence of leakage.

b. Inspect pump for cracks, corrosion, dents, deep scratches or damage to splines of shaft. If damage is found, send pump to next higher level of maintenance for repairs. No cracks allowed.

c. Inspect all fittings, elbows, reducers, nuts, hoses, and check valve for cracks, corrosion, dents, thread damage and deterioration. No cracks allowed.

d. Inspect pump, nuts, and hose assemblies for security.

7-22. Repair or Replacement — Hydraulic Pump. a. Replace unserviceable fittings, reducers, elbows, nuts, and hoses.

b. Replace all packings, backup rings, and gaskets.

c. Replace pump if damage limits are exceeded or malfunction occurs, and forward pump to next higher level of maintenance.

d. Any cracks to pump require replacement of pump.

7-23. Installation—Hydraulic Pumps. a. System No. 2 Pump. Install components to System No. 2 hydraulic pump (13, figure 7-5) as follows:

NOTE

All fluid connections will be properly torqued in accordance with limits outlined in table 7-3. When preparing replacement pump for installation, ensure that all hose assemblies are clean and are not frayed or cracked. All threads of connections will have hydraulic fluid (C112 or C112.1) applied to them prior to installation. If replacement of pump is required, preservative fluid must be drained. Flush replacement pump with clean hydraulic fluid (C112 or C112.1).

(1) Remove all protective plugs from replacement pump (13, figure 7-5) and drain preservative fluid from pump.

(2) Flush replacement pump (13) with clean hydraulic fluid (C112 or C112.1).

(3) Install nut (24), backup ring (25), and packing (26) on fitting (23). Install and position fitting into SEAL DRAIN port of pump (13) and tighten nut (24) against pump.

(4) Install packing (21) on fitting (20). Install fitting (20) into SUCTION port of pump (13).

CAUTION

Make sure directional flow arrow on check valve (17) is installed in the proper direction (figure 7-5).

(5) Install packing (16) on check valve (17) and install check valve into PRESS port of pump (13).

(6) Install packing (7) on fitting (8) and install fitting into fitting (6).

(7) Install packing (5) on bushing (4) and install bushing into fitting (6).

CAUTION

Make sure directional flow arrow on check valve (2) is installed in the proper direction (figure 7-5).

(8) Install packing (3) on check valve (2) and install check valve into bushing (4).

(9) Install nut (10), backup ring (11), and packing (12) on fitting (6). Install and position fitting (6), as shown, into CASE DRAIN port on top of pump (13) and tighten nut (10) against pump.

b. Install pump (13) to accessory drive quill pad (28) as follows:

(1) Place new gasket (27) over studs of accessory drive quill pad (28).

(2) Apply a coat of grease (C111) or anti-seize compound (C28) to splines of pump shaft and splines of accessory drive quill pad (28).

(3) While holding pump (13) level, fill pump (through CASE DRAIN port) with hydraulic fluid (C112 or C112.1). Place pump (13) over studs of accessory drive quill pad (28) and install washers (14) and nuts (15). Torque nuts **120 TO 145** inch-pounds.

(4) Remove protective plug from hose assemblies (1, 9, 18, 19, and 22):

CAUTION

Do not allow hose to kink, twist, or chafe surrounding components upon installation.

(5) Install hose (22) to fitting (23).

(6) Install hose (18) to check valve (17).

(7) Install hose (19) to fitting (20).

(8) Install hoses (1 and 9) to check valve (2) and fitting (8).

c. Check that hoses are not kinked or chafing.

NOTE

Ensure hydraulic reservoirs are full in order to completely fill reservoir to pump line and pump case drain port. If pump case drain port and reservoir to pump line are not completely filled before connecting line to pump, air will be trapped in pump. Extensive bleeding procedures will then be necessary.

d. Service System No. 2 reservoir with hydraulic fluid (C112 or C112.1) to overflow level.

e. Bleed and test hydraulic System No. 2 (paragraph 7-4).

f. Perform test procedure of hydraulic pump (13, figure 7-5) (paragraph 7-24).

g. **System No. 1 Pump.** Install components to System No. 1 hydraulic pump (7, figure 7-6) as follows:

NOTE

All fluid connections will be properly torqued in accordance with limits outlined in table 7-3. When preparing replacement pump for installation, ensure that all hose assemblies are clean and are not frayed or cracked. All threads of connections will have hydraulic fluid (C112 or C112.1) applied to them prior to installation. If replacement pump is required, preservative fluid must be drained. Flush replacement pump with clean hydraulic fluid (C112 or C112.1).

(1) Remove all protective plugs from replacement pump (7, figure 7-6).

(2) Flush replacement pump (7) with clean hydraulic fluid (C112 or C112.1).

(3) Install nut (18), backup ring (19), and packing (20) on fitting (17). Position and install fitting (17), as shown, into SEAL DRAIN port of pump (7) and tighten nut (18) against pump.

(4) Install packing (15) on fitting (14) and install fitting into SUCTION port of pump (7).

CAUTION

Make sure directional flow arrow on check valve (9) is installed in the proper direction as shown in figure 7-6.

(5) Install packing (8) on check valve (9) and install check valve (with directional flow arrow pointing away from pump) into PRESS port of pump (7).

(6) Install nut (4), backup ring (5), and packing (6) on fitting (2). Position and install fitting as shown, and tighten nut (4) against pump.

h. Install pump (7) to accessory drive quill pad (22) as follows:

(1) Place new gasket (21) over studs of accessory drive quill pad (22).

(2) Apply a coat of grease (C111) or anti-seize compound (C28) to splines of pump shaft and splines of accessory drive quill pad (22).

(3) While holding pump (7) level, fill pump (through CASE DRAIN port) with hydraulic fluid (C112 or C112.1). Place pump (13) over studs of accessory drive quill pad (22) and install washers (11) and nuts (12). Torque nuts **120 TO 145** inch-pounds.

(4) Remove protective plugs from hose assemblies (1, 3, 10, 13 and 16).

CAUTION

Do not allow hose to kink, twist, or chafe surrounding components upon installation.

(5) Install hose (16) to fitting (17).

(6) Install hose (10) to check valve (9).

(7) Install hose (13) to fitting (14).

(8) Install hoses (1 and 3) to fitting (2).

i. Check that hoses are not kinked or chafing.

NOTE

Make sure hydraulic reservoirs are full in order to completely fill reservoir to pump line and pump CASE DRAIN port. If pump CASE DRAIN port and reservoir to pump line are not completely filled before connecting line to pump, air will be trapped in pump. Extensive bleeding procedures will then be necessary.

j. Service System No. 1 reservoir with hydraulic fluid (C112 or C112.1) to overflow level.

k. Bleed and test hydraulic System No. 1 (paragraph 7-4).

l. Perform test procedures of hydraulic pump (7, figure 7-6) (paragraph 7-24).

7-24. Test Procedures—Hydraulic Pumps. a. Start and ground run helicopter at engine idle (TM 55-1520-220-10) and functionally check operation of hydraulic pump (7, figure 7-6, and 13, figure 7-5).

b. Check for leakage of fittings or hose connections.

c. Shut down engine (TM 55-1520-220-10).

7-25. CHECK VALVES.

7-26. Description — Check Valves. Twelve check valves (eleven in hydraulic system and one in armament system) allow fluid to flow, one direction only, in lines during movement of flight controls.

7-27. Removal — Check Valves. Remove check valve, as required to perform necessary maintenance functions.

7-28. Inspection — Check Valves. a. Inspect check valves for cracks.

b. Inspect check valves for corrosion or thread damage, when removed.

c. Inspect check valves for security.

d. Inspect check valves for evidence of fluid leakage.

7-29. Repair or Replacement — Check Valves. a. Any evidence of cracks requires replacement of part.

c. Visually inspect coupling half assembly (1) and coupling halves (5 and 6) and connection of hose (7) for leaks.

7-37. Repair or Replacement — Ground Test Connections. a. Any cracks or damaged threads to test couplings (figure 7-7) or attaching components requires replacement of part.

b. Any corrosion damage to interior areas, or threads of coupling half, hose or tube assembly requires replacement of part.

WARNING

Chemical film material and primers are flammable and toxic. Provide adequate ventilation. Do not use near fire or open flame.

c. Minor corrosion on exterior surfaces of hose assembly (8) or coupling halves is allowed, provided damaged areas are polished out with 600 grit sandpaper (C185.2), treated with chemical film material (C42), followed with a light coat of thinned primer (C167).

d. Any evidence of leaks to coupling half requires replacement of part.

e. Replace all preformed packings.

7-38. Installation — Ground Test Connections.

NOTE

All threads and preformed packings will have hydraulic fluid (C112 or C112.1) applied to them prior to installation.

a. Remove protective plugs, if installed, from ports of filter module (3, figure 7-7).

b. Install packing (2) on coupling half assembly (1) and install coupling half assembly into PRESS port of filter module (3). Connect lanyard (8) to filter module. Secure coupling half assembly (1) together.

c. Install packing (4) to coupling half (5) and install coupling half to filter module (3).

d. Connect coupling half (6) to coupling half (5). Secure together with lockwire (C127).

e. Install hose (7) to coupling half (6).

f. Close drain valve (35, figure 7-3 or 34, figure 7-4).

g. Service reservoir to proper level with hydraulic fluid (C112 or C112.1).

h. Using hydraulic test stand bleed and test hydraulic system (paragraph 7-4).

i. Check system for leaks. Remove hydraulic test stand.

j. Close and secure right transmission cowling (3, figure 2-19).

7-39. RELIEF VALVES.

7-40. Description — Relief Valves. There are five relief valves incorporated into the hydraulic system which relieves system pressure into the return circuit to prevent damage to the system or components. The relief valve(s) acts as a safety device that monitors system pressure and must not be used to adjust system pressure.

7-41. Removal — Relief Valves. a. Two relief valves are installed in the hydraulic module assemblies. Refer to paragraph 7-55 for module removal procedure.

b. Remove relief valves (11 and 41, figure 7-14) as follows:

WARNING

Before loosening any connections in the accumulator circuit, be certain that trapped hydraulic pressure is released. Do not press accumulator drain valve button with hydraulic systems operating.

(1) Connect coupling halves (14 and 15, figure 7-1).

(2) Relieve pressure from the accumulator system by pressing the button on top of drain valve (13).

(3) Disconnect tube from pressure port of relief valve (11, figure 7-14).

(4) Disconnect return port of relief valve from reducer (13) and remove relief valve (11).

(5) Remove reducer (9) from pressure port and remove preformed packings (10 and 12).

(6) Disconnect tube from return port of relief valve (41).

(7) Disconnect pressure port of relief valve from reducer (43) and remove relief valve (41).

(8) Remove union (39) from return port and remove preformed packings (40 and 42).

(9) Cap or cover all openings.

7-42. Cleaning — Relief Valves.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not submerge relief valve in solvent. Open ports of relief valve must be capped prior to cleaning.

a. Wash relief valve with clean cloth saturated with solvent (C205).

b. Allow relief valve to air dry.

7-43. Inspection — Relief Valves. a. Inspect relief valve and all tube assemblies for nicks, scratches, cracks, and dents or evidence of leakage.

b. Inspect relief valve for thread damage.

c. Inspect relief valve internally and externally for corrosion damage (TM 43-0105). No internal corrosion damage allowed.

7-44. Repair or Replacement — Relief Valves. a. Replace relief valve when malfunction exists.

b. Any internal corrosion damage to relief valve, or threads of ports of relief valve requires replacement of part.

c. No cracks or repairs allowed to relief valve.

d. Replace all packings and backup rings when removed.

WARNING

Chemical film material and primers are flammable and toxic. Provide adequate ventilation. Do not use near fire or open flame.

e. Minor corrosion scratches or gouges to the external surface of relief valve are allowed, provided damaged areas are polished out with 600 grit sandpaper (C185.2) to original finish and treated with chemical film material (C42) followed with a light application (by brush) of thinned primer (C167).

7-45. Installation — Relief Valves. Install relief valve(s) that have been removed, due to malfunction, or, to perform necessary maintenance functions.

7-46. MODULE FILTERS.

7-47. Description — Module Filters. Pressure and return filters of each module are standard hydraulic line filters enclosed in separate bowls screwed into bottom of module housing. Normal replacement of filters will be as scheduled in Preventive Maintenance Checklists. In addition, filters must be replaced when their indicator buttons (two on each module) are tripped during operation, except when the indicators can be reset and do not trip again or when the condition is known to be caused by fluid temperature below 20 degrees F (-6.7 degrees C). Part No. 205-076-034-7 filter element is a metal mesh element. P/N AN6235 series filter elements are made of paper (figure 7-8).

Premaintenance requirements for module filters

Conditions	Requirements
Model	All
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C47) (C54) (C67.2) (C77) (C79) (94.1) (C103) (C112) (C112.1) (C113) (C126) (C127) (C205) (C233)
Special Environmental Conditions	Clean, Dust Free Area

7-48. Removal — Module Filters. a. Turn battery switch OFF and disconnect external power, if connected to helicopter.

b. Open right transmission cowling (3, figure 2-19).

c. Open drain valve (35, figure 7-3 or 34, figure 7-4) and drain reservoir.

d. Remove lockwire from bowl (6, figure 7-8).

e. Remove bowl (6) from module (1) and drain fluid from bowl.

f. Remove retainer (3) from bowl (6) and remove element (5) from bowl.

g. Remove packing (4) from element (5) and discard packing.

h. Remove packing (2) from bowl (6) and discard packing.

i. Examine filter and all fluiid in filter bowl for unusual contamination which might indicate need for corrective action beyond replacement of the element.

j. The hydraulic filter element shall be a condition component to be removed and replaced every 3rd and 6th phase inspection.

NOTE

The filter element shall be unserviceable if any of the following is present: cracks, tears, separation, deterioration, corrosion, crushing, or collapse.

k. If red indicator button extends, operate hydraulic system until normal operating temperature is obtained. Reset button. If red indicator button extends again, filter element shall be considered unservicable and shall be replaced.

NOTE

Ignore extension of filter indicators if hydraulic fluid temperature is below plus 20 degrees F (minus 6.7 degrees C).

7-49. Inspection — Module Filters. a. Inspect filter element (5, figure 7-8) for contamination.

b. Inspect filter element (5) for tears and deformation.

7-50. Cleaning — Module Filters.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

Cleaning (Exterior). Wipe exterior of module filter with a soft cloth dampened with solvent (C205).

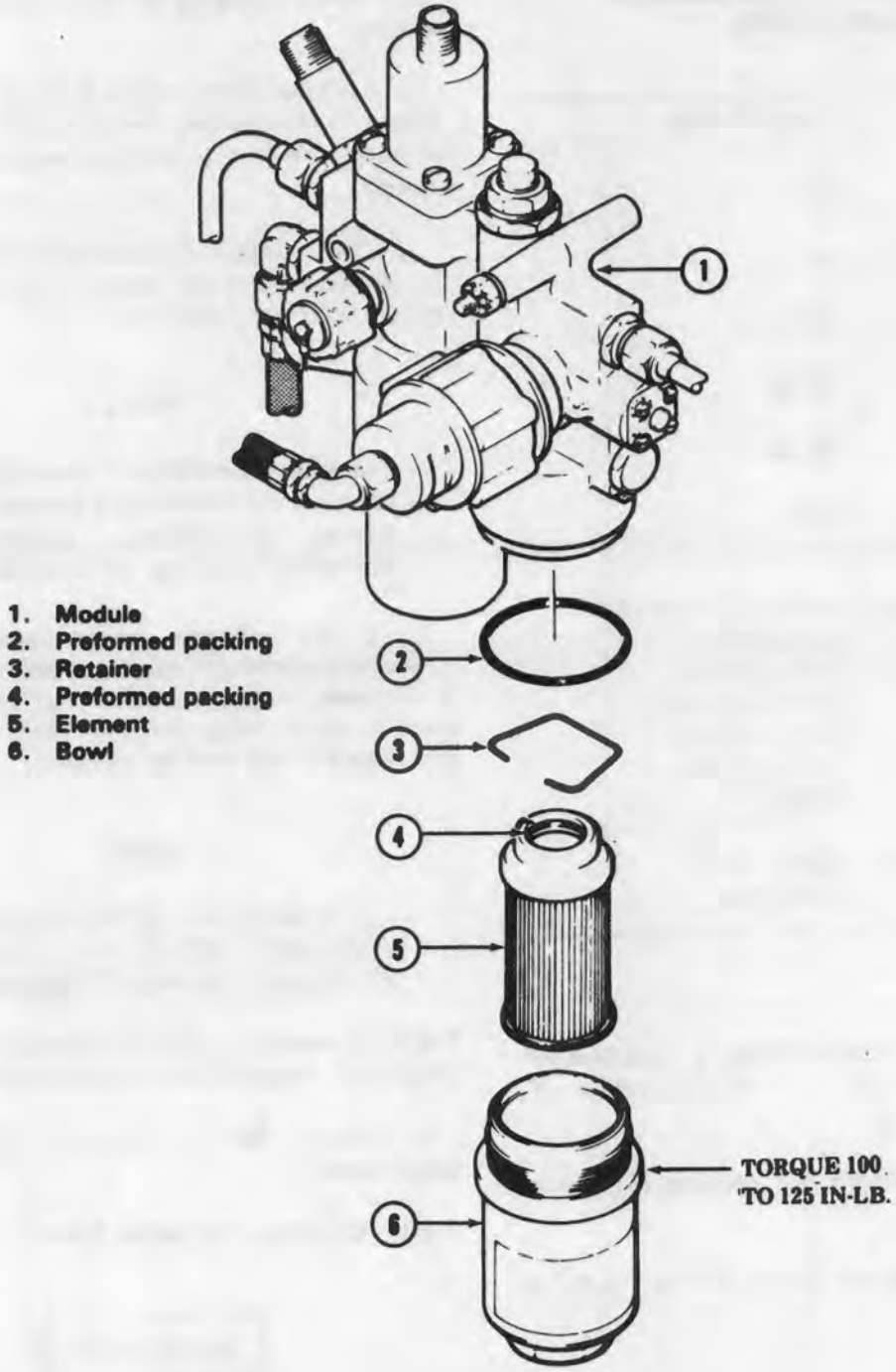


Figure 7-8. Module filter element replacement

7-51. Repair or Replacement - Hydraulic Filter Assembly. Filter elements (figure 7-9) Part No. 205-076-034-7 are rated at 15 micron. These filter elements are of metal construction. Other 15 micron filters Part No. 205-076-034-3 are of fiber or paper construction.

NOTE

The filter element shall be considered unserviceable if it is cracked, torn, separated, deteriorated, corroded, crushed, or collapsed.

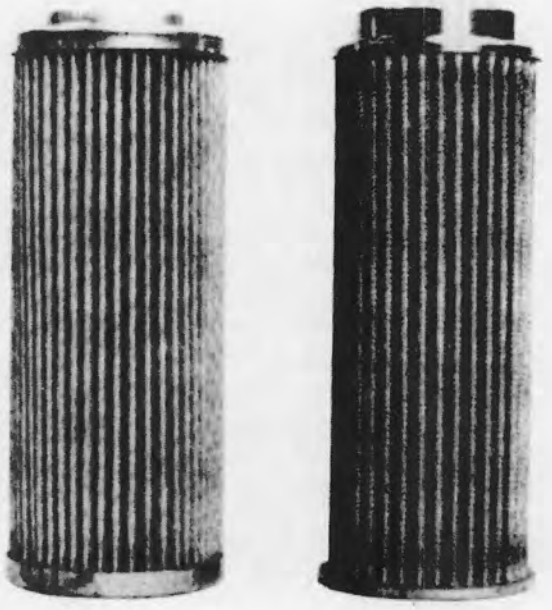


Figure 7-9. Module filter elements

NOTE

When ambient temperatures are below +20 degrees F (-6.7 degrees C) the indicator buttons may extend. Reset button after fluid warms up.

c. If the red indicator button extends, remove and replace filter element. Reset the button; operate the hydraulic system until normal operating temperature is obtained.

d. Replace all preformed packings and backup rings (if required).

e. Replace filter assembly when evidence of corrosion exists in internal area of filter.

f. Check for proper security of filter assembly.

g. Any cracks to the filter assembly requires replacement of part. Replace without repair.

h. Contamination: Flush hydraulic system and replace all filter elements.

7-52. Installation — Module Filters. a. Wipe bowl (6, figure 7-8) and mating surfaces of module (1) clean. Install packing (4) in element (5).

b. Place element (5) in bowl (6) and install retainer (3).

c. Install packing (2) into groove of module (1).

d. Install bowl (6) to module (1). Torque bowl (6) 100 TO 125 inch-pounds and secure with lockwire (C127).

e. Close drain valve (35, figure 7-3 or 34, figure 7-4).

f. Service reservoir to overflow level with clean hydraulic fluid (C112 or C112.1).

g. Close right transmission cowling (3, figure 2-19).

7-53. MODULE ASSEMBLIES.

7-54. Description — Module Assemblies. Two hydraulic module assemblies (3 and 4, figure 7-1) are located on right, aft side of the cabin bulkhead. Access to both module assemblies is by opening the right transmission cowling. Each module assembly consists of a housing equipped with the system solenoid valve, relief valve, pressure switch (for caution panel light), pressure and return filters, filter indicators (pop out button), marked ports for system connection, and two quick-disconnect couplings for connection of hydraulic test stand. Each module assembly outboard quick-disconnect coupling has a hose that returns fluid to the system reservoir. System No. 1 module assembly is at left and System No. 2 module assembly at right on bulkhead.

7-55. Removal — Module Assemblies. Either module can be removed in the same manner.

NOTE

Module assemblies will normally be left in place, since filter elements, valves, and other components can be replaced without removing the module assembly.

a. Open right transmission cowling (3, figure 2-19).

NOTE

Removal procedures are typical for either System No. 1 or System No. 2 module assembly.

b. Open drain valve (35, figure 7-3 or 34, figure 7-4) and drain reservoir.

c. Place container under module assembly (4, figure 7-10) to catch fluid seepage when disconnecting tube and hose connectors.

d. Turn battery switch OFF and disconnect external power, if connected to helicopter.

e. Remove electrical plugs from pressure switch and solenoid valve.

f. Remove tube (1) from fitting (2).

g. Remove hose (24) from fitting (28).

h. If removing System No. 2 module assembly, remove tube (8). Loosen nut (10) and remove fitting (9) from module assembly (4). Remove packing (12), backup ring (11), and nut (10) from fitting (9) and discard packing.

i. Remove tube (14) from fitting (13). Remove fitting (13) from module assembly (4). Remove packing (12) from fitting (13) and discard packing.

j. Remove lockwire from coupling assembly (19) and module assembly (4).

k. Remove coupling assembly (19) from module assembly (4). Remove packing (20) from coupling assembly and discard packing.

l. Remove lockwire from coupling half (17) and coupling (16) and disconnect coupling halves.

m. Remove lockwire from coupling half (16) and module assembly (4) and remove coupling half from module assembly. Remove packing (15) from coupling half (16) and discard packing.

n. Remove three cotter pins (21) from three nuts (22) and discard cotter pins.

o. Remove three nuts (22) and three washers (23) from bolts (7) and remove module assembly (4) from cabin bulkhead. Remove six washers (5), six shock mounts (6), and three bolts (7) from cabin bulkhead.

p. Install protective plugs in all open ports of module assembly (4) and connectors of hoses (18 and 24), and tubes (1, 8, and 14).

q. Install protective caps to the pressure switch and solenoid valve of module assembly (4). Tag module assembly and forward to Depot for repairs (as required).

7-56. Cleaning — Module Assemblies.

WARNING

Goggles will be worn when using compressed air. Do not allow more than 5 psi air pressure to come in contact with skin.

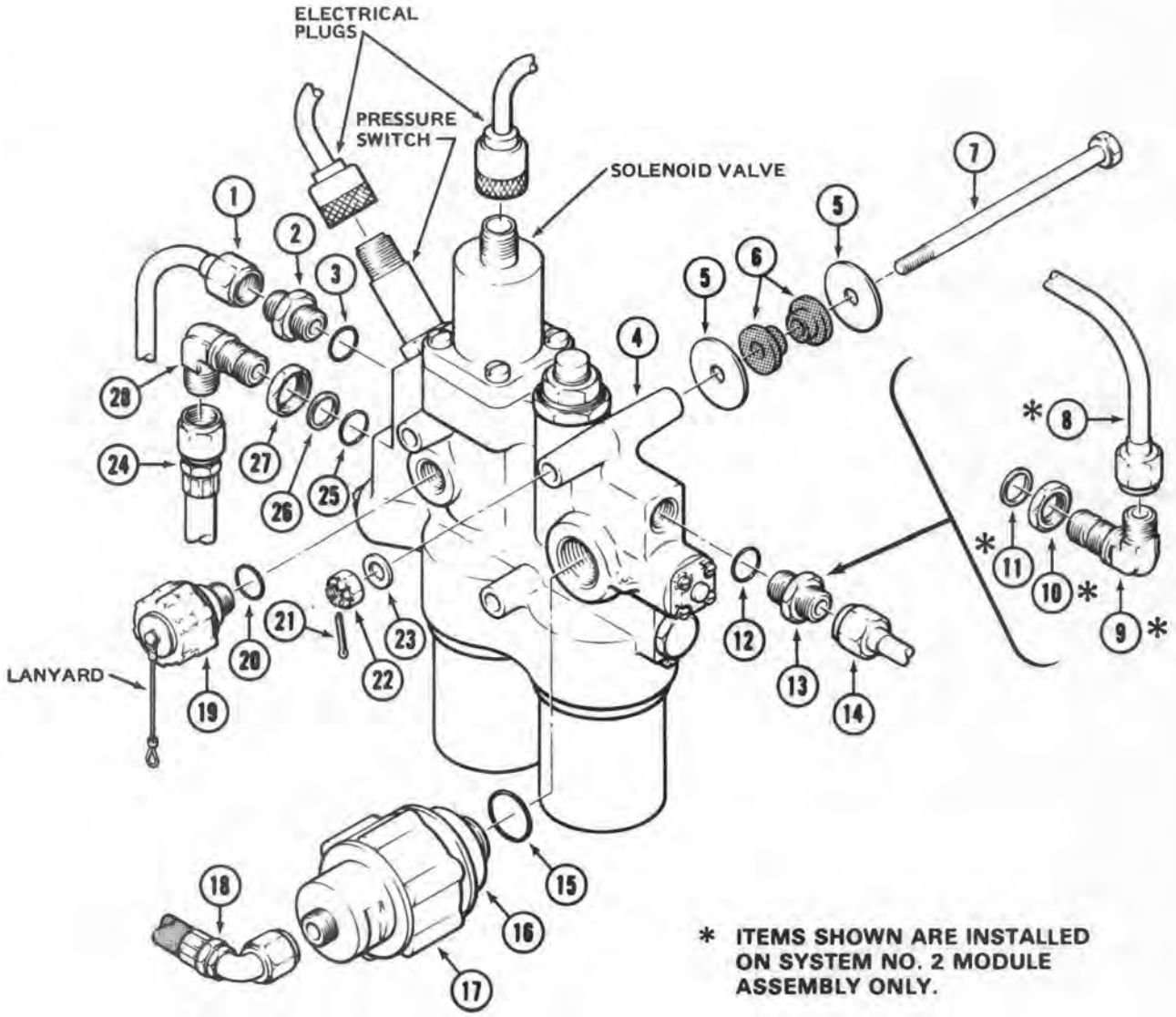
a. Clean electrical components of module assembly with filtered compressed air.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not submerge module assembly in solvent.



1. Tube
2. Fitting (Union)
3. Preformed packing
4. Module
5. Washer (6)
6. Shock mount (6)
7. Bolt (3)
*8. Tube
*9. Fitting (Elbow)
*10. Nut
*11. Backup ring
12. Preformed packing
13. Fitting (Union)
14. Tube
15. Preformed packing
16. Coupling half
17. Coupling half
18. Hose
19. Coupling assembly
20. Preformed packing
21. Cotter pin (3)
22. Nut (3)
23. Washer (3)
24. Hose
25. Preformed packing
26. Backup ring
27. Nut
28. Fitting (Elbow)

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Figure 7-10. Module assembly (hydraulic) — removal and installation

b. Wash module assembly externally with solvent (C205).

7-57. Inspection — Module Assemblies. Visually inspect module assembly for cleanliness.

b. Visually inspect module assembly for leaks and malfunction during opeational checks (paragraph 7-4).

c. Visually inspect module assembly for security.

d. Visually inspect module assembly for nicks, scratches, dents, cracks, and corrosion. No cracks allowed (TM 55-1500-204-25/1).

e. Visually inspect hoses for tears, frayed wires, deterioration, thread damage, and corrosion.

f. Visually inspect electrical connectors for damage.

g. Visually inspect tubes for nicks, scratches, dents, kinks, thread damage, and corrosion. (TM 55-1520-204-25/1).

h. Visually inspect fittings for nicks, scratches, cracks, thread damage, and corrosion. No cracks allowed (TM 55-1500-204-25/1).

i. Visually inspect coupling half (16 and 17) for damage and leaks.

j. Visually inspect all hardware for damage, cracks, thread damage, and corrosion. No cracks allowed.

7-58. Repair or Replacement — Module Assemblies. a. Replace damaged module assembly (4, figure 7-10), fittings, nuts, and backup rings.

b. Replace all packings when leaking or removed.

c. Replace coupling assembly (19) or coupling half (16 and 17) when leaking or damaged.

d. Replace part when cracked.

e. Replace filter elements (figure 7-8) when required.

f. Replace hose or tube assemblies when damaged. No cracks allowed.

g. Replace shock mounts (6, figure 7-10) when cracked or deteriorated.

h. Replace cotter pin (21) when removed.

i. No repairs allowed to module assembly (4). Part must be tagged and forwarded to Depot for repairs.

j. Replace hardware when damaged.

7-59. Installation — Module Assemblies.

NOTE

All packings and threads will have hydraulic fluid (C112 or C112.1) applied prior to installation. All fluid connections will be torqued in accordance with limits outlined in table 7-3. Either module assembly can be installed in the same manner.

a. Remove protective plugs and covers from all ports and electrical plugs of module assembly (4, figure 7-10).

b. Install packing (3) on fitting (2) and install fitting into SYS PRESS port of module assembly (4).

c. Install nut (27), backup ring (26), and packing (25) on fitting (28) and install and position fitting into PUMP PRESS port of module assembly (4).

d. If installing System No. 1 module assembly, proceed to following step e. If installing System No. 2 module assembly, install packing (12), backup ring (11), and nut (10) on fitting (9). Install and position fitting (9) to SYS RET port and tighten nut (10) against module assembly.

e. Install packing (12) on fitting (13) and install fitting into SYS RET port of module assembly (4).

f. Install packing (20) on coupling assembly (19) and install coupling assembly into GRND TEST PRESS port of module assembly (4). Secure coupling assembly (19) to module assembly (4) with lockwire (C127). Secure coupling assembly (19) together with lockwire (C127). Connect lanyard of coupling assembly (19) to module assembly (4).

g. Install packing (15) to coupling half (16) and install coupling half to GRND TEST RTN port of module assembly (4). Secure coupling half (16) to module assembly (4) with lockwire (C127).

h. Install hose (18) to coupling half (17).

i. Install three bolts (7), six washers (5), and six shock mounts (6) to cabin bulkhead.

j. Position module assembly (4) to cabin bulkhead over bolts previously installed in above step i. and install three washers (23) and three nuts (22). Tighten nuts (22) to snug fit on shock mount and secure with cotter pin (21).

k. Install tube (1) to fitting (2).

l. Install tube (8) to fitting (9) or tube (14) to fitting (13).

m. Install hose (24) to fitting (28). Check that hose is not kinked, twisted, or chafing.

n. Install coupling half (17) to coupling half (16) and secure together with lockwire (C127).

o. Install electrical connector to the pressure switch and secure with lockwire (C127).

p. Install electrical connector to the solenoid valve and secure with lockwire (C127).

q. Close drain valve (35, figure 7-3 or 34, figure 7-4).

r. Service reservoir to overflow level with hydraulic fluid (C112 or C112.1).

s. Close and secure right transmission cowling (3, figure 2-19).

t. Bleed and test hydraulic system (paragraph 7-4).

7-60. PRESSURE SWITCHES.

7-61. Description — Pressure Switches. Two hydraulic pressure switches are provided in the dual hydraulic system (one in System No. 1 and one in System No. 2) to sense the system pressure. The pressure switch closes the circuit to the caution panel when pressure is a **500** plus or minus **100** psig decreasing pressure, and the HYD PRESSURE caution light and master caution light will then be illuminated. The pressure switch should open at **800** plus or minus **100** psig increasing pressure (figure 7-2).

7-62. Removal — Pressure Switches. a. Open right transmission cowling (3, figure 2-19).

b. Turn battery switch OFF and disconnect external power, if connected to helicopter.

c. Remove lockwire from electrical connector (1, figure 7-11) and pressure switch (2) and remove pressure switch.

d. Remove packing (11) from pressure switch (2). Discard packing.

e. If replacement switch is not immediately installed, install protective plug into open port of module assembly.

7-63. Inspection — Pressure Switches. a. Inspect pressure switch (2, figure 7-11) for evidence of fluid leakage.

b. Inspect pressure switch (2) for corrosion (internally and externally). No internal corrosion allowed. Maximum depth of corrosion after cleanup: **0.010** inch.

c. Inspect pressure switch (2) for cracks or thread damage. No cracks allowed. Maximum thread damage: Depth — one-third of thread. Length — 0.25 inch cumulative.

d. Maximum depth of nicks and scratches: **0.010** inch after cleanup. No dents allowed.

e. Inspect pressure switch (2) for security.

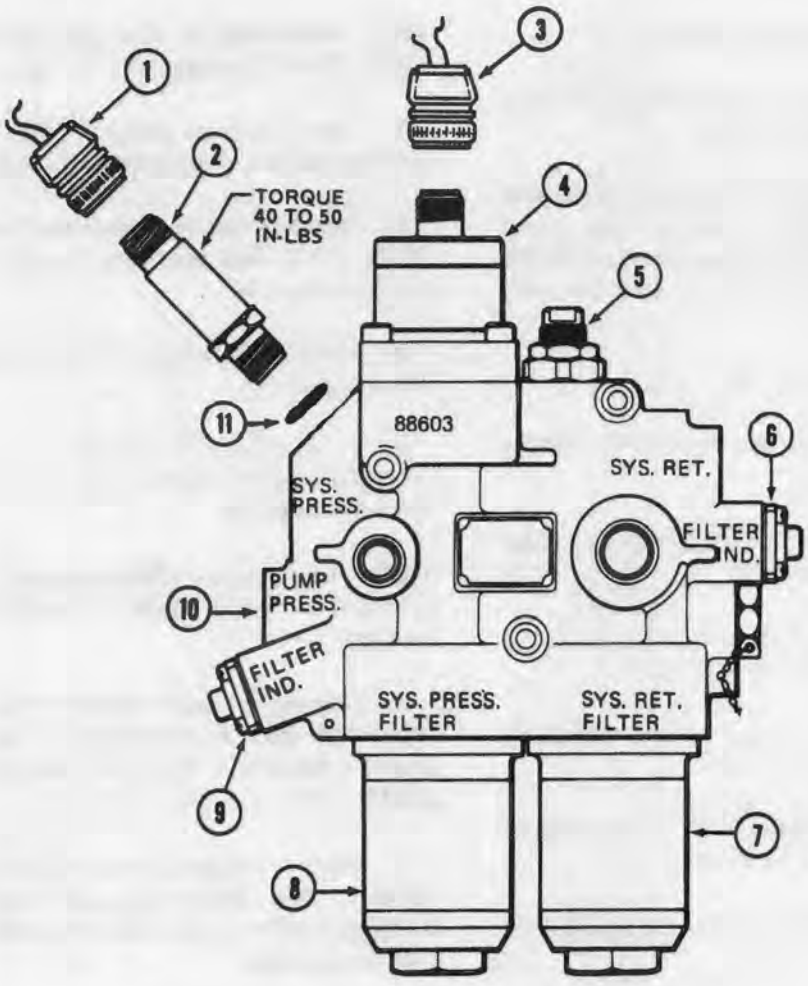
7-64. Repair or Replacement — Pressure Switches. a. Any evidence of leakage of body of pressure switch (2, figure 7-11) requires replacement part.

b. Replace packing (11).

c. Any corrosion to internal area, or threads of pressure switch (2), requires replacement of part. No repairs allowed.

WARNING

Chemical film material and primers are toxic. Provide adequate ventilation. Do not use near fire or open flame.



1. Electrical connector
2. Pressure switch
3. Electrical connector
4. Solenoid valve
5. Relief valve
6. Return filter indicator
7. Return filter
8. Pressure filter
9. Pressure filter indicator
10. Module assembly
11. Preformed packing

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Figure 7-11. Hydraulic pressure switch — removal and installation

d. Polish corrosion, nicks or scratches to external area of pressure switch (2) in accordance with limits in paragraph 7-65 with 600 grit sandpaper (C185.2) to original finish and touched-up with chemical film material (C42) followed with a light application of thinned primer (C167).

e. Cracks or malfunction of the pressure switch (2) requires replacement of part. No repairs allowed.

f. Any dents to pressure switch (2) require replacement of part. No repair allowed.

g. When replacing pressure switch (2), ensure proper security.

7-65. Installation — Pressure Switches. a. Remove protective plug from module assembly (10).

b. Install packing (11) on pressure switch (2).

c. Install pressure switch (2) to module assembly (10). Torque pressure switch (2) **40 TO 50** inch-pounds and secure with lockwire (C127).

d. Install electrical connector (1) to pressure switch (2) and secure with lockwire (C127).

e. Close and secure right transmission cowling (3, figure 2-19).

7-66. Test Procedures — Pressure Switches. Bleed and test applicable hydraulic system from which pressure switch was replaced (paragraph 7-4).

7-67. SOLENOID VALVES.

7-68. Description — Solenoid Valves. Four solenoid (shut-off) valves are included in the hydraulic systems to permit shutting off fluid circulation to any one of four (System No. 1, System No. 2, emergency collective, and armament) systems in the event of a pressure droppage. Two solenoid valves (located in each of system modules) is controlled by a single, three-position switch for System No. 1 and System No. 2 and is located in upper right corner (on control panel) of the lower console for shutting off either system or for checkout purposes. It is not possible in the manipulation of this switch to purposely or inadvertently turn both systems off simultaneously. In addition, the switch is the automatic type which will center to BOTH position when released. The switch will then return to the center position when released. The emergency collective system solenoid valve is controlled by a single, two-position switch, located on the instrument panel for shutting off fluid circulation in the event of a pressure droppage and for checkout purposes. The fourth solenoid valve, if armament provisions are installed, is controlled by a single, three-position (ARMD, SAFE, OFF) switch, located on a control panel in the lower console and is also for shutting off fluid circulation in the event of a pressure droppage (figure 7-2).

7-69. Removal — Solenoid Valves.

NOTE

System No. 1 and System No. 2 solenoid valves cannot be repaired by AVUM/AVIM maintenance personnel. In the event that either solenoid valve is malfunctioning, the module will be replaced. Removed module shall be tagged and forwarded to next higher level of maintenance for repairs.

a. Solenoid Valve — Emergency Collective System. Remove solenoid valve (4, figure 7-12) as follows:

(1) Open access door (17, figure 2-19).

(2) Turn battery switch OFF and disconnect external power, if connected to helicopter.

(3) Remove lockwire from electrical connector (5, figure 7-12) and solenoid valve (4).

CAUTION

Before disconnecting any lines associated with the accumulator or solenoid valve, be certain that trapped hydraulic pressure is released (paragraph 7-74).

(4) Connect coupling halves (14 and 15, figure 7-1).

(5) Release pressure from system by depressing button on drain valve (13).

(6) Disconnect tubes (1 and 10, figure 7-12) from fittings (2 and 7).

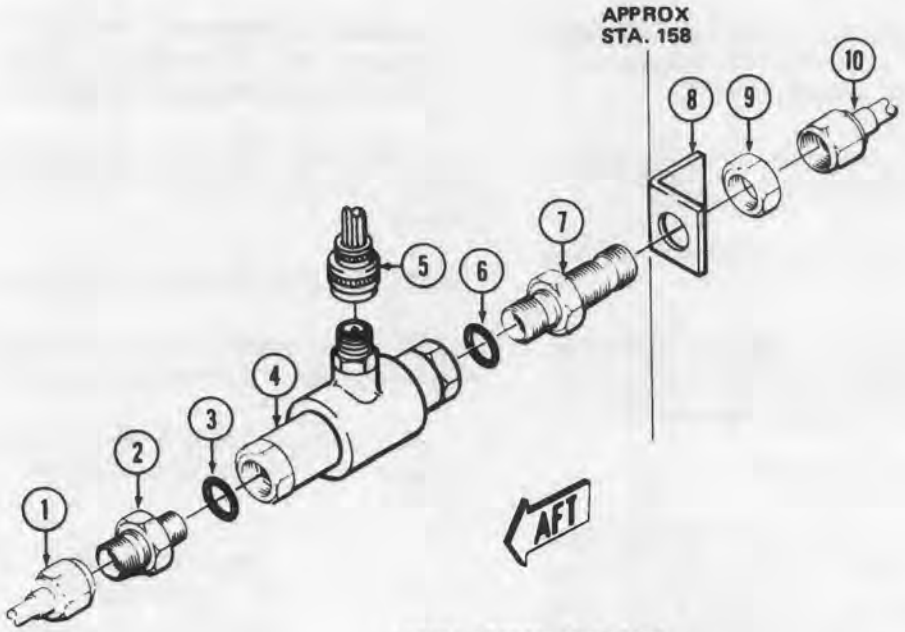
(7) Remove nut (9) from fitting (7) and remove fitting from support (8). Install protective plugs to tube connectors.

(8) Remove fitting (2) from solenoid valve (4). Remove packing (3) from fitting (2) and discard packing.

(9) Remove fitting (7) from solenoid valve (4). Remove packing (6) from fitting (7). Solenoid valve is nonreparable and shall be discarded.

b. **Solenoid Valve — Armament.** Remove solenoid valve (7, figure 7-13) as follows:

(1) Turn battery switch OFF and disconnect external power, if connected to helicopter.



1. Tube
2. Fitting (union)
3. Preformed packing
4. Solenoid valve
5. Electrical connector
6. Preformed packing
7. Fitting (union)
8. Support
9. Nut
10. Tube

Figure 7-12. Hydraulic solenoid valve (emergency collective) — removal and installation

(2) Place shop towels under solenoid valve (7) and disconnect tubes (1 and 12).

(3) Remove lockwire from electrical connector (6) and solenoid valve (7) and remove electrical connector.

(4) Remove two nuts (8), four washers (9), and two bolts (15) from solenoid valve (7) and cabin bulkhead. Remove solenoid valve and drain fluid from solenoid valve.

(5) Remove plug (14) from solenoid valve (7). Remove packing (13) from plug (14) and discard packing.

(6) Remove fitting (11) from solenoid valve (7). Remove packing (10) from fitting (11) and discard packing.

(7) Loosen nut (3) and remove fitting (2) from solenoid valve (7). Remove packing (5), backup ring (4), and nut (3) from fitting (2) and discard packing and backup ring.

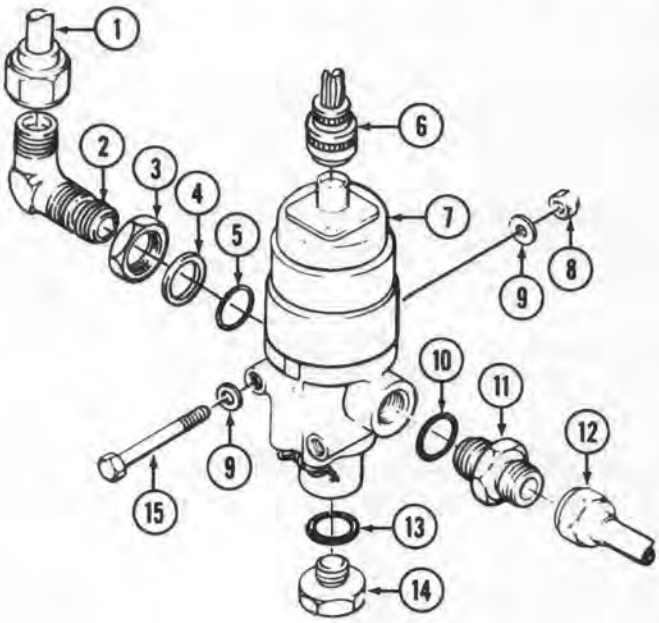
7-70. Inspection — Solenoid Valves. a. Inspect solenoid valves for corrosion and thread damage.

b. Inspect solenoid valves for leaks and cracks. No cracks allowed.

c. Inspect solenoid valves for security.

d. Inspect electrical connectors (5, figure 7-12 and 6, figure 7-13) for damage, condition of wires, safetying and security.

7-71. Repair or Replacement — Solenoid Valves. a. Replace solenoid valve if it does not meet



1. Tube
2. Fitting
3. Nut
4. Backup ring
5. Preformed packing
6. Electrical connector
7. Solenoid valve
8. Nut (2)
9. Washer (4)
10. Preformed packing
11. Fitting (union)
12. Tube
13. Preformed packing
14. Plug
15. Bolt (2)

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Figure 7-13. Hydraulic solenoid valve (armament) — removal and installation

inspection requirements outlined in above paragraph 7-70.

b. Replace solenoid valve when external corrosion exists.

c. Replace solenoid valve when cracked.

d. There are no repairs allowed to solenoid valve.

e. Remove solenoid valve when malfunctioning.

f. Repair and treat corrosion damage to solenoid valve (TM 43-0105).

g. Replace solenoid valve when leakage to valve body exists.

7-72. Installation — Solenoid Valves.

NOTE

All threads of tubes and ports of solenoid valve will have hydraulic fluid (C112 or C112.1) applied prior to assembly. Refer to table 7-3 for proper torque requirements of fluid connectors. Do not overtorque fluid connectors.

a. Solenoid Valve — Armament System. Install solenoid valve (7, figure 7-13) as follows:

(1) Remove protective plugs and cover from replacement solenoid valve (7) and drain preservative hydraulic fluid from solenoid valve. Flush replacement solenoid valve (7) with clean hydraulic fluid (C112 or C112.1).

(2) Install nut (3, figure 7-13), backup ring (4), and packing (5) on fitting (2). Install and position fitting (2) into port 2 of solenoid valve (7) and tighten nut (3) against solenoid valve.

(3) Install packing (10) on fitting (11) and install fitting into port 1 of solenoid valve (7).

(4) Install packing (13) on plug (14) and install plug into port 3 of solenoid valve (7).

(5) Remove protective plugs from connectors of tubes (1 and 12).

(6) Position solenoid valve (7) to cabin bulkhead and install bolts (15), washers (9), and nuts (8).

(7) Install tube (1) to fitting (2).

(8) Install tube (12) to fitting (11).

(9) Install electrical connector (6) to solenoid valve (7) and secured electrical connector to solenoid valve with lockwire (C127).

(10) Service reservoir, bleed hydraulic System No. 2, and functional test solenoid valve (7) (paragraph 7-73).

b. Solenoid Valve — Emergency Collective System. Install solenoid valve (4, figure 7-12) as follows:

(1) Remove protective plugs and cover from replacement solenoid valve (4) and drain preservative.

(2) Flush replacement solenoid valve (4) with clean hydraulic fluid (C112 or C112.1)

(3) Observe above NOTE. Install packing (3) on fitting (2) and install fitting into OUTLET port of solenoid valve (4).

(4) Install packing (6) on fitting (7) and install fitting into INLET port of solenoid valve (4).

(5) Remove protective plugs from connectors of tubes (1 and 10).

(6) Insert fitting (7) into support (8), with electrical connector pointing up, and install nut (9).

(7) Install tube (10) to fitting (7).

(8) Install tube (1) to fitting (2).

(9) Install electrical connector (5) to solenoid valve (4) and secure electrical connector to solenoid valve with lockwire (C127).

(10) Charge accumulator (12 figure 7-1) (paragraph 7-107).

(11) Service System No. 1 reservoir, bleed system, and functional test solenoid valve (4, figure 7-12).

7-73. Test Procedures — Solenoid Valves. When replacement of solenoid valve is required, the applicable hydraulic system will be serviced, bled, and tested (paragraph 7-4).

7-74. LOCKOUT VALVE AND ACCUMULATOR ASSEMBLY (CYCLIC CONTROL SYSTEM).

7-75. Description — Lockout Valve and Accumulator Assembly (Cyclic Control System). The cyclic control emergency boost lockout valve and accumulator assembly provides pressurized irrevesibility in event of failure of the hydraulic system. The assembly consists of an accumulator (28, figure 7-14) and a lockout valve accumulator (31).

NOTE

The lockout valve and the accumulator are replaceable as separate parts.

7-76. Removal — Lockout Valve and Accumulator Assembly (Cyclic Control System). a. Connect coupling halves (14 and 15, figure 7-1).

WARNING

Before loosening any connections in the accumulator circuit, ensure trapped hydraulic pressure is released. Never depress accumulator drain valve button with hydraulic system operating.

b. Relieve pressure from the system by depressing the button on top of the drain valve (13).

c. Disconnect tube from tee (6, figure 7-14).

d. Remove tube from fitting (9) and tee (6). Install protective plugs to tube connectors to prevent entry of dirt.

e. Disconnect tube from fitting (1).

f. Remove tube from fittings (19 and 27). Install protective dust plugs to tube connectors to prevent entry of dirt.

g. Disconnect tubes from fittings (32 and 39, view A).

h. Remove fitting (43), with relief valve (41), from tee (45). Install protective plug to lower tube connector to prevent entry of dirt. Remove packing (44).

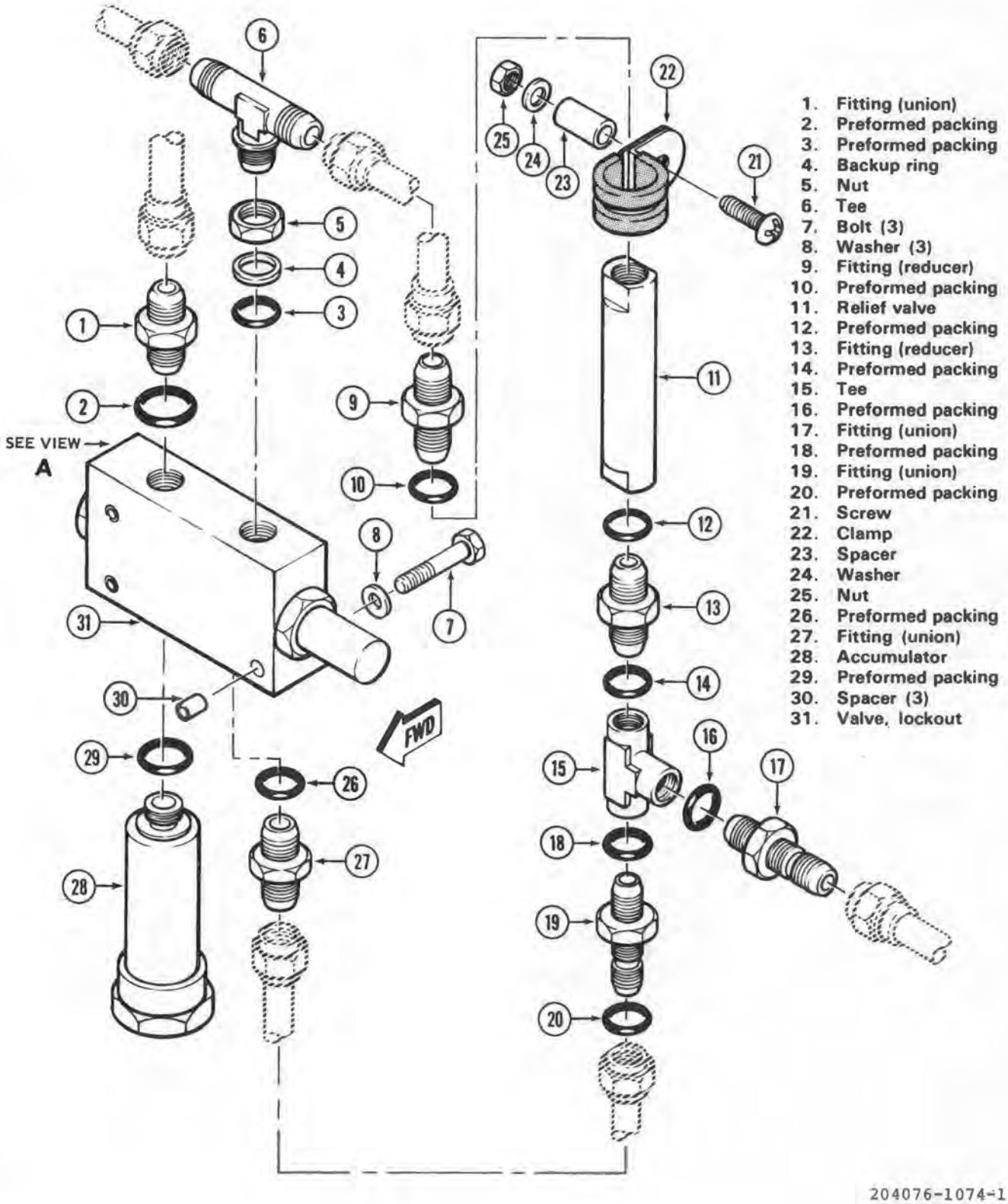
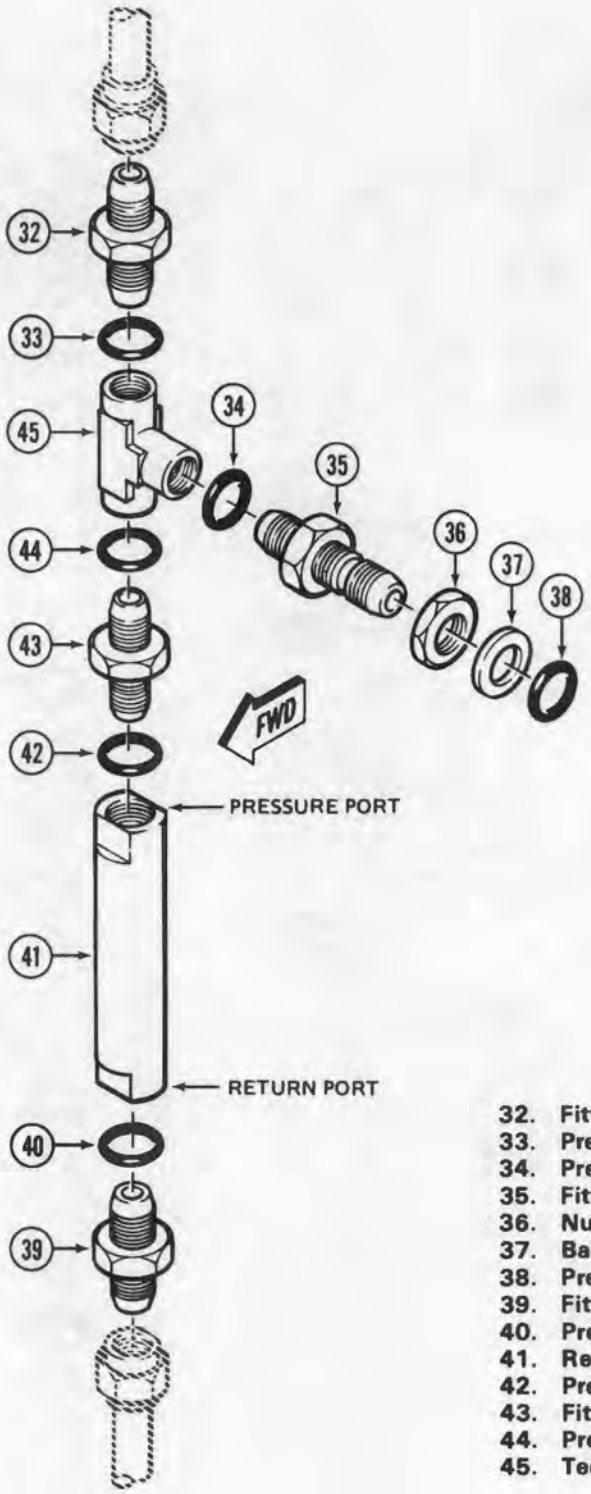


Figure 7-14. Lockout valve and accumulator, and relief valves — removal and installation (Sheet 1 of 2)



32. Fitting (union)
33. Preformed packing
34. Preformed packing
35. Fitting (union)
36. Nut
37. Backup ring
38. Preformed packing
39. Fitting (union)
40. Preformed packing
41. Relief valve
42. Preformed packing
43. Fitting (reducer)
44. Preformed packing
45. Tee

Figure 7-14. Lockout valve and accumulator, and relief valves — removal and installation (Sheet 2 of 2)

i. Loosen nut (36) and remove tee (45) from lockout valve (31).

j. Remove packing (38) from fitting (35) and discard packing.

k. Remove packing (44) from fitting (43) and discard packing.

l. Remove three bolts (7), three washers (8), and three spacers (30) from lockout valve (31) and remove lockout valve. Drain fluid from lockout valve (31). Install protective plugs to all open tube connectors to prevent entry of dirt.

m. Remove fitting (1) from lockout valve (31). Remove packing (2) from fitting (1) and discard packing.

n. Loosen nut (5) and remove tee (6) from lockout valve (31). Remove packing (3), backup ring (4), and nut (5) from tee (6). Discard packing and backup ring.

o. Remove fitting (27) from lockout valve (31). Remove packing (26) from fitting (27) and discard packing.

p. Remove accumulator (28) from lockout valve (31). Drain fluid from accumulator (28). Remove packing (29) from accumulator (28) and discard packing.

NOTE

To prevent entry of dirt, all ports shall be capped or plugged, until either reinstalled or assembled.

7-77. Cleaning — Lockout Valve and Accumulator Assembly (Cyclic Control System).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not submerge lockout valve in solvent because it could damage internal components.

a. Clean external surface of lockout valve (31, figure 7-14) with a clean rag saturated with solvent (C205).

b. Allow lockout valve (31) to air dry.

7-78. Inspection — Lockout Valve and Accumulator Assembly (Cyclic Control System). a. Inspect lockout valve (31, figure 7-14) for damage, cracks, corrosion, thread damage, leaks, or malfunction. No cracks allowed.

b. Inspect accumulator (28) for damage, cracks, corrosion, leaks, and thread damage. No cracks allowed.

c. Inspect all fittings, tees, nuts, and tube connectors for thread damage, cracks, and corrosion. No cracks allowed.

d. Inspect all hardware for corrosion and thread damage.

e. Inspect lockout valve and accumulator (31) for security.

7-79. Repair or Replacement — Lockout Valve and Accumulator Assembly (Cyclic Control System). a. Replace lockout valve (31, figure 7-14) when cracked, leaking, or malfunction exists. No repairs or internal corrosion allowed.

b. Replace accumulator (28) when cracked, leaking, or internal corrosion exists.

c. Replace all preformed packings and backup rings when leaking or removed.

d. Replace hardware when damaged or corroded.

e. Replace fitting, tee, or nut when corroded, cracked, or having thread damage.

f. Replace tubes when damaged, cracked, corroded, or having thread damage. No cracks allowed. No internal corrosion allowed.

g. Repair and treat corroded component(s) when damaged (TM 43-0105).

7-80. Installation — Lockout Valve and Accumulator Assembly (Cyclic Control System).

NOTE

All threads of tube connectors, tees, fittings, accumulator, ports of lockout valve, and packings will have hydraulic fluid (C112 or C112.1) applied prior to assembly. Refer to table 7-3 for proper torque requirements of fluid connectors. Do not overtorque fluid connectors.

a. Remove protective plugs from all ports of replacement lockout valve (31, figure 7-14) and drain preservative fluid from lockout valve.

b. Flush replacement lockout valve with clean hydraulic fluid (C112 or C112.1).

c. Install packing (29) on accumulator (28) and install accumulator into adjacent port of RES RET port.

d. Install packing (26) on fitting (27) and install fitting into RES RET port of lockout valve (31).

e. Install packing (2) on fitting (1) and install fitting into SYS PRESS port of lockout valve (31).

f. Install nut (5), backup ring (4), and packing (3) on tee (6). Thread tee (6) into SYS RET port of lockout valve (31). Do not tighten nut (5).

g. Install nut (36), backup ring (37), and packing (38) on fitting (35). Install fitting (35) into PRESS port of lockout valve (31), position tee (45) as shown. Do not tighten nut (36).

h. Install packing (44) on fitting (43).

i. Install packing (40) on fitting (39) and install relief valve (41) into tee (45).

j. Remove protective plugs.

k. Insert three bolts (7) with three washers (8) through body of lockout valve (31) and place a spacer (30) on each of the bolts. Position lockout valve (31) as shown and secure lockout valve to fuselage.

l. Install tubes to fittings (32 and 39).

m. Install tube to fittings(19 and 27)

n. Install tubes to fittings (6 and 9).

o. Install tube to fitting (17).

p. Tighten nuts (5 and 36).

q. Service System No. 1 reservoir, bleed system, and test lockout valve and accumulator assembly (paragraph 7-81).

7-81. Test Procedures — Lockout Valve and Accumulator Assembly (Cyclic Control System). When replacement of lockout valve and accumulator assembly is required, System No. 1 will be serviced, bled and tested (paragraph 7-4).

7-82. LOCKOUT VALVE ASSEMBLY, COLLECTIVE.

7-83. Description — Lockout Valve Assembly Collective. A pressurized lockout valve is incorporated into the collective control system of System No. 1. If pressure in System No. 1 should fall to 650 psig for any reason, the pressurized lockout valve and the pressure operated shut-off valve will close, locking 650 psig on both pressure and return sides of the hydraulic servo cylinders. This is fdone to ensure that the servo cylinders remain full of hydraulic fluid and free of air (figure 7-2).

7-84. Removal — Lockout Valve Assembly Collective.

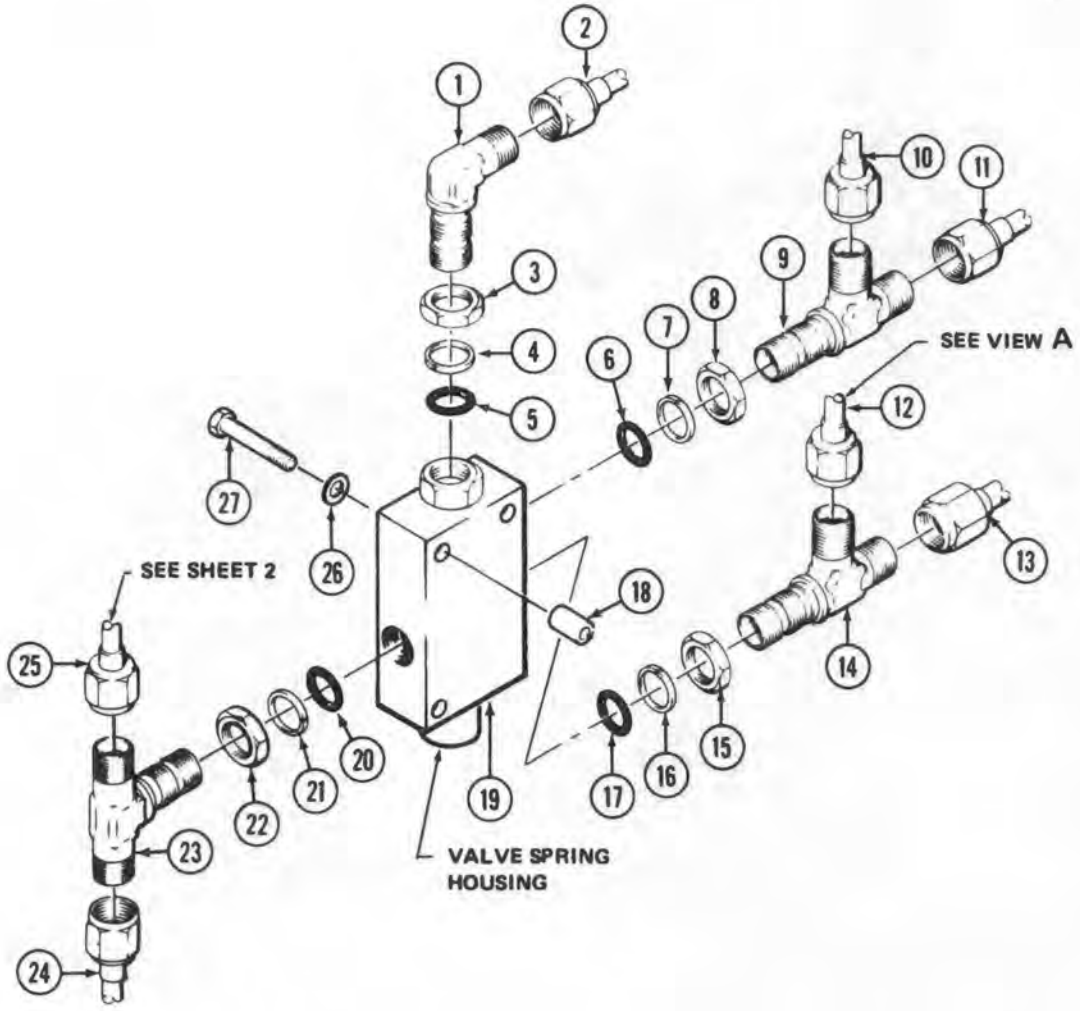
WARNING

Before loosening any connections in the accumulator circuit, ensure trapped hydraulic pressure is released. Do not depress accumulator drain valve button with hydraulic systems operating.

a. Connect coupling halves (14 and 15, figure 7-1).

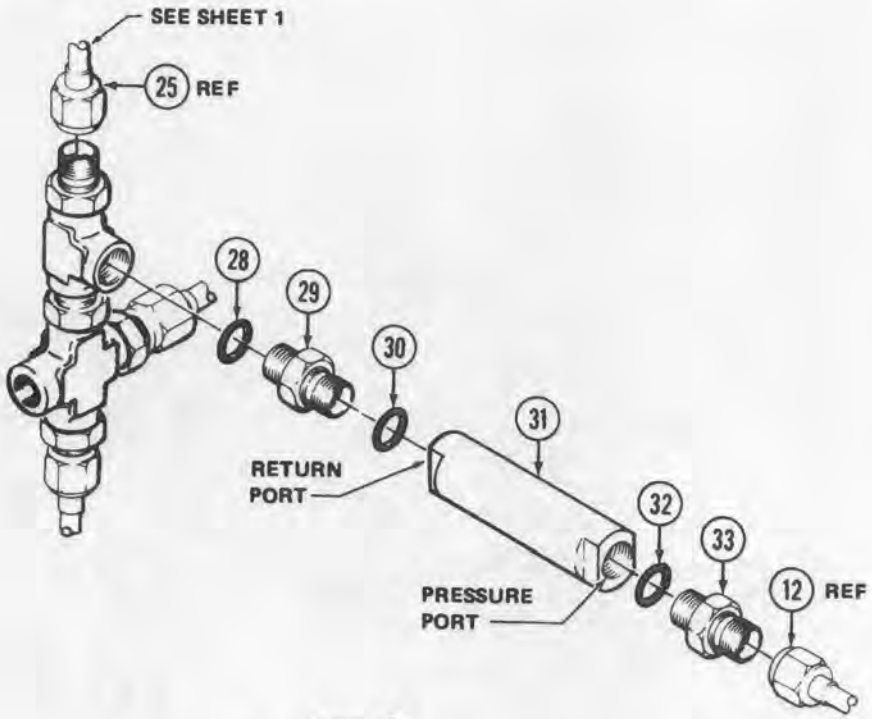
b. Relieve pressure from the accumulator system by depressing the button on top of drain valve (13).

c. Place suitable container under lockout valve (19, figure 7-15).



1. Elbow
2. Tube
3. Nut
4. Backup ring
5. Preformed packing
6. Preformed packing
7. Backup ring
8. Nut
9. Tee
10. Tube
11. Tube
12. Tube
13. Tube
14. Tee
15. Nut
16. Backup ring
17. Preformed packing
18. Spacer (3)
19. Lockout valve
20. Preformed packing
21. Backup ring
22. Nut
23. Tee
24. Tube
25. Tube
26. Washer (3)
27. Bolt (3)

Figure 7-15. Lockout valve assembly and relief valve — removal and installation (Sheet 1 of 2)



28. Preformed packing
29. Fitting (reducer)
30. Preformed packing
31. Relief valve
32. Preformed packing
33. Fitting (reducer)

Figure 7-15. Lockout valve assembly and relief valve — removal and installation (Sheet 2 of 2)

d. Disconnect each tube (2, 10, 11, 12, 13, 24, and 25).

e. Remove three bolts (27), three washers (26), and three spacers (18) from lockout valve (19) and remove lockout valve. Install protective plug to all open tube connectors.

f. Loosen nut (22) on tee (23) and remove tee from lockout valve (19). Remove packing (20), backup ring (21), and nut (22) from tee (23) and discard packing and backup ring.

g. Loosen nut (3) and remove elbow (1) from lockout valve (19). Remove packing (5), backup ring (4), and nut (3) from elbow (1) and discard packing and backup ring.

h. Loosen nut (8) and remove tee (9) from lockout valve (19). Remove packing (6), backup ring (7), and nut (8) from tee (9) and discard packing and backup ring.

i. Loosen nut (15) and remove tee (14) from lockout valve (19). Remove packing (17), backup ring (16), and nut (15) from tee (14) and discard packing and backup ring.

7-85. Cleaning — Lockout Valve Assembly Collective.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

CAUTION

Do not submerge lockout valve in solvent because it could damage internal components.

a. Clean external surface of lockout valve (19, figure 7-15) with a clean cloth saturated with solvent (C205).

b. Allow lockout valve (19) to air dry.

7-86. Inspection — Lockout Valve Assembly Collective. a. Inspect lockout valve (19, figure 7-15) for damage, cracks, corrosion, leaks, or malfunction. No cracks or internal corrosion allowed.

b. Inspect lockout valve (19) for security.

c. Inspect all ports of lockout valve (19) for thread damage.

d. Inspect all hardware for corrosion, cracks, and thread damage. No cracks allowed.

e. Inspect fittings, tees, nuts, elbows, and tube connectors for corrosion, thread damage, and cracks. No cracks or internal corrosion allowed.

7-87. Repair or Replacement — Lockout Valve Assembly Collective. a. Replace fitting nut, tee, or elbow when cracks, internal corrosion, or having thread damage. Replace part when internal corrosion exists or it is cracked. Repair and treat external corrosion (TM 43-0105).

b. Replace lockout valve (19, figure 7-15) if it is cracked, has thread damage, or internal corrosion, or if it is malfunctioning. For external corrosion repairs and treatment to lockout valve, refer to TM 43-0105.

c. Replace all preformed packings and backup rings when leaking or removed.

d. Replace hardware when damaged or corroded.

7-88. Installation — Lockout Valve Assembly.

NOTE

All threads of tube connectors, tees, fittings, elbows, ports of lockout valve, and packings will have hydraulic fluid (C112 or C112.1) applied prior to assembly. For proper torque requirements of fluid connectors, refer to table 7-3. Do not overtorque fluid connectors.

a. Remove protective plugs from all ports of replacement lockout valve (19, figure 7-15) and drain preservative fluid from lockout valve.

b. Flush replacement lockout valve with clean hydraulic fluid (C112 or C112.1).

c. Install nut (15), backup ring (16), and packing (17) on tee (14). Thread and position tee (14) as shown into SYS RET port of lockout valve (19). Do not tighten nut (15) against lockout valve.

d. Install nut (8), backup ring (7), and packing (6) on tee (9). Thread and position tee (9), as shown, into SYS PRESS port of lockout valve (19). Do not tighten nut (8) against lockout valve.

e. Install nut (3), backup ring (4), and packing (5) on elbow (1). Thread and position elbow (1), as shown, into PRESS port of lockout valve (19). Do not tighten nut (3) against lockout valve.

f. Install nut (22), backup ring (21), and packing (20) on tee (23). Thread and position tee (23), as shown, into RES RET port of lockout valve (19). Do not tighten nut (22) against lockout valve.

g. Remove protective plugs from all tube connectors.

h. Place three washers (26) on three bolts (27) and insert bolts into body of lockout valve (19). Place three spacers (18) on each of three bolts (27), position lockout valve to bulkhead and install bolts (27).

i. Install tube (2) to elbow (1) and tighten nut (3) against lockout valve (19).

j. Install tubes (25 and 24) to tee (23) and tighten nut (22) against lockout valve (19).

k. Install tubes (10 and 11) to tee (9) and tighten nut (8) against lockout valve (19).

l. Install tubes (12 and 13) to tee (14) and tighten nut (15) against lockout valve (19).

m. Fill and recharge emergency collective accumulator (paragraph 7-107).

n. Service System No. 1 reservoir, bleed system, and test lockout valve (19) (paragraph 7-89).

7-89. Test Procedures — Lockout Valve Assembly Collective. Perform operational check of lockout valve (19, figure 7-15) in accordance with procedures outlined in paragraph 7-4.

7-90. DRAIN VALVE (COLLECTIVE ACCUMULATOR).

7-91. Description — Drain Valve (Collective Accumulator). The drain valve (13, figure 7-1) for the emergency collective accumulator system is set for an operating pressure of **1500** psi. Pressure on the hydraulic fluid in the emergency collective accumulator (12) may be relieved by depressing the button on this valve only with no hydraulic systems operating.

7-92. Removal — Drain Valve (Collective Accumulator).

WARNING

Before loosening any connections in the emergency collective accumulator system, be certain that trapped hydraulic pressure is released by depressing button on drain valve (13, figure 7-1). Do not depress accumulator drain valve button with hydraulic systems operating.

a. Connect coupling halves (14 and 15).

b. Relieve hydraulic fluid pressure from emergency collective accumulator (12) by depressing button on drain valve (13).

c. Place suitable container under tee (2, figure 7-16) and housing (14).

d. Loosen connectors of tubes (1, 3, 26, 31, and 35) to allow fluid to seep slowly into container and disconnect tubes from tee (2) and cross (32).

e. Remove two nuts (20), two washers (19), and two bolts (13) from housing (14) and bracket and remove drain valve from bracket. Install protective plugs to all open tube connectors to prevent entry of dirt.

f. Loosen nut (4) and remove tee (2) from cap (7). Remove packing (6), backup ring (5), and nut (4) from tee (2) and discard packing and backup ring.

g. Remove cap (7) and spring (9) from housing (14).

h. Remove nut (10), retainer (11), and seat (12) from piston (15) and remove piston from housing (14).

i. Remove screw (18) and button (17) from piston (15).

j. Remove packing (16) from piston (15) and discard packing.

k. Loosen nut (23) and remove fitting (24) with cross (32) from housing (14). Remove packing (21), backup ring (22), and nut (23) from fitting (24) and discard packing and backup ring.

l. Remove fitting (27) from cross (32). Remove packing (28) from fitting (27) and discard packing.

m. Remove fitting (30) from cross (32). Remove packing (29) from fitting (30) and discard packing.

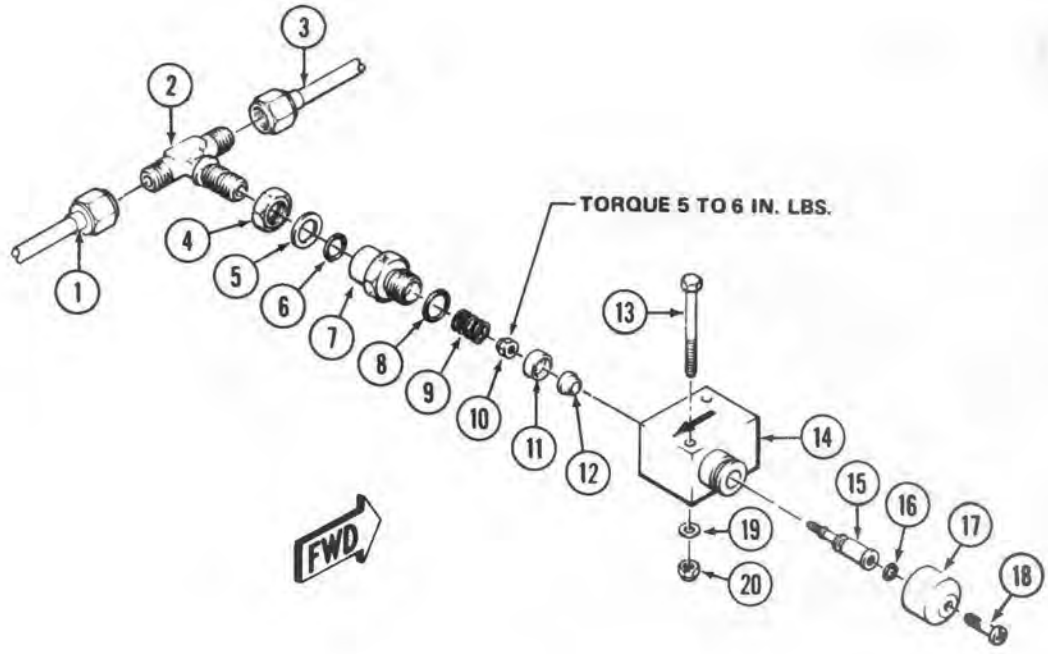
n. Remove check valve (34) from cross (32). Remove packing (33) from check valve (34) and discard packing.

7-93. Cleaning — Drain Valve (Collective Accumulator).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

a. Wash parts with a soft bristle brush (C32) solvent (C205).



1. Tube
2. Tee
3. Tube
4. Nut
5. Backup ring
6. Preformed packing
7. Cap
8. Preformed packing
9. Spring
10. Nut
11. Retainer
12. Seat
13. Bolt (2)
14. Housing
15. Piston
16. Preformed packing
17. Button
18. Screw
19. Washer (2)
20. Nut (2)

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Figure 7-16. Drain valve (emergency collective accumulator) — removal and installation (Sheet 1 of 2)

21. Preformed packing
22. Backup ring
23. Nut
24. Fitting (Union)
25. Preformed packing
26. Tube
27. Fitting (reducer)
28. Preformed packing
29. Preformed packing
30. Fitting (union)
31. Tube
32. Cross
33. Preformed packing
34. Check valve
35. Tube

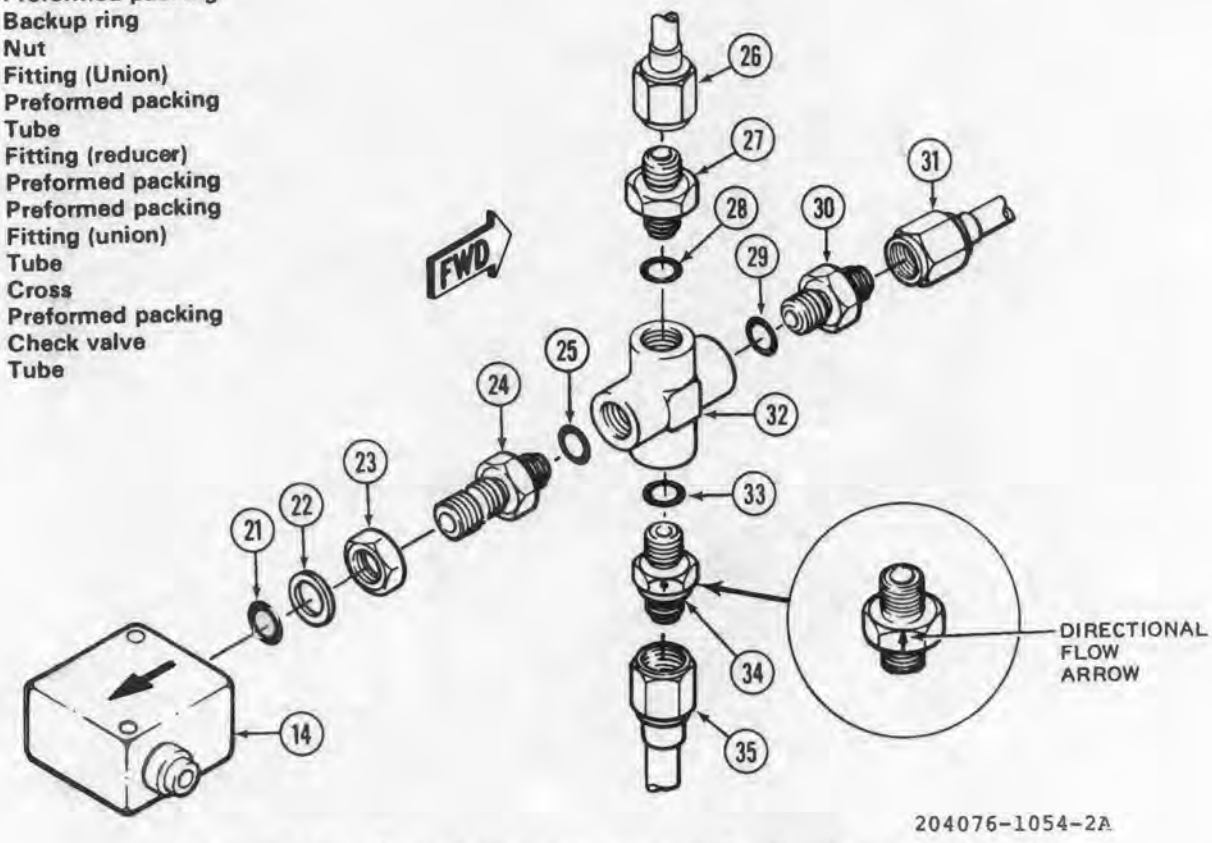


Figure 7-16. Drain valve (emergency collective accumulator) — removal and installation (Sheet 2 of 2)

WARNING

Goggles will be worn when using compressed air. Do not allow more than 5 psi air pressure to come in contact with skin.

b. Blow dry parts with clean, filtered compressed air.

7-94. Inspection — Drain Valve (Collective Accumulator). a. Visually inspect drain valve for evidence of external leakage.

b. Inspect button (17, figure 7-16) on drain valve for proper operation.

c. Inspect all parts of drain valve for obvious damage and corrosion.

d. Inspect tee (2) and nut (4) for corrosion, cracks, and thread damage.

e. No cracks are allowed to any part.

f. Inspect drain valve for security.

7-95. Repair or Replacement — Drain Valve (Collective Accumulator). a. Replace all preformed packings and backup ring.

b. Repair and treat corroded parts of drain valve in accordance with TM 43-0105.

c. Replace drain valve when malfunctioning.

d. Replace external parts of drain valve when corroded. No internal corrosion allowed.

e. Replace part when cracked.

f. Replace tee, fittings, cross, and check valve when corroded internally.

g. Any thread damage to part requires replacement of part.

h. Replace spring (9) when removed.

7-96. Installation — Drain Valve (Collective Accumulator).

NOTE

All threads and internal parts of drain valve and packings will have hydraulic fluid (C112 or C112.1) applied prior to assembly. For proper torque requirements of fluid connector, refer to table 7-3. Do not overtorque fluid connectors.

a. Install packing (16, figure 7-16) on piston (15). Place button (17) on piston (15) and install screw (18).

b. Saturate piston (15) with hydraulic fluid (C112 or C112.1) and insert piston into housing (14). Install seat (12), retainer (11), and nut (10) on piston (15). Torque nut **5 TO 6** inch-pounds.

c. Install spring (9) into housing (14).

d. Install packing (8) on cap (7) and install cap to housing (14).

e. Install nut (4), backup ring (5), and packing (6) on tee (2) and install tee to housing (14). Do not tighten nut (4).

f. Install packing (25) on fitting (24) and install fitting (24) into cross (32).

g. Install packing (28) on fitting (27) and install fitting into cross (32).

h. Install packing (29) on fitting (30) and install fitting into cross (32).

i. Install packing (33) on check valve (34).

CAUTION

Ensure directional flow arrow of check valve (34) is pointing toward cross (32).

j. Install check valve (34) to cross (32) (with direction flow arrow pointing toward cross).

k. Install nut (23), backup ring (22), and packing (21) on fitting (24).

l. Thread fitting (24) into housing (14) and position cross (32), as shown. Do not tighten nut (23).

m. Remove protective plugs from connectors of tube (1 and 3).

n. Position drain valve, as shown, to bracket and install two bolts (13), two washers (19), and two nuts (20).

o. Install tubes (1 and 3) to tee (2).

p. Install tube (26) to fitting (27).

q. Install tube (31) to fitting (30).

r. Install tube (35) to check valve (34).

s. Tighten nuts (4 and 23) against housing (14).

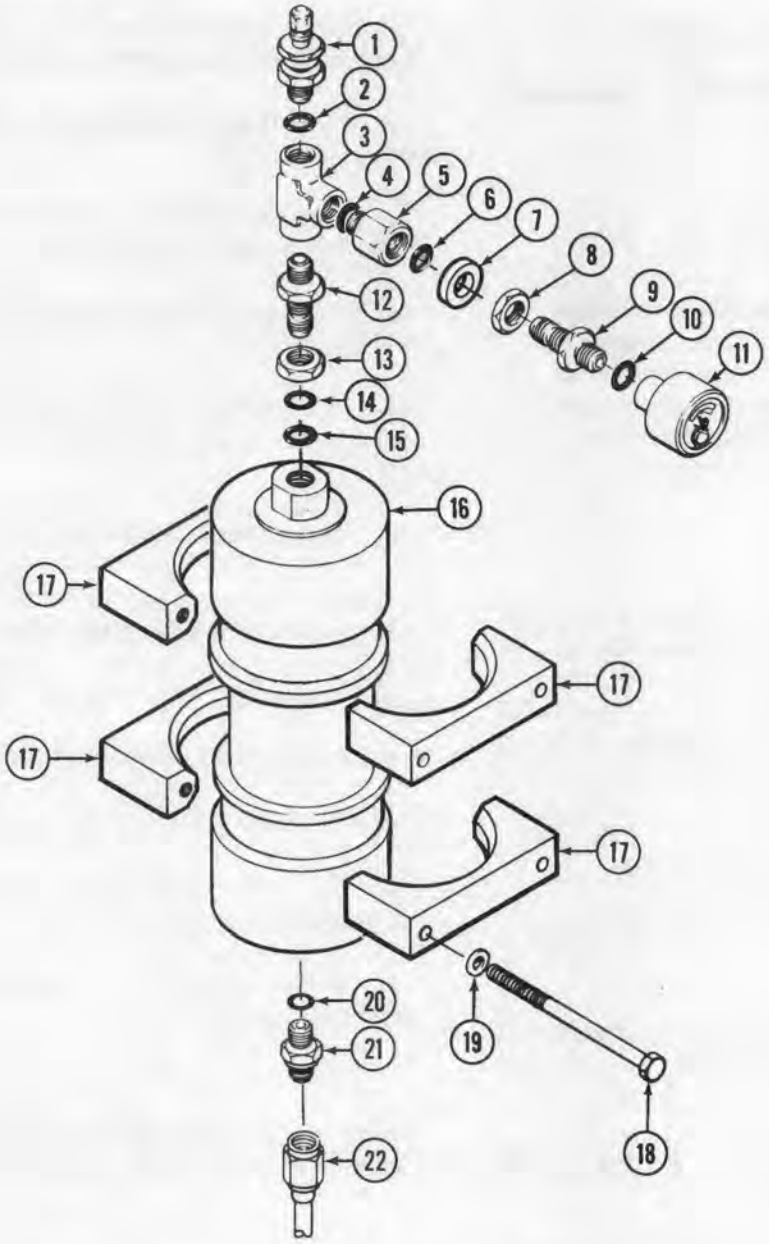
t. Fill and recharge emergency collective accumulator (paragraph 7-107).

u. Service System No. 1 reservoir, bleed hydraulic system (paragraph 7-4).

