TM 55-1520-210-20

TECHNICAL MANUAL

ORGANIZATIONAL MAINTENANCE MANUAL

ARMY MODEL UH-1D/H HELICOPTERS

This manual supersedes TM 55-1520-210-20, 7 May 1969, including all changes.

HEADQUARTERS, DEPARTMENT OF THE ARMY 10 SEPTEMBER 1971

WARNING

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

Starting and operation of the helicopter will be performed only by authorized personnel in accordance with AR95-13.

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.

Self-luminous dials and ignition units contain radio active materials. If such an instrument or unit is broken or becomes unsealed avoid personal contact. Use forceps, rubber or polyethylene gloves to pick up contaminated material. Place material and gloves in a plastic bag. Seal bag and dispose of it as radio active waste in accordance with AR755-15 and TM 3-261 (Refer to TB 55-1500-314-25). Repair procedure shall conform to requirements in AR700-52.

Exposure to high concentrations of fire extinguishing agents can cause severe irritation of eyes and nose.

When working on or near an armed helicopter, take all possible precautions to avoid accidental firing of armament. Personnel shall not occupy possible firing pattern. Munitions shall be handled by authorized personnel only.

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.

Lubricating oil used in engine, transmission, and gear boxes may cause a skin rash if prolonged contact is allowed.

When handling fuel, observe precautions and procedures in TM 10-1101.

Battery electrolyte is a strong alkaline solution and is harmful to hands and clothing. Wear protective clothing that is used exclusively for servicing nickel-cadmium batteries. Use a 3 percent solution of boric acid to neutralize any spilled electrolyte. Flush contacted areas thoroughly with water.

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 740 consisting of the following:

Page No.	# Change No.
Title	0
Warning	0
A – C	0
D blank	0
i – x	0
1-1 – 1-28	0
2-1 – 2-4	0
3-1 – 3-73	0
3-74 blank	0
4-1 – 4-54	0
5-1 – 5-2	0
5-2A – 5-2B	0
5-3 – 5-40	0
5-40A – 5-40B	0
5-41 – 5-63	0
5-64 blank	0
6-1 – 6-23	0
6-24 blank	0
7-1 – 7-47	0
7-48 blank	0
8-1 – 8-50	0
9-1 – 9-34	0
10-1 – 10-15	0
10-16 blank	0
11-1 – 11-22	0
12-1 – 12-43	0
12-44 blank	0
13-1 – 13-29	0
13-30 blank	0
13-31	0
13-32 blank	0
13-33	0
13-34 blank	0
13-35	0
13-36 blank	0
13-37	0
13-38 blank	0
13-39	0
13-40 blank	0
13-41	0
13-42 blank	0
13-43	0
13-44 blank	0
13-45	0
13-46 blank	0
13-47	0
13-48 blank	0
13-49	0
13-50 blank	0
13-51	0
13-52 blank	0
13-53	0
13-54 blank	0
13-55	0
13-56 blank	0
13-57	0
13-58 blank	0
13-59	0
13-60 blank	0
13-61	0
13-62 blank	0
13-63	0
13-64 blank	0
13-65	0
13-66 blank	0
13-67	0
13-68 blank	0
13-69	0
13-70 blank	0
13-71	0
13-72 blank	0
13-73	0
13-74 blank	0

Zero in this column indicates an original page.

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 740 consisting of the following:

Page No.	# Change No.	Page No.	# Change No.
13-75	0	13-121 – 13-125	0
13-76 blank	0	13-126 blank	0
13-77	0	13-127	0
13-78 blank	0	13-128 blank	0
13-79 – 13-85	0	13-129 – 13-131	0
13-86 blank	0	13-132 blank	0
13-87	0	13-133	0
13-88 blank	0	13-134 blank	0
13-89	0	13-135	0
13-90 blank	0	13-136 blank	0
13-91 – 13-93	0	13-137	0
13-94 blank	0	13-138 blank	0
13-95	0	13-139	0
13-96 blank	0	13-140 blank	0
13-97	0	13-141	