7-97. ACCUMULATOR — EMERGENCY COLLECTIVE SYSTEM.

7-98. Description — Accumulator — Emergency Collective System. a. A piston type air-oil pressure accumulator (16, figure 7-17) is incorporated into pressure lines to collective control hydraulic power cylinder of System No. 1. Hydraulic fluid contained in the accumulator temporarily maintains pressure throughout the collective control system for emergency use in the event both hydraulic systems fail.

7-99. Removal — Accumulator — Emergency Collective System. a. Connect coupling halves (14 and 15, figure 7-1).



1. Charging valve
2. Preformed packing
3. Tee
4. Preformed packing
5. Reducer
6. Preformed packing
7. Backup ring
8. Nut
9. Fitting
10. Preformed packing
11. Pressure gage
12. Fitting
13. Nut
14. Backup ring
15. Preformed packing
16. Accumulator
17. Support (4)
18. Bolt (4)
19. Washer (4)
20. Preformed packing
21. Reducer
22. Hydraulic line

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Figure 7-17. Hydraulic accumulator (emergency collective) — removal and installation

WARNING

Before loosening any connections in the emergency collective accumulator system, be certain that trapped hydraulic pressure is released by depressing button on drain valve (13). Do not depress accumulator drain valve button with hydraulic systems operating.

a. Relieve fluid pressure from collective accumulator (12) by depressing button on top of drain valve (13).

CAUTION

Open valve slowly and allow pressure to escape. Ensure pressure is relieved.

c. Carefully remove cap from top of charging valve (1, figure 7-17) and relieve pressure.

d. Remove charging valve (1), packing (2), pressure gage (11), and packing (10). Refer to paragraphs 7-110 and 7-117.

e. Disconnect hydraulic line (22) from bottom of accumulator (16). Cap or cover openings in hydraulic line and accumulator.

f. Remove accumulator (16) by removing bolts (18), washers (19), and supports (17).

g. Remove fitting (9), nut (8), backup ring (7), packing (6), reducer (5) and packing (4).

h. Remove tee (3), fitting (12), nut (13), backup ring (14), and packing (15).

i. Remove reducer (21) and packing (20) at bottom of accumulator.

7-100. Disassembly — Accumulator — Emergency Collective System. (AVIM)

NOTE

Determine whether the accumulator to be repaired is manufactured by Parker-Hannifin Corporation or Sprague Engineering.

a. Disassemble accumulator manufactured by Parker-Hannifin Corporation as follows (figure 7-18).

(1) Remove lockwire and half-mounting rings (9).

(2) Remove strap (16) and identification band (10). Keep identification band with accumulator.

CAUTION

The holding device used must encase the accumulator with equal tightness around its circumference. Vice jaws should not be used because the tightness will be unequally distributed and will distort the accumulator cylinder.

(3) Place accumulator in bench clamp fixture to hold accumulator during disassembly.

(4) Remove plugs (1 and 15) and nuts (2 and 14).

(5) Remove air end cap (13), backup ring (12), and packing (11).

(6) Remove hydraulic end cap (3), backup ring (4), and packing (5).

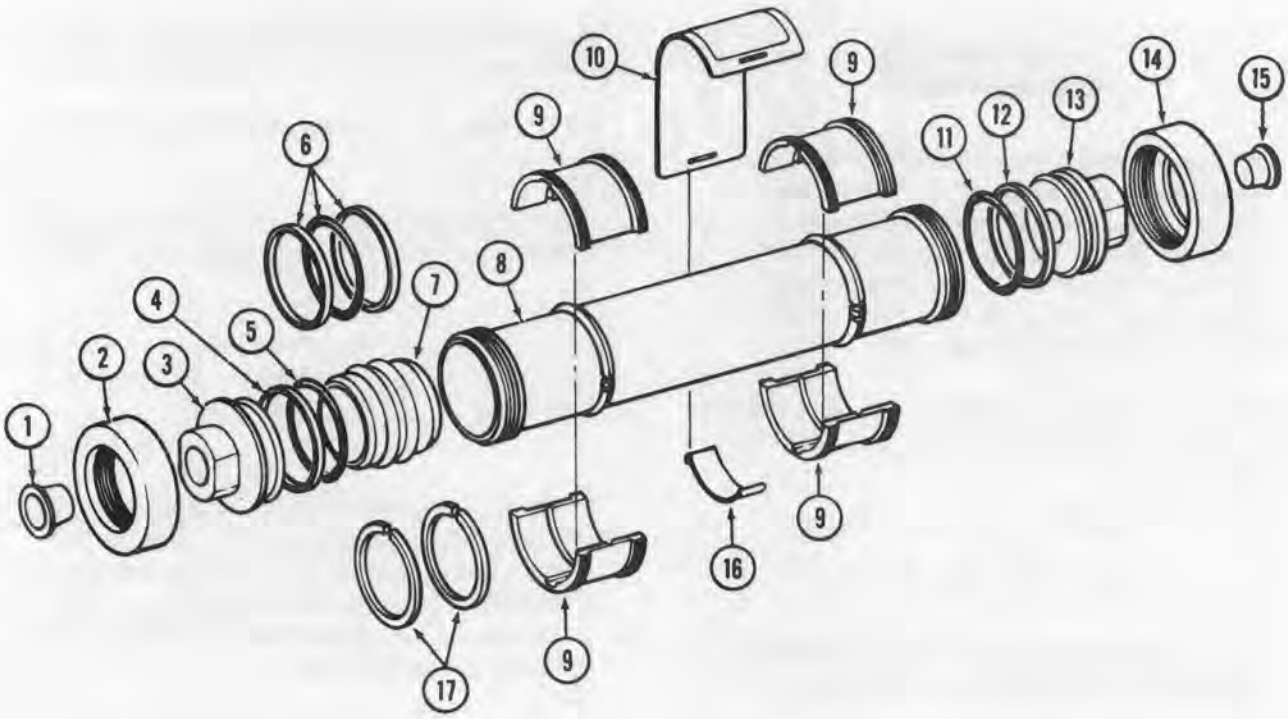
CAUTION

Do not use a sharp or pointed object to remove piston from cylinder.

(7) Remove piston (7), aligning rings (17), and seal assembly "T" (6).

b. Disassemble accumulator manufactured by Sprague Engineering as follows (figure 7-19):

(1) Remove strap (6) and identification band (12). Keep identification band with accumulator.



1. Plug
2. Nut
3. Hydraulic End Cap
4. Backup Ring
5. Preformed Packing
6. Seal Assembly "T"
7. Piston
8. Cylinder
9. Half-mounting Ring
10. Identification Band
11. Preformed Packing
12. Backup Ring
13. Air End Cap
14. Nut
15. Plug
16. Strap
17. Aligning Ring

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Figure 7-18. Hydraulic accumulator assembly (Parker-Hannifin) disassembled view

CAUTION

The holding device used must encase the accumulator with equal tightness around its circumference. Vice jaws should not be used because the tightness will be unequally distributed and will distort the accumulator cylinder.

(2) Place accumulator in bench clamp fixture to hold accumulator during disassembly.

(3) Remove lockwire and remove pin (7) and air end cap (8).

(4) Remove packing (9) and backup ring (10).

(5) Remove lockwire and remove pin (1) and hydraulic end cap (2).

(6) Remove packing (16) and backup ring (15).

CAUTION

Do not use a sharp or pointed object to remove piston from cylinder.

(7) Remove piston (13), packings (3, 4, and 14), and backup rings (5).

7-101. Inspection — Accumulator — Emergency Collective System. a. Inspect accumulator for general condition and evidence of leaks or malfunction.

b. Inspect fittings for damaged threads.

c. Inspect ID of cylinder and OD of piston for evidence if scratches, scoring, or other damage affecting free sliding motion of piston in cylinder. (AVIM)

d. Inspect metal parts for structure damage. (AVIM)

e. Inspect threads of end caps and cylinder for good condition and cleanliness. (AVIM)

f. Check proper fit of piston in cylinder. There should be no points of wear. (AVIM)

7-102. Cleaning — Accumulator — Emergency Collective System.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

a. Wash all metal parts with solvent (C205).

WARNING

Goggles will be worn when using compressed air. Do not allow more than 5 psi air pressure to come in contact with skin.

b. Dry with filtered, compressed air.

7-103. Repair or Replacement — Accumulator — Emergency Collective System. a. Replace preformed packings.

b. Replace fittings having unserviceable threads.

c. Do not attempt repair of metal parts.

d. Replace aligning rings (17, figure 7-18) and seal assembly "T" (6) on Parker-Hannifin accumulator. (AVIM)

e. Replace backup retainers (5, 10, and 15, figure 7-19) and packings (3, 4, 14, and 16) on Sprague accumulator. (AVIM)

7-104. Assembly — Accumulator — Emergency Collective System. (AVIM) a. Assemble accumulator manufactured by Parker-Hannifin Corporation as follows (figure 7-18):

NOTE

Apply light coating of hydraulic fluid (C112 or C112.1) to all preformed packings and backup rings prior to installation.

Lubricate threads with hydraulic fluid (C112 or C112.1) or petrolatum (C164) to facilitate reassembly.

(1) Install backup ring (12) and packing (11) on air end cap (13).

(2) Install air end cap (13) and nut (14). Tighten nut and apply lockwire (C127). Install plug (15).

(3) Install seal assembly "T" (6), and aligning rings (17) on piston (7).

(4) Install piston (7) in cylinder (8) with face of piston toward hydraulic end cap (3).

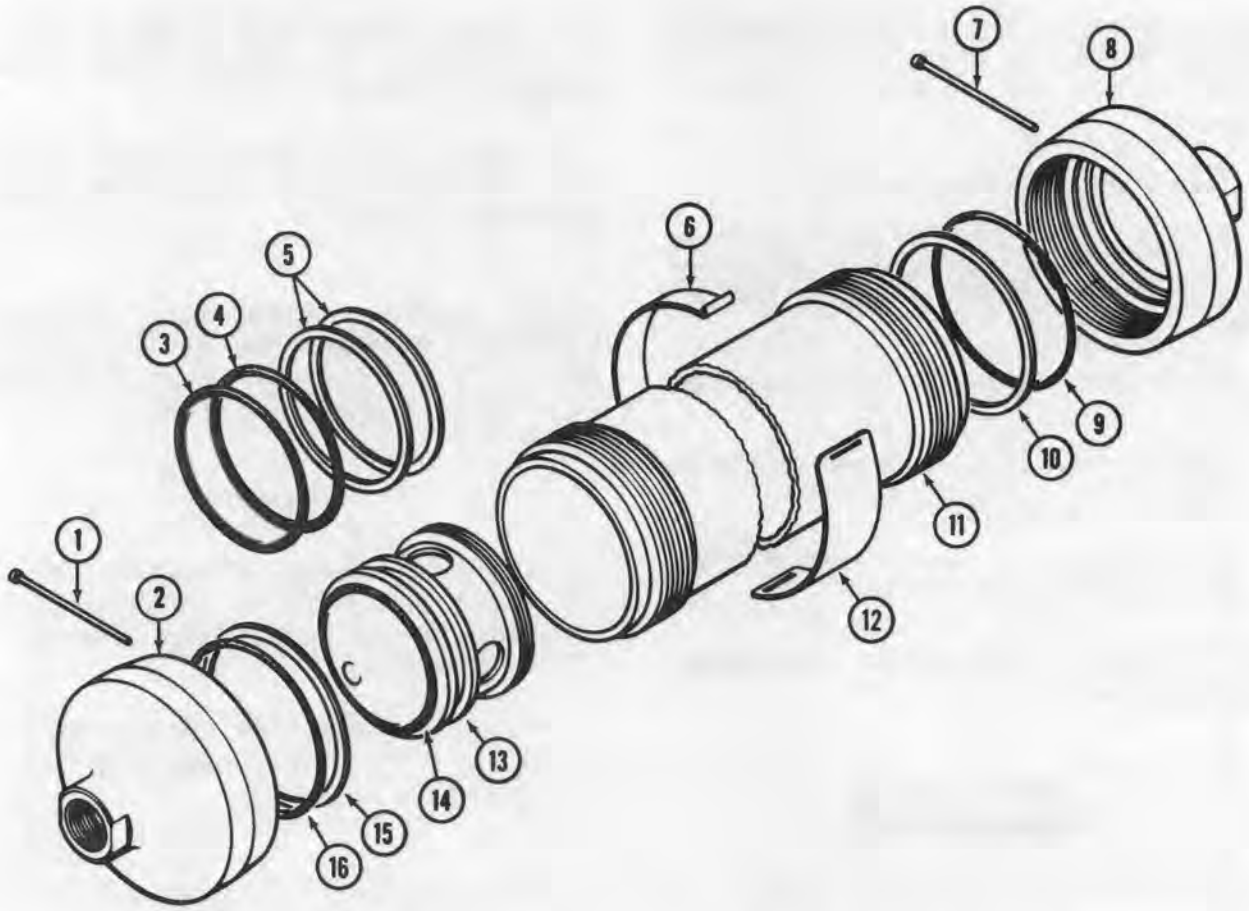
(5) Install backup ring (4) and packing (5) on hydraulic end cap (3).

(6) Install hydraulic end cap (3) and nut (2). Tighten nut and apply lockwire (C127). Install plug (1).

(7) Install half-mounting rings (9) and lockwire (C127) to cylinder.

(8) Install identification band (10) and strap (16).

b. Assemble accumulator manufactured by Sprague Engineering as follows (figure 7-19).



1. Pin
2. Hydraulic end cap
3. Preformed packing
4. Preformed packing
5. Backup ring
6. Strap
7. Pin
8. Air end cap
9. Preformed packing
10. Backup ring
11. Cylinder
12. Identification band
13. Piston
14. Preformed packing
15. Backup ring
16. Preformed packing

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Figure 7-19. Hydraulic accumulator assembly (Sprague) — disassembled view

NOTE

Apply light coating of hydraulic fluid (C112 or C112.1) to all packings and backup rings prior to installation.

Lubricate threads with hydraulic fluid (C112 or C112.1) or petrolatum (C164) to facilitate reassembly.

(1) Install backup rings (5) and packings (3, 4, and 14) on piston (13).

(2) Install piston (13) in cylinder (11) with face of piston toward hydraulic end cap (2).

(3) Install backup ring (10) and packing (9) in air end cap (8).

(4) Install air end cap (8) on cylinder (11).

(5) Install backup ring (15) and packing (16) in hydraulic end cap (2).

(6) Install hydraulic end cap (2) on cylinder (11).

(7) Hold accumulator by flats on one end cap and tighten other end cap **1400 TO 1500** inch-pounds torque.

(8) Install pins (1) and (7) and apply lockwire (C127).

7-105. Testing — Accumulator — Emergency Collective System. (AVIM) a. Test equipment must have capability to provide controlled hydraulic fluid pressures to **3000** psig and air, or nitrogen, pressures to **1000** psig.

WARNING

Exercise extreme caution with test equipment as the air or nitrogen is under pressure.

NOTE

Use nitrogen (C145.1) or dry air for testing. Fluid used for testing must be the same as that used for installed accumulator to prevent contamination.

(1) Piston seizure test.

(a) Connect pressure source to end cap nearest to piston and slowly apply pressure not to exceed **50** psig. The piston should move the entire length of the cylinder with no seizing or binding.

(b) Connect pressure source to other end cap and repeat same procedure as in (1) (a).

(c) Repeat (1) (a) and (b). If the accumulator fails any part of test, improper fit or surface damage is indicated.

(d) After test is completed, connect pressure source to an end cap and apply pressure to move piston to approximate center of accumulator.

(2) Proof pressure test:

WARNING

Remove all air from both air and hydraulic chambers of the accumulator and connecting lines. Be certain that connecting lines and connections are capable of withstanding 3000 psig pressure.

(a) Fill hydraulic end and air end of accumulator with hydraulic fluid (C112 or C112.1). Plug one end cap port and apply **3000** psig hydraulic pressure to other port.

(b) Hold pressure for five minutes. If there is any external or internal fluid leakage or evidence of damage or deformation, correct the discrepancy and repeat the test.

(3) Hydraulic leakage test.

(a) With air port open, apply **3000** psig hydraulic pressure and hold for three minutes. If there is any external or internal fluid leakage, correct the discrepancy and repeat the test.

(b) Repeat the test outlined in step (a) with **2** psig hydraulic pressure.

(4) Air leakage test: air end cap.

(a) Remove all fluid hydraulic pressure from hydraulic chamber of accumulator.

(b) Apply **200** psig air pressure into air chamber and hold for three minutes. If there is an external air leakage at air end cap, correct the discrepancy and repeat the test.

NOTE

A leakage test check can be performed by making a continuous ring of oil on groove formed by air end cap and cylinder. Bubbles that form and do not dissipate in one minute indicate a leak.

(5) Air leakage test: fluid end cap.

NOTE

A leakage test check can be performed by filling hydraulic end cap port with hydraulic fluid. Bubbles that form indicate a leak.

In an emergency, the accumulator may be installed and operated in the helicopter, in lieu of this test.

(a) With hydraulic port open, apply **200** psig air pressure to accumulator and hold for three minutes. There should be no leakage at hydraulic port.

(b) Repeat test (5) (a) using **1000** psig air pressure.

7-106. Installation — Accumulator — Emergency Collective System. a. Install reducer (21, figure 7-17) with packing (20) at bottom of accumulator.

b. Install fitting (12) with packing (15), backup ring (14), and nut (13). Install tee (3).

c. Install packing (4), reducer (5), packing (6), backup ring (7), nut (8), and fitting (9).

d. Position accumulator (16) and supports (17) and install attaching washers (19) and bolts (18).

NOTE

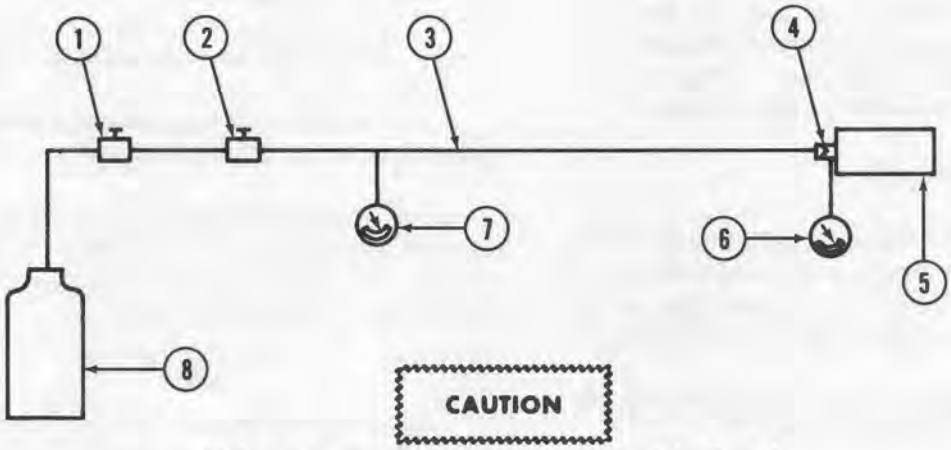
The supports shall have a 0.10 TO 0.14-inch gap between halves prior to tightening the bolts. Shim this gap using washers Part Nos. AN960PD416L and AN960PD416. Do not enlarge gap.

e. Install pressure gage (11) with preformed packing (10) (paragraph 7-117).

f. Install charging valve (1) with packing (2) (paragraph 7-110).

7-107. Accumulator Charging — Emergency Collective System. a. Charge collective accumulator with nitrogen (C145.1) as follows (figure 7-20):

(1) Connect cylinder (8), shut-off valve (1), and pressure regulator (2) to hose (3) (with shut-off valve in OFF position).



CAUTION

Valve on accumulator has special threads. Adaptor (4), Schrader part No. 2755, must be procured or fabricated to enable hose to be connected.

1. **Shut-off valve (3000 psi)**
2. **Pressure regulator (1000 to 3000 psi)**
3. **Hose (working pressure 3000 psi, bursting pressure 12,000 psi)**
4. **Adaptor (Schrader part No. 2755)**
5. **Accumulator**
6. **Gage (accumulator pressure gage)**
7. **Gage (0 to 3000 psi, Bourdon type)**
8. **Cylinder (nitrogen, 1000 psi)**

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Figure 7-20. Charging hydraulic accumulator

NOTE

Shut-off valve and pressure regulator are supplied with cylinder.

(2) Connect hose (3) to adapter (4).

NOTE

Valve on accumulator (5) has special threads. Adapter must be procured or fabricated to enable hose to be connected.

(3) Connect adapter (4) to accumulator (5).

(4) Open shut-off valve (1) and regulate pressure with pressure regulator valve (2) to **650 TO 850** psi as indicated on pressure gage (7).

(5) Charge accumulator (5) while checking the indicator on pressure gage (6) as follows:

NOTE

Indicator on dial of pressure gage (6) shall be in the green area for correct accumulator pressure.

(a) If indicator is in the green area, turn shut-off valve (1) to the OFF position.

(b) If indicator is in the yellow area below the green area, increase pressure with the pressure regulator valve (2) until indicator is in the green area, then turn shut-off valve (1) to the OFF position.

(c) If indicator is in the yellow area above the green area, turn shut-off valve (1) to the OFF position, then drain excess pressure until indicator is in green area.

(6) Disconnect adapter (4) from accumulator (5).

b. Refill, bleed, and test hydraulic systems (paragraph 7-4).

c. Install cap on charging valve (1, figure 7-17).

7-108. ACCUMULATOR CHARGING VALVE — EMERGENCY COLLECTIVE SYSTEM.

7-109. Description — Accumulator Charging Valve — Emergency Collective System. The charging valve (1, figure 7-17) is a high pressure check valve used to charge the emergency collective system accumulator (16) with nitrogen.

7-110. Removal — Accumulator Charging Valve — Emergency Collective System. a. Connect coupling halves (14 and 15, figure 7-1).

WARNING

Before loosening any connections in the emergency collective accumulator system, ensure trapped hydraulic pressure is released by depressing button on drain valve (13). Do not depress accumulator drain valve button with hydraulic systems operating.

b. Relieve fluid pressure from collective accumulator (12) by depressing button on top of drain valve (13).

CAUTION

Open valve very slowly and allow pressure to escape. Ensure all pressure is relieved.

c. Remove cap from top of charging valve (1, figure 7-17) and relieve nitrogen pressure.

d. Unscrew charging valve (1) from tee on top of collective accumulator. Remove packing (2). Cap or cover openings.

7-111. Inspection — Accumulator Charging Valve — Emergency Collective System. Inspect charging valve for leaks, damage, and malfunction.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

7-112. Cleaning — Accumulator Charging Valve — Emergency Collective System. Clean surfaces of charging valve with clean cloth and solvent (C205).

7-113. Repair or Replacement — Accumulator Charging Valve — Emergency Collective System. Replace charging valve having leaks and/or damage that would impair function.

7-114. Installation — Accumulator Charging Valve — Emergency Collective System. a. Uncap or uncover openings in tee on top of collective accumulator (16, figure 7-17) and charging valve (1).

b. Place packing (2) on charging valve (1) and screw into tee (3) on top of collective accumulator (16).

c. Disconnect coupling halves (14 and 15, figure 7-1).

d. Refill, bleed, and test hydraulic systems (paragraph 7-4).

e. Install charging valve cap.

7-115. ACCUMULATOR PRESSURE GAGE — EMERGENCY COLLECTIVE SYSTEM.

7-116. Description — Accumulator Pressure Gage — Emergency Collective System. Nitrogen pressure contained in collective accumulator (16, figure 7-17) is measured by the pressure gage (11).

7-117. Removal — Accumulator Pressure Gage — Emergency Collective System. a. Connect coupling halves (14 and 15, figure 7-1).

WARNING

Before loosening any connections in the emergency collective accumulator system, be certain that trapped hydraulic pressure is released by depressing button on drain valve (13). Do not depress accumulator drain valve button with hydraulic systems operating.

b. Relieve fluid pressure from collective accumulator (12) by depressing button on top of drain valve (13).

CAUTION

Open valve slowly and allow pressure to escape. Ensure pressure is relieved.

c. Carefully remove cap from top of charging valve (1, figure 7-17) and relieve pressure.

d. Unscrew pressure gage (11) from fitting (9) on top of collective accumulator (16). Remove packing (10). Cap or cover openings.

7-118. Inspection — Accumulator Pressure Gage — Emergency Collective System. Inspect pressure gage for leaks and/or damage that would cause malfunction.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

7-119. Cleaning — Accumulator Pressure Gage — Emergency Collective System. Clean external surfaces of pressure gage with solvent (C205).

7-120. Repair or Replace — Accumulator Pressure Gage — Emergency Collective System. Replace pressure gage showing evidence of leakage or damage that would impair function.

7-121. Installation — Accumulator Pressure Gage — Emergency Collective System. a. Uncap or uncover opening in fitting (9, figure 7-17) on top of collective accumulator (16).

b. Place packing (10) on pressure gage (11) and screw into fitting (9) on top of collective accumulator (16).

c. Disconnect coupling halves (14 and 15, figure 7-1).

d. Refill, bleed, and test hydraulic systems (paragraph 7-4).

7-122. ACCUMULATOR DRAIN VALVE COUPLINGS.

7-123. Description — Accumulator Drain Valve Couplings (figure 7-21). Access to the drain valve couplings is through the aft right side access door. Normally the drain hose and socket (coupling) assembly will be stowed in the plug assembly, and the pressure cap assembly will be installed on the nipple (coupling) assembly. In this position hydraulic fluid will be prevented from draining out of the collective accumulator. To drain hydraulic fluid and pressure from the collective accumulator, the socket and nipple assemblies must be connected together prior to actuating the drain valve.

7-124. Removal — Accumulator Drain Valve Couplings (figure 7-21).

WARNING

Before loosening any connections in the emergency collective accumulator system, ensure trapped hydraulic pressure is released. Do not relieve accumulator pressure with hydraulic systems operating. Open aft right side access door.

a. Relieve collective accumulator pressure.

(1) Remove pressure cap assembly (17, figure 7-21) from nipple assembly (3).

(2) Disconnect hose (5) and socket assembly (4) from plug assembly (9). Connect socket assembly (4) to nipple assembly (3).

(3) Relieve hydraulic fluid pressure from collective accumulator (12, figure 7-1) by depressing button on drain valve (13).

b. Only after system pressure has been relieved, disconnect socket assembly (4, figure 7-21) from nipple assembly (3). Install pressure cap assembly on nipple assembly (3).

NOTE

Install caps or plugs on all open hoses and elbows.

c. Back off nut on hose (5) and detach hose from elbow (7).

d. When replacing hose (5) with new hose, remove socket assembly (4) from hose end. Connect socket assembly to plug assembly.

e. Detach socket (4) and plug assembly (9) from bulkhead at station 173.00 by removing cotter pin (19) and pin (10).

f. Back off nut on end of tube (6) and detach tube from elbow (7). Remove nut (12), washer (11), and elbow (7) from support (8).

g. Unscrew nipple (3) and pressure cap assembly (17) from elbow (2). Remove packing (16).

h. Back off nut on end of tube (1) and detach tube from nipple (13). Remove nipple (13), nut (14), packing (15), and elbow (2) from support (8).

7-125. Cleaning — Accumulator Drain Valve Couplings.

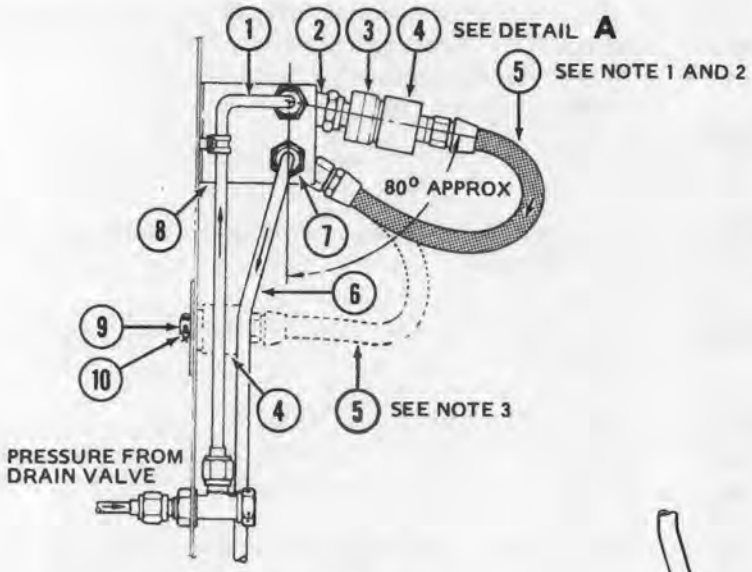
WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

a. Clean external surfaces with solvent (C205).

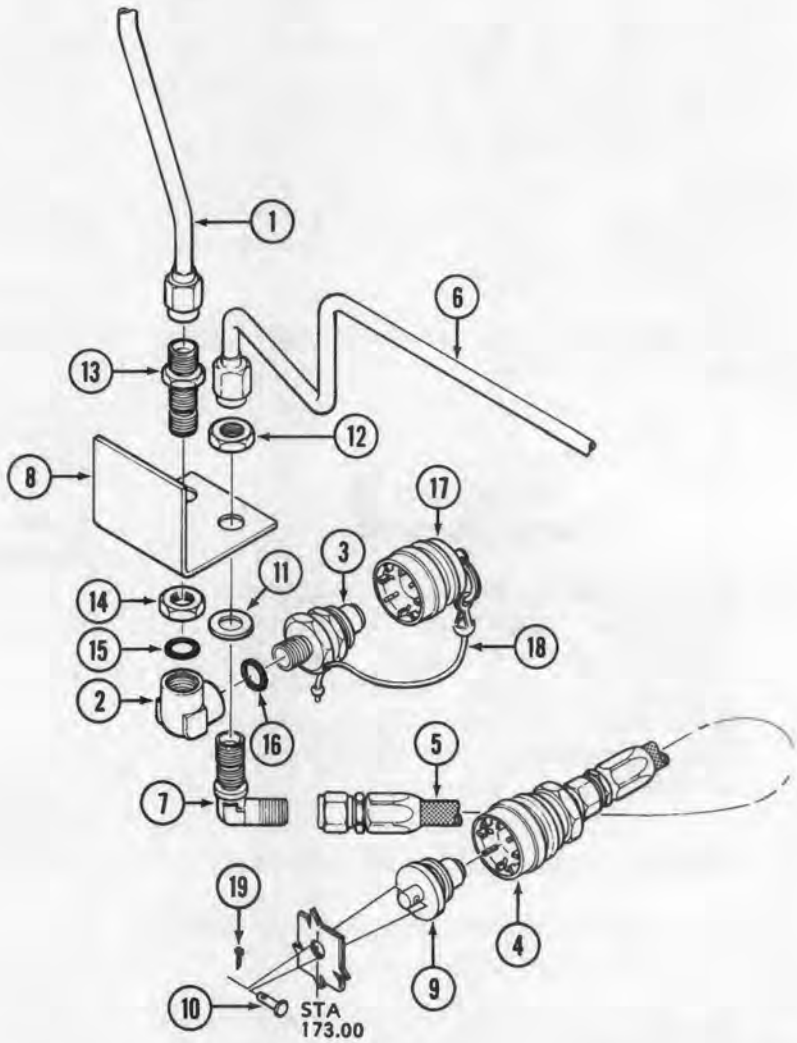
b. Dry clean parts with clean, lint-free cloth or low pressure air.

7-126. Inspection — Accumulator Drain Valve Couplings. a. Inspect hose for corrosion, cracked connectors, deterioration or fraying, damaged threads, security, and leaks.



DRAIN VALVE COUPLINGS
VIEW LOOKING DOWN

NOTES:
1. Hose is shown connected in drain position.
2. When hose is connected in drain position, hose will prevent access door from closing.
3. Hose is shown connected in normal stowed position.



DETAIL A

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1. Tube (pressure)
2. Elbow
3. Nipple assembly
4. Socket assembly
5. Hose
6. Tube (drain)
7. Elbow
8. Support
9. Plug assembly
10. Pin
11. Washer
12. Nut
13. Nipple
14. Nut
15. Preformed packing
16. Preformed packing
17. Pressure cap assembly
18. Cable assembly
19. Cotter pin

Figure 7-21. Accumulator drain valve couplings — removal and installation

b. Inspect tube assemblies for corrosion, cracks, dents, serviceability, scores, bends, damaged threads, security, and leakage.

c. Inspect nipple, nuts, and elbows for corrosion, cracks, serviceability, damaged threads, security, and leakage.

d. Inspect socket and plug assembly and nipple and pressure cap assembly for corrosion, cracks, damaged threads, security, and leakage.

7-127. Repair or Replacement — Accumulator Drain Valve Couplings. a. Repair and treat nicks, scratches, and corrosion on surfaces of tubes and attaching parts in accordance with procedures in TM 55-1500-204-25/1.

b. Replace parts with damaged threads or internal corrosion.

c. Replace hose or tube assemblies when cracked, worn, frayed, bent, deformed.

d. Replace leaking hose tubes, nipple and pressure cap assembly, and socket and plug assembly.

e. Tighten loose nipples, nuts, and elbow.

f. Replace packing at leaking connection. Retighten leaking nipples or elbows.

7-128. Installation — Accumulator Drain Valve Couplings.

NOTE

All threads and internal parts of drain valve and packings will have hydraulic fluid (C112 or C112.1) applied prior to assembly. For proper torque requirements of fluid connector(s), refer to table 7-3 for torque requirements.

a. Install nipple (13, figure 7-21) in support (8). Install nut (14), new packing (15) and elbow (2) on nipple (13). Torque nipple (13) and nut (14).

b. Install elbow (7) in support (8). Install washer (11) and nut (12). Torque nut.

c. Connect tube (1) to nipple (13) and tube (6) to elbow (7). Torque flareless fittings of tubes.

d. Connect one end of hose (5) to socket (4) and the remaining end of hose to elbow (7). Torque flareless fittings.

e. Install new packing (16) and connect nipple assembly (3) to elbow (2). Torque nipple assembly.

f. Position plug assembly (9) in its mounting port on bulkhead at station 173.00. Secure to bulkhead with pin (10) and cotter pin (19).

g. Service hydraulic reservoir with hydraulic fluid (paragraph 7-7).

h. Charge collective accumulator with nitrogen (paragraph 7-107).

i. Pressurize system in accordance with paragraph 7-4 and inspect fittings for leakage. If leakage occurs, retorque flareless fittings or nuts in accordance with table 7-3.

j. Connect socket assembly (4) to plug assembly (9). Connect pressure cap assembly (17) to nipple assembly.

k. Secure access door.

7-129. ARMAMENT COUPLINGS.

7-130. Description — Armament Couplings. External armament couplings (7 and 14, figure 7-22), located on left and right side of helicopter are provided for attaching external hydraulically operated armament system supports. The armament coupling also allow for quick disconnect of armament systems supports.

7-131. Removal — Armament Couplings.

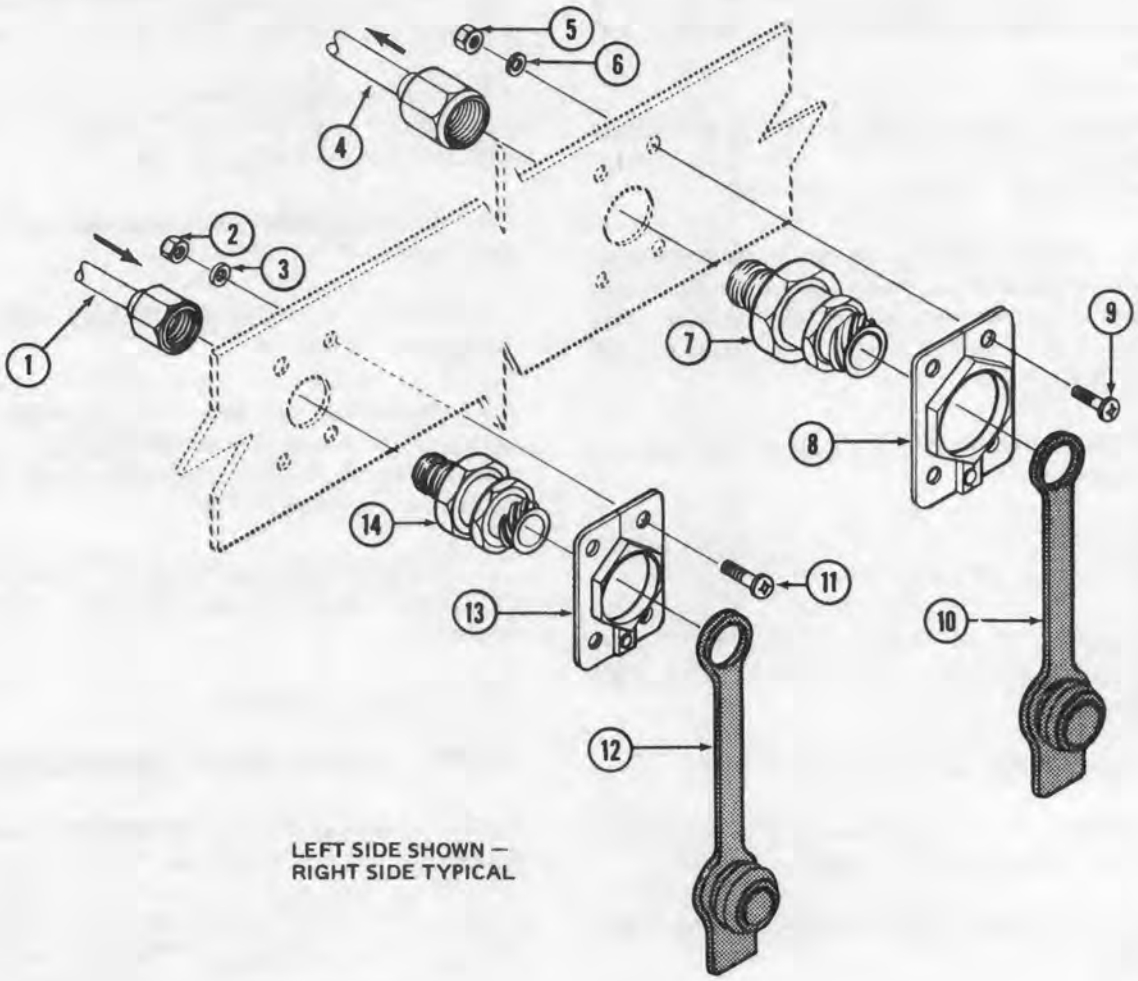
NOTE

Removal procedures are typical for left or right armament couplings.

a. **Armament Coupling (Pressure).** Remove armament coupling (14, figure 7-22) from pressure side of hydraulic system as follows:

(1) Remove left or right access door (20, figure 2-19).

(2) Place container under connector of tube assembly (1, figure 7-22) to catch fluid seepage and disconnect tube assembly from coupling half (14).



1. Tube assembly
2. Nut
3. Washer
4. Tube assembly
5. Nut
6. Washer
7. Coupling half
8. Flange
9. Screw
10. Dust cap
11. Screw
12. Dust cap
13. Flange
14. Coupling half

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Figure 7-22. Armament couplings, hydraulic — removal and installation

(3) Remove dust cap (12) from coupling half (14).

(4) Remove four nuts (2), four washers (3), and four screws (11) attaching flange (13) to cabin structure. Remove flange (13) and coupling half (14).

b. Armament Coupling (Return). Remove coupling half (7, figure 7-22) from return side of hydraulic system as follows:

(1) Disconnect tube assembly (4) from coupling half (7).

(2) Remove dust cap (10) from coupling half (7).

(3) Remove four nuts (5), four washers (6), and four screws (9) attaching flange (8) to cabin structure and remove flange (8) and coupling half (7).

7-132. Inspection — Armament Couplings. a. Inspect coupling halves (7 and 14, figure 7-22) for corrosion. Minor corrosion is allowed only to external surface, provided damaged area is polished (by sanding) and treated (step b). No corrosion damage is allowed to fluted or internal areas of coupling halves.

b. Polish nicks, scratches, or corrosion to original finish with 600 grit sandpaper (C185.2). Treat repaired area with chemical film material (C42) followed with a light application of primer (C167).

c. Inspect dust caps (10 and 12) for deterioration and tears.

d. Inspect flanges (8 and 13) for corrosion. Minor corrosion is allowed, provided corroded area is removed by polishing (sanding).

e. Inspect coupling halves (7 and 14) and attaching components for security.

f. Inspect coupling halves (7 and 14) for leaks.

g. Inspect all parts for thread damage.

h. Inspect coupling halves (7 and 14) for cracks. No cracks are allowed.

i. Inspect tube assemblies (1 and 4) in accordance with paragraph 7-138.

7-133. Repair or Replacement — Armament Couplings. a. Internal corrosion damage to coupling halves (7 and 14, figure 7-22) requires replacement of part.

b. Any damaged part that does not warrant time expended for repairs requires replacement of part.

c. Replace all parts that have thread damage or cracks.

d. Tighten any component that is loose.

e. Replace part when leaking fluid.

f. Replace dust caps (10 or 12) when torn or deteriorated.

7-134. Installation — Armament Couplings.

NOTE

Installation procedures are typical for left or right armament couplings.

a. Armament Coupling (Pressure). Install armament coupling half (14, figure 7-22) to pressure side of hydraulic system as follows:

(1) Install coupling half (14). Position flange (13) over coupling half (14) (with hinge down) and install screws (11), washers (3), and nuts (2).

(2) Install tube assembly (1) to coupling half on fitting (14). Torque tube assembly connector (table 7-3).

b. Armament Coupling (Return). Install armament coupling half (7) to return side of hydraulic system as follows:

(1) Install coupling half (7) to cabin structure. Position flange (8) over coupling half (7) (with hinge down) and install screws (9), washers (6), and nuts (5).

(2) Install tube assembly (4) to coupling half (7). Torque tube assembly connector (table 7-3).

c. Bleed hydraulic system (paragraph 7-4).

d. Perform operational check of hydraulic system and check for leakage (paragraph 7-4, and table 7-1).

e. Install left or right access door (20, figure 2-19).

7-135. HOSES, TUBING, AND ATTACHING HARDWARE.

7-136. Description — Hoses, Tubing, and Attaching Hardware. Throughout the hydraulic system are hoses, tubing, and attaching hardware that interconnects check valves, relief valves, solenoid valves, irreversible valves, pump, reservoir, and cyclic, collective, tail rotor cylinder assemblies. The tube assemblies are secured to cabin structure with clamps, spacers, washers, and nuts.

7-137. Removal — Hoses, Tubing, and Attaching Hardware. Remove hose assemblies, tube assemblies, attaching clamps, and hardware from cabin structure as necessary to perform maintenance functions of hydraulic system.

7-138. Inspection — Hoses, Tubing, and Attaching Hardware.

NOTE

For further inspection criteria and/or testing of hydraulic hose or tube assemblies, refer to TM 55-1500-204-25/1.

a. Inspect hose and tube assemblies for leaks.

b. Inspect hose and tube assemblies for security.

c. Inspect hose and tube assemblies for corrosion.

d. Inspect tube assemblies and hose connector for cracks.

e. Inspect hose assemblies for deterioration or fraying.

f. Inspect hose and tube assemblies for deformation.

g. Inspect hose and tube assemblies for wear or binding.

7-139. Repair or Replacement — Hoses, Tubing, and Attaching Hardware. (AVIM) a. For repairs to hose or tube assemblies, refer to TM 55-1500-204-25/1.

b. Replace hose or tube assemblies when cracked or deteriorated.

c. Replace clamps or hardware when damaged.

d. Tighten hose or tube assembly when leaking.

e. Tighten hardware attaching hose or tube assembly when loose.

f. Replace hose or tube assembly when component is deformed.

g. Ensure that all hose and tube assemblies do not foul, to prevent wear from chafing. Spiral wrap all hoses that are chafing with tape (C224).

h. Any wear to hose or tube assemblies as a result of chafing, requires replacement of part.

i. Any damage to hoses, tubes, and hardware that does not warrant time expended for repairs, necessitates replacement of part.

7-140. Installation — Hoses, Tubing, and Attaching Hardware. (AVIM)

NOTE

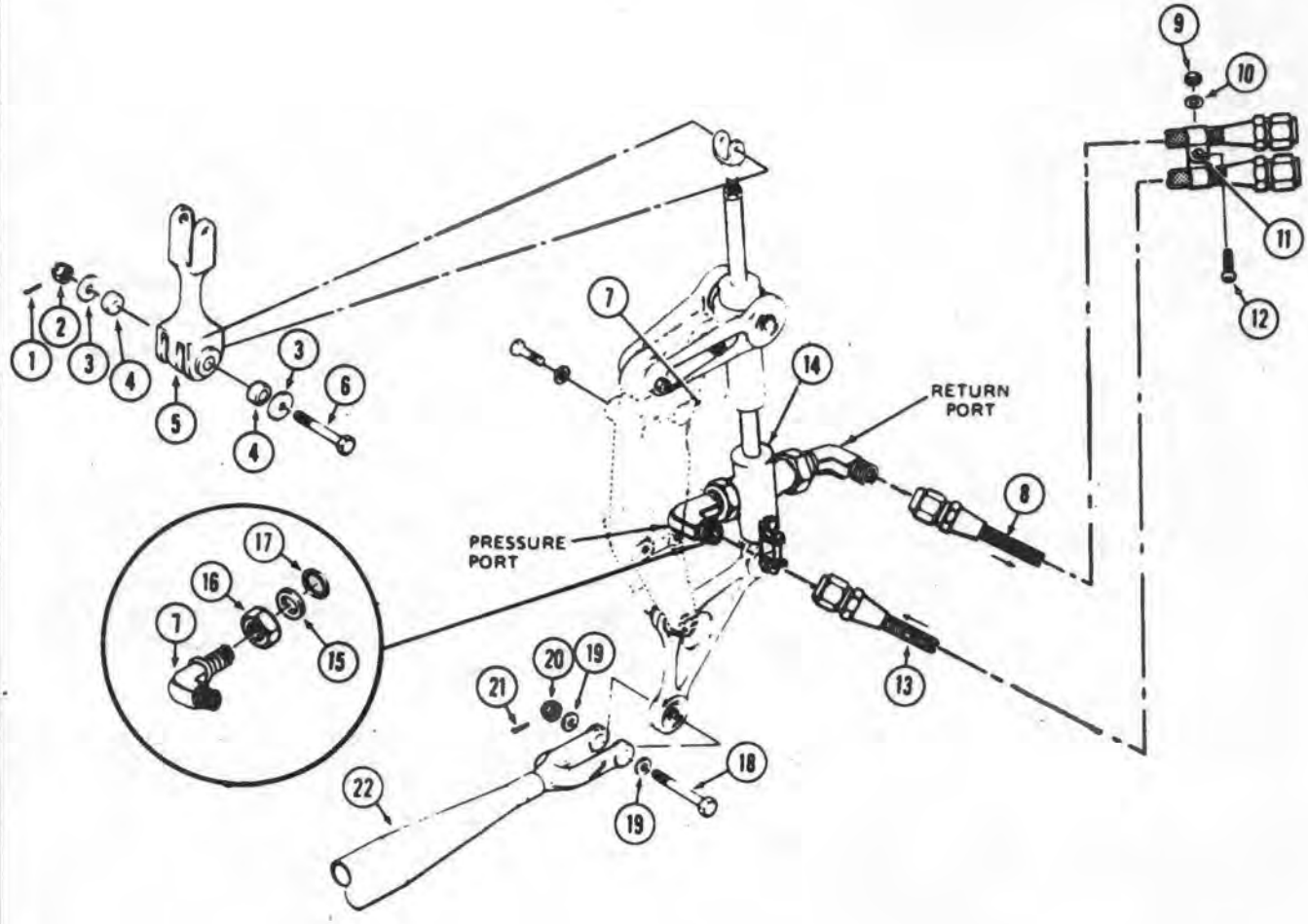
Threads of tube and hose connectors and fittings will have hydraulic fluid (C112 and C112.1) applied to them prior to torquing. Do not exceed limits outlined in table 7-3 or torque threads when dry. Hydraulic fluid serves as a seal also after fluid dries.

a. Install hose assemblies and attaching clamps and hardware to cabin structure as necessary to perform maintenance functions to the hydraulic system; reference: when component has been removed for repairs or damaged part is being replaced.

b. Install tube assemblies and attaching clamps and hardware to cabin structure as necessary to perform maintenance functions to the hydraulic system; reference: when component has been removed for repairs, or damaged part is being replaced.

7-141. TAIL ROTOR HYDRAULIC CYLINDER.

7-142. Description — Tail Rotor Hydraulic Cylinder. A hydraulic power cylinder in the tail rotor control linkage is vertically mounted in a support (figure 7-23) on Station 211 fuselage bulkhead, accessible through a door on right side of helicopter.



1. Cotter pin
2. Nut
3. Washers
4. Sleeves
5. Link assembly
6. Bolt
7. Fitting
8. Hose assembly
9. Nut
10. Washer
11. Clamps
12. Screw
13. Hose assembly
14. Cylinder
15. Ring
16. Nut
17. Preformed packing
18. Bolt
19. Washers
20. Nut
21. Cotter pin
22. Control tube

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Figure 7-23. Tail rotor cylinder — removal and installation

7-143. Adjustment — Tail Rotor Hydraulic Cylinder. a. Adjust adapter (6, figure 7-24) 1.67 inches from centerline of hole to top surface of piston rod of power cylinder as shown and tighten nut (7) prior to installation of cylinder and support assembly to helicopter.

NOTE

Pedal creep can be controlled by adjusting the amount of twist in the tail rotor servo hydraulic fluid supply hoses.

b. Rig tail rotor control system (paragraph 11-120).

7-144. Inspection — Tail Rotor Hydraulic Cylinder. a. Check hydraulic cylinder for tightness or binding. Valve should be free to move on shaft. Be sure hose assemblies (8 and 13, figure 7-23) do not restrict valve movement.

b. Inspect hydraulic power cylinder for cleanliness, damage, freedom of movement, and evidence of leaks. Allowable leakage for this cylinder is one drop per 25 cycles.

c. Inspect cylinder (14) and attaching components for security.

d. Inspect piston rod of power cylinder for nicks, scratches, and cracks. (AVIM)

e. Inspect cylinder (14) for proper installation.

f. Inspect arm assemblies (5, figure 7-24) and bellcrank assembly (20) for corrosion damage, pitting, or distortion; refer to table 7-4 (figure 7-25).

g. Inspect hydraulic fittings (7, figure 7-23) and nuts (16) for corrosion, cracks, and thread damage.

7-145. Removal — Tail Rotor Hydraulic Cylinder. a. Open right access door (17, figure 2-190).

NOTE

The tail rotor control servo cylinder and support may be removed as an assembly, or the servo cylinder alone may be removed from the support assembly. To remove servo cylinder, perform steps a. through d. A small amount of fluid seepage will occur when disconnecting hoses. Ensure protective covers are installed on all open ports to prevent entry of foreign material.

b. Place a suitable container under hose assemblies (8 and 13, figure 7-23); disconnect hoses from fittings (7). Cap all fittings and hose connectors.

c. Remove cotter pin (1), nut (2), washers (3), sleeves (4), and bolt (6) attaching link assembly (5) to adapter of power cylinder (14). Keep attaching parts with link assembly.

d. Remove cotter pin (21), nut (20), washers (19), and bolt (18) from control tube (22) and disconnect control tube from bellcrank.

e. If cylinder and support assembly are to be removed as a unit, disconnect support assembly from bulkhead and remove cylinder and support assembly as a single unit. See paragraph 11-177 for support assembly removal.

f. Remove nut (9), washer (10) and screw (12) from clamps (11). Remove clamps (11) from hose assemblies (8 and 13).

g. If support assembly is not being removed from helicopter, remove cylinder and bellcrank as follows:

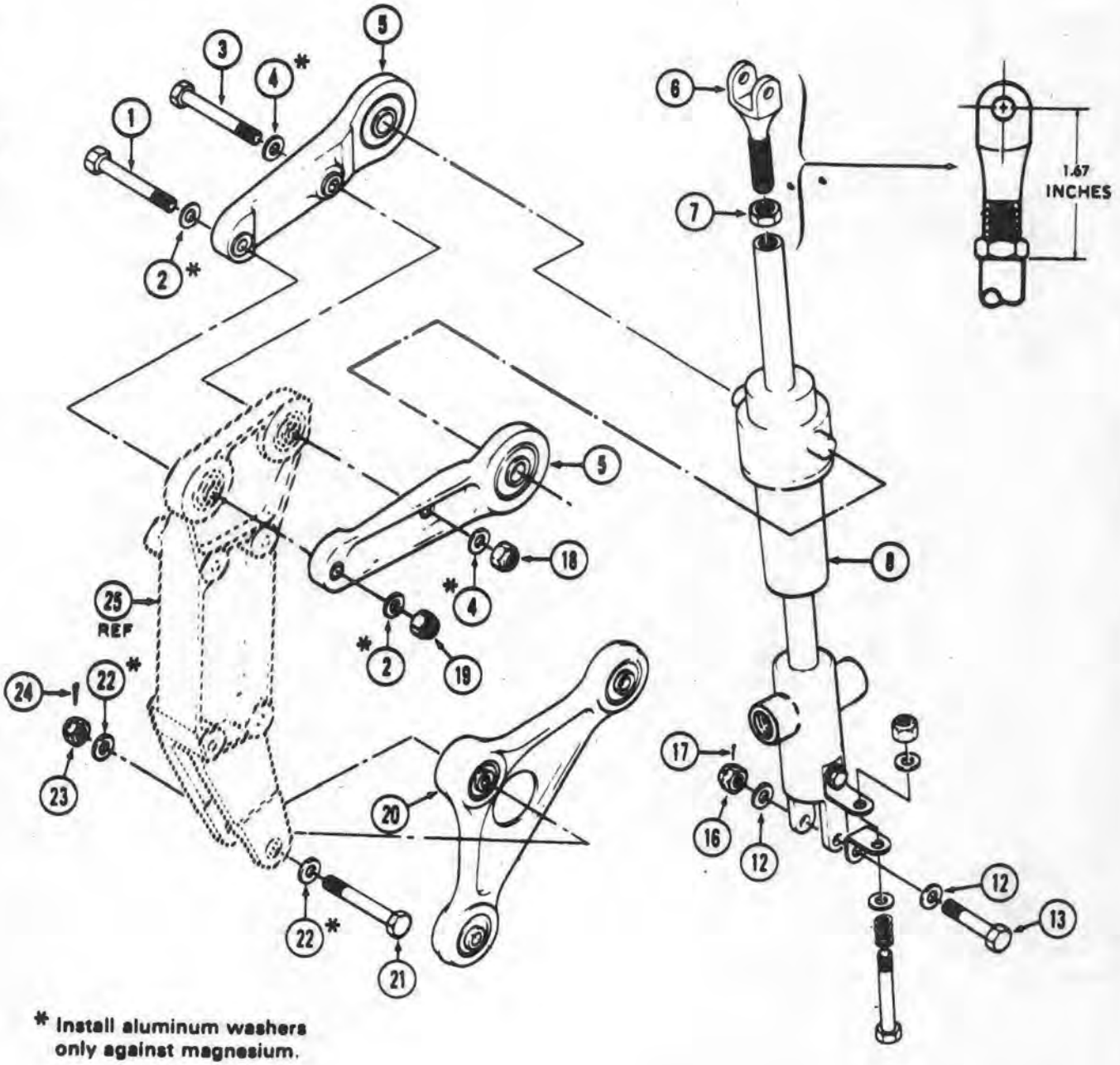
(1) Remove nut (18, figure 7-24), washers (4), and bolt (3) from arm assembly (5).

(2) Remove nut (19), washers (2), and bolt (1) from arm assembly (5).

(3) Remove both arm assemblies (5).

(4) Remove cotter pin (24), nut (23), washers (22) and bolt (21).

(5) Remove cylinder from helicopter.



1. Bolt
*2. Washers
3. Bolt
*4. Washers
5. Arm assembly
6. Adapter
7. Nut
8. Power cylinder
9. Deleted
10. Deleted
11. Deleted
12. Washers
13. Bolt
14. Deleted
15. Deleted
16. Nut
17. Cotter pin
18. Nut
19. Nut
20. Bellcrank assembly
21. Bolt
*22. Washers
23. Nut
24. Cotter pin
25. Support assembly (ref)

Figure 7-24. Tail rotor cylinder — disassembled view

Table 7-4. Inspection Requirements for Cylinder, Tail Rotor (AVIM)

FIGURE 7-	INDEX NO.	NOMENCLATURE	METHOD OF INSPECTION			TYPICAL DEFECTS	REFERENCE PARAGRAPH		REMARKS
			VISUAL	*MAGNETIC PARTICLE	FLUORESCENT **PENETRANT		INSPECTION	REPAIR	
23	8	Hose Assembly	X			Cracks, corrosion, frayed wire mesh, deterioration, deformed	7-138	Refer to TM 55-1500-204-25/1	
23	13	Hose Assembly	X			Corrosion, cracks, frayed, wire mesh, deterioration deformed	7-138	Refer to TM 55-1500-204-25/1	
23	7	Fitting	X			Corrosion, cracks and thread damage	7-138	Replace if damaged	
23	16	Nut	X			Corrosion, cracks and thread damage	7-138	Replace if damaged	
24	5	Arm Assembly			X	Corrosion, nicks, scratches, cracks, deformed and damaged bearing	7-138 and figure 7-25	7-148 and figure 7-25	
24	6	Adapter (Clevis)	X	X		Nicks, scratches, cracks, corrosion and thread damage	7-138 and figure 7-25	7-148 and figure 7-25	
24	7	Nut	X	X		Corrosion, cracks and thread damage	7-138	7-148	
24	8	Power Cylinder	X			Nicks, scratches, cracks, leaks, binding, corrosion, deformed and thread damage, cleanliness	7-147	7-148	
24	20	Bellcrank Assembly			X	Nicks, scratches, cracks, corrosion and damaged bearings	7-138 and figure 7-25	7-148 and figure 7-25	

*Magnetic particle inspect in accordance with TM 43-0103
**Fluorescent penetrant inspect in accordance with TM 43-0103

Table 7-4. Inspection Requirements for Cylinder, Tail Rotor (AVIM) (Cont)

FIGURE 7-	INDEX NO.	NOMENCLATURE	METHOD OF INSPECTION			TYPICAL DEFECTS	REFERENCE PARAGRAPH		REMARKS
			VISUAL	*MAGNETIC PARTICLE	**FLUORESCENT PENETRANT		INSPECTION	REPAIR	
24	25	Support Assembly			X	Cracks, corrosion, nicks, scratches, and damaged bearings	7-147 and figure 7-25	7-148 and figure 7-25	

*Magnetic particle inspect in accordance with TM 43-0103
**Fluorescent penetrant inspect in accordance with TM 43-0103

P/N 204-001-832

P/N 204-001-799

P/N 204-001-799

P/N 204-001-803

TYPE OF DAMAGE	DAMAGE AREA REPAIR ZONES ▨	DAMAGE AREA REPAIR ZONES ▭
MECHANICAL	0.010 INCH MAX. DEPTH	0.020 INCH MAX. DEPTH
CORROSION	0.005 INCH MAX. DEPTH	0.010 INCH MAX. DEPTH
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 SQUARE INCH	NOT CRITICAL
MAXIMUM NUMBER OF REPAIRS	TWO PER ZONE	NOT CRITICAL
EDGE CHAMFER	0.040 INCH MAX.	0.080 INCH MAX.
BORE HOUSING AND BUSHING		

BORE DAMAGE: 0.002 INCH FOR ONE-FOURTH CIRCUMFERENCE

NO CRACKS ALLOWED

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Figure 7-25. Tail rotor cylinder arms and bellcranks — damage limits (Sheet 1 of 2)

NOTE: The allowable in-service bearing wear limits prior to replacement are as follows:

BEARING DESIGNATION		BEARING WEAR LIMITS
MILITARY STANDARD PART NUMBER	MANUFACTURE PART NUMBER	MAXIMUM RADIAL PLAY
MS27643-4	DSP4, DSRP4	0.006 INCH
MS27643-4	DW4, MDW4, DW4K	0.005 INCH
MS27641-8	KP8A	0.006 INCH

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Figure 7-25. Tail rotor cylinder arms and bellcranks — damage limits (Sheet 2 of 2)

7-146. Disassembly — Tail Rotor Hydraulic Cylinder.

NOTE

If tail rotor hydraulic cylinder and support assembly have been removed as a single unit, perform steps a, b, and c.

a. Place cylinder and support assembly on a clean workbench and remove nut (18, figure 7-24), washers (4), and bolt (3) from arm assembly (5).

b. Remove nut (19), washers (2), and bolt (1) from arm assembly (5).

c. Remove cotter pin (24), nut (23), washers (22), and bolt (21).

d. Remove cotter pin (17), nut (16), washers (12), and bolt (13) from power cylinder (8) and brackets (11).

e. Remove fittings (7, figure 7-23), packings (17), rings (15), and nuts (16) from cylinder assembly.

7-147. Inspection — Tail Rotor Hydraulic Cylinder. (AVIM) a. Power Cylinder and Adapter. (AVIM) Inspect power cylinder (8, figure 7-24) and adapter (6) in accordance with table 7-4 and paragraph 7-144 and as follows:

(1) Inspect power cylinder (8) for cleanliness, damage, freedom of movement, and evidence of leaks.

(2) Inspect adapter (6) for nicks and scratches (figure 7-25).

(3) Inspect lower end of power cylinder clevis (8) and adapter (6, Figure 7-24) for hole elongation.

(4) Inspect piston rod of power cylinder (8) and adapter (6) for stripped or crossed threads.

(5) Inspect adapter (6) for cracks, using magnetic particle method per TM 43-0103.

(6) Inspect all bearings for maximum radial play in accordance with limits shown in figure 7-25. (AVIM)

b. Arms and Bellcranks. (AVIM)

(1) Inspect left and right arm assembly (5, figure 7-24) and bellcrank assembly (20), in accordance with limits outlined in table 7-4 and figure 7-25).

(2) Inspect two arm assemblies (5, figure 7-24), and bellcrank assembly (20), using fluorescent penetrant method per TM 43-0103.

c. Attaching Hardware. Inspect attaching hardware of hydraulic cylinder assembly as follows:

(1) Inspect for loose or missing hardware.

(2) Inspect hardware for corrosion (TM 55-1500-204-25/1).

(3) Inspect hardware for cracks, using magnetic particle method per TM 43-0103. No cracks allowed.

(4) Inspect hardware for security.

(5) Inspect washers for elongated holes.

(6) Inspect all bolts and nuts for thread damage.

7-148. Repair or Replacement — Tail Rotor Hydraulic Cylinder. (AVIM)

Premaintenance requirements for repair of tail rotor cylinder (AVIM)

Conditions	Requirements
Model	All
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C98), (C167), (C220), (C221), (C253).
Special Environmental Conditions	Dust Free/Well Ventilated Area

a. Power Cylinder Assembly. (AVIM) Repair power cylinder assembly (8, figure 7-24) as follows:

(1) Any cracks to components of power cylinder (8) require replacement of part.

(2) Replace any bearing in arm assembly (5) or bellcrank assembly (20) that is damaged or exceeds inspection limits outlined in figure 7-25.

(3) For bearing replacement procedures see paragraph 11-181 and figure 11-43 .

(4) Replace packings (17, figure 7-23) and backup rings (15) when removed or leaking.

b. Attaching Hardware.

(1) Replace any missing hardware.

(2) Tighten hardware when loose.

(3) Any cracks or corrosion require replacement of part.

(4) Elongated holes in washers require replacement of part.

(5) Replace tape (C220) to mounting pads of support assembly (25) (ref) when missing or torn.

7-149. Assembly — Tail Rotor Hydraulic Cylinder. (AVIM)

CAUTION

Aluminum washers (2 and 4, figure 7-24) will be installed only adjacent to arm assemblies (5).

NOTE

Do not perform steps a, b, and c, unless hydraulic cylinder and support assembly are removed and installed as a unit.

a. Position arm assemblies (5) to mounting bosses of power cylinder (8) and upper bearings of support assembly. Install bolt (3), washers (4), and nut (18).

b. Install bolt (1), washers (2), and nut (19) to arm assemblies (5).

CAUTION

Install aluminum washers (22) against support assembly (25) (Ref).

c. Position bellcrank assembly (20) to support assembly (25) (ref) and install bolt (21), two washers (22), and nut (23). Secure nut (23) with cotter pin (24).

d. Place washer (12) on bolt (13) and position bellcrank (20) to power cylinder (8) and install bolt (13), washer (12), nut (16), and secure with cotter pin (17).

e. Install nut (7) to adapter (6), thread adapter into piston rod of power cylinder (8) and adjust adapter (6) 1.67 inches from centerline of adapter (6) hole to top surface of piston rod of power cylinder as shown (Figure 7-24). Tighten nut (7) against piston rod.

CAUTION

When hydraulic cylinder is not scheduled for immediate installation to helicopter, precautionary measures must be exercised at all times to keep component clean and to prevent corrosion. Prepare as follows:

f. Wrap hydraulic cylinder (14, figure 7-23) in barrier material (C98), and secure with tape (C221).

7-150. Installation — Tail Rotor Hydraulic Cylinder.

CAUTION

Install aluminum washers (22, figure 7-24) against support assembly (25) (ref).

NOTE

Prior to installation of hydraulic cylinder and support assembly as a unit, ensure that tape (C220) on mounting pads of support assembly (paragraph 11-117) is not torn or missing. Tape will extend past edges of mounting pads 0.25 inch. If cylinder (14, figure 7-23) and support assembly are installed as a unit, unthinned primer (C253) or primer (C167) shall be applied to shank of bolts that install support assembly to bulkhead.

a. Position hydraulic cylinder (14) and support assembly to bulkhead and install support assembly (paragraph 11-117).

CAUTION

Aluminum washers (2 and 4, figure 7-24) will be installed only, adjacent to arm assemblies (5).

NOTE

Perform steps b and c when hydraulic cylinder and support assembly are not removed and installed as a unit.

b. Position arm assemblies (5) to mounting bosses of power cylinder (8) and upper bearings of support assembly. Install bolt (3), washers (4), and nut (18).

c. Install bolt (1), washers (2), and nut (19) to arm assemblies (5).

CAUTION

Install aluminum washers (2) against support assembly (25) (ref).

d. Position bellcrank assembly (20) to support assembly (25) (ref) and install bolt (21), two washers (22), and nut (23). Secure nut (23) with cotter pin (24).

e. Insert adapter (6, figure 7-24) into link assembly (5, figure 7-23) and install bolts (6), washers (3), sleeves (4) and nuts (2). Secure nut (2) with cotter pin (1).

NOTE

A small amount of fluid seepage may occur when removing protective dust covers from power cylinder (8, figure 7-24) which will require placing a suitable container under pressure and return ports to catch seepage.

f. Remove protective dust covers from pressure and return ports of power cylinder (14).

g. The following installation procedures for fitting (7, figure 7-23) are typical for both pressure and return ports of power cylinder.

(1) Install nut (16), backup ring (15), and packing (17) on fitting (7) and thread fittings into pressure and return ports of power cylinder.

(2) Position fittings (7), approximately as shown and secure nut (16).

h. Install hose assemblies (8 and 13) to fittings (7). Ensure that hose assemblies are not twisted or kinked and do not foul.

i. Position control tube (22) to bellcrank and install bolt (18), washers (19), and nut (20). Secure nut (20) with cotter pin (21).

j. Remove cloth or container from under power cylinder.

k. Move pedals to full left and full right and check hose assemblies (8 and 13) during both positions for fouling.

l. Service and bleed hydraulic system (paragraph 7-4).

m. Check rigging of tail rotor flight control system (paragraph 11-120).

n. Close and secure access door (17, figure 2-19).

o. Perform operational check of tail rotor flight control system (paragraph 7-4).

7-151. Test Procedures — Tail Rotor Hydraulic Cylinder and Support Assembly. (AVIM) Test power cylinder (8, figure 7-24) during next runup.

7-152. Miscellaneous Hydraulic Components. Miscellaneous hydraulic components consist of solenoid valves, pressure switches, check valves, relief valve, quick-disconnects, and hydraulic fittings.

a. Remove hydraulic system components as follows:

(1) The various components of the servo system may be removed and replaced in a similar manner by disconnecting lines and removing mounting bolts. Disconnect electrical plugs from solenoid valve and pressure switch when necessary for removal. When installing components, replace large diameter washers between component and bulkhead. See figure 7-2 to determine direction of flow of hydraulic fluid. Refer to following step b. for installation.

(2) Refill, bleed, and test system after removal and installation of a component (paragraph 7-4). If hydraulic leaks are present, refer to Troubleshooting, table 7-2, for corrective action.

b. Install hydraulic system components as follows:

NOTE

The following basic information is considered standard practice for the installation of hydraulic fittings.

(1) Coat male threads of fitting packing and non-metallic washer sparingly with petrolatum (C164) or hydraulic fluid (C112 or C112.1) and assemble as illustrated in view A, figure 7-26. Work packing into counterbase of nut then turn the nut down until the packing is pushed firmly against the lower threaded section of the fitting.

NOTE

If there is any doubt that the point of sudden torque increase has been reached, rapidly loosen and tighten the nut several times (use light torque) until sure increase in torque is due to the sleeve and tube touching the fitting seat, and is not due to thread friction.

(2) Install fitting into boss and at the same time, keep the nut turning with the fitting until the packing contacts the boss (view B). This point is indicated by a sudden increase in torque. With the fitting in this position, put a wrench on the nut to prevent its turning and at the same time, turn the fitting in one and one-half turns. Position fitting by turning not more than one additional turn.

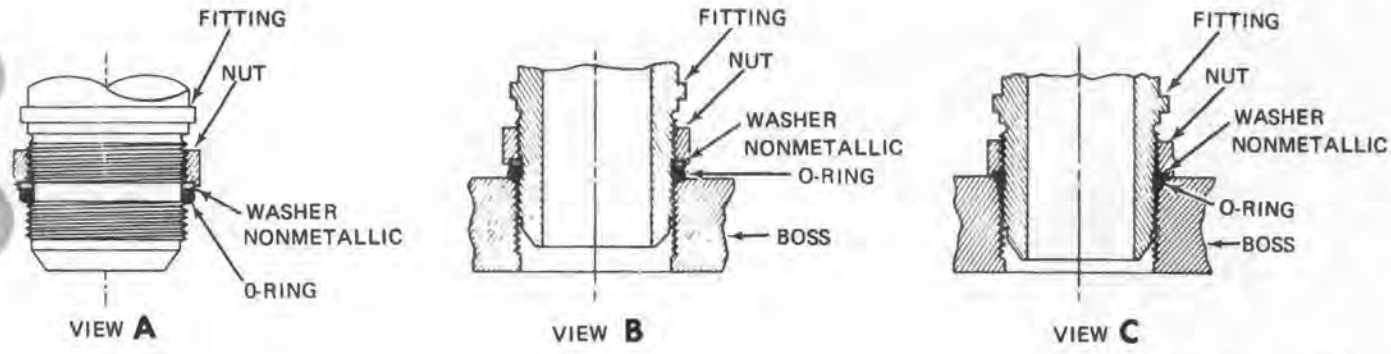


Figure 7-26. Installation method — hydraulic fittings

(3) Hold fitting and turn nut down tightly against boss. Slight extrusion of the packing is not detrimental.

7-153. HYDRAULIC SERVO CYLINDER ASSEMBLY (CYCLIC CONTROL).

7-154. Description — Hydraulic Servo Cylinder Assembly (Cyclic Control). Two hydraulic servo cylinder assemblies (6 and 25, figure 7-28) are incorporated in the cyclic controls to reduce effort required for fore and aft and lateral control and to reduce feedback of forces from main rotor.

7-155. Adjustment — Hydraulic Servo Cylinder Assembly (Cyclic Control). a. Adjust hydraulic servo cylinder assembly for proper length as shown in figure 7-27).

b. Adjust spring tension of lever assembly on servo control valve as follows:

(1) Adjust spring adjustment nut so that **0.12** inch of threads are above spring adjustment nut (figure 7-27).

(2) If motoring occurs in the collective controls during operation, correct as follows:

(a) Add washers between top nut and top spring (figure 7-38).

(b) Add washers in multiples of one until tendency to motor stops. Do not exceed a maximum of six washers.

(3) Final adjustments of hydraulic servo cylinder will be made concurrent with rigging (paragraph 11-55).

7-156. Inspection — (Acceptance/Rejection Criteria) Hydraulic Servo Cylinder Assembly (204-076-005) (Cyclic Control). Perform the following inspection functions with hydraulic servo cylinder assembly installed.

a. Inspect all parts of hydraulic servo cylinder assemblies (6 and 25, figure 7-28) for damage, corrosion, or pitting, and distorted threads (paragraph 7-160 and table 7-5).

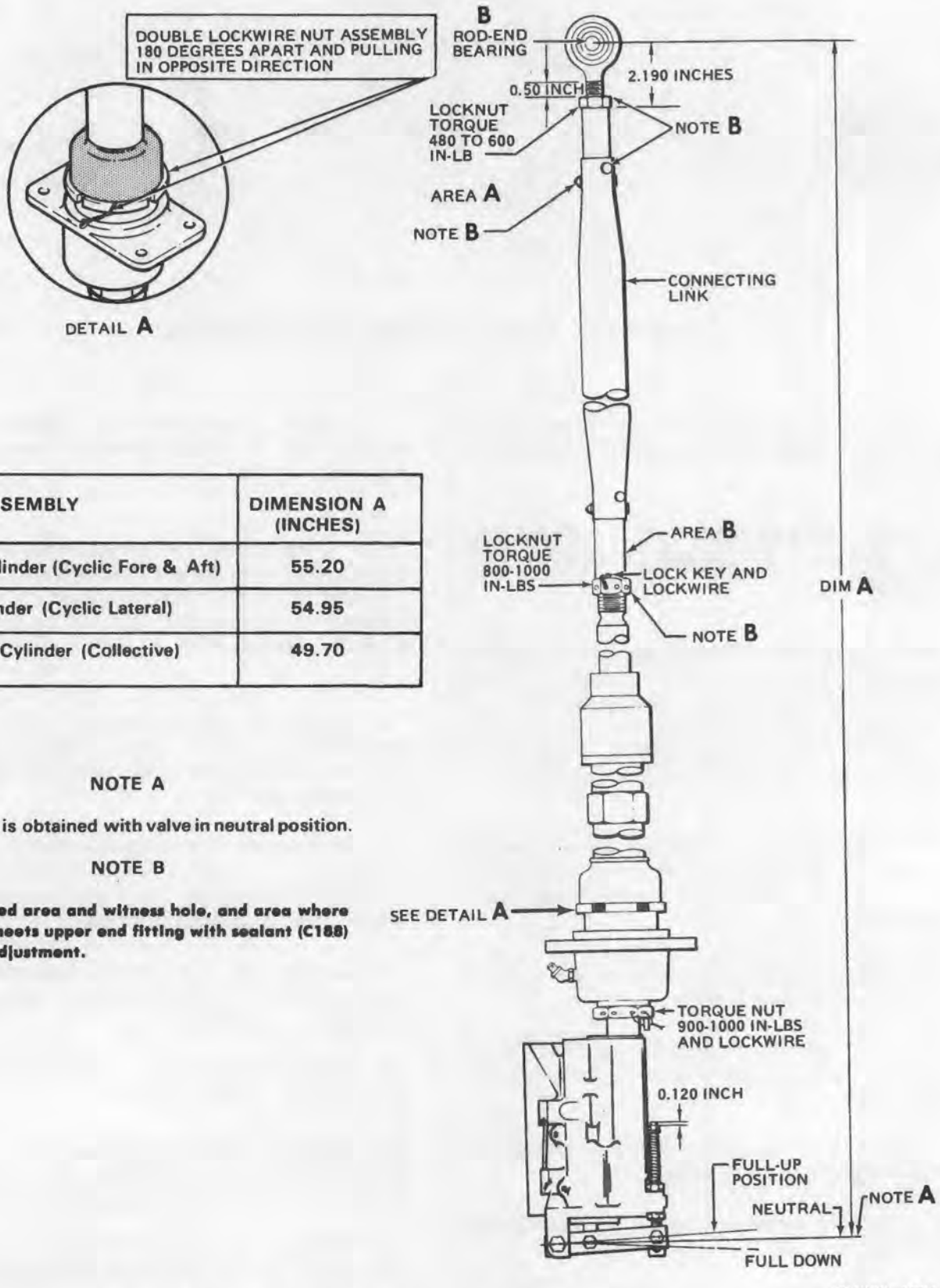
b. Inspect piston rods of hydraulic servo cylinder assemblies (6 and 25) for nicks, scratches, cracks, and evidence of scoring. Check for smooth operation within cylinders (paragraph 7-160).

c. Inspect housing (11, figure 7-29) for looseness, serviceability, and proper installation. There must be no indication of binding.

d. Inspect hydraulic servo cylinder assemblies (6 and 25, figure 7-28) for security.

e. Inspect hydraulic servo cylinder assemblies (6 and 25) for evidence of leakage. Any evidence of leakage to cylinders requires assistance from AVIM.

f. Inspect protective boots (9, figure 7-29) and (5, figure 7-32) for cuts, holes, tears, and deterioration. Replace boot if any of the above are evident. If boot is dirty or oil soaked, remove boot and wash inside and outside of boot with a mild detergent and warm water.



ASSEMBLY	DIMENSION A (INCHES)
Right Cylinder (Cyclic Fore & Aft)	55.20
Left Cylinder (Cyclic Lateral)	54.95
Left/Aft Cylinder (Collective)	49.70

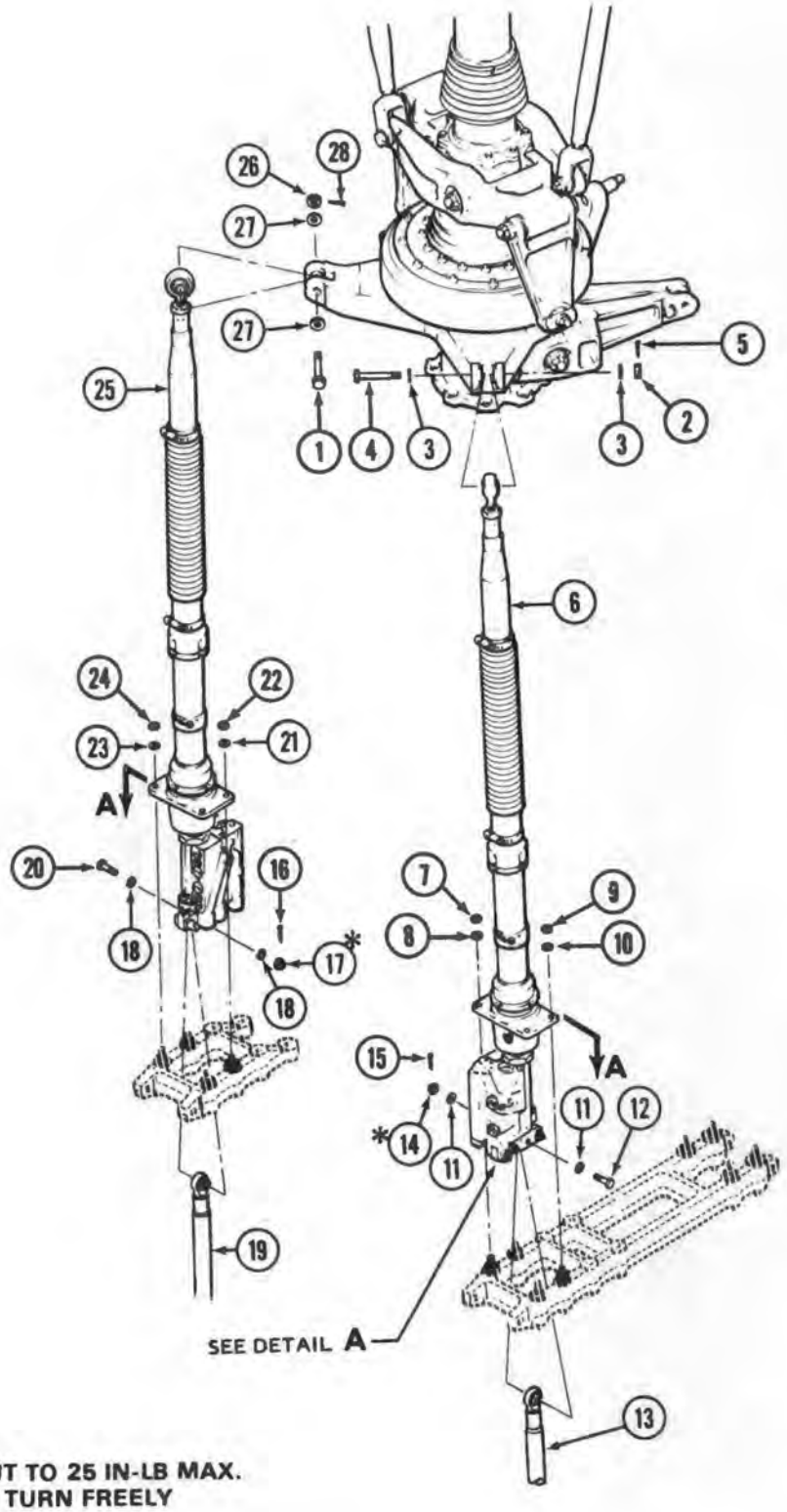
NOTE A

Dimension is obtained with valve in neutral position.

NOTE B

Seal threaded area and witness hole, and area where tube body meets upper end fitting with sealant (C188) after final adjustment.

Figure 7-27. Hydraulic servo cylinder adjustment dimensions



1. Bolt
2. Nut
3. Washer
4. Bolt
5. Cotter pin
6. Hydraulic cylinder
7. Nut
8. Washer
9. Nut
10. Washer
11. Washer
12. Bolt
13. Control tube
14. Nut
15. Cotter pin
16. Cotter pin
17. Nut
18. Washer
19. Control tube
20. Bolt
21. Washer
22. Nut
23. Washer
24. Nut
25. Hydraulic cylinder
26. Nut
27. Washer
28. Cotter pin

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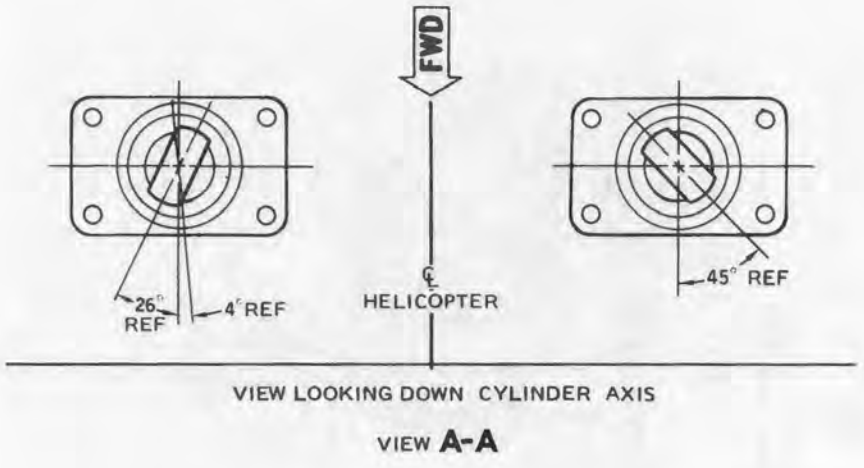
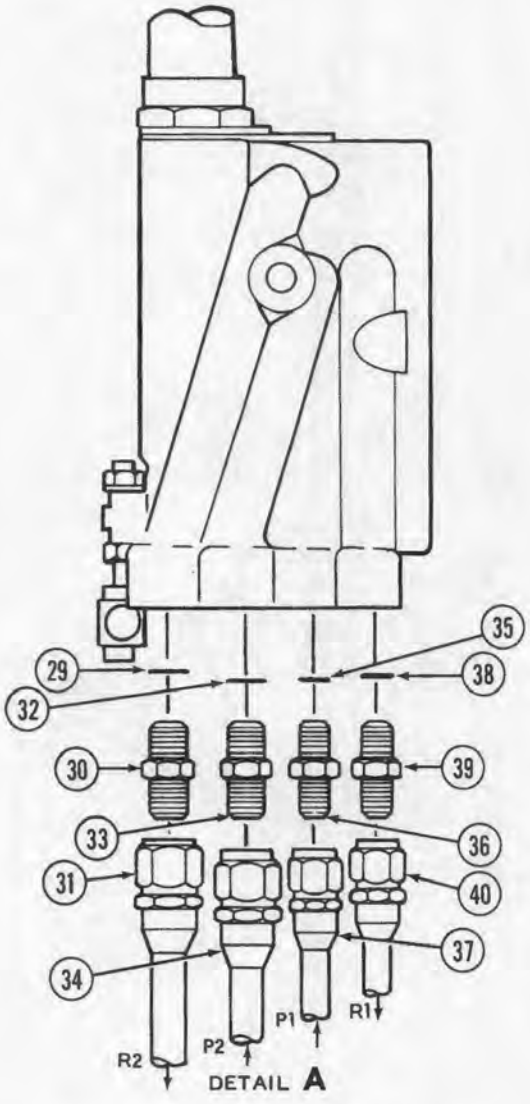
Figure 7-28. Hydraulic servo cylinder assembly (cyclic controls) — removal and installation (Sheet 1 of 2)



VIEW **A-A**



DETAIL **A**

29. Preformed packing
30. Fitting (union)
31. Hose
32. Preformed packing
33. Check valve (L)/union
34. Hose
35. Preformed packing
36. Check valve (R)/union
37. Hose
38. Preformed packing
39. Fitting (union)
40. Hose

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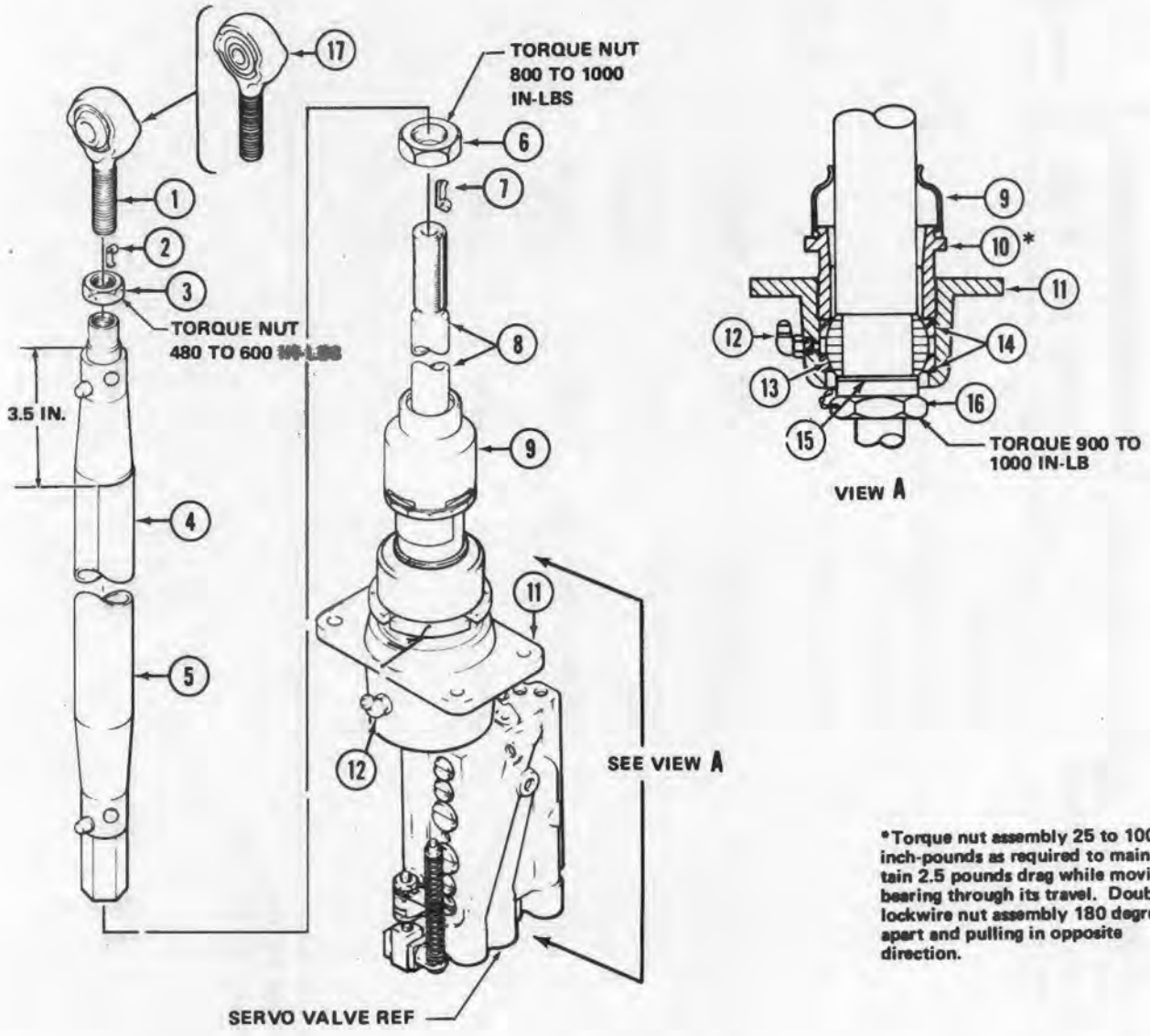
Figure 7-28. Hydraulic servo cylinder assembly (cyclic controls) — removal and installation (Sheet 2 of 2)

Table 7-5. Inspection Requirements for Hydraulic Servo Cylinder Assembly (AVIM)

FIGURE 7-	INDEX NO.	NOMENCLATURE	METHOD OF INSPECTION			TYPICAL DEFECTS	REFERENCE PARAGRAPH		REMARKS
			VISUAL	*MAGNETIC PARTICLE	FLUORESCENT **PENETRANT		INSPECTION	REPAIR	
29	9	Boot	X			Cracks, tears and deterioration	7-160	7-163	
29	10	Nut Assembly	X			Cracks, corrosion, scratches and thread damage	7-160	7-163	
29	11	Housing	X		X	Cracks, corrosion, scratches and thread damage	7-160	7-163	See figure 7-34
29	12	Fitting (Grease)	X			Corrosion, plugged up and thread damage	7-160	Replace if damaged	
29	13	Bearing	X			Cracks, corrosion and bent	7-160	Replace if damaged	
29	14	Bushing Set	X			Cracks, corrosion, and wear	7-160	Replace if damaged	
29	15	Tab Washer	X			Cracks, corrosion, and wear	7-160	Replace if damaged	
29	16	Retaining Nut	X	X		Cracks, bent, and corrosion	7-160	Replace if damaged	

*Magnetic particle inspect in accordance with TM 43-0103
**Fluorescent penetrant inspect in accordance with TM 43-0103



*Torque nut assembly 25 to 100 inch-pounds as required to maintain 2.5 pounds drag while moving bearing through its travel. Double lockwire nut assembly 180 degrees apart and pulling in opposite direction.

1. Rod end Bearing
2. Lock
3. Nut
4. Decal
5. Tube Assembly
6. Nut
7. Lock
8. Piston Rod
9. Boot
*10. Nut Assembly
11. Housing
12. Fitting (Grease)
13. Bearing
14. Bushing Set
15. Tab Washer
16. Retaining Nut
17. Rod end Bearing

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Figure 7-29. Hydraulic servo cylinder assembly (204-076-005)

g. Disconnect hydraulic servo cylinders (6 or 25, figure 7-28) from the swashplate and control tubes (13 or 19).

NOTE

Hydraulic Cylinder Assemblies containing Bearing P/N KSP 6099-1 do not require spring scale check. The required friction has been built into this bearing during manufacturing process and requires no further adjustment. The bearing is designed to gimbal freely, thus does not have the characteristic tightness as the uniball bearing which requires the spring scale check. The rotational freedom of the KSP 6099-1 bearing should not be interpreted as wear, and the axial movement should not be considered as excessive unless feed back is felt in the controls. The KSP 6099-1 bearing does not require lubrication, and should have plugs in the grease fitting (12, figure 7-29) holes. Installation of KSP 6099-1 bearing requires that the bearing housing nut (10) be torqued 25 to 100 inch-pounds. This torque does not affect the friction of the bearing. KSP 9046-1 shield replaces the rubber boot on the bearing housing nut (10) when KSP 6099-1 bearing is used.

h. Remove hoses from fittings (30, 33, 36 and 39, figure 7-28) and install container under irreversible valve. Bottom hydraulic cylinders (6 and 25) in the full up position and attach a pound-reading spring scale to clevis (on top of cylinder tube). Check the force required to move the piston rod through full travel as shown in view B, figure 7-32. If force is not within 1 TO 2.5 pounds retorque nut (10, figure 7-29) as follows:

(1) Lubricate fitting (12) and using spanner wrench (T2), torque nut (10) **25 TO 100** inch-pounds. Rotate cylinder assembly through full travel (view B, figure 7-32) several times to ensure proper seating of bearing surfaces to bushing set (view A, item 14, figure 7-29).

(2) Loosen nut (10, figure 7-29) and retorque to obtain **1 TO 2.5** pounds drag by spring scale on bearing. Retorque nut **25 TO 100** inch-pounds.

NOTE

Locknut assembly used on cylinder assemblies containing KSP 6099-1 bearings require one positive safety only.

(3) After proper drag on bearing has been accomplished, secure nut (10, figure 7-29) to housing (11) with lockwire (C127) in two places, one positive safety to prevent loosening and one negative safety to prevent further tightening.

(4) Apply slippage marks using retaining compound (C62) on nut (10) and housing (11).

(5) Connect control tube at bottom of the cylinder assembly and connect the cylinder assembly to the collective lever or swashplate assembly. Install cotter pins.

NOTE

It is permissible for the main servo cylinder barrel to turn within the housing assembly, provided there is no vertical movement of the barrel. When vertical movement is detected at the uni-ball, retorque nut (10), perform spring drag check and relube.

i. Inspect linkage part for serviceability, elongated bolt holes, cracks, nicks, and surface damage.

j. Inspect hydraulic cylinder servo valve for serviceability.

k. Check selector set for hydraulic cylinder of servo valve sticking or binding.

l. Inspect housing for cracks. No cracks allowed.

m. Inspect lever stop for distortion.

7-157. Inspection — (Acceptance/Rejection Criteria) Hydraulic Servo Cylinder Assembly (204-076-511) (Cyclic Control. Perform the following inspection functions with hydraulic servo cylinder assembly installed.

a. Inspect all parts of hydraulic servo cylinder assemblies (6 and 25, figure 7-28) for damage, corrosion, or pitting, and distorted threads (paragraph 7-161 and table 7-6).

b. Inspect piston rods of hydraulic servo cylinder assemblies (6 and 25) for nicks, scratches, cracks, and evidence of scoring. Check for smooth operation within cylinders (paragraph 7-161).

c. Inspect housing (11, figure 7-30) for looseness, serviceability, and proper installation. There must be no indication of binding.

NOTE

The presence of KSP9046 shield and plastic plug in grease zerk port is the only indication of the presence of KSP6099 bearing, other than physical teardown.

This bearing does not require the spring scale torque check. The required friction has been built into this bearing during manufacture and it requires no additional adjustment. The bearing is designed to gimbal freely, thus does not have the characteristic tightness of the uniball bearing which requires the spring scale torque test. The rotational freedom of the KSP6099-1 bearing should not be interpreted as wear and the axial movement should not be considered as excessive unless feedback is felt in the controls. The bearing requires no lubrication and plugs should be installed in the grease fitting (12) holes. Installation of the KSP6099-1 bearing requires that the bearing housing retaining nut be torqued 1100 to 1180 inch- pounds to secure it to the servo cylinder. This torque does not affect the friction on the bearing. When the KSP6099-1 bearing is installed, the KSP9046-1 shield must also be installed. Do not use (rubber) boot (9) when installing shield on P/N 205-076-099 cylinder assembly.

d. Inspect hydraulic servo cylinder assemblies (6 and 25, figure 7-28) for security.

e. Inspect hydraulic servo cylinder assemblies (6 and 25) for evidence of leakage. Any evidence of leakage to cylinders requires assistance from AVIM.

f. Inspect protective boots (9, figure 7-30) and (5, figure 7-32) for cuts, holes, tears, and deterioration. Replace boot if any of the above are evident. If boot is dirty or oil soaked, remove boot and wash inside and outside of boot with a mild detergent and warm water.

g. Disconnect hydraulic servo cylinders (6 and 25, figure 7-28) from the swashplate and control tubes (13 or 19).

h. Remove caps or hoses from servo valve and install container under valve.

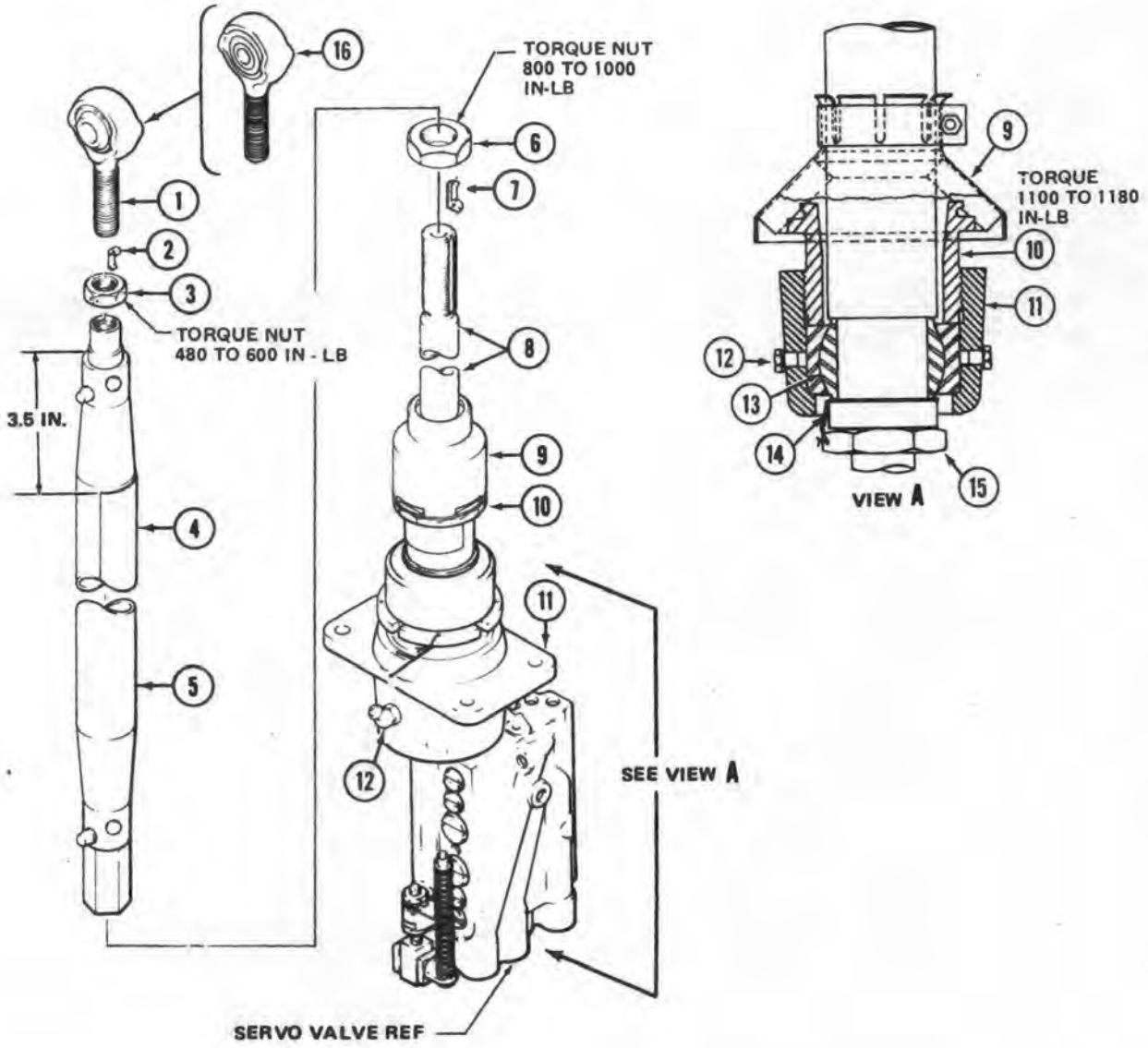
CAUTION

Do not lubricate bearing (13, figure 7-30) or remove plugs (12).

Table 7-6. Inspection Requirements for Hydraulic Servo Cylinder Assembly (AVIM)

FIGURE 7-	INDEX NO.	NOMENCLATURE	METHOD OF INSPECTION			TYPICAL DEFECTS	REFERENCE PARAGRAPH		REMARKS
			VISUAL	*MAGNETIC PARTICLE	FLUORESCENT **PENETRANT		INSPECTION	REPAIR	
30	9	Boot	X			Cracks, tears, and deterioration	7-161	7-164	
30	10	Nut Assembly	X			Cracks, corrosion, scratches and thread damage	7-161	7-164	
30	11	Housing	X		X	Cracks, corrosion, scratches and thread damage	7-161	7-164	See figure 7-34
30	12	Fitting (Grease)	X			Corrosion, plugged up and thread damage		Replace if damaged	
30	13	Bearing Assembly	X			Cracks, corrosion, and bent	7-161	Replace if damaged	
30	14	Tab Washer	X			Cracks, corrosion, and wear	7-161	Replace if damaged	
30	15	Retaining Nut	X	X		Cracks, bent, and corrosion	7-161	Replace if damaged	

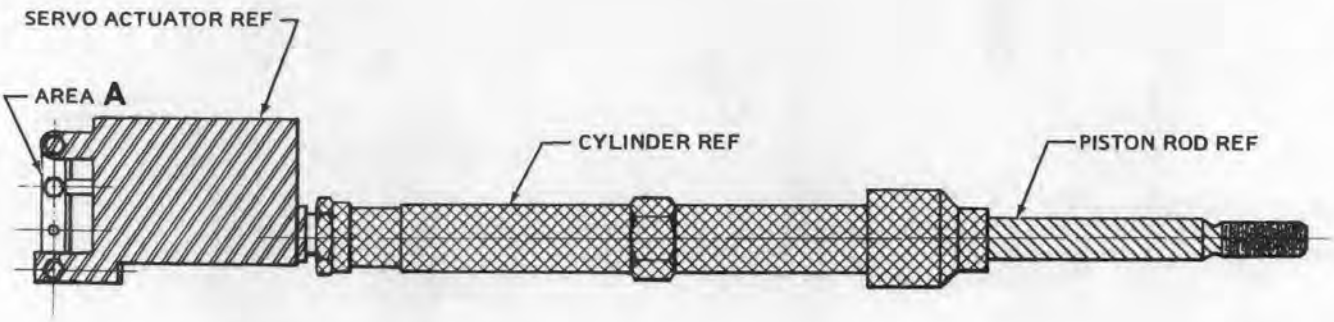
*Magnetic particle inspect in accordance with TM 43-0103
**Fluorescent penetrant inspect in accordance with TM 43-0103



1. Rod end bearing
2. Lock
3. Nut
4. Decal
5. Tube assembly
6. Nut
7. Lock
8. Piston rod
9. Boot
10. Nut assembly
11. Housing
12. Plug
13. Bearing assembly
14. Tab washer
15. Retaining nut
16. Rod end bearing

204076-1077

Figure 7-30. Hydraulic servo cylinder assembly (204-076-511)



NICKS AND SCRATCHES — DEPTH: 0.040 INCH
DENTS — DEPTH: 0.003 INCH

NO DAMAGE ALLOWED THIS SURFACE.

NICKS AND SCRATCHES — DEPTH: 0.025 INCH
DENTS — DEPTH: 0.003 INCH

THREAD DAMAGE — DEPTH: 1/3 THREAD
LENGTH: 1/4 INCH CUMULATIVE EACH SEGMENT

BLEND AND POLISH OUT ALL IMPERFECTIONS:
MINIMUM DIAMETER AFTER REPAIR IS 0.996 INCH.

AREA A HOLE REPAIR: DEPTH: 0.0005 INCH
AREA: 1/4 CIRCLE (2 HOLES)

CRACKS — NONE ALLOWED

204076-1016A

Figure 7-31. Hydraulic servo cylinder assembly — damage limits

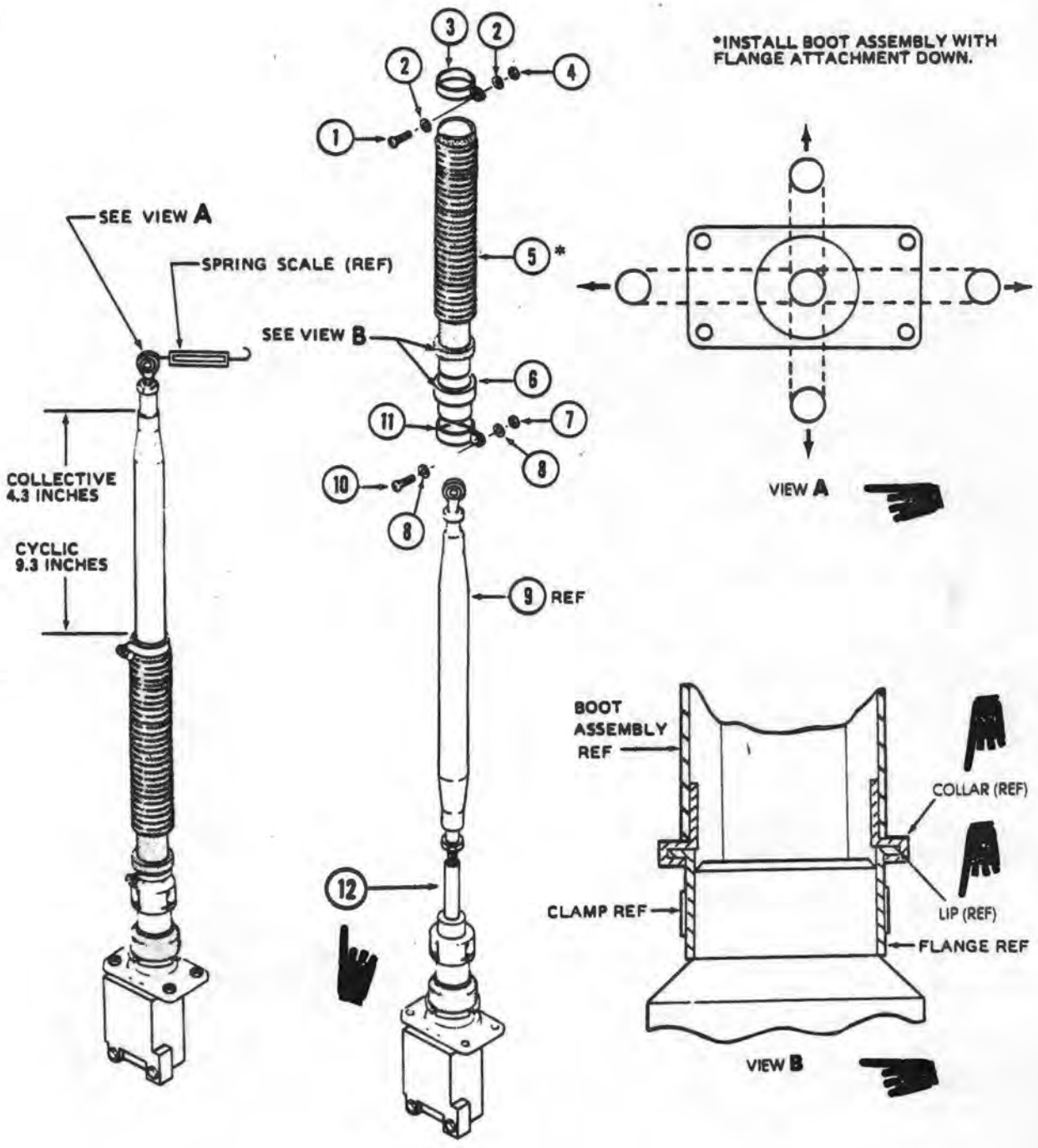


Figure 7-32. Bearing drag check and boot installation — hydraulic servo cylinder assembly

(1) Rotate cylinder assembly through full travel (view A, figure 7-32) several times to ensure proper bearing (13) operation (view A, figure 7-30).

(2) Connect control tube at bottom of the cylinder assembly and connect the cylinder assembly to the collective lever or swashplate assembly. Install cotter pins.

NOTE

It is permissible for the main servo cylinder barrel to turn within the housing assembly, provided there is no vertical movement of the barrel. When vertical movement is detected at the uniball, retorque nut (10), perform spring drag check and relube.

i. Inspect linkage part for serviceability, elongated bolt holes, cracks, nicks, and surface damage.

j. Inspect hydraulic cylinder servo valve for serviceability.

k. Check selector set for hydraulic cylinder of servo valve sticking or binding.

l. Inspect housing for cracks. No cracks allowed.

m. Inspect lever stop for distortion.

n. Inspect bolts through arm lever for serviceability, bolt to be fingertight only.

o. Check cotter pins for security.

p. Inspect bearing housing (11) flange for elongation of holes.

q. Inspect hydraulic servo cylinder assembly for leaks at all connections and fittings. With power on, seepage around piston rod seals is permissible but not to exceed one drop for every 25 cycles. A cycle is defined as valve position neutral to full up to full down to neutral (NOTE A of figure 7-27).

r. For inspection of the upper tube assembly (5, figure 7-30), at time of replacement of cyclic control hydraulic servo cylinder (pargraph 7-159).

s. Inspect moisture seal (sealant) on rod end bearing on top of tube assembly (5) for looseness or cracking.

7-158. Removal — Hydraulic Servo Cylinder Assembly (Cyclic Control).

NOTE

Ensure protective covers are installed on all open ports to prevent entry of foreign material.

Premaintenance requirements for removal of hydraulic servo cylinder assembly (cyclic control)

Conditions	Requirements
Model	All
Part No. or Serial No.	All
Special Tools	None
Test Equipment	None
Support Equipment	Maintenance Work Stands
Minimum Personnel Required	Two
Consumable Materials	None
Special Environmental Conditions	Dust Free/Well Ventilated Area

a. **Hydraulic Servo Cylinder (6, figure 7-28).** Remove hydraulic servo cylinder assembly in accordance with the following procedures:

(1) Open left and right transmission fairing (3, figure 2-19) and left side engine cowls (6 and 7).

(2) Remove soundproofing blankets and left side access doors (3 and 24) from pylon island in cabin area.

(3) Remove soundproofing blanket and access door (79) from pylon island in cabin area.

(4) Remove cotter pin (15, figure 7-28), washers (11), and bolt (12) from control tube (13) and disconnect control tube from bottom of servo valve.

NOTE

When disconnecting hydraulic hose assemblies from servo control valve, a small amount of fluid seepage may occur and will require placing a suitable container under fittings.

(5) Disconnect hose assemblies from fittings of servo control valve. Install covers to connectors of hose assemblies and fittings.

(6) Install covers on open ports of hydraulic servo valve.

(7) Remove cotter pin (5), nut (2), washer (3), and bolt (4) from rod end bearing of hydraulic cylinder assembly (6).

(8) Remove nuts (9), washers (10), nut (7), and washer (8) attaching hydraulic cylinder (6) to support and remove hydraulic cylinder (6).

b. Hydraulic Servo Cylinder (25, figure 7-28.) Remove hydraulic servo cylinder assembly in accordance with the following procedures:

(1) Open right transmission fairing (3, figure 2-19).

(2) Remove troop seats, soundproofing blanket, and access door (41) in cabin area.

(3) Remove cotter pin (16, figure 7-28), nut (17), washers (18), and bolt (20) from control tube (19) and disconnect control tube from bottom of servo valve.

NOTE

When disconnecting hydraulic hose assemblies from bottom of servo control valve (detail A, figure 7-28.) A small amount of fluid seepage may occur and will require placing a small container under fittings.

(4) Disconnect hose (31, 34, 37 and 40) assemblies from servo control valve (detail A, figure 7-28). Install protective dust covers to connectors of hose assemblies and fittings.

(5) Remove cotter pin (28), nut (26), washer (27), and bolts (1) from rod end bearing of hydraulic cylinder assembly (25).

(6) Remove three nuts (24), three washers (23), nut (22), and washer (21) attaching hydraulic servo cylinder (25) to support and remove cylinder.

7-159. Disassembly — Hydraulic Servo Cylinder Assembly (Cyclic Control). (AVIM)

NOTE

The extent of disassembly procedures is limited to replacement of upper preformed packings to cap of the hydraulic servo cylinder assembly and will be accomplished by AVIM personnel only (figure 7-36).

a. Servo Cylinder P/N 100310, 41000310 (204-076-005) and 41000311 (204-076-511) (figures 7-29 and 7-30).

(1) Place hydraulic servo cylinder assembly on a clean workbench in dust free area.

(2) Using a plastic scraper, so as not to damage the threads on rod end (1, figures 7-29 and 7-30), clean sealant from top of nut (3) and threads of rod end (1).

(3) Break torque on nut (3) and remove rod end (1), lock (2), and nut (3) from tube assembly (5).

(4) Remove nut (4, figure 7-32), washers (2) and screw (1) from clamp (3). Remove clamp (3) from boot assembly (5).

(5) Remove nut (7), washers (8), and screw (10) from clamp (11). Remove clamp (11) from flange (6).

(6) Remove boot assembly (5) and flange (6) from tube assembly (9).

(7) Remove lockwire from nut (6, figures 7-29 and 7-30) and lock (7), and tube assembly (5) from piston rod (8).

NOTE

Exercise piston rod to discharge residual fluid.

(8) Remove lockwire from lock (10, figure 7-36) and break torque on cap (6).

(9) Unscrew cap (6) and remove cap from cylinder assembly.

(10) Remove retaining ring (1), ring spacer (2) and wiper ring (3) from cap (6).

(11) Remove channel seal (4) from cap (6).

(12) Remove packing (5) from cap (6).

(13) Remove retainer (7), packing (8), and second retainer (7) from cap (6).

(14) Remove nut (9) and lock (10) from cylinder assembly.

b. When replacing hydraulic servo cylinder assembly, remove fittings from bottom of servo valve as follows:

(1) Remove fitting (30, figure 7-28) from servo valve. Remove packing (29) from fitting (30) and discard packing. Install protective plug to open port of servo valve.

(2) Remove check valve (33) from servo valve. Remove packing (32) from check valve (33) and discard packing. Install protective plug to open port of servo valve.

(3) Remove check valve (36) from servo valve. Remove packing (35) from check valve (36) and discard packing. Install protective plug to open port of servo valve.

(4) Remove fitting (39) from servo valve. Remove packing (38) from fitting (39) and discard packing. Install protective plug to port of servo valve.

7-160. Inspection — Hydraulic Servo Cylinder Assembly (204-076-005) (AVIM). a. Tube Assembly (5, figure 7-29). Inspect tube assembly in accordance with the following inspection requirements and limits outlined in figure 7-35 and table 7-5).

(1) Inspect tube assembly (5) for thread damage, corrosion, abrasions, and dents (figure 7-35).

(2) Inspect tube assembly (5) for cracks. No cracks allowed.

(3) Inspect installation of tube assembly (5) for security.

(4) Inspect decal (4) for damage and legibility.

b. Hydraulic Servo Cylinder Assembly (AVIM) (table 7-5).

(1) Inspect hydraulic servo cylinder assembly for cracks. No cracks allowed.

(2) Inspect upper and lower end of hydraulic servo cylinder assembly for evidence of leakage.

(3) Inspect external surfaces of hydraulic servo cylinder assembly and piston rod (8, figure 7-29) for nicks, scratches, or scoring, and check for smooth operation within cylinder. A friction drag of approximately **25** pounds is considered normal for the cylinder assembly (figure 7-29) (table 7-5).

(4) Inspect external surfaces of hydraulic servo cylinder assembly and piston rod for corrosion (figure **7-31** and table 7-5). Maximum diameter of damage, after repair, **0.996** inch. Thread damage limits to piston rod are as follows: (a) Depth — One-third thread. (b) Length — **one-quarter** inch cumulative each segment.

c. Rod End Bearings.

(1) Inspect rod end bearings (1 or 17, figure 7-29) for corrosion.

(2) Inspect rod end clevis (1) or (17) for cracks. No cracks allowed.

(3) Inspect rod ends (1) or (17) in accordance with limits outlined in figure 7-33 and table 7-5.

(4) Inspect rod end bearings (1) or (17) for security.

d. Bearing Housing. (AVIM)

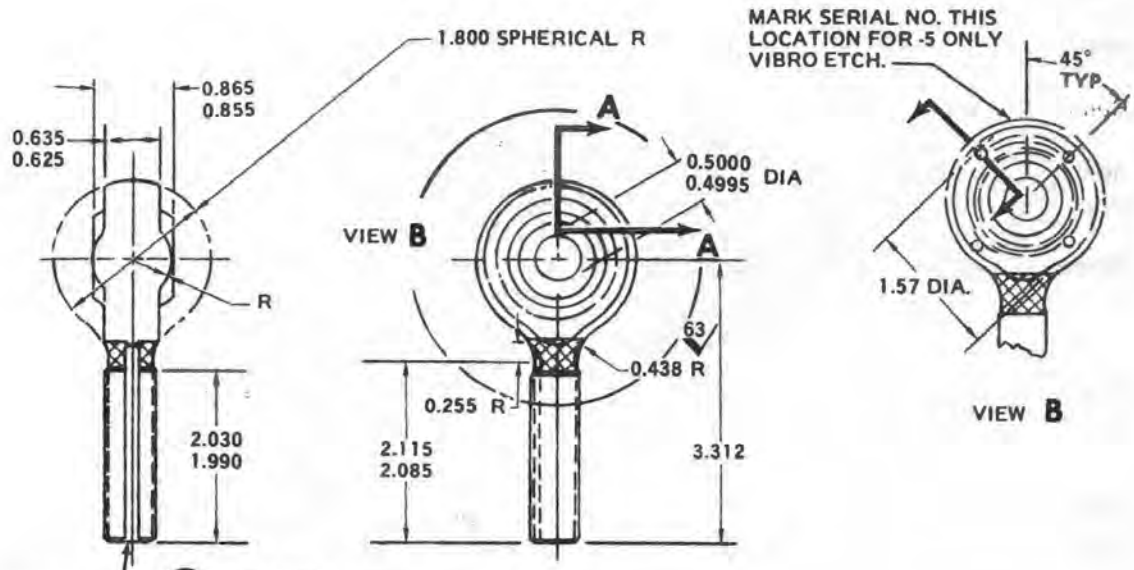
(1) Inspect bearing housing (11, figure 7-29) for nicks, scratches, corrosion, and sharp dents in accordance with limits outlined in figure 7-34.

(2) Inspect bearing housing (11) for security.

e. Nut Assembly. (AVIM)

(1) Inspect nut assembly (10, figure 7-29) for corrosion and thread damage.

(2) Inspect nut assembly (10) for cracks. No cracks allowed.



(-1) BEARING

(-3) BEARING SAME AS -1 EXCEPT AS SHOWN IN VIEW B

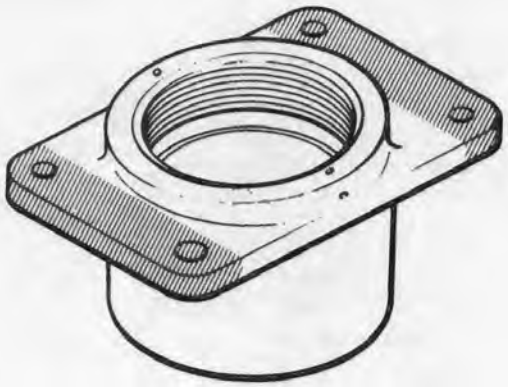
(-5) BEARING - SAME AS -3 EXCEPT TO BE SERIALIZED

	DAMAGE AREA REPAIR ZONES	
	▨	▭
CRACKS	None	None
MECHANICAL DAMAGE DEPTH AFTER REPAIR	0.010	0.020
CORROSION DAMAGE DEPTH AFTER REPAIR	0.005	0.010
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq. in.	Not critical
NUMBER OF REPAIRS	Two per zone	Not critical
EDGE CHAMFER	0.040	0.080
BORE DAMAGE	0.002 for 1/4 circumference	
THREAD DAMAGE:		
DEPTH:	One-third of thread	
LENGTH:	One-quarter inch	
NUMBER:	Two per segment	
BEARING WEAR LIMITS	Radial	Axial
	0.012	0.030

NOTE: ALL DIMENSIONS IN INCHES UNLESS OTHERWISE NOTED.

209076-68

Figure 7-33. Rod end bearings P/N 204-076-428 and P/N 540-011-413 — damage limits



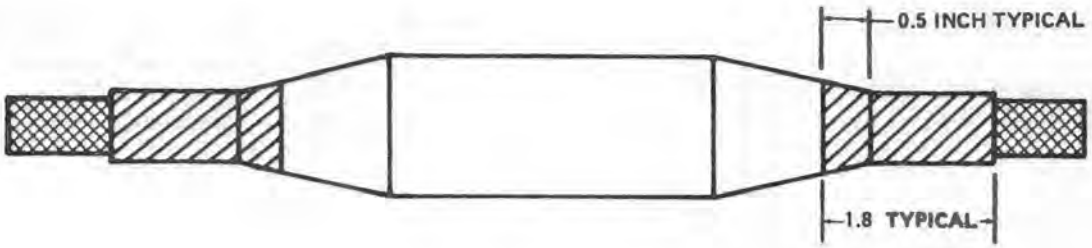
DAMAGE LOCATION SYMBOLS

TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
CRACKS ALLOWED	None	None
NICKS, SCRATCHES, AND SHARP DENTS	0.020	0.040
CORROSION	0.010	0.020
MAXIMUM AREA PER FULL DEPTH REPAIR	0.10 Sq.	Not critical
NUMBER OF REPAIRS	Not critical	Not critical
EDGE CHAMFER	0.040	0.060
BORE DAMAGE	0.002 for 1/2 circumference	
THREAD DAMAGE:		
DEPTH:	One-third of thread	
LENGTH:	cumulative	
NUMBER:		

NOTE: NO CRACKS ALLOWED

209076-28F

Figure 7-34. Damage limits for P/N 204-076-317 bearing housing — hydraulic servo cylinder assembly



TYPE OF DAMAGE	DAMAGE AREA AND REPAIR ZONES		
	▨	▩	□
NICKS, SCRATCHES AND DENTS	0.005 INCH	0.005 INCH	0.010 INCH
CORROSION	0.0025 INCH	0.005 INCH	0.005 INCH
MAXIMUM AREA PER FULL DEPTH REPAIR	0.25 SQ. IN.	0.10 SQ. IN.	NOT CRITICAL
MAXIMUM NUMBER OF REPAIRS	TWO PER SEGMENT		NOT CRITICAL
EDGE CHAMFER	0.020 INCH	0.020 INCH	NOT APPLICABLE

THREAD DAMAGE:
DEPTH: ONE-THIRD OF THREAD
LENGTH: ONE-QUARTER INCH
NUMBER: TWO PER SEGMENT

NOTES:
(1) The width of repair at any section shall not exceed one-third of the tube circumference.

(2) Material: 2024-T4 Al Aly, 1-1/2 OD X 0.083 wall thickness, per WW-T-700/3, Type 1, Temp-T3.

(3) NO CRACKS ALLOWED

204076-1001C

Figure 7-35. Tube assembly P/N 204-076-068 damage limits — hydraulic servo cylinder assembly

(3) Inspect nut assembly (10) for security.

(4) Inspect nuts (3) and (6) for maximum thread damage as follows: (a) Depth: One-third of thread, (b) Length: 1.0 inch cumulative.

(5) Inspect nut (16) for security. If there is evidence that nut (15) has loosened, remove servo cylinder, inspect, retorque nut, and lockwire (C127).

f. Boots.

(1) Inspect boot (5, figure 7-32) for deterioration and tears.

(2) Inspect flange (6) for tears.

(3) Inspect boot (5) for security. All servo cylinders must have boots installed.

g. Attaching Hardware.

(1) Inspect hydraulic servo cylinder assembly and attaching components for missing or loose hardware.

(2) Inspect all attaching hardware to hydraulic servo cylinder assembly for cracks or corrosion. No cracks allowed.

(3) Inspect all attaching hardware to hydraulic servo cylinder assembly for security.

h. Inspect holes in pilot input lever of servo valve (figure 7-29) for elongation.

7-161. Inspection — Hydraulic Servo Cylinder Assembly (Cyclic Control) (204-076-511) (table 7-6) (AVIM). a. Tube Assembly (5, figure 7-30). Inspect tube assembly in accordance with the following inspection requirements and limits outlined in figure 7-35 and table 7-6.

(1) Inspect tube assembly (5) for thread damage, corrosion, abrasions, and dents (figure 7-35).

(2) Inspect tube assembly (5, figure 7-30) for cracks. No cracks allowed.

(3) Inspect installation of tube assembly (5) for security.

(4) Inspect decal (4) for damage and legibility.

b. Hydraulic Servo Cylinder Assembly (AVIM) (table 7-5).

(1) Inspect hydraulic servo cylinder assembly for cracks. No cracks allowed.

(2) Inspect upper and lower end of hydraulic servo cylinder assembly for evidence of leakage.

(3) Inspect external surfaces of hydraulic servo cylinder assembly and piston rod (8, figure 7-29) for nicks, scratches, or scoring, and check for smooth operation within cylinder. A friction drag of approximately **25** pounds is considered normal for the cylinder assembly (figure 7-30) (table 7-6).

(4) Inspect external surfaces of hydraulic servo cylinder assembly and piston rod for corrosion (figure 7-29 and table 7-5). Maximum diameter of damage, after repair, **0.996** inch. Thread damage limits to piston rod as are follows: (a) Depth — One-third thread. (b) Length — **one-quarter** inch cumulative each segment.

c. Rod End Bearings.

(1) Inspect rod end bearings (1 or 16, figure 7-30) for corrosion.

(2) Inspect rod end clevis (1) or (16) for cracks. No cracks allowed.

(3) Inspect rod ends (1) or (16) in accordance with limits outlined in figure 7-33 and table 7-6.

(4) Inspect rod end bearings (1) or (16) for security.

d. Bearing Housing. (AVIM)

(1) Inspect bearing housing (11, figure 7-30) for nicks, scratches, corrosion, and sharp dents in accordance with limits outlined in figure 7-34.

(2) Inspect bearing housing (11) for security.

e. Nut Assembly. (AVIM)

(1) Inspect nut assembly (10, figure 7-30) for corrosion and thread damage.

(2) Inspect nut assembly (10) for cracks. No cracks allowed.

(3) Inspect nut assembly (10) for security.

(4) Inspect nuts (3) and (6) for maximum thread damage as follows: (a) Depth: One-third of thread, (b) Length: **1.0** inch cumulative.

CAUTION

Tab washer (14, figure 7-30) tangs making contact with rounded corners of nut (15) will not provide locking action

(5) Inspect nut (15) for security. If there is evidence that nut (15) has loosened, remove servo cylinder, inspect, retorque nut and lockwire (C127).

f. **Boots.**

(1) Inspect boot (5, figure 7-32) for deterioration and tears.

(2) Inspect flange (6) for tears.

(3) Inspect boot (5) for security. All servo cylinders must have boots installed.

g. **Attaching Hardware.**

(1) Inspect hydraulic servo cylinder assembly and attaching components for missing or loose hardware.

(2) Inspect all attaching hardware to hydraulic servo cylinder assembly for cracks or corrosion. No cracks allowed.

(3) Inspect all attaching hardware to hydraulic servo cylinder assembly for security.

h. Inspect holes in pilot input lever of servo (figure 7-30) for elongation.

7-162. Cleaning — Hydraulic Servo Cylinder Assembly (Cyclic Control).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

a. Immerse and wash all metallic parts in solvent (C205). Pay particular attention to passages and threaded areas.

b. Use a stiff-bristled, non-metallic brush (C32) moistened with solvent (C205) to remove caked dirt from parts.

WARNING

Goggles will be worn when using compressed air. Do not allow more than 5 psi air pressure to come in contact with skin.

c. Dry all parts with compressed air at **15** psig (maximum pressure).

d. If parts are not to be placed into immediate use after cleaning, flush parts with preservative hydraulic fluid (C113), wrap with barrier material (C98) and place in dust-free container.

e. Wash inner and outer areas of rubber boot (5, figure 7-32) with mild detergent soap and warm water. Rinse thoroughly and allow to air dry or wipe with clean cloth.

7-163. Repair or Replacement — Hydraulic Servo Cylinder Assembly (204-076-005) (Cyclic Control). (AVIM)

Premaintenance requirements for repair of hydraulic servo cylinder assembly (cyclic control)

Conditions	Requirements
Model	All
Part No. or Serial No.	204-076-005-1, -3, -13, and -15
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C1), (C42), (C49), (C167), (C185.2), (C205), (C253)
Special Environmental Conditions	Dust Free/Well Ventilated Area

a. Prior to performing repair or replacement tasks to the hydraulic servo cylinder assembly, visually check the following items:

(1) Verify that replacement part number is same as part being replaced or that it is completely interchangeable part.

(2) Ensure that caps and plugs remain on open ports, fittings, and lines until part is ready to be installed.

(3) If part being removed is not be replaced immediately, cap all open ports, lines, and fittings to prevent entry of foreign material into system. Cap openings on part being removed.

b. Service and bleed hydraulic system after replacing hydraulic servo cylinder assembly (paragraph 7-4).

c. Replace any lockwire and cotter pins removed.

d. Replace all packings and seals.

e. Replace tab washer (15, figure 7-29) if unserviceable.

CAUTION

After upper cylinder repair, adjust friction on (uniball) bearing (13, figure 7-29) in lower housing (11) (paragraph 7-155). Ensure that bearing retaining nut (16) is properly secured, tab washer (15) installed and safetied, and no evidence of nut slippage (check torque seal). If nut has slipped, replace hydraulic cylinder assembly. (AVIM)

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

g. Repair components of hydraulic servo cylinder assembly as follows:

(1) Tube Assembly (5, figure 7-29).

WARNING

Chemical film material and primers are flammable and toxic. Provide adequate ventilation. Do not use near fire or open flame.

(a) Remove clevis. Polish nicks, corrosion and scratches with 600 grit sandpaper (C185.2) and treat repair area with chemical film material (C42). Touch-up treated area with primer (C253) or primer (C167). See figure 7-35 for damage limits.

(b) Any cracks to tube assembly (5, figure 7-29) require replacement of part.

(c) Check security of rivets and bonded seams.

(d) Replace decal (4) when damaged.

(e) Inspect the internal threaded area of upper and lower tube assembly (5) fittings for corrosion damage (figure 7-35). Replace tube assembly if corrosion is found. If no corrosion is noted at time of inspection, flush tube assembly with primer (C167) as follows:

NOTE

For new cylinder assemblies that have tubes attached, it is not necessary to remove the tube in order to accomplish the flushing procedure. Remove the rod end (1 or 17, figure 7-29) from upper end of tube (5) and proceed with flushing operation as outlined in following substep. In the event a replacement tube is not available, the tube may be continued in service by applying Primer (C253) or (C167) to the inner circumference of the end fittings. By this application, the corrosion will be temporarily retarded until a replacement tube becomes available. Make replacement as soon as possible

1 Plug one end and pour primer (C167) into opposite end of tube assembly (5).

2 Rotate tube assembly (5) several times to ensure full coverage of primer on both end fittings.

3 Drain for 2 hours prior to installation.

4 Apply sealant (C189.1) to mating threads of clevis and control tube(s) and fill keyway. Wipe away exposed sealant.

(f) Replace tube assembly (5) when threads are corroded, damaged, bent, or damaged beyond limits outlined in figure 7-35.

(2) Servo Cylinder Assembly P/N 100310 and 41000310 (204-076-005) (AVIM).

(a) Any cracks to servo cylinder assembly requires replacement of part. Tag and send damaged servo cylinder assembly to next higher level of maintenance.

(b) The extent of repairs for leakage to cylinder assembly is limited to replacing packings and seals to upper cap (figure 7-36). Any leakage to lower end of servo cylinder assembly requires replacement of part. Tag and send damaged servo cylinder assembly to next higher level of maintenance for additional repairs.

(c) Frequent replacement of packings and seal to upper cap of servo cylinder assembly indicates a possibility of piston rod or glide seal wear. When evidence of wear appears, such as frequent leakage, replace servo cylinder assembly, tag and send damaged servo cylinder assembly to next higher level of maintenance.

(d) Minor corrosion to external surfaces of servo cylinder assembly may be repaired by sanding corroded area with 600 grit sandpaper (C185.2) to original finish.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(e) Minor nicks and scratches are acceptable, provided the damage area is sanded with 600 grit crocus cloth (C49) to its original finish. Use polishing cloth (C1) or equivalent, to polish out minor scoring on aluminum parts. Thoroughly clean any polished parts with solvent (C205).

(3) Bearing. Inspect rod end bearing (1 or 17, figure 7-29) in accordance with limits outlined in figure 7-33 and table 7-5.

(4) Bearing Housing. (AVIM) Inspect bearing housing (11, figure 7-29) in accordance with limits outlined in figure 7-34 and table 7-5.

(5) Nut Assembly. (AVIM) Inspect nut assembly (10, figure 7-29) in accordance with limits outlined in table 7-5.

(6) Boot. Any cracks, tears, or deterioration to boot (5, figure 7-32) requires replacement of part. No repairs allowed.

7-164. Repair or Replacement — Hydraulic Servo Cylinder Assembly (204-076-511) (Cyclic Control). (AVIM)

Premaintenance requirements for repair of hydraulic servo cylinder assembly (cyclic control)

Conditions	Requirements
Model	All
Part No. or Serial No.	204-076-511-17, -19, -21
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C1), (C42), (C49), (C167), (C185.2), (C205), (C253)
Special Environmental Conditions	Dust Free/Well Ventilated Area

a. Prior to performing repair or replacement tasks to the hydraulic servo cylinder assembly, visually check the following items:

(1) Verify that replacement part number is same as part being replaced or that it is completely interchangeable part.

(2) Ensure that caps and plugs remain on open ports, fittings, and lines until part is ready to be installed.

(3) If part being removed is not to be replaced immediately, cap all open ports, lines, and fittings to prevent entry of foreign material into system. Cap openings on part being removed.

b. Service and bleed hydraulic system after replacing hydraulic servo cylinder assembly (paragraph 7-4).

c. Replace any lockwire and cotter pins removed.

d. Replace all packings and seals.

e. Replace tab washer (14, figure 7-30) if unserviceable.

CAUTION

Ensure that bearing retaining nut (15) is properly secured, tab washer (14) installed and safetied and no evidence of nut slippage (check torque seal). If nut has slipped, replace hydraulic cylinder assembly. (AVIM)

NOTE

Bearing (13) is not adjustable and is not to be lubricated. Do not remove plugs (12) and apply lubricant.

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

g. Repair components of hydraulic servo cylinder assembly as follows:

(1) Tube assembly (5, figure 7-30).

WARNING

Chemical film material and primers are flammable and toxic. Provide adequate ventilation. Do not use near fire or open flame.

(a) Remove clevis. Polish nicks, corrosion and scratches with 600 grit sandpaper (C185.2) and treat repair area with chemical film material (C42). Touch-up treated area with primer (C253) or primer (C167). See figure 7-35 for damage limits.

(b) Any cracks to tube assembly (5, figure 7-30) require replacement of part.

(c) Check security of rivets and bonded seams.

(d) Replace decal (4) when damaged.

(e) Inspect the internal threaded area of upper and lower tube assembly (5) fittings for corrosion damage (figure 7-35). Replace tube assembly if corrosion is found. If no corrosion is noted at time of inspection, flush tube assemby with primer (C167) as follows:

NOTE

For new cylinder assemblies that have tubes attached, it is not necessary to remove the tubes in order to accomplish the flushing procedure. Remove the rod end (1 or 17, figure 7-30) from upper end of tube (5) and proceed with flushing operation as outlined in following sub-step. In the event a replacement tube is not available, the tube may be continued in service by applying Primer (C253) or (C167) to the inner circumference of the end fittings. By this application, the corrosion will be temporarily retarded until a replacement tube becomes available. Make replacement as soon as possible.

1 Plug one end and pour primer (C167) into opposite end of tube assembly (5).

2 Rotate tube assembly (5) several times to ensure full coverage of primer on both end fittings.

3 Drain for 2 hours prior to installation.

4 Apply sealant (C189.1) to mating threads of clevis and control tube(s) and fill keyway. Wipe away exposed sealant.

(f) Replace tube assembly (5) when threads are corroded, damaged, bent, or damaged beyond limits outlined in figure 7-35.

(2) Servo Cylinder Assembly 41000311 (204-076-511) (AVIM).

(a) Any cracks to servo cylinder assembly requires replacement of part. Tag and send damaged servo cylinder assembly to next higher level of maintenance.

(b) The extent of repairs for leakage to cylinder assembly is limited to replacing packings and seals to upper cap (figure 7-36). Any leakage to lower end of servo cylinder assembly requires replacement of part. Tag and send damaged servo cylinder assembly to next higher level of maintenance for additional repairs.

(c) Frequent replacement of packings and seal to upper cap of servo cylinder assembly indicates a possibility of piston rod or glide seal wear. When evidence of wear appears, such as frequent leakage, replace servo cylinder assembly, tag and send damaged servo cylinder assembly to next higher level of maintenance.

(d) Minor corrosion to external surfaces of servo cylinder assembly may be repaired by sanding corroded area with 600 grit sandpaper (C185.2) to original finish.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(e) Minor nicks and scratches are acceptable, provided the damage area is sanded with 600 grit crocus cloth (C49) to its original finish. Use polishing cloth (C1) or equivalent, to polish out minor scoring on aluminum parts. Thoroughly clean any polished parts with solvent (C205).

(3) Bearing. Inspect rod end bearing (1 or 17, figure 7-30) in accordance with limits outlined in figure 7-33 and table 7-5.

(4) Bearing Housing (AVIM). Inspect bearing housing (11, figure 7-30) in accordance with limits outlined in figure 7-34 and table7-6.

(5) Nut Assembly (AVIM). Inspect nut assembly (10, figure 7-30) in accordance with limits outlined in table 7-6.

(6) Boot. Any cracks, tears, or deterioration to boot (5, figure 7-32) requires replacement of part. No repairs allowed.

(7) Flange (AVIM). Any damage to flange (6) requires replacement of part.

(8) Attaching Hardware. Replace any damaged hardware.

7-165. Assembly — Hydraulic Servo Cylinder Assembly (Cyclic Control) (AVIM).

Premaintenance requirements for assembly of hydraulic servo cylinder assembly (cyclic control)

Conditions	Requirements
Model	All
Part No. or Serial No.	204-076-005-1, -3, -13, and -15
Special Tools	None
Test Equipment	None
Support Equipment	None
Minimum Personnel Required	One
Consumable Materials	(C112), (C112.1), (C127), (C188)
Special Environmental Conditions	Temperature/ Dust Free/Well Ventilated

NOTE

One of the following seal replacement functions must be accomplished prior to assembly of hydraulic servo cylinder assembly.

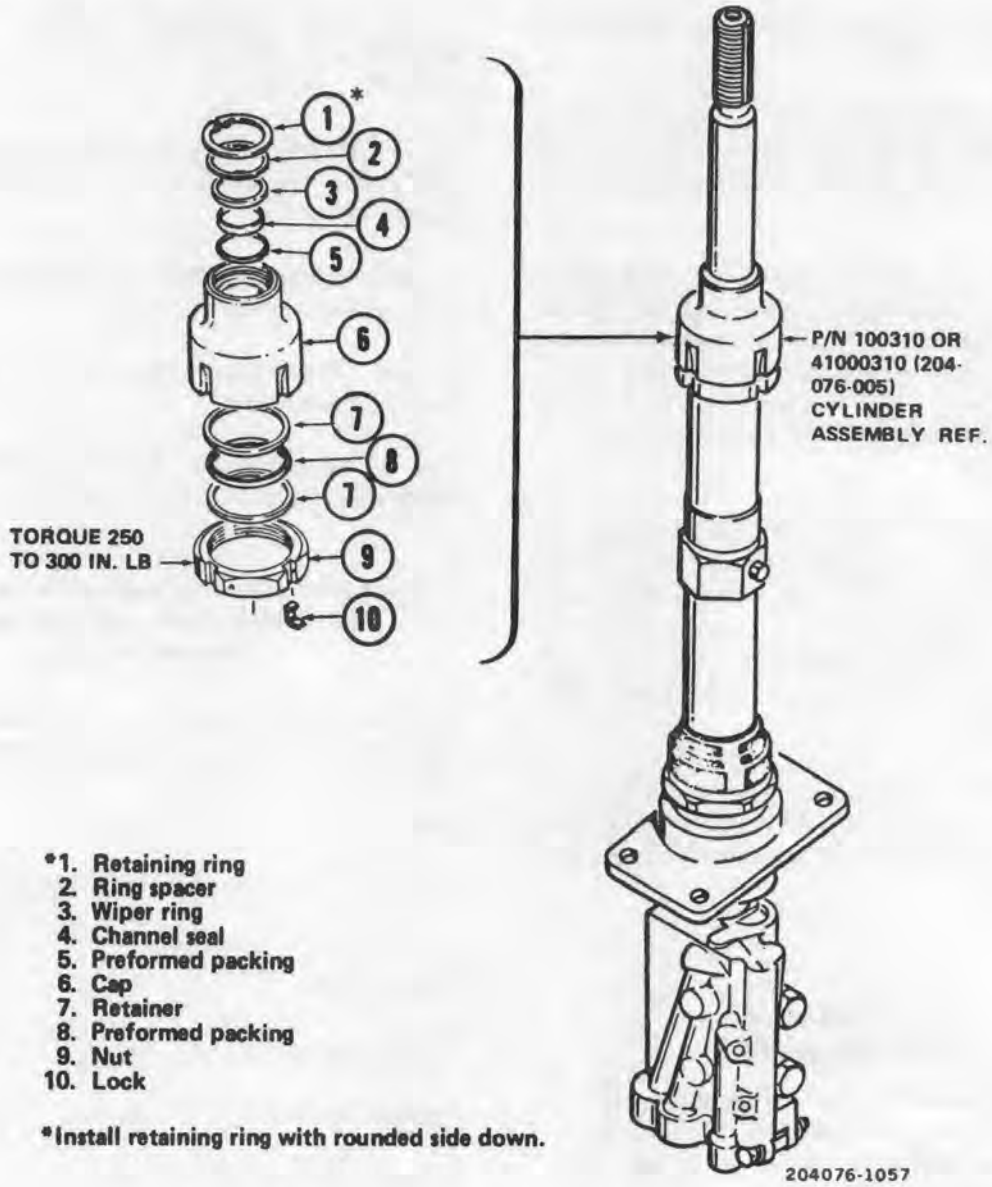


Figure 7-36. Hydraulic servo cylinder assembly — replacement of seals

a. Servo Cylinder P/N 100310 or 41000310 (204-076-005) (figure 7-36).

NOTE

Apply hydraulic fluid (C112) or (C112.1) to all packings, ring seals, and thread connections prior to assembly.

(1) Place lock (10) in nut (9). Align lock (10) with slot in cylinder and install nut to cylinder.

(2) Install packing (5) in cap (6).

CAUTION

Concave surface of channel seal (4) must be against packing (5).

(3) Using tweezers, install channel seal (4) over packing (5) and within packing groove. Seat channel seal.

(4) Install wiper ring (3), ring spacer (2) and secure with retaining ring (1), rounded side down.

(5) Install retainer (7), packing (8) and second retainer (7) in cap (6).

(6) Install assembly cap (6) on cylinder to bottom. Thread nut (9) against cap (6) and torque nut (9) **250 TO 300** inch-pounds. Secure nut (9) to lock (10) with lockwire (C127).

(7) Place lock with lockwire hole down (7, figure 7-29 or 7-30) inside of nut (6). Align lock with slot in piston rod (8) and thread nut (6) onto piston rod (8). Add sealant (C189.1) to mating threads of tube (5) and piston rod (8) filling key way. Install tube (5) on piston rod (8). Wipe away exposed sealant.

(8) Adjust hydraulic servo cylinder assembly in accordance with dimension A, figure 7-27. Torque nut (6, figure 7-29 or 7-30) **800 TO 1000** inch-pounds and secure with lockwire (C127).

(9) Install boot assembly (5, figure 7-32) to hydraulic servo cylinder assembly as follows:

(a) Compress and insert (swivel-joint) flange (6) into lower end of boot assembly (5) and engage flange lip in collar.

(b) Slip flange (6) with boot assembly (5) down over tube assembly (9) and cylinder.

(c) Position clamp (11) around flange (6) and install screw (10), two washers (8), and nut (7).

(d) With piston rod (12) in full up position, adjust boot assembly (5) **9.3** inches from top flange of tube assembly (9) as shown (**4.3** inches for collective). Position clamp (3) around top of boot assembly (5) and install screw (1), two washers (2), and nut (4).

(e) Check for proper security of boot (9, figures 7-29 or 7-30).

(10) Place lock (2) into nut (3). Align lock (2) with slot in rod end (1) and thread nut (3) on rod end.

(11) Install rod end (1) in tube assembly (5). Adjust rod end to **2.19** inches, measured from center of rod end bolt hole to top of tube assembly as shown in figure 7-27. This is an initial dimension and may change slightly during rigging.

(12) Torque nut (3, figures 7-29 and 7-30) **480 TO 600** inch-pounds and secure with lockwire (C127).

(13) If decal (4) is damaged, position and install new decal as shown on applicable hydraulic servo cylinder assembly.

(14) Install fittings to bottom of replacement hydraulic cylinder assembly servo valve as follows:

(a) Remove protective plugs from ports of servo valve.

(b) Install packing (38, figure 7-28) on fitting (39) and install fitting into R1 port of servo valve.

CAUTION

When replacing either cyclic servo-control valves, ensure the proper check valve is installed in the correct system (figure 7-28). Check valve, P/N (204-076-437-1), is installed in pressure port (P1) on the right cyclic and check valve P/N (204-076-437-3) is installed in pressure port (P2) on the left cyclic servo-control valves.

(c) Install packing (35) on check valve (36) and install fitting into P1 port of servo valve.

(d) Install packing (32) on check valve (33) and install fitting into P2 port of servo valve.

(e) Install packing (29) on fitting (30) and install fitting into R2 port of servo valve.

NOTE

If hydraulic cylinder assembly is not to be installed immediately, all fittings in bottom of servo valve will be capped to prevent entry of dirt.

7-166. Lubrication — Hydraulic Servo Cylinder Assembly (Cyclic Control).

CAUTION

Do not grease bearing assembly (13, figure 7-30) in 204-076-511 type cylinders.

Apply grease to hydraulic cylinder assembly (6 or 25, figure 7-28) in accordance with figure 1-2.

7-167. Installation — Hydraulic Servo Cylinder Assembly (Cyclic Control). a. Install hydraulic servo cylinder assembly (25, figure 7-28) in accordance with the following procedures:

NOTE

Before installing replacement servo cylinders, be certain each assembly is correct part number for its location in cyclic control system.

(1) Position servo valve as shown in view A-A, figure 7-28. Lower hydraulic cylinder assembly (25) onto studs of cylinder support.

(2) Install washer (21), nut (22), washers (23), and nuts (24). Tighten nuts (22 and 24) evenly using standard torque (TM 55-1500-204-25/1).

(3) Check position of rod end bearing (figure 7-37) on hydraulic servo cylinder assembly and connect clevis to swashplate assembly. Install bolt (1, figure 7-28), washer (27) and nut (26) and secure with cotter pin (28).

(4) Remove covers from fittings at bottom of servo valves. Install hose assemblies to fittings.

(5) Position control tube (19) to lever of servo valve and install bolt (20), washers (18), and nut (17). Torque nut to a maximum of **25** inch-pounds. Bolt must turn freely. Secure nut (17) with cotter pin (16).

(6) Rig hydraulic cylinder assembly (25) to cyclic control system (paragraph 11-55).

(7) Torque nut (3, figures 7-29 and 7-30) **480 TO 600** inch-pounds and secure with lockwire (C127).

(8) After rigging procedures have been accomplished, apply a bead of sealant (C188) to top of nut (3) and adjacent to threads of rod end bearing (1). Ensure that no weep holes exist after applying sealant. Check slot in rod end bearing for positive sealing.

(9) Perform operational check (paragraph 7-165) and check hydraulic servo cylinder (25, figure 7-28) for leaks (table 7-1).

(10) Install access door (44, figure 2-19), soundproofing blanket, and troop seats in cabin area.

(11) Close and secure left and right transmission cowls (3).

b. Install hydraulic servo cylinder assembly (6, figure 7-28) in accordance with the following procedures:

(1) Position servo valve as shown in view A-A, and lower hydraulic servo cylinder assembly (6) onto studs of cylinder support.

(2) Install washer (8), nut (7), washers (10), and nuts (9). Tighten nuts (7 and 9) evenly using standard torque (TM 55-1500-204-25/1).

(3) Check position of rod end bearing (figure 7-37) of hydraulic servo cylinder assembly and connect rod end bearing to swashplate assembly and install bolt (4, figure 7-28), washer (3), and nut (2). Secure nut with cotter pin (5). Refer to figure 5-2 for correct torque.

(4) Remove protective dust covers from fittings at bottom of servo valve. Install hose assemblies to fittings.

CAUTION

Four bolts in lever assembly of servo cylinder will be finger-tight only. Cotter pin (15) will not be re-used. Servo valve must operate freely without binding.

(5) Position control tube (13) to lever of servo valve and install bolt (12), washers (11) and nut (14). Torque nut (14) to a maximum of **25** inch-pounds, bolt (12) must turn freely. Secure nut (14) with cotter pin (15).

(6) Rig hydraulic servo cylinder assembly (6, figure 7-38) to cyclic control system (paragraph 11-55).

(7) Torque nut (3, figures 7-29 and 7-30) **480 TO 600** inch-pounds and secure with lockwire (C127).

NOTE

Do not use sealant on lower tube nut or on bearing housing nut.

(8) After rigging procedures have been accomplished, apply a bead of sealant (C188) to top of nut (3, figures 7-29 and 7-30) and adjacent to threads of rod end bearing (1). Ensure that no weep holes exist after applying sealant. Check slot in rod end bearing for positive sealing.

(9) Perform operational check and check for leaks of hydraulic servo cylinder (6, figure 7-28) (paragraph 7-165).

(10) Install access door (44, figure 2-19), soundproofing blanket and troop seats in cabin area.

(11) Close and secure left and right transmission cowls (3).

7-168. Operational Check — Hydraulic Servo Cylinder Assembly (Cyclic Control). a. Perform operational check of hydraulic servo cylinder assembly (6 and 25, figure 7-28) (paragaraph 7-4).

b. Check hydraulic servo cylinder assembly (6 and 25) for leaks (table 7-1).

7-169. HYDRAULIC SERVO CYLINDER ASSEMBLY (COLLECTIVE CONTROL).

7-170. Description — Hydraulic Servo Cylinder Assembly (Collective Control). A hydraulic servo cylinder is used to reduce feedback forces and assist collective pitch control of the main rotor.

7-171. Adjustment — Hydraulic Servo Cylinder Assembly (Collective Control). a. Adjust collective hydraulic cylinder as shown in dimension A of figure 7-27 and paragraph 7-155.

b. Adjust rod end bearing as shown in figure 7-27 and paragraph 7-155.

c. Rig collective hydraulic servo cylinder after installation procedures have been accomplished (paragraph 11-6).

7-172. Inspection (Acceptance/Rejection Criteria) — Hydraulic Servo Cylinder Assembly (Collective Control). (Paragraph 7-156 or 7-160 and table 7-5.)

7-173. Removal — Hydraulic Servo Cylinder Assembly (Collective Control). a. Open left transmission cowling (3, figure 2-19).

b. Remove suspension (cargo hook) assembly (paragraph 14-).

c. While gaining access through suspension (cargo hook) opening, remove cotter pin (12, figure 7-38), nut (13), washers (9), and bolt (10) from lever of servo valve and remove tube assembly (11).

NOTE

When disconnecting hydraulic hose assemblies, a small amount of fluid seepage may occur and will require placing a small container under fittings of servo valve (detail A, figure 7-28).

d. Disconnect hose assemblies from bottom of servo.

e. Install protective dust covers to open ports of hydraulic servo valves and hose connectors.

f. Remove nuts (7, figure 7-38) and washers (8).

g. Remove nuts (15) and washers (14).

h. Remove cotter pin (3), nut (2), washer (4), and bolt (5) from rod end bearing of hydraulic servo cylinder assembly and disconnect rod end bearings from lever assembly (1).

i. Carefully rotating hydraulic servo cylinder assembly for clearance of servo valve through cylinder support; lift cylinder assembly from helicopter.

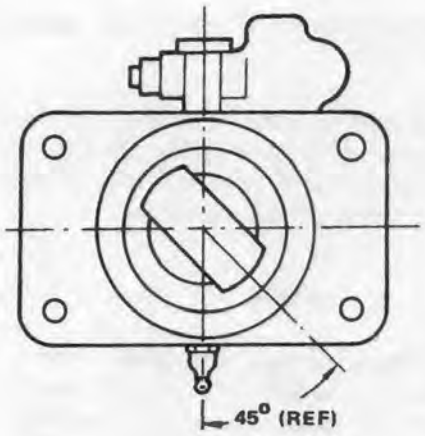
7-174. Disassembly — Hydraulic Servo Cylinder Assembly (Collective Control) (AVIM).

NOTE

Disassembly procedures for collective hydraulic servo cylinder assembly are same as cyclic control hydraulic servo cylinder assembly.

a. Disassemble hydraulic cylinder assembly (6, figure 7-38) (paragraph 7-159).

7-175. Inspection — Hydraulic Servo Cylinder Assembly (Collective Control) (AVIM). Inspect collective hydraulic servo cylinder assembly in accordance with inspection limits outlined in paragraph 7-156, or 7-160, and table 7-5.

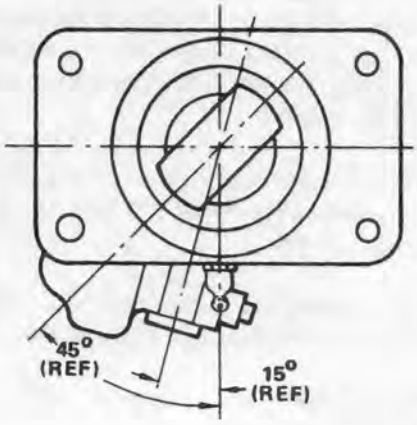


NOTE

The above rodend bearing position is for the following lateral cyclic hydraulic cylinder assemblies only.

PART NUMBER

204-076-005-1
204-076-005-13
204-076-511-17

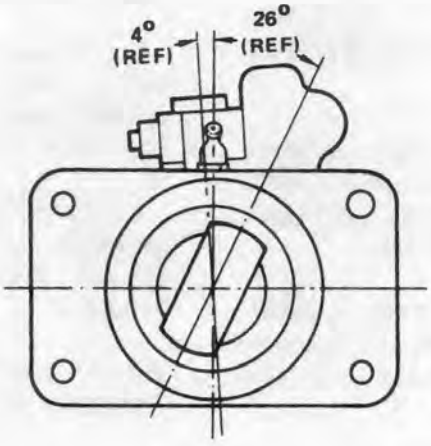


NOTE

The above rodend bearing position is for the following fore & aft cyclic hydraulic cylinder assemblies only.

PART NUMBER

204-076-005-3
204-076-005-15
204-076-511-19



NOTE

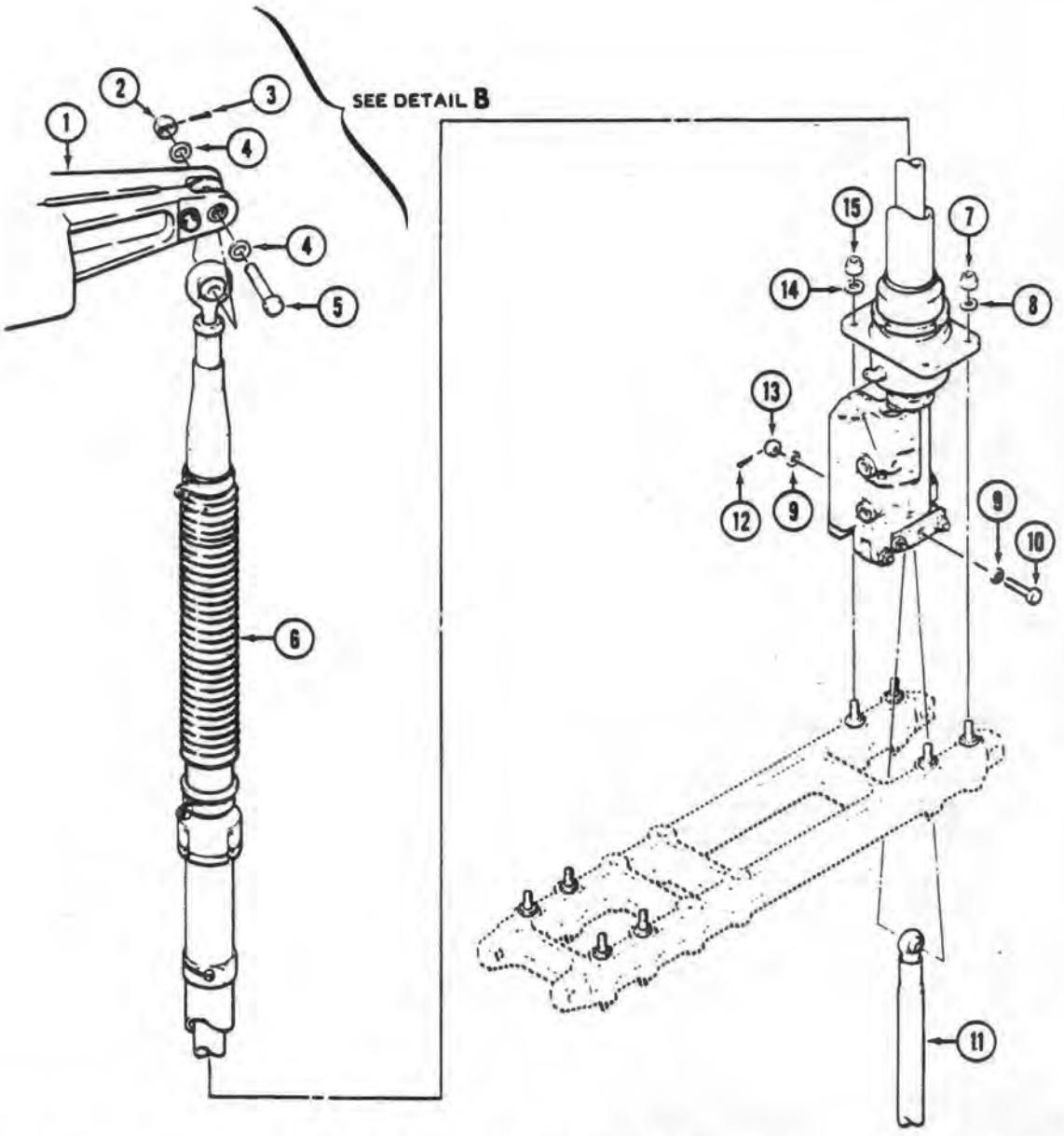
The above rodend bearing position is for the following collective hydraulic cylinder assemblies only.

PART NUMBER

204-076-005-5
204-076-005-9
204-076-511-21

204076-1058A

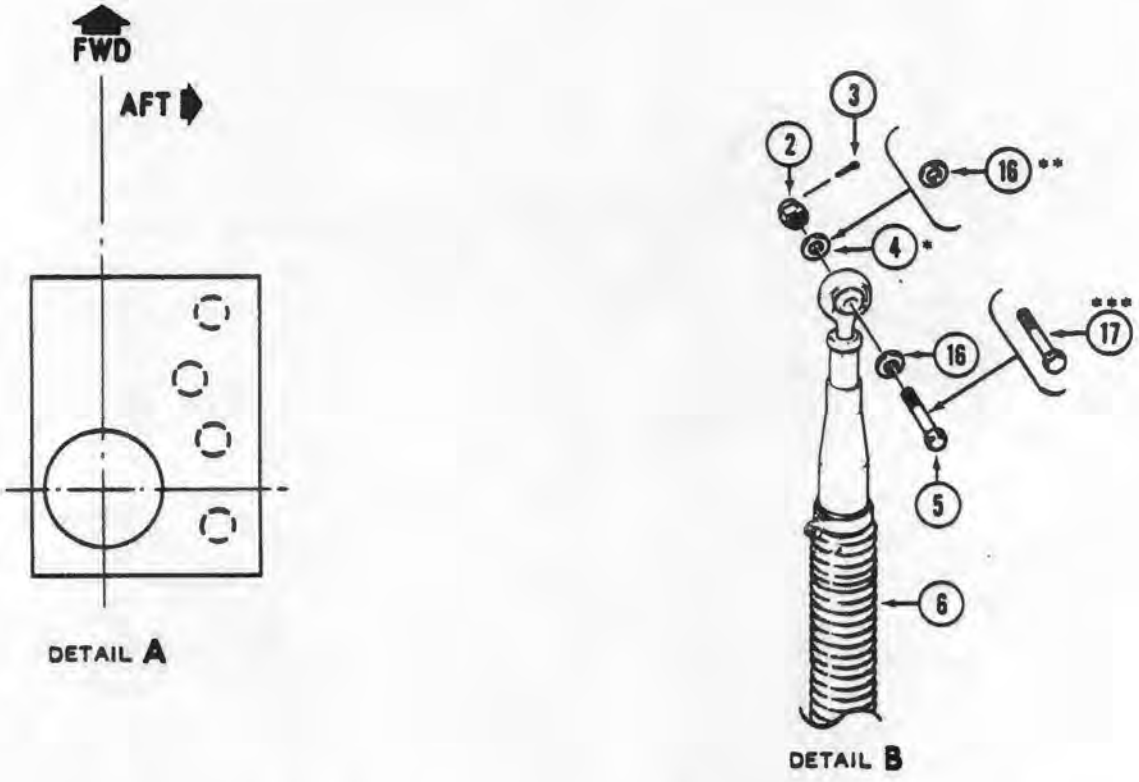
Figure 7-37. Positioning of rod end bearing to servo actuator



1. Lever assembly
2. Nut
3. Cotter pin
*4. Washer
5. Bolt
6. Cylinder assembly
7. Nut
8. Washer
9. Washers
10. Bolt
11. Tube assembly
12. Cotter pin
13. Nut
14. Washer
15. Nut
**16. Washer
***17. Bolt

204076-1059-1

Figure 7-38. Hydraulic servo cylinder assembly (collective control) (typical) — removal and installation (Sheet 1 of 2)



* Washer P/N AN960PD816 on helicopter serial numbers 64-14101 thru 64-14174.

** Washer P/N 140-007-33-32C4 on helicopter serial numbers 65-14173 thru 65-12744 and 65-12772 and 66-491 and subsequent.
WARNING: Countersink side of washer will be next to bolt head.

*** Bolt P/N NAS1308-34D on helicopter serial numbers 64-14175 thru 65-12744 and 65-12772.

204076-1059-2

Figure 7-38. Hydraulic servo cylinder assembly (collective control) (typical) — removal and installation (Sheet 2 of 2)

7-176. Cleaning — Hydraulic Servo Cylinder Assembly (Collective Control) (paragraph 7-162).

7-177. Repair or Replacement — Hydraulic Servo Cylinder Assembly (Collective Control) (AVIM). For repairs or replacement to components of collective hydraulic servo cylinder assembly (paragraph 7-163).

7-178. Assembly — Hydraulic Servo Cylinder Assembly (Collective Control). (AVIM)

CAUTION

When replacing the collective servo-control valve, make sure check valve P/N 204-076-437-3 is installed in P2 pressure port.

NOTE

Assembly procedures for collective control hydraulic servo cylinder assembly are same as cyclic control hydraulic servo cylinder assembly, except for maintenance task outlined in the following steps (paragraph 7-165).

a. With piston rod (8, figure 7-29) in full up position, adjust boot assembly (5, figure 7-32) 4.3 inches as shown.

b. Adjust and position rod end (1, figure 7-29) 2.19 inch from center of hole in rod end bearing to top

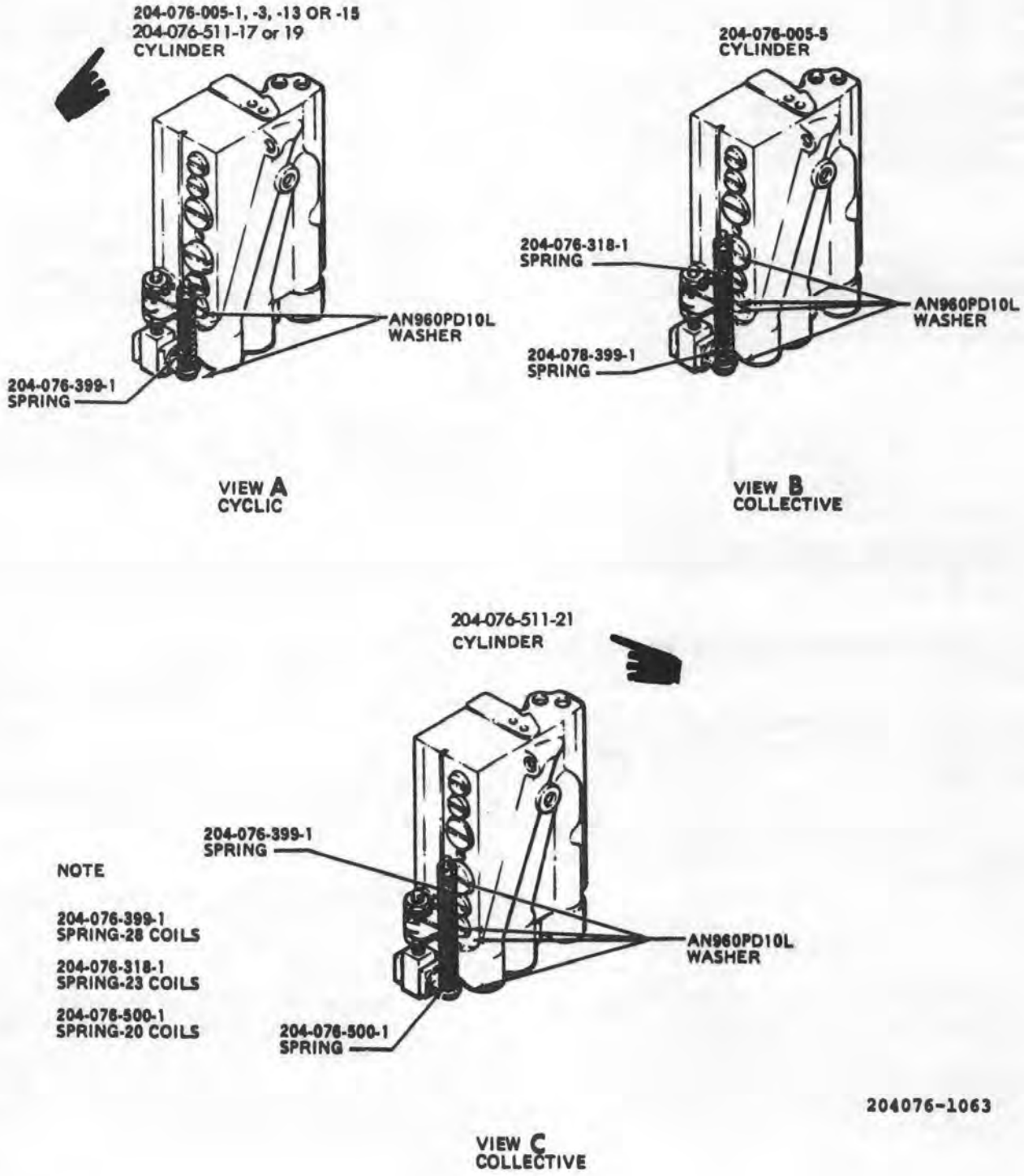


Figure 7-39. Servo control valve springs

of tube assembly (5) as shown in figure 7-27. Torque nut (3, figure 7-29) **480 TO 600** inch-pounds and secure with lockwire (C127). Check dimension A, figure 7-27 measurements of collective hydraulic servo cylinder assembly.

7-179. Lubrication — Hydraulic Servo Cylinder Assembly (Collective Control). Apply grease to collective hydraulic cylinder assembly (6, figure 7-38) in accordance with figure 1-2.

7-180. Installation — Hydraulic Servo Cylinder Assembly (Collective Control). a. Install collective hydraulic servo cylinder assembly (6, figure 7-38) in accordance with the following procedures:

CAUTION

Before installing a replacement hydraulic servo cylinder, ensure assembly is correct part number for collective pitch control system.

(1) Ensure installation of springs (figure 7-30) on servo valve.

(2) Position servo valve as shown in detail A, figure 7-38 and lower assembly (6) onto studs of cylinder support.

(3) Install washers (8), nuts (7), washers (14), and nut (15). Tighten nut (7 and 15) evenly using standard torque (TM 55-1500-204-25/1).

NOTE

Protective dust covers in ports of servo valve will have to be removed prior to hookup of rod end bearing to lever assembly (1, figure 7-38) for release of cylinder pressure while moving piston rod up or down.

(4) Check position of rod end bearing to servo valve as shown in figure 7-37. Position rod end bearing of hydraulic servo cylinder assembly (6, figure 7-37) to lever assembly (1) and install bolt (4) of bolt (17) (detail B), washer (4), and nut (2). Secure nut (2) with cotter pin (3).

CAUTION

Four bolts in lever assembly of servo cylinder (figure 7-38) will be fingertight only. Cotter pin (12) will not be re-used. Servo valve must operate freely without binding.

(5) Position bearing of tube assembly (11, figure 7-38) into lever of servo valve and install bolt (10), washers (9), and nut (13). Secure nut (13) with cotter pin (12).

(6) Remove protective dust covers from hose assemblies.

(7) Install hose assemblies to fittings located on bottom of servo valve.

(8) Service and bleed hydraulic system (paragraph 7-4).

(9) Close left transmission cowling (3, figure 2-19).

7-181. Operational Check — Hydraulic Servo Cylinder Assembly (Collective Control). Perform operational check of hydraulic system (paragraph 7-4). With hydraulic test stand attached to hydraulic system, move collective stick up and down and check hydraulic cylinder for leaks (table 7-1).

Section II. PNEUMATIC SYSTEM

(Not Applicable)

CHAPTER 8

INSTRUMENTS SYSTEMS

SECTION I — INSTRUMENT MAINTENANCE

8-1. INSTRUMENT MAINTENANCE.

8-2. Description — Instrument Maintenance. Instrument maintenance refers to general maintenance procedures which are applicable to all instruments mounted in the instrument panel.

8-3. Cleaning — Instrument Maintenance. Clean panel and instrument cover glasses with a suitable soft, lint-free cloth.

8-4. Inspection — Instrument Maintenance. a. Inspect for loose, cracked, or broken cover glasses.

b. Inspect for proper and secure mounting.

c. Inspect range markings and decals for completeness and legibility.

d. Inspect for proper operation.

8-5. Removal — Instrument Maintenance. a. Ensure all electrical power is OFF.

b. Disconnect electrical leads or instrument piping from back of panel. Necessary access may be through pedestal, through back of cabin mounting holes in panel after instrument is detached.

CAUTION

When removing exhaust gas temperature gage, place a short piece of wire across the terminal posts. This will ground the terminals and preclude violent needle movements and damage by static electricity. Instrument internal components are easily damaged, rendering the instrument out of calibration or inoperative. Do not replace washers on instrument terminal posts, as they are of special material. Replacing them with standard washers will cause a faulty EGT indication.

c. Protect ends of electrical leads, and cap open piping and openings on instrument.

NOTE

On UH-1C/M Helicopters, Serial No. 66-502 and subsequent; to mount certain round instruments the MS28042 clamp will be used. In order to remove this clamp it will be necessary to hold the clamp from the aft side while removing the screw from the front of the panel.

d. Remove mounting screws or loosen mounting clamp screw. Remove instrument.

8-6. Repair or Replacement — Instrument Maintenance. a. Replace missing or illegible range markings on cover glasses of instruments.

NOTE

When replacing instrument range markings (see Operators Manual TM 55-1520-220-10 for ranges) use a suitable lacquer, tape (C217), or prepared decals. Protect markings by applying a light coat of clear cellulose nitrate dope (C254). Apply range markings accurately on cover glass.

b. Replace any required decals which are not clearly legible.

c. Replace any instrument if cover glass is loose, cracked or broken, or when found to be unserviceable.

8-7. Installation — Instrument Maintenance.

CAUTION

On UH-1C/M Helicopters, Serial No. 66-502 and subsequent; to mount certain round instruments MS28042 clamp will be used. The installation technique required to ensure instrument security is that the clamp must be held in place from the aft side while tightened by a screw visible on the front side of the panel. A gap between the head of the screw and the face of the instrument panel may exist. Do not attempt to over-torque the screw to eliminate the clearance since the scissors mechanism of the clamp will be damaged.

NOTE

When installing AIMS altimeter, insure that the spacer is installed with thickest section at the bottom to prevent chafing.

a. Position instrument in panel. Install mounting screws or tighten screw of mounting clamp.

CAUTION

When connecting electrical plugs to dual tachometer indicator, ensure that plugs are connected to correct receptacle.

b. Remove protective caps or covers as necessary. Connect electrical leads and instrument piping.

c. Check operation of instruments.

8-8. INSTRUMENT PREMAINTENANCE REQUIREMENTS.

8-9. Description — Instrument Premaintenance Requirements. Throughout this chapter, unless otherwise specified, instrument maintenance, testing, and troubleshooting procedures will utilize only tools and equipment contained in Electronic Equipment Tool Kit, TK100/G and multimeter (AN/PSM-6A, or equivalent.)

SECTION II — ENGINE INSTRUMENTS

8-10. ENGINE INSTRUMENTS.

8-11. Description — Engine Instruments. Engine instruments include the tachometer, engine oil pressure, engine oil temperature, exhaust gas temperature, fuel pressure, and torque pressure indicating systems.

8-12. TACHOMETER INDICATING SYSTEMS.

8-13. Description — Tachometer Indicating Systems. The tachometer indicating systems are self-generating rotary type systems consisting of the dual tachometer, rotor tachometer generator, and power turbine tachometer generator as one system; and gas producer tachometer and gas producer tachometer generator as the other system.

8-14. DUAL TACHOMETER.

8-15. Description — Dual Tachometer. The dual tachometer indicates both main rotor rpm and engine output shaft rpm. Each tachometer has a synchronous motor connected electrically to separate tachometer generator. The system operates independently of helicopter electrical power systems. The rotor rpm pointer indicates on the inner scale of instrument, and the engine rpm pointer indicates on the outer scale. The pointers will be aligned when engine and rotor speeds are synchronized in normal operation.

8-16. Cleaning — Dual Tachometer. Refer to paragraph 8-3 for cleaning procedure.

8-17. Inspection — Dual Tachometer. Refer to paragraph 8-4 for inspection procedures.

8-18. Functional Test — Dual Tachometer (AVIM) a. Disconnect plug (P35) from rotor tachometer generator. Connect plug to the MASTER GENERATOR output plug on tachometer tester TTU-27E (T90). Energize test stand and set controls according to the instructions on the cover of the tester.

b. Check that the rotor tachometer portion of the indicator indicates within tolerance of the various check points in the following chart:

TEST POINTS ON TEST SET (RPM)	INDICATOR ROTOR (RPM)	TOLERANCE
0	0	± 3
531	40	± 4
1063	80	± 4
1992	150	± 4
2523	190	± 4
3055	230	± 4
3320	250	± 4
3586	270	± 3
3852	290	± 2
3984	300	± 2
4117	310	± 2
4250	320	± 2
4383	330	± 3
4649	350	± 3

c. Disconnect plug (P35) from the TTU-27E tester (T90) and reconnect it to the rotor tachometer generator. Check that connector is properly mated and secure.

d. Disconnect plug (P86) from the power turbine tachometer generator. Connect plug to the MASTER GENERATOR output plug on the TTU-27E tester (T90). Energize test stand and set controls according to the tester instructions on the cover of the tester.

e. Check that the power turbine engine portion of the indicator indicates within tolerance of the various check points in the following chart:

TEST POINTS ON TEST SET (RPM)	INDICATOR ENGINE (RPM)	TOLERANCE
0	0	± 50
511	800	± 70
958	1500	± 70
1980	3100	± 70
2491	3900	± 70
2938	4600	± 70
3257	5100	± 50
3576	5600	± 50
3832	6000	± 30
3959	6200	± 30
4023	6300	± 20
4151	6500	± 30
4342	6800	± 40
4534	7100	± 60

f. Disconnect plug (P86) from the test stand and reconnect it to the power turbine tachometer generator. Check that connector is properly mated and secure.

8-19. Troubleshooting — Dual Tachometer. Use table 8-1 and perform necessary checks to isolate trouble. Broken or shorted wiring is always a probable cause of malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-1. Troubleshooting — Dual Tachometer

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Tachometer has excessive scale error.

   STEP 1. Determine if indicator has weak magnet assembly.

   Replace indicator if defective (paragraphs 8-5 and 8-7).

2. Tachometer indication only half of actual speed.

   STEP 1. Determine if electrical connectors are connected to correct receptacle on indicator.

   Reconnect electrical connectors if reversed at indicator.

Table 8-1. Troubleshooting — Dual Tachometer (Cont)

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
3. No reading on tachometer indicator.
STEP 1. Check for poor connection at indicator or generator.
Clean or tighten connections.
STEP 2. Determine if internal circuit is defective in indicator or generator.
Replace defective indicator and/or generator (paragraphs 8-5, 8-7, 8-22, and 8-31).
4. High or low reading on indicator either constant or intermittent.
STEP 1. Determine if indicator resistance is out of adjustment.
Replace indicator if defective (paragraphs 8-5 and 8-7).

8-20. Removal/Installation — Dual Tachometer. Refer to paragraphs 8-5 and 8-7 for removal and installation procedures.

8-21. Repair or Replacement — Dual Tachometer. Refer to paragraph 8-6 for repair or replacement criteria.

8-22. POWER TURBINE ENGINE TACHOMETER GENERATOR.

8-23. Description — Power Turbine Engine Tachometer Generator. The power turbine engine tachometer generator is mounted on the governor and tachometer drive gearbox on the left upper side of the engine, and is connected to the dual tachometer indicator on the instrument panel.

8-24. Cleaning — Power Turbine Engine Tachometer Generator. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

8-25. Inspection — Power Turbine Engine Tachometer Generator. a. Inspect tachometer generator case for cracks, or any visible damage.

b. Check connector for damaged or bent pins and cracked inserts.

c. Check that rotor turns freely and there is no visible indication of excessive wear to bearings.

8-26. Troubleshooting — Power Turbine Engine Tachometer Generator. Refer to paragraph 8-19 and table 8-1 for troubleshooting; procedures are the same.

8-27. Removal — Power Turbine Engine Tachometer Generator. a. Remove cowling from left side of engine.

b. Disconnect electrical receptacle, remove mounting nuts and washers and lift tachometer generator from engine.

8-28. Repair or Replacement — Power Turbine Engine Tachometer Generator. a. Replace tachometer generator if case is cracked or damaged.

b. Replace tachometer generator if rotor does not turn freely or for visible indication of excessive wear to bearings.

NOTE

Replacement of power turbine engine tachometer generator will require testing the rpm limit warning system (Refer to paragrph 9-181).

c. Repair damaged connectors.

8-29. Bench Test — Power Turbine Engine Tachometer Generator (AVIM) a. Remove tachometer generator from helicopter and mount on tachometer tester TTU-27E (T90). Connect generator to the TEST GENERATOR INPUT. Operate tester according to instructions on cover and check voltage outputs of the tachometer generator. With a 40 ohm "Y" connected resistance and a shaft speed of 4200 rpm, check voltage output across each phase of the generator (A — B, A — C, and B — C). The three voltage outputs should be **21 ± 0.5** Vac.

b. Decrease generator speed to 1,000 rpm with a 20 ohm "Y" connected resistance.

c. Check the voltage output of the three phases. Voltage should not go below **3.5** Vac.

d. Disconnect tachometer generator and remove from the TTU-27E.

e. Measure the resistance of each phase (A — B, A — C, and B — C). At **25°** Celsius **(77°F)**, the resistance should be between **15 and 20** ohms. Each phase should be within **one** (1) ohm of each other.

f. At completion of testing, install tachometer generator and connect electrical plug and check for proper mating and security.

8-30. Installation — Power Turbine Engine Tachometer Generator. a. Position tachometer generator and gasket on studs and install nuts.

b. Connect electrical receptacle and install cowling.

c. Coat tachometer generator shaft and packing mating splines of shaft in accessory drive gearbox 2/3 full with lubricant (C132).

8-31. ROTOR TACHOMETER GENERATOR.

8-32. Description — Rotor Tachometer Generator. The rotor tachometer generator is located on the lower right side of the transmission. The generator is mounted on the hydraulic pump and tachometer drive quill assembly and is connected to the dual tachometer indicators on the instrument panels.

8-33. Cleaning — Rotor Tachometer Generator. Refer to paragraph 8-24, cleaning procedures are the same.

8-34. Inspection — Rotor Tachometer Generator. Refer to paragraph 8-25, inspection procedures are the same.

8-35. Troubleshooting — Rotor Tachometer Generator. Refer to paragraph 8-19 for troubleshooting; procedures are the same.

8-36. Removal — Rotor Tachometer Generator. a. Remove cowling from right side of transmission.

b. Disconnect electrical receptacle, remove mounting nuts and washers, and lift rotor tachometer generator from helicopter.

8-37. Repair or Replacement — Rotor Tachometer Generator. a. Replace tachometer generator if case is cracked or damaged.

b. Replace tachometer generator if rotor does not turn freely or for visible indication of excessive wear to bearings.

NOTE

Replacement of rotor tachometer generator will require testing the rpm limits warning system. (Refer to paragraph 9-181.)

8-38. Bench Test — Rotor Tachometer Generator (AVIM). Refer to paragraph 8-29; procedures are the same.

8-39. Installation — Rotor Tachometer Generator. a. Apply a thin film of antiseize compound (C28) to tachometer generator splines and to mating splines in transmission.

b. Position tachometer generator on mounting studs and install mounting washers and nuts.

c. Connect electrical receptacle and install cowling.

8-40. GAS PRODUCER TACHOMETER INDICATOR.

8-41. Description — Gas Producer Tachometer Indicator. The gas producer tachometer, located on the instrument panel, provides indication in percent rpm of the engine gas producer (first stage on N1 turbine and compressor) by connection to a synchronous generator, mounted on engine accessory drive section. The indicator and generator circuit are independent of helicopter electrical power system.

8-42. Cleaning — Gas Producer Tachometer Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-43. Inspection — Gas Producer Tachometer Indicator. Refer to paragraph 8-4 for inspection procedure.

8-44. Troubleshooting — Gas Producer Tachometer Indicator. Refer to paragraph 8-19; procedures are the same.

8-45. Removal — Gas Producer Tachometer Indicator. Refer to paragraph 8-5 for removal procedure.

8-46. Repair or Replacement — Gas Producer Tachometer Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-47. Bench Test — Gas Producer Tachometer Indicator (AVIM). a. Disconnect plug (P87) from gas producer tachometer generator. Connect plug to the MASTER GENERATOR output plug on the TTU-27E tester (T90). Energize the test stand and set controls according to the instructions on the cover of the tester.

b. Check that the gas producer tachometer indicator indicates within tolerance of the various check points in the following chart:

TEST POINTS (RPM)	INDICATOR (RPM)	TOLERANCE
5%	5%	± 1.00
20%	20%	± 1.25
70%	70%	± 1.25
100%	100%	± 1.00

c. Disconnect plug (P87) from TTU-27E tester (T90) and reconnect it to gas producer tachometer generator. Check that connector is properly mated and secure.

8-48. Installation — Gas Producer Tachometer Indicator. Refer to paragraph 8-7 for installation procedure.

8-49. GAS PRODUCER TACHOMETER GENERATOR.

8-50. Description — Gas Producer Tachometer Generator. The gas producer tachometer generator, located on the right side of the engine on the accessory gearbox, monitors the rpm of the gas producer turbine and transmits voltage signals to drive the gas producer tachometer indicator.

8-51. Cleaning — Gas Producer Tachometer Generator. Refer to paragraph 8-24; procedures are the same.

8-52. Inspection — Gas Producer Tachometer Generator. Refer to paragraph 8-25; procedures are the same.

8-53. Troubleshooting — Gas Producer Tachometer Generator. Refer to paragraph 8-19 for troubleshooting; procedures are the same.

8-54. Removal — Gas Producer Tachometer Generator. Refer to paragraph 8-27; procedures are the same.

8-55. Repair or Replacement — Gas Producer Tachometer Generator. Refer to paragraph 8-28; procedures are the same.

8-56. Bench Test — Gas Producer Tachometer Generator. (AVIM) Refer to paragraph 8-29; procedures are the same.

8-57. Installation — Gas Producer Tachometer Generator. Refer to paragraph 8-30; procedures are the same.

8-58. ENGINE OIL PRESSURE INDICATING SYSTEM.

8-59. Description — Engine Oil Pressure Indicating System. The engine oil pressure indicating system includes the engine oil pressure indicator and the engine oil pressure transmitter. The system is powered from the 28 Vac bus, and is protected by a 1 ampere PRESSURE ENG circuit breaker.

8-60. ENGINE OIL PRESSURE INDICATOR.

8-61. Description — Engine Oil Pressure Indicator. The engine oil pressure indicator, located on the instrument panel, indicates engine oil pressure in psi by means of the engine oil pressure transmitter.

8-62. Cleaning — Engine Oil Pressure Indicator. Refer to paragraph 8-3 for cleaning procedures.

8-63. Inspection — Engine Oil Pressure Indicator. Refer to paragraph 8-4 for inspection procedure.

8-64. Functional Test — Engine Oil Pressure Indicator. a. Disconnect pressure line from the engine oil pressure transmitter.

b. Connect variable pressure tester (T10.1) to input line on engine oil pressure transmitter.

c. Energize main or standby inverter. Close 28V TRANS circuit breaker and PRESSURE ENG circuit breaker.

d. Apply pressure to the transmitter input port while monitoring the engine oil pressure indicator. Indicated pressure shall be **50** psi when applied pressure is **50 ± 7** psi.

8-65. Troubleshooting — Engine Oil Pressure Indicator. Use table 8-2 and perform checks as necessary to isolate trouble.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-2. Troubleshooting — Engine Oil Pressure Indicator

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Pressure indicator is reading low.
STEP 1. Check for obstructed pressure line.
Replace or clean obstructed line (paragraph 4-60).
2. Pressure indicator is inaccurate or sticking.
STEP 1. Determine if indicator is defective.
Replace indicator if defective (paragraphs 8-5 and 8-7).
3. Pressure indicator has sluggish action.
STEP 1. Check for sludge in pressure line.
Bleed pressure line.

Table 8-2. Troubleshooting — Engine Oil Pressure Indicator (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
4. Pressure indicator is inoperative.	
STEP 1. Determine if pressure indicator is defective.	**Replace indicator if defective (paragraphs 8-5 and 8-7).**
STEP 2. Perform continuity check of circuit between transmitter and indicator.	**Repair or replace electrical leads.**
5. Pressure indicator shows fluctuating pressure indicator.	
STEP 1. Check for loose electrical connections and determine if instrument is clamped too tight.	**Tighten electrical connections or readjust clamp.**
STEP 2. Determine if incorrect restrictor is installed in system.	**Install correct restrictor.**

8-66. Removal — Engine Oil Pressure Indicator. Refer to paragraph 8-5 for removal procedure.

8-67. Repair or Replacement — Engine Oil Pressure Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-68. Installation - Engine Oil Pressure Indicator. Align engine oil pressure indicator so that **90** psi is at 9 o'clock for T53-L-13 engine and align so that **70** psi is at 9 o'clock for T53-L-11 engine. Refer to paragraph 8-7 for installation procedure.

8-69. ENGINE OIL PRESSURE TRANSMITTER.

8-70. Description — Engine Oil Pressure Transmitter. The engine oil pressure transmitter, located on top of the engine inlet section, monitors engine oil pressure and transmits voltage signals to the engine oil pressure indicator.

8-71. Cleaning — Engine Oil Pressure Transmitter. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Remove oil, grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

8-72. Inspection — Engine Oil Pressure Transmitter. a. Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

b. Inspect oil line and fitting connection for leaks and proper installation.

c. Inspect electrical connector for damaged or bent pins and cracked inserts.

8-73. Functional Test — Engine Oil Pressure Transmitter.

NOTE

The pressure transmitter is functionally tested during testing of the pressure indicator using variable pressure tester, paragraph 8-64. The following electrical resistance check may be conducted on the pressure transmitter independently from the pressure indicator.

a. Using multimeter (T3), check resistance between contacts of electrical receptacle on top of transmitter.

b. Resistance should be approximately **10** ohms across contacts A to C and B to C, and approximately **20** ohms across contacts A to B.

8-74. Troubleshooting — Engine Oil Pressure Transmitter. Refer to paragraph 8-65 for troubleshooting; procedures are the same.

8-75. Removal — Engine Oil Pressure Transmitter. a. Remove cowling from engine.

b. Disconnect electrical connector. Disconnect oil line. Place protective covers over connector and oil line.

c. Remove lockwire and mounting screws and lift transmitter from mounting bracket.

8-76. Repair or Replacement — Engine Oil Pressure Transmitter. a. Repair damaged electrical connectors.

b. Tighten loose oil line or fitting connection.

c. Replace defective or damaged oil line or fitting.

d. Replace pressure transmitter if cracked or damaged.

e. Reinstall improperly mounted pressure transmitter.

8-77. Installation — Engine Oil Pressure Transmitter. a. Position transmitter on bracket and install mounting screws. Install lockwire (C126.1).

b. Remove protective covers and connect electrical receptacle and oil line. Install cowling.

8-78. ENGINE OIL TEMPERATURE INDICATING SYSTEM.

8-79. Description — Engine Oil Temperature Indicating System. The engine oil temperature indicating system includes the engine oil temperature indicator and the engine oil temperature bulb. The system is powered from the 28 Vdc essential bus and is protected by a 5 ampere TEMP IND ENG & XMSN circuit breaker.

8-80. ENGINE OIL TEMPERATURE INDICATOR.

8-81. Description — Engine Oil Temperature Indicator. The engine oil temperature indicator, located on the instrument panel, indicates engine oil temperature in degrees Celsius by means of an electrical resistance type temperature bulb.

8-82. Cleaning — Engine Oil Temperature Indicator. Refer to paragraph 8-3 for cleaning procedures.

8-83. Inspection — Engine Oil Temperature Indicator. Refer to paragraph 8-4 for inspection procedure.

8-84. Functional Test — Engine Oil Temperature Indicator. a. Place BAT switch to ON. Close TEMP IND ENG & XMSN circuit breaker.

b. Check that temperature indicator indicates approximate ambient temperature.

8-85. Troubleshooting — Engine Oil Temperature Indicator. Use table 8-3 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-3. Troubleshooting — Engine Oil Temperature Indicator

CONDITION TEST OR INSPECTION	**CORRECTIVE ACTION.**
1. Oil temperature indication off scale at low end, or low reading — constant or intermittent.	
STEP 1. Determine if indicator is defective.	**Replace indicator if defective (paragraphs 8-5 and 8-7).**
STEP 2. Perform continuity check from temperature bulb to indicator.	**Repair or replace electrical leads.**
2. Oil Temperature indication off scale at high end, or high reading — either constant or intermittent.	
STEP 1. Check for short circuit in temperature bulb.	**Replace temperature bulb if defective (paragraph 8-95).**
STEP 2. Check for open circuit in temperature bulb or between temperature bulb and indicator.	**Replace temperature bulb or repair electrical wiring (paragraph 8-96).**
STEP 3. Check for defective indicator.	**Replace indicator if defective (paragraphs 8-5 and 8-7).**
3. No indication on temperature indicator.	
STEP 1. Ensure voltage is present on 28 Vdc bus and check for defective TEMP IND ENG & XMSN circuit breaker.	**Replace circuit breaker if defective (paragraph 9-12).**
STEP 2. Check for open electrical wire from circuit breaker to indicator.	**Repair electrical wiring.**

8-86. Removal — Engine Oil Temperature Indicator. Refer to paragraph 8-5 for removal procedure.

8-87. Repair or Replacement — Engine Oil Temperature Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-88. Bench Test — Engine Oil Temperature Indicator (AVIM). a. Disconnect electrical plug in back of oil temperature indicator. Remove indicator from instrument panel. Connect indicator to electric thermometer tester using the appropriate adapter cable provided with the tester.

CAUTION

Always be certain that the indicator is connected before turning switch "7" to the "24" volt position.

b. Check zero setting of the voltmeter "1" and adjust if necessary. Turn switch "7" to the "24" volt position.

c. Adjust pointer of voltmeter "1" to coincide with the red line at 28.50 volts by operating rheostat "5.". Position switch "8" to the left and single position.

d. Set temperature selector switch "2" to temperature points in the "left inner scale" (90.38 ohms at zero degrees temperature).

e. Rotate switch "2" to required test points. Tap the indicator before taking a reading. The test points and tolerances are listed in the following chart:

TEST POINTS	INDICATOR READING	TOLERANCE
-70	-70° Celsius	± 4
-30	-30° Celsius	± 3
0	0° Celsius	± 2
+30	30° Celsius	± 2
+80	80° Celsius	± 2
+120	120° Celsius	± 3
+150	150° Celsius	± 4

f. Turn switch "7" to the "OFF" position and disconnect indicator from tester. Install indicator in instrument panel and check for security.

8-89. Installation - Engine Oil Temperature Indicator. Align engine oil temperature indicator so that **70°**C is at 9 o'clock. position. Refer to paragraph 8-7 for installation procedure.

8-90. ENGINE OIL TEMPERATURE BULB.

8-91. Description — Engine Oil Temperature Bulb. The engine oil temperature bulb, installed in the engine oil pump housing is a resistance type temperature bulb which monitors the engine oil temperature and transmits varying voltage signals to the engine oil temperature indicator.

8-92. Cleaning — Engine Oil Temperature Bulb. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Remove oil, grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connector with a bristle brush (C32).

8-93. Inspection — Engine Oil Temperature Bulb. a. Inspect temperature bulb for cracks, leaks, security and proper mounting.

b. Inspect electrical connector for damaged or bent pins and cracked inserts.

8-94. Troubleshooting — Engine Oil Temperature Bulb. Refer to paragraph 8-85 for troubleshooting; procedures are the same.

8-95. Removal — Engine Oil Temperature Bulb. a. Cut lockwire and disconnect electrical connector.

b. Remove lockwire and unscrew temperature bulb from oil manifold.

c. Remove gasket.

8-96. Repair or Replacement — Engine Oil Temperature Bulb. a. Repair damaged electrical connector.

b. Replace damaged or worn gasket.

c. Replace temperature bulb if cracked or damaged.

8-97. Bench Test — Engine Oil Temperature Bulb (AVIM). a. Resistance check.

(1) Remove oil temperature bulb to be checked and allow sufficient time to adjust to ambient temperature.

(2) With a Wheatstone bridge, measure the resistance of the temperature bulb between pin A and B. Ambient temperature test points and tolerances are listed in the following chart:

AMBIENT TEMPERATURE TEST POINT DEGREES	RESISTANCE (OHMS)	TOLERANCE (OHMS)
-20° Celsius (-4°F)	83.77	± 0.4
-10° Celsius (14°F)	87.04	± 0.4
0° Celsius (32°F)	90.38	± 0.4
10° Celsius (50°F)	93.80	± 0.4
20° Celsius (68°F)	97.31	± 0.4
30° Celsius (86°F)	100.91	± 0.4
40° Celsius (104°F)	104.60	± 0.4

b. Insulation Leakage Test. With the temperature bulb subjected to a 100 volt potential between any electrical pin and the bulb housing, the minimum resistance shall be **5** megohms.

c. Reinstall temperature bulb.

8-98. Installation — Engine Oil Temperature Bulb. a. Coat threads and gasket with lubricating oil (C136) when installing gasket on temperature bulb.

b. Install temperature bulb and gasket in manifold.

c. Lockwire (C127) to adjacent bolt head on manifold.

d. Connect and lockwire (C126.1) electrical connector.

8-99. EXHAUST GAS TEMPERATURE INDICATING SYSTEM.

8-100. Description — Exhaust Gas Temperature Indicating System. The exhaust gas temperature indicating system includes the exhaust gas temperature indicator and the thermocouple lead spool resistor. The system is self-generating, operating on electrical potential from the engine thermocouple harness assembly.

8-101. EXHAUST GAS TEMPERATURE INDICATOR.

8-102. Description — Exhaust Gas Temperature Indicator. The exhaust gas temperature indicator, located on the instrument panel, indicates exhaust gas temperature in degrees Celsius. The indicator operates on electrical potential from the engine thermocouple harness, mounted in the aft section of the engine exhaust diffuser.

8-103. Cleaning — Exhaust Gas Temperature Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-104. Inspection Exhaust Gas Temperature Indicator. Refer to paragraph 8-4 for inspection procedure.

8-105. Functional Test — Exhaust Gas Temperature Indicator. a. Connect and operate the engine exhaust gas temperature tester (T3.1) in accordance with TM 55-4920-244-14.

(1) Determine EGT indicator accuracy and adjust or replace as required.

(2) Establish circuit insulation to ground, and confirm that thermocouple probes are operative.

(3) Perform EGT circuit resistance check, and adjust thermocouple lead spool resistor to obtain **8** ± **0.05** ohms (paragraph 8-120).

NOTE

Engine EGT tester and helicopter instrument must be at same ambient temperature for accurate check.

b. Perform functional check of EGT circuit.

(1) EGT system error must not exceed **10°** Celsius at test temperature (600° Celsius).

(2) Troubleshoot as necessary, using exhaust gas temperature tester to isolate causes of error.

8-106. Troubleshooting — Exhaust Gas Temperature Indicator. Use table 8-4 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-4. Troubleshooting — Exhaust Gas Temperature Indicator

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
1. EGT indicator reads high or low.
STEP 1. Perform functional test of EGT indicator (paragraph 8-105).
Replace indicator if defective (paragraphs 8-5 and 8-7). Adjust thermocouple lead spool resistor to obtain correct resistance. Replace thermocouple lead spool resistor if circuit resistance is less than 7.95 ohms (paragraph 8-117).
2. EGT indicator fails to indicate.
STEP 1. Troubleshoot EGT wiring.
Replace defective wiring.
STEP 2. Perform functional test of EGT indicator (paragraph 8-105).
Replace indicator if defective (paragraphs 8-5 and 8-7). Adjust thermocouple lead spool resistor to obtain correct resistance (paragraph 8-117).

8-107. Removal — Exhaust Gas Temperature Indicator. Refer to paragraph 8-5 for removal procedure.

8-108. Repair or Replacement — Exhaust Gas Temperature Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-109. Bench Test — Exhaust Gas Temperature Indicator (AVIM).

NOTE

Prior to bench test, the indicator shall be subjected to a constant room temperature for a period of not less than one hour.

a. Apply millivoltage to the indicator terminals for each test point as specified in table 8-5 for the prevailing ambient temperature. The millivoltage shall be applied to the indicator through a series external circuit resistance of **8 ± 0.05** ohms. The millivoltage applied shall be measured with a potential measuring instrument having a minimum accuracy of **0.2** percent and a minimum readability of **0.2** percent.

b. Tap the indicator slightly after each reading. The difference in reading after tapping shall be considered friction error. Refer to table 8-6 for scale error and friction error tolerances.

Table 8-5. Millivolts vs Temperature

AMBIENT TEMPERATURE	INDICATOR TEST POINT °Celsius MILLIVOLTS					
°Celsius	500	600	700	800	900	1,000
10	20.24	24.50	28.74	32.91	36.96	40.91
15	20.04	24.30	28.54	32.71	36.76	40.71
20	19.84	24.10	28.34	32.51	36.56	40.51
25	19.64	23.90	28.14	32.31	36.36	40.31
30	19.44	23.70	27.94	32.11	36.16	40.11
35	19.24	23.50	27.74	31.90	35.96	39.90

NOTE: For intermediate ambient temperatures, subtract 0.04 mv for each °Celsius above the next lower ambient temperature.

Table 8-6. EGT Indicator Scale and Friction Error Tolerances Plus or Minus °Celsius

TEST POINTS °CELSIUS	SCALE ERROR	FRICTION
500	20	30
600	10	30
700	5	30
800	10	30
900	20	30
1,000	30	30

8-110. Installation — Exhaust Gas Temperature Indicator. Refer to paragraph 8-7 for installation procedure.

NOTE

Replacement of exhaust gas temperature indicator requires a functional test in accordance with paragraph 8-105.

8-111. THERMOCOUPLE LEAD SPOOL RESISTOR.

8-112. Description — Thermocouple Lead Spool Resistor. The thermocouple lead spool resistor, located in aft electrical compartment, provides a means of adjusting the resistance within the EGT circuitry to calibrate the EGT indicator.

8-113. Cleaning — Thermocouple Lead Spool Resistor. Remove moisture and dirt from cover with a clean, lint-free cloth.

8-114. Inspection — Thermocouple Lead Spool Resistor. Inspect resistor for loose connections, corrosion, broken wires, broken terminals, and damage to cover or cover fasteners.

8-115. Functional Test — Thermocouple Lead Spool Resistor. Refer to paragraph 8-105 for functional test; procedures are the same.

8-116. Troubleshooting — Thermocouple Lead Spool Resistor. Refer to paragraph 8-106 for troubleshooting; procedures are the same.

8-117. Adjustment — Thermocouple Lead Spool Resistor.

CAUTION

To maintain proper accuracy, use only a JetCal analyzer (T3.1) when making resistance adjustments.

NOTE

The EGT indicator is calibrated to give accurate temperature readings when the circuit resistance is 8 ohms. Adjustment of spool resistor may be required when engine or thermocouple harness is replaced. Adjustment can also compensate for change in thermocouple harness resistance (resistance increases with time in service). See paragraph 8-105 for resistance check.

a. Check total circuit lead resistance by using a JetCal analyzer (T3.1) connected to the indicator leads (indicator disconnected and engine furnished harness connected). Resistance should read **8** ohms plus or minus **0.05** ohm.

b. Adjust resistance by adding or removing turns of wire from the resistance spool.

8-118. Removal — Thermocouple Lead Spool Resistor. a. Remove cover.

b. Remove alumel lead to resistor.

c. Unsolder resistor spool lead and remove spool.

8-119. Repair or Replacement — Thermocouple Lead Spool Resistor. a. Tighten loose connections.

b. Replace or repair damaged cover.

c. Replace spool resistor if wires are broken or corroded.

d. Replace spool resistor if circuit resistance is less than **7.95** ohms.

8-120. Installation — Thermocouple Lead Spool Resistor.

NOTE

New spool resistors have only one end of the winding soldered to a terminal. The other end is free to permit adjustment.

a. Position resistor spool in place, solder lead to spool terminal and attach alumel lead to resistor lug.

b. Scrape off insulation at free end of wire. Touch bare wire to other terminal and check circuit resistance.

(1) If circuit resistance is **7.95 to 8.05** ohms, solder bare wire to terminal.

(2) If circuit resistance exceeds **8.05** ohms, unsolder end of resistor winding. Unwind a turn or two of wire at a time and scrape off insulation. Touch bare wire to the terminal and check circuit resistance. When resistance of **7.95 to 8.05** ohms is indicated, cut the wire and solder to terminal.

(3) If circuit resistance is less than **7.95** ohms, replace spool resistor and repeat preceding steps a. and b.

c. Install cover.

8-121. FUEL PRESSURE INDICATING SYSTEM.

8-122. Description — Fuel Pressure Indicating System. The fuel pressure indicating system includes the fuel pressure indicator and the fuel pressure transmitter. The system is powered by the 28 Vac bus, and is protected by a one ampere PRESSURE FUEL circuit breaker.

8-123. FUEL PRESSURE INDICATOR.

8-124. Description — Fuel Pressure Indicator. The fuel pressure indicator, located on the instrument panel, provides indication in psi of pressure in the main fuel supply line by means of an electrical fuel pressure transmitter.

8-125. Cleaning — Fuel Pressure Indicator. Refer to paragraph 8-3 for cleaning procedures.

8-126. Inspection — Fuel Pressure Indicator. Refer to paragraph 8-4 for inspection procedure.

8-127. Functional Test — Fuel Pressure Indicator. a. Energize main inverter by placing INVTR switch to MAIN ON.

b. Close PRESSURE FUEL circuit breaker.

c. Disconnect the fuel pressure line from fuel pressure transmitter. Using variable pressure tester (T10.1), apply pressure while monitoring pilots fuel pressure indicator. Indicated pressure shall be **50 ± 7** psi when applied pressure is **50** psi.

d. Open PRESSURE FUEL circuit breaker and reconnect the fuel pressure lines.

8-128. Troubleshooting — Fuel Pressure Indicator. Use Table 8-7 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-7. Troubleshooting — Fuel Pressure Indicator

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1 Pressure indicator is reading low.
STEP 1. Check for obstructed pressure line.
Replace or clean obstructed line. (Refer to TM 55-1500-204-25/1.)
2 Pressure indicator is inaccurate or sticking.
STEP 1. Determine if indicator is defective.
Replace indicator if defective (paragraphs 8-5 and 8-7).
3 Pressure indicator is inoperative.
STEP 1. Determine if pressure indicator is defective.
Replace indicator if defective (paragraphs 8-5 and 8-7).
STEP 2. Perform continuity check of circuit between transmitter and indicator.
Repair or Replace electrical leads.
STEP 3. Perform functional test (paragraph 8-127) to determine if pressure transmitter is defective.
Replace defective pressure transmitter (paragraph 8-139).
4. Pressure indicator shows fluctuating pressure indication.
STEP 1. Check for loose electrical connections and determine if instrument is clamped too tight.
Tighten electrical connections or readjust clamp.

Table 8-7. Troubleshooting — Fuel Pressure Indicator (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
STEP 2.	Perform functional test (paragraph 8-127) to determine if pressure transmitter is defective.	**Replace defective pressure transmitter (paragraph 8-139).**

8-129. Removal — Fuel Pressure Indicator. Refer to paragraph 8-5 for removal procedures.

8-130. Repair or Replacement — Fuel Pressure Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-131. Installation — Fuel Pressure Indicator. Refer to paragraph 8-7 for installation procedure.

8-132. FUEL PRESSURE TRANSMITTER.

8-133. Description — Fuel Pressure Transmitter. The fuel pressure transmitter, mounted on right engine deck level just ahead of forward firewall, monitors pressure in the main fuel supply line and transmits voltage signals to the fuel pressure indicator (paragraph 8-123).

8-134. Cleaning — Fuel Pressure Transmitter. a. Remove moisture and loose dirt with clean, soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Remove oil, grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

8-135. Inspection — Fuel Pressure Transmitter. a. Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

b. Inspect fuel line and fitting connection for leaks and proper installation.

c. Inspect electrical connector for damaged or bent pins and cracked inserts.

8-136. Functional Test — Fuel Pressure Transmitter. Refer to paragraph 8-127 for functional test; procedures are the same.

8-137. Troubleshooting — Fuel Pressure Transmitter. Refer to paragraph 8-128 for troubleshooting; procedures are the same.

8-138. Removal — Fuel Pressure Transmitter. a. Open right aft pylon access door to gain access to pressure transmitter.

b. Cut lockwire and disconnect electrical connector from transmitter.

c. Disconnect pressure hose from transmitter mount.

d. Remove four screws and washers from transmitter mount.

e. Remove transmitter.

8-139. Repair or Replacement — Fuel Pressure Transmitter. a. Repair damaged electrical connectors.

b. Tighten loose fuel line or fitting connection.

c. Replace defective or damaged fuel line or fitting.

d. Replace pressure transmitter if cracked or damaged.

e. Reinstall improperly mounted pressure transmitter.

8-140. Installation — Fuel Pressure Transmitter. a. Install transmitter in mount using four screws and four washers.

b. Connect fuel pressure hose to union and connect electrical connector and lockwire (C126.1).

c. Close access door.

8-141. TORQUE PRESSURE INDICATING SYSTEM.

8-142. Description — Torque Pressure Indicating System. The torque pressure indicating system includes the torque pressure indicator (paragraph 8-143) and torque pressure transmitter (paragraph 8-152.) The system is powered from the 28 Vac bus, and is protected by a 1 ampere PRESSURE TORQUE circuit breaker.

8-143. TORQUE PRESSURE INDICATOR.

8-144. Description — Torque Pressure Indicator. The torque pressure indicator, mounted in the instrument panel, indicates engine output shaft torque pressure in psi by means of the torque pressure transmitter (paragraph 8-152).

8-145. Cleaning — Torque Pressure Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-146. Inspection — Torque Pressure Indicator. Refer to paragraph 8-4 for inspection procedure.

8-147. Functional Test — Torque Pressure Indicator. a. Disconnect pressure line from the torque pressure transmitter.

b. Connect variable pressure tester (T10.1) to input line on torque pressure transmitter.

c. Energize main or standby inverter. Close 28V TRANS circuit breaker and PRESSURE TORQUE circuit breaker.

d. Apply pressure to the transmitter input port while monitoring the engine oil pressure indicator. Indicated pressure should be **100** psi when applied pressure is **100 ± 1** psi.

8-148. Troubleshooting — Torque Pressure Indicator. Use table 8-8 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-8. Troubleshooting — Torque Pressure Indicator

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Pressure indicator is inaccurate or sticking.
STEP 1. Determine if indicator is defective.
Replace indicator if defective (paragraphs 8-5 and 8-7).
2. Pressure indicator has sluggish action.
STEP 1. Check for sludge in pressure line, in accordance with paragraph 8-147.
Bleed pressure line.
3. Pressure indicator is inoperative or reading low.
STEP 1. Determine if pressure indicator is defective.
Replace indicator if defective (paragraphs 8-5 and 8-7).
STEP 2. Perform continuity check of circuit between transmitter and indicator.
Repair or replace electrical leads.

Table 8-8. Troubleshooting — Torque Pressure Indicator (Cont)

CONDITION / TEST OR INSPECTION / CORRECTIVE ACTION
STEP 3. Check for obstructed pressure line.
Replace or clean obstructed line (TM 55-1500-204-25/1).
STEP 4. Perform functional check (paragraph 8-147) to determine if pressure transmitter is defective.
Replace defective pressure transmitter (paragraph 8-152).
STEP 5. Determine if pressure metering valve is defective.
Replace defective pressure metering valve (TM 55-2840-229-23).
4. Pressure indicator shows fluctuating pressure indication.
STEP 1. Check for loose electrical connections and determine if instrument is clamped too tight.
Tighten electrical connections or readjust clamp.
STEP 2. Perform functional test (paragraph 8-147) to determine if pressure transmitter is defective.
Replace defective pressure transmitter (paragraph 8-152).

8-149. Removal — Torque Pressure Indicator. Refer to paragraph 8-5 for removal procedure.

8-150. Repair or Replacement — Torque Pressure Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-151. Installation — Torque Pressure Indicator. Refer to paragraph 8-7 for installation procedure.

8-152. TORQUE PRESSURE TRANSMITTER.

8-153. Description — Torque Pressure Transmitter. The torque pressure transmitter, mounted on a bracket on the right side of the engine, monitors engine output shaft torque and transmits varying voltage signals to the torque pressure indicator (paragraph 8-143).

8-154. Cleaning — Torque Pressure Transmitter. **a.** Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Remove oil, grease, fungus, and dirt with a clean lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connector with a bristle brush (C32).

8-155. Inspection — Torque Pressure Transmitter. **a.** Inspect pressure transmitter for cracks, secure and proper mounting, and proper operation.

b. Inspect oil line and fitting connection for leaks and proper installation.

c. Inspect electrical connector for damaged or bent pins and cracked inserts.

8-156. Functional Test — Torque Pressure Transmitter. Refer to paragraph 8-147 for functional test; procedures are the same.

8-157. Troubleshooting — Torque Pressure Transmitter. Refer to paragraph 8-148 for troubleshooting; procedures are the same.

8-158. Removal — Torque Pressure Transmitter. a. Open upper right engine cowling.

b. Disconnect electrical connector and oil line from pressure transmitter.

c. Cap openings of oil line and protect electrical connector with electrical tape (C118).

d. Cut lockwire, remove mounting screws and washers, and remove pressure transmitter from mounting bracket.

8-159. Repair or Replacement — Torque Pressure Transmitter. a. Repair damaged electrical connector.

b. Tighten loose oil line or fitting connection.

c. Replace defective or damaged oil line or fitting.

d. Replace pressure transmitter if cracked or damaged.

e. Reinstall pressure transmitter.

8-160. Installation - Torque Pressure Transmitter. a. Position pressure transmitter on bracket and install mounting screws and washers. Install lockwire (C126.1).

b. Remove protective covers and connect oil line and electrical connector to pressure transmitter. Install cowling.

SECTION III — FLIGHT INSTRUMENTS

8-161. FLIGHT INSTRUMENTS.

8-162. Description — Flight Instruments. Flight instruments include the pitot-static system, airspeed indicator, altimeter, attitude indicating system, turn and slip indicator, and vertical velocity indicator.

8-163. PITOT-STATIC SYSTEM.

NOTE

Except for use of the system drain, a functional test of the pitot static system and pitot static instruments will be performed following any opening and closing of the pitot static system.

8-164. Description—Pitot Static System. The pitot tube, which has a heating element for icing conditions, is located on top right hand side of cabin roof. Static air pressure vents are incorporated into pitot head, with piping to altimeters, vertical velocity indicators, and airspeed indicators (figure 8-1).

8-165. Cleaning — Pitot-Static System. a. Pitot-Static Lines, Tubing, and Fittings.

(1) Disconnect pitot and static lines from airspeed indicators. Disconnect static lines from altimeters and vertical velocity indicators. Cap openings in indicators to prevent entrance of foreign material.

(2) Remove drain cap(s) and blow all lines clean with filtered, compressed air.

(3) Uncap openings in instruments. Apply silicone compound (C195) to threads of nuts and fittings and reconnect all lines.

(4) Install drain cap(s).

(5) Perform functional tests (paragraph 8-218.1).

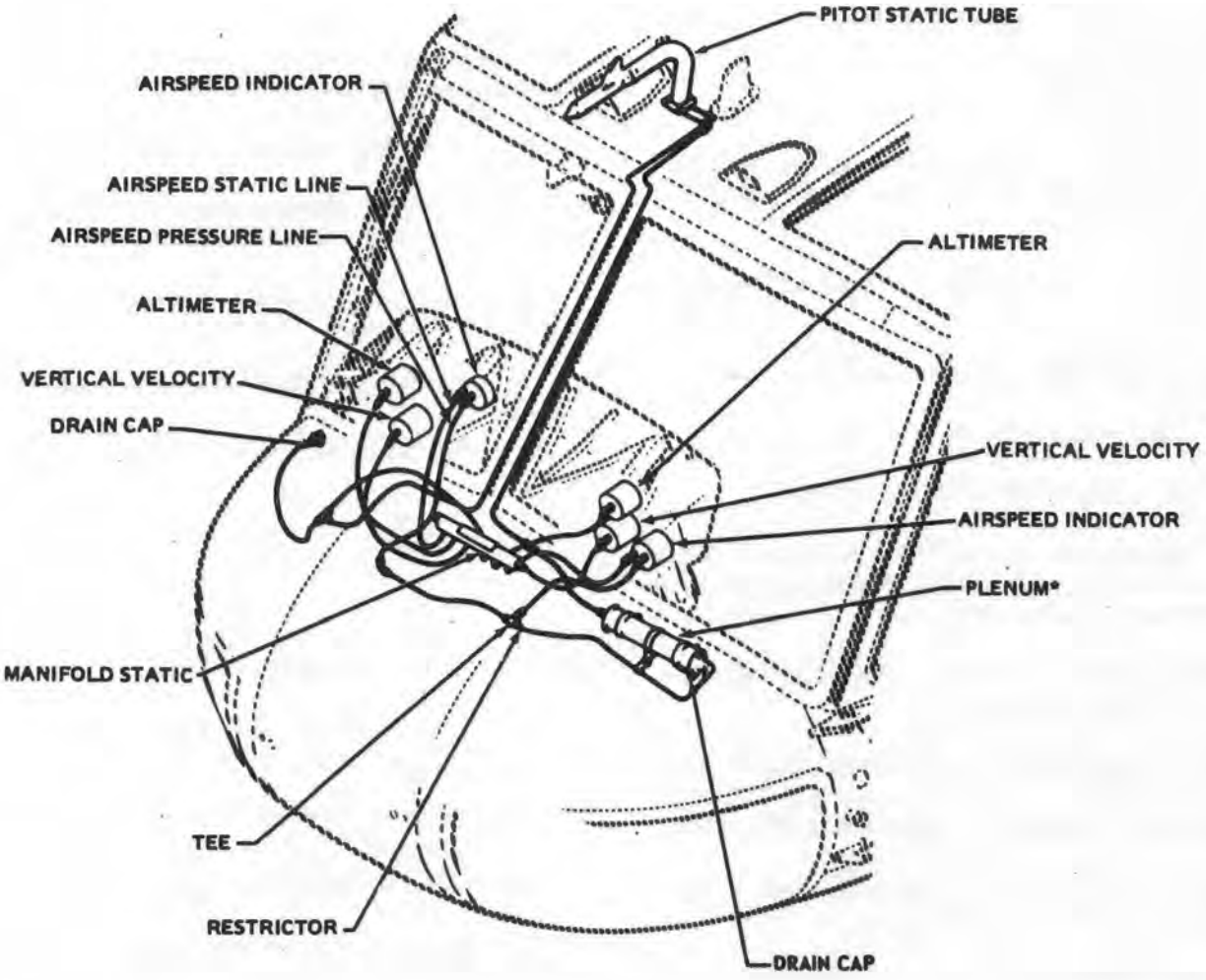
b. Pitot Tube.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(1) Clean pitot tube head with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

(2) Clean mount with a clean, lint-free cloth dampened with dry cleaning solvent (C205).



* INSTALLED ON HELICOPTERS 66-602 AND SUBSEQUENT

204072-1003A

Figure 8-1. Pitot-static system

8-166. Inspection — Pitot-Static System. a. Pitot-Static Lines, Tubing, and Fittings.

(1) Inspect lines, tubing, and fittings for leaks, chafing, crimping, or other visible damage.

(2) Inspect system for improperly installed fittings and clamps.

b. Pitot Tube.

(1) Inspect pitot tube for clogged or obstructed inlet opening, and clogged drain hole on bottom of tube.

(2) Inspect pitot tube for cracks or damage.

(3) If pitot tube head is removed, inspect electrical receptacle, pins, and sockets for damage.

c. Operational Check.

(1) Close PITOT HTR circuit breaker.

(2) Position PITOT HTR switch (S9) to ON and check that pitot tube heating element is energized. Return switch (S9) to OFF.

8-167. Functional Test — Pitot-Static System. (Refer to paragraph 8-218.1.)

8-168. Troubleshooting — Pitot-Static System. Refer to applicable portions of tables 8-9, 8-10, 8-13 and perform checks as necessary to isolate trouble.

8-169. Removal — Pitot-Static System. a. Pitot-Static Lines, Tubing, and Fittings.

(1) Disconnect pitot and static lines from indicators. Cap openings in indicators to prevent entrance of foreign material.

(2) Disconnect applicable fittings and clamps.

(3) Remove pitot and static lines.

b. Pitot Tube.

(1) Check that system electrical power is OFF.

(2) Gain access to roof mounted pitot tube through overhead console.

(3) From inside the helicopter, remove the clamps securing the pitot line and pitot heater electrical wires.

(4) Disconnect tube assembly and install protective caps on open ends of fittings.

(5) From outside the helicopter, remove the screws and lockwashers attaching pitot tube head to support.

(6) Carefully pull pitot tube from support to expose electrical connector and pitot line coupling. Disconnect electrical connector. Disconnect coupling from adapter. Cap open adapter and tape electrical connector to prevent entrance of foreign material.

8-170. Repair or Replacement — Pitot-Static System. a. Pitot-Static Lines, Tubing, and Fittings.

(1) Replace defective or damaged pitot and static lines or tubing.

(2) Tighten or properly install fittings and clamps.

(3) Replace defective or damaged fittings or clamps.

b. Pitot Tube.

(1) Replace pitot tube if; inlet opening is clogged or obstructed, drain hole is clogged, or electrical connector is damaged.

(2) Replace pitot tube if cracked or damaged to the extent it would restrict impact air pressure.

(3) Replace defective or damaged pitot electrical connector.

(4) Tighten or properly install fittings.

8-171. Installation — Pitot-Static System. a. Pitot-Static Lines, Tubing, and Fittings.

(1) Route pitot and static lines in place through clamps. Apply silicone compound (C195) to threads of nuts and fittings and connect all lines.

(2) Apply silicone compound (C195) to threads of tubing nuts and fittings. Position tubing in place and connect. Install clamps.

(3) Perform functional tests (paragraph 8-218.1.)

b. Pitot Tube.

(1) At pitot tube support, remove protective cap from adapter and remove tape from electrical connector.

(2) Apply silicone compound (C195) to threads of coupling.

(3) Connect pitot line coupling to adapter.

(4) Connect electrical connector to pitot tube connector.

(5) Carefully position pitot tube into support and install mounting screws and lockwashers. Apply sealant (C188) around edges on pitot tube mounting surface.

(6) From inside helicopter, remove protective caps from fittings. Apply silicone compound (C195) to threads of nuts and fittings, and connect.

(7) Install pitot line clamp and electrical clamp.

8-172. AIRSPEED INDICATOR.

8-173. Description — Airspeed Indicator. The airspeed indicator, located on the instrument panel, is a standard pitot-static instrument. The single-scale indicator provides airspeed indication in knots by measuring differences between impact air pressure from the pitot tube and atmospheric pressure from the pitot tube static pressure port.

8-174. Cleaning — Airspeed Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-175. Inspection — Airspeed Indicator. Refer to paragraph 8-4 for inspection procedure.

8-176. Functional Test — Airspeed Indicator. (Refer to paragraph 8-218.1.)

8-177. Troubleshooting — Airspeed Indicator. Use table 8-9 and perform checks as necessary to isolate trouble. (See figure 8-1.)

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-9. Troubleshooting — Airspeed Indicator

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Pointer fails to respond.
STEP 1. Determine if pitot or static lines are improperly connected or disconnected (paragraph 8-166).
Connect line(s).
2. Pointer indicates incorrectly.
STEP 1. Determine if lines clogged by water or dirt.
Open drain(s), disconnect and blow lines clear (paragraph 8-165).
STEP 2. Perform functional test (paragraph 8-218.1.)
Replace defective indicator or lines (paragraphs 8-5 and 8-7).

8-178. Removal — Airspeed Indicator. Refer to paragraph 8-5 for removal procedure.

8-179. Repair or Replacement — Airspeed Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-180. Installation — Airspeed Indicator. Refer to paragraph 8-7 for installation procedure.

8-181. ALTIMETER.

8-182. Description — Altimeter. The altimeter, located on the instrument panel, furnishes direct readings of helicopter height in feet above sea level. The altimeter is connected through piping to the pitot tube static pressure port to sense atmospheric pressure. An external adjustment knob is provided to make compensation for variations of prevailing barometric pressure. AIMS altimeters require a minimum of one minute warm up before checking and setting.

8-183. Cleaning — Altimeter. Refer to paragraph 8-3 for cleaning procedure.

8-184. Inspection — Altimeter. Refer to paragraph 8-4 for inspection procedure.

8-185. Functional Test — Altimeter. (Refer to paragraph 218.1.)

8-186. Troubleshooting — Altimeter. Use table 8-10 and perform checks as necessary to isolate trouble. (See figure 8-1.)

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-10. Troubleshooting — Altimeter

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
1. Pointer fails to respond.
STEP 1. Determine if static lines are improperly connected or disconnected (paragraph 8-166).
Connect line(s).
2. Pointer indicates incorrectly.
STEP 1. Determine if lines are clogged by water or dirt.
Open drain(s), disconnect and blow lines clear (paragraph 8-166).
STEP 2. Perform functional test (paragraph 8-218.1.)
Replace defective indicator or lines (paragraphs 8-5 and 8-7).

8-187. Removal — Altimeter. Refer to paragraph 8-5 for removal procedure.

8-188. Repair or Replacement — Altimeter. Refer to paragraph 8-6 for repair or replacement criteria.

8-189. Installation — Altimeter. Refer to paragraph 8-7 for installation procedure.

NOTE

When installing AIMS altimeter, ensure that spacer is installed with the thickest section at the bottom to prevent chafing.

8-190. ATTITUDE INDICATING SYSTEM.

8-191. Description — Attitude Indicating System. The attitude indicating system includes the pilot and copilot attitude indicators, roll and pitch gyro, and rate switching gyro. The system is powered from the 115 Vac bus and pilot and copilot indicators are each protected by two 1 ampere circuit breakers. Refer to TM 11-1520-211 series maintenance manuals for information and procedures pertaining to the roll and pitch gyro, and rate switching gyro.

8-192. ATTITUDE INDICATORS.

8-193. Description — Attitude Indicators. The pilot and copilot attitude indicators, mounted in the instrument panel, display flight attitude of the helicopter relative to the earth. Pitch attitude is indicated by motion of the sphere with respect to the miniature airplane. Roll attitude is indicated by motion of the roll pointer with respect to the fixed roll scale located at the top of the display. The indicator sphere can be adjusted to zero indication by the pitch trim knob and roll trim knob. The copilot attitude indicator contains a PULL TO CAGE knob to cage and release the self-contained gyro. The power OFF flag is energized (out of view) by a connection to the power supply. Any interruption of indicator power will indicate a failure and the flag will be exposed.

8-194. Cleaning — Attitude Indicators. Refer to paragraph 8-3 for cleaning procedure.

8-195. Inspection — Attitude Indicators. Refer to paragraph 8-4 for inspection procedure.

8-196. Functional Test — Attitude Indicators. a. Attitude Indicator (Type 4005).

(1) Energize main inverter and close both PILOT ATTD circuit breakers. Check that OFF flag (power warning) disappears within one minute, and that the display erects properly and remains stable in both pitch and roll.

(2) Rotate roll trim knob (on upper right side of indicator) to its clockwise limit. Check that an **8 TO 20** degree left bank is indicated.

(3) Rotate roll trim knob to its counterclockwise limit. Check that an **8 TO 20** degree right bank is indicated, and return roll trim knob to zero trim.

(4) Rotate pitch trim knob (on lower right side of indicator) to its counterclockwise limit. Check that deflection of the horizon line is a minimum of **8** degrees upward.

(5) Rotate pitch trim knob to its clockwise limit. Check that deflection of the horizon line is a minimum of **16** degrees downward. Return pitch trim knob to zero trim.

(6) Turn main inverter off, and, after a few seconds delay, turn spare inverter on. Check that display remains properly erected, and that pitch and bank axes remain stable. Open PILOT ATTD circuit breakers and turn spare inverter off.

b. Attitude Indicator (Type J-8).

(1) Turn main inverter on. Close COPILOT ATTD circuit breakers. Check that OFF flag (power warning) disappears, and, after 15 seconds, pull out and then release the PULL TO CAGE knob. The gyro should cage and release, settling to a proper display in both pitch and roll.

(2) Rotate pitch trim knob to its clockwise limit. Check that deflection of the miniature airplane is approximately **15** degrees downward.

(3) Rotate pitch trim knob to its counterclockwise limit. Check that deflection of the miniature airplane is approximately **10** degrees upward. Return pitch trim knob to zero trim.

(4) Turn main inverter off and open COPILOT ATTD circuit breakers.

8-197. Troubleshooting — Attitude Indicators. Use table 8-11 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-11. Troubleshooting — Attitude Indicators.

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Indicator does not operate.
STEP 1. Conduct continuity test of circuit to determine if wiring is defective.
Repair or replace defective wiring.
STEP 2. Determine if indicator is defective.
Replace defective indicator (paragraphs 8-5 and 8-7).

8-198. Removal — Attitude Indicators. Refer to paragraph 8-5 for removal procedure.

8-199. Repair or Replacement — Attitude Indicators. Refer to paragraph 8-6 for repair or replacement criteria.

8-200. Installation — Attitude Indicators. Refer to paragraph 8-7 for installation procedure.

8-201. TURN AND SLIP INDICATOR.

8-202. Description — Turn and Slip Indicator. The turn and slip indicator, located on the instrument panel, is controlled by an electrically actuated gyro. This instrument has a needle (turn indicator) and a ball (slip indicator). Although the needle and ball are combined in one instrument and are normally read and interpreted together, each has its own specific function, and operates independently of the other. The ball indicates when the helicopter is in directional balance, either in a turn or in straight and level flight. If the helicopter is yawing or slipping, the ball will be off center. The needle indicates in which direction and at what rate the helicopter is turning.

8-203. Cleaning — Turn and Slip Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-204. Inspection — Turn and Slip Indicator. Refer to paragraph 8-4 for inspection procedure.

8-205. Functional Test — Turn and Slip Indicator.
a. Close TURN & SLIP IND circuit breaker.

b. Check that indicator gyro is running.

8-206. Troubleshooting — Turn and Slip Indicator. Use table 8-12 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-12. Troubleshooting — Turn and Slip Indicator

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Pointer remains centered, either constantly or intermittently.	STEP 1. Determine if gyro is sticking.	**Replace defective indicator (paragraphs 8-5 and 8-7).**
2. Ball too sensitive.	STEP 1. Determine if damping fluid has leaked out of indicator.	**Replace defective indicator (paragraphs 8-5 and 8-7).**
	STEP 2. Conduct continuity test of circuit to determine if wiring is defective.	**Replace defective wiring or connectors.**

8-207. Removal — Turn and Slip Indicator. Refer to paragraph 8-5 for removal procedure.

8-208. Repair or Replacement — Turn and Slip Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-209. Installation — Turn and Slip Indicator. Refer to paragraph 8-7 for installation procedure.

8-210. VERTICAL VELOCITY INDICATOR.

8-211. Description — Vertical Velocity Indicator. The vertical velocity indicator is connected to the static air system to sense the rate of atmospheric pressure change. The indicator registers ascent or descent in feet.

8-212. Cleaning — Vertical Velocity Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-213. Inspection — Vertical Velocity Indicator. Refer to paragraph 8-4 for inspection procedure.

8-214. Functional Test — Vertical Velocity Indicator. (Refer to paragraph 8-218.1.)

8-215. Troubleshooting — Vertical Velocity Indicator. Use table 8-13 and perform checks as necessary to isolate trouble. (See figure 8-1.)

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-13. Troubleshooting — Vertical Velocity Indicator

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
1. Inaccurate readings.
STEP 1. Determine if indicator is defective.
Replace defective indicator (paragraphs 8-5 and 8-7).
STEP 2. Check for loose connections in static line (paragraph 8-166).
Tighten connections.
STEP 3. Determine if indicator case leaks.
Replace indicator if case leaks (paragraphs 8-5 and 8-7).
2. Indicator pointer off zero.
STEP1. Determine if mechanism has shifted.
Tap face of indicator lightly while turning adjustment knob and returning pointer to zero.
3. Excessive indicator pointer oscillation.
STEP 1. Determine if there is a leak in the static lines (paragraph 8-166).
Tighten connections and/or replace lines.
STEP 2. Determine if indicator is defective.
Replace defective indicator (paragraphs 8-5 and 8-7).

8-216. Removal — Vertical Velocity Indicator. Refer to paragraph 8-5 for removal procedure.

8-217. Repair or Replacement — Vertical Velocity Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-218. Installation — Vertical Velocity Indicator. Refer to paragraph 8-7 for installation procedure.

8-218.1 Functional Test — Pitot Static System.

WARNING

Do not turn selector valves or disconnect hoses unless instruments read zero.
Do not operate rate of climb indicator over 3000 feet per minute ascending or descending.

CAUTION

Do not apply suction to pitot lines. Do not apply pressure to static lines. The only exception is when specifically required in a procedure.

When operating pressure side (airspeed indicator) make sure vacuum UP and DOWN valves are open. When operating vacuum side (altimeter, rate of climb indicator) make sure PRESSURE UP and DOWN valves are open.

NOTE

Before starting any checks, make sure all connections are secure and system drain caps are installed.

a. Pitot Line Leak Check (figure 8-1.1).

(1) Seal pitot head drain holes (on bottom of head) with pressure sensitive tape (C217.1). Attach hose assembly to pitot head.

(2) Position PRESSURE selector to AIRSPEED, and VACUUM selector to ALTIMETER/RATE OF CLIMB.

(3) Connect hose assembly from pitot head to AIRSPEED outlet (rear of tester). Make sure both VACUUM UP and DOWN valves are open and PRESSURE UP and DOWN valves are closed. Slowly open PRESSURE UP valve until airspeed indicators read approximately 120 knots.

(4) Gently tap airspeed indicators to remove friction effects. If indicator drops more than 8.7 knots in one minute, a leak is present. Close PRESSURE UP valve until tester airspeed indicator reads zero.

(5) Troubleshoot to determine source of leak and repair as necessary. Repeat above steps until airspeed drop is 8.7 knots or less.

b. Airspeed Indicator Functional Test.

(1) Make sure VACUUM UP and DOWN valves are opened and PRESSURE UP and DOWN valves are closed. Slowly open PRESSURE UP valve until tester airspeed indicator reads 40 knots.

(2) Gently tap aircraft indicators to remove friction effects. Continue opening PRESSURE UP valve in increments so that indicators read airspeeds shown in table 8-13.1.

(3) Slowly close PRESSURE UP valve until test unit indicator reads zero. If readings are not within tolerances shown in table 8-13.1, replace indicator with serviceable unit and repeat above steps.

c. Static Line Leak Check (figure 8-1.2.)

(1) Connect hose assembly to pitot head as shown on figure 8-1.2.

CAUTION

Connecting pitot head to RATE OF CLIMB/ALTIMETER outlet is done during static line leak check to prevent damage to the airspeed indicator diaphragm.

(2) Connect hose assembly from pitot head to RATE OF CLIMB/ALTIMETER outlet.

(3) Cover all static ports with tape (C217.1).

(4) Adjust test unit and aircraft altimeter barometric scales to read 29.92. Gently tap altimeter bodies and check to see if aircraft altimeters read the same as test unit altimeters and calibration data (on top of tester) within the tolerance given in table 8-13.2.

(5) If aircraft altimeter(s) do not read the same as the test altimeter (within the tolerance given in table 8-13.2), replace the aircraft altimeter(s) with servicable unit(s) and repeat step (4).

(6) Make sure PRESSURE UP and DOWN valves are open. Make sure VACUUM UP and DOWN valves are closed. Slowly open VACUUM UP valve until the aircraft altimeters read 1000 feet above reading established in step (3).

(7) Close VACUUM UP valve and gently tap both aircraft altimeters until rate of climb indicator stabilizes at zero. After stabilization, the altimeters should not drop more than 100 feet in one minute. Slowly open VACUUM DOWN valve until rate of climb stabilizes at zero. Repair any faults (if necessary) and repeat this step until altitude drop is less than 100 feet.

d. Vertical Velocity indicator Functional Test.

(1) Connect hose assembly to pitot head as shown in figure 8-1.2.

(2) Cover all static ports with tape (C217.1).

(3) Make sure both PRESSURE UP and DOWN valves are open. Close VACUUM UP and DOWN valves. Slowly open VACUUM UP valve until vertical velocity indicator starts to move. As altimeter starts to read attitudes listed in table 8-13.3, check to see if rate of ascent is within tolerance. After rate stabilizes, gently tap the indicator body to remove any mechanical friction, and compare the readings to the test unit calibration data (on top of test unit). Record the readings and close VACUUM UP valve.

(4) Slowly open VACUUM DOWN valve until desired rate of descent is reached. After rate stabilizes, gently tap the instrument body to remove any mechanical friction and compare the readings to the test unit calibration data. Record the readings and close VACUUM UP valve.

(5) Replace vertical velocity indicator(s) that exceed tolerances listed in table 8-13.3.

Table 8-13.1 Airspeed Indicator Tolerance (± Knots)

Airspeed Check Points (Knots)	MS28045 10 to 150 Knots	MS28021 20 to 250 Knots	MS28046 40 to 400 Knots
40	3	5	4
60	3	3	3
80	3	3	3
100	3	4	3
120	3	4	3
140	3	5	4
160		5	4

Table 8-13.2 Altimeter Scale Error

Altitude (Feet)	Tolerance ± Feet
0	70
500	70
1000	70
2000	70
3000	70
5000	100
10000	130
15000	140

Table 8-13.3 Vertical Velocity Tolerance Scale Accuracy

Standard Altitude Check Interval (Feet)	Check Rate Ascent or Descent (fpm)	Tolerance Scale Error (fpm)
2000 to 2500	500	± 100
2000 to 2500	1000	± 200
2000 to 4000	2000	± 300
2000 to 5000	3000	± 300
15,000 to 17,000	2000	± 300

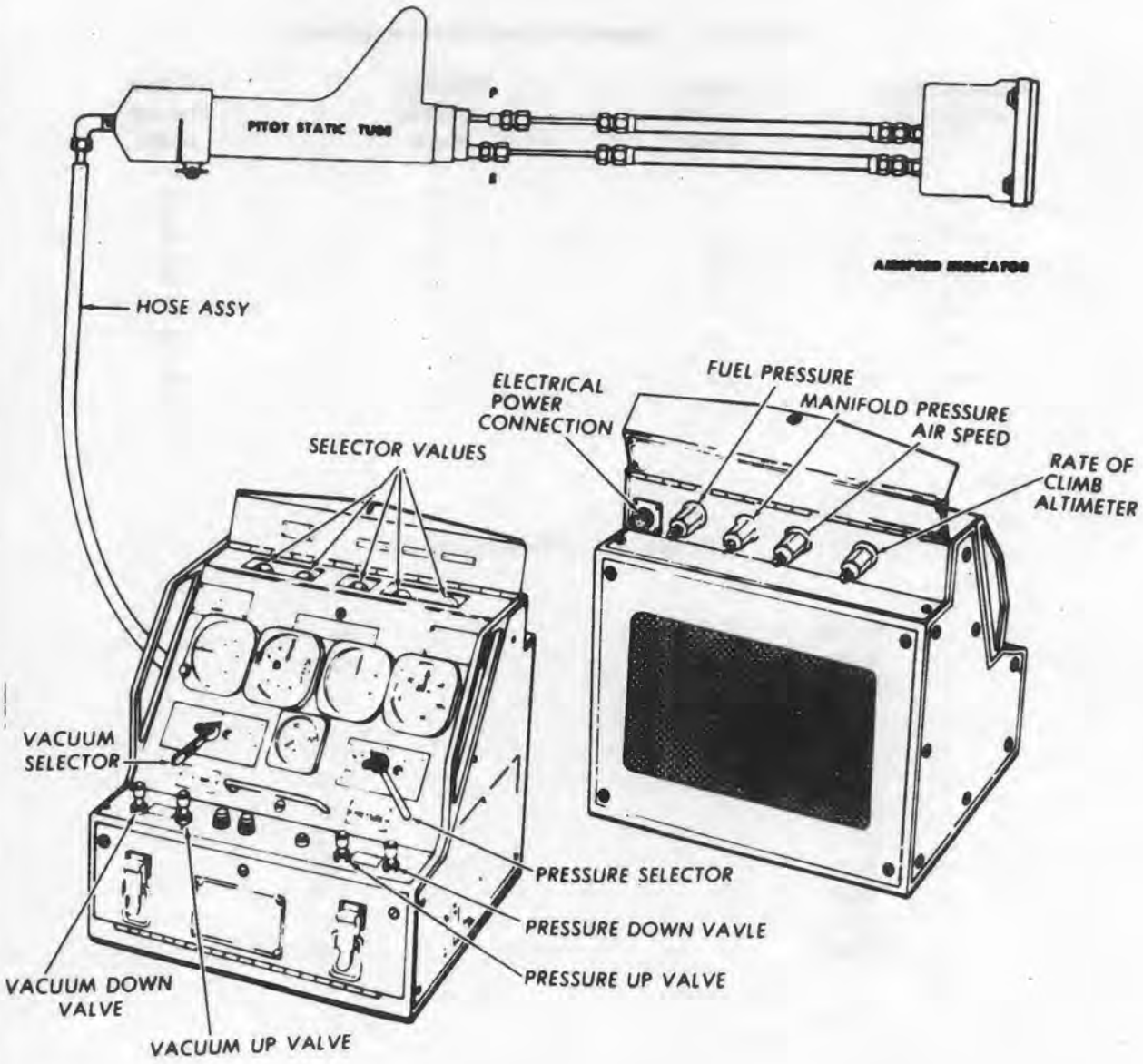


Figure 8-1.1. Connection for Pitot Leak Check (Typical)

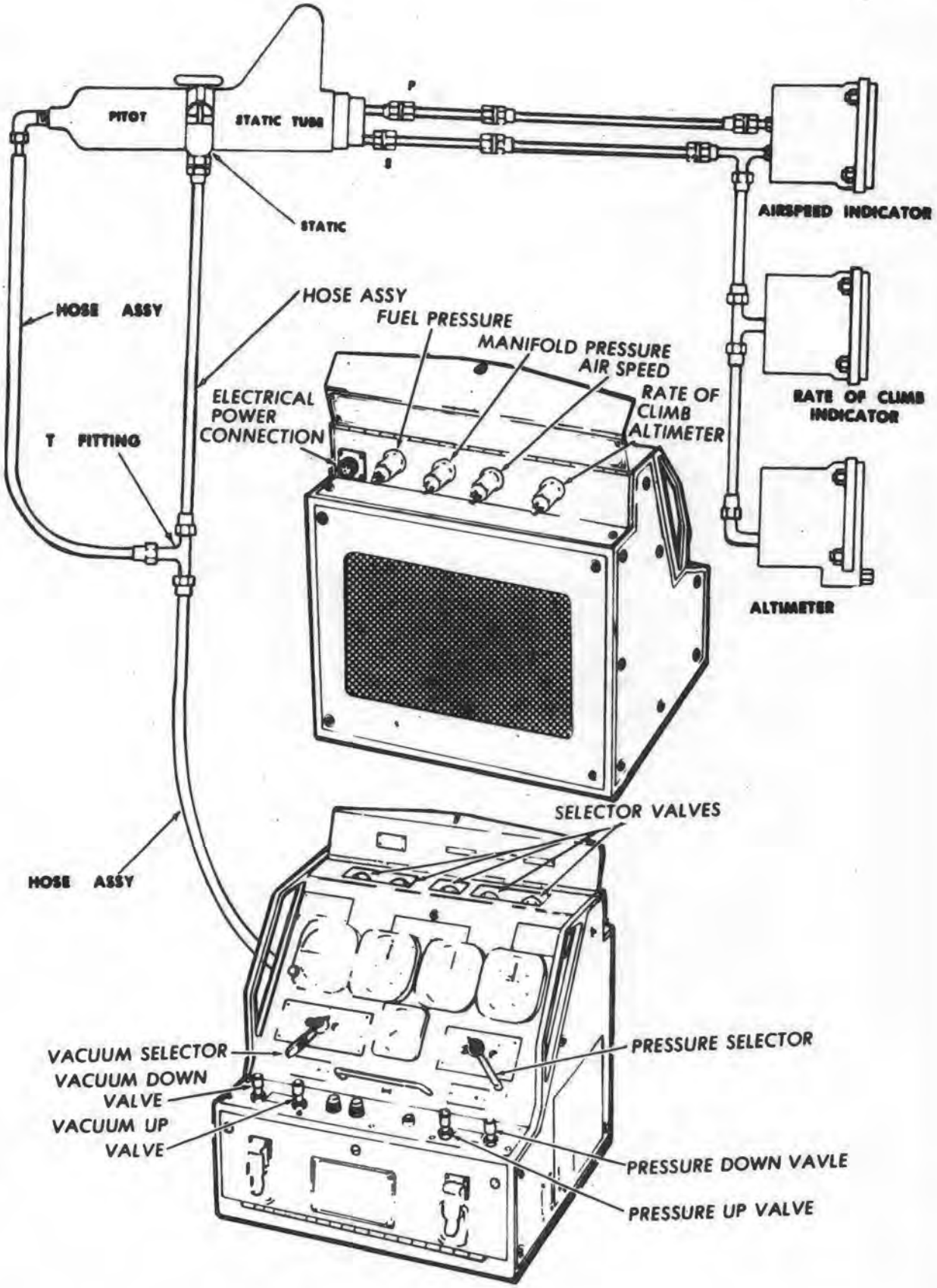


Figure 8-1.2. Connections for Static Leak Check (Typical)

SECTION IV — NAVIGATION INSTRUMENTS

8-219. NAVIGATION INSTRUMENTS.

8-220. Description — Navigation Instruments. Navigation instruments include the course indicator, bearing heading indicator, and standby compass.

8-221. COURSE INDICATOR (ID-453( )/ARN).

8-222. Description — Course Indicator (ID-453( )/ARN). The course indicator provides visual indication of the position of the helicopter in relation to a VOR station being received. The vertical pointer provides fly right, fly left, and on station indications. The horizontal pointer indicates passage over the station and signal strength. Two power OFF flags (vertical and horizontal) come into view when power is interrupted or unreliably weak. The power OFF flags disappear from view under normal operating conditions. Refer to TM 11-1520-211-20 for description, operational check, troubleshooting, and maintenance of system components. Refer to paragraph 8-3 through 8-7 for instrument maintenance.

8-223. RADIO MAGNETIC INDICATORS (ID-998( )/ASN AND ID-250( )/ARN).

8-224. Description — Radio Magnetic Indicators (ID-998( )/ASN and ID-250( )/ARN). The pilot ID-998( )/ASN and copilot ID-250( )/ARN RMI indicators are dual pointer, moving dial type indicators. The ID-250( )/ARN is a repeater type indicator driven by the ID-998( )/ASN indicator. The compass dial on each indicator rotates under the fixed index reference mark to indicate compass heading information from the gyromagnetic compass system Type J-2. Pointer number one of each indicator displays radio magnetic bearing information received from the direction finder set AN/ARN-59(V). Pointer number two displays omni magnetic bearing from the VOR system. Refer to TM 11-1520-211-20 for description, operational check, troubleshooting, and maintenance of system components. Refer to paragraphs 8-3 through 8-7 for instrument maintenance.

8-225. STANDBY COMPASS.

8-226. Description — Standby Compass. The standby compass, of standard magnetic type, is provided for navigational use. This instrument is to be used with the compass correction card which is located adjacent to the compass. Refer to paragraphs 8-3 through 8-7 for maintenance procedures.

8-227. Troubleshooting — Standby Compass. Use table 8-14 and perform checks as necessary to isolate trouble.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-14. Troubleshooting — Standby Compass

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Excessive card error.	STEP 1. Check for external magnetic interference.	**Locate magnetic interference and eliminate if possible.**
	STEP 2. Check for air or insufficient liquid in bowl.	**Replace standby compass (paragraphs 8-5 and 8-7).**

Table 8-14. Troubleshooting — Standby Compass (Cont)

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
STEP 3. Determine if compass is improperly compensated. **Accomplish compass compensation procedure (paragraph 8-228).**
2. Card element not level. STEP 1. Check for leaking float chamber. **Replace standby compass (paragraphs 8-5 and 8-7).**
3. Card has sluggish rotation. STEP 1. Determine if pivots or jewels are dirty and restricting rotation or card magnet is weak. **Replace standby compass (paragraphs 8-5 and 8-7).**

8-228. Compensation — Standby Compass. The standby magnetic compass may be calibrated concurrently with the gyromagnetic compass system. Refer to TM 11-1520-211 series maintenance manuals. Refer to TM 55-1500-204-25/1 for standard compass compensation procedure.

SECTION V — MISCELLANEOUS INSTRUMENTS

8-229. MISCELLANEOUS INSTRUMENTS.

8-230. Description — Miscellaneous Instruments. The miscellaneous instruments include the clock, fuel quantity indicating system, transmission oil pressure indicating system, transmission oil temperature indicating system, ac voltmeter, dc voltmeter, dc loadmeter, and free air temperature gage.

8-231. CLOCK.

8-232. Description — Clock. The clock, located on the instrument panel, is an 8-day clock with added stopwatch feature for elapsed time. The clock has a sweep-second pointer and a minute totalizer hand to indicate elapsed time. A control knob on the upper right corner of the case starts the pointers when pressed, stops both pointers when pressed a second time, and returns pointers to 12 o'clock when pressed a third time. A separate control knob, located at the lower left corner of the clock face, winds and sets the clock.

8-233. Cleaning — Clock. Refer to paragraph 8-3 for cleaning procedure.

8-234. Inspection — Clock. Refer to paragraph 8-4 for inspection procedure.

8-235. Functional Test — Clock. Check that control knob on the case starts the pointers when pressed, stops both pointers when pressed a second time, and returns both pointers to 12 o'clock when pressed a third time.

8-236. Troubleshooting — Clock. Use table 8-15 and perform checks as necessary to isolate trouble.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-15. Troubleshooting Clock

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. Clock does not run.	
STEP 1. Determine if clock needs winding.	**Wind clock if needed.**
STEP 2. Determine if clock is defective.	**Replace clock if defective (paragraphs 8-5 and 8-7).**
2. Clock does not keep accurate time.	
STEP 1. Determine if clock is out of adjustment.	**Adjust clock to run faster or slower as needed.**
STEP 2. Determine if clock is defective.	**Replace clock if defective (paragraphs 8-5 and 8-7).**
3. Pointers do not start, stop, or return when control knob is pressed through three time cycles.	
STEP 1. Determine if control knob, pointer(s), or instrument is defective.	**Replace clock if defective (paragraphs 8-5 and 8-7).**

8-237. Adjustment — Clock. Remove clock from instrument panel. Adjustment is on back of clock which adjusts clock to run faster or slower.

8-238. Removal — Clock. Refer to paragraph 8-5 for removal procedure.

8-239. Repair or Replacement — Clock. Refer to paragraph 8-6 for repair or replacement criteria.

8-240. Installation — Clock. Refer to paragraph 8-7 for installation procedure.

8-241. FUEL QUANTITY INDICATING SYSTEM.

8-242. Description — Fuel Quantity Indicating System. The fuel quantity indicating system is a bridge capacitance, balance type system which includes a fuel quantity indicator, located on the instrument panel, and one fuel quantity transmitter, located in the left fuel cell. The system is powered from the 115 Vac bus, and is protected by a one ampere FUEL QTY circuit breaker. Pressing the FUEL QUANTITY TEST SWITCH, located on the pilot instrument panel, checks the fuel quantity indicator for zero return.

8-243. FUEL QUANTITY INDICATOR.

8-244. Description — Fuel Quantity Indicator. The fuel quantity indicator provides readings of fuel supply in tank system. The indicator is connected to capacitor-type probes and requires 115 Vac power source.

8-245. Cleaning — Fuel Quantity Indicator. Refer to paragraph 8-3 for cleaning procedures.

8-246. Inspection — Fuel Quantity Indicator. Refer to paragraph 8-4 for inspection procedure.

8-247. Troubleshooting — Fuel Quantity Indicator. Use table 8-16 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

The following troubleshooting table covers both crashworthy and noncrashworthy fuel systems.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-16. Troubleshooting Fuel Quantity Indicator

CONDITION TEST OR INSPECTION	**CORRECTIVE ACTION**
1. Fuel quantity indicator reads low.	
STEP 1. Determine if fuel quantity system is out of adjustment.	**Perform adjustment procedure (paragraph 8-249).**
STEP 2. Determine if compensator capacitance is too high.	**Replace tank unit (paragraphs 8-254 and 8-257).**
STEP 3. Determine if tank unit capacitance is low.	**Replace tank unit (paragraphs 8-254 and 8-257).**
2. Fuel quantity indicator reads high.	
STEP 1. Determine if fuel quantity system is out of adjustment.	**Perform adjustment procedure (paragraph 8-249).**
STEP 2. Determine if tank unit capacitance is too high.	**Replace tank unit (paragraphs 8-254 and 8-257).**
STEP 3. Check for open lead on compensator circuit.	**Repair wiring as necessary.**
STEP 4. Check for open circuit in compensator section of tank unit.	**Replace tank unit (paragraphs 8-254 and 8-257).**

Table 8-16. Troubleshooting Fuel Quantity Indicator (Cont)

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
3. Fuel quantity indicator remains at one point on scale.
STEP 1. Ensure that **115 Vac, 400 Hz** power is available and determine if indicator is defective. **Replace indicator if defective (paragraphs 8-5 and 8-7).**
STEP 2. Check for grounded coaxial lead. **Repair or replace wiring as necessary.**
STEP 3. Determine if 400 Hz lead is grounded. (Prolonged existence of this condition will burn out fire hazard resistor in indicator.) **Repair wiring and/or replace indicator (paragraphs 8-5 and 8-7).**
4. Fuel quantity indicator remains at zero or below.
STEP 1. Check for open wiring. **Repair wiring.**
5. Indicator operation is sluggish.
STEP 1. Check wiring and tank unit for low insulation resistance of the circuit. **Replace or repair wiring or replace tank unit (paragraphs 8-254 and 8-257).**

8-248. Removal — Fuel Quantity Indicator. Refer to paragraph 8-5 for removal procedure.

8-249. Bench Test — Fuel Quantity (AVIM). Proceed with the following steps.

a. Capacitance Test.

(1) Using Testor (T68), measure the capacitance between the coaxial and compensator Lo Z terminals.

(2) When measuring the capacitance between the coaxial and 400 Hertz terminal, ground the compensator to Lo Z terminal.

(3) Also, when measuring the capacitance between coaxial and compensator Lo Z terminals, ground the 400 Hertz terminal.

(4) The tank unit capacitance should be as shown below. (Figure 8-2.)

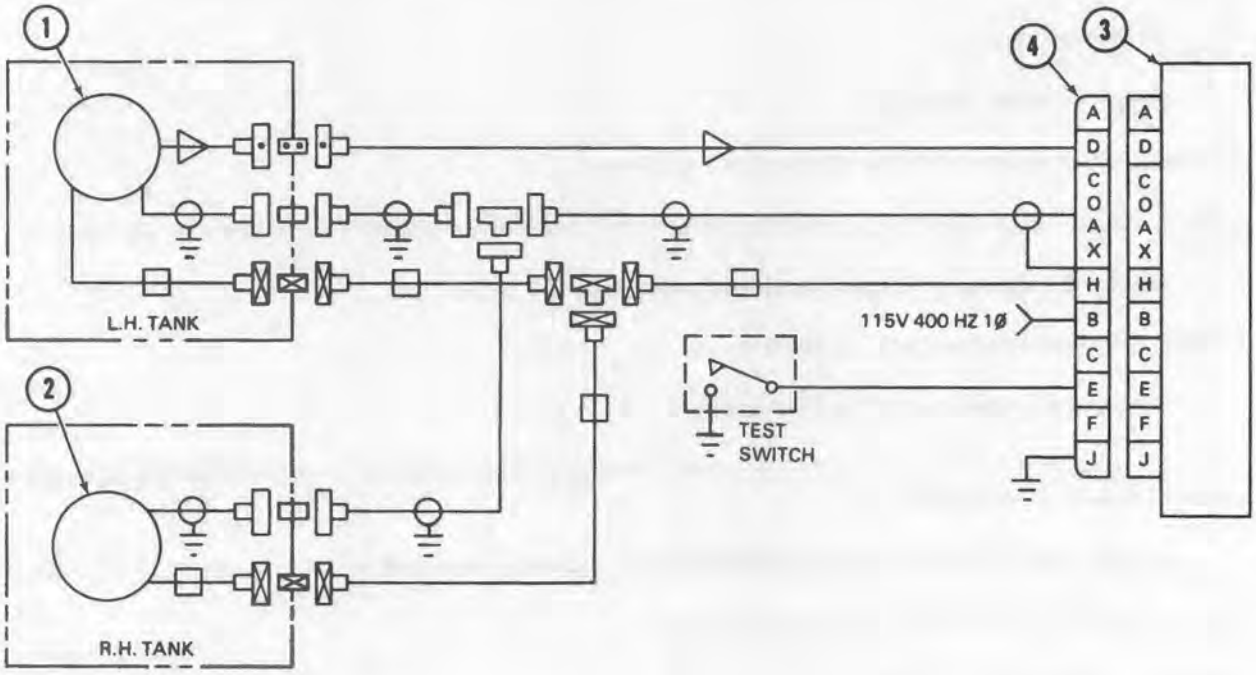
Tank Unit	Capacitance (pf)
Circuit	112.1 ± 0.5
(Compensator)	25.0 ± 1.9

NOTE

Tolerance of measuring equipment must be taken into consideration in making all capacitance measurements.

b. Test Indicator Amplifier Bridge Assembly.

(1) Set up test circuit (Figure 8-3.)



NOTES:

1. **All wiring to be #20 unshielded unless otherwise specified.**
2. **Total power requirements 115V, 400 HZ 1Ø, 3.5 watts, PF = 1.0.**

	PART NAME	PART NUMBER	REQ
1	Tank unit	204-060-683-1	1
2	Tank unit	204-060-683-3	1
3	Indicator	393004-01970	1
4	Plug (amphenol)	165-61	1
	Test switch	AN3021-11	1
	400 HZ Feed thru (dage)	1-891-1	1
	400 HZ Feed thru (dage)	1-892-1	2
	Coax feed thru	1-890-1	2
	400 HZ Tee	1-708-1	1
	Coax tee	1-711-1	1
	400 HZ Plug	1-728-1	1
	400 HZ Plug	1-916-1	5
	Coax plug (dage)	1-817-1	5
	Comp lead (surprenant)	SA-KF728A	As Req
	400 HZ Lead (suprenant)	SA-KF728A	As Req
	Coax cable (suprenant)	X-12109	As Req

Figure 8-2. Schematic diagram — fuel quantity installation

NOTE

The adjustment controls require 40 complete turns to travel from end to end. Also no stops are incorporated so that when control runs off end of winding, indicator pointer will jump; continuous rotation in same direction will result in pointer returning to its correct position.

(2) Set capacitance of **112.1** pf on tank unit section of tester and **50.7** pf on compensator section. Adjust EMPTY control so that pointer reads **zero**.

(3) For crashworthy, set tank unit section of tester to **226.6** pf and leave compensator section set at **50.7** pf. Adjust FULL control until pointer reads **1450** pounds.

(4) For non-crashworthy, set tank unit section of tester to **240.7** pf and leave compensator section set at **50.7** pf. Adjust FULL control until pointer reads **1750** pounds.

(5) With compensator section set at **50.7** pf, vary tank unit section of tester so that pointer reads at graduations shown. Capacitance must be as shown opposite indicator reading.

Indicator Reading (LBS)	Capacitance (pf)
0	112.1 ± 0.0
200	126.8 ± 1.0
400	141.5 ± 1.0
600	156.2 ± 1.0
800	170.9 ± 1.0
1000	185.6 ± 1.0
1200	200.3 ± 1.0
1400	215.0 ± 1.0
1450	226.6 ± 1.0
1600	*229.7 ± 1.0
1750	*240.7 ± 1.0

*Non-crashworthy only.

NOTE

In the following step the indicator should travel from 1750 to 0 pounds for non-crashworthy in 30 seconds or 1450 to 0 pounds for crashworthy in 25 seconds and return to original position in the same amount of time when test switch is released.

(6) Adjust tester so that indicator is upscale. Close test switch. Indicator should go to **zero**. Release test switch. Pointer should go back to its original position.

c. Insulation Test. After a tank unit has been replaced, it is recommended the insulation resistance of the circuits be tested. Using a three-wire insulation resistance tester, make the following insulation resistance tests at the Amphenol connector disconnected from the indicator:

(1) Between compensator (Pin D) and ground (Pin J) - not less than **3** megohms.

(2) Between coaxial and ground - not less than **3** megohms.

(3) Between 400 Hertz (Pin H) and ground - not less than **3** megohms.

(4) Between coaxial and 400 Hertz (Pin H) — not less than **700** megohms.

(5) Between coaxial and compensator (Pin D) — not less than **800** megohms.

(6) Between 400 Hertz (Pin H) and compensator (Pin D) - not less than **10** megohms.

d. Adjustment Procedure. (Preferred Method.) (Empty Tanks.)

NOTE

Does not account for some differences in tank units.

(1) See that all connecting cables and units have been installed properly, connections are tight and the requirements of paragraph c. above are met.

(2) Make sure all tanks are empty and turn on power.

(3) Turn EMPTY control until indicator reads exactly **zero**.

(4) Connect Testor (T68), in parallel with helicopter wiring. (See figure 8-4.)

(5) Set compensator section of tester to **25.7** pf and the tank unit section to **115.7** pf for crashworthy (**128.6** pf for non-crashworthy).

(6) Adjust FULL control on indicator to cause pointer to read at last dial division (**1463** pounds for crashworthy and **1750** pounds for non-crashworthy).

NOTE

When tank is filled to bottom of filler port, indicator should read approximately 1574 pounds. This will occur when the tank unit section is set to 115.7 pf.

(7) Disconnect adapter cable and reconnect helicopter wiring to indicator.

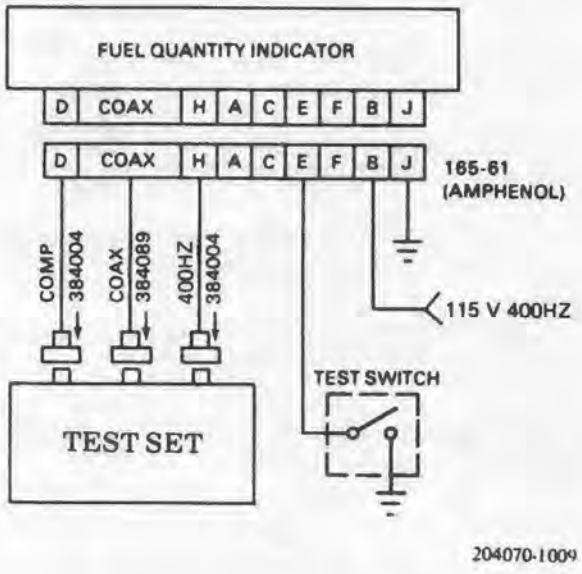


Figure 8-3. Indicator bench test circuit

e. Adjustment Procedures (Alternate Method) Fuel in Tanks.

NOTE

Does not account for any tolerance or difference in tank units or wiring.

(1) Disconnect the Amphenol connector at the indicator and insert the adapter cable. (See figure 8-4.) Connect Testor (T68) and leave cables marked 1, 2, and 3 disconnected.

(2) Set the compensator section of the tester on **50.7** pf and the tank unit section to **112.1** pf. Adjust EMPTY control on the indicator to cause pointer to read **zero**.

(3) Leave compensator section set at **50.7** pf and set tank unit section to **227.8** pf for crashworthy (**240.7** pf for non-crashworthy). Adjust FULL control so that indicator pointer reads at last dial division (**1463** pounds for crashworthy and **1750** pounds for non-crashworthy).

f. Test Values.

(1) Tank Unit Empty Capacities Values.

Circuit	Capacitance (Pf)
Tank Unit (Dry)	112.1 ± 0.5
Compensator Section (Dry)	25.0 ± 1.9

(2) Added and Full Capacitance Values.

Capacitance (pf)		Indicator Readings
Added	Full	(Pounds)
128.6	240.7	1750 (Non-crashworthy)
115.7	226.6	1450 (Crashworthy)

(3) Tank Unit Resistance Check Values. Using the three wire insulation tester, or equivalent, measure from center of coaxial connector to center of 400 Hertz connector. Values should be not less than **700** megohms.

8-250. Repair or Replacement — Fuel Quantity Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-251. Installation — Fuel Quantity Indicator. Refer to paragraph 8-7 for installation procedure.

8-252. FUEL QUANTITY TRANSMITTER.

8-253. Description — Fuel Quantity Transmitter. One fuel quantity transmitter probe (tank unit) is installed in the left fuel cell. The probe acts as a sensor for the fuel quantity indicator (paragraph 8-243).

NOTE

If fuel quantity system is found inaccurate when checked with known

quantity of fuel and further investigation reveals a defective fuel quantity gage tank unit, the fuel cells shall be thoroughly cleaned.

8-254. Removal — Fuel Quantity Transmitters. a. Defuel helicopter (paragraph 1-4).

b. Remove fuel cell (paragraph 10-15.)

c. Disconnect grounding jumper of fuel quantity gage tank unit from support clip screw on outlet fitting.

d. Detach transmitter unit from upper and lower spring clips. Remove unit through top cell door.

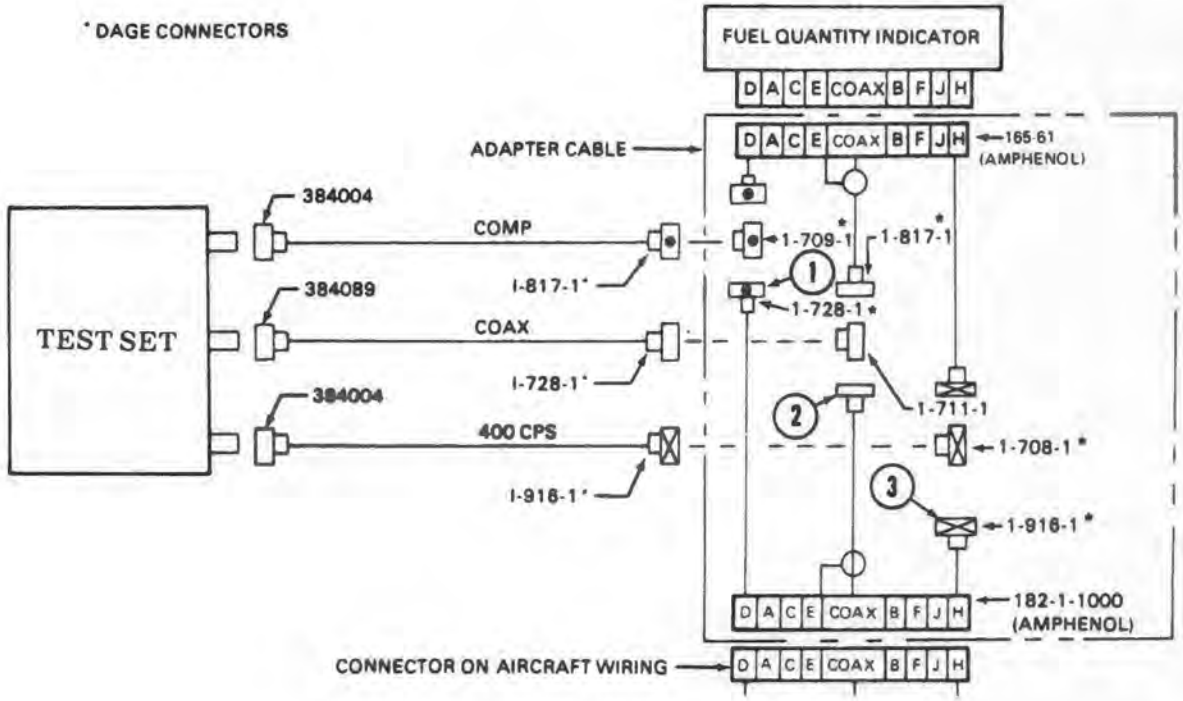


Figure 8-4. Circuit arrangement and adapter cable for adjustment procedures

8-255. Inspection — Fuel Quantity Transmitter. a. Inspect transmitter for security, corrosion, and cracks.

b. Inspect electrical leads for damage.

8-256. Repair or Replacement — Fuel Quantity Transmitter. a. Reinstall improperly mounted transmitter.

b. Replace transmitter if cracked or damaged.

8-257. Installation — Fuel Quantity Transmitter. a. Place fuel quantity gage tank unit, with connector leads at top, in cell through door opening.

b. Engage tank unit in lower support clip.

c. Connect bonding jumper on one screw of upper support clip.

d. Lockwire (C126.1) screw heads together.

e. Secure tank unit in upper clip.

f. Install fuel cell door. (paragraph 10-20).

8-258. TRANSMISSION OIL PRESSURE INDICATING SYSTEM.

8-259. Description — Transmission Oil Pressure Indicating System. The transmission oil pressure indicating system consists of the transmission oil pressure transmitter (paragraph 8-269) and indicator (paragraph 8-260).

8-260. TRANSMISSION OIL PRESSURE INDICATOR.

8-261. Description — Transmission Oil Pressure Indicator. The transmission oil pressure indicator provides continuous readings in psi by means of an electrical transmitter (paragraph 8-269) mounted directly into an oil manifold located on right side of transmission case. Electrical circuit is operated by 28 Vac power.

8-262. Cleaning — Transmission Oil Pressure Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-263. Inspection — Transmission Oil Pressure Indicator. Refer to paragraph 8-4 for inspection procedure.

8-264. Functional Test — Transmission Oil Pressure Indicator. Refer to paragraph 8-64, except, close PRESSURE XMSN circuit breaker.

8-265. Troubleshooting — Transmission Oil Pressure Indicator. Refer to paragraph 8-65 for troubleshooting; procedures are the same.

8-266. Removal — Transmission Oil Pressure Indicator. Refer to paragraph 8-5 for removal procedure.

8-267. Repair or Replacement — Transmission Oil Pressure Indicator. Refer to paragraph 8-6 for repair or replacement criteria.

8-268. Installation - Transmission Oil Pressure Indicator. Align transmission oil pressure indicator so that **50** psi is at 9 o'clock position. Refer to paragraph 8-7 for installation procedure.

8-269. TRANSMISSION OIL PRESSURE TRANSMITTER.

8-270. Description — Transmission Oil Pressure Transmitter. The transmission oil pressure transmitter, located on the right side of the transmission, monitors transmission oil pressure and transmits voltage signals to the transmission oil pressure indicator.

8-271. Cleaning — Transmission Oil Pressure Transmitter. Refer to paragraph 8-71 for cleaning; procedures are the same.

8-272. Inspection — Transmission Oil Pressure Transmitter. Refer to paragraph 8-72 for inspection; procedures are the same.

8-273. Functional Test — Transmission Oil Pressure Transmitter. Refer to paragraph 8-73 for functional test; procedures are the same.

8-274. Troubleshooting — Transmission Oil Pressure Transmitter. Refer to paragraph 8-65 for troubleshooting; procedures are the same.

8-275. Removal — Transmission Oil Pressure Transmitter. Refer to paragraph 8-75 for removal; procedures are the same.

8-276. Repair and Replacement — Transmission Oil Pressure Transmitter. Refer to paragraph 8-76 for repair and replacement; criteria is the same.

8-277. Installation — Transmission Oil Pressure Transmitter. Refer to paragraph 8-77 for installation; procedures are the same.

8-278. TRANSMISSION OIL TEMPERATURE INDICATING SYSTEM.

8-279. Description — Transmission Oil Temperature Indicating System. The transmission oil temperature indicating system consists of the transmission oil temperature indicator and an electrical resistance type temperature bulb. The system is powered from the 28 Vdc essential bus, and is protected by a 5 ampere TEMP IND ENG & XMSN circuit breaker.

8-280. TRANSMISSION OIL TEMPERATURE INDICATOR.

8-281. Description — Transmission Oil Temperature Indicator. The transmission oil temperature indicator, located on the instrument panel, indicates transmission oil temperature in degrees Celsius by means of an electrical resistance type temperature bulb.

8-282. Cleaning — Transmission Oil Temperature Indicator. Refer to paragraph 8-3 for cleaning procedure.

8-283. Inspection — Transmission Oil Temperature Indicator. Refer to paragraph 8-4 for inspection procedure.

8-284. Functional and Bench Test — Transmission Oil Temperature Indicator. Refer to paragraphs 8-84 and 8-88 for functional and bench test; procedures are the same.

8-285. Troubleshooting — Transmission Oil Temperature Indicator. Refer to paragraph 8-85 for troubleshooting; procedures are the same.

8-286. Removal — Transmission Oil Temperature Indicator. Refer to paragraph 8-5 for removal procedure.

8-287. Repair and Replacement — Transmission Oil Temperature Indicator. Refer to paragraph 8-6 for repair and replacement criteria.

8-288. Installation - Transmission Oil Temperature Indicator. Align transmission oil temperature indicator so that **75**°C is at 9'clock position. Refer to paragraph 8-7 for installation procedure.

8-289. TRANSMISSION OIL TEMPERATURE BULB.

8-290. Description — Transmission Oil Temperature Bulb. The transmission oil temperature bulb, installed in the transmission oil manifold, monitors transmission oil temperatures which cause a resistance change that provides a voltage variation signal condition in the transmission oil temperature indicator.

8-291. Cleaning — Transmission Oil Temperature Bulb. Refer to paragraph 8-92 for cleaning; procedures are the same.

8-292. Inspection — Transmission Oil Temperature Bulb. Refer to paragraph 8-93 for inspection; procedures are the same.

8-293. Troubleshooting — Transmission Oil Temperature Bulb. Refer to paragraph 8-85 for troubleshooting; procedures are the same.

8-294. Removal — Transmission Oil Temperature Bulb. Refer to paragraph 8-95 for removal; procedures are the same.

8-295. Repair and Replacement — Transmission Oil Temperature Bulb. Refer to paragraph 8-96 for repair and replacement; criteria is the same.

8-296. Bench Test — Transmission Oil Temperature Bulb. Refer to paragraph 8-97 for bench test; procedures are the same.

8-297. Installation — Transmission Oil Temperature Bulb. Refer to paragraph 8-98 for installation; procedures are the same.

8-298. AC VOLTMETER.

8-299. Description — AC Voltmeter. The ac voltmeter indicates voltage of the main or spare inverter for AB, AC, or BC phases, according to position of VM selector switch on ac power panel in overhead console. The ac voltmeter is functionally tested as part of the Alternating Current Power Distribution System (paragraph 9-95). Refer to paragraphs 8-3 through 8-7 for maintenance procedures.

8-300. DC VOLTMETER.

8-301. Description — DC Voltmeter. A dc voltmeter is provided to indicate the voltage of the main generator, standby generator, essential bus, nonessential bus, or battery. These sources are selected by the VM selector on the dc power panel in the overhead console. The dc voltmeter is functionally tested as part of the Direct Current Power Distribution System (paragraphs 9-28 and 9-29). Refer to paragraphs 8-3 through 8-7 for maintenance procedures.

8-302. Troubleshooting — DC Voltmeter. Use table 8-17 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-17. Troubleshooting — DC Voltmeter

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. No reading or erratic reading on dc voltmeter.	STEP 1. Check for open or short circuit in voltmeter.	**Replace voltmeter if defective (paragraphs 8-5 and 8-7).**

Table 8-17. Troubleshooting — DC Voltmeter (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
STEP 2. Determine if mechanism in instrument is worn or dirty.	**Replace voltmeter if defective (paragraph 8-1).**

8-303. LOADMETER.

8-304. Description — Loadmeter. Two dc loadmeters are provided for main and standby dc generators to indicate output or load of each generator as a percent of total capacity. The dc loadmeter is functionally tested as a part of Direct Current Distribution System (paragraphs 9-56 and 9-57). Refer to paragraphs 8-3 through 8-7 for maintenance procedures.

8-305. FREE AIR TEMPERATURE GAGE.

8-306. Description — Free Air Temperature Gage. The free air temperature gage is a bimetallic, probe type thermometer mounted on the upper left side of the pilot windshield. The probe portion is exposed to outside temperature through a rubber grommet mounted on the skin of the helicopter. The indicator is calibrated in degrees Celsius.

8-307. Cleaning — Free Air Temperature Gage. Refer to paragraph 8-3 for cleaning procedure.

8-308. Inspection — Free Air Temperature Gage.

a. Inspect assembly for corrosion.

b. Inspect for discoloration.

c. Inspect for leaking seal.

d. Check for proper temperature indication.

8-309. Functional Test - Free Air Temperature Gage. Refer to TM 55-1500-204-25/1.

8-310. Troubleshooting — Free Air Temperature Gage. Use table 8-18 and perform necessary checks to isolate trouble. Refer to TM 55-1500-204-25/1.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 8-18. Troubleshooting — Free Air Temperature Gage

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. Gage indicating upscale of range.	
STEP 1. Check for missing or improperly installed sunshield.	**Install missing or reinstall improperly mounted sunshield.**
STEP 2. Determine if gage is defective.	**Replace gage if defective (paragraphs 8-5 and 8-7).**

Table 8-18. Troubleshooting — Free Air Temperature Gage (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
2. Gage indicating downscale of range.	STEP 1. Determine if gage is defective.	**Replace gage if defective (paragraphs 8-5 and 8-7).**

8-311. Removal — Free Air Temperature Gage. a. Unscrew and remove sunshield, dished washer, and one case washer from outer end of thermometer.

b. Remove thermometer and other case washer from inside of pilot compartment.

8-312. Repair or Replacement — Free Air Temperature Gage. Replace gage if any of the inspection requirements are not met (paragraph 8-6).

8-313. Installation — Free Air Temperature Gage. a. Hold washers and thermometer case in position at mounting flange.

b. Insert probe through grommet and mounting flange.

c. Place sunshield over thermometer probe and tighten.

d. Apply sealant (C188) around nut and washer (outside of cabin), fair and smooth sealant.

SECTION VI — INSTRUMENT PANELS

8-314. INSTRUMENT PANELS.

8-315. Description — Instrument Panels. The instrument panel is mounted on the top forward section of the pedestal and contains all instruments for the pilot and copilot. Instrument panel vibration may be eliminated or minimized by adjusting the tube and brace assemblies provided for this purpose. The tube assemblies are attached to the helicopter structure by means of a pin, washers, and cotter pin. They are equipped with a clevis and check nut for adjustment. The brace assemblies are attached to the pedestal and may be adjusted by turnbuckles incorporated in the brace assemblies.

8-316. Cleaning — Instrument Panels. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

8-317. Inspection — Instrument Panels. a. Visually inspect panels for surface scratches, warpage, cracks, and loose mounting screws.

b. Inspect compass correction cards, placards, and decals for legibility.

c. Inspect shock mounts and vibration dampers for sagging, deterioration, cracks, and permanent set.

d. Inspect rheostats and switches for missing and loose knobs.

8-318. Removal — Instrument Panels. a. Ensure all electrical power is off.

b. Disconnect all electrical connectors and hoses from instruments.

c. Cover all receptacles and hoses to prevent entrance of foreign particles.

d. Cover openings on instruments.

e. Remove pin, washers, and cotter pin securing each tube assembly.

f. Remove instrument panel from helicopter.

8-319. Repair or Replacement — Instrument Panels. a. Repair cracks. (Refer to TM 55-1500-204-25/1.)

b. Replace shock mount if warped.

c. Replace loose or worn mounting screws.

8-320. Installation — Instrument Panels. a. Ensure all electrical power is off.

b. Install shock mounts if removed.

c. Position panel in place on console and install mounting hardware.

d. Connect electrical connectors to instruments.

e. Apply silicone compound (C195) to threads of pitot-static fittings.

f. Connect nylon fittings. Torque coupling nuts fingertight.

CHAPTER 9

ELECTRICAL SYSTEMS

SECTION I — DIRECT CURRENT POWER DISTRIBUTION SYSTEM

NOTE

Power loading charts and wiring diagrams are contained in Appendix F. Aviation Unit Maintenance activities shall request AVIM for electrical system repairs in accordance with the Maintenance Allocation Chart, Appendix B.

9-1. DIRECT CURRENT POWER DISTRIBUTION SYSTEM.

9-2. Description — Direct Current Power Distribution System. The direct current power distribution system provides all basic power for operation of electrical components installed in the helicopter and consists of the main and standby generators, battery, external power, and dc bus systems.

The primary electrical power is supplied by the transmission driven 30 volt, 300 ampere main generator (G2). In the event of main generator failure, emergency dc power is supplied by the engine driven, 30 volt, 300 ampere standby starter-generator (G6). If both generators fail, power is supplied by the 24 volt, 34 ampere/hour battery which also furnishes starting power.

Primary power is distributed by a dual-bus arrangement, so that nonessential dc loads are automatically de-energized in the event of main generator failure. A bus-reset feature is provided to permit reactivation of these loads at the pilots discretion.

9-3. COMMON ELECTRICAL COMPONENTS (DC).

9-4. Description — Common Electrical Components (DC). Common electrical components include the miscellaneous electrical components (paragraph 9-5), circuit breakers (paragraph 9-12), and control panels (paragraph 9-19).

9-5. MISCELLANEOUS ELECTRICAL COMPONENTS.

9-6. Description — Miscellaneous Electrical Components. Capacitors, diodes, leads and wiring, panel lights, connectors, relays, rheostats, shock mounts, shunts and bus bars, switches, terminal boards, and transistors are included in this catagory.

9-7. Cleaning — Miscellaneous Electrical Components (General). a. Remove moisture, dust, and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt from the equipment cases and mountings; use a cloth dampened (not wet) with dry cleaning solvent (C205).

9-8. Inspection — Miscellaneous Electrical Components. a. Inspect rheostats for security, corrosion, burned element, damaged wiper, cracks, and correct resistance.

b. Inspect switches for weak detents, security, corrosion, faulty operation, and continuity in ON position.

c. Inspect plugs, connectors and receptacles for security, contact corrosion, damaged contacts, broken wires, faulty contacts, insert cracks, and faulty insulation.

d. Inspect leads and wiring for loose terminals, chafing, corrosion or deteriorated condition, faulty or damaged insulation, excessive mechanical stress, broken strands, damaged shielding, shorted shielding, routing and mounting conditions.

e. Inspect conduits for security, surface damage, cracks, dents, corrosion, and deterioration.

f. Inspect shunts and bus bars for corrosion, security, deep scratches, physical damage, deformity, and discoloration (indicating excessive overloading).

g. Inspect shockmounts for binding, compression, retention, security, cracks, distortion, and corroded bonding.

h. Inspect relays for loose connections, damaged or broken contact pins or terminals, damage to case or insulation between contact pins, and evidence of corrosion, pits, or discoloration (indicating arcing due to loose connections, internal shorting, or excessive overload).

i. Inspect terminal boards for cracks, corrosion, security, and damaged threads.

j. Inspect panel lights for faulty bulbs, security, and corrosion.

k. Visually check capacitors for loose connections, security of mounting, seeping dielectric, and apparent damage.

l. Visually check diodes for loose connection and broken leads. Check suspected faulty diode front to back conductivity ratio with standard multimeter (T3).

m. Visually check transistor mount for security. Check suspected faulty transistor by multimeter (T3).

9-9. Removal — Miscellaneous Electrical Components.

NOTE

Before removing or adjusting any electrical component, disconnect battery.

a. Remove attaching hardware, clamps, connectors or conductors; identify connectors and/or conductors.

b. Remove component.

9-10. Repair or Replacement — Miscellaneous Electrical Components. a. Tighten loose terminal connectors, mounting and attachments of electrical components.

b. Replace miscellaneous electrical components that fail to meet inspection requirements.

9-11. Installation — Miscellaneous Electrical Components. a. Install component and secure with attaching hardware or clamps.

b. Attach identified terminals and/or connectors.

c. Non-mechanical lock AN type connectors (cannon plugs) that have lockwire provisions will be lockwired.

9-12. DC CIRCUIT BREAKERS.

9-13. Description — DC Circuit Breakers. The dc circuit breakers are mounted on the overhead console. Dc circuits can be opened or closed by operating these trip-free, push-pull circuit breakers.

9-14. Cleaning — DC Circuit Breakers (General). Refer to paragraph 9-7. Procedure is the same.

9-15. Inspection — DC Circuit Breakers. Inspect circuit breakers for reset retention, activation for circuit ON and power OFF, faulty operation, corrosion, and security.

9-16. Removal — DC Circuit Breakers. a. Ensure all electrical power is OFF. Disconnect battery.

b. Disconnect wiring to appropriate circuit breaker and cover wire ends with electrical tape.

c. Remove mounting hardware and lift circuit breaker from panel assembly.

9-17. Repair and Replacement — DC Circuit Breakers. a. Repair is limited to tightening or properly installing any loose or improperly installed mounting hardware and connectors.

b. Replace circuit breaker if any other inspection requirements are not met.

9-18. Installation — DC Circuit Breakers. a. Position circuit breaker in panel assembly and install mounting hardware.

b. Remove cover from wire ends and connect to circuit breaker.

9-19. CONTROL PANELS.

9-20. Description — Control Panels. The control panels on the overhead console are as follows: DOME LT-PITOT, EXT LTS, CABIN HEATING, MISC, DC POWER, INST LTG, and AC POWER. The control panels on the pedestal are as follows: ENGINE, FORCE TRIM-HYD CONTROL, and CAUTION.

9-21. Cleaning — Control Panels. Refer to paragraph 9-7. Procedure is the same.

9-22. Inspection — Control Panels. Visually inspect for scratches, chipped edges, faulty edge light panels and bulbs, broken edge light panels, damaged or faulty switches, loose or damaged wiring and connectors, and broken or missing mounting fasteners.

9-23. Removal — Control Panels.

NOTE

The removal procedures for all electrical control panels are relatively the same. A single removal procedure may be used for any electrical control panel.

a. Ensure all electrical power is OFF.

b. Disengage fasteners holding panel mounting.

c. Carefully lift panel from mount.

d. Disconnect electrical connector(s).

9-24. Repair and Replacement — Control Panels. **a.** Repair any scratches or chipped edge light panels.

b. Replace any burned out or defective bulbs on edge light panels.

c. Replace control panel if any other inspection requirements are not met.

9-25. Installation — Control Panels. **a.** Connect electrical connector(s).

b. Position panel in mount, being careful not to damage wiring. Engage fasteners.

c. Apply power and check components for proper operation.

9-26. BATTERY SYSTEM.

9-27. Description — Battery System. The battery system is comprised of the battery (BT2), battery relay (K9), and BAT switch (S40). The battery system is associated with the BATTERY VOLTMETER circuit breaker, VM switch (S2), dc voltmeter (M2), nonessential bus relay (K2) and NON-ESS BUS switch (S62). The battery also furnishes power for the XMSN OIL LEVEL LT (I25).

The battery circuit is activated by placing BAT SW (S40) to the ON position. Battery relay (K9) is energized and battery power is transferred through the contacts of battery relay (K9) to the main and essential dc buses.

The nonessential bus relay (K2) is energized when battery power is applied to the essential bus by placing the NON-ESS BUS switch (S62) to the MANUAL position. Battery power is then applied through the contacts of the nonessential bus relay to the nonessential bus.

The dc voltmeter (M2) monitors battery voltage when VM switch (S2) on DC POWER control panel (A1) is positioned to BAT and BATTERY VOLTMETER circuit breaker (CB6) is closed. The battery voltage applied to the essential or nonessential bus may be monitored by placing the VM switch (S2) to ESS BUS or NON-ESS BUS position.

9-28. Functional Test — Battery System. **a.** Before connecting the battery, check for correct polarity and tightness of the battery leads and terminals.

b. Open all circuit breakers and place all switches in the open position. Place NON-ESS BUS switches (S62) to NORMAL ON. Ensure that BAT switch (S40) is OFF. Connect battery.

c. Close BATTERY, MAIN GENERATOR, STANDBY GENERATOR, GEN & BUS RESET, and NON-ESS BUS voltmeter circuit breakers in the overhead console and electrical compartment.

NOTE

Unless otherwise specified, the voltmeter circuit breakers are to remain closed throughout the test.

d. Position VM switch (S2) to BAT and check that voltmeter indicates battery voltage.

e. Position VM switch (S2) to each remaining position. Voltmeter should indicate **zero** voltage.

f. Position VM switch (S2) to ESS BUS. Position BAT switch (S40) to ON. Check that voltmeter indicates battery voltage. Other positions, except BAT, should indicate **zero**.

g. Position NON-ESS BUS switch (S62) to MANUAL ON and check that voltmeter indicates

battery voltage for the NON ESS BUS, ESS BUS and BAT positions of the VM selector switch (S2). Return switches to normal.

h. Repeat steps e., f., and g. with the battery or 24 volt external power source connected to the power cables at the quick-disconnect in the aft battery location.

9-29. Troubleshooting — Battery System. Use Table 9-1 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-1. Troubleshooting — Battery System

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Dc voltmeter indicates zero volts with BATTERY VOLTMETER circuit breaker closed and VM switch in BAT position.	STEP 1. Ensure that battery is installed and power is available. Check that battery voltage is present on both sides of BATTERY VOLTMETER circuit breaker with a multimeter.	**If voltage is present on battery side but not present on dc voltmeter side of circuit breaker, replace circuit breaker (paragraphs 9-16 and 9-18).**
	STEP 2. Ensure that battery voltage is present at terminal 17 of VM switch (S2) and check for voltage on terminal 11.	**If voltage is present on terminal 17 but not present on terminal 11, replace VM switch (paragraphs 9-9 and 9-11).**
	STEP 3. Check for battery voltage across dc voltmeter (M2).	**If battery voltage is present, replace dc voltmeter (paragraph 8-5 and 8-7).**
2. DC voltmeter indicates zero volts with BAT switch (S40) ON, VM switch (S2) in ESS BUS, and GEN & BUS RESET circuit breaker closed. (Dc voltmeter indicates correct voltage with VM switch in BAT position.)	STEP 1. Check that battery voltage is present on 28 Vdc essential bus with a multimeter. (If voltage is not present on essential bus, continue with step 3.) Using a multimeter, determine if voltage is present across the GEN & BUS RESET circuit breaker.	**Replace the GEN & BUS RESET circuit breaker if defective (paragraph 9-16 and 9-18).**
	STEP 2. Ensure that essential bus voltage is present on terminal 14 of VM switch (S2) and check for voltage at terminal 11.	**Replace VM switch if voltage is not present at terminal 11 (paragraphs 9-9 and 9-11).**
	STEP 3. Check that BAT switch (S40) completes ground circuit in ON position.	**Replace BAT switch if defective (paragraphs 9-9 and 9-11).**

Table 9-1. Troubleshooting — Battery System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 4. When battery is installed and battery voltage is present on terminal A2 of battery relay (K9), determine if battery relay (K9) is actuated by checking for battery voltage at terminal A1. If relay is not actuated, determine that ground potential is present at terminal X2 and check for relay actuating voltage across terminals X1 and X2.

Replace relay if actuating voltage is present across terminals X1 and X2 and relay is not actuated (paragraphs 9-9 and 9-11).

3. Dc voltmeter indicates zero volts with BAT switch (S40) ON, VM switch (S2) in NON ESS BUS, NON-ESS BUS switch (S62) in MANUAL ON, and VOLTMETER NON ESS BUS circuit breaker closed. (Dc voltmeter indicates correct voltage in BAT and ESS BUS positions.)

STEP 1. Check for battery voltage at 28 Vdc nonessential bus and VOLTMETER NON ESS BUS circuit breaker. (If battery voltage is not present on 28 Vdc and nonessential bus, continue with step 3.)

Replace VOLTMETER NON ESS BUS circuit breaker if defective (paragraphs 9-9 and 9-11).

STEP 2. Ensure that nonessential bus voltage is present at terminal 13 of VM switch (S2) and check for voltage at terminal 11.

Replace VM switch if voltage is not present on terminal 11 (paragraphs 9-9 and 9-11).

STEP 3. With battery voltage from main bus present on terminal A1 of nonessential bus relay (K2), determine if nonessential bus relay is actuated by checking for battery voltage at terminal A2. If relay is not actuated, determine that ground potential is present at terminal X1 and check for actuating voltage across terminals X1 and X2.

Replace relay if activating voltage is present across terminals X1 and X2 and relay is not actuated (paragraphs 9-9 and 9-11).

STEP 4. Check for battery voltage on center contact of NON ESS BUS switch (S62).

Replace NON ESS BUS switch if defective (paragraphs 9-9 and 9-11).

4. Battery (BT 2) will not hold charge.

STEP 1. Determine if battery usage is too great.

Use external power source whenever possible.

STEP 2. Check for too low charging rate.

Adjust voltage regulator (paragraph 9-73).

STEP 3. Perform a visual inspection for broken cell partitions.

Replace battery if cell partition is broken (paragraphs 9-36 and 9-38).

Table 9-1. Troubleshooting — Battery System (Cont)

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
STEP 4. Determine if battery cells are unbalanced. **Refer to TM 11-6140-203-14-2 for servicing of battery.**
5. Battery life is short. STEP 1. Determine if electrolyte level is below top of plate. **Refer to TM 11-6140-203-14-2 for servicing of battery.**
6. Excessive loss of electrolyte. STEP 1. Determine if charging rate is too high. (If loss is in individual cells only, cell is faulty.) **Reduce charging rate; replace battery (paragraphs 9-36 and 9-38).** STEP 2. Inspect for cracked battery case. **Replace battery if battery case is defective (paragraphs 9-36 and 9-38).**
7. Battery terminals corroded. STEP 1. Check for excessive charging or discharging rate. **Clean terminals and adjust charging rate or load (paragraph 9-32).**
8. Polarity is reversed. STEP 1. Determine if battery connections are reversed. **Reverse wiring connections if necessary.**

9-30. BATTERY.

9-31. Description — Battery. The 24 volt, 34 ampere-hour, nickel cadmium type battery is located in the lower section of the electrical compartment on the left side of the helicopter. Two overflow or vent tubes extend from the battery to the underside of the fuselage.

The prime purpose for the battery is to start the engine at remote fields where external power is not available. The battery is not to be used to power the inverters because battery will be electrically depleted. After engine is started, the battery switch should remain ON until the battery is fully recharged by the main generator. Refer to TM 11-6140-203-14-2 for maintenance instructions other than removal or installation.

CAUTION

Remove battery to heated area if helicopter is to remain at outside tiedown for a prolonged period at -18° Celsius (0°F) or below.

9-32. Deleted.

9-33. Deleted.

9-34. Condition Check - Battery. On the helicopter, a charged battery can be determined only by moving the battery switch from ON to OFF and observing the effect on the generator loadmeter. If the change in indications is less than **5** amperes, the battery is considered adequately charged.

9-35. Deleted.

9-36. Removal - Battery.

WARNING

DANGEROUS CHEMICALS ARE USED IN NICKEL-CADMIUM BATTERIES

The electrolyte used in nickel-cadmium batteries contains potassium hydroxide (KOH), which is a caustic chemical agent. Serious and deep burns of body tissue will result if the electrolyte comes in contact with the eyes or any part of the body. Use rubber gloves, rubber apron, and protective eye covering when handling the battery. If accidental contact with the electrolyte is made, use ONLY clean water and immediately (seconds count) flush contaminated areas. Continue flushing with large quantities of clean water. Seek medical attention immediately. Before removing or installing the battery, insure that the battery switch is off and the battery has cooled down if overheated. Removal or installation of the battery connector while the battery is under load may result in explosion, electrical arcing, and possible severe burns to personnel.

CAUTION

Take every possible step to keep the nickel-cadmium battery as far away as possible from the lead-acid type of battery. Do not use the same tools and materials (screwdrivers, wrenches, gloves, apron, etc.) for both types of batteries. Anything associated with the lead-acid battery, even the air, must never come in contact with the nickel-cadmium battery or its electrolyte. Even a trace of sulphuric acid fumes from a lead-acid battery may result in damage to the nickel-cadmium battery. If sulphuric acid has been inadvertently mixed with the electrolyte in the battery, the upper areas of the cells will appear greenish in color. In such cases, the battery must be replaced.

a. Check that BAT switch is OFF, and external power is not applied. Open compartment door.

b. Disconnect battery cable connector by turning knob counterclockwise.

c. Disconnect two vent tubes from battery case.

d. Open tie-down clamps and disengage rods from battery cover. Lift battery from compartment.

e. Stow battery cable connector in dummy receptacle. Close compartment door.

9-37. Deleted.

9-38. Installation — Battery.

WARNING

DANGEROUS CHEMICALS ARE USED IN NICKEL-CADMIUM BATTERIES

The electrolyte used in nickel-cadmium batteries contains potassium hydroxide (KOH), which is a caustic chemical agent. Serious and deep burns of body tissue will result if the electrolyte comes in contact with the eyes or any part of the body. Use rubber gloves, rubber apron, and protective eye covering when handling the battery. If accidental contact with the electrolyte is made, use ONLY clean water and immediately (seconds count) flush contaminated areas. Continue flushing with large quantities of clean water.

Seek medical attention immediately. Before removing or installing the battery, insure that the battery switch is off and the battery has cooled down if overheated. Removal or installation of the battery connector while the battery is under load may result in explosion, electrical arcing, and possible severe burns to personnel.

CAUTION

Take every possible step to keep the nickel-cadmium battery as far away as possible from the lead-acid type of battery. Do not use the same tools and materials (screwdrivers, wrenches, gloves, apron, etc.) for both types of batteries. Anything associated with the lead-acid battery, even the air, must never come in contact with the nickel-cadmium battery or its electrolyte. Even a trace of sulphuric acid fumes from a lead-acid battery may result in damage to the nickel-cadmium battery. If sulphuric acid has been inadvertently mixed with the electrolyte in the battery, the upper areas of the cells will appear greenish in color. In such cases, the battery must be replaced.

CAUTION

Incorrect installation of the battery cover does not allow the rubber retainer strip to cover two center cell caps. Loosening of these caps and electrolyte-spillage may cause battery overheating and/or explosion.

NOTE

Insure battery area is clean before installing battery.

a. Place battery on shelf, aligned for connections. Engage tie-down rods to strap on cover. Secure and lockwire (C127).

b. Connect two vent tubes to battery case and tighten clamps.

c. Insert cable connector in battery receptacle and secure by turning knob clockwise.

d. Check that BATTERY VOLTMETER circuit breaker is closed and that voltmeter will show indication when BAT switch is ON. Return switch to OFF after test. Close compartment door.

NOTE

Replacement of the battery will require that the installed voltage regulators be adjusted by an electrician. This applies to both carbon-pile and the solid state voltage regulator.

e. Adjust voltage regulator (refer to TM 55-1500-204-25/1).

9-39. BATTERY RELAY.

9-40. Description — Battery Relay. Battery relay (K9) is mounted in the left side of the electrical compartment. The relay is an electrically operated switch between the battery and the main bus bar. It is controlled by BAT switch (S40) which opens or closes the circuit to the actuating coil of the relay. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-41. EXTERNAL POWER SYSTEM.

9-42. Description — External Power System. During ground operations, external power may be connected to the systems through an external power receptacle (J109), located on the aft left side of fuselage. No special action or switching is necessary to connect external power. If external power connections are of the correct polarity, the external power relay (K1), located in the aft electrical compartment, closes automatically, and connects the ground unit to the main power cables energizing the essential bus; if not, no action occurs. The nonessential bus is energized with NON-ESS BUS switch (S62) in either NORMAL or MANUAL position. All circuits in the helicopter, with exception of the overvoltage protection circuit, function the same on external power as on helicopter power. Helicopter circuits are not protected against overvoltage when operating on external power.

9-43. Functional Test — External Power System.

NOTE

Unless otherwise specified, the voltmeter circuit breakers are to remain closed throughout all operational checks. Except where otherwise specified, all operational checks shall utilize external power. All circuit breakers shall be opened before external power is connected to the helicopter.

a. Before connecting external power for the first time, check for correct polarity and terminations then accomplish following steps:

b. Apply 28 Vdc of reverse polarity between the small pin on the external power receptacle and the frame of the helicopter. Check that the external power relay (K1) does not close. Remove 28 Vdc reverse polarity.

c. Connect a 28 Vdc external power source to the helicopter external power receptacle (J109). Energize power source. Close GEN & BUS RESET circuit breaker. Dc voltmeter should indicate external power on the essential bus.

d. Place NON-ESS BUS switch (S62) in the NORMAL ON position. Place VM switch (S2) in NON-ESS BUS position. Voltmeter should indicate 28 Vdc on the nonessential bus. Repeat test with NON-ESS switch (S62) in MANUAL ON position. Voltmeter should indicate 28 Vdc on the nonessential bus.

9-44. Troubleshooting — External Power System. Use table 9-2 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers and burned-out indicator lamps are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-2. Troubleshooting — External Power System

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. Power not available when external power plug is inserted into connector (J109).	
STEP 1. Inspect for loose connection between external power plug and connector (J109).	**Reconnect external power plug if loose.**
STEP 2. Check for reversed polarity in external power plug.	**Reterminate at attachment points on APU if reversed.**
STEP 3. Check for low voltage from external power supply.	**Increase output of external power.**
STEP 4. Determine if external power relay (K1) is activated. If relay is not actuated, check that ground potential is present at terminal X1 of relay. Check that relay actuating voltage is present across terminals X1 and X2 of relay.	**Replace external power relay if relay actuating voltage is present but relay is not actuated (paragraph 9-9).**

9-45. EXTERNAL POWER RECEPTACLE.

9-46. Description — External Power Receptacle. The external power receptacle (J109) is mounted just below the aft electrical compartment access door and is covered by an access door. The receptacle provides for connection of an external power source to the helicopter.

NOTE

External power is not required but is recommended for starting the aircraft.

9-47. Cleaning — External Power Receptacle. Refer to paragraph 9-7 for cleaning procedure.

9-48. Inspection — External Power Receptacle. Refer to paragraph 9-8 for inspection procedure.

9-49. Removal — External Power Receptacle. a. Ensure that all electrical power is OFF.

b. Remove nuts and washers from terminal posts of receptacle and remove wires to receptacle. Cover wire ends with tape (C217.1).

c. Remove mounting screws and lift receptacle from bracket.

9-50. Repair or Replacement — External Power Receptacle. Refer to paragraph 9-10 for repair or replacement criteria.

9-51. Installation — External Power Receptacle. a. Position receptacle on bracket and install mounting screws.

b. Remove tape from wire ends and install on terminal posts of receptacle.

9-52. EXTERNAL POWER RELAY.

9-53. Description — External Power Relay. The external power relay (K1), installed in the aft electrical compartment, connects an external source of power through the external power receptacle to the electrical system of the helicopter. A diode (CR2), located near the relay, serves to complete ground return for the holding coil and prevents reverse polarity to the helicopter electrical system. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-54. GENERATOR AND DC BUS SYSTEM.

9-55. Description — Generator and DC Bus System. The dc bus system supplies regulated power for all dc electrical components of the helicopter. This system is fed by external power, battery (BT 2), main dc generator (G2), and standby starter-generator (G6).

The self-excited main generator (G2) normally supplies electrical power to the main bus when its output voltage is approximately 1/2 volt above that existing at the bus. Mechanical power is not supplied to the main generator until the engine starts driving the main rotor transmission. The voltage of the main generator at which it starts supplying power to bus system will vary according to the voltage applied to the main bus from other sources (other sources may be battery of approximately 24 volts, standby generator of approximately 26.5 volts, or external power supply of varying voltages). If no other voltage source is connected to the bus, the main generator will be connected to the main bus when its output is 22 to 24 volts with main generator switch on. The main generator reverse current relay (K5) automatically closes and opens the circuit between the generator and the main bus. The voltage regulator (VR1) provides for proper generator voltage output during normal operating speeds and loads. A field control relay (K7) operating in conjunction with the overvoltage relay (K6) protects the dc powered components on the helicopter from over-voltage from the main generator. The MAIN GEN switch (S8) on the dc power control panel provides manual control of the reverse current relay. A warning light is provided on the caution panel to indicate when the main generator reverse current relay is not closed. The warning light is provided with an electrical ground through the contacts of the bus control relay (K4). The main generator supplies power to the bus control relay coil through the IND terminal on the reverse current relay when it closes and connects the main generator to the main bus.

The standby generator (G6) develops voltage whenever it is being driven by the engine. The voltage regulator (VR2) in the standby system is adjusted so the voltage output of the standby generator is approximately one volt below that of the main generator normal output. A reverse current relay (K23) is also provided for the standby system. Control of the reverse current relay is provided for by the standby position of the starter-generator switch (S70) and the bus control relay (K4). During normal operation the main generator reverse current relay energizes the bus control relay when the main generator is connected to the bus. The bus control relay performs three functions: (1) Opens the circuit between the standby position of the starter-generator switch and the standby reverse current relay preventing the relay from automatically connecting the standby generator to the main bus. (2) Opens the circuit to the DC generator light, turning the caution light off. (3) Completes a circuit from the essential bus through the "normal on" position of the nonessential bus switch (S62) to the nonessential bus relay (K2), energizing the nonessential bus. If the main generator fails or is disconnected from the main bus by its reverse current relay for any reason the bus control relay also becomes de-energized to: (1) illuminate the DC generator caution light, (2) open the circuit to the nonessential bus relay, (3) de-energize the nonessential bus, (4) close the circuit between the

standby position of the starter-generator switch and the standby reverse current relay allowing the standby reverse current relay to connect the standby generator to the main bus. No over-voltage protection is provided for the standby system. A loadmeter (M1) is provided for measuring the system amperage load on the standby generator. On helicopters S/N 66-461 and subsequent, a standby generator field relay (K15) is provided.

The purpose of the standby generator field control relay is to open the standby generator's shunt field circuit whenever the coil is energized. Power is applied to the coil whenever the starter relay is energized by pressing the start switch. The shunt field circuit is completed through the relay when the start switch is released.

9-56. Functional Test — Generator and DC Bus System. a. Perform functional test of main generator circuitry as follows:

(1) Disconnect wires P13A4, P13B4 and P13C4 from positive terminal B, and disconnect wires P14A4, P14B4, and P14C4 from negative terminal E of main generator. Connect these wires to an adjustable 28 volt dc power source (26 to 33 Vdc), observing the proper polarity.

(2) Energize power source.

(3) Close GEN & BUS RESET, MAIN GENERATOR VM and CAUTION LIGHTS circuit breakers. There should be no voltage on the main bus in the electrical compartment. Check that dc voltmeter (M2) indicates voltage in the MAIN GEN position.

(4) Close MAIN GEN FIELD circuit breaker. Position MAIN GEN switch (S8) to ON. Reverse current relay (K5) should close and both essential and nonessential buses should be energized. Check that DC GENERATOR caution light is off.

(5) Momentarily turn on a load, such as the main inverter, and check that main generator loadmeter (M4) reads upscale.

(6) Ensure that BAT switch (S40) is OFF. Slowly increase voltage to the power source. At **31 to 33** volts, over-voltage relay (K6) should actuate, causing field relay (K7) to trip and reverse current relay (K5) to open and thus remove voltage from all buses. Do not exceed **33** volts.

(7) Reduce voltage to 28 volts. Position battery switch (S40) to ON. Reset main generator system by placing generator switch (S8) in the RESET position and then back to OFF. Return battery switch to OFF. Position generator switch to ON. Field relay (K7) should reset and reverse current relay (K5) should reclose again energizing all buses.

(8) Return MAIN GEN switch to OFF, open GEN & BUS RESET circuit breaker, and reconnect wires.

b. Perform functional test of standby starter-generator circuit as follows:

(1) Ensure BAT SW is OFF. Disconnect wire P37A2 from positive terminal B and disconnect wires K5A4 and K5C4 from negative terminal E on the starter-generator. Connect these wires to an adjustable 28 volt dc power source (26 to 33 Vdc), observing the proper polarity.

(2) Close both STANDBY GENERATOR loadmeter circuit breakers in the electrical compartment. Position STARTER-GEN switch (S70) to START. Energize external power source. There should be no voltage on the main bus in the electrical compartment. Check that dc voltmeter (M2) indicates power source voltage in the STBY GEN position.

(3) Close STBY GEN FIELD circuit breaker. Position STARTER-GEN switch (S70) to STBY GEN and check that essential bus is energized.

(4) Close GEN & BUS RESET circuit breaker. Position NON-ESS BUS switch (S62) to MANUAL ON. Both essential and nonessential buses should be energized. Check that dc voltmeter indicates voltage of the power source in the STBY GEN, ESS BUS and NON ESS BUSS positions.

(5) Momentarily engage a load, such as the main inverter, and check that the standby generator loadmeter (M1) reads upscale. Return all switches and breakers to the open position and reconnect wires to their proper terminals.

9-57. Troubleshooting — Generator and DC Bus System. Perform checks as necessary to isolate trouble using the following troubleshooting table. In the following table, tripped circuit breakers and burned-out indicator lamps are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-3. Troubleshooting — Generator and DC Bus System

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. DC GENERATOR light on caution panel not illuminated prior to engine start-up. Bus is energized by battery or external power and CAUTION LIGHT circuit breaker is closed.

   STEP 1. Determine if bus control relay (K4) is defective by connecting a jumper between terminals B2 and B3 on relay.

   Replace relay if DC GENERATOR light comes on (paragraphs 9-9 and 9-11).

   STEP 2. Determine if master caution panel (A4) is defective by disconnecting plug (P24) from caution panel and checking for dc voltage between W (+) and Z (–). Voltage should be present. Replace lamps in DC GENERATOR segment and reconnect plug (P24).

   Replace master caution panel if light still does not illuminate (paragraphs 9-23 and 9-25).

2. DC GENERATOR light on caution panel does not go out after engine start-up.

   STEP 1. Determine if main generator voltage is less than **1.0** volt above standby generator voltage.

   Adjust or replace main generator voltage regulator (VR1) (paragraphs 9-73 or 9-74 and 9-75).

   STEP 2. Determine if bus control relay (K4) is defective by moving VM switch (S2) alternately to MAIN GEN, STBY GEN, and ESS BUS positions.

   Replace bus control relay if rated voltage is indicated in all positions and main generator voltage is on essential bus (paragraph 9-5). If rated voltage is indicated in all positions and standby generator voltage is on essential bus, continue with step 3.

   STEP 3. Check for dc voltage at SW terminal of reverse current relay (K5).

   Replace reverse current relay if dc voltage is present at SW terminal (paragraphs 9-9 and 9-11).

3. No output from main generator (G2) (standby generator (G6) operates normally).

CAUTION

If voltage begins to build up quickly, return MAIN GEN switch to OFF to prevent excessive voltage build-up.

Table 9-3. Troubleshooting — Generator and DC Bus System (Cont)

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

STEP 1. Place MAIN GEN switch (S8) in OFF and VM switch (S2) in MAIN GEN postion. Remove plug (P60) from main generator field relay, and jumper-connect pins H and N. Place MAIN GEN switch in ON position and observe dc voltmeter.

Replace main generator (G2) if voltage does not build up (paragraphs 9-62 and 9-64).

STEP 2. Check main generator field relay (K7). If relay is tripped, place VM switch in MAIN GEN position; then, while observing voltmeter, momentarily place MAIN GEN switch in RESET position.

Replace overvoltage relay (K6) if voltage builds up and generator cuts out at less than 31 volts on each reset attempt (paragraphs 9-9 and 9-11).

STEP 3. Remove plug (P60) from main generator field relay (K7). Check for continuity between relay sockets N and P.

Replace main generator field relay if no continuity exists or if resistance is more than one ohm (paragraphs 9-9 and 9-11).

STEP 4. If main generator field relay (K7) will not reset, check for voltage between pin B and helicopter structure when MAIN GEN switch (S8) is moved to RESET position.

Replace relay if voltage is present (paragraphs 9-9 and 9-11).

4. No output from standby generator (main generator operates normally)

CAUTION

If voltage begins to build up, remove jumper from across terminals.

STEP 1. Place VM switch (S2) in STBY GEN position. On heiicopters S/N 66-461 and subsequent, ensure that standby generator field control relay (K15) is de-energized. Momentarily place a 16 gauge jumper wire across main voltage regulator terminal B and standby voltage regulator terminal A.

Replace standby generator (G6) if voltage does not build up (paragraph 4-110). Replace standby generator voltage regulator (VR2) if voltage does build up (paragraphs 9-74 and 9-76).

5. Standby generator does not switch on to bus to provide power when main generator is inoperative.

STEP 1. Check for dc voltage on terminal D2 of bus control relay (K4).

Replace starter-generator switch (S70) if voltage is not present (paragraphs 9-9 and 9-11).

STEP 2. Jumper terminals D2 and D3 on bus control relay (K4).

Replace bus control relay if standby generator output switches on to bus. Replace reverse current relay (K23) if standby generator does not switch onto bus (paragraphs 9-9 and 9-11).

Table 9-3. Troubleshooting — Generator and DC Bus System (Cont)

CONDITION TEST OR INSPECTION	**CORRECTIVE ACTION**
6. No voltage to nonessential bus when NON-ESS BUS switch is in NORMAL ON position. Main generator voltage is present on essential bus. GEN & BUS RESET circuit breaker is closed.	
STEP 1. Ensure that actuating voltage is present across terminals X1 and X2 of bus control relay (K4) and that 28 Vdc essential bus voltage is present at terminal A1. Check for voltage at terminal A2.	**Replace bus control relay if voltage is not present at terminal A2 (paragraphs 9-9 and 9-11).**
STEP 2. Check for actuating voltage at nonessential bus relay (K2).	**Replace NON-ESS BUS switch (S62) if voltage is not present. Replace relay if voltage is present (paragraphs 9-9 and 9-11).**
7. No voltage on nonessential bus when NON-ESS BUS switch is in MANUAL ON position. Main generator voltage present on essential bus. GEN & BUS RESET circuit breaker is closed.	
STEP 1. Check for actuating voltage at nonessential bus relay (K2).	**Replace NON-ESS BUS switch (S62) and/or GEN & BUS RESET circuit breaker if actuating voltage is not present at relay (paragraphs 9-9 and 9-11 or 9-16 and 9-18). Replace relay if actuating voltage is present (paragraphs 9-9 and 9-11).**

9-58. MAIN DC GENERATOR.

9-59. Description — Main DC Generator. The main dc generator (G2) is mounted on an accessory pad on the left side of the main rotor transmission. Its capacity is rated at 300 amperes and its voltage is controlled by a voltage regulator which is part of the main generator system. The main dc generator is driven at the same speed as the engine output shaft and has to be turned within a specific range of speed to furnish rated current at normal regulated voltage.

9-60. Cleaning — Main DC Generator. a. Remove moisture with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Do not use near a flame. Provide adequate ventilation.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical terminals with a bristle brush (C32).

9-61. Inspection — Main DC Generator. a. Visually inspect generator for damage.

b. Check terminals for damage and terminal board to ensure that it is not warped or cracked.

c. Check brush cover for dents and loose or bent pins.

d. Check that wear indicator (diagonal groove on edge of brush) indicates that brush has more than one-fourth life remaining.

e. Check brushes for freedom of movement in brush holders. Refer to paragraph 9-63.

f. Check brush springs for proper tension on brushes. Refer to paragraph 9-63.

g. Check that brush leads are flexible and have a bright appearance.

h. Check that commutator has a smooth bright appearance with a light filming.

i. Check that brushes are properly seated (**100** percent in direction of rotation and a minimum of **75** percent axially).

j. Check drive splines for excessive wear by rocking armature back and forth.

9-62. Removal — Main DC Generator. a. Open cowling on left side of transmission.

b. Tag wires to identify for reinstallation and disconnect from generator.

c. Loosen attaching nuts and position each washer out of recess, turn generator housing counterclockwise, and pull generator free of transmission drive.

9-63. Repair or Replacement — Main DC Generator. a. Repair brush cover dents. (Refer to TM 55-1500-204-25/1.)

b. Replace brush when cracked, chipped, or no part of diagonal groove on edge is visible. (AVIM)

(1) Loosen screw and remove brush cover band.

(2) Remove screw from brush pigtail being careful not to drop screw.

(3) Using needle nose pliers, carefully pull brushes out of brush holder.

(4) Hold brush spring out of the way and insert replacement brush into brush holder. Ensure that spring seats properly on top of brush.

(5) Install screw to secure brush pigtail.

(6) Install brush cover and tighten screw.

c. No other repairs are authorized.

d. Check brush springs for proper tension on brushes (**45** to **54** ounces).

9-64. Installation — Main DC Generator. a. Apply light coat of grease (C132) on generator shaft. Place gasket into position. Align generator with transmission drive, and slide generator into drive spline.

b. Position generator on studs with terminals one bolt left of helicopter centerline and tighten retaining nuts to attach generator to drive pad.

c. Connect wires to generator terminals.

d. Position rubber boot to cover generator connections and secure with lacing cord.

9-65. STANDBY GENERATOR (STARTER-GENERATOR).

9-66. Description — Standby Generator. The starter-generator (G6) is mounted on the aft side of the engine accessory drive gearbox. It serves to drive the engine compressor rotor during the start cycle and also serves as a 300 amp, engine driven standby generator at normal engine speeds. Refer to paragraphs 4-99 through 4-101 for maintenance procedures.

9-67. GENERATOR SHUNT.

9-68. Description — Generator Shunt. The standby generator shunt (R1) and main generator shunt (R2) provide a voltage drop, proportional to the current, to operate the standby generator loadmeter (M1) and main generator loadmeter (M4). Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-69. VOLTAGE REGULATOR.

9-70. Description — Voltage Regulator. The main generator voltage regulator (VR1) and standby generator voltage regulator (VR2) are located in the aft electrical compartment on the left side of the helicopter. The voltage regulator controls the voltage output on the generator by controlling the magnetic field strength within the generator. Variation of the resistance which is in series with the generator shunt field coil controls shunt field current to control generator voltage output. The voltage regulator of the standby generator is set at a lower voltage than that of the main generator. Solid state voltage regulators incorporate a circuit breaker which will open the field circuit of the generator when regulated potential exceeds 30.5 volts.

9-71. Cleaning — Voltage Regulator. a. Remove moisture and dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean lint-free cloth dampened with solvent (C205).

c. Remove dirt from electrical terminals with a bristle brush (C32).

d. Clean corroded contact pins and spring tabs with a pencil eraser (carbon pile regulators only).

9-72. Inspection — Voltage Regulator. a. Visually inspect regulator case for physical damage that could impair normal operation of the unit (cracked case, damaged or corroded contact pins, loose terminals, etc.).

b. Check for secure mounting of regulator.

c. For regulators with separate base, inspect spring tabs for security and condition.

9-73. Adjustment - Voltage Regulator. (Refer to TM 55-1500-204-25/1.)

9-74. Removal — Voltage Regulator. a. Ensure that all electrical power is off.

b. Unlock snap clamps and remove regulator from base. For regulators without base, disconnect wires, remove nuts and washers, and remove regulator from shelf.

9-75. Repair or Replacement — Voltage Regulator. Other than repositioning spring tabs by bending them a small amount in the direction opposite from which contact pins on regulator applies pressure, no other repairs are authorized.

9-76. Installation — Voltage Regulator. a. Ensure that all electrical power is OFF.

b. Position regulator on mounting base and lock snap clamps. For regulators without separate base, insert regulator studs through mounting holes, secure with washers and nuts, and reconnect wires.

c. Adjust voltage regulators (reference TM 55-1500-204-25/1).

9-77. GENERATOR FIELD RELAY.

9-78. Description — Generator Field Relay. Helicopters prior to S/N 66-461 have a field control relay (K7) for only the main generator system located in aft electrical compartment. The above and subsequent serial numbered helicopters have two generator field control relays in the aft electrical compartment. The field control relay in the main generator system opens the shunt field circuit between the voltage regulator and the generator whenever the over-voltage relay closes the circuit to the trip coil of the field control relay. The tripped field control relay opens the circuit to SW terminal of the main generator reverse current relay. Once tripped, the generator field control relay can be reset by placing the generator switch in the RESET position.

The standby generator field control relay (K15) is a different type than that in the main generator system. The purpose of the standby generator field control relay is to open the standby generator's shunt field circuit whenever the coil is energized. Power is applied to the coil whenever the starter relay is energized by pressing the start switch. The shunt field circuit is completed through the relay when the start switch is released. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-79. REVERSE CURRENT RELAY.

9-80. Description — Reverse Current Relay. Two reverse current relays (K5 and K23) are mounted in the aft electrical compartment. Each is a part of two separate generator systems. Its purpose is to automatically connect and disconnect its own generator to or from the dc bus. Automatic operation of the reverse current relay is possible only when generator voltage is applied to the "SW" terminal of the unit.

Automatic connection of the generator to the dc bus is accomplished only when the following conditions of the generator voltage are satisfied: the polarity is correct, a minimum of 22 to 24 volts dc is attained, and voltage at GEN terminal of reverse current relay exceeds voltage at its BAT terminal by approximately 0.5 volt.

Automatic disconnection of the generator from the dc bus is accomplished by reverse current through the reverse current relay when generator voltage decreases below the voltage of another source connected to the bus. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-81. BUS CONTROL RELAY.

9-82. Description — Bus Control Relay. Operation of the bus control relay (K4) is controlled through the IND terminal of the main generator reverse current relay (K5). Closing of the reverse current relay supplies power from the main generator (G2) to the coil of the bus control relay. With this coil energized the following events happen: one set of contacts B2 and B3 terminals open to remove electrical ground from the DC GENERATOR segment on the caution panel to turn light off, the contacts between A2 and A1 terminals close to allow main generator voltage to energize nonessential bus relay, and the contacts between D2 and D3 terminals open to disconnect standby generator power from the "SW" terminal of the standby generator reverse current relay (K23). When the main generator reverse current relay opens, the bus control relay coil is not energized; it moves to its spring loaded position which results in power supply to DC GENERATOR light on caution panel and removal of power to the nonessential bus relay coil resulting in nonessential bus disconnecting from the main bus. Power from the external power supply closes the nonessential relay through the disengaged bus control relay. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-83. OVERVOLTAGE RELAY.

NOTE

The solid state voltage regulator is protected from over voltage and over current, by a manually reset relay on the voltage regulator. When either condition trips the relay, the affected generator cannot be reset from the cockpit. The reset can be accomplished when the aircraft is on the ground with access to the voltage regulators.

9-84. Description — Overvoltage Relay. The overvoltage relay (K6) is located in the aft electrical compartment. Voltage from the main generator is applied to the coil of the overvoltage relay only when MAIN GEN switch (S8) is ON. The overvoltage relay contacts are normally open, but 31-33 volts across its coil from the main generator will close the relay which connects power from the bus to the trip coil of the main generator field control relay (K7). Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

9-85. NONESSENTIAL BUS RELAY.

9-86. Description — Nonessential Bus Relay. The nonessential bus relay (K2) is mounted in the aft electrical compartment. The nonessential bus relay is an electrically operated switch between the main bus bar and nonessential bus. It is operated by power from external power receptacle when external power is supplied. Power from the main generator will also operate the nonessential bus relay through the bus control relay when main generator reverse current relay closes. Placing the nonessential bus switch in the manual position will also allow standby generator or battery power to close the relay. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

SECTION II — ALTERNATING CURRENT POWER DISTRIBUTION SYSTEM

NOTE

Power loading charts and detail system wiring diagrams are contained in Appendix F. Aviation Unit Maintenance activities shall request AVIM for electrical system repairs in accordance with the Maintenance Allocation Charts Appendix B.

9-87. ALTERNATING CURRENT POWER DISTRIBUTION SYSTEM.

9-88. Description — Alternating Current Power Distribution System. The alternating current power distribution system provides all secondary power (115 Vac) for operation of the ac instruments and avionics systems.

9-89. COMMON ELECTRICAL COMPONENTS (AC).

9-90. Description - Common Electrical Components (AC). Common electrical components consist of the miscellaneous electrical components, circuit breakers, and control panels. Refer to paragraphs 9-5 through 9-25 for description and maintenance procedures. The AC circuit breaker panel is located on the right side of pedestal base.

9-91. INVERTER SYSTEM.

9-92. Description — Inverter System. The inverter system is a dual system consisting of a main and spare inverter. The units are interchangeable and are rated at 250 VA. They produce 115 Vac with a frequency response of 400 Hz. The system is comprised of the main inverter (D1), spare inverter (D2), main inverter power relay (K35), spare inverter power relay (K36), inverter transfer relay (K27), ac failure relay (K8), AC POWER panel (A2, includes INVTR switch (S39) and ac VM selector switch (S11), ac voltmeter (M3), 115 to 28 Vac autotransformer (T1), and the power factor correction network. The inverter system is powered from the 28 Vdc essential bus and is protected by the MAIN INVTR PWR, SPARE INVTR PWR, and INVTR CONT circuit breakers.

With INVTR switch (S39) positioned to MAIN ON, dc power from the 28 Vdc essential bus is routed through the main inverter power relay to the main inverter. The ac output of the main inverter is routed through the inverter relay to the autotransformer and various ac instrument circuit breakers. With INVTR switch positioned to SPARE ON, dc power from the 28 Vdc essential bus is routed through the spare inverter power relay to the spare inverter. The ac output of the spare inverter is routed through the inverter relay to the autotransformer and various ac instrument and avionics circuit breakers. The autotransformer reduces 115 Vac to 28 Vac for instrument power.

9-93. Functional Test — Inverter System. a. Open all circuit breakers and place all switches to their OFF or NORMAL positions.

b. Connect a 28 Vdc power source to the external power receptacle (J109). Energize power source.

c. Close the MAIN INVTR PWR, SPARE INVTR PWR, INVTR CONT, CAUTION LIGHTS, J2 CMPS IND, POWER FACTOR CORRECTION, and all ac circuit breakers in the pedestal breaker panel. Check that INST INVERTER caution light illuminates.

d. Position INVTR switch (S39) to MAIN ON. Check that main inverter (D1) and all ac instruments are on and INST INVERTER light is extinguished.

e. Select each phase with ac VM switch (S11) and check that voltmeter indicates **115 ± 3 Vac**, on each phase when dc bus voltage is **28** volts.

f. Position INVTR switch (S39) to OFF and check that INST INVERTER light illuminates.

NOTE

When switch (S39) is moved from MAIN ON to OFF, the ac bus voltages decrease gradually because the buses remain connected to the main inverter output through the inverter relay contacts. If the MASTER CAUTION light is reset during the time period in which the main inverter is still decreasing in speed, false MASTER CAUTION and INST INVERTER indications may occur.

g. Position INVTR switch (S39) to SPARE ON and check that ac voltmeter indicates **115 ± 3** Vac on each phase.

NOTE

When INVTR switch (S39) is moved from SPARE ON to OFF, the ac bus voltages will drop off immediately from the spare inverter output by the inverter relay.

9-94. Troubleshooting — Inverter System. Use table 9-4 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers and burned-out indicator lamps are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. (Refer to paragraph F-11 for index to wiring diagrams.)

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-4. Troubleshooting — Inverter System

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Main inverter (D1) fails to operate.	STEP 1. With INVTR switch (S39) positioned to MAIN ON, check for 28 Vdc essential bus voltage on terminals 1 and 2 of switch.	**Replace switch if voltage is not present on terminal 1 (paragraphs 9-9 and 9-11).**
	STEP 2. Ensure that actuating voltage is present across terminals X1 and X2 and that 28 Vdc essential bus voltage is present at terminal A1 of main inverter power relay (K35). Check for voltage at terminal A2.	**Replace main inverter power relay if voltage is not present at terminal A2 (paragraphs 9-9 and 9-11).**
	STEP 3. Check for 28 Vdc essential bus voltage at pins F and G of main inverter connector (P191). Ensure that ground potential is present at pin E.	**Replace main inverter (D1) if voltage is present on pins F and G of connector (paragraph 9-95).**
2. Spare inverter (D2) fails to operate.	STEP 1. With INVTR switch (S39) positioned to SPARE ON, check for 28 Vdc essential bus voltage on terminals 2 and 3 of switch.	**Replace switch if voltage is not present on terminal 3 (paragraphs 9-9 and 9-11).**
	STEP 2. Ensure that actuating voltage is present across terminals X1 and X2 and that 28 Vdc essential bus voltage is present at terminal A1 of spare inverter power relay (K36). Check for voltage at terminal A2.	**Replace spare inverter power relay if voltage is not present at terminal A2 (paragraphs 9-9 and 9-11).**
	STEP 3. Check for 28 Vdc essential bus voltage at pins F and G of spare inverter connector (P192). Ensure that ground potential is present at pin E.	**Replace spare inverter (D2) if voltage is present on pins F and G of connector (paragraphs 9-100 and 9-102).**

Table 9-4. Troubleshooting — Inverter System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
3. Inverter (D1 or D2) operates but no voltage to instruments.	
STEP 1. Check continuity of inverter transfer relay (K27) contacts; terminals A2 to A3 and B2 to B3 for main inverter and terminals A1 to A2 and B1 to B2 for spare inverter (relay actuated for spare inverter operation).	**Replace inverter transfer relay if defective (paragraphs 9-9 and 9-11).**
STEP 2. Check for 115 Vac output from inverter at inverter transfer relay terminals A3 and B3 (for main inverter) and terminals A1 and B1 (for spare inverter).	**Replace inverter (D1 and D2) if defective (paragraphs 9-100 and 9-102).**
4. Improper inverter output voltage or frequency.	
STEP 1. Check for proper input voltage to inverter.	**Correct primary voltage if low (paragraph 9-73).**
STEP 2. Check inverter output voltage and frequency with voltmeter and frequency meters.	**Replace inverter if defective (paragraphs 9-100 and 9-102).**

9-95. INVERTER.

9-96. Description — Inverter. The main and spare 115 Vac, 400 Hz, 250 VA, 3 phase inverters are interchangeable. These units are located in the aft electrical compartment. All three phases of the inverter are loaded equally as far as is practicable. Since loads are primarily inductive in nature, power factor correction capacitors are mounted in the compartment with the inverters to maintain a power factor of 0.97 (lag) under normal load.

9-97. Cleaning — Inverter. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt, with a clean, lint-free cloth dampened with solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

9-98. Inspection — Inverter. a. Inspect case for cracks or damage.

b. Inspect electrical connectors for broken pins or cracked connector inserts.

c. Check for bonding and security of mounting.

9-99. Adjustment — Inverter.

NOTE

To properly conduct the inverter check, apply a regulated 28 Vdc external power source or ground run the helicopter to assure an adequate source of dc power for inverter operation. Do not use helicopter battery power.

a. Turn on inverter and actuate all ac circuits to produce maximum demand on inverter.

b. Using multimeter (T3) and frequency meter (T7), check output voltage and frequency at the 115 Vac bus (engine vibration receptacle (J115) or other convenient monitoring point).

c. If the output voltage is 115 ± 2.5 Vac, and the frequency is between 390 and 410 Hz, no adjustment is necessary.

d. If the output voltage is above or below the limits prescribed in the preceding step, proceed as follows: Turn off dc power to inverter. Loosen hex-head jam nut securing adjustment screw.

e. Close all ac circuit breakers. Actuate all ac circuits. Turn on inverter power. Connect multimeter (T3) and frequency meter (T7) at one of the test points described in step b. and note reading. Turn inverter output adjustment screw clockwise to increase or counterclockwise to decrease inverter output. Nominal setting of 115 volts at full output load should produce an output frequency within limits of 390 to 410 Hz.

9-100. Removal — Inverter. a. Ensure that all electrical power is OFF.

b. Disconnect electrical cable and protect connectors with cap or electrical tape.

c. Remove mounting bolts and lift inverter from compartment.

9-101. Repair or Replacement - Inverter. Repair connectors, replace missing mounting bolts. Replace unit for any of the following conditions: excessive vibration, overheating, unusually noisy and for pitting and grooving of the brush area on the commutator and/or slip rings. (Refer to TM 11-6125-220-12.)

9-102. Installation — Inverter. a. Ensure all electrical power is OFF.

b. Carefully position and secure inverter in compartment with mounting bolts.

c. Remove caps or electrical tape from plugs and receptacles.

d. Connect electrical connectors to the inverter.

9-103. MAIN INVERTER POWER RELAY.

9-104. Description — Main Inverter Power Relay. The main inverter power relay (K35) is located in the aft electrical compartment. The relay is used as a remote controlled switch. When the relay is energized, 28 Vdc is routed from the essential bus through the relay to the main inverter. Refer to paragraphs 9-5 through 9-11 for maintenance procedure.

9-105. SPARE INVERTER POWER RELAY.

9-106. Description — Spare Inverter Power Relay. The spare inverter power relay (K36) is located in the aft electrical compartment. The relay is used as a remote controlled switch. When the relay is energized, 28 Vdc is routed from the essential bus through the relay to the spare inverter. Refer to paragraphs 9-5 through 9-11 for maintenance procedure.

9-107. INVERTER RELAY.

9-108. Description — Inverter Transfer Relay. The inverter transfer relay (K27) is used as a double-pole, double-throw remote controlled switch. The relay is energized by 28 Vdc when inverter switch (S39) is in SPARE ON position. When energized, 115 Vac from the spare inverter is routed through the relay to the ac systems. When de-energized, 115 Vac from the main inverter is routed through the relay to the ac systems. Refer to paragraphs 9-5 through 9-11 for maintenance procedure.

9-109. INVERTER FAILURE RELAY.

9-110. Description — Inverter Failure Relay. The ac failure relay (K8) monitors the 115 Vac, phase C bus. When the bus is de-energized, the INST INVERTER caution panel segment will illuminate to warn the pilot that the 115 Vac bus is no longer energized. Refer to paragraphs 9-5 through 9-11 for maintenance procedure.

9-111. AC TRANSFORMER.

9-112. Description — AC Transformer. The ac transformer (T1), which is an autotransformer, reduces 115 Vac to 28 Vac for instrument power.

9-113. Cleaning — AC Transformer. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with solvent (C205).

9-114. Inspection — AC Transformer. a. Inspect transformer for broken contact pins.

b. Inspect transformer case for damage.

c. Inspect for damaged insulation between pins.

d. Check for discoloration that would indicate internal shorting or excessive overload.

e. Check for security of mounting.

9-115. Removal — AC Transformer. a. Ensure all electrical power is OFF.

b. Disconnect wiring from transformer and cover wire ends. Tag wires for proper identification.

c. Remove mounting screws and lift transformer from compartment.

9-116. Repair or Replacement — AC Transformer. a. Replace transformer if case is damaged or discolored.

b. Replace transformer if insulation between pins is damaged or broken, or contact pins are broken.

c. Repair is limited to tightening or properly installing any loose or improperly installed mounting hardware.

9-117. Installation — AC Transformer. a. Ensure all electrical power is OFF.

b. Position transformer in compartment and secure with mounting screws.

c. Remove cover from wire ends and connect tagged wires to transformer.

9-118. ENGINE VIBRATION METER RECEPTACLE.

9-119. Description — Engine Vibration Meter Receptacle. The engine vibration meter receptacle, powered from the 115 Vac essential bus, is used as source of 115 Vac power for the vibration meter during engine vibration tests. It is also used as a convenient point to monitor ac voltage from the 115 Vac essential bus during functional tests or troubleshooting. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

SECTION III — STARTING SYSTEM

9-120. STARTING SYSTEM.

9-121. Description — Starting System. The starting system requires 24 Vdc to activate the starter portion of the starter-generator during the starting cycle. The 24 Vdc power may be supplied by the battery or by an external power source. The starting system consists of the starter portion of the starter-generator (G6) and the starter relay (K3).

9-122. Functional Test — Starting System. a. Disconnect wires K4B4 and K4D4 from terminal C of starter-generator.

b. Position starter-generator switch (S70) to START.

c. Close STARTER RELAY circuit breaker.

d. Actuate starter switch (S6) on pilot collective stick and check that starter relay (K3) closes and that voltage is present at the ends of the disconnected wires.

e. Position starter-generator switch (S70) to STBY GEN.

f. Actuate starter switch (S6) and check that starter relay (K3) does not close.

g. Position starter-generator switch (S70) to START.

h. Actuate starter switch (S77) on copilot collective stick and check that voltage is present at the ends of disconnected wires.

i. Position starter-generator switch (S70) to STBY GEN.

j. Actuate starter switch (S77) and check that starter relay (K3) does not close.

k. Open STARTER RELAY circuit breaker.

l. Reconnect wires K4B4 and K4D4 to terminal C of starter-generator.

9-123. Troubleshooting — Starting System. Use table 9-5 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers and burned-out indicator lamps are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-5. Troubleshooting — Starting System

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Starter (G6) fails to operate when starter switch (S6 or S77) is depressed with starter-generator switch (S70) in START position.
STEP 1. Ensure that dc essential bus voltage is present and determine if STARTER RELAY circuit breaker is defective.
Replace circuit breaker if defective (paragraphs 9-16 and 9-18).
STEP 2. Check starter-generator switch (S70) for proper operation.
Replace switch if defective (paragraphs 9-9 and 9-11).
STEP 3. With starter switch (S6) depressed, check for relay actuating voltage at terminal X2 of starter relay (K3).
Replace switch (S6) if defective (paragraphs 9-9 and 9-11).
STEP 4. With starter switch (S6) depressed, check for main dc bus voltage at terminal A2 of starter relay (K3).
Replace relay if defective (paragraphs 9-9 and 9-11).
STEP 5. Check for excessively worn brushes.
Replace brushes as required (paragraph 9-63).
2. Starter fails to produce sufficient rpm during start cycle.
STEP 1. Rock armature back and forth to check for excessive wear to armature bearings.
Replace starter if bearings are worn excessively (paragraph 4-110).

Table 9-5. Troubleshooting — Starting System (Cont)

CONDITION TEST OR INSPECTION CORRECTIVE ACTION
STEP 2. Check for low battery power.
Charge battery (TM 11-6140-203-14-2) or connect external power source.
3. Engine rotates when battery is turned on.
STEP 1. Check for defective starter relay (K3).
Replace relay if defective (paragraphs 9-9 and 9-11).
STEP 2. Check for defective starter switch (S6).
Replace starter switch if defective (paragraphs 9-9 and 9-11).

9-124. STARTER GENERATOR.

9-125. Description — Starter Generator. The starter-generator (G6) is mounted on the aft side of the engine accessory drive gearbox. It serves to drive the engine compressor rotor during the start cycle and also serves as a 300 amp, engine driven stand-by generator at normal engine speeds. Refer to paragraphs 4-99 through 4-101 for maintenance procedures.

9-126. STARTER RELAY.

9-127. Description — Starter Relay. The starter relay (K3) is located in the aft electrical compartment. This unit is an electrically operated switch between the main bus bar and the starter-generator. It is energized when starter switch (S6 or S77) on the pilot or copilot collective stick is depressed. Refer to paragraphs 9-5 through 9-11 for maintenance procedures.

SECTION IV — IGNITION SYSTEM

9-128. IGNITION SYSTEM.

9-129. Description — Ignition System. Ignition to the power plant is provided by the igniter pack (Z2), furnished with and attached to the engine. This unit provides a continuous ignition arc during engine start cycle. The igniter solenoid valve (L1) located on the engine also operates during this cycle to direct fuel to the starting fuel nozzle during engine start. A key lock ignition switch is installed on the right side of pedestal above the AC circuit breaker panel. The circuits are energized when fuel switch (S38) located on the engine control panel (A3) and key lock ignition switch are placed to MAIN ON and the starter switch (S6) is depressed.

9-130. Functional Test — Ignition System.

NOTE

Ensure that wire K3D20 is disconnected at starter relay (K3) and that terminal is protected to prevent activation of engine.

a. Close IGNITION SYSTEM & IGNITER SOL circuit breaker. Position fuel switch (S38), starting fuel switch (S88) and key lock ignition switch to ON. Actuate pilot starter switch (S6) and check that ignition unit (Z2) and igniter solenoid valve (L1) both operate.

b. Actuate copilot starter switch (S77). Check that ignition unit and igniter solenoid valve are both operating.

c. Position starting fuel switch (S88) to OFF. Actuate pilots starter switch (S6) and check that ignition unit operates.

d. Repeat step c. using copilot starter switch (S77).

e. Position starting fuel switch (S88) to ON. Place fuel switch (S38) to OFF. Actuate pilot starter switch (S6) and check that neither the ignition nor the solenoid valve operates.

f. Repeat step e. using copilot starter switch (S77). Reconnect starter wires.

9-131. Troubleshooting — Ignition System. Use table 9-6 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-6. Troubleshooting — Ignition System

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Igniter and/or igniter solenoid valve fails to operate when starter switch is depressed.
STEP 1. Ensure that proper voltage is present on 28 Vdc bus. Determine with a voltmeter if the IGNITION SYSTEM & IGNITER SOLENOID circuit breaker is defective. **Replace circuit breaker if defective (paragraphs 9-16 and 9-18).**
STEP 2. Check fuel switch (S38) for proper operation. **Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 3. Check start fuel switch (S88) for proper operation. **Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 4. Check starter switch (S6) for proper operation. **Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 5. Check igniter (Z2) for proper operation. **Replace igniter if defective.**
STEP 6. Check igniter solenoid valve (L1) for proper operation. **Replace solenoid if defective (paragraphs 9-9 and 9-11).**
STEP 7. Determine that key lock ignition switch is functional. **If key lock ignition switch is not functioning properly, replace switch (paragraphs 9-9 and 9-11).**

9-132. IGNITER PACK.

9-133. Description — Igniter Pack. The igniter pack is furnished with and attached to the engine. This unit provides a continuous ignition arc during the engine start cycle. Refer to TM 55-2840-229-23 for maintenance procedures.

9-134. IGNITER SOLENOID VALVE.

9-135. Description — Igniter Solenoid Valve. The igniter solenoid valve (L1) is installed on the engine and operates during the start cycle. It directs fuel to the starting fuel nozzle during engine start. Refer to TM 55-2840-229-23 for maintenance procedures.

SECTION V — LIGHTING PROVISIONS

9-136. LIGHTING PROVISIONS.

9-137. Description — Lighting Provisions. Lighting provisions include all equipment necessary for the illumination of instruments and switches; also interior and exterior lighting used for night operation of the helicopter.

9-138. INTERIOR LIGHTS SYSTEM.

9-139. Description — Interior Lights System. Interior light circuits include the instrument lights, instrument secondary lights located on the glare shield, overhead console and pedestal panel lights, dome light, and cockpit lights.

9-140. COCKPIT LIGHTS.

9-141. Description — Cockpit Lights. The cockpit lights (I9 and I28) are multiple-purpose utility lights designed to selectively provide red or white illumination utilizing a narrow spotlight beam or a wide floodlight beam. Controls necessary to obtain operational modes of ON-OFF, dim-bright, spot-flood, and red or white illumination are incorporated into the lamp body.

9-142. Cleaning — Cockpit Lights. Refer to paragraph 9-7 for cleaning procedures.

9-143. Inspection — Cockpit Lights. Inspect light for corroded lamp socket terminals, shorted or broken wires, cracked lens, burned out lamp bulbs, and improper bonding to ground.

9-144. Functional Test — Cockpit Lights. a. Close COCKPIT LTS circuit breaker. Check that pilot and copilot utility lights are operational in each mode. (ON-OFF, Dim-Bright and Spot-Flood on both red and white.)

b. Open COCKPIT LTS circuit breaker.

9-145. Troubleshooting — Cockpit Lights. Use table 9-7 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers and burned-out bulbs are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-7. Troubleshooting — Cockpit Lights

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Switch fails to operate lights.	STEP 1. Use a multimeter to determine if switch or rheostat is defective.	**Replace switch or rheostat if defective (paragraphs 9-9 and 9-11).**

Table 9-7. Troubleshooting — Cockpit Lights (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
2. One light dim or intermittent.	STEP 1. Check for proper circuit ground contact.	**Remove light and clean ground (paragraphs 9-9 and 9-11).**
3. One light does not illuminate.	STEP 1. Check for corroded lamp socket.	**Clean terminals or replace light (paragraphs 9-9 and 9-11).**

9-146. Removal — Cockpit Lights. a. Open COCKPIT LTS circuit breaker.

b. Remove mounting hardware, lift out light assembly, and disconnect light wire.

9-147. Repair or Replacement — Cockpit Lights. Light assembly may be repaired by replacing damaged or defective component parts. If light case is damaged beyond repair, complete unit must be replaced.

9-148. Installation — Cockpit Lights. a. Connect light wire and install light assembly with mounting hardware.

b. Close COCKPIT LTS circuit breaker and check light for proper operation.

9-149. DOME LIGHTS.

9-150. Description — Dome Lights. The aft dome lights are designed to provide red or white illumination as selected by switch (S1) on the aft dome lights panel (A20). A rheostat (R21) on the panel controls off-on-dimming of the aft dome lights. On helicopters prior to S/N 66-15000, a forward dome light is installed and provides red or white illumination as selected by forward dome light switch (S35).

9-151. Cleaning — Dome Lights. Refer to paragraph 9-7 for cleaning procedure.

9-152. Inspection — Dome Lights. Inspect lights for corroded lamp socket terminals, cracked lens, burned out lamp bulbs, improper bonding to ground, and broken or shorted wires.

9-153. Functional Test — Dome Lights. a. Close DOME LTS circuit breaker. Position switch (S1) to RED. Rotate rheostat (R21) clockwise from OFF. Check that the two aft dome lights are full bright with (R21) in the full clockwise position.

b. Repeat step a. with switch (S1) positioned to WHITE.

NOTE

Step c. is not applicable to Serial No. 66-15000 and subsequent.

c. Check that forward dome light is operational for both RED and WHITE positions of switch (S35).

d. Open DOME LTS circuit breaker.

9-154. Troubleshooting — Dome Lights. Refer to paragraph 9-145; procedure is the same.

9-155. Removal — Dome Lights. a. Open DOME LTS circuit breaker.

b. Remove mounting hardware, lift out light assembly, and disconnect light wires.

9-156. Repair or Replacement — Dome Lights. Light assembly may be repaired by replacing damaged or defective component parts. If case is damaged beyond repair, complete unit must be replaced.

9-157. Installation — Dome Lights. a. Connect light wires and install light assembly with mounting hardware.

b. Close DOME LTS circuit breaker and check light for proper operation.

9-158. INSTRUMENT, CONSOLE, AND PEDESTAL LIGHTS.

9-159. Description — Instrument, Console, and Pedestal Lights. The instrument, console, and pedestal lights are energized by the 28 Vdc essential bus and protected by INST SEC LTS, INST PANEL LTS, and CONSOLE & PEDESTAL LTS 5 ampere circuit breakers. Six rheostats on the INST LTG panel (A6) control off-on-dimming of pilot instrument, copilot instrument, engine instrument, pedestal, instrument secondary, and console lights.

9-160. Cleaning — Instrument, Console, and Pedestal Lights. Refer to paragraph 9-7 for cleaning procedure.

9-161. Inspection — Instrument, Console, and Pedestal Lights. Refer to paragraph 9-8 for inspection procedure.

9-162. Functional Test — Instrument, Console, and Pedestal Lights. a. Close INSTR PANEL LIGHTS circuit breaker. Rotate PILOT instrument lights rheostat (R4) clockwise from OFF. Check that all instrument lights on the pilots side of the panel, including the standby compass and collective stick light, come on and increase in brightness with clockwise rotation of the rheostat.

b. Rotate ENGINE instrument lights rheostat (R9) clockwise from OFF. Check that all engine instrument lights come on and increase in brightness with clockwise rotation of the rheostat.

c. Rotate the COPILOT instrument lights rheostat (R10) clockwise from OFF. Check that all instrument lights on the copilots panel come on and increase in brightness with clockwise rotation of the rheostat.

d. Open INST PANEL LIGHTS circuit breaker.

e. Close CONSOLE PED LIGHTS circuit breaker. Rotate PED lights rheostat (R8) clockwise from OFF. Check that all edge lit panel lights on the pedestal come on and increase in brightness with clockwise rotation of the rheostat.

f. Rotate CONSOLE lights rheostat (R6) clockwise from OFF. Check that all edge lit panel lights in the overhead console plus the aft dome lights panel and crew ICS panel lights come on and increase in brightness with clockwise rotation of the rheostat.

g. Open CONSOLE PED LIGHTS circuit breaker.

h. Close INST SEC LIGHTS circuit breaker.

i. Rotate SEC lights rheostat (R5) clockwise from OFF. Check that instrument secondary lights come on and increase in brightness with clockwise rotation of the rheostat.

j. Open INST SEC LIGHTS circuit breaker.

9-163. Troubleshooting — Instrument, Console, and Pedestal Lights. Refer to paragraph 9-145; procedure is the same. Refer to paragraph F-11 for index to wiring diagrams.

9-164. Removal — Instrument, Console, and Pedestal Lights. Refer to paragraph 9-9 for removal procedure.

9-165. Repair or Replacement — Instrument, Console, and Pedestal Lights. Refer to paragraphs 9-10 and 9-24 for repair or replacement criteria.

9-166. Installation — Instrument, Console, and Pedestal Lights. Refer to paragraph 9-11 for installation procedure.

9-167. CAUTION LIGHT SYSTEM.

9-168. Description — Caution Light System. The caution light system includes a master caution panel (A4) located in the pedestal and a master caution light (I13) located on instrument panel. The caution panel contains a number of internally lighted capsules that illuminate when associated switches, located at different places in the helicopter, actuate to complete circuits thus indicating malfunctions in respective system. The panel is energized from 28 Vdc essential bus and protected by a 5 ampere circuit breaker located in the dc circuit breaker panel in the overhead console.

9-169. Functional Test — Caution Light System.

NOTE

The following paragraphs cover functional tests of all caution light circuits. All circuit breakers shall be open before making tests. The master caution light should illuminate each time a caution panel segment illuminates and shall be reset each time in readiness for another fault indication.

a. Master Caution Panel.

(1) Close CAUTION LIGHTS circuit breaker. Check that MASTER CAUTION light illuminates and that each caution light segment operates as follows:

Caution Light	On/OFF Condition
ENGINE OIL PRESS	ON
*ENGINE ICING	OFF
*ENGINE ICE DET	ON
LEFT FUEL BOOST	ON
RIGHT FUEL BOOST	ON
**ENG FUEL PUMP	ON
***20 MINUTE FUEL	ON
AUX FUEL LOW	OFF
XMSN OIL PRESS	ON
XMSN OIL HOT	OFF
HYD RPESS NO. 1	ON
HYD PRESS NO. 2	ON
INST INVERTER	ON
DC GENERATOR	ON
EXTERNAL POWER	ON
FUEL FILTER	OFF
GOV EMER	OFF
CHIP DET	OFF
IFF	OFF

NOTES

***These caution lights not applicable on helicopters equipped with particle separator.**

****ENG FUEL PUMP caution light will be illuminated only when a Hydra-Electric Company, P/N 40210 or Cook Electric Co. P/N 575-1337, fuel pump pressure switch is installed on the engine.**

*****Light will remain OFF when fuel tanks are full.**

(2) Reset the master caution light. Test the lights using the test switch on the panel. Push the dim switch to DIM and release. Check that caution lights do not dim.

(3) Rotate PILOT instrument lights rheostat (R4) clockwise from OFF. Again actuate the dim switch and check that lights dim and hold.

(4) Rotate rheostat (R4) counterclockwise to OFF and check that lights return to bright.

b. Engine Oil Pressure Light.

(1) Connect a pressure gun to the engine oil pressure switch and apply pressure. Check that ENGINE OIL PRESS indicator extinguishes with increasing pressure at **27 ± 1** psi.

(2) Relieve pressure on engine oil pressure switch. Check that ENGINE OIL PRESS indicator illuminates before **25** psi decreasing pressure (paragraph 8-64).

c. Engine Icing and Engine Ice Detector Lights. (Helicopters not equipped with particle separator.)

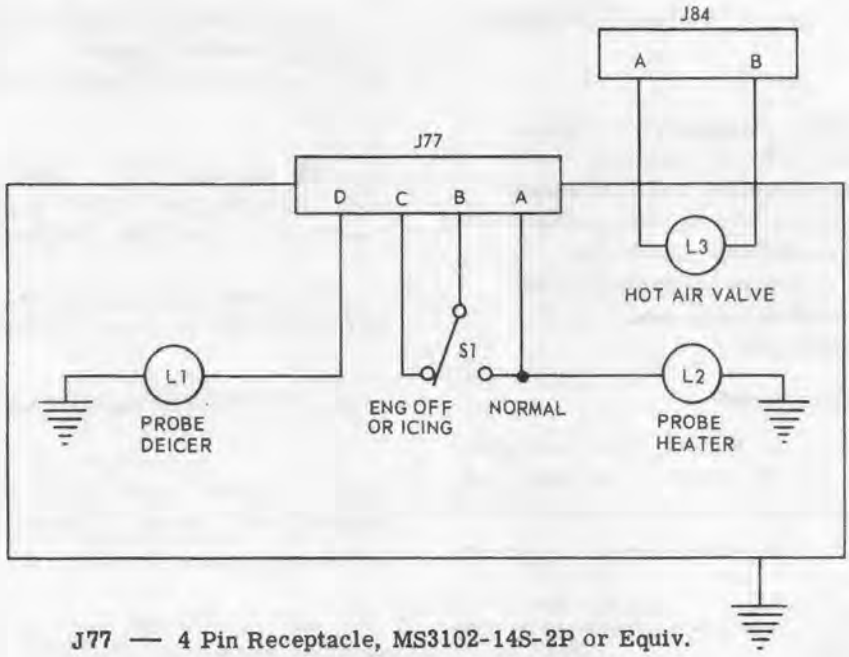
(1) Connect test box, wired similar to that shown in figure 9-1, into the engine harness at the hot air valve and ice detector. Refer to paragraph F-11 for index to wiring diagrams.

(2) Position test switch to ENGINE OFF and close ANTI-ICE ENG circuit breaker. Check that probe deicer test light (L1) is off. Probe heater test light (L2) should remain on as long as power is applied to the system.

(3) Position DE-ICE switch (S81) on the engine control panel to the closed position. Check that test light (L3) illuminates.

(4) Simulate the engine operating condition by positioning test switch to NORMAL. Check that the light (L1) remains off and the ENGINE ICE DET light on the caution panel extinguishes, indicating the system is armed.

(5) Simulate icing condition by placing test switch in the icing (ENGINE OFF) position. Check that ENGINE ICING light on the caution panel illuminates, indicating an icing condition in the engine and that test light (L1) illuminates, indicating power is applied to the probe deicing heater element.



J77 — 4 Pin Receptacle, MS3102-14S-2P or Equiv.
J84 — 2 Pin Receptacle, MS3101-12S-3P or Equiv.
L1 — Any 28 Volt Lamp Not Exceeding 6 Amperes
S1 — Test Switch, On-None-On Type, MS35058-23 or Equiv.
L2 — Any 28 Volt Lamp Not Exceeding 1 Ampere
L3 — Any 28 Volt Lamp Not Exceeding 1 Ampere

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Figure 9-1. Icing System Test Box Schematic

CAUTION

Do not leave switch in icing position for more than 10 seconds before returning it to the normal position.

(6) Return test switch to NORMAL. Check that test light (L1) and the ENGINE ICING caution light extinguish.

(7) Simulate a failure of the ice detector probe by placing test switch in the ENGINE OFF or ICING position. After 11 to 18 seconds, check that test light L1 and ENGINE ICING light extinguish and that ENGINE ICE DET light illuminates, indicating that the system is disarmed. This condition is similar to the engine off condition or to losing electric power to the ice detection system.

d. Left and Right Fuel Boost Lights.

(1) Disconnect electrical connector (P133) at fuel boost pressure switch (S79) and check that LEFT FUEL BOOST indicator extinguishes.

(2) Disconnect electrical connector (P134) at fuel boost pressure switch (S80) and check that RIGHT FUEL BOOST indicator extinguishes.

(3) Reconnect electrical connectors (P133 and P134).

e. Engine Fuel Pump Light.

(1) Disconnect both pressure ports at the fuel pressure switch on the engine. Determine the manufacturer and the manufacturer's part number of the fuel pressure switch, then accomplish following steps (2) and (3) as applicable.

NOTE

Cook Electric P/N 575-684, Cook Electric P/N 712-0063, Hydraulic Research P/N 96025, and Gorn Electric P/N GP2B-3000-1 pressure switches are differential types which are activated only when a pressure imbalance exists between the fuel pump elements. Equal pressures, whether low or high, have no effect on the caution indicator.

Cook Electric Co. P/N 575-1337 and Hydra-Electric P/N 40210 pressure switches are not of a differential type and are normally closed. The caution light remains illuminated until both pumps have reached operating pressure. Low pressure from either or both fuel pumps will deactivate the switch and cause the caution light to illuminate.

(2) To test Cook Electric Co., Part No. 575-684; Hydraulic Research and Mfg. Co., Part No. 96025; or Gorn Electric Co., Part No. GP2B-3000-1 proceed as follows:

(a) Apply pressure to a single port at a time and check that ENGINE FUEL PUMP indicator illuminates at **56.5 ± 3.5** psi increasing differential pressure at either port.

(b) Relieve any applied pressure and reconnect the pressure hoses to the switch.

(3) To test Cook Electric Co. P/N 575-1337 or Hydra-Electric Co., Part No. 40210, the ENGINE FUEL PUMP indicator shall be illuminated when both pressure ports are exposed to atmosphere pressure.

(a) Apply a steady pressure of **70** psi to the top pressure port of the switch and check that ENGINE FUEL PUMP indicator remains illuminated.

(b) Maintain a pressure of **70** psi at the top pressure port of the switch and apply an increasing pressure to the bottom pressure port. Check that ENGINE FUEL PUMP indicator extinguishes by the time that the pressure on the bottom port is **65** psi.

(c) Reduce pressure applied to the bottom port and check that ENGINE FUEL PUMP indicator illuminates at **56.5 ± 3.5** psi decreasing pressure.

(d) Apply a steady pressure of **70** psi to the bottom port of the switch and allow pressure applied to the top port to decrease to atmospheric pressure. Check that ENGINE FUEL PUMP indicator illuminates.

(e) Maintain pressure applied to the bottom port at **70** psi and increase pressure applied to top port of the switch. Check ENGINE FUEL PUMP indicator extinguishes by the time that the pressure applied to the top port is **65** psi.

(f) Reduce pressure applied to the top port. Check that ENGINE FUEL PUMP indicator illuminates at **56.5 ± 3.5** psi decreasing pressure. Relieve pressure applied to both ports and reconnect the pressure hoses to the switch.

f. Twenty Minute Fuel Light.

(1) With 20 MINUTE FUEL indicator illuminated (no fuel in tanks) disconnect wire E12A20 at terminal 2 of terminal board (TB28) under the left fuel cell and wire E12B20 at terminal 2 of terminal board (TB36) under right fuel cell. Check that 20 MINUTE FUEL light extinguishes.

(2) When 20 MINUTE FUEL indicator is extinguished (fuel in tanks) connect wire E12A20 or E12B20 to ground and check that 20 MINUTE FUEL indicator illuminates.

(3) Reconnect wire E12A20 to terminal 2 of terminal board (TB28) and wire E12B20 to terminal 2 of terminal board (TB36).

g. Auxiliary Fuel Low Light.

(1) Test internal auxiliary fuel tank provisions for AUX FUEL LOW light indication as follows:

(a) Ground the end of wire E11A20 (stowed) or use a jumper to ground terminal 2 of terminal board (TB30) located underneath the ferry tank, if internal ferry tank is installed.

(b) Place FUEL TRANS PUMP switch (S45) in ON position and check that AUX FUEL LOW indicator illuminates.

(c) Place FUEL TRANS PUMP switch (S45) in OFF position and check that AUX FUEL LOW indicator extinguishes.

(2) Test external auxiliary fuel tank provisions for AUX FUEL LOW light indication as follows:

(a) Connect a jumper wire between pins K and m of the right hand external fuel tank receptacle (J1024). Check that AUX FUEL LOW indicator illuminates.

(b) Remove jumper wire and place it between pins K and m of the left hand external fuel tank receptacle (J1017). Check that AUX FUEL LOW indicator illuminates.

h. Transmission Oil Pressure Light.

(1) Apply pressure at the transmission oil pressure switch (S28) and check that XMSN OIL PRESS indicator extinguishes at **33 to 37** psi increasing pressure.

(2) Relieve pressure on transmission oil pressure switch (S28) and check that XMSN OIL PRESS indicator illuminates at **28 to 32** psi decreasing pressure.

i. Transmission Oil Hot Light.

(1) Connect stud on top of the transmission oil oil temp switch (S26) (located on transmission) to ground and check that XMSN OIL HOT indicator illuminates.

(2) Remove ground from transmission oil temperature switch (S26) and check that XMSN OIL HOT indicator extinguishes.

j. Hydraulic Pressure Lights. (System No. 1 and System No. 2.)

(1) Apply external hydraulic pressure to hydraulic system and check that HYD PRESSURE indicator extinguishes at **800 ± 100** psi increasing pressure.

(2) Relieve pressure applied to hydraulic system and check that HYD PRESSURE indicator illuminates at **500 ± 100** psi decreasing pressure.

k. Instrument Inverter Light. The instrument inverter light is checked as a part of the inverter system (paragraph 9-93).

l. DC Generator Light. The DC generator light is checked as a part of the main generator system (paragraph 9-56).

m. External Power Light.

NOTE

Disconnect external power from the helicopter before performing external power light test.

(1) Turn battery switch (S40) ON. Open external power access door and check that EXTERNAL POWER indicator illuminates.

(2) Close external power access door and check that EXTERNAL POWER indicator extinguishes.

n. Fuel Filter Bypass Light.

(1) Disconnect plug (P195) from fuel filter bypass switch (S119). Short pin A to pin B and check that FUEL FILTER indicator illuminates.

(2) Remove short between pins A and B of plug (P195) and check that FUEL FILTER indicator extinguishes. Reconnect plug (P195).

o. Transmission Oil Level Light.

(1) Close BATTERY VOLTMETER circuit breaker.

(2) Actuate push button switch (S4) and check operation of the indicator through the fire access door in the right side transmission cowl.

p. Governor Emergency Caution Light.

(1) Verify that GOV CONT circuit breaker is closed. Position governor switch on the engine control panel to AUTO. Check that GOV EMER indicator light is extinguished.

(2) Move governor switch to EMER position. Check that GOV EMER indicator is illuminated.

q. Transmission and Tail Rotor Gearbox Chip Detector Light. (Helicopters S/N 65-9416 and subsequent.)

(1) Check that CHIP DETECTOR light is extinguished with the CHIP DET selector switch in the BOTH position.

(2) Short transmission magnetic chip detector output wire to ground. Position CHIP DET selector switch to each of its three positions and check that CHIP DETECTOR light illuminates with the switch in the BOTH and XMSN positions only. Remove short.

(3) Short tail rotor shaft chip detector (in 42° gearbox) output wire to ground. Position CHIP DET switch to each of its three positions and check that CHIP DETECTOR light illuminates with the switch in the BOTH and TAIL ROTOR position only. Remove short.

(4) Short tail rotor chip detector (in 90° gearbox) output wire to ground. Position CHIP DET selector switch to BOTH and TAIL ROTOR and check that CHIP DETECTOR light illuminates in both positions. Remove short.

r. Fire Detection.

(1) Close FIRE DET circuit breaker.

(2) Depress fire detector test switch (S20) on the instrument panel. Check that fire detection control relay actuates and causes the FIRE WARNING light to illuminate.

9-170. Troubleshooting — Caution Light System. Refer to schematic diagram and trace malfunctioning circuit or loop, using standard electronic troubleshooting procedures and standard test equipment. Localize malfunctioning switch components, and repair or replace as required. Refer to paragraph F-11 for index to wiring diagrams.

9-171. MASTER CAUTION PANEL.

9-172. Description — Master Caution Panel. The master caution panel contains a number of internally lighted segments that illuminate when associated switches, located at different places in the helicopter, actuate to complete circuits, thus indicating malfunctions in respective systems. The panel is energized by the 28 Vdc essential bus and protected by the CAUTION LTS circuit breaker.

9-173. Cleaning — Master Caution Panel. Refer to paragraph 9-7 for cleaning procedure.

9-174. Inspection — Master Caution Panel. Refer to paragraph 9-22 for inspection procedure.

9-175. Troubleshooting — Master Caution Panel. Refer to paragraph F-11 for index to wiring diagrams and trace malfunctioning circuit or loop, using standard electronic troubleshooting procedures and standard test equipment. Localize malfunctioning components, and repair or replace as required.

9-176. Removal — Master Caution Panel. a. Loosen fasteners and lift caution panel from panel.

b. Disconnect electrical connector.

9-177. Repair or Replacement — Master Caution Panel (AVIM). a. Disassembly.

NOTE

Disassemble panel in order indexed. Disassemble only to extent necessary to accomplish replacement of damaged parts, as determined by inspection or troubleshooting procedure.

(1) Turn three fasteners (1, figure 9-2) to remove cover (5) from assembly to obtain access to interior of unit.

(2) If malfunction has been traced to a component of one of the printed circuit board assemblies (7, 8, or 9) remove the circuit board involved by removing screws (6) and unplugging board from electrical connector (29, 30, or 31).

(3) Before disconnecting any electrical leads, tag wire leads to aid in replacement of wiring at reassembly.

b. Cleaning.

(1) Remove dust or dirt from exposed surfaces, using dry compressed air at a maximum pressure of **10** psig.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

(2) Remove corrosion, dirt or other foreign matter from parts with cleaning solvent (C205), using a clean, lint-free cloth or a soft bristle brush (C32).

(3) Thoroughly dry all parts after cleaning with a clean, lint-free cloth or with compressed air at **10** psig.

c. Inspection.

(1) Inspect all components for security of connections and bent or broken pins, contacts, and terminals.

(2) Inspect wiring and connections to all parts for loose connections, burned or broken wires and insulation, and proper grounding.

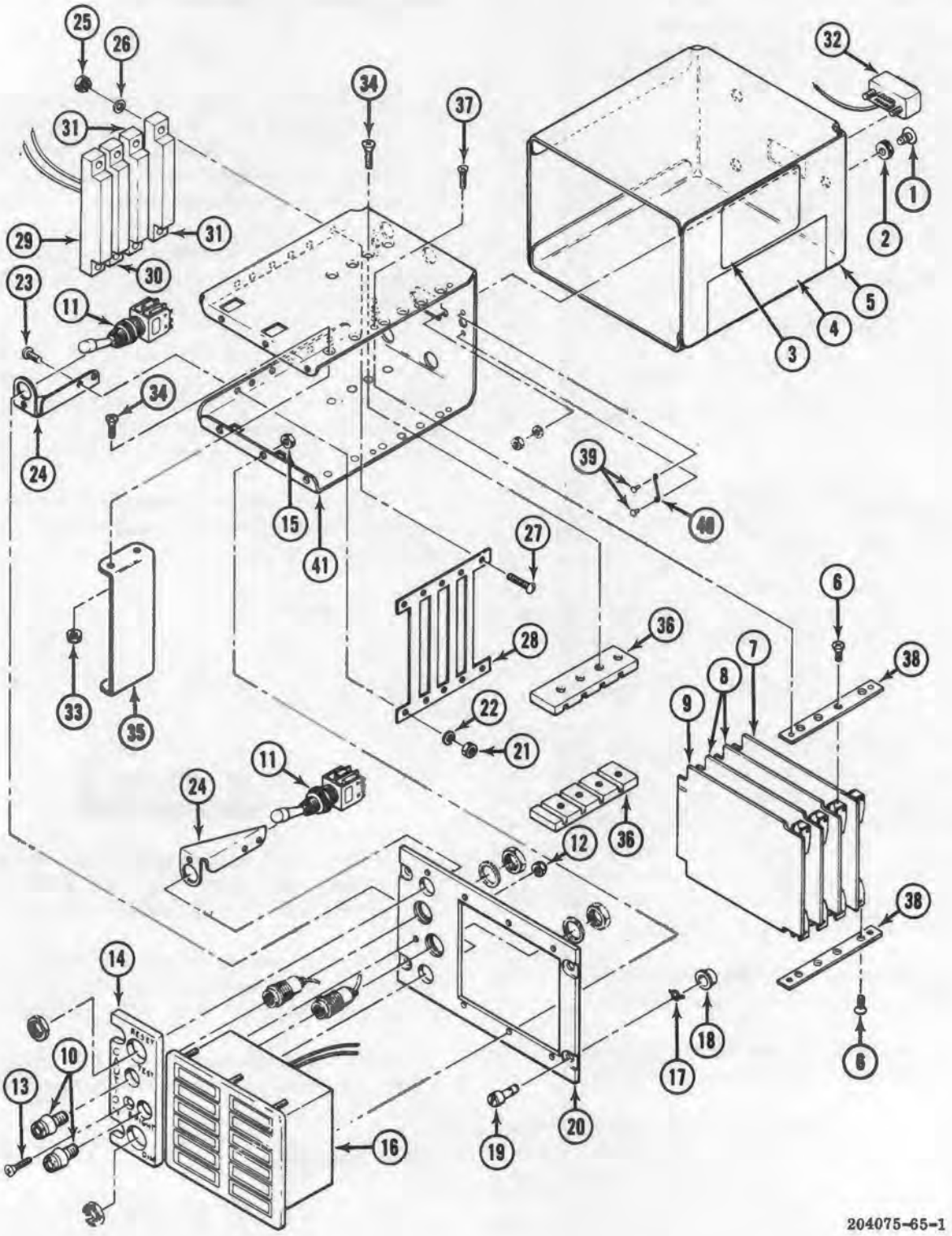

Figure 9-2. Master caution panel — exploded view (Sheet 1 of 2)

1. Fastener
2. Grommet
3. Plate, identification
4. Plate, schematic
5. Cover
6. Screw
7. Printed circuit board assy
8. Printed circuit board assy
9. Printed circuit board assy
10. Light, panel
11. Switch
12. Nut
13. Screw
14. Panel
15. Nut
16. Roto-tellite
17. Spring
18. Cup
19. Fastener
20. Plate
21. Nut
22. Washer, lock
23. Screw
24. Bracket
25. Nut
26. Washer, lock
27. Screw
28. Stiffener
29. Connector, electrical
30. Connector, electrical
31. Connector, electrical
32. Connector, electrical
33. Nut
34. Screw
35. Stiffener
36. Rail
37. Screw
38. Rail
39. Rivet
40. Spring
41. Bracket clamp, cable bus bar, light ground

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Figure 9-2. Master caution panel — exploded view (Sheet 2 of 2)

(3) Inspect resistors for evidence of loose or broken terminals and wire leads, burned or swollen bodies, or other visual signs of damage.

(4) Inspect coils for evidence of damage. If necessary, check continuity of coils with an ohmmeter.

(5) Inspect removed printed circuit boards for broken leads, short, or damaged components. Inspect relays and diodes for broken glass envelopes.

d. Repair or Replacement.

(1) Repair of the master caution panel is limited to minor repairs, such as soldering loose connections and straightening bent connector pins. Damaged or malfunctioning electronic parts shall be replaced with no attempt at repair of such items.

NOTE

In each case, replace components in the exact location from which the replaced part was removed.

(2) Replace lamps in indicators of the rototellite assembly by rotating the indicator to reach the lamps in base of the unit. Lamps are held in place by spring clips.

e. Assembly.

(1) Reassemble master caution panel in reverse order of index numbers assigned in figure 9-2 noting the following.

(2) Refer to master caution panel schematic diagram in Appendix F when installing new electronic components or wiring.

(3) If new parts are installed, trim excess wire leads after soldering.

(4) Install all attaching hardware in same position and location from which removed.

f. Test Procedure. Inflight testing should be limited to periodically pushing the test/reset switch to TEST. This results in every indicator, including the master caution indicator, lighting either bright or dim, depending on the condition to which the system was last set by the bright/dim switch.

9-178. Installation — Master Caution Panel. a. Connect electrical connector.

b. Position panel in mount, being careful not to damage wiring.

c. Engage fasteners.

9-179. RPM LIMIT WARNING SYSTEM.

9-180. Description — RPM Limit Warning System. The rpm limit warning system includes the RPM WARN SYSTEM circuit breaker located in the overhead console, rpm limit warning detector (DS1), rpm warning light (I45), LOW RPM switch (S118) and related wiring and connectors. The rpm warning detector, operating on dc power, senses and interprets rotor and engine rpm through connection to tachometer circuits. If the rotor rpm exceeds normal limit, warning light will illuminate. When either rotor or engine rpm reaches low limit, a warning light is illuminated. When both rotor and engine rpm reach low limit, an audio signal is produced in pilot's and gunner's headset, and the warning light is illuminated. For starting and ground operation, audio tone can be turned off by the AUDIO RPM switch.

NOTE

Before installation, the rpm warning system detector is adjusted. Readjustment may be required whenever a tachometer generator is replaced, due to tolerances on tachometer components. Replacement of an engine tachometer generator will not require a check of rotor high rpm setting.

9-181. Functional Test — RPM Limit Warning System.

NOTE

Test the rpm limit warning system with engine running after replacement of rpm limit warning detector, rotor tachometer generator, or engine tachometer generator.

a. Low Rpm Limit Test.

(1) Position the LOW RPM switch (S118) on the pilots engine control panel to AUDIO.

(2) Adjust for an engine speed of approximately **6300** rpm (corresponds to **310** rotor rpm) and check that the red rpm limit warning light on the instrument panel is off and that the audio warning signal is not audible in the pilot or copilot headsets.

(3) Decrease engine speed very slowly to the point where the rpm limit warning light illuminates and a swept-frequency audio warning signal (series of audio bursts) is audible in the pilot and copilot headsets. This point should be at an engine speed of **6200 ± 100** rpm (corresponds to **305 ±5** rotor rpm.

(4) Position the LOW RPM switch (S118) to OFF. The audio signal in the headsets should cease.

(5) Adjust for an engine speed below **6000** rpm (corresponds to **295** rotor rpm), the rpm limit warning light should be illuminated, but the audio warning signal should not be audible in the pilot and copilot headsets.

(6) Increase the engine speed and verify that the rpm limit warning light extinguishes within the limits of **6200 ± 100** engine rpm (corresponds to **305 ± 5** rotor rpm). The LOW RPM switch should automatically return to AUDIO position.

b. High Rotor Rpm Warning Test.

(1) Position the LOW RPM switch (S118) to the AUDIO position.

CAUTION

Do not exceed 15 psi torque pressure (L-13) or 85% N1 (L-11).

NOTE

For this test/alignment only, a steady state rpm of up to 6900 output shaft speed is permissible and is not to be considered an engine overspeed as long as 15 psi torque meter pressure (L-13) or 85% N1 (L-11) is not exceeded. The collective pitch must be at the full down position at all times during this check.

(2) With the rotor in flat pitch and the GOV AUTO/EMER governor switch set to EMER, slowly increase throttle until the rpm warning light illuminates. The warning light should illuminate at a rotor speed of **334 ± 5** rpm (corresponds to an engine speed of **6800 ± 100** rpm) and the audio warning signal should not be audible in the pilot and copilot headsets.

9-182. Alignment — RPM Warning System. If the rpm limit warning system does not meet the requirements of the high and low rpm warning tests, align the system in accordance with the following paragraphs. Determine the model of the detector and test point location from figures 9-3, 9-4, and 9-5, then use table 9-8 to properly isolate each circuit for alignment in the different models. Test equipment is shown in figure 9-7. See figure 9-6 for cables to align rpm warning detector.

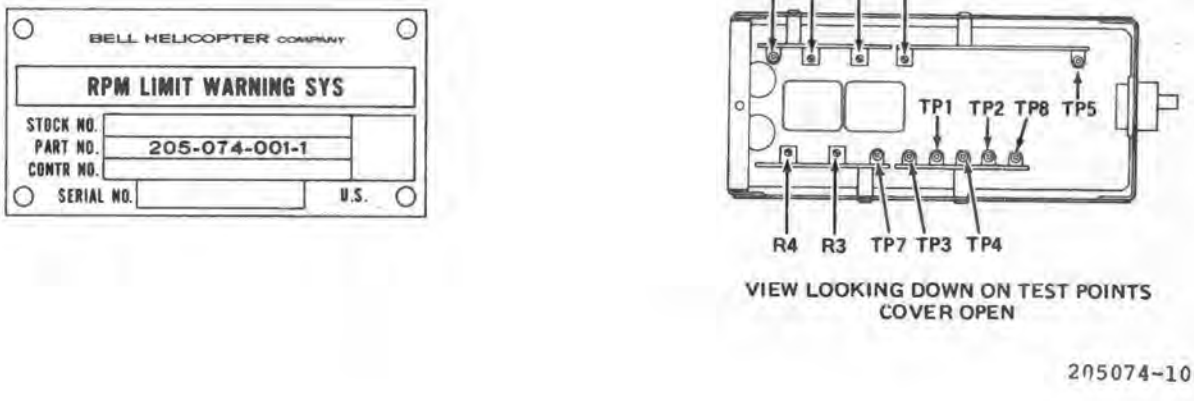


Figure 9-3. BHT model rpm limit warning detector

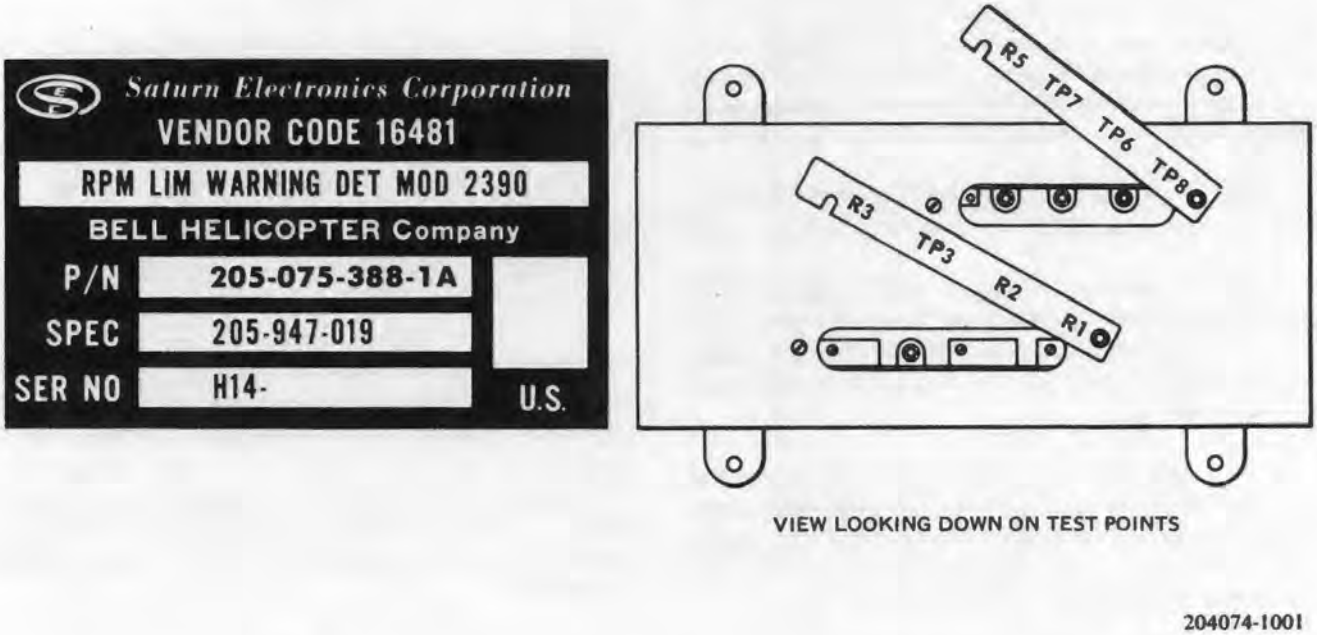


Figure 9-4. Saturn model rpm limit warning detector

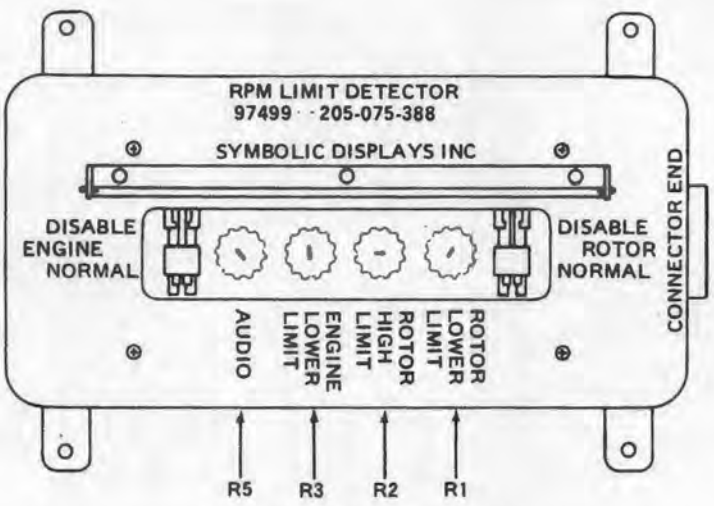
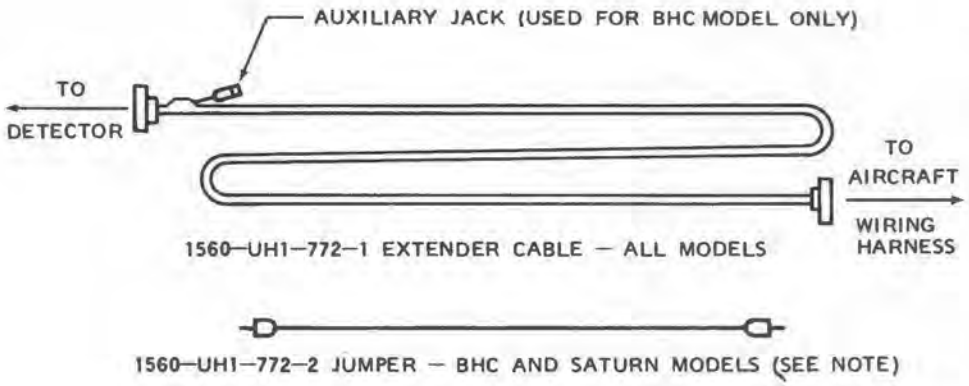
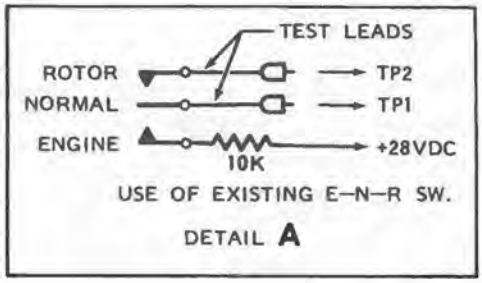


Figure 9-5. SDI model rpm limit warning detector





NOTE
Existing test sets using an ENGINE-NORMAL-ROTOR (E-N-R) switch may be used. Connect as shown in Detail A for BHC models or position switch to ROTOR and use test leads only as a jumper for SATURN models.

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Figure 9-6. Cables for alignment of rpm limit warning detector

WARNING

If alignment of RPM limit warning detector is necessary the engine should be shut down, the detector detached from the aircraft, and the 1560-UH-1-772-1 extender cable or equivalent used to align the detector with the repairman strapped in one of the helicopter seats during the engine run.

CAUTION

Use caution in making adjustments as excessive turning of screw or slotted adjustment can damage box.

NOTE

To increase the rpm at which the warning light will illuminate, turn slotted adjustments clockwise. One half turn of the potentiometer shaft will cause a change of 5 rotor rpm or 100 engine rpm. Do not adjust R4 and R5. These are bench check adjustments.

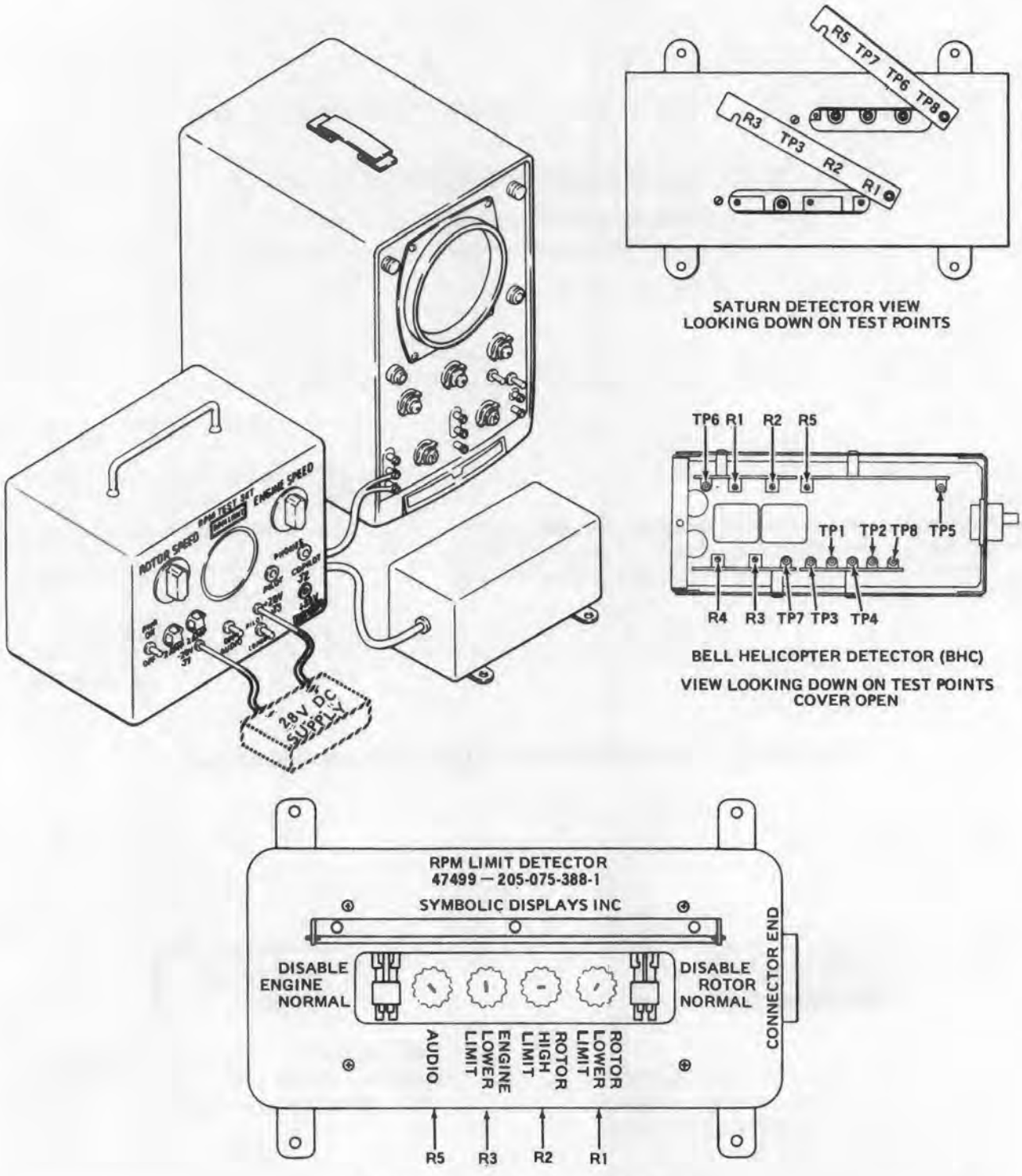


Figure 9-7. Bench test set-up for rpm limit warning detector

Table 9-8. Isolation of Circuits for Alignment — RPM Limit Warning Detector Models

TO ALIGN	DISABLE	B.H.C. Model	SATURN Model	S.D.I. Model
R3 ENGINE LOWER LIMIT	ROTOR CIRCUIT	To CONNECT TP1 Through 10,000 Ohm RESISTOR to +28 VDC, Jumper TP1 to AUX JACK or E-N-R Switch — ENGINE	CONNECT TP6 to TP8 With Jumper	ENGINE Switch — NORMAL ROTOR Switch — DISABLE
R1 ROTOR LOWER LIMIT	ENGINE CIRCUIT	CONNECT TP1 to TP2 With Jumper or E-N-R Switch — ROTOR	CONNECT TP7 to TP8 With Jumper	ENGINE Switch — DISABLE ROTOR Switch — NORMAL

a. Alignment of RPM lower limit.

(1) Disengage the RPM WARN SYSTEM Circuit Breaker.

(2) Disconnect helicopter harness from detector, detach detector from helicopter, and install 1560-UH1-772-1 Extender cable or equivalent between detector and helicopter harness.

(3) Loosen screws and open cover of the detector.

(4) Engage the RPM WARN SYSTEM circuit breaker and position LOW RPM audio switch to the AUDIO position. An audio warning should be present in both pilot and copilot headsets.

(5) Start the helicopter engine and increase engine speed to approximately **6300** rpm (corresponds to **310** rotor rpm). The audio signal in the headsets should cease.

(6) Set switch or connect jumper to align R3 ENGINE LOWER LIMIT in accordance with table 9-8.

(7) Decrease the engine speed to **6100** rpm (corresponds to **300** rotor rpm).

(8) If, following step (7), the warning light is illuminated, turn R3 slowly counterclockwise until the warning light just extinguishes and then very slowly clockwise until the light again illuminates. If, following step (7), the warning light is extinguished, turn R3 very slowly clockwise until the light just illuminates.

(9) Vary the engine speed slowly above and below **6100** rpm (corresponds to **300** rotor rpm) while observing the warning light. Verify that the warning occurs at an engine speed of **6100 ± 100** rpm (corresponds to **300 ± 5** rotor rpm), if not, repeat steps (7), (8), and (9).

(10) Reset switches or reconnect jumper to align R1 ROTOR LOWER LIMIT in accordance with table 9-8.

(11) Adjust for a rotor speed of **305** rpm (corresponds to **6200** engine rpm.)

(12) If, following step (11), the warning light is illuminated, turn R1 slowly counterclockwise until the light just extinguishes, then very slowly clockwise until the light again illuminates. If, following step (11), the warning light is extinguished, turn R1 very slowly clockwise until the light just illuminates.

(13) Vary the rotor speed above and below **305** rpm (corresponds to **6200** engine rpm) while observing the warning light. Verify that warning occurs at **300 ± 5** rotor rpm (corresponds to **6100 ± 100** engine rpm). If not, repeat steps (11), (12), and (13).

(14) Reset switches to NORMAL or remove jumper. Extender cable will remain connected for alignment of RPM High Limit.

b. Alignment of RPM High Limit.

(1) The high limit uses rotor RPM only, and disabling the engine circuit is not necessary to align R2 rotor high limit.

(2) With the rotor in flat pitch and the GOV AUTO/EMER switch set to EMER, slowly increase throttle until the rotor speed is **334 ± 5** rpm (corresponds to engine speed of **6800 ± 100** rpm).

NOTE

A rotor rpm of 329-334 (engine rpm of 6700-6800) is preferable to increase the margin of over speed warning.

(3) If, following step (2), the warning light is illuminated, turn R2 clockwise until the light just extinguishes, then very slowly counterclockwise until the light just illuminates. If, following step (2), the warning light is extinguished, turn R2 very slowly counterclockwise until the warning light just illuminates.

(4) Vary the engine speed to verify that the warning light illuminates and that audio warning does not occur at **334 ± 5** rotor rpm (corresponds to **6800 ± 100** engine rpm). If the warning light does not illuminate, repeat steps (2), (3) and (4).

(5) Disengage the RPM WARN SYSTEM circuit breakers.

(6) Reset switches to normal, remove any test leads, close detector cover and secure.

(7) After engine shutdown, remove extender cable and reinstall the rpm limit warning detector.

(8) Engage the RPM WARN SYSTEM circuit breaker.

9-183. Troubleshooting — RPM Limit Warning System. Use table 9-9 and perform checks as necessary to isolate trouble. In the following table, tripped circuit breakers and burned-out indicator lamps are omitted from indications of trouble. Such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-9. Troubleshooting — RPM Limit Warning System

CONDITION
TEST OR INSPECTION
CORRECTIVE ACTION

1. No audio tone is present in pilot or copilot headsets; engine not running and rpm warning light is illuminated.

   STEP 1. Check for defective LOW RPM switch (S118).

   Replace switch if defective (paragraphs 9-9 and 9-11).

   STEP 2. Check for defective rpm limit warning detector (DS1).

   Replace rpm limit warning detector if defective (paragraphs 9-189 and 9-191).

2. Placing LOW RPM switch (S118) to OFF does not eliminate audio tone in headsets.

   STEP 1. Check for defective LOW RPM switch (S118).

   Replace switch if defective (paragraphs 9-9 and 9-11).

3. Rpm warning light (I45) does not illuminate when engine is not running. Audio tone present in headsets.

   STEP 1. Check for defective rpm limit warning detector (DS1).

   Replace rpm limit warning detector if defective (paragraphs 9-189 and 9-191).

Table 9-9. Troubleshooting — RPM Limit Warning System (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
4. Rpm warning light (I45) does not illuminate, no audio tone present in headsets when engine is not running.	STEP 1. Check for defective RPM WARN SYSTEM circuit breaker.	**Replace circuit breaker if defective (paragraphs 9-16 and 9-18).**
	STEP 2. Check for defective rpm limit warning detector (DS1).	**Replace rpm limit warning detector if defective (paragraphs 9-189 and 9-191).**

9-184. RPM LIMIT WARNING DETECTOR.

9-185. Description — RPM Limit Warning Detector. The rpm limit warning detector (DS1), operating on dc power from the 28 Vdc essential bus, senses and interprets rotor and engine rpm through connection to tachometer circuits. If rotor exceeds normal limit, power is furnished through the detector to illuminate the rpm warning light (I45). When either rotor or engine rpm reaches low limit, the detector produces an audio signal in the pilot and copilot headsets and illuminates the rpm warning light.

9-186. Cleaning — RPM Limit Warning Detector.
a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connector with a bristle brush (C32).

9-187. Inspection — RPM Limit Warning Detector. **a.** Inspect detector for cracked or distorted case.

b. Check for bent or broken connector pins.

c. Check for proper operation.

9-188. Bench Test and Adjustment — RPM Limit Warning Detector. (AVIM)

NOTE

The rpm test set may be locally fabricated. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

The pilot and copilot audio outputs are loaded within the test set so that an oscilloscope may be used to monitor audio signals. The scope input cable is connected to a scope input switch that allows selection of pilot or copilot audio output.

a. Use table 9-8 to isolate circuits in different models of rpm detectors.

b. Use equipment shown in figure 9-7 and F-13 and test each rpm limit warning detector as follows:

(1) Loosen detector cover strip screws and move cover strips to expose test points and adjustment potentiometers.

(2) Connect detector to the bench test equipment as shown in figure 9-7. Set initial control positions on the test set as follows:

CONTROL	POSITION
PWR ON/OFF	OFF
ENGINE SPEED	FULLY COUNTER-CLOCKWISE
ROTOR SPEED	FULLY COUNTER-CLOCKWISE
AUDIO ON/OFF	ON
SCOPE INPUT	PILOT

(3) Energize the test equipment and allow a sufficient warmup period.

(4) Apply 27.5 Vdc power to the DC power packs on the front of the test set. Observe that the warning light on the test set is illuminated and that a sweeping audio signal is displayed on the oscilloscope for both the PILOT and COPILOT positions of the scope input switch.

(5) Connect a headset to the COPILOT phone jack and determine that the aural signal is of good quality. Disconnect headset.

(6) Repeat step (5) with headset plugged into the PILOT phone jack.

(7) Disable engine circuit to align R1 ROTOR LOWER LIMIT in accordance with table 9-8.

(8) Adjust test set for a simulated rotor speed of **300** rpm and an engine speed of **6100** rpm. If the warning light is illuminated, adjust R1-ROTOR LOWER LIMIT counterclockwise until the light just extinguishes.

(9) Adjust R1-ROTOR LOWER LIMIT clockwise very slowly until the light just illuminates. With the light illuminated, an audio signal must be displayed on the oscilloscope for both the PILOT and COPILOT positions of the scope input switch.

(10) Position audio ON/OFF switch to OFF. The sweeping audio signal must cease.

(11) Slowly increase simulated rotor speed through **300** rpm. Observe that the audio switch automatically returns to the ON position when the warning light extinguishes.

(12) Increase simulated rotor speed to **334** rpm. If the warning light is illuminated, adjust R2-ROTOR HIGH LIMIT clockwise until the light just extinguishes.

(13) Ajust R2-ROTOR HIGH LIMIT very slowly counterclockwise until the light just illuminates. Observe that an audio signal is not displayed on the oscilloscope for either PILOT or COPILOT positions of the scope input switch.

(14) Adjust for a simulated rotor speed of **315** rpm. Observe that the warning light is extinguished and that audio signal is not displayed on the oscilloscope for either the PILOT or COPILOT positions of the scope input switch.

NOTE

For Saturn detectors, step (15) checks the engine channel tachometer failure circuits. For other models go to step (16).

(15) Momentarily adjust for a simulated engine speed of **0** rpm. Observe that the warning light illuminates and that audio signal is displayed on the oscilloscope for both PILOT and COPILOT positions of the scope input switch.

(16) Remove jumper or reposition switch used to disable engine circuits in step (7) and disable rotor circuit to align R3-ENGINE LOWER LIMIT in accordance with table 9-9.

(17) With the simulated rotor speed still at **315** rpm, adjust for a simulated engine speed of **6200** rpm. If the warning light is illuminated adjust R3-ENGINE LOWER LIMIT counterclockwise until the light just extinguishes.

(18) Adjust R3-ENGINE LOWER LIMIT clockwise until the light just illuminates. While the warning light is illuminated, observe that audio signal is displayed on the oscilloscope for both the PILOT and COPILOT positions of the scope input switch.

(19) Adjust for a simulated engine speed of **6400** rpm. Observe that the warning light is extinguished and that the audio signal is not displayed on the oscilloscope for either the PILOT or COPILOT positions of the scope input switch.

NOTE

Step (20) checks proper function only. The engine high limit potentiometer R4 is factory adjusted fully clockwise and is not to be adjusted.

(20) Repeat step (19) at a simulated engine speed of **7000** RPM.

NOTE

For Saturn detectors, step (21) checks the audio portion of the rotor channel tachometer failure circuits. For other models go to step (22).

(21) Momentarily adjust the simulated rotor speed to **0** rpm. Observe that the warning light is illuminated and that audio signal is displayed on the oscilloscope for both PILOT and COPILOT positions of the scope input switch.

(22) Remove jumper or reposition switch used to disable rotor circuit in step (16). Adjust rotor and engine speed controls on test set fully counterclockwise.

(23) Position scope input switch to PILOT and adjust R5-AUDIO for a waveform of **0.5** volts peak-to-peak. Position scope input switch to COPILOT and observe that the indicated waveform is not less than **0.25** volts peak-to-peak and not more than **0.75** volts peak-to-peak.

(24) Disconnect detector from test set and reassemble unit.

9-189. Removal — RPM Limit Warning Detector. a. Remove attaching hardware and electrical connector.

b. Remove detector.

9-190. Repair or Replacement — RPM Limit Warning Detector. a. Tighten or repair any loose or defective mounting hardware or electrical connector.

b. Replace detector if any other inspection requirements are not met.

9-191. Installation — RPM Limit Warning Detector. a. Postion detector into place and install mounting hardware.

b. Connect electrical connector.

9-192. EXTERIOR LIGHTS SYSTEM.

9-193. Description — Exterior Lights System. The exterior lights system includes the landing and searchlights, anticollision light, navigation lights, navigation lights flasher, and transmission oil level light.

9-194. LANDING AND SEARCHLIGHT SYSTEM.

9-195. Description — Landing and Searchlight System. One landing light and one searchlight are located on the underside of the cabin. Each has individual control and power circuits which are powered from essential bus and protected by circuit breakers. Control switches for both lights are located on the pilots collective stick. They consist of four switches, two that control power to the lamps, and two that control the positions of the lights.

9-196. Functional Test — Landing and Searchlight System. a. Perform functional test of landing light as follows:

CAUTION

Do not operate landing light in areas of combustible material, such as tall grass. etc.

(1) Close LDG LT PWR and LDG & SEARCHLIGHT CONT circuit breakers. Position landing light control switch (S76) on the pilot collective stick to ON and check that landing light illuminates. Return switch (S76) to OFF.

(2) Position landing light extend-retract switch (S25) to EXTEND (fwd position). Check that light extends and is stopped by the extend limit switch at approximately **120** degrees extension.

(3) Position switch (S25) to RETRACT (aft position). Check that landing light retracts and is stopped in the stowed position by the retract limit switch.

b. Perform functional test of searchlight as follows:

CAUTION

Do not operate searchlight in areas of combustible material, such as tall grass. etc.

(1) Close SEARCHLIGHT PWR and LDG & SEARCHLIGHT CONT circuit breakers. Position search light control switch (S75) to ON and check that searchlight illuminates. Return switch to OFF.

(2) Position four-way switch (S12) to EXT (fwd position). Check that light extends and is stopped by extend limiter switch at approximatley **120** degrees extension.

(3) Position switch (S12) to RETR (aft position). Check that light retracts.

(4) With light partially extended, position switch (S12) to "L" and check that light rotates to the left.

(5) Position switch (S12) to "R" and check that light rotates to the right.

(6) With light extended and rotated, position switch (S75) to S L STOW. Check that light retracts and is stopped by the retract limit switch and then rotates to its level stowed position and stops.

9-197. Troubleshooting — Landing and Searchlight System. Use table 9-10 and perform checks as necessary to isolate trouble. Tripped circuit breakers are omitted from indication of trouble since such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-10. Troubleshooting — Landing and Searchlight System

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. Landing light (I16) inoperative.	
STEP 1. Ensure that voltage is present on 28 Vdc bus. Check for defective LDG LT PWR and/or LDG & SEARCHLIGHT CONT circuit breakers.	**Replace circuit breaker(s) if defective (paragraphs 9-16 and 9-18).**
STEP 2. Check for defective landing light switch (S76).	**Replace switch if defective (paragraphs 9-5 through 9-11).**
2. Landing light dim, constant or intermittent.	
STEP 1. Place temporary jumper from bare metal on lamp to metal frame and then turn on. If lamp burns brightly constantly, check mounting of lamp for corrosion and/or paint.	**Clean as necessary to provide a good electrical ground (paragraph 9-7).**
STEP 2. Check for loose power lead or corroded terminal.	**Tighten or clean connection in power circuit (paragraph 9-7, 9-10).**
STEP 3. Check for burned relay contacts.	

Table 9-10. Troubleshooting — Landing and Searchlight System (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
		Replace relay if defective (paragraphs 9-5 through 9-11).
3. Searchlight (I11) inoperative.	STEP 1. Ensure that voltage is present on 28 Vdc bus and check for defective SEARCHLIGHT PWR and/or LDG & SEARCHLIGHT CONT circuit breakers.	**Replace circuit breaker(s) if defective (paragraphs 9-16 and 9-18).**
	STEP 2. Check for defective searchlight switch (S75).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
4. Searchlight dim, constantly or intermittently.	STEP 1. Place temporary jumper from bare metal on lamp to metal frame and then turn on. If lamp burns brightly constantly, check mounting of lamp for corrosion and/or paint.	**Clean as necessary to provide a good electrical ground (paragraph 9-7).**
	STEP 2. Check for loose power lead or corroded terminal.	**Tighten or clean connection in power circuit (paragraphs 9-7 and 9-10).**
	STEP 3. Check for burned relay contacts.	**Replace relay if defective (paragraphs 9-9 and 9-11).**

9-198. LANDING AND SEARCHLIGHTS.

9-199. Description — Landing and Searchlights. The landing light is controllable with extend and retract motion. The searchlight is controllable with extend, retract, rotate left, and rotate right motion.

9-200. Cleaning — Landing and Searchlights. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

9-201. Inspection — Landing and Searchlights. a. Check light for defective or broken sealed beam unit.

b. Check for loose connections, and damaged or defective component parts (terminal strips, limit switches, drive motors, relays, etc.).

9-202. Removal — Landing and Searchlights. a. Ensure all electrical power is OFF.

b. Remove attaching screws from light assembly mounting plate; lower light and plate.

c. Remove light mounting screws.

d. Remove terminal cover, disconnect and protect wires.

e. Remove light assembly.

9-203. Repair or Replacement — Landing and Searchlights. a. Accomplish replacement of sealed beam lamp as follows: Remove three screws from lamp retainer ring, remove ring and gasket, lift lamp and disconnect wiring.

NOTE

Observe position of lamp before removal and install new unit in same position using reverse order of removal procedure.

b. Replace complete unit if inspection items in paragraph 9-201, step b. are not met.

9-204. Installation — Landing and Searchlights. a. Connect wires and install terminal cover and clamp.

b. Position light on mounting plate; secure with mounting screws.

c. Position plate and light assembly on fuselage and secure with mounting screws.

d. Check light for proper operation.

9-205. ANTICOLLISION LIGHT SYSTEM.

9-206. Description — Anticollision Light System. Anticollision light system consists of a circuit breaker, a switch, and the anticollision light assembly. Anticollision light is installed on tailpipe fairing. Circuit breaker and switch are on overhead console.

9-207. Functional Test — Anticollision Light System. a. Close ANTI-COLL LIGHT circuit breaker.

b. Position ANTI-COLL switch (S59) to ON and check that lamp(s) illuminate and that the light rotates at approximately **45** rpm, giving **90** flashes per minute.

9-208. Troubleshooting — Anticollision Light System. Use table 9-11 and perform checks as necessary to isolate trouble. Tripped circuit breakers are omitted from indication of trouble since such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-11. Troubleshooting — Anticollision Light System

CONDITION TEST OR INSPECTION **CORRECTIVE ACTION**
1. Anticollision light (I40) fails to operate with anticollision light switch (S59) in ON position.
STEP 1. Ensure that voltage is present on 28 Vdc bus and check for defective ANTI-COLL LIGHT circuit breaker.
Replace circuit breaker if defective (paragraphs 9-16 and 9-18).
STEP 2. Check for defective anticollision light switch (S59).
Replace switch if defective (paragraphs 9-9 and 9-11).
2. Anticollision light fails to rotate with anticollision light switch (S59) in ON position.
STEP 2. Check for proper operating voltage at pin B of connector (P111).
Replace anticollision light if defective (paragraphs 9-213 and 9-215).

9-209. ANTICOLLISION LIGHT.

9-210. Description - Anticollision Light. The anticollision light may have one or two bulbs. The internal assembly is motor driven and rotates to produce a flash effect.

9-211. Cleaning — Anticollision Light. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

9-212. Inspection — Anticollision Light. a. Inspect light for broken cover, lens or open lamp filament.

b. Inspect light for damaged case, or broken connector pins.

c. Inspect motor for damage and proper operation.

9-213. Removal — Anticollision Light. a. Ensure that all electrical power is OFF.

b. Remove mounting screws around base of light, lift light up, and disconnect electrical connector.

9-214. Repair or Replacement — Anticollision Light. a. Loosen screw securing lens cover retaining ring, lift lens from light base. Install and secure lamp, lens or cover in reverse order of removal procedure.

b. Replace complete unit if inspection requirements are not met.

c. Replace motor if defective.

9-215. Installation — Anticollision Light. a. Connect electrical connector to light and secure with lockwire (C126.1).

b. Place light in recess and install mounting screws.

c. Check light for proper operation.

9-216. NAVIGATION LIGHTS SYSTEM.

9-217. Description — Navigation Lights System. The navigation lights system consists of circuit breaker, two selector switches, flasher, two red lights on the left side and two green lights on the right side (one each above and below the cabin door), three fuselage white lights (one above each cabin door and one on bottom right side of cabin), and one amber/clear light in the vertical fin of the aft section assembly. On helicopters S/N 66-9416 and subsequent the white lights are protected by a separate circuit breaker.

9-218. Functional Test — Navigation Lights System. a. Close NAV LIGHTS circuit breaker. On helicopters S/N 66-9416 and subsequent, also close FUS LIGHTS circuit breaker.

b. Place POSITION or NAVIGATION lights switch (S13) to STEADY.

c. Place POSITION or NAVIGATION lights switch (S14) to BRIGHT and check for the following:

(1) The two upper and one lower fuselage lights are on bright.

(2) The two red (left side) and two green (right side) navigation lights and the tail light are illuminated and are on bright.

d. Place POSITION or NAVIGATION lights switch (S14) to DIM and check that the fuselage and navigation lights specified in step c. above are on dim.

e. Place POSITION or NAVIGATION lights switch (S13) to FLASH and check for the following:

(1) On helicopters prior to S/N 66-9416, the fuselage lights flash alternately with the navigation lights at a rate of approximately 40 cycles per minute.

(2) On helicopters S/N 66-9416 and subsequent, only the navigation and tail lights flash at a rate of 85 ± 15 cycles per minute.

9-219. Troubleshooting — Navigation Lights System. Use table 9-12 and perform checks as necessary to isolate trouble. Tripped circuit breakers are omitted from indication of trouble since such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-12. Troubleshooting — Navigation Lights System

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Fuselage lights (white) fail to burn bright with switch (S13) to STEADY and switch (S14) to BRT.

   STEP 1. Check for defective switch (S14).

   Replace switch if defective (paragraphs 9-9 and 9-11).

2. Fuselage lights (white) fail to dim with switch (S14) to DIM.

   STEP 1. Check for defective switch (S14).

   Replace switch if defective (paragraphs 9-9 and 9-11).

3. One fuselage or navigation light dim or intermittent.

   STEP 1. Check for poor electrical ground at light.

   Remove light and clean ground (paragraph 9-7).

4. Navigation lights (red, green, and amber/clear) fail to burn bright with switch (S13) to STEADY and switch (S14) to BRT.

   STEP 1. Check for defective switch (S14).

   Replace switch if defective (paragraphs 9-9 and 9-11).

5. Navigation lights (red, green, and amber/clear) fail to dim with switch (S14) to DIM.

   STEP 1. Check for defective switch (S14).

   Replace switch if defective (paragraphs 9-9 and 9-11).

   STEP 2. Check for defective dimming resistor (R7).

   Replace resistor if defective (paragraphs 9-9 and 9-11).

Table 9-12. Troubleshooting — Navigation Lights System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
6. Navigation lights (red, green, and amber/clear) fail to flash when switch (S13) is placed to FLASH.	
STEP 1. Check for defective switch (S13).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 2. Check for defective flasher (Z3).	**Replace flasher if defective (paragraphs 9-231 and 9-233).**
7. On helicopters prior to S/N 66-9416, fuselage lights (white) fail to flash when switch (S13) is placed to FLASH.	
STEP 1. Check for defective switch (S13).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 2. Check for defective flasher (Z3).	**Replace flasher if defective (paragraphs 9-231 and 9-233).**

9-220. NAVIGATION LIGHTS.

9-221. Description — Navigation Lights. The navigation lights consist of the upper and lower fuselage lights, upper and lower navigation lights, and the tail light. The fuselage light units have two bulbs which furnish dim or bright white light. The navigation lights installed on the right side of the helicopter furnish green light, the lights installed on the left side of the helicopter furnish red light, and the tail light furnishes amber or clear light.

9-222. Cleaning — Navigaiton Lights. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush (C32).

9-223. Inspection — Navigation Lights. Inspect lights for corroded lamp socket terminals, shorted or broken wires, cracked lens, burned out lamp bulbs, or improper bonding of light case to airframe.

9-224. Removal — Navigation Lights. a. Check that all electrical power is OFF.

b. Remove cover retaining screw. Remove screws attaching light assembly to bracket, pull assembly from helicopter, and disconnect electrical connector. Lift light assembly from helicopter. Cover loose wire with tape.

9-225. Repair or Replacement — Navigation Lights. Replace faulty or damaged component parts (lens, lamp bulbs, etc.). If light case is damaged beyond repair, complete unit must be replaced.

9-226. Installation — Navigation Lights. a. Remove tape from wire and connect wire to light. Secure light to adapter bracket with screws. Install cover with screw.

b. Check operation of light.

9-227. NAVIGATION LIGHTS FLASHER.

9-228. Description — Navigation Lights Flasher. The navigation lights flasher is mounted in the aft electrical compartment. On helicopters prior to S/N 66-9416, the flasher will cause the white and colored navigation lights to flash alternately. On helicopters S/N 66-9416 and subsequent, the flasher will cause only the colored navigation lights to flash.

9-229. Cleaning — Navigation Lights Flasher. a. Remove moisture and loose dirt with a clean, soft cloth.

WARNING

Dry cleaning solvent is flammable and its fumes are toxic. Provide adequate ventilation. Do not use near a flame.

b. Remove grease, fungus, and dirt with a clean, lint-free cloth dampened with dry cleaning solvent (C205).

c. Remove dirt from electrical connectors with a bristle brush.

9-230. Inspection — Navigation Lights Flasher. Inspect flasher case for dents or damage that would impair normal operation of the unit. Check connector for broken or corroded pins and cracked inserts.

9-231. Removal — Navigation Lights Flasher. a. Ensure all electrical power is OFF.

b. Disconnect electrical connector. Remove mounting hardware and lift from compartment.

9-232. Repair or Replacement — Navigation Lights Flasher. Replace item if inspection requirements are not met.

9-233. Installation — Navigation Lights Flasher. a. Position flasher in compartment and install mounting hardware.

b. Connect electrical connector. Check for proper operation.

9-234. TRANSMISSION OIL LEVEL LIGHT.

9-235. Description — Transmission Oil Level Light. The transmission oil level light (I25) is located inside the transmission cowling on the right side of the helicopter. The light is used to illuminate the transmission sump area so that the transmission oil level sight gages will be visible when viewing through the fire access door in the right side transmission cowling. The light is powered from the battery system through the BATTERY VOLTMETER circuit breaker. Pressing the XMSN OIL LEVEL LT SWITCH (S4), located on the right side of the helicopter, illuminates the light. Refer to paragraphs 9-5 through 9-11 for maintenance procedure.

9-236. Functional Test — Transmission Oil Level Light. a. Close BATTERY VOLTMETER circuit breaker.

b. Press pushbutton switch (S4). Check operation of the light through the fire access door in the right hand transmission cowling.

9-237. Troubleshooting — Transmission Oil Level Light. Use table 9-13 and perform checks as necessary to isolate trouble. Tripped circuit breakers are omitted from indication of trouble since such trouble is usually easily detected and corrected. Broken wiring is always a probable cause of circuit malfunction or failure and has not been included. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-13. Troubleshooting — Transmission Oil Level Light

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. Transmission oil level light (I25) fails to illuminate.	
STEP 1. Check for defective transmission oil level light switch (S4).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 2. Check for defective BATTERY VOLTMETER circuit breaker.	**Replace circuit breaker if defective (paragraphs 9-16 and 9-18).**
STEP 3. Check for defective transmission oil level light assembly.	**Replace lamp assembly if defective (paragraphs 9-9 and 9-11).**

SECTION VI — MISCELLANEOUS EQUIPMENT

9-238. MISCELLANEOUS EQUIPMENT.

9-239. Description — Miscellaneous Equipment. Miscellaneous equipment includes engine controls and accessories, flight control systems, bleed air heater, muff heater, heated blanket receptacles, utility outlets, windshield wipers, and cargo hook.

9-240. ENGINE CONTROLS AND ACCESSORIES.

9-241. Description — Engine Controls and Accessories. Engine controls and accessories include engine de-icing, fuel valve, fuel boost pumps, governor control, and idle stop solenoid circuitry.

9-242. ENGINE DE-ICE CIRCUITRY.

9-243. Description — Engine De-ice Circuitry. The engine de-ice system is comprised of an engine hot air de-icing valve (L6) located on the engine, DE-ICE switch (S81) located on the engine control panel, ice interpreter (Z8) and ice detector probe (Z13), and is protected by a 15 ampere ANTI-ICE ENG circuit breaker. Refer to TM 55-2840-229-24 and paragraphs 9-5 through 9-18 for maintenance procedures.

9-244. Functional Test — Engine De-ice Circuitry. Refer to paragraph 9-169 for additional testing of engine de-ice and ice detector circuitry.

a. Open all circuit breakers and return all switches to their normal positions.

b. Check that DE-ICE switch (S81) is in OFF position, then close ANTI-ICE ENG circuit breaker. Check that solenoid valve (L6) has actuated.

c. Place DE-ICE switch (S81) in ON position. Check that solenoid valve (L6) is not energized.

d. Return DE-ICE switch (S81) to OFF position and check that solenoid valve has actuated again.

9-245. Troubleshooting — Engine De-ice Circuitry. Use table 9-14 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-14. Troubleshooting — Engine De-ice Circuitry

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. De-icing solenoid valve (L6) fails to operate when DE-ICE switch (S81) is placed to OFF position.	
STEP 1. Ensure that voltage is present on 28 Vdc essential bus and determine if ANTI-ICE ENG circuit breaker is defective.	**Replace circuit breaker if defective (paragraphs 9-16 and 9-18).**
STEP 2. Check for loose connections or broken wiring.	**Repair wiring and/or tighten connections.**
STEP 3. Check for defective DE-ICE switch (S81).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 4. Determine if de-icing solenoid valve (L6) is defective.	**Replace solenoid valve if defective. Refer to TM 55-2840-229-24.**

9-246. FUEL BOOST AND FUEL VALVE CIRCUITRY.

9-247. Description — Fuel Boost and Fuel Valve Circuitry. The electrical portion of the fuel control system consists of fuel shutoff valve (B5), FUEL switch (S38), left and right fuel boost pumps (B6 and B18), FUEL TRANS PUMP switch (S45), fuel transfer pump relay (K25), fuel transfer pump (B6), associated interconnecting wiring, terminal boards, fuel cells and associated switches. The electrical power to the fuel boost and fuel valve system is supplied through, and protected by FUEL VALVE, LEFT FUEL BOOST PUMP, RIGHT FUEL BOOST PUMP, and FUEL TRANS PUMP circuit breakers. The entire fuel boost and valve system serves to supply, regulate and control fuel for operation of the helicopter. Refer to paragraphs 9-5 through 9-18 and Chapter 4 for maintenance procedures.

9-248. Functional Test — Fuel Boost and Fuel Valve Circuitry.

a. Fuel Valve.

(1) Close FUEL VALVE circuit breaker. Position MAIN FUEL switch (S38) to ON and ensure that fuel valve (B5) is open.

(2) Position switch (S38) to OFF and check that fuel valve (B5) closes.

b. Fuel Boost Pumps.

(1) Close LEFT FUEL BOOST PUMP, RIGHT FUEL BOOST PUMP, and FUEL TRANS PUMP.

(2) Position FUEL switch (S38) to ON. Check that right and left fuel boost pumps are operating.

(3) Check that the fuel boost pumps are wired to the correct circuit breaker by opening one circuit breaker at a time.

(4) Position FUEL switch (S38) to OFF.

(5) Position FUEL TRANS PUMP switch (S45) to ON. If the main fuel cell is not full, check that transfer pump is operating. If transfer pump is not installed, check that voltage is present on wire Q33A20 (stowed inboard of L.H. beam, forward of station 118).

(6) Place a jumper wire between terminals 2 and 3 of terminal board (TB35) on top of left fuel cell or ground terminal B1 of fuel transfer pump relay (K25)

to simulate lower float switch (S72) being covered by fuel. Check that voltage is present on wire Q33A20.

(7) Place a jumper wire between terminals 1 and 3 of terminal board (TB35) or ground terminal X1 of fuel transfer pump relay (K25) to simulate upper float switch (S71) being covered by fuel. Check that fuel transfer relay (K25) actuates and shuts off the transfer pump by removing voltage from wire Q33A20.

(8) Remove jumper wire from between terminals 1 and 3 of terminal board (TB35) or remove ground from terminal X1 of the fuel transfer relay (K25). Check that relay (K25) is energized and that no voltage is present on wire Q33A20.

(9) Remove jumper wire from between terminals 2 and 3 of terminal board (TB35) or remove ground from terminal B1 of fuel transfer relay (K25). Check that relay (K25) is de-energized and that voltage is present on wire Q33A20.

(10) Position FUEL TRANS PUMP switch (S45) to OFF.

9-249. Troubleshooting — Fuel Boost and Fuel Valve Circuitry. Refer to paragraph F-11 for index to wiring diagrams and use standard troubleshooting techniques to isolate and correct trouble.

9-250. GOVERNOR CONTROL SYSTEM CIRCUITRY.

9-251. Description — Governor Control System Circuitry. The governor control system consists of a fuel control solenoid valve (L2) located on engine; and a motor driven governor rpm actuator (B12) also located on engine. Power is supplied by the 28 Vdc essential bus and protected by a 5 ampere GOV CONT circuit breaker located in overhead console. The governor control actuator is energized either by pilot GOV-RPM switch (S37) or by copilot GOV-RPM switch (S51). With the switch placed to INCR position, the circuit to the actuator motor is completed and allows motor to move actuator arm in one given direction. With the switch in DECR position, polarity to the actuator motor is reversed, allowing the actuator arm to move in the opposite direction. The fuel control solenoid valve is energized by the GOV AUTO EMER switch (S33) located on the engine control panel. Refer to paragraphs 9-5 through 9-18 and Chapter 4 for maintenance procedures.

9-252. Functional Test — Governor Control System Circuitry. a. Close GOV CONT circuit breaker. Position GOV AUTO EMER switch (S33) to AUTO. Check that fuel control solenoid valve (L2) on the engine is energized in the normal or automatic position (voltage at pin C of P90 on valve).

b. Position switch (S33) to EMER and check that valve is energized in the bypass or emergency position (voltage at pin A of P90) and that GOV EMER indicator on caution panel is illuminated.

c. Return switch (S33) to AUTO and check that GOV EMER indicator is extinguished.

d. Position GOV RPM switch (S37) on pilot collective stick, to INCR and check that governor rpm actuator (B12) on the engine retracts.

e. Position switch (S37) to DECR and check that actuator extends.

f. Repeat steps d. and e. using switch (S51) on copilot collective stick.

9-253. Troubleshooting — Governor Control System Circuitry. Use table 9-15 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-15. Troubleshooting — Governor Control System Circuitry

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Governor actuator (B12) fails to respond when either GOV RPM switch (S37) or (S51) is placed to INCR or DECR position.

   STEP 1. Check for faulty wiring or loose connections.

   Repair wiring or tighten connections.

   STEP 2. Check for defective switch.

   Replace switch if defective (paragraphs 9-9 and 9-11).

   STEP 3. Check for defective governor actuator.

   Replace actuator if defective (paragraph 4-124).

2. Governor Actuator (B12) operates in reverse.

   STEP 1. Check for reversed wiring at switch (S37 or S51) and actuator (B12).

   Reconnect wiring if reversed.

3. Fuel control solenoid valve (L2) fails to operate when GOV AUTO EMER switch (S33) is actuated.

   STEP 1. Check for defective switch (S33).

   Replace switch if defective (paragraphs 9-9 and 9-11).

   STEP 2. Check for faulty wiring or loose connections.

   Repair wiring and tighten connections.

   STEP 3. Check for defective fuel control solenoid valve (L2).

   Replace valve if defective. Refer to TM 55-2840-229-24.

4. Solenoid valve (L2) operates in reverse.

   STEP 1. Check for reversed wiring at switch (S33) or solenoid valve (L2).

   Reconnect wiring if reversed.

9-254. IDLE STOP SYSTEM CIRCUITRY.

9-255. Description — Idle Stop System Circuitry. The idle stop system consists of an idle stop release solenoid (L7), an idle stop release switch (S50) located on pilots collective stick and IDLE STOP RELEASE circuit breaker which protects the system against overload. Refer to paragraphs 9-5 through 9-18 and 4-115 for maintenance procedures.

9-256. Functional Test — Idle Stop System Circuitry. a. Close IDLE STOP REL circuit breaker.

b. Actuate the idle stop release switch (S50) on the pilot collective stick and check that solenoid (L7) retracts when power is applied.

9-257. Troubleshooting — Idle Stop System Circuitry. Refer to paragraph F-11 for index to wiring diagrams and use standard troubleshooting procedures to isolate and correct malfunctions.

9-258. FLIGHT CONTROL SYSTEMS (ELECTRICAL).

9-259. Description — Flight Control Systems (Electrical). The flight control systems include the force trim and hydraulic control systems.

9-260. FORCE TRIM SYSTEM CIRCUITRY.

9-261. Description — Force Trim System Circuitry. The force trim system consists of an anti-torque force trim magnetic brake (L8), a fore and aft force trim magnetic brake (L9), a lateral force trim magnetic brake (L10), pilot and copilot force trim switches (S18 and S10), and a master FORCE TRIM switch (S68) located on the hydraulic control panel. The magnetic brakes are wired in parallel. The force trim switches are all series wired. The system is protected by the FORCE TRIM circuit breaker located in overhead console. The entire system serves to return pilot and copilot cyclic sticks to desired initial position when master force trim switch is set to on. Pilot and copilot force trim switches may be triggered to de-energize brakes and eliminate centering force. Refer to paragraphs 9-5 through 9-18 and 11-74 for maintenance procedures.

9-262. Functional Test — Force Trim System Circuitry. a. Close FORCE TRIM circuit breaker. Position FORCE TRIM switch (S68) to ON. Check the cyclic stick and pedals for centering force.

b. Depress force trim switch (S18) on the pilot cyclic stick. Check that the three magnetic brakes de-energize and that there is no centering force in the cyclic stick and pedals.

c. Repeat step b. using switch (S10) on the copilot cyclic stick.

9-263. Troubleshooting — Force Trim System Circuitry. Use table 9-16 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-16. Troubleshooting — Force Trim System Circuitry

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. All magnetic brakes fail to energize with FORCE TRIM switch (S68) in ON position.	STEP 1. Check for faulty wiring or loose connections.	**Repair wiring or tighten connections.**

Table 9-16. Troubleshooting — Force Trim System Circuitry (Cont)

CONDITION TEST OR INSPECTION	**CORRECTIVE ACTION**
STEP 2. Check for defective FORCE TRIM switch (S68).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
2. Any magnetic brake fails to energize with FORCE TRIM switch (S68) in ON position.	
STEP 1. Check for defective magnetic brake.	**Replace magnetic brake if defective (paragraph 11-74).**
3. Magnetic brakes fail to de-energize when pilot or copilot FORCE TRIM switch (S68) is depressed.	
STEP 1. Check for defective FORCE TRIM switch.	**Replace switch if defective (paragraphs 9-9 and 9-11).**
STEP 2. Check for shorted wiring.	**Repair wiring.**

9-264. HYDRAULIC CONTROL SYSTEM CIRCUITRY.

9-265. Description — Hydraulic Control System Circuitry. The hydraulic system is composed of a hydraulic solenoid valve mounted on the lift beam of the transmission. The valve is controlled by the HYD CONT switch on the hydraulic control panel and protected by the HYD CONT circuit breaker located on the overhead console. The valve is normally de-energized in ON position. This valve closes off hydraulic pump pressure to the flight control servos and allows unrestricted fluid flow to and from the servos when the control switch is in the closed (OFF) position. Manual operation of flight controls is then possible.

9-266. Functional Test — Hydraulic Control System Circuitry. a. Close HYD CONT circuit breaker. With external hydraulic pressure applied, position hydraulic control switch (S7) to OFF. Close CAUTION LIGHTS circuit breaker and check that HYD PRESSURE caution light illuminates.

b. Operate the cyclic, collective and directional controls with switch (S7) in the ON and OFF positions. Check that controls require more force to operate with switch (S7) in the OFF position than in the ON position.

9-267. Troubleshooting — Hydraulic Control System Circuitry. Use table 9-17 and perform checks as necessary to isolate trouble. Refer to paragraph F-11 for index to wiring diagrams.

NOTE

Before you use this table, be sure you have performed all normal operational checks. If you have a malfunction which is not listed in this table, notify the next higher level of maintenance.

Table 9-17. Troubleshooting — Hydraulic Control System Circuitry

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
1. Hydraulic solenoid fails to actuate when hydraulic control switch is placed to OFF position.	STEP 1. Check for defective HYD CONT circuit breaker.	**Replace circuit breaker if defective (paragraphs 9-16 and 9-18).**
	STEP 2. Check for faulty wiring or loose connections.	**Repair wiring or tighten connections.**
	STEP 3. Check for defective hydraulic control switch (S7).	**Replace switch if defective (paragraphs 9-9 and 9-11).**
	STEP 4. Check for defective hydraulic bypass solenoid valve (L4).	**Replace solenoid valve if defective (paragraph 7-60).**

9-268. BLEED AIR HEATING SYSTEM CIRCUITRY.

9-269. Description — Bleed Air Heating System Circuitry. On helicopters prior to S/N 65-9416, the bleed air heating circuitry includes bleed AIR switch (S83), DEFROST switch (S84), AFT OUTLETS switch (S85), bleed air limit switch (S86), aft outlet limit switch (S87), bleed air valve (B19), heat defrost valve (L13), and aft outlet valve (L14). The circuitry is protected by BLEED AIR and HEATER CONTROL circuit breakers. On helicopters S/N 65-9416 and subsequent, the bleed air heating circuitry includes bleed AIR switch (S83), overheat switch (S73), bleed air valve (B19), overheat relay (K46), aft outlet valve (L14), aft outlet switch (S85), and aft outlet limit switch (S87). The circuitry is protected by the CABIN HEATER CONT circuit breaker. Refer to paragraphs 9-5 through 9-18 and chapter 12 for maintenance and troubleshooting procedures. Refer to paragraph F-11 for index to wiring diagrams.

9-270. Functional Test — Bleed Air Heating System Circuitry. a. For helicopters prior to S/N 65-9416, accomplish the following:

(1) Close BLEED AIR and HEATER CONTROL circuit breakers.

(2) Actuate AIR switch (S83) to positions 1, 2, 3, and 4. Check that bleed air valve (B19) opens to maximum when switch is at position 4.

(3) With switch (S83) in position 4, move manual defrost knob slightly toward defrost. Check that bleed air valve returns to its closed position.

(4) Return the manual defrost knob to the full heat position. Check that bleed air valve opens to maximum.

(5) Actuate the AFT OUTLETS switch (S85) to positions 1, 2, and 3. Check that aft outlet valve (L14) opens to maximum when switch is at position 3.

(6) With switch (S85) in position 3, move manual defrost knob to full defrost. Check that aft outlet valve returns to its closed position.

(7) Move the manual defrost knob slightly toward heat position. Check that aft outlet valve opens to maximum.

(8) Actuate DEFROST switch (S84) to positions 1, 2, and 3. Check that the heat defrost valve (L13) opens to maximum when switch is in position 3.

b. For helicopters S/N 65-9416 and subsequent, accomplish the following:

(1) Close CABIN HEATER CONT circuit breaker. Actuate bleed air switch (S83) from off to positions 1, 2, 3, and 4. Check that bleed air valve opens to a maximum at position 4.

(2) Actuate aft outlet switch (S85) from OFF to position 1, 2, and 3. Check that the door post outlet valve opens to a maximum at position 3.

(3) With switch (S85) in position 3, move the manual defrost lever to the full ON position. Check that the door post outlet valve returns to its closed position.

(4) Move manual defrost lever slightly toward the OFF position. Check that the door post outlet valve switch returns to position 3.

(5) Place switch (S83) in any position (1, 2, 3, or 4) except OFF. Obtain access to relay (K46) behind heater panel in overhead console. Find wire H110A20 attached to a terminal of relay (K46). Temporarily jump with relay terminal to ground, thus simulating on overheat condition. Check that the bleed air valve returns to the off or closed position.

(6) Remove the temporary jumper. Check that the bleed air valve returns to its preset position.

9-271. COMBUSTION HEATER SYSTEM CIRCUITRY. (Helicopters equipped with combustion heater kit.)

9-272. Description — Combustion Heater System Circuitry. The combustion heater system circuitry includes heater switch (S3), TEMP CONT switch (S17), thermostat (S21), VIBRATOR switch (S56), PRESS TO START switch (S34), cabin air element (RT4), heater discharge air element (Z20), outside air element (Z21), purging relay (K22), purging switch (S69), vent blower motor (B15), combustion blower motor (B16), vent air pressure switch (S110), combustion air pressure switch (S67), ignition unit (Z4), cycling switch (S19), overheat switch (S16), and heater control box (Z14, includes fuel pump (B9), solenoid valve (L3) and lockout relay (K11). The circuitry is protected by HEATER CONTROL and HEATER POWER circuit breakers. Refer to paragraphs 9-5 through 9-18 and chapter 12 for maintenance and troubleshooting procedures.

9-273. Functional Test — Combustion Heater System Circuitry. a. Close HEATER CONTROL and HEATER POWER circuit breakers.

b. Position heater switch (S3) to ON.

(1) Check that vent blower and combustion blower motors (B15 and B16) are operating.

(2) Check that combustion air pressure switch (S67) and vent air pressure switch (S110) are actuated.

(3) Check that voltage is present on terminals A2 and B2 of lockout relay (K11).

c. Momentarily actuate PRESS TO START switch (S34).

(1) Check that lockout relay (K11) is energized and latched.

(2) Check for voltage at terminal X1 of relay (K11).

(3) Check for voltage at terminal 2 of terminal board (TB17).

(4) Check that fuel pump (B9), solenoid valve (L3), and ignition unit (Z4) are energized and operating.

d. Position VIBRATOR switch (S56) to RESERVE and check that ignition unit is operating.

e. Turn cabin thermostat (S21) to a setting higher than ambient temperature. If this is impossible, disconnect electrical connector (P27) from cabin thermostat and insert jumper between pins B and C. Check that fuel solenoid valve (L3) opens. Remove jumper and reconnect electrical connector.

f. Turn cabin thermostat (S21) to a setting lower than ambient temperature. Check that fuel solenoid valve (L3) closes.

g. Place a jumper between pins A and B of purging switch connector (P139).

h. Disconnect electrical connector (P140) from cycling switch (S19) and check that fuel solenoid valve (L3) opens. Reconnect electrical connector.

i. Disconnect electrical connector (P141) from overheat switch (S16). Check that lockout relay (K11)

de-energizes, thus, de-energizing the fuel pump (B9), solenoid valve (L3), and ignition unit (Z4). Reconnect electrical connector.

j. Restart heater and place hand over inlet to combustion blower. Check that combustion air pressure switch (S67) opens and lockout relay (K11) de-energizes.

k. Restart heater and place hand over inlet to vent blower. Check that vent air pressure switch (S110) opens and lockout relay (K11) de-energizes.

l. Restart heater, then position heater switch (S3) to OFF. Check that vent and combustion blower motors continue to run until jumper is removed from purging switch electrical connector (P139). Reconnect electrical connector.

9-274. HEATER BLANKET RECEPTACLES.

9-275. Description — Heated Blanket Receptacles. Heated blanket receptacles are provided in the cabin interior, right and left side cabin roof. These utility receptacles are supplied by the 28 Vdc nonessential bus and protected by the HEATED BLANKET circuit breaker. Refer to paragraphs 9-5 through 9-18 for maintenance procedures.

9-276. Functional Test — Heated Blanket Receptacles. a. Close HEATED BLANKET circuit breaker.

b. Check for 28 Vdc at each receptacle mounted in the cabin roof.

9-277. Troubleshooting — Heated Blanket Receptacles. Refer to paragraph F-11 for index to wiring diagrams and use standard troubleshooting procedures to isolate and correct malfunction.

9-278. WINDSHIELD WIPER SYSTEM CIRCUITRY.

9-279. Description — Windshield Wiper System Circuitry. The windshield wiper system includes windshield WIPERS switch (S23), WIPER SEL switch (S124), resistor panel (A-13), pilot windshield wiper motor (B7), and copilot windshield wiper motor (B8). The system is protected by WINDSHIELD WIPER PILOT and WINDSHIELD WIPER COPILOT circuit breakers. Refer to paragraphs 9-5 through 9-18 and Chapter 12 for maintenance and troubleshooting procedures.

9-280. Functional Test — Windshield Wiper System Circuitry. a. Protect windshield from being scratched by wiper blades.

b. Close WINDSHIELD WIPER PILOT and WINDSHIELD WIPER COPILOT circuit breakers. Position wiper selector switch (S124) to BOTH. Position windshield wiper switch (S23) to LOW. Check that pilot and copilot wipers operate at low speed.

c. Position switch (S23) to MED position. Check that both wipers operate at medium speed.

d. Position switch (S23) to HIGH. Check that both wipers operate at high speed.

e. Position switch (S23) to PARK. Check that both wipers move at high speed to their park positions and stop.

f. Open WINDSHIELD WIPER COPILOT circuit breaker. Position selector switch (S124) to PILOT. Check that pilots wiper operates with wiper switch (S23) in the LOW, MED, HIGH, and PARK positions.

g. Open WINDSHIELD WIPER PILOT circuit breaker. Close WINDSHIELD WIPER COPILOT circuit breaker. Position selector switch (S124) to COPILOT. Check that copilot wiper operates with wiper switch (S23) in the LOW, MED, HIGH, and PARK positions. Position wiper switch (S23) to OFF and open the WINDSHIELD WIPER COPILOT circuit breaker.

9-281. CARGO HOOK SYSTEM CIRCUITRY.

9-282. Description — Cargo Hook System Circuitry. The cargo hook system circuitry includes cargo release switch (S36), cargo release armed light (I44), copilots cyclic stick release switch (S78), pilots cyclic stick release switch (S32), and cargo hook release relay (K24). Power for the system is supplied by the 28 Vdc essential bus and protected by the 10 ampere CARGO HOOK REL circuit breaker. Refer to paragraphs 9-5 through 9-18 and Chapter 14 for maintenance and troubleshooting procedures. Refer to paragraph F-11 for index to wiring diagrams.

9-283. Functional Test — Cargo Hook System Circuitry. a. Close CARGO HOOK REL circuit breaker. Close and latch the hook. Position the cargo release switch to ARM. Check that cargo release armed light on the instrument panel is illuminated.

b. Depress cargo release switch (S32) on the pilots cyclic stick. Check that solenoid in the hook actuates and causes the hook to fall open.

c. Repeat step b. for switch (S78) on the copilots cyclic stick.

9-284. RESCUE HOIST SYSTEM CIRCUITRY (PROVISIONS).

9-285. Description — Rescue Hoist System Circuitry. The rescue hoist system circuitry includes RESCUE HOIST PWR, HOIST CONT, and RESCUE HOIST CABLE CUTTER circuit breakers, hoist switch (S112), cable cutter switch (S96), hoist power relay (K32), and overload sense control (S101). Refer to paragraphs 9-5 through 9-18 and Chapter 14 for maintenance and troubleshooting procedures. (See figure F-38.)

9-286. Functional Test — Rescue Hoist System Circuitry. a. Check that wire M20A20 is connected to RESCUE HOIST PWR circuit breaker.

b. Check that wires M21A20 and M22A20 are connected to HOIST CONT circuit breaker.

c. Check that wire M25A20 is connected to HOIST CUT circuit breaker.

NOTE

The following checks are basically voltage (28 Vdc) checks between the designated pin of connector (J119) and ground (pin X of J119).

d. Close RESCUE HOIST CONT circuit breaker and measure for **28** Vdc on pin G of connector (J119).

e. Open RESCUE HOIST CONT circuit breaker and measure for **zero** Vdc on pin G of connector (J119).

f. Close RESCUE HOIST CONT circuit breaker. Position HOIST switch (S112) (located on pilot's cyclic stick) to DN. Measure for **28** Vdc on pin C of connector (J119).

g. Release HOIST switch (S112) and measure for **zero** Vdc on pin C of connector (J119).

h. Position HOIST switch (S112) to RH/OUT, and measure for **28** Vdc on pin D of connector (J119).

i. Release HOIST switch (S112) and measure for **zero** Vdc on pin D of connector (J119).

j. Position HOIST switch (S112) to UP, and measure for **28** Vdc on pin E of connector (J119).

k. Release HOIST switch (S112) and measure for **zero** Vdc on pin E of connector (J119).

l. Position HOIST switch (S112) to LH/IN and measure for **28** Vdc on pin F of connector (J119).

m. Release HOIST switch (S112) and measure for **zero** Vdc on pin F of connector (J119).

n. Close RESCUE HOIST CUT circuit breaker. Close CABLE CUT switch (S96) (located on pedestal). Measure for **28** Vdc on pin H of connector (J119).

o. Open CABLE CUT switch (S96) and measure for **zero** Vdc on pin H of connector (J119).

p. Close NON ESS BUS switch (S62). Close RESCUE HOIST PWR circuit breaker and measure for **28** Vdc on pin W of connector (J119).

q. Open HOIST PWR circuit breaker and measure for **zero** Vdc on pin W of connector (J119).

r. Position all circuit breakers and switches to OFF.

s. Position crew HOT MIC switch (S66) to OFF and measure resistance between Pins J and K of (J119). The resistance should be **500** ohms or greater if ICS units are installed or **infinite** if ICS units are not installed.

t. Position crew HOT MIC switch (S66) to ON and measure resistance between pins J and K of connector (J119). The resistance should be **zero** ohms.

u. Hold crew HOT MIC switch in MOM position and measure resistance between pins J and K of connector (J119). The resistance should be **zero** ohms.

v. Position crew HOT MIC switch (S66) to OFF. Disconnect multimeter.

CHAPTER 10

FUEL SYSTEM

SECTION I — FUEL CELLS

10-1. FUEL CELLS — NON-CRASHWORTHY.

10-2. Description — Fuel Cells — Non-Crashworthy. Two fuel cells are located in airframe cavities on left and right sides of helicopter just aft of cabin bulkhead (figure 10-1). The left side cell is larger and extends higher and further aft. Both fuel cells are equipped with a sump assembly and fuel boost pump. The left side cell contains low level float switch, fuel quantity transmitter and high level auxiliary fuel float switch. The lower half (approximately) of each cell is the self sealing type and the upper half is the bladder type.

CAUTION

If a fuel cell is punctured, it shall be replaced as soon as possible. The sealant between inner and outer fabric layers of self-sealing cell wall is caused to congeal and swell by contact with fuel, filling the hole and usually being extruded on the inner wall. If left for long without repair, the sealant plug may begin to deteriorate and the particles will contaminate the fuel.

10-3. Cleaning — Fuel Cells — Non-Crashworthy (Installed) a. Remove deck panels (2, figure 10-1), upper doors, and sumps (9) for access to interior of fuel cells. Refer to paragraph 10-55. Remove fuel quantity transmitter (14). Refer to paragraph 8-254.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Mix a solution of cleaner (C54) using four ounces of cleaner to each gallon of water. Use cleaning solution with a stiff bristle brush to clean fuel cell interior thoroughly. Wipe dry after scrubbing.

NOTE

It is not necessary to remove crossover lines between cells, but care should be used to prevent cleaning solution and water from entering fuel lines.

c. Saturate a clean cloth with water and remove all traces of cleaning solution. Wipe all surfaces dry with a clean cloth.

d. Inspect cell for lint and fibers from wiping cloths.

e. Install fuel quantity transmitter (14). Refer to paragraph 8-257. Install sumps (9), fuel vent plate (18), and deck panels (2). Refer to paragraph 10-58.

10-4. Removal — Fuel Cells — Non-Crashworthy. (AVIM)

NOTE

Steps c., d., h., i., and l. refer to left cell only. Other steps refer to both fuel cells.

a. Defuel system (paragraph 10-23).

b. Remove sump assembly (paragraph 10-55).

c. Remove fuel vent plate (18, figure 10-1) and auxiliary fuel transfer float switch (16) (paragraph 10-26).

d. Remove fuel quantity transmitter (14) (paragraph 10-30). Tape transmitter bracket clips (11) to protect cell during subsequent removal.

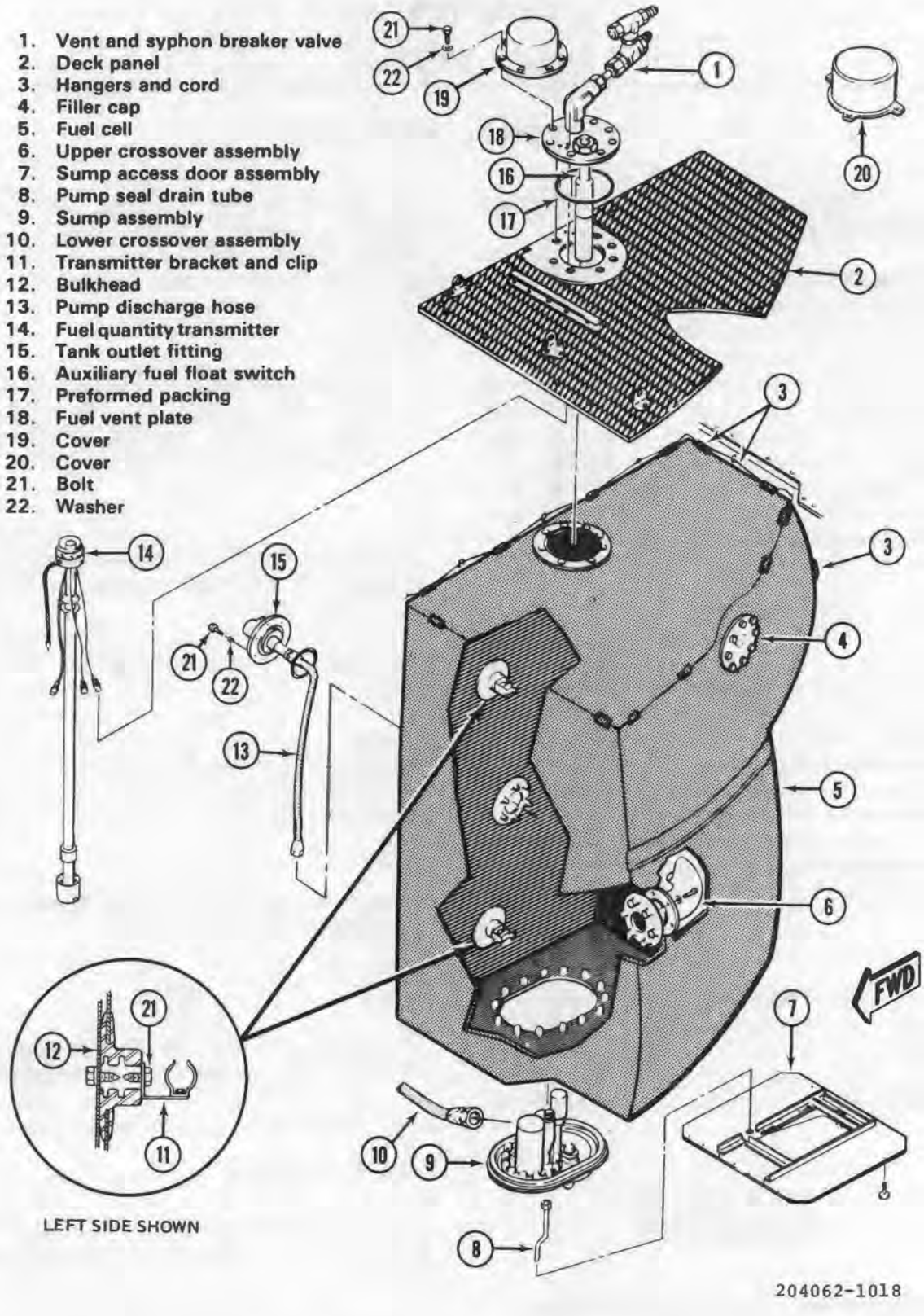


Figure 10-1. Fuel cell installation — non-crashworthy

e. Remove section of transmission cowling and support frame by removing lock pin and rod to detach at deck fittings and roller track.

f. Remove upper left deck panel (2) and right cell cover.

g. Remove screws around edge of upper left cell cover (deck panel) and three screws from middle on right cell cover.

h. Remove bolts around filler cap (4) and remove cap assembly.

i. Remove upper and lower quantity transmitter support bracket bolts (21) located outside of cell in compartment below transmission. Remove brackets and clips (11) from inside of cell.

j. Disconnect fuel outlets and crossover tubes.

k. Remove cord lacing from hangers around top of fuel cell (5).

l. On left cell only, remove cord lacing from two hangers at aft side of fuel cell approximately one foot below lacing hangers at top of cell. Lift cell out of compartment. Avoid contact with edges of cavity and projections.

m. On right cell only remove twelve bolts from outer access bar. Carefully collapse cell and remove.

NOTE

A fuel cell which has contained fuel and is to remain empty for more than ten days should be fogged with light lubricating oil (C154) to prevent drying, checking and cracking.

After removal place fuel cell in a suitable stand or container such as normally is used for shipping. Restore cell to normal shape and seal all openings to prevent contamination.

10-5. Inspection — Fuel Cells — Non-Crashworthy. a. Inspect fuel cell fittings for defective and leaking attachment fittings. Inspect attachment points for burrs and thread damage.

b. Inspect fuel cell externally and internally for cuts and tears, especially in area around lacing hangers.

c. Refer to TM 55-1500-204-25/1 for detailed fuel cell inspection procedures.

10-6. Repair or Replacement — Fuel Cell — Non-Crashworthy. (AVIM) Refer to TM 55-1500-204-25/1 for fuel cell repair procedures.

10-7. Installation — Fuel Cells — Non-Crashworthy. (AVIM)

NOTE

Steps b., d., e., k., and m. refer to left cells only. Other steps refer to both fuel cells.

A work aid to facilitate attaching fuel cell fittings to the fuel cell may be fabricated as follows: Cut the heads off two AN-4 bolts approximately six inches long. Grind the ends of the bolts to a bullet shape and remove all burrs. Install the bolts in opposite fuel cell nut plate holes and use to hold cell in position while fitting attaching bolts are started into remaining fuel cell nut plate holes.

a. Clean fuel cell cavity thoroughly. Inspect to ensure that there are no sharp edges or projections that might chafe the fuel cell. Apply talcum power (C214.2) to the cell compartment.

NOTE

To ensure a fuel tight installation, assure that the sump mounting flange on bottom honeycomb panel is 0.050 TO 0.063-inch thick without surface defects.

b. Position fuel quantity transmitter (14, figure 10-1) lower bracket and clip (11) facing aft, on boss insert located inside of fuel cell. Attach with bolt and washer. Install upper bracket in same manner. Tape clips to prevent cell damage during installation of cell.

c. Lower fuel cell (5) into compartment and align openings.

d. On left cell only, use nine lengths of nylon cord (C67.1), or suitable substitute, to lace cell hangers (3) to structure hangers. On right cell lace all around between cell and structure using one length of same type cord.

e. Enter access area beneath transmission and install bolts (21) with washers (22) in holes approximately ten inches above and sixteen inches below fuel outlet fitting (15) to secure quantity transmitter brackets (11). Remove tape, which was installed in step b., from clips.

NOTE

Do not tighten any bolts until all attaching bolts are started. Then torque evenly 45 TO 50 inch pounds.

f. Install sump and pump assembly (9). Connect pump discharge hose (13) to pump outlet.

g. Install cross over assemblies (6 and 10).

h. Secure fuel outlet fitting (15) with four bolts. Torque **45 TO 60** inch pounds. Attach fuel line.

i. Tighten and re-tie cell hanger cord at top of cell.

j. Install twelve bolts in access bar on right side only.

k. Install fuel filler cap adapter assembly (4) with eight bolts. Torque **50 TO 60** inch pounds.

l. Coat mating surfaces of fuel cell cover with sealant (C187). Install cover and secure with screws.

m. Install fuel quantity transmitter (14) and auxiliary fuel transfer float switch (16).

10-8. Testing — Fuel Cell — Non-Crashworthy. (AVIM) a. Cap main fuel line and vent connections.

b. Attach a source of regulated, low pressure filtered compressed air with a manometer or accurate pressure gage and shut-off valve.

CAUTION

Do not apply excessive pressure or severe damage to cells and structure may occur.

c. Apply pressure until gage indicates **2.5** psi in cells and crossover lines. Shut off air source. Fuel **cells should hold this pressure for fifteen minutes.**

d. Locate and correct any leaks indicated by loss of pressure and repeat tests until results are satisfactory.

e. Refuel helicopter. Calibrate fuel quantity gage (pararaph 8-247). Functional test boost pumps (paragraph 10-65).

10-9. FUEL CELLS — CRASHWORTHY.

10-10. Description — Fuel Cells — Crashworthy. Two fuel cells, located identical to the non-crashworthy fuel cells (paragraph 10-2) are self-sealing and incorporate frangible clips (16, figure 10-2) to secure fuel cell fittings. Left side fuel cell contains fuel quantity transmitter (8), and a low level float switch.

10-11. Cleaning — Fuel Cells — Crashworthy (Installed). a. Remove deck panels, vent plate (2) and sumps (11) for access to interior of fuel cells. (Refer to paragraph 10-26 and 10-55). Remove fuel quantity transmitter (8). Refer to paragraph 8-252.

WARNING

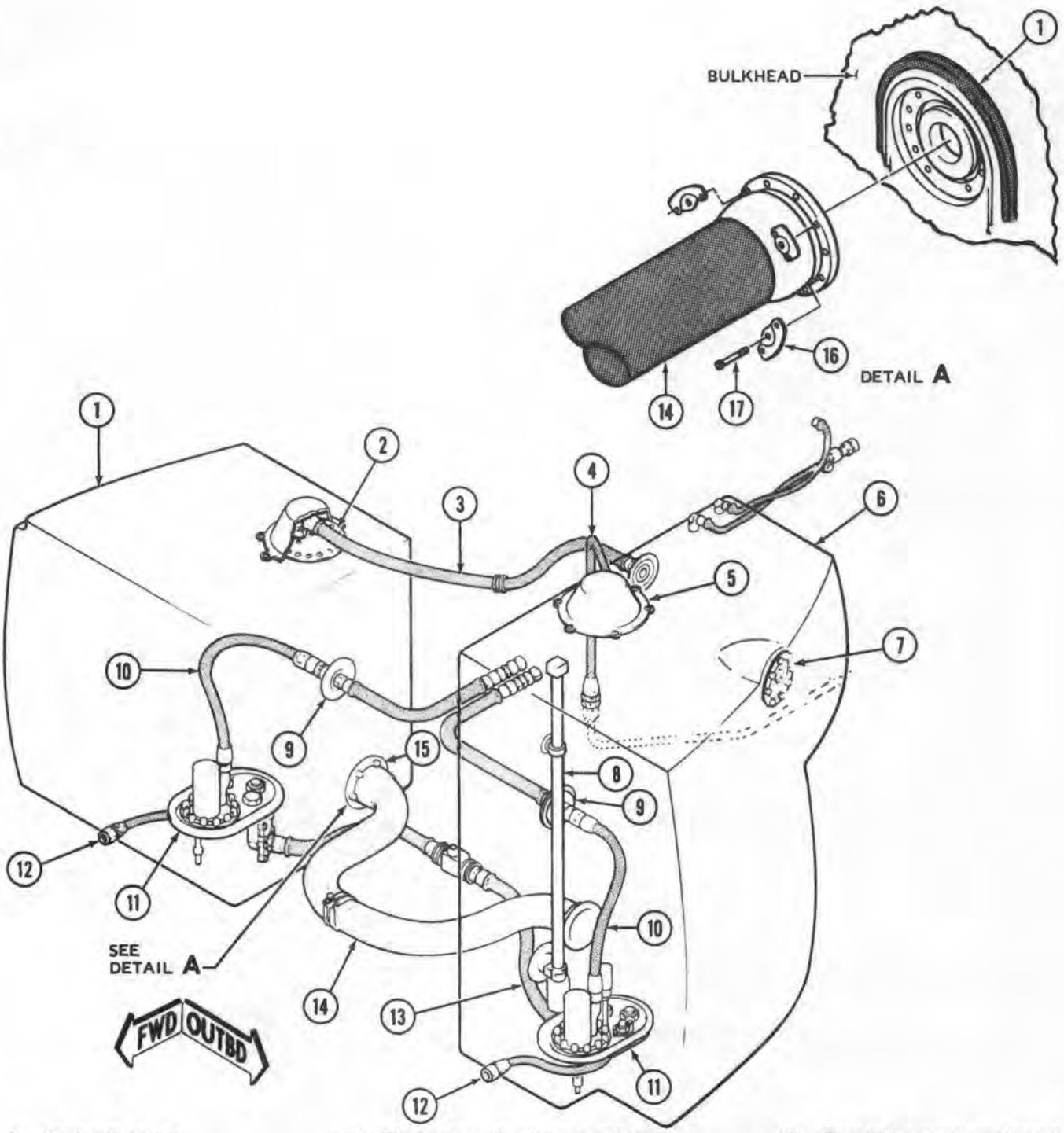
Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Mix a solution of cleaner (C54) using four ounces of cleaner to each gallon of water. Use cleaning solution with a stiff bristle brush to clean fuel cell interior thoroughly. Wipe dry after scrubbing.

NOTE

It is not necessary to remove crossover lines between cells, but care should be used to prevent cleaning solution and water from entering fuel lines.

c. Saturate a clean cloth with water and remove all traces of cleaning solution. Wipe all surfaces dry with a clean cloth.



1. Fuel cell (right)
2. Vent plate
3. Vent line
4. Vent line (overboard)
5. Vent cover
6. Fuel cell (left side)
7. Closed circuit refueling receiver
8. Fuel quantity transmitter
9. Fuel outlet fitting
10. Fuel outlet line
11. Sump assembly
12. Fuel line (auxiliary)
13. Fuel cell crossover (lower)
14. Fuel crossover (upper)
15. Crossover fitting
16. Frangible clip
17. Bolt

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Figure 10-2. Fuel cell installation — crashworthy

d. Inspect cell for lint and fibers from wiping cloths.

f. Install fuel quantity transmitter (8). (Refer to paragraph 8-257.) Install sumps (11), vent plate (2), and deck panels (Refer to paragraphs 10-29, 10-30, and 10-58.)

10-12. Removal — Fuel Cells — Crashworthy. (AVIM)

NOTE

Removal is the same for either side except for the closed circuit refueling receiver and fuel quantity transmitter. Before removing any line, hose or component, be sure it is properly identified and its route understood for replacement in same manner.

a. Defuel system (paragraph 10-23).

b. Remove access plates under fuel cells.

NOTE

Record location and number of frangible clips in any subsequent steps where removal is required.

c. Remove lower crossover fuel line (13, figure 10-2) and fuel cell sump (11) (paragraph 10-55).

d. Remove fuel cell vent cover (5) from top of both cells. Remove fuel cell vent plate (2) from top of each cell.

e. Remove fuel quantity transmitter (8) from left fuel cell.

f. Remove fuel quantity transmitter upper clip, bracket, and attaching hardware from left fuel cell.

g. Working through sump port of left fuel cell, remove fuel quantity transmitter lower bracket and clip.

h. Working in cargo hook area, remove bolts, washers and frangible clips securing upper crossover fuel line (14) and cell to airframe. Remove remaining bolts and washers securing lines to fuel cell.

i. Working in cargo hook area, remove bolts, washers and frangible clips securing fuel outlet line (10) and cell to airframe structure. Remove remaining bolts and washers securing lines to fuel cell.

j. Carefully collapse cell as necessary for removal. Lift cell out of compartment, avoiding contact with edges of cavity or any projecting fittings.

k. For support and protection in handling or storage, place removed cell in a suitable container such as those normally used for shipping. Restore cell to normal shape, and seal openings to prevent contamination.

CAUTION

Do not allow cell to remain collapsed longer than 30 minutes.

When a cell, which has contained fuel, is to remain empty of fuel for more than 10 days, inner liner should be fogged with light lubricating oil (C154) to prevent deterioration from drying out and cracking or checking.

10-13. Inspection — Fuel Cell — Crashworthy. a. Inspect fuel cell fittings for defective and leaking attachment fittings. Inspect attachment points for burrs and thread damage. Inspect metal fittings protective coating.

CAUTION

If a fuel cell is punctured, it shall be replaced as soon as possible. The sealant between inner and outer fabric layers of self-sealing cell wall is caused to congeal and swell by contact with fuel, filling the hole and usually being extruded on the inner wall. If left for long without repair, the sealant plug may begin to deteriorate and the particles will contaminate the fuel.

b. Inspect fuel cell externally and internally for cuts, tears, abrasions, blisters, loose seams, scuffed surfaces, and any area for indications of fuel soaking.

c. Refer to TM 55-1500-204-25/1 for detailed fuel cell inspection procedures.

10-14. Repair or Replacement — Fuel Cells — Crashworthy. (AVIM)

NOTE

Fuel cells requiring fabric repair shall be forwarded to depot.

a. **Replacing Fitting Inserts.** Standard maintenance procedures are adequate to replace the coil-type inserts in each fuel cell fitting.

b. **Restoring Protective Fitting Finishes.**

(1) Using a fine-toothed file or fine emery paper, carefully remove any roughness from the fitting to be refinished.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

(2) Clean metal surfaces of fitting using pads dampened with MEK (C142).

(3) Obtain a small container of alodine 1200 (C42) solution from stock.

WARNING

In the following steps, do not allow the alodine 1200 (C42) solution to come into contact with the hands, body, or clothing. The solution is corrosive and can injure personnel who are working with it.

(4) Moisten fitting surface with clean pad dampened in water.

(5) Using a narrow nylon brush, apply an undiluted, unadulterated coat of alodine 1200 solution (C42) to the moistened area.

(6) Allow solution to dry until a light, golden coating appears on the fitting. When coating has formed, remove excess solution by wiping the surface with clean pads dampened in water. Dry the restored area with dry pads.

10-15. Installation — Fuel Cell — Crashworthy (AVIM) a. Check fuselage cavity, including access panels to be clean and free of any foreign objects or rough surfaces which could damage fuel cells.

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

b. Where cleaning is required, wipe surfaces with a cloth saturated with solvent and wipe dry with a clean cloth before solvent evaporates. Use MEK (C142) on bare metal surfaces, aliphatic naphtha (C143) on surfaces of other materials.

c. Remove old sealing compound from edges of access panels and mating surfaces on structure.

d. Apply talcum power (C214.2) to cell compartment.

e. Partially flatten fuel cell by pushing in on sides, allowing cell to collapse downward. Apply straps or ropes vertically around cell to temporarily retain this shape. Place fuel cell in cavity, remove straps or ropes and allow cell to expand. Align all fittings with openings in structural panels.

f. Install fuel cells as follows: (figure 10-2).

CAUTION

Do not fold the fuel cell if the ambient temperature of work area is less than 70 degrees F (21.1 degrees C). If the temperature is less than 70 degrees F (21.1 degrees C), move cell into warm

area before folding cell. Do not allow the fuel cell to remain in its folded condition for more than 30 minutes. Non-visible permanent damage to cell walls may occur. Do not use wire or other thin diameter material to restrain cell, permanent damage to self-sealing characteristics of the cell could result.

NOTE

In the following instructions do not tighten bolts securing frangible clips to structure until all clips have been installed and fuel cell properly positioned. To ensure a satisfactory seal at bolted connections, alternately snug up and torque opposite bolts at each connection.

(1) Working in cargo hook area, align all fittings with holes in main beam.

(2) At large (upper crossover) hole in main beam, align fuel cell upper crossover fitting (15), with hole in beam and temporarily secure in position with three frangible clips (16), and three bolts (17) at alternate holes in cell fitting beginning with aft hole.

(3) At fuel cell outlet line (10) hole in main beam, align fuel cell outlet line fitting (9) with hole in beam.

(4) Install packing lubricated with petrolatum (C164) in groove of cell port and install fuel cell outlet line fitting (9) to cell port, using two screws and two washers in lower forward and upper aft holes.

(5) Secure fuel cell fitting (9) to main beam using two frangible clips (16) and two screws in remaining holes. Align cell so that frangible clips are flat on nose flange and lips of clips engage main beam panel.

(6) Install retainer, packing and closed circuit receiver (7, left side cell only). Do not tighten bolts until cell is completely installed.

g. Complete installation of upper fuel crossover line (14). Install remaining three screws and washers in crossover fitting. Alternately snug up and torque opposite bolts to ensure a satisfactory seal. Torque bolts **50 TO 60** inch-pounds (paragraph 10-93).

h. Install fuel quantity transmitter clips and brackets in left cell.

i. Install fuel quantity transmitter (8).

j. Install sump assembly (11) and door (2) (paragraphs 10-29 and 10-58).

k. Torque bolts securing cells to structure as follows:

(1) Adjust position of cell in cavity so that all frangible clips are bearing on aircraft structure. Torque bolts securing clips to cell and structure **50 TO 60** inch-pounds.

(2) Torque closed circuit receiver bolts **50 TO 60** inch-pounds.

l. Install lower crossover (13).

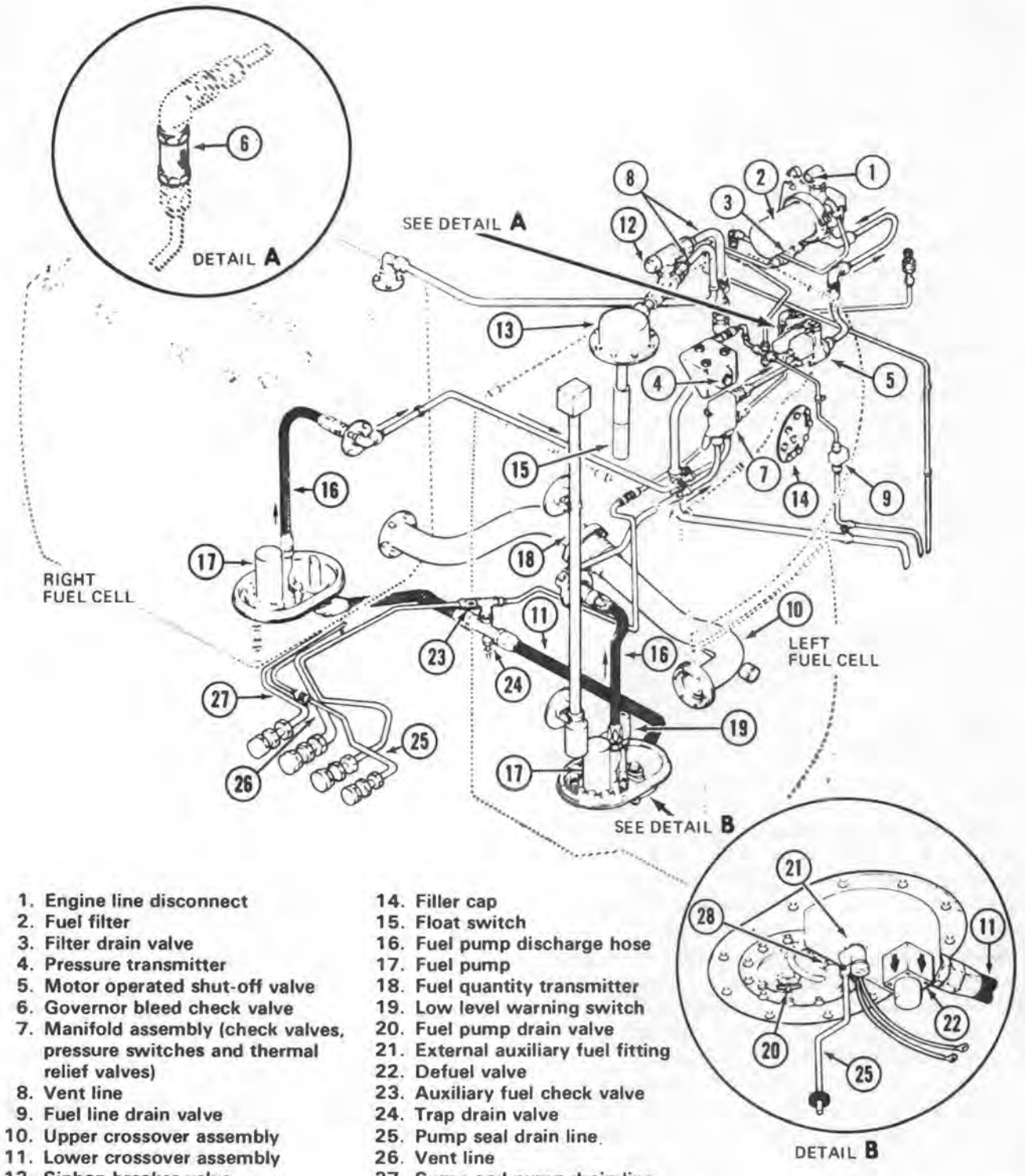
m. Install access panel under sump.

10-16. Testing — Fuel Cell — Crashworthy. Refer to paragraph 10-8 for fuel cell pressure test.

SECTION II — FUEL SYSTEMS

10-17. FUEL SYSTEM.

10-18. Description — Fuel System. a. Non-crashworthy fuel system. The non-crashworthy fuel supply system contains two interconnected, self-sealing type, fuel cells which are filled through the closed circuit refueling receiver mounted in the top of the left cell (figure 10-3). Additional fuel may be



1. Engine line disconnect
2. Fuel filter
3. Filter drain valve
4. Pressure transmitter
5. Motor operated shut-off valve
6. Governor bleed check valve
7. Manifold assembly (check valves, pressure switches and thermal relief valves)
8. Vent line
9. Fuel line drain valve
10. Upper crossover assembly
11. Lower crossover assembly
12. Siphon breaker valve
13. Cover
14. Filler cap
15. Float switch
16. Fuel pump discharge hose
17. Fuel pump
18. Fuel quantity transmitter
19. Low level warning switch
20. Fuel pump drain valve
21. External auxiliary fuel fitting
22. Defuel valve
23. Auxiliary fuel check valve
24. Trap drain valve
25. Pump seal drain line
26. Vent line
27. Sump and pump drain line
28. Sump drain valve

Figure 10-3. Non-crashworthy fuel system

transferred into the main fuel cells from internal auxiliary fuel cell(s) through the lower crossover assembly and from external auxiliary fuel tanks through sump fittings. Both main fuel cells are equipped with a sump assembly and a fuel boost pump. A fuel pump drain valve and pump seal drain line facilitate draining the system. A sump drain valve is incorporated in the external auxiliary fuel fitting. A gravity defuel valve is located in the bottom of the left fuel cell sump assembly, and a trap drain valve is at midpoint of the lower crossover assembly (11). The left fuel tank contains the fuel low-level warning switch, fuel quantity transmitter, and high-level auxiliary fuel float switch. Both main fuel cells are vented. A siphon breaker valve, located on top of the left cell, prevents siphoning through the vent lines. Fuel flows from boost pumps in the main fuel cell to a manifold assembly which contains check valves, pressure switches, and thermal relief provisions. Fuel then passes through the motor-operated shutoff valve, which contains a thermal relief valve and through fuel filter into engine fuel system. A fuel pressure transmitter senses fuel pressure at fuel filter outlet and transmits pressure to pressure gage on instrument panel.

b. Crashworthy fuel system. The crashworthy fuel system (figure 10-4) consists of two self sealing fuel cells (1 and 17) connected through upper crossover (27) and lower crossover (25) which maintains equal level in the cells. A closed circuit refueling receiver (14) for filling is mounted in the left cell (17). The left cell also contains fuel quantity transmitter (24), low level float switch (19) to activate 20 MINUTE FUEL caution panel light, and upper float switch mounted on cell door to control auxiliary fuel transfer. Each cell contains a sump (21 and 31), sump and defuel drain valve (20), boost pump (23), check valve from auxiliary fuel transfer line (28), and breakaway valve (30) to which lower crossover mounts. Both boost pumps (23) are electrically operated and are controlled by MAIN FUEL switch. Either pump alone can maintain normal fuel flow and pressure. Pump outlet lines (18) are separate hoses to connect fuel valve manifold (6) located on left main beam below engine deck. Fuel valve manifold contains two check valves, two pressure switches to activate caution panel light if a boost pump fails, and two thermal relief orifices. Fuel shutoff valve (11) is an electric operated gate valve controlled by MAIN FUEL switch. A thermal relief valve is mounted in shutoff valve to relieve pressure trapped in upper part of system. Fuel filter (37), mounted on left side of engine deck uses quick disconnect coupling at filter outlet to engine fuel control inlet hose. A separate line from filter (37) connects to pressure gage transmitter (7), drain valve (9), and provides connection for heater fuel supply. Engine fuel control bleed line connects to lower crossover fitting (26). Self sealing breakaway valves are used at each end of lower crossover fitting (26) and at filter (37) inlet and outlet to prevent spilled fuel in a crash. A frangible ring (33) is used at fuel cell door (vent plate). Frangible clips are used at upper crossover fittings, fuel outlet fittings, sump plates, and vent fitting. Incorporation of MWO 55-1500-206-30-4 provides a rollover vent valve in the left aft fuel cell to minimize fire hazard in the event of helicopter rollover during a crash.

10-19 General Maintenance — Fuel System. a. Organizational maintenance will consist of visual inspections, ground operational checks, cleaning of filter and strainers, specified adjustment of control linkage system, and replacement of piping, fittings, and seals. Observe general notes and precautions below, and procedures for replacement or adjustment of principal components in subsequent paragraphs. Fuel lines and components on the engine constitute the fuel control system and will be found in TM 55-2840-229-23. Fuel system schematic is shown in figure 10-5.

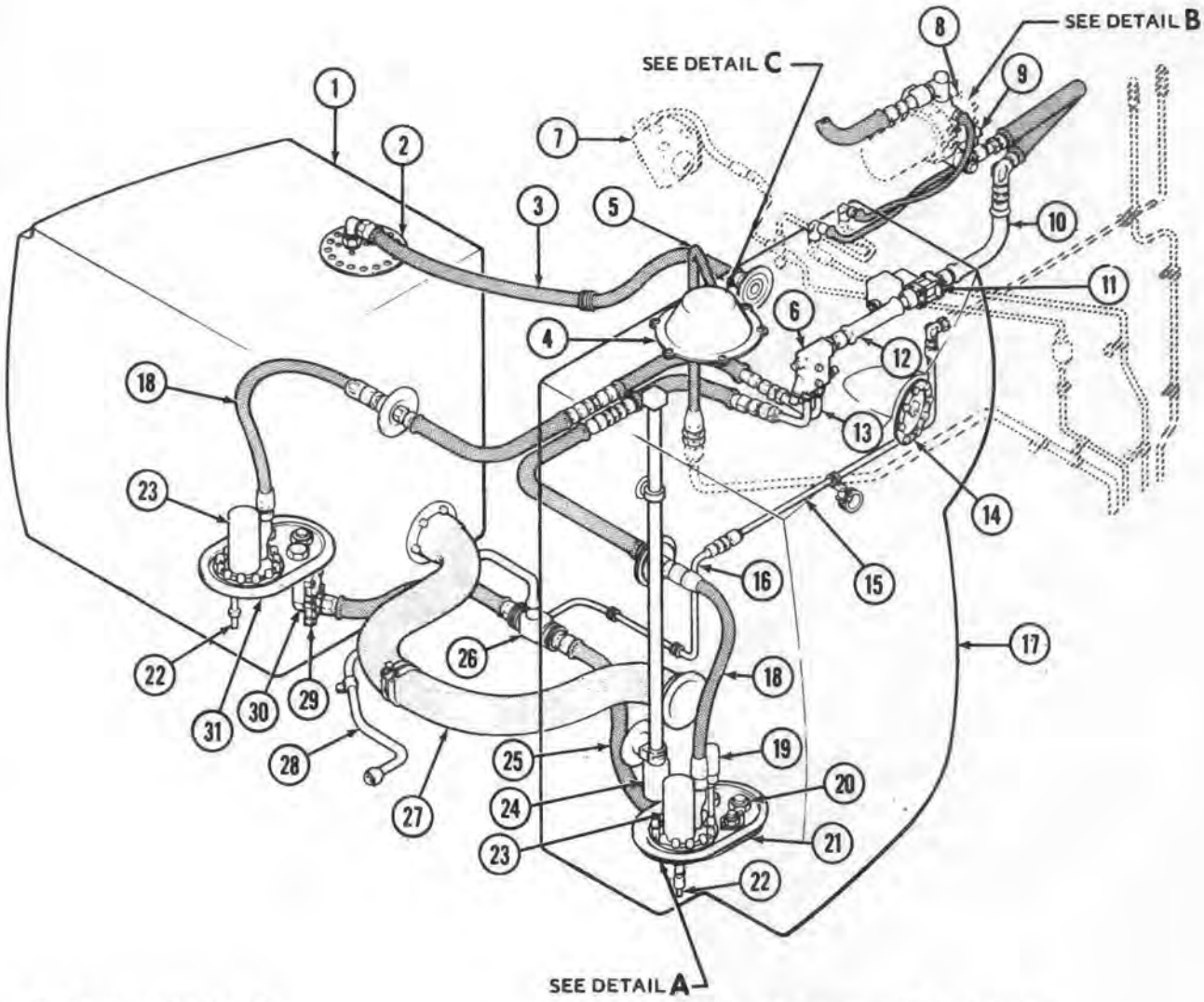
b. Intermediate maintenance will include more detailed procedures as indicated by (AVIM) throughout the chapter.

c. Before removing any line or hose, be sure it is properly identified and its route understood for replacement in same manner.

d. Cap or cover any open lines, fittings, or exposed opening in units (other than normal vents and drains) to protect fuel system from contaminations. Be sure vent lines are not obstructed.

e. For electrical circuits of boost pump, shutoff valve, fuel quantity gage system, pressure transmitter, pressure or flow switches, and float switches, see applicable wiring diagrams. (Appendix F).

f. Conduct any defueling or drainage of fuel in accordance with applicable directives, and with extreme care to avoid fire hazards.



1. Fuel cell (right side)
2. Plate, fuel vent
3. Vent line
4. Cover, fuel cell vent
5. Vent line (fuel overboard)
6. Manifold assembly (check valves, pressure switches and thermal relief)
7. Pressure transmitter
8. Filter, fuel (impending bypass indicator)
9. Valve, drain
10. Line, fuel (valve to deck)
11. Valve, motor-operated shutoff
12. Line, fuel (valve to valve)
13. Tube, fuel (BHD to valve)
14. Fuel tank cap and adapter (receiver, closed circuit refueling)
15. Line, governor bleed, upper
16. Line, governor bleed, lower
17. Fuel cell (left side)
18. Fuel pump discharge line
19. Switch, low fuel level warning
20. Valve, defuel and sump drain
21. Sump (left side fuel cell)
22. Pump, seal drain line
23. Pump, fuel
24. Fuel quantity transmitter
25. Lower crossover fuel line
26. Fitting, lower crossover
27. Line, upper crossover fuel
28. Line, internal fuel
29. Fitting, valve (right side sump)
30. Valve, breakaway, self-sealing
31. Sump (right side fuel cell)

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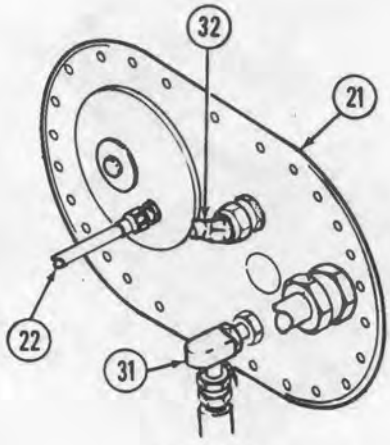
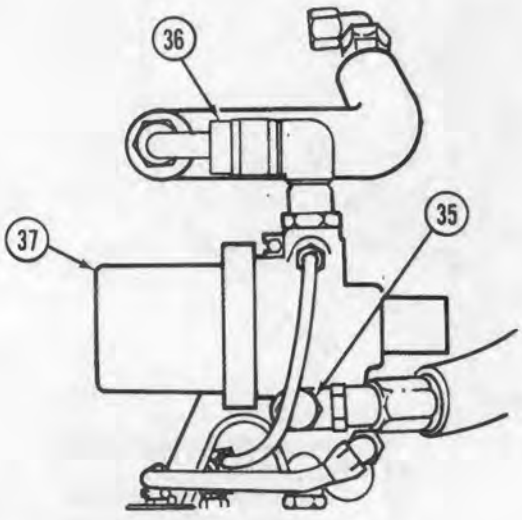
Figure 10-4. Crashworthy fuel system (Sheet 1 of 3)



DETAIL A



DETAIL B

FRANGIBLE CLIP

32. Auxiliary transfer line
33. Frangible ring
34. Rivet
35. Breakaway coupling, self-sealing
36. Breakaway coupling, self-sealing
37. Fuel filter

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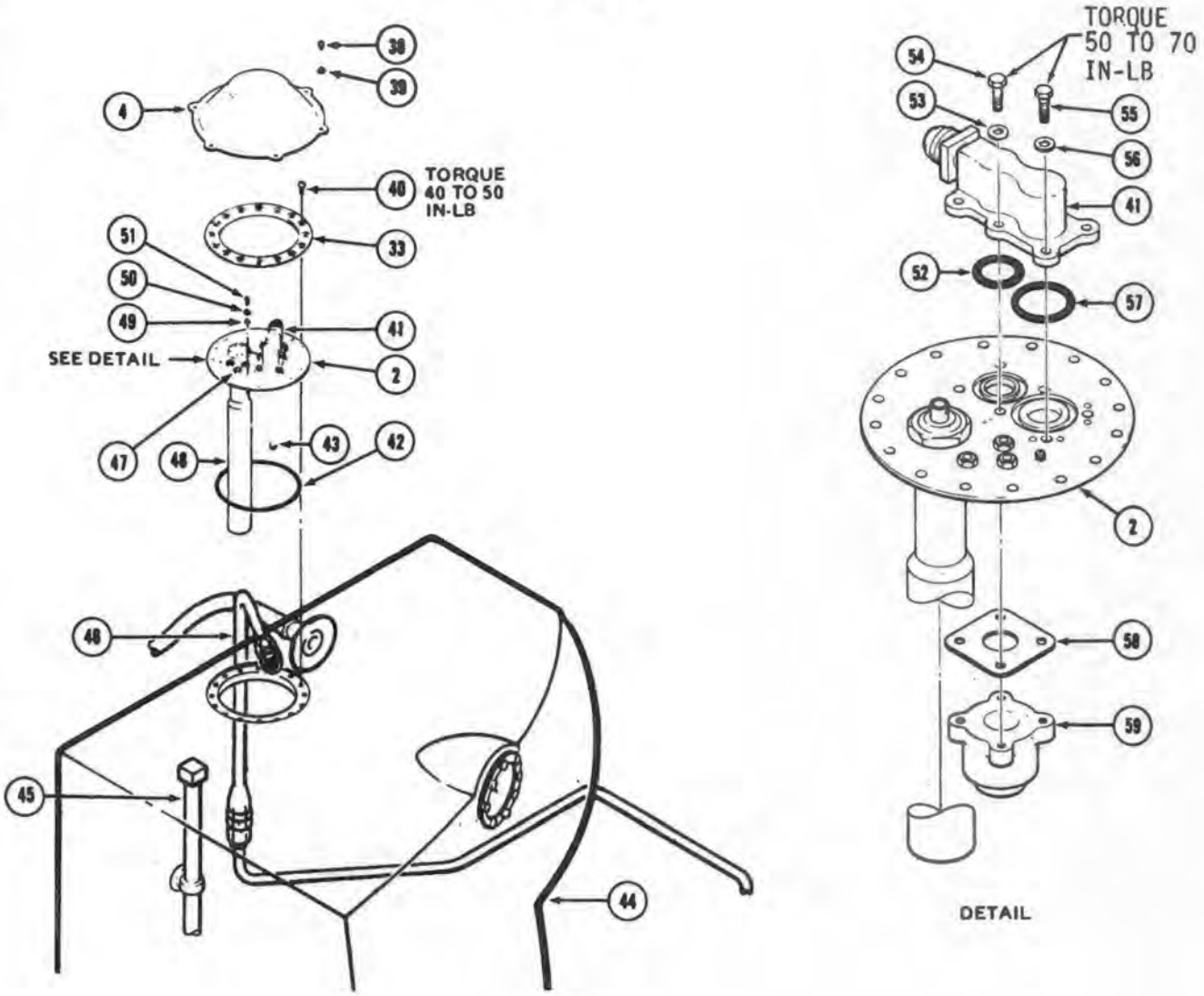
Figure 10-4. Crashworthy fuel system (Sheet 2 of 3)

DETAIL C



38.	Screw	49.	Seal
39.	Washer	50.	Washer
40.	Screw	51.	Screw
41.	Manifold	52.	Packing
42.	Packing	53.	Washer
43.	Nut	54.	Bolt, Drilled Head
44.	Fuel Cell	55.	Bolt
45.	Fuel Quantity Transmitter	56.	Washer
46.	Hose	57.	Packing
47.	Connectors	58.	Gasket
48.	Float Switch	59.	Vent Valve

Figure 10-4. Fuel supply system - crashworthy (Sheet 3 of 3)

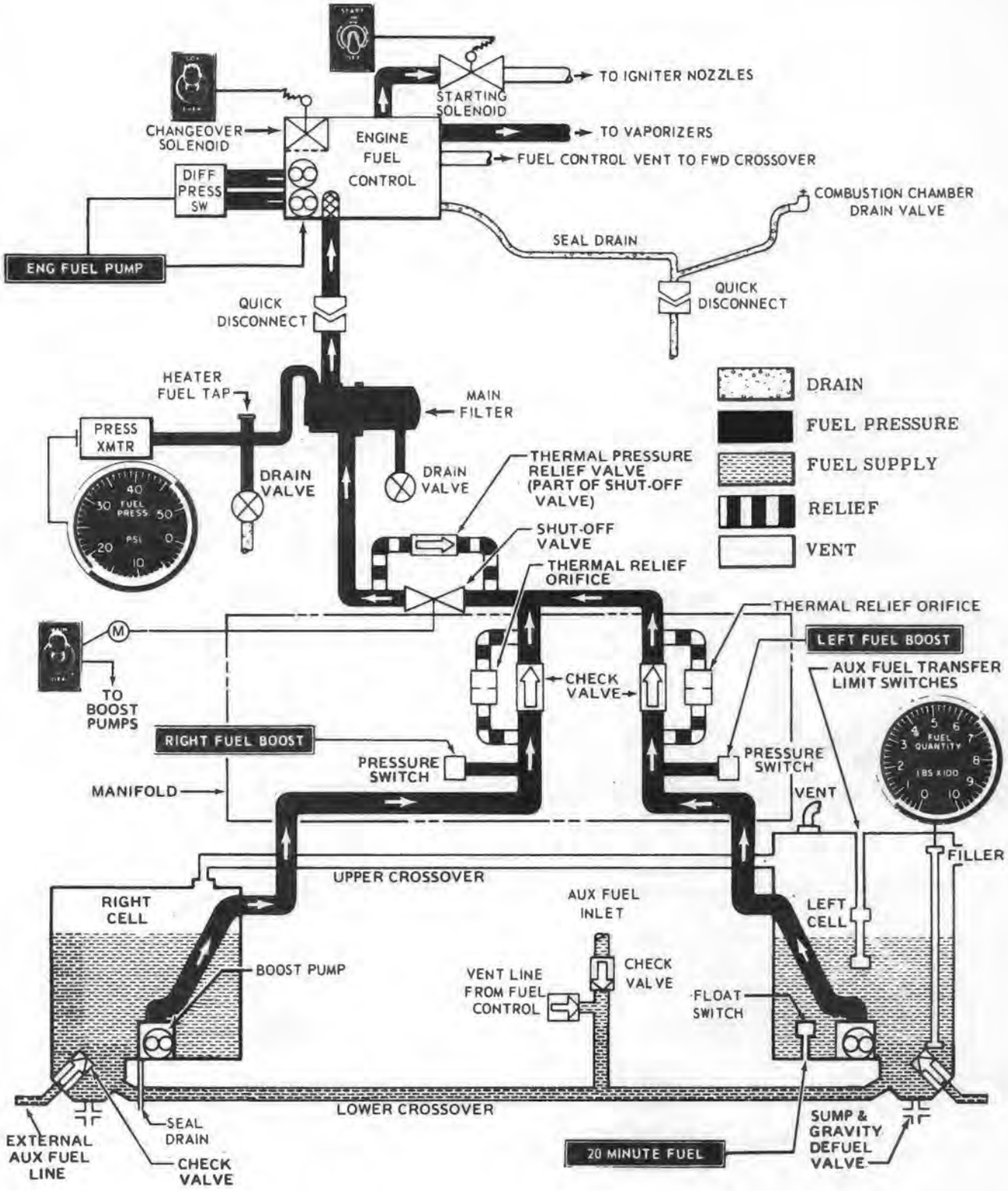


Figure 10-5. Fuel system schematic

10-20. Troubleshooting Fuel System. (Table 10-1.)

NOTE

Before using this table be sure to perform all normal operational checks. If a malfunction which is not listed in this table is evident, notify the next higher level of maintenance.

Table 10-1. Troubleshooting — Fuel System

CONDITION

TEST OR INSPECTION

CORRECTIVE ACTION

1. Right side boost pump warning light illuminated, no pressure indicated on fuel pressure gage.

   STEP 1. Ensure electrical boost pump is operative.

   Replace boost pump if defective (paragraphs 10-61 and 10-64).

   STEP 2. Check for faulty wiring.

   Correct wiring if defective.

   STEP 3. Check for fuel in cell.

   Service as required.

2. Left side boost pump warning light illuminated, fuel pressure low or zero.

   STEP 1. Ensure electrical boost pump is operative.

   Replace boost pump if defective (paragraphs 10-61 and 10-64).

3. Engine fuel pump warning light illuminated.

   STEP 1. Check each pressure switch mounted on engine adjacent to fuel pump.

   Check switches and replace defective switch (paragraphs 10-49 and 10-52).

   STEP 2. Check for faulty engine driven fuel pump (two).

   Replace engine driven fuel pump if defective. Refer to TM 55-2840-229-24.

4. Fuel filter warning light illuminated.

   STEP 1. Check for dirty fuel filter.

   Replace filter. If frequent filter changes are required, investigate fuel source (paragraphs 10-39 and 10-45).

Table 10-1. Troubleshooting — Fuel System (Cont)

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
5. Shut-off valve inoperative.	
STEP 1. Check for defective valve or lack of electrical power.	**Check for electrical power at valve; if power available, valve is defective. Replace. (Paragraphs 10-33 and 10-3).**
6. Fuel low level light fails to illuminate.	
STEP 1. Check for faulty low level switch or wiring.	**Replace defective switch or wiring (paragraph 9-9 and 9-11).**
7. Fuel low level light illuminates above normal low level fuel quantity.	
STEP 1. Check for faulty fuel quantity system.	**Adjust, repair fuel quantity system as required (paragraph 8-247).**
8. Fuel pressure fluctuating, low, or zero with boost pump warning light not illuminated.	
STEP 1. Check for faulty fuel pressure transmitter or indicator.	**Replace defective transmitter or indicator (paragraph 8-139).**
STEP 2. Check for faulty wiring.	**Replace defective wiring.**

10-21. Operational Check — Fuel System. Test installation for leaks. Request maintenance to perform air pressure-type test or add small, measured amount of fuel and check for leaks. If no leaks are noted, add additional measured amounts of fuel increments. Stop fueling after each increment of fuel is added and check for proper operation of low level fuel warning system, fuel quantity indicating system and boost pumps. It is necessary to check operation of the low fuel level warning system when fuel is below that required for twenty minutes flight and again when fuel level is above that quantity.

10-22. Purging — Fuel System. Refer to TM 55-1500-204-25/1 for purging procedures.

10-23. Defueling — Fuel System.

WARNING

Conduct any defueling or drainage of fuel in accordance with applicable directives. Exercise extreme care to avoid fire hazards.

NOTE

Procedures for defueling are similar for both non-crashworthy and crashworthy systems.

a. Disconnect battery.

b. Remove left side lower fuel cell panel on lower side of fuselage to gain access to defuel valve.

c. With suitable hose attached to defuel valve and defuel truck, open valve and defuel system.

d. Use sump drain valves (28, figure 10-3) to empty cells of fuel trapped below level of crossover tubes.

e. To drain trapped fuel in upper parts of system, use main filter drain valve (3), and trap drain valve (24) located in aft cargo compartment opposite door.

10-24. FUEL CELL DOOR (AVIM).

10-25. Description — Fuel Cell Door. Removable sections of service deck between cabin and engine firewall give access to a door (fuel cell vent plate) in top of each cell. Door provides connection for tank vent line, and electrical connectors for fuel quantity transmitter. Left cell door also includes an assembly of two float switches for the auxiliary fuel transfer pump circuit.

10-26. Removal — Fuel Cell Door. a. Defuel cells (paragraph 10-23).

b. Remove section of transmission cowling with support frame by removing lockpin and rod to detach from deck fittings and roller track.

c. Remove screws around edge of deck panel (2, figure 10-1) above fuel cell, leaving fittings attached where possible. Lift off deck panel.

d. Disconnect vent and syphon breaker valve (1) from elbow on cell door. Relocate line as necessary until clear of fuel vent plate (18).

e. On left cell door disconnect fuel quantity gage circuit leads from connectors on door. Disconnect auxiliary fuel transfer circuit leads from terminal block.

f. Remove bolts and lift fuel vent plate (18). Disconnect fuel quantity transmitter leads from connectors on underside of left door. Remove door (with attached float switch assembly (16) on left cell). Keep door opening covered when not in use.

10-27. Inspection — Fuel Cell Door. a. Inspect fuel cell door for cracks, damage, and corrosion.

b. Inspect terminal block on left cell door for security and corroded terminals.

c. Inspect seal groove and door face for burrs and nicks.

d. Inspect left cell door for float switch security.

10-28. Repair or Replacement — Fuel Cell Door. a. Polish out nicks and burrs in sealing groove.

b. Replace electrical terminals that are corroded or damaged.

c. Replace damaged or defective float switch (16, figure 10-1) as follows:

(1) Cut lockwire from retaining nut and remove nut.

(2) Remove float switch (16) from door.

(3) Install serviceable preformed packing lubricated with petrolatum (C164) in seal groove.

(4) Position switch in hole in door and secure with nut.

(5) Lockwire (C127) nut.

10-29. Installation — Fuel Cell Door. a. Ensure seal groove and face of door are clean and free of burrs or nicks (figure 10-6). Install packing lubricated with petrolatum (C164) in groove.

b. Position fuel vent plate (18, figure 10-1) on cell opening with vent fitting pointing inboard. (If on left cell, float switch assembly will be at forward end of door.)

c. Raise door as necessary to connect quantity gage transmitter leads to connectors on underside of left door.(Appendix F.)

d. Secure door with bolts and thin aluminum alloy washers. Tighten bolts evenly and torque **45 TO 50** inch-pounds.

e. Connect vent line tube to fitting on door.

f. Connect quantity gage circuit leads and float switch leads between connectors on left cell door and at aft inboard corner of cell compartment. (Appendix F.)

g. Install deck panel (2) over cell compartment, sealing edges fumetight with a bead of sealing compound (C187). Install cowling and support frame assembly.

10-30. FUEL QUANTITY TRANSMITTER.

Refer to paragraph 8-252 for removal, replacement, troubleshooting, and installation procedures.

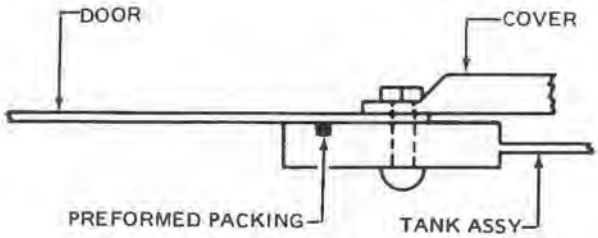


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Figure 10-6. Installation of fuel cell across doors

10-31. FUEL SHUT-OFF VALVE.

10-32. Description — Fuel Shutoff Valve. Fuel shutoff valve is a motor-operated gate valve in main fuel supply line, located in main fuselage compartment on aft bulkhead. Valve is electrically controlled by a switch on cabin pedestal. The switch is marked MAIN FUEL. The valve has a manual override handle which also serves as a visual position indicator when used in ground maintenance. A thermal pressure relief valve is mounted in the valve body. See figure 10-7.

10-33. Removal — Fuel Shutoff Valve. a. Open shutoff valve manually. Defuel system (paragraph 10-23).

b. Disconnect electrical leads at connector on valve (8, figure 10-7).

c. Disconnect fuel line tubes (1 and 7) from valve inlet and outlet adapter fittings (3). Catch trapped fuel in suitable container.

d. Remove four bolts (2) to detach valve, adapter fittings, and gaskets (4) from bulkhead.

10-34. Inspection — Fuel Shutoff Valve. a. Inspect fuel shutoff valve for corrosion, damage and proper operation.

b. Inspect thermal pressure relief valve for damage and corrosion. Refer to TM 55-1560-235-40 for inspection and replacement.

10-35. Repair or Replacement. Replace damaged or defective shutoff valve.

10-36. Installation — Fuel Shutoff Valve. a. Assemble valve (8, figure 10-7), gaskets (4), and adapters (3). Position outlet adapter through bulkhead from forward side.

b. Insert four bolts (2) through valve (8) and bulkhead. Ensure that actuator is on right side of valve.

c. Place an aluminum alloy washer (5) on each bolt (2). Secure with nuts (6) on bolts (2).

d. Connect fuel line tubes (1 and 7) to valve inlet and outlet adapter fittings (3).

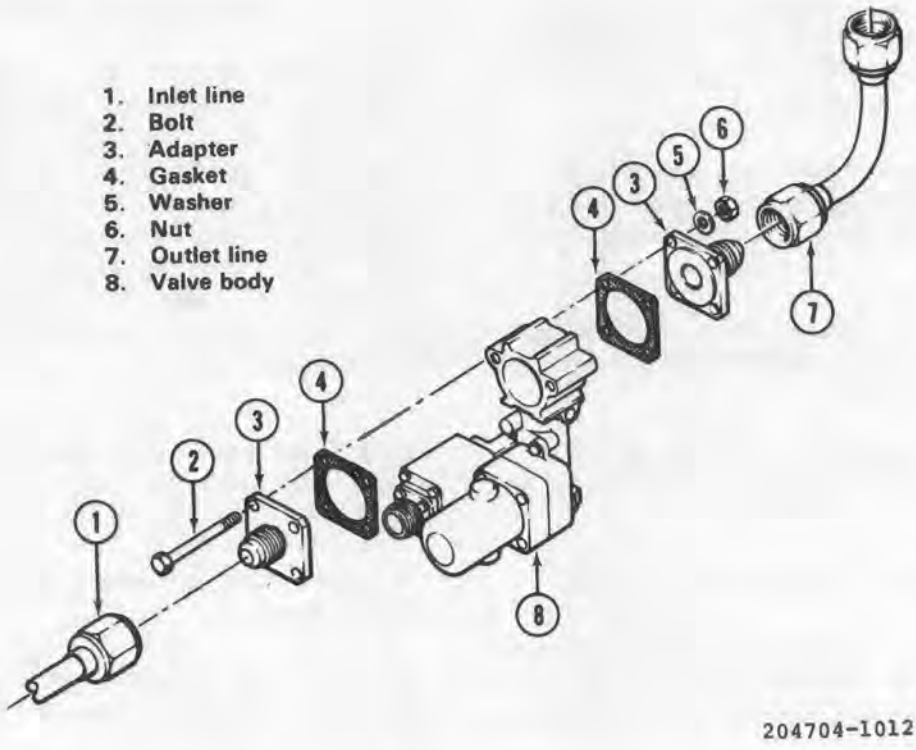


Figure 10-7. Fuel shutoff valve

e. Connect electrical cable connector to valve actuator.

f. Close valve manually. Before refueling, check electrical operation of valve.

10-37. FUEL FILTER.

10-38. Description — Fuel Filter. The main fuel filter has a micronic type element and electrical means of indicating any impending bypass condition which may occur. The filter is a cylindrical unit, horizontally mounted on a support bracket attached on forward leg of the engine mount tripod at left side of the engine deck. See figure 10-8. Piping connections to the filter head include an inlet from the fuel shutoff valve of the supply system, an outlet coupling for engine fuel control hose, a drain line with a manual valve, and a line to the pressure gage transmitter. Filter element and other parts, except head assembly and preformed packings are interchangeable with those used in external filter of the transmission oil system. If a clogging condition should develop in the filter element, a normally-open switch would be closed by differential pressure. Pressure switch would light FUEL FILTER caution panel segment as a warning that further clogging may cause fuel to flow through bypass valve without filtration. After incorporation of MWO 55-1500-206-30-3, the outlet side of the fuel filter will have breakaway coupling valves installed. This will allow for complete separation of components in a crash without loss of fuel.

10-39. Removal — Fuel Filter. a. Open left engine compartment cowling.

b. Disconnect fuel hose from outlet coupling (7, figure 10-8) on filter. Manually open drain valve (9) to drain fuel from filter (1).

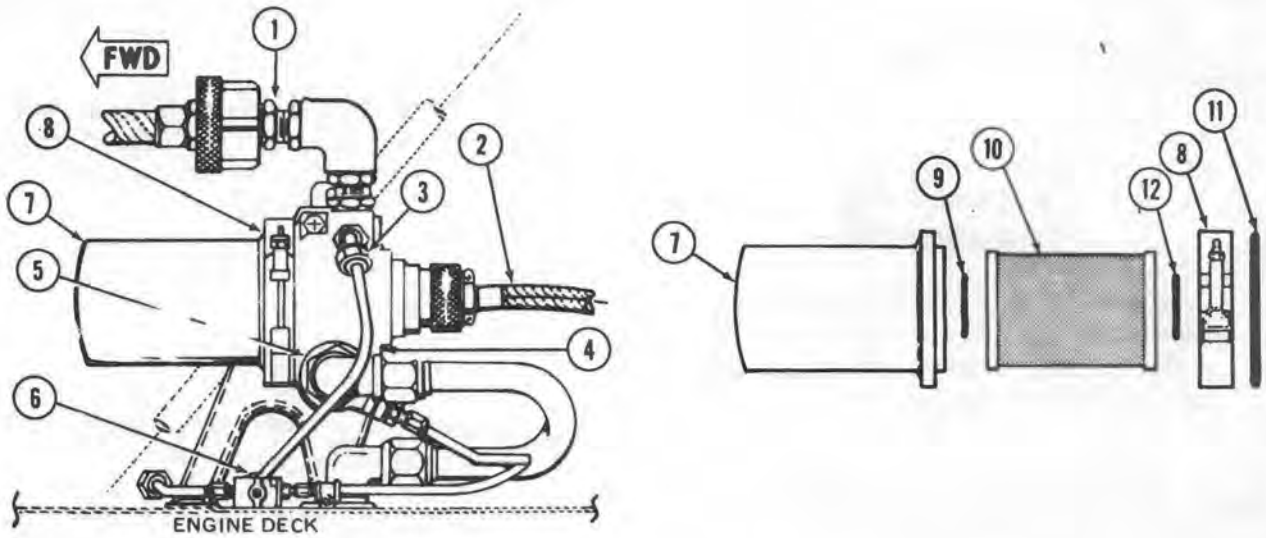
NOTE

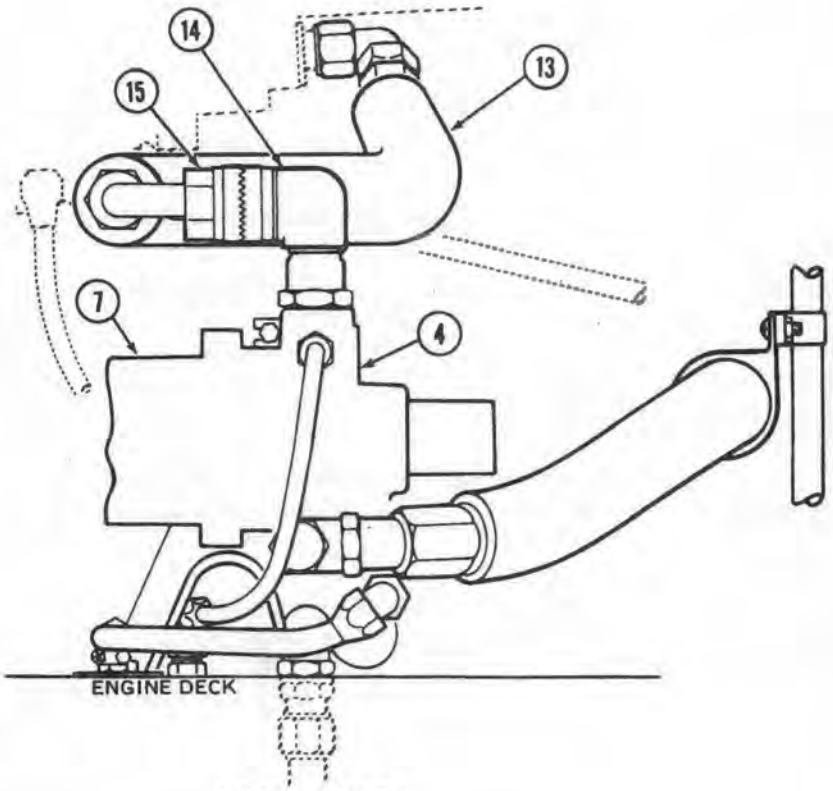
Use suitable tool to depress self-closing valve in filter outlet coupling to admit some air and facilitate drainage.

c. Disconnect fuel hose from inlet coupling (10) on filter.

d. Disconnect electrical cable plug and all piping from filter head. Remove bolts attaching filter to support bracket and remove filter.

10-40. Disassembly — Fuel Filter. a. Open V-band coupling (5, figure 10-8).





ALTERNATE VIEW
(AFTER INCORPORATION OF
MWO 55-1500-206-30-3)

1. Fuel outlet coupling (see alternate view for crashworthy coupling)
2. Electrical wiring
3. Pressure transmitter line
4. Filter head
5. Fuel inlet
6. Drain valve
7. Filter body
8. Clamp
9. Packing
10. Filter element
11. Packing
12. Packing
13. Outlet hose
14. Coupling half, breakaway
15. Coupling half, breakaway

Figure 10-8. Fuel filter installation

b. Remove filter body (1) and element (3) from filter head (8).

c. Separate element (3) and packings (2, 4 and 6) from filter body (1).

WARNING

Cleaning solvent is flammable and toxic. Provide adequate ventilation. Avoid prolonged breathing of solvent vapors and contact with skin or eyes.

10-41. Cleaning — Fuel Filter, Electrical Bypass Indicator Type. Clean filter body (1, figure 10-8) and head (8) as necessary with cleaning solvent (C205). Protect electrical connections when cleaning head.

10-42. Inspection — Fuel Filter. a. Inspect filter element for contamination. Any metal contamination should be investigated for source. Inspect preformed packings for tears or other damage.

b. Inspect filter head and body for cleanliness and damage.

10-43. Repair or Replacement — Fuel Filter. Replace any damaged component or preformed packings.

10-44. Reassembly — Fuel Filter. a. Place packing (2, figure 10-8) on boss in bottom of filter body (1). Lubricate packing with petrolatum (C164).

b. Position filter element (3) in body (1). Seat firmly on boss.

c. Install packing (6), lubricated with petrolatum (C164) around upper lip of filter body (1) next to flange.

d. Place packing (4) lubricated with petrolatum (C164) around center boss in filter head.

e. Install body assembly into filter head (8). Press firmly into place to seat.

f. Install V-band coupling (5) around mating flanges of filter head (8) and body (1) assembly. Torque nut **50** inch-pounds. Lockwire V-band (TM 55-1500-204-25/1).

10-45. Installation — Fuel Filter. a. Position filter head to support bracket and install bolts, washers, and nuts, using thin washers under bolt head and under nuts (figure 10-8).

b. Connect fuel line tube to inlet coupling (10), transmitter line to pressure tap fitting, and drain line to fitting at bottom of head. Connect and lockwire (C126.1) electrical cable plug.

c. Connect hose from engine fuel control inlet to outlet coupling (7) on filter.

NOTE

Engine inlet system quick-disconnect couplings are hand tightened.

d. During next ground runup, check fuel filter and connections for leaks. Ensure FUEL FILTER caution panel does not light.

10-46. FUEL PRESSURE TRANSMITTER.

Refer to paragraph 8-132 for fuel pressure transmitter maintenance procedures.

10-47. FUEL PRESSURE SWITCH.

10-48. Description — Fuel Pressure Switch. Two pressure switches **(4, figure 10-9)**, electrically connected to caution panel lights, monitor outlet pressures from both boost pumps of fuel supply system. Switches are mounted in the manifold valve.

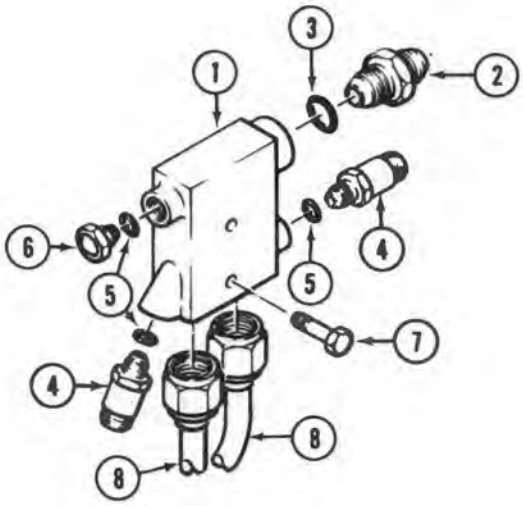
10-49. Removal — Fuel Pressure Switch. a. Drain fuel in cells to a level below tank outlets (paragraph 10-23).

b. Disconnect battery. Disconnect electrical cable connector from switch to be removed.

c. Disconnect fuel line coupling (1, figure 10-8) at fuel filter outlet.

d. Remove pressure switch **(4, figure 10-9)** from manifold valve (1) and plug port in manifold valve. Use a suitable container to catch trapped fuel.

10-50. Inspection — Fuel Pressure Switch. Inspect fuel pressure switch for corrosion, damage and proper operation.



1. Manifold Valve Body
2. Outlet Fitting
3. Preformed Packing
4. Pressure Switch
5. Preformed Packing
6. Plug
7. Bolt
8. Inlet Lines

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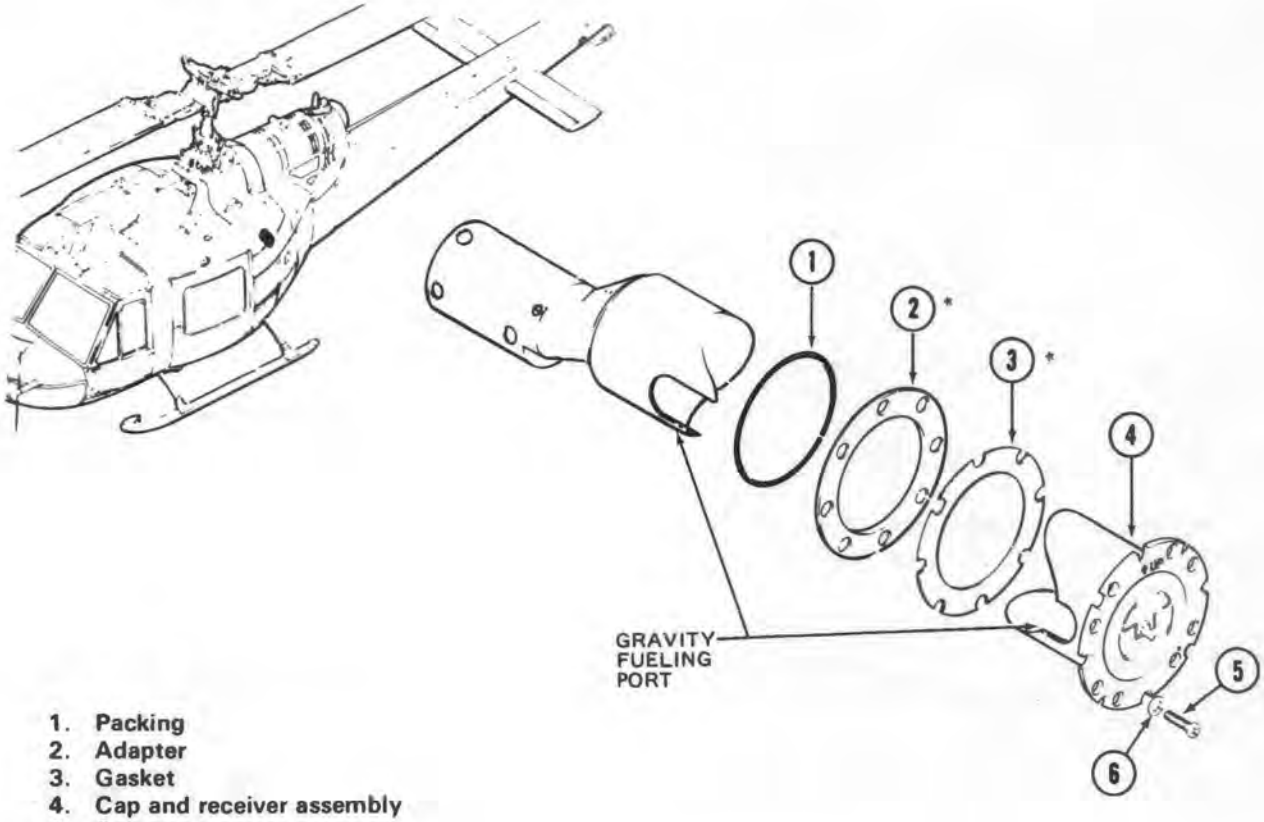
Figure 10-9. Fuel valve manifold



1. Packing
2. Adapter
3. Gasket
4. Cap and receiver assembly
5. Screw
6. Washer

*Not required on crashworthy system.

204704-1013

Figure 10-10. Closed circuit refueling receiver

10-51. Repair or Replacement — Fuel Pressure switch. Replace damaged or inoperative pressure switch.

10-52. Installation — Fuel Pressure Switch. a. Install serviceable preformed packing (5, figure 10-9) lubricated with petrolatum (C164) on pressure switch (4).

b. Install pressure switch (4) in manifold valve (1).

c. Connect fuel filter outlet coupling (7, figure 10-8).

d. Connect electrical cable connector to receptacle on switch.

e. Check for fuel leaks and proper operation during next ground runup.

10-53. FUEL CELL SUMP ASSEMBLY.

10-54. Description — Fuel Cell Sump Assembly. A fuel cell sump assembly is located in lowest section of each fuel cell. Left sump assembly has a drain valve and a float switch for fuel-low caution light. Right cell sump has a drain valve only. An electrically operated boost pump is mounted on each sump assembly.

10-55. Removal — Fuel Cell Sump Assembly.

NOTE

Removal is the same for either left or right sump.

a. Defuel system. Refer to paragraph 10-23.

b. Remove access plate under fuel cell. Open valves to drain trapped fuel from pump and sump. Remove pump seal drain tube.

c. Disconnect pump (11, figure 10-11) and fuel-low float switch electrical leads from terminal bigck located on adjacent structure.

d. Remove auxiliary fuel hose between sump and bulkhead.

NOTE

Record location and number of frangible clips (4) in any subsequent steps where removal is required.

e. Remove screws, washers, and frangible clips (4) from sump plate. Lower sump assembly (8) until float switch is clear of cell opening and withdraw sump with attached pump discharge hose. Disconnect fuel discharge hose (12) at pump.

10-56. Inspection — Fuel Cell Sump Assembly. a. Inspect low level switch (5, figure 10-11) for damage and security.

b. Inspect pump, hoses and lines for corrosion and general condition.

c. Inspect breakaway valve (30, figure 10-4) for cracks or leaks.

d. Insepct auxiliary transfer line (32) and check valve for damage or leakage.

e. Inspect for nicks and burrs in sealing groove.

10-57. Repair or Replacement — Fuel Cell Sump Assembly. a. Polish out nicks or burrs in sealing surface.

b. Replace damaged valves or fittings.

c. Replace damaged float switch as follows:

(1) Cut lockwire from retaining nut and remove retaining nut.

(2) Remove low level warning switch (5, figure 10-11) from sump.

(3) Install serviceable preformed packing lubricated with petrolatum (C164) in sealing groove.

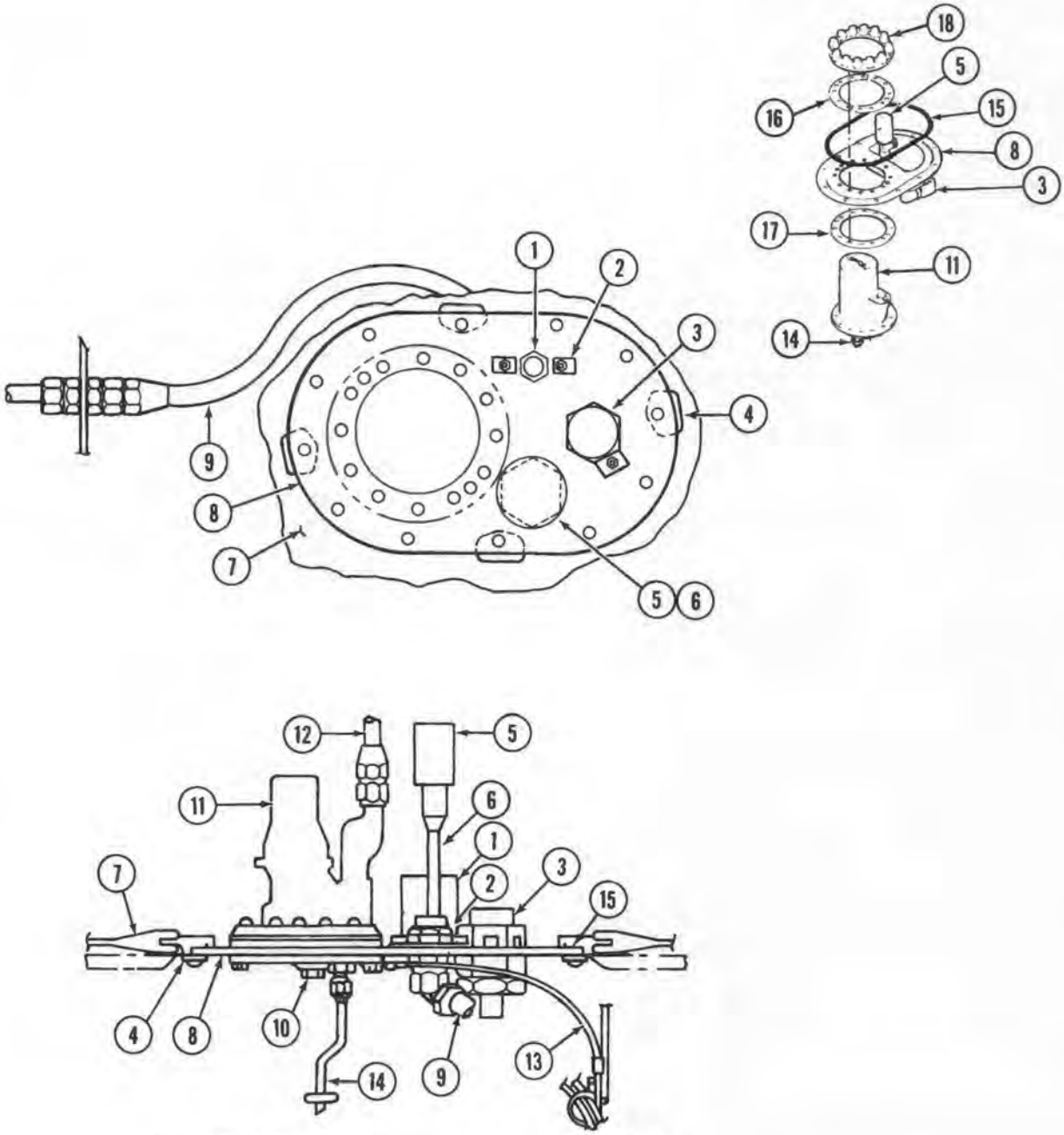
(4) Position switch in hole in sump and secure with retaining nut.

(5) Secure retaining nut with lockwire (C127).

10-58. Installation — Fuel Cell Sump Assembly.

NOTE

In the following instructions, do not tighten screws securing frangible clips to structure until all clips have been installed and sump properly positioned. To ensure a satisfactory seal at bolted connections, alternately snug up and torque opposite bolts at each connection.



1. Valve, check
2. Clip check valve
3. Valve, sump drain and defuel
4. Clip, frangible
5. Switch, low level
6. Support, switch
7. Cell, fuel
8. Sump
9. Line, external auxiliary fuel
10. Plug
11. Pump, fuel
12. Line, fuel pump discharge
13. Jumper, electrical
14. Line, pump seal drain
15. Preformed packing
16. Split gasket
17. Gasket
18. Flange ring

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Figure 10-11. Fuel cell sump assembly

a. Connect fuel pump discharge hose (16, figure 10-3) to outlet port fitting inside fuel cell.

b. Install packing (15, figure 10-11) in groove of fuel cell fitting. Use petrolatum (C164) to retain packing.

c. Connect lower end of hose (12) installed in previous step a., to outlet port of fuel pump (11) on sump (8).

d. Position assembled fuel sump to cell fitting. Secure sump (8) to fuel cell (7) cavity floor at four places using four frangible clips (4) and four screws. Install 20 screws and 20 washers in remaining holes.

e. Install auxiliary fuel line (9) to bulkhead and sump (8).

f. Install lower crossover to sump fitting. (Detail B, figure 10-3).

g. Adjust position of cell in cavity so that all frangible clips are bearing on helicopter structure. Torque bolts securing sump to cell and structure **45 TO 50** inch-pounds.

10-59. FUEL BOOST PUMPS.

10-60. Description — Fuel Boost Pumps. An electrically operated boost pump is mounted through plate of sump assembly in each cell (figure 10-3). The pump is equipped with a drain valve (20), a seal drain line (25), an intake screen, a discharge fitting inside cell and a plugged discharge port outside cell.

10-61. Removal — Fuel Boost Pumps. a. Disconnect battery. Defuel cells. (Refer to paragraph 10-23).

b. Remove access door (7, figure 10-1) under fuel cell sump. Disconnect seal drain tube (8) from pump fitting. Drain trapped fuel through pump and sump drain valves.

c. Disconnect pump electrical jumper (13, figure 10-11) from terminal block aft side of access opening.

d. Remove bolts and washers around pump mounting flange. Lower fuel pump (11) through opening in sump plate until fuel pump discharge hose (12) connection is exposed. Disconnect line from fitting. Remove pump and gasket (17). Cover sump opening immediately.

10-62. Inspection — Fuel Boost Pumps. a. Inspect fuel boost pump for corrosion, damage and proper operation.

b. Inspect fittings for cracks and damaged threads.

c. Inspect electrical leads for frayed or damaged insulation.

10-63. Repair or Replacement — Fuel Boost Pumps. a. Replace gasket if leaking or damaged.

b. Replace damaged or defective pump.

c. Replace damaged fittings.

10-64. Installation — Fuel Boost Pumps. a. At pump mounting hole in sump plate, check for proper installation of flange ring (18, figure 10-11) and split gasket (16) at inner side, secured by two countersunk screws through plate.

b. Place gasket (17) on pump flange. Hold fuel pump (11) slightly below sump plate opening, with discharge port fitting aft and 30 degrees inboard. Connect line (12) from cell outlet to pump fitting.

c. Secure pump flange and gasket to sump plate with bolts and washers.

d. Connect pump electrical jumper (13) to terminal block at aft side of access opening.

e. Attach pump seal drain line (14) to pump fitting. Install access plate, inserting drain tube through grommet.

10-65. Functional Test — Fuel Boost Pumps. a. Service fuel cells as required.

b. Connect external power.

c. Close following circuit breakers:

(1) INVTR CONT and MAIN INVTR PWR.

(2) FUEL VALVE, FUEL BOOST LEFT, FUEL BOOST RIGHT, and FUEL PRESSURE.

d. INVTR switch — ON MAIN.

e. FUEL switch — ON. Pull circuit breaker of boost pump not being tested.

f. Check that fuel low caution light is extinguished and FUEL BOOST caution light of pump being tested is extinguished.

g. Check fuel pressure gage for required pressure.

h. All switches off and circuit breakers out.

i. Check fuel system for leaks.

10-66. FUEL CELL FITTINGS — NON-CRASHWORTHY.

10-67. Description — Fuel Cell Fittings Non-Crashworthy. Externally accessible fittings on fuel cells include upper crossover tube, lower crossover fitting, and cell outlet fitting.

10-68. UPPER CROSSOVER — NON-CRASHWORTHY.

10-69. Description — Upper Crossover — Non-Crashworthy. Upper crossover is a large diameter, two-piece tube that equalizes fuel level in main fuel cells.

10-70. Removal — Upper Crossover — Non-Crashworthy. a. Defuel fuel cell below crossover level (paragraph 10-23).

b. Disconnect coupling in center of upper crossover (10, figure 10-3).

c. Remove bolts and washers from crossover flanges. Remove crossover.

10-71. Inspection — Upper Crossover — Non-Crashworthy. Inspect upper crossover (10, figure 10-3) for evidence of chafing, leakage, cracks, dents, and corrosion.

10-72. Repair or Replacement — Upper Crossover — Non-Crashworthy. a. Polish out nicks or burrs on packing groove or sealing face of flange.

b. Replace damaged or leaking crossover.

10-73. Installation — Upper Crossover — Non-Crashworthy. a. Install new preformed packing lubricated with petrolatum (C164) in groove.

b. Position crossover to cells and start bolts with washers through flanges. Do not tighten bolts at this time.

c. Secure coupling in middle of crossover assembly.

d. Torque flange bolts **45 TO 50** inch pounds.

e. Service fuel cells and check for leaks.

10-74. LOWER CROSSOVER FITTINGS — NON-CRASHWORTHY.

10-75. Description — Lower Crossover Fitting — Noncrashworthy. Lower crossover fittings are bulkhead tubing fittings threaded into lower sump plate.

10-76. Removal — Lower Crossover Fitting — Non-Crashworthy. a. Remove access door (7, figure 10-1) under sump (9).

b. Defuel fuel cell completely (paragraph 10-23).

c. Remove crossover tube (10) from fitting.

d. Loosen lock nut and unscrew fitting from sump plate.

10-77. Inspection — Lower Crossover Fitting — Non-Crashworthy. Inspect threads for damage.

10-78. Repair or Replacement — Lower Crossover Fitting — Non-Crashworthy. Replace damaged fittings.

10-79. Installation — Lower Crossover Fitting — Non-Crashworthy. a. Screw fitting into sump plate with serviceable preformed packing.

b. Secure fitting with lock nut.

c. Attach lower crossover tube (10, figure 10-1) to fitting.

d. Service fuel cells and check for leaks.

e. Install access panel (7) under sump (9).

10-80. CELL OUTLET FITTING — NON-CRASHWORTHY.

10-81. Description — Cell Outlet Fitting — Non-Crashworthy. Cell outlet fitting is a flange with

provisions to accept tubing fittings on each side. Fitting secures cell to structure.

10-82. Removal — Cell Outlet Fitting — Non-Crashworthy. a. Defuel fuel cell completely (paragraph 10-23).

b. Gain access to cell outlet in cargo hook area.

c. Remove outlet line from fitting (15, figure 10-1).

d. Remove bolts (21) and washers (22) from fitting (15). Remove fitting from cell (5)and structure.

e. Disconnect fuel pump outlet hose (13) inside fitting. Remove fitting from helicopter.

10-83. Inspection — Cell Outlet Fitting — Non-Crashworthy. a. Inspect threads for damage.

b. Inspect packing groove for nicks and burrs.

10-84. Repair or Replacement — Cell Outlet Fitting. a. Replace damaged fitting.

b. Polish out nicks and burrs on sealing face.

10-85. Installation — Cell Outlet Fitting — Non-Crashworthy. a. Install serviceable preformed packing lubricated with petrolatum (C164) in sealing groove.

b. Attach pump discharge hose (13, figure 10-1) to inside of fitting.

c. Position cell outlet fitting (15) in cell port and secure with washers (22) and bolts (21). Torque bolts **45 TO 50** inch-pounds.

d. Attach outlet line to fitting.

e. Service fuel cells and check for leaks.

10-86. FUEL CELL FITTINGS — CRASHWORTHY.

10-87. Description — Fuel Cell Fittings — Crashworthy. Refer to paragraph 10-67.

10-88. UPPER CROSSOVER FITTING — CRASHWORTHY.

10-89. Description — Upper Crossover Fitting — Crashworthy. Upper crossover fitting is a large diameter metal flange bonded to self sealing flexible crossover hose. Fitting secures upper crossover and fuel cell to structure. See detail A, figure 10-2.

10-90. Removal — Upper Crossover Fitting — Crashworthy. a. Defuel fuel cell below crossover outlet (paragraph 10-23).

b. Remove clamps from crossover.

NOTE

Record location and number of frangible clips in any subsequent steps where removal is required.

c. Remove bolts (17, figure 10-2), washers, and frangible clips (16) from fitting (15). Remove crossover (14).

10-91. Inspection — Upper Crossover Fitting — Crashworthy. a. Inspect crossover fitting (15, figure 10-2) for damage or corrosion.

b. Inspect sealing face for nicks or burrs.

c. Inspect crossover for damage or evidence of leakage.

10-92. Repair or Replacement — Upper Crossover Fitting — Crashworthy. a. Polish out nicks and burrs in packing groove or sealing face.

b. Replace damaged or leaking crossover.

10-93. Installation — Upper Crossover Fitting — Crashworthy. a. Install preformed packing lubricated with petrolatum (C164) in packing groove.

b. Position crossover (14, figure 10-2) between cells and install bolts (17), washers, and frangible clips (16). Do not tighten bolts at this time.

c. Install clamp in center of crossover.

d. Torque bolts (17) alternately and evenly to **50 TO 60** inch-pounds.

e. Service fuel cell and check for leaks.

10-94. LOWER CROSSOVER FITTINGS — CRASHWORTHY.

10-95. Description — Lower Crossover Fitting — Crashworthy. Crashworthy lower crossover tube fitting is a self sealing breakaway valve mounted through sump plate.

10-96. Removal — Lower Crossover Tube Fitting — Crashworthy. a. Remove access panel under sump access door (7, figure 10-1).

b. Defuel fuel cell completely (paragraph 10-23).

c. Remove crossover line (25, figure 10-4) from fitting.

d. Loosen lock nut and unscrew breakaway valve (30) from sump (21).

10-97. Inspection — Lower Crossover Tube Fitting — Crashworthy. a. Inspect breakaway valve for damage or evidence of leakage.

10-98. Repair or Replacement — Lower Crossover Tube Fitting — Crashworthy. No repairs are permitted to breakaway valves.

10-99. Installation — Lower Crossover Tube Fitting — Crashworthy. a. Install serviceable preformed packing lubricated with petrolatum (C164) on breakaway valve (30, figure 10-4).

b. Thread breakaway valve into sump plate (21).

c. Attach crossover tube to breakaway valve.

d. Tighten locknut on breakaway valve.

e. Service fuel cells and check for leaks.

f. Install access panel under sump.

10-100. CELL OUTLET FITTING — CRASHWORTHY.

10-101. Description — Cell Outlet Fitting — Crashworthy. Cell outlet fitting is a flange with male tubing threads on each side to secure pump discharge line (18, figure 10-4) from the fuel supply line to the fuel valve manifold (6).

10-102. Removal — Cell Outlet Fitting — Crashworthy. a. Defuel cell below outlet (paragraph 10-23).

b. Unscrew hose fitting from outlet fitting (9, figure 10-2).

NOTE

Record location and number of frangible clips in any subsequent steps where removal is required.

c. Remove screws and frangible clips or washers from outlet fitting.

d. Remove fitting from cell and structure.

e. Unscrew pump discharge line from fitting.

f. Cover open cell port immediately.

10-103. Inspection — Cell Outlet Fitting — Crashworthy. a. Inspect sealing face for nicks and burrs.

b. Inspect threads for damage.

10-104. Repair or Replacement — Cell Outlet Fitting — Crashworthy. a. Polish out nicks and burrs.

b. Replace damaged fitting.

10-105. Installation — Cell Outlet Fitting — Crashworthy. a. Install serviceable preformed packing lubricated with petrolatum (C164) in seal groove.

b. Hold outlet fitting at cell port and secure pump discharge line to outlet fitting (9, figure 10-2).

c. Secure cell outlet fitting to cell integral fitting and structure with two screws and frangible clips.

d. Install remaining two screws and washers in outlet fitting. Torque all screws **50 TO 60** inch-pounds.

e. Secure fuel supply hose to outlet fitting.

f. Service fuel cell and check for leaks.

10-106. CLOSED CIRCUIT REFUELING RECEIVER.

10-107. Description — Closed Circuit Refueling Receiver. A closed circuit refueling receiver replaces the standard filler cap and adapter, and is used in conjunction with a closed circuit refueling nozzle. The closed circuit refueling receiver provides automatic shutoff of fuel when cells are full. Provisions are also incorporated for refueling with a standard nozzle (figure 10-10).

10-108. Removal — Closed Circuit Refueling Receiver. a. Disconnect battery.

CAUTION

It is not necessary to defuel helicopter. However, accomplish the following in a well ventilated area, ensuring the helicopter is properly grounded.

b. Remove screws (5, figure 10-10) and washers (6) attaching cap and receiver (4) to fuel cell.

c. Remove cap and receiver (4) and packing (1).

10-109. Inspection — Closed Circuit Refueling Receiver. a. Inspect receiver assembly for damage, corrosion and proper operation.

b. Inspect cap for proper locking on receiver.

c. Inspect gravity fueling port cover for damage.

10-110. Repair or Replacement — Closed Circuit Refueling Receiver. Replace receiver that is malfunctioning or damaged.

NOTE

Ensure installation is in accordance with instructions on face of cap and receiver assembly.

10-111. Installation — Closed Circuit Refueling Receiver. a. Install packing (1, figure 10-10) lubricated with petrolatum (C164) on receiver assembly (4). Install receiver (4) and secure with screws (5) and washers (6).

b. Torque screws **50 TO 60** inch-pounds.

10-112. FUEL VALVE MANIFOLD.

10-113. Description — Fuel Valve Manifold. A fuel valve manifold (6, figure 10-4) located on the inboard side of the left main beam is connected into the fuel pressure lines ahead of the shutoff valve. The manifold contains two separate valve elements at the inlet ports, each consisting of a check valve which prevents reverse flow of trapped fuel except through its thermal relief bypass. The manifold also has an outlet port and a tap for the fuel transmitter at the outlet side of the check valves. Two taps on the inlet side of the check valves are used for connection of the pressure switches in the RIGHT FUEL BOOST and LEFT FUEL BOOST caution panel circuits.

10-114. Removal — Fuel Valve Manifold. a. Disconnect two fuel inlet lines (8, figure 10-9) at inlet ports of the manifold (1). Cap open lines and fittings.

b. Disconnect pressure switch leads at pressure switches (4).

c. Disconnect fuel line at outlet fitting (2) of manifold.

d. Remove nuts from two bolts (7) through valve body. Remove valve assembly. Install nuts to keep bolts, spacers and washers in place as sets.

10-115. Inspection — Fuel Valve Manifold. a. Inspect manifold (1, figure 10-9) for cracks and fittings for damaged threads.

b. Inspect pressure switches (4) for cracks or other damage.

c. Inspect manifold for evidence of leaks and corrosion.

10-116. Repair or Replacement — Fuel Valve Manifold. a. Replace cracked or damaged pressure switches (4, figure 10-9).

b. If manifold is replaced, transfer fittings to replaced assembly.

10-117. Installation — Fuel Valve Manifold. a. Install manifold on inboard side of left main beam using spacers, bolts, washers and nuts.

b. Connect fuel lines to inlet fittings.

c. Connect outlet line to outlet fitting.

d. Connect pressure switch leads to pressure switches.

e. Perform operational check in accordance with TM 55-1520-220-10. Check for leaks.

10-118. TUBES — FUEL SYSTEM.

10-119. Description — Tubes — Fuel System. Metal tubes are used in the fuel system for fuel supply, vent, and transfer lines. Flared fittings are used.

10-120. Removal — Tubes — Fuel System. a. Defuel cell (paragraph 10-23).

b. Loosen tubing end fittings.

c. Remove any clamps from tube.

d. Remove tube.

e. Cap fittings to avoid foreign material entry into fuel system.

10-121. Inspection — Tubes — Fuel System. a. Inspect tubes for leaks, cracks, kinks, dents, and chafing damage TM 55-1500-204-25/1).

b. Inspect fittings for corrosion and cracked sleeves.

10-122. Repair or Replacement — Tubes — Fuel System. Replace tubes with damage other than negligible.

10-123. Installation — Tubes — Fuel System. a. Position tube to fittings and screw tubing end fittings onto fittings.

b. Install any clamps previously removed.

c. Tighten tubing and fittings.

d. Service fuel cells and check for leaks.

10-124. HOSES — FUEL SYSTEM.

10-125. Description — Hoses — Fuel System. Flexible hoses are used in the fuel system to permit easier maintenance. The crashworthy system uses self-sealing flexible hoses to prevent fuel spillage in event of a crash.

10-126. Removal — Hoses — Fuel System. a. Defuel fuel cell (paragraph 10-23).

b. Loosen end fittings of hose.

c. Remove any clamp and remove hose.

d. Cap fittings to avoid foreign material entry into fuel system.

10-127. Inspection — Hoses — Fuel System. a. Inspect hoses for damage and evidence of leakage (TM 55-1500-204-25/1).

b. Inspect hoses for evidence of chafing.

c. Inspect hose fittings for corrosion.

10-128. Repair or Replacement — Hoses — Fuel System. Replace hoses with damage, evidence of leakage, or corroded fittings.

10-129. Installation — Hoses — Fuel System. a. Attach hose end fittings.

b. Secure only clamps previously removed.

c. Service fuel system and check for leaks.

SECTION III — AUXILIARY FUEL SYSTEMS

10-130. AUXILIARY FUEL SYSTEMS.

10-131. Description — Auxiliary Fuel Systems. Various auxiliary fuel systems are available to provide additional fuel for extended distance and ferry missions. Internal 50.0 or 60.0 gallon capacity, self-sealing auxiliary fuel cells may be installed in either the forward or aft portion of the passenger-cargo compartment. A 165 gallon capacity, non-self sealing fuel bladder enclosed in a metal container may be installed in the passenger-cargo compartment. A 350 gallon capacity, metal-enclosed fuel cell is also available for installation in the passenger-cargo compartment. Permanently installed provisions for use of internally installed auxiliary fuel cells include

drain, vent, and fuel transfer lines with quick-disconnect couplings. Comparable provisions for use of externally installed auxiliary fuel cells include interconnecting air lines between the tanks, and fuel lines connected to each fuel cell. A transfer pump relay circuit with float switch in the left main fuel cell limits fuel level during transfer. Wiring for the transfer pump and fuel level transfer circuits is stowed when not in use.

10-132. Troubleshooting — Auxiliary Fuel Systems.

NOTE

Before using this table, ensure all normal operational checks have been performed. If a malfunction not listed in this table is found, notify the next higher level of maintenance.

Table 10-2. Troubleshooting — Auxiliary Fuel Systems

CONDITION TEST OR INSPECTION	CORRECTIVE ACTION
1. No fuel transfer from one auxiliary fuel cell.	
STEP 1. Check fuel discharge hose coupling for proper seating.	**Connect coupling properly or replace coupling.**
STEP 2. Ensure check valve (fuel discharge line) is operating correctly.	**If check valve is defective, replace check valve. Do not attempt to clean and reuse check valve except in emergency conditions (paragraphs 10-151 and 10-154).**
STEP 3. Check for defective fuel pump or fuel pump electrical circuit.	**If electrical power is available at fuel pump, replace defective pump (paragraphs 10-145 and 10-148). Otherwise check and repair defective wiring.**
2. No fuel transfer from either auxiliary fuel cell.	
STEP 1. Check for faulty transfer relay (paragraph 9-5).	**Repair or replace transfer relay (paragraphs 10-159 or 10-157 and 10-160).**
STEP 2. Check for faulty float switch or electrical circuit.	**Replace float switch or repair faulty circuit (paragraphs 9-9 and 9-11).**

Table 10-2. Troubleshooting — Auxiliary Fuel Systems (Cont)

CONDITION	TEST OR INSPECTION	CORRECTIVE ACTION
3. Fuel overflows main cell vents during fuel transfer.		
	STEP 1. Check upper float switch to ensure it is actuating transfer relay.	**Replace upper float switch (paragraphs 9-9 and 9-11) or transfer relay (paragraphs 10-157 and 10-160), as required.**
4. Auxiliary cell collapsing during fuel transfer.		
	STEP 1. Check for clogged vent valve or vent line.	**Replace vent valve or clean vent line (paragraphs 10-169 and 10-172 or 10-170).**

10-133. INTERNAL AUXILIARY FUEL CELL — 50 OR 60 GALLONS.

10-134. Description — Internal Auxiliary Fuel Cell — 50 or 60 Gallons. A 50.0 or 60.0 U.S. gallon capacity auxiliary fuel cell may be installed in the passenger-cargo compartment for extended distance and ferry missions. The cell consists of a self-sealing, self-supporting bladder and may be installed just aft of the pilot and copilot seats or at the rear of the passenger-cargo compartment just forward of the aft cabin bulkhead. The cell sump is equipped with an electrically-operated fuel transfer pump, a fuel-low switch for caution panel circuit, fittings, and flexible hoses for quick connection to the permanently installed piping of the main fuel system. Wiring for the transfer pump and fuel level transmitter circuits is also permanently installed and is stowed when not in use. A check valve is incorporated in the fuel transfer line to the main fuel system to prevent reverse flow of fuel. The auxiliary transfer pump circuit relay is controlled by a float switch in the main fuel cell. (See figure 10-3).

10-135. Removal — Forward Internal Auxiliary Fuel Cell — 50 or 60 Gallons.

WARNING

Ensure helicopter battery is disconnected, all external power disconnected, and helicopter is properly grounded.

a. Remove floor panel at F.S. 112.00, center of cabin floor to gain access to fuel and vent disconnects of helicopter.

b. Disconnect fuel vent hose (4, figure 10-12), fuel system hose (5), and pump drain hose (6). Cap or cover hose openings to prevent entrance of foreign material.

c. Remove clamps attaching hose bundle to cabin floor tie-down rings.

d. Loosen and release hold-down straps (7) from tie-down rings on cabin floor.

e. Remove bolts (8) attaching cell to cabin floor.

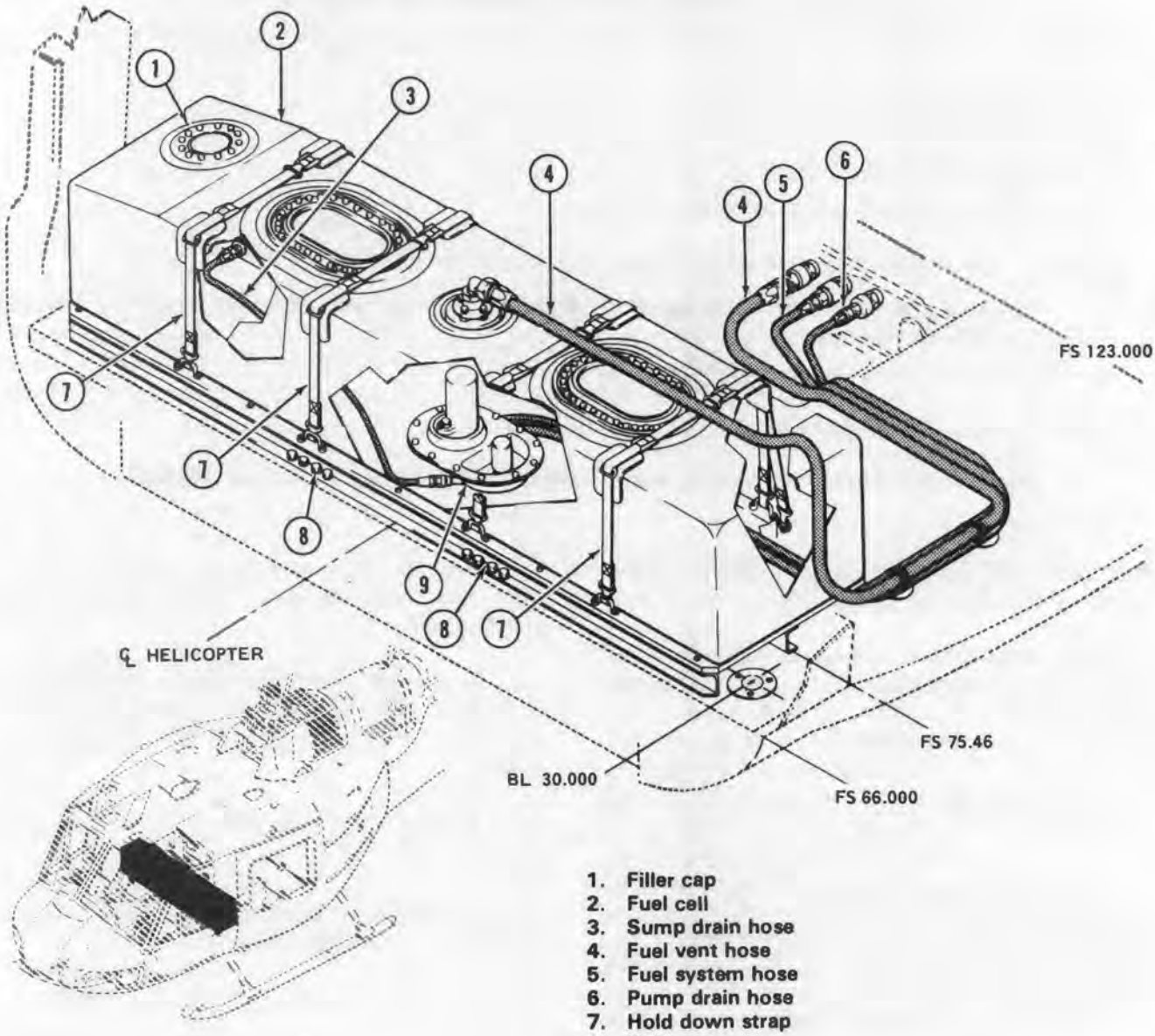
f. Disconnect electrical wiring under cabin floor at F.S. 112.00, B.L. 10.00 left side, and cover wire ends with tape (C217.1). Stow wiring under clamp provided for this purpose on left side of access cavity.

g. Remove cell from helicopter and prepare for storage. Refer to TM 55-1500-204-25/1 for procedure.

h. Install floor panel.

i. Connect battery.

10-136. Inspection — Forward Internal Auxiliary Fuel Cell — 50 or 60 Gallon. a. Inspect fuel cell for leakage, damage and general condition.



1. Filler cap
2. Fuel cell
3. Sump drain hose
4. Fuel vent hose
5. Fuel system hose
6. Pump drain hose
7. Hold down strap
8. Bolts
9. Sump assembly

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Figure 10-12. Typical forward 50 and 60 U.S. gallon auxiliary fuel cell

b. Refer to TM 55-1500-204-25/1 for detailed inspection procedures.

10-137. Repair or Replacement — Forward Internal Auxiliary Fuel Cell — 50 or 60 Gallon. Refer to TM 55-1500-204-25/1 for fuel cell repair procedures.

10-138. Installation — Forward Internal Auxiliary Fuel Cell — 50 or 60 Gallon.

WARNING

Ensure battery is disconnected, all external power is disconnected, and helicopter grounded.

NOTE

If fuel cell was previously installed in aft location, the cell pump must be removed from the sump assembly (9, figure 10-12), rotated 120 degrees counterclockwise, and reinstalled. Check for leaks after reinstallation.

a. Remove floor panel at F.S. 112.00, center of cabin floor, to gain access to fuel, vent, and electrical connections.

b. Position the fuel cell (2, figure 10-12) on the cabin floor, just aft of the pilot and copilot seats, with the fuel filler cap (1) on the right side of the helicopter.

c. Remove electrical wiring from under clamp on left side of access cavity and remove tape from wire ends.

d. Route fuel and vent lines and electrical wires to access cavity in cabin floor. Connect electrical wires.

NOTE

Ensure electrical wiring is protected from possible chafing and abrasion.

e. Align fuel cell mounting holes with holes in cabin floor and install bolts (8) attaching fuel cell to cabin floor.

f. Uncap or uncover openings in pump drain hose (6), fuel system hose (5), fuel vent hose (4), and connect to mating lines.

g. Bundle hoses and clamp in two places to tie-down rings on cabin floor.

h. Position hold-down straps (7) over fuel cell (2) and attach to tie-down rings on cabin floor. Tighten and secure hold-down straps.

i. Connect battery.

j. Install access doors and panels.

10-139. Removal — Aft Internal Auxiliary Fuel Cell — 50 or 60 Gallon.

WARNING

Ensure battery is disconnected, all external power is disconnected, and helicopter is grounded.

a. Remove floor panel at F.S. 112.00 left side of cabin floor to gain access to fuel, vent, and electrical connections.

b. Disconnect fuel vent hose (2, figure 10-13), fuel system hose (6) and pump drain hose (4). Cap or cover hose openings to prevent entrance of foreign material.

c. Loosen, release, and remove hold-down straps (3) from litter rack-support rings on aft cabin bulkhead and from tie-down rings in cabin floor on both sides of fuel cell (1).

d. Remove bolts securing fuel cell to cabin floor.

e. Tip fuel cell (1) slightly to facilitate access to electrical wiring on tank sump (11).

f. Disconnect electrical wiring and cover wire ends with tape (C217.1). Stow wiring under clamp provided for this purpose on left side of access cavity.

NOTE

Do not cut wiring to shorten length and facilitate stowage. Full length is required when fuel cell is installed in forward position.

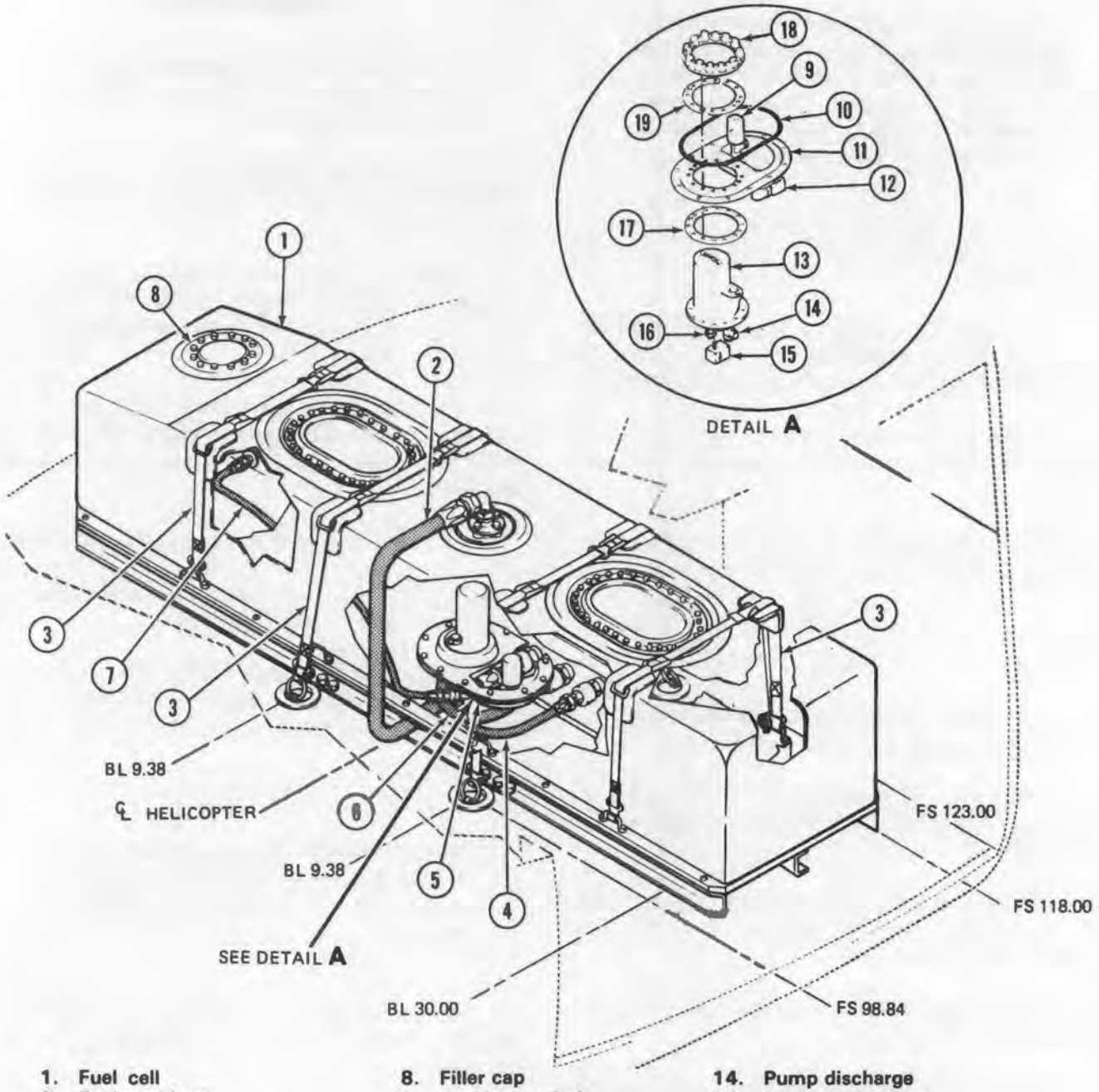
g. Remove cell from helicopter and prepare for storage. Refer to TM 55-1500-204-25/1 for procedure.

h. Install floor panels.

i. Connect battery.

10-140. Inspection — Aft Internal Auxiliary Fuel Cell — 50 or 60 Gallon. a. Inspect fuel cell for damage and general condition.

b. Refer to TM 55-1500-204-25/1 for detailed inspection procedures.



1. Fuel cell
2. Fuel vent hose
3. Hold down straps
4. Pump drain hose
5. Sump assembly
6. Fuel system hose
7. Sump drain hose
8. Filler cap
9. Fuel-low switch
10. Preformed packing
11. Sump assembly
12. Sump drain valve
13. Transfer pump
14. Pump discharge
15. Pump drain valve
16. Pump seal drain
17. Gasket
18. Flange ring
19. Split gasket

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Figure 10-13. Typical aft 50 and 60 U.S. gallon auxiliary fuel cell

10-141. Repair or Replacement — Aft Internal Fuel Cell — 50 or 60 Gallon. Refer to TM 55-1500-204-25/1 for detailed fuel cell repair procedures.

10-142. Installation — Aft Internal Auxiliary Fuel Cell — 50 or 60 Gallon.

WARNING

Ensure battery is disconnected, all external power is disconnected, and helicopter is grounded.

NOTE

If fuel cell was previously installed in forward location, cell pump must be removed from the sump assembly (11, figure 10-13), rotated 120 degrees clockwise, and reinstalled. Check for leaks after reinstallation.

a. Remove floor panel at F.S. 112.00 center of cabin floor to gain access to fuel and vent connections.

b. Position the fuel cell (1, figure 10-13) on cabin floor, approximately three inches forward of aft cabin bulkhead, with filler cap (8) on right side of helicopter.

c. Remove electrical wiring from under clamp on left side of access cavity and remove tape from wire ends.

d. Tip fuel cell (1) slightly to facilitate access to cell sump (11) and connect electrical wiring to pump.

NOTE

Ensure electrical wiring is protected from possible chafing and abrasion.

e. Align fuel cell mounting holes with holes in cabin floor and install bolts attaching fuel cell to cabin floor.

f. Uncap or uncover openings in pump drain hose (4), fuel system hose (6), fuel vent hose (2), and connect to mating lines.

g. Position hold-down straps (3) over fuel cell and attach to litter rack support rings on aft cabin bulkhead and to tie-down rings in cabin floor on both sides of fuel cell. Tighten and secure hold-down straps (3).

h. Connect battery.

i. Install access doors and panels.

10-143. INTERNAL AUXILIARY TRANSFER PUMP AND SUMP — 50 OR 60 GALLONS.

10-144. Description — Internal Auxiliary Transfer Pump and Sump — 50 or 60 Gallon. A sump assembly, mounted in lower center of auxiliary fuel cell, provides a low point drain for fuel cell and mounting of auxiliary transfer pump.

10-145. Removal — Internal Auxiliary Transfer Pump and Sump — 50 or 60 Gallon. a. Remove auxiliary fuel cell. Refer to paragraphs 10-135 or 10-139.

b. Disconnect pump drain hose (4, figure 10-13) from fitting in pump. Disconnect fuel system hose (6) from outlet fitting.

c. Remove twelve bolts and washers attaching transfer pump (13) and gasket to sump assembly (11) and pump mounting flange (18).

d. Remove pump (13) and gasket (17) from sump assembly and cap or cover openings in sump and drain lines.

e. Remove sump by removing twelve bolts, washers, and wiring support bracket. Disconnect sump drain hose (7) from sump fitting.

f. Remove sump assembly (11) and packing (10) from the fuel cell.

g. Remove packing from sump assembly and cover opening in fuel cell.

10-146. Inspection — Internal Auxiliary Transfer Pump and Sump — 50 or 60 Gallon. a. Inspect pump and sump for damage and corrosion.

b. Inspect threaded inserts and fittings for damaged threads.

c. Refer to TM 55-1520-204-25/1, for detailed inspection procedures.

10-147. Repair or Replacement — Internal Auxiliary Transfer Pump and Sump — 50 or 60 Gallon. a. Polish out nicks and burrs in sealing faces.

b. Replace damaged electrical connectors.

c. Replace defective or damaged components.

10-148. Installation — Internal Auxiliary Transfer Pump and Sump — 50 or 60 Gallon. a. Uncover opening in fuel cell and place packing (10, figure 10-13) in groove of sump assembly (11).

b. Position sump assembly (11) in fuel cell opening. Install twelve washers and bolts, with wiring support bracket in place of washer on forward bolt at left side. Tighten bolts evenly and torque **45 TO 50** inch-pounds.

c. Place gasket (17) on transfer pump (13) and position pump and gasket in sump assembly port with pump discharge aft.

d. Install twelve washers and bolts attaching transfer pump (13) to sump assembly (11) and pump mounting flange.

e. Connect pump drain hose (4) to fitting in sump. Connect sump drain to sump fitting. Connect fuel system hose (6) to pump fitting.

f. Remove caps from all hose openings and connect fuel system hose (6) and pump drain hose (4) from cell to main fuel system hoses at bulkhead below deck.

g. Remove electrical wires from stowage at beam under the deck and remove insulating tape from wire ends. Connect electrical wiring at outboard side of left center cell support.

h. Connect battery.

10-149. AUXILIARY TRANSFER CHECK VALVE.

10-150. Description — Fuel Transfer Check Valve. The auxiliary fuel system transfer check valve is an in-line check valve mounted in the fitting in the lower crossover line between the main fuel cells. Two additional check valves (1, figure 10-11), one in each main cell sump, are used in the external auxiliary fuel system (9, figure 10-11).

10-151. Removal — Auxiliary Transfer Check Valve. a. Disconnect auxiliary fuel cell quick disconnect coupling.

b. Defuel main fuel cells. Refer to paragraph 10-23.

c. Remove line from check valve (23, figure 10-3) at the crossover line fitting.

d. Remove check valve (23) from fitting.

NOTE

External auxiliary system check valves can only be removed when the sump is removed.

10-152. Inspection — Auxiliary Transfer Check Valve. Inspect check valve for damage, leakage, and proper operation.

10-153. Repair or Replacement — Auxiliary Transfer Check Valve. No repairs are permitted to check valve. Replace damaged or defective units.

10-154. Installation — Auxiliary Transfer Check Valve. a. Install serviceable preformed packing lubricated with petrolatum (C164) on check valve.

b. Install check valve into crossover line, fitting carefully, and observing flow direction.

c. Install auxiliary fuel line to check valve.

d. Connect auxiliary fuel cell quick disconnect coupling.

e. Actuate auxiliary fuel cell transfer pump and inspect check valve for leaks.

f. Service main fuel cells as needed.

10-155. AUXILIARY FUEL TRANSFER RELAY.

10-156. Description — Auxiliary Fuel Transfer Relay. The auxiliary fuel transfer relay controls auxiliary fuel cell transfer pump in response to signals from the transfer switch through the high level float switch and low level float switch in the left main fuel cell.

10-157. Removal — Auxiliary Fuel Transfer Relay. a. Disconnect battery.

b. Gain access to fuel transfer relay in aft electrical compartment.

c. Index wires for proper installation. Disconnect wires from relay.

d. Remove bolts and remove fuel transfer relay from helicopter.

10-158. Inspection — Auxiliary Fuel Transfer Relay. Inspect relay for damage and proper operation.

10-159. Repair or Replacement — Auxiliary Fuel Transfer Relay. No repairs are permitted to relay. Replace damaged or defective relay.

10-160. Installation — Auxiliary Fuel Transfer Relay. a. Position fuel transfer relay to bulkhead and secure with bolts.

b. Install wires to relay.

c. Reconnect battery.

10-161. AUXILIARY FUEL CELL FLOAT SWITCH.

10-162. Description — Auxiliary Fuel Cell Float Switch. The auxiliary fuel cell float switch mounts in the auxiliary fuel cell sump plate. The switch activates a low fuel level warning light on the caution panel.

10-163. Removal — Auxiliary Fuel Cell Float Switch. a. Remove sump from auxiliary fuel cell. Refer to paragraph 10-145.

b. Remove locknut and remove switch (9, figure 10-13) from sump assembly.

10-164. Inspection — Auxiliary Fuel Cell Float Switch. Inspect switch for damage and proper operation.

10-165. Repair or Replacement — Auxiliary Fuel Cell Float Switch. No repairs are permitted to float switch. Replace damaged or defective switch.

10-166. Installation — Auxiliary Fuel Cell Float Switch. a. Install serviceable preformed packing lubricated with petrolatum (C164) on float switch.

b. Position switch (9, figure 10-13) in sump plate (11) and secure with locknut. Secure with lockwire (C126.1).

c. Install sump plate. Refer to paragraph 10-148.

10-167. AUXILIARY FUEL CELL VENT VALVE.

10-168. Description — Auxiliary Fuel Cell Vent Valve. Auxiliary fuel cell vent valve is mounted in the upper portion of the auxiliary fuel cell. The purpose of the vent valve is to prevent negative pressure inside the cell which would prevent fuel transfer.

10-169. Removal — Auxiliary Fuel Cell Vent Valve. a. Disconnect vent hose (2, figure 10-12) from vent fitting.

b. Remove bolts from vent valve and remove valve from fuel cell.

10-170. Inspection — Auxiliary Fuel Cell Vent Valve. Inspect vent valve for cleanliness, damage, and proper operation.

10-171. Repair or Replacement — Auxiliary Fuel Cell Vent Valve. No repairs are permitted to vent valve. Replace damaged or defective valve.

10-172. Installation — Auxiliary Fuel Cell Vent Valve. a. Install serviceable preformed packing lubricated with petrolatum (C164) on valve and position valve in cell port.

b. Install bolts and tighten alternately. Torque bolts **50 TO 60** inch pounds.

c. Connect vent hose (2) to vent fitting.

10-173. AUXILIARY FUEL CELL — 165 GALLONS.

10-174. Description — Auxiliary Fuel Cell — 165 Gallons. A 165 gallon capacity auxiliary fuel cell may be installed in the passenger-cargo compartment for extended distance and ferry missions. The cell consists of a non-self-sealing bladder cell enclosed in a metal cylinder which is mounted in four cradle type supports. The cell sump assembly provides mounting for an electrically operated fuel transfer pump, a fuel low switch and fittings and flexible hoses for quick attachment to permanently installed provisions (tubing) which is part of the main fuel system. Wiring provisions for the transfer pump and fuel quantity transmitter circuits is also permanently installed and is stowed when not in use. A check valve is

incorporated in the transfer line to the main fuel system to prevent reverse fuel flow. The auxiliary transfer pump circuit relay is controlled by float switches permanently installed in left main fuel cell. (Figure 10-3.)

10-175. Removal — Auxiliary Fuel Cell — 165 Gallons. a. Transfer or pump fuel from auxiliary system into main fuel system.

WARNING

Ensure battery is disconnected, helicopter is properly grounded and all external power disconnected prior to fuel system maintenance.

NOTE

Defuel main fuel cells prior to transferring fuel from auxiliary cell.

b. Open sump drain valves (10 and 14, figure 10-14) to drain residual fuel from cell.

c. Disconnect sump drain line (6), fuel transfer line (16), pump drain line (17), cell vent line (2), and pump seal drain line (18) at quick-disconnect fittings on bulkhead below deck and cap all hose openings.

d. Disconnect pump and fuel-low switch circuit wires from below deck at terminal block and grounding screw, located on outboard side of left center cell support.

e. Cover wire ends with insulating tape (C217.1) and stow at beam under deck.

f. Cut and remove lockwire and loosen eight turnbuckles (4).

g. Detach turnbuckle forks from tie-down rings (5) by removing bolts, washers, and nuts.

h. Remove mounting bolts (19) and washers attaching tank supports to deck.

i. Remove cell and support assembly from helicopter.

j. Install removable floor panel (21) in deck.

k. Install two screws in open holes of each cargo deck tie-down ring (20) in two aft rows.

l. Reconnect battery.

10-176. Inspection — Auxiliary Fuel Cell — 165 Gallons. a. Inspect fuel cell for damage, corrosion and serviceability.

b. Inspect threaded fittings for leakage and looseness.

c. Refer to TM 55-1500-204-25/1 for detailed inspection procedure.

10-177. Repair or Replacement — Auxiliary Fuel Cell — 165 Gallons. Refer to TM 55-1500-204-25/1 for detailed repair procedures.

10-178. Installation — Auxiliary Fuel Cell — 165 Gallons. a. Remove all cargo and equipment from the cargo tie-down area of the cabin.

b. Remove floor panel (21, figure 10-14) in cargo deck, giving access to main fuel system quick-disconnect hoses.

c. Remove attachment screws from each cargo tie-down ring (5 and 20) in the two aft rows of rings in the cabin floor according to instructions in figure 10-15. These rows of ring fittings are parallel to the aft cabin bulkhead.

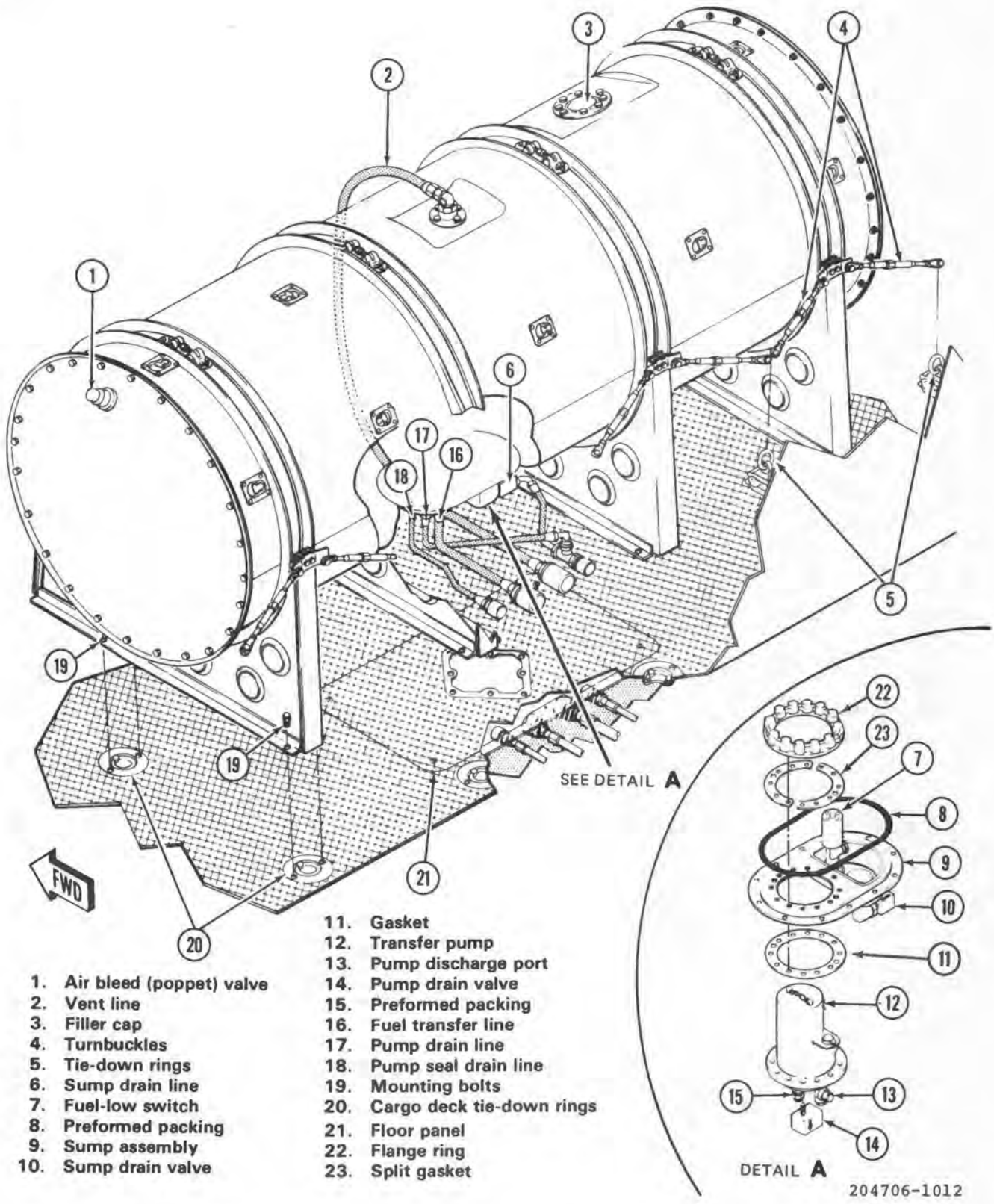
d. Position the auxiliary cell and support assembly across the cabin with the cell filter cap (3, figure 10-14) at right of center on the forward side.

e. Secure supports to the cargo deck by installing washers and mounting bolts (19) in open holes in the tie-down rings (20). Use thin aluminum washers under boltheads.

WARNING

Ensure battery is disconnected, the helicopter grounded, and external power source disconnected prior to completing any fuel line connection.

f. Remove caps from all hose openings and connect sump drain line (6, figure 10-14), fuel transfer line (16), cell vent line (2), pump drain line (17), and pump seal drain line (18) to main fuel system hoses at bulkhead below deck.



1. Air bleed (poppet) valve
2. Vent line
3. Filler cap
4. Turnbuckles
5. Tie-down rings
6. Sump drain line
7. Fuel-low switch
8. Preformed packing
9. Sump assembly
10. Sump drain valve
11. Gasket
12. Transfer pump
13. Pump discharge port
14. Pump drain valve
15. Preformed packing
16. Fuel transfer line
17. Pump drain line
18. Pump seal drain line
19. Mounting bolts
20. Cargo deck tie-down rings
21. Floor panel
22. Flange ring
23. Split gasket

Figure 10-14. Auxiliary fuel cell — 165 gallon

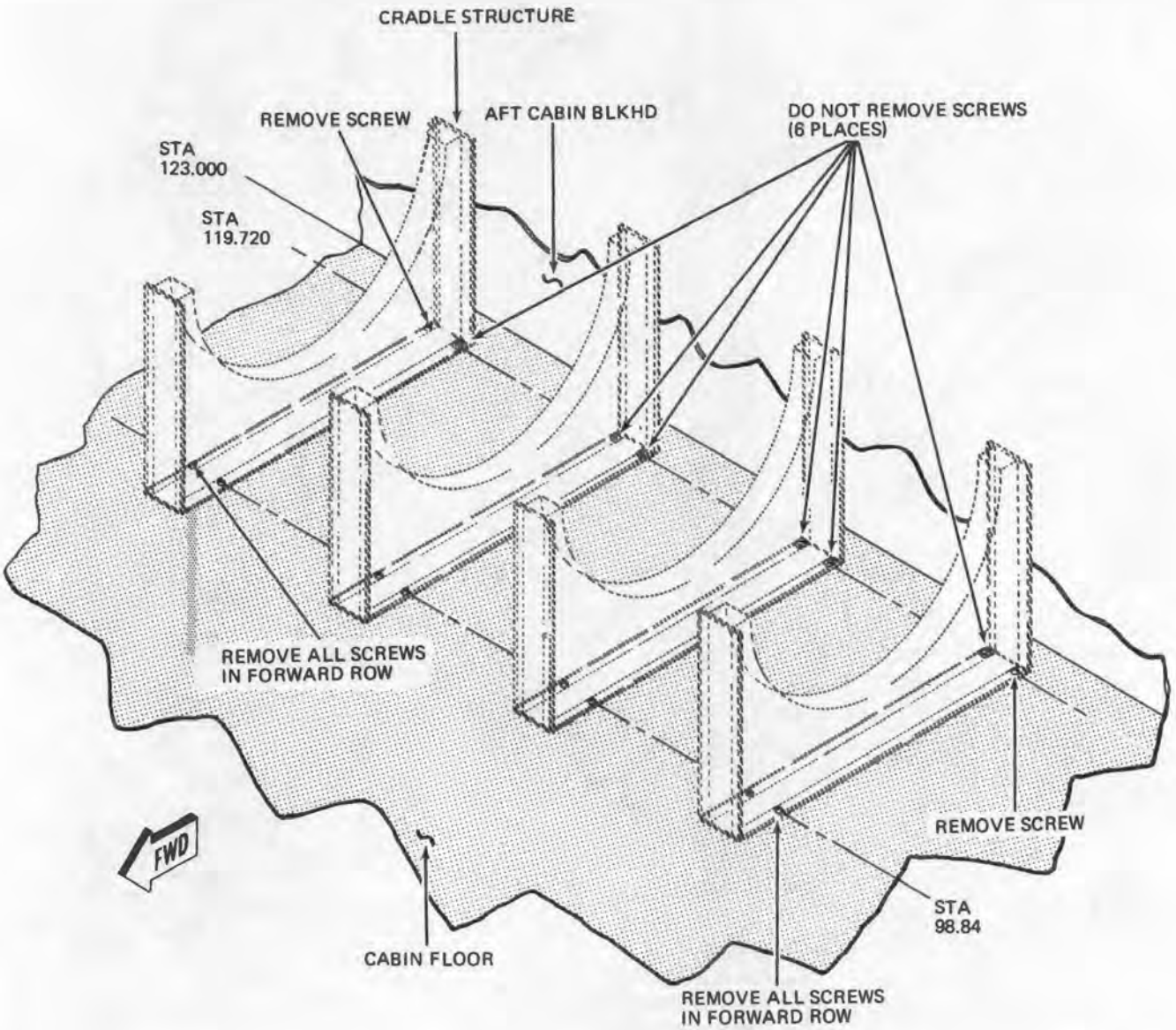


Figure 10-15. Tie-down fittings screw removal

g. Remove electrical wires from stowage at beam under the deck and remove insulating tape from wire ends.

h. Connect electrical wiring to terminal block and grounding screw on outboard side of left center cell support.

i. Attach eight turnbuckles (4), between brackets on tank supports, to tie-down rings (5) and cargo deck tie-down rings (20) located in the cargo deck and on the cabin bulkhead, using bolt (19), thin aluminum washer and self-locking nut at each attachment point.

j. Tighten turnbuckles (4) evenly and lockwire (C126.1).

k. Reconnect battery.

l. Check operation of auxiliary fuel low light, and transfer pump.

10-179. AUXILIARY FUEL CELL — 350 GALLONS.

10-180. Description — Auxiliary Fuel Cell — 350 Gallons. An auxiliary fuel cell with a capacity of 350.0 U.S. gallons may be installed in the passenger-cargo compartment for extended distance and ferry missions. The cell consists of a non-self-sealing bladder enclosed in a metal container which is secured to the floor section at the tie-down fittings. The cell sump is equipped with an electrically operated fuel transfer pump, fittings, and flexible hoses, for quick connection, to the permanently installed piping of the main fuel system. Wiring for the transfer pump and the fuel level transmitter circuits is also permanently installed and is stowed when not in use. A check valve is incorporated in the fuel transfer line to the main fuel system to prevent reverse flow of fuel. The auxiliary transfer pump circuit relay is controlled by float switches in the main fuel cell. (See figure 10-3.)

10-181. Removal — Auxiliary Fuel Tank — 350 Gallons.

WARNING

Ensure battery is disconnected, helicopter grounded, and external power source disconnected prior to breaking any fuel connections.

a. Attach a suitable hose to the drain coupling on the right bottom side of the auxiliary fuel cell and open tank drain valve (5, figure 10-16) to drain fuel from the tank.

b. Remove access door in bottom of fuselage, forward of cargo sling clearance hole, and open pump drain valve (12), sump drain valve (9), and pump seal drain (13) to drain trapped fuel.

c. Disconnect sump drain line (16), fuel transfer line (19), pump drain line (18), cell vent line (2), and pump seal drain (17) from permanently-installed lines and cap all line openings.

d. Disconnect pump switch circuit electrical wiring. Cover wire ends with insulating tape and stow under deck.

e. Remove bolts, washers, and nuts attaching tie-rod assembles (4) to cell.

f. Remove bolts and washers at mounting holes (20) attaching cell assembly to cabin floor and remove cell assembly from helicopter.

g. Remove bolts and washers attaching tie rod assemblies (4) to aft cabin bulkhead and remove tie rod assemblies.

h. Remove screws attaching special access door to aft cabin bulkhead and remove door. Using same screws, replace removed door with standard configuration access door.

i. Install standard configuration center floor assembly in aft center section of the cabin floor.

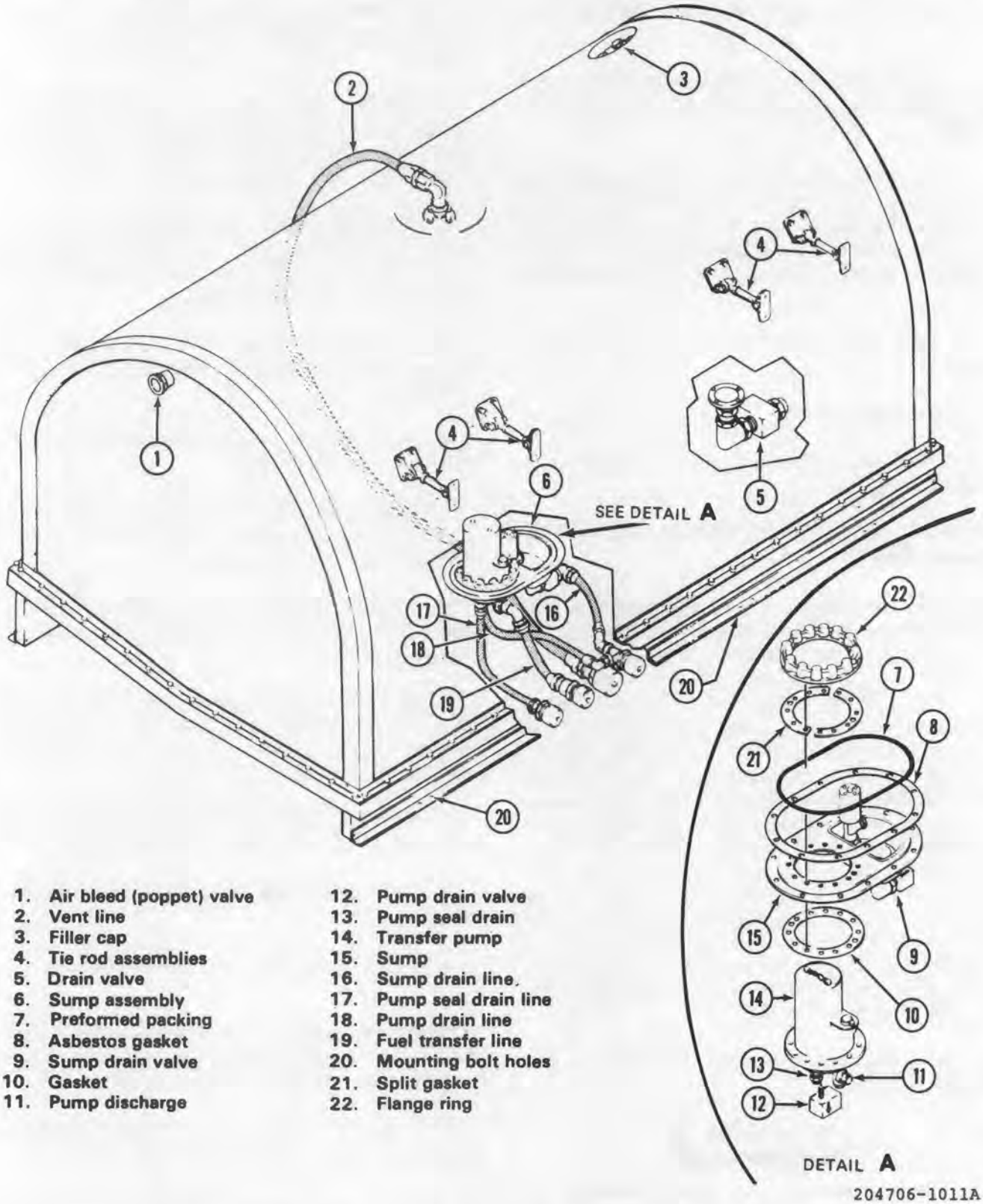
j. Install original size screws in the cargo tiedown fittings.

k. Install access door in bottom of fuselage.

10-182. Inspection — Auxiliary Fuel Cell — 350 Gallons. a. Inspect fuel cell for damage and general condition as detailed in TM 55-1500-204-25/1.

b. Inspect attaching lines and fittings for leakage, damaged threads and general condition.

10-183. Repair or Replacement — Auxiliary Fuel Cell — 350 Gallons. Repair in accordance with TM 55-1500-204-25/1.



1. Air bleed (poppet) valve
2. Vent line
3. Filler cap
4. Tie rod assemblies
5. Drain valve
6. Sump assembly
7. Preformed packing
8. Asbestos gasket
9. Sump drain valve
10. Gasket
11. Pump discharge
12. Pump drain valve
13. Pump seal drain
14. Transfer pump
15. Sump
16. Sump drain line
17. Pump seal drain line
18. Pump drain line
19. Fuel transfer line
20. Mounting bolt holes
21. Split gasket
22. Flange ring

Figure 10-16. 350 gallon axuiliary fuel cell

10-184. Installation — Auxiliary Fuel Cell — 350 Gallons. a. Remove all cargo and equipment from the cargo tiedown area of the cabin.

b. Remove standard configuration access door (43, figure 2-19) in the lower section of the aft cabin bulkhead, and install special access door, using original hardware.

c. Remove two aft screws from each cargo tiedown fitting in the aft row of fittings parallel to the aft cabin bulkhead.

d. Remove two forward screws from each cargo tiedown fitting in the forward row of fittings.

e. Remove the standard configuration center floor assembly from the aft center section of the cabin floor.

f. Position the auxiliary fuel cell assembly in the cabin parallel to the aft cabin bulkhead and with filler cap (3, figure 10-16) forward.

g. Align the fuel cell base with the open hoses, by the cargo tiedown fittings, and install attaching washers and bolts through mounting holes (20).

h. Position tie rod assemblies (4) in fuel cell fittings and against aft cabin bulkhead and install attaching nuts, washers, and bolts.

i. Remove access door in bottom of fuselage, forward of cargo sling clearance hole.

j. Remove caps from all line openings and connect sump drain line (16), fuel transfer line (19), cell vent line (2), pump drain line (18) and seal drain line (17) to permanently installed lines.

NOTE

Ensure pump drain valve (12), sump drain valve (9), and pump seal drain (13) are closed.

k. Remove electrical wiring from stowage and remove insulating tape from wire ends.

l. Connect electrical wiring to pump switch circuit.

m. Install access door in bottom of fuselage, forward of cargo sling clearance hole.

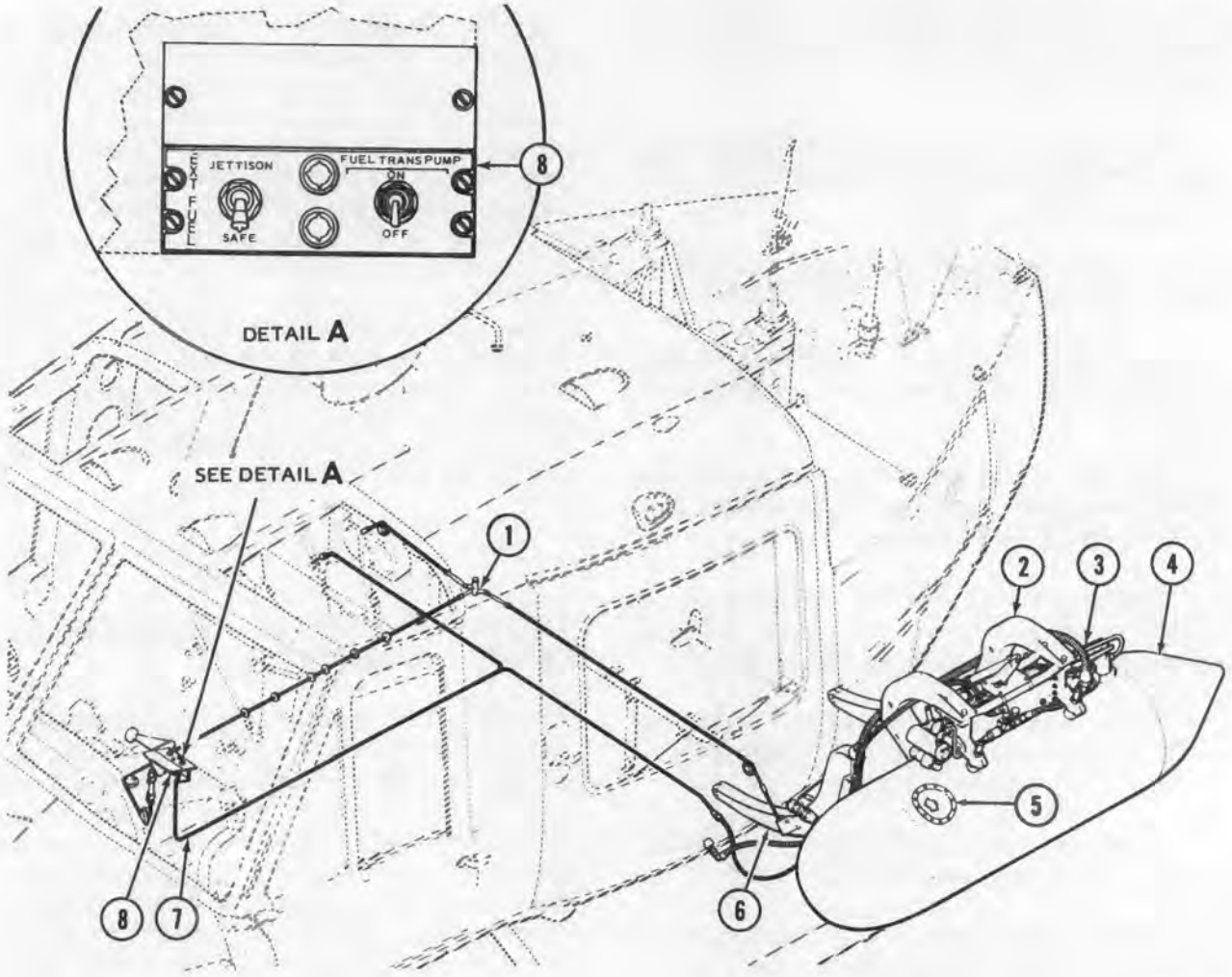
n. Reconnect battery.

10-185. EXTERNAL AUXILIARY FUEL SYSTEM — 60 GALLONS.

10-186. Description — External Auxiliary Fuel System — 60 Gallon. An externally mounted fuel cell (60 gallon) may be mounted on an external pylon support. Fuel in the cells is forced into the main fuel system by means of an air pressurization system which is protected by a pressure regulator. Air for this system is provided by a pump on each pylon assembly (3, figure 10-17) and is interconnected, so if one pump fails the other will supply the required pressure. The pylon assemblies (3) are attached to pylon supports (2) which, in turn, are attached to external stores support assemblies (6). The external stores support assemblies are attached to hard-points on the aircraft structure. Provisions for the external auxiliary fuel system (figure 10-18) form a part of the basic fuel system.

10-187. EXTERNAL AUXILIARY FUEL CELLS — 60 GALLONS.

10-188. Description — External Auxiliary Fuel Cells — 60 Gallons. Two 60.0 U.S. gallon capacity external auxiliary fuel cells (4, figure 10-17) may be installed. The fuel cells are of welded aluminum construction and are equipped with two suspension lugs for attachment to the pylon assembly. The filler cap is located in the forward end of the cell and will accommodate fuel nozzles up to 2.0 inches in diameter. Each cell is attached to a pylon assembly from which it may be released by either manual or electrical means. When cells are jettisoned, all hoses and electrical cables are automatically disconnected. Hoses have poppet type connections that immediately seal when disconnected. Mechanical jettisoning of the fuel cells is accomplished by activating the mechanical jettison lever mounted on the right side of the instrument pedestal. Electrical jettisoning is accomplished by placing the JETTISON-SAFE switch on the instrument pedestal control panel (8, figure 10-17) in the JETTISON position.



1. Manual release mechanism
2. Pylon support
3. Pylon assembly
4. Auxiliary fuel tank
5. Filler cap
6. External stores support assembly
7. Electrical release controls
8. Control panel

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Figure 10-17. External auxiliary fuel system

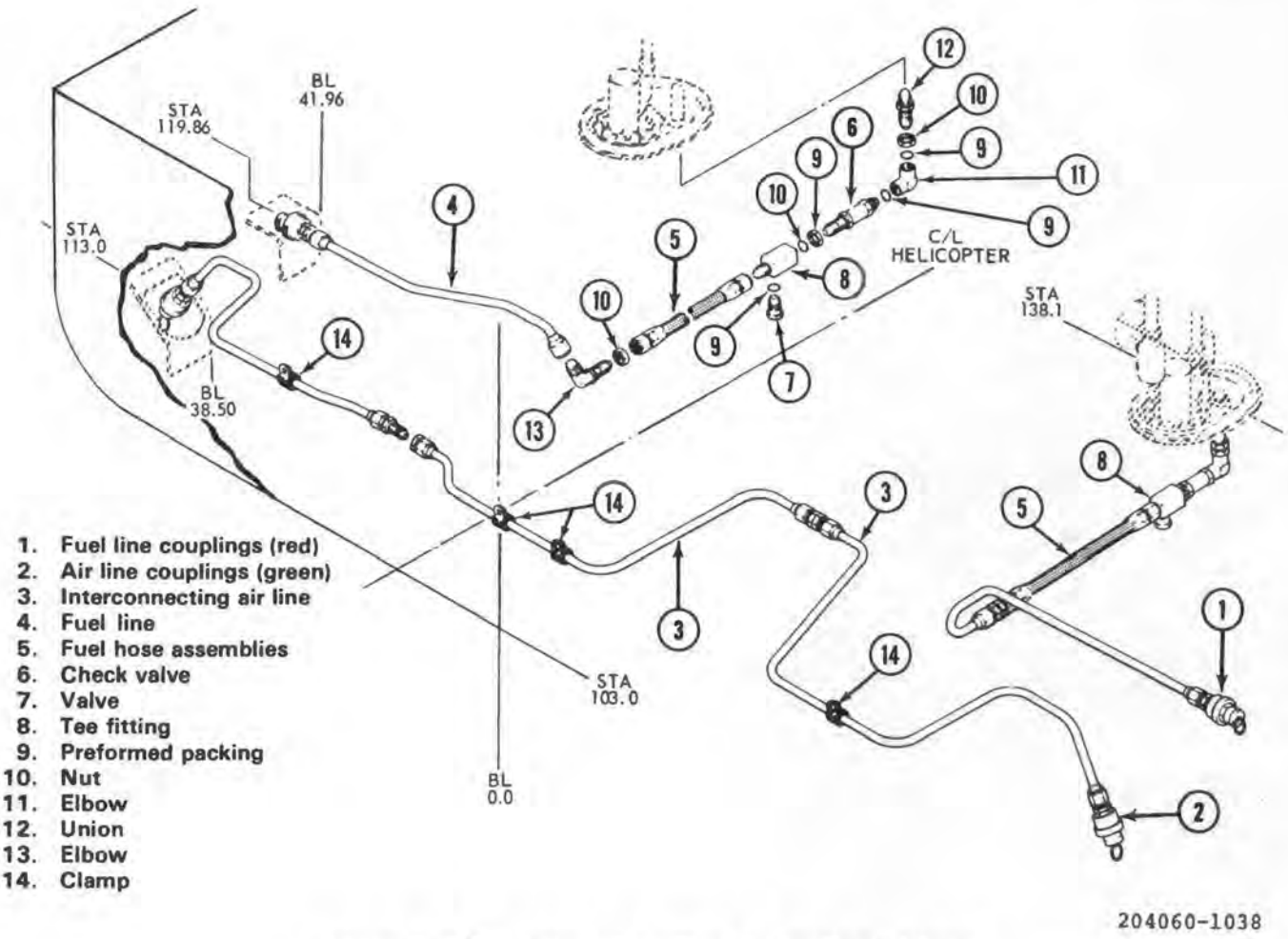

Figure 10-18. External auxiliary fuel cell provisions

10-189. Removal — External Auxiliary Fuel Cells — 60 Gallon. a. Drain auxiliary cells as follows:

(1) Pump fuel into main fuel system.

(2) Defuel main fuel system through defueling valve (paragraph 10-23).

(3) Open sump drains in auxiliary cells to discharge trapped fuel.

CAUTION

Fuel cell shall be adequately supported at time of release to prevent damage.

b. Auxiliary fuel cell shall be released by either of the following methods.

(1) Activate mechanical linkage with mechanical release lever.

(2) Position JETTISON-SAFE switch to JETTISON.

10-190. Inspection — External Auxiliary Fuel Cell. a. Inspect cell for damage, security, and evidence of leaks.

b. Refer to TM 55-1500-204-25/1 for detailed inspection procedures.

10-191. Repair or Replacement — External Auxiliary Fuel Cell. Refer to TM 55-1500-204-25/1 for detailed fuel cell repair procedures.

10-192. Installation — External Auxiliary Fuel Cell — 60 Gallon. a. Position battery switch to ON.

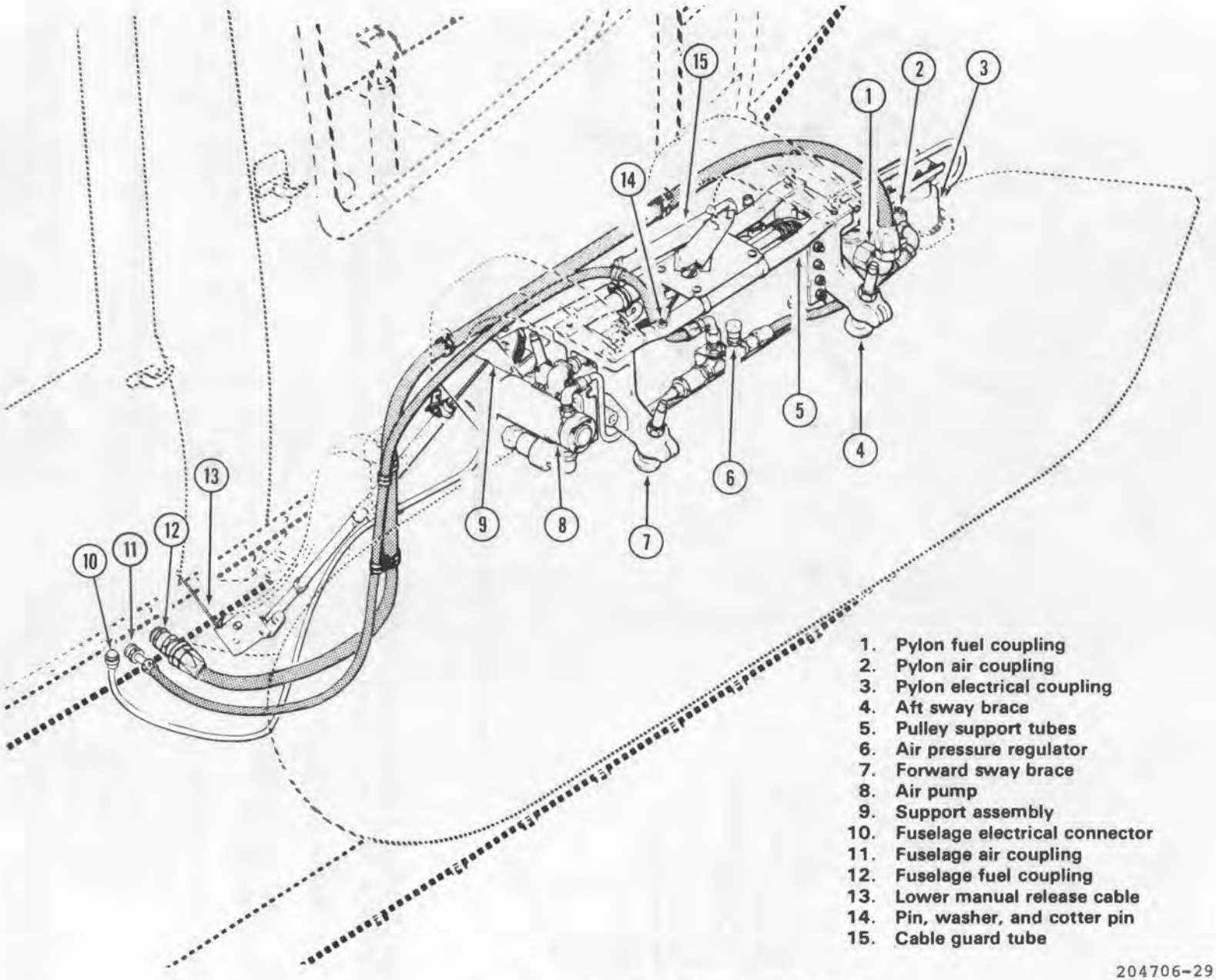

Figure 10-19. External auxiliary fuel cell installation

b. Position JETTISON-SAFE switch to SAFE.

c. Remove lockpins from pylon fuel coupling (1, figure 10-19) and pylon air coupling (2).

d. Rotate wing nuts under each coupling mounting flange to raise coupling body to its highest position to avoid contact between cell and couplings during positioning of cell and arming of pylon.

e. Loosen sway brace jamnuts. Raise fore and aft sway braces (7 and 4) approximately 0.75 inch to avoid contact with cell during arming.

CAUTION

The following step requires a minimum of two persons.

f. Carefully raise cell until suspension lugs engage pylon hooks.

g. Mate electrical coupling (3) to fuel cell.

h. Arm pylon.

i. Engage fuel coupling (1) and air coupling (2). Ensure pilot on each coupling poppet barrel properly engages cell opening and lower portion of coupling body aligns with red groove around poppet barrel.

j. Install lockpins in coupling flange.

k. Position sway braces as follows:

(1) Push down on nose of cell. Lower forward sway braces (7) to contact cell.

(2) Align cell carefully to ensure that fuel and air couplings are approximately perpendicular to coupling seats on cell.

(3) Lower aft sway braces (4) to contact cell.

(4) Tighten all sway braces finger-tight.

NOTE

If helicopter is to be flown with empty cells, secure sway braces with jamnuts.

If cells are to be fueled, do not secure sway braces. After cells are full, tighten sway braces finger-tight and secure with jamnuts.

NOTE

Prior to completion of main fuel system fueling, close auxiliary fuel cell, filler caps, pressurize cells, and transfer a small amount of fuel from auxiliary cells to main fuel system. Check fuel and air couplings for leaks. If no leaks are found, top off auxiliary cells and complete fueling of main fuel system.

10-193. EXTERNAL AUXILIARY FUEL CONTROL PANEL.

10-194. Description — External Auxiliary Fuel Control Panel. The control panel (8, figure 10-17) is located in the lower right corner of the instrument pedestal where it is readily available to the pilot. This panel contains the JETTISON-SAFE switch, the FUEL TRANS PUMP switch, and two instrument lights.

10-195. Removal — External Auxiliary Fuel Control Panel. a. Disconnect quick-disconnects and raise panel from instrument pedestal.

b. Disconnect electrical connector from receptacle on back of control panel and cover connector and receptacle with tape to prevent entrance of foreign material.

c. Remove blank panel above control panel and install second blank panel to completely cover opening in instrument pedestal.

10-196. Inspection — External Auxiliary Fuel Control Panel. a. Inspect electrical connector for bent or broken pins.

b. Inspect panel for defective lights, switches, and quick disconnect fasteners.

10-197. Repair or Replacement — External Auxiliary Fuel Control Panel. a. Replace burned out instrument lights.

b. Replace defective switches.

c. Replace damaged quick disconnect fasteners and electrical connectors.

10-198. Installation — External Auxiliary Fuel Control Panel. a. Remove existing blank panel from lower right corner of instrument pedestal.

b. Remove tape from electrical connector and receptacle on back of control panel and connect receptacle and connector.

c. Position control panel in instrument pedestal and connect quick-disconnect fasteners.

d. Position and install blank panel just above control panel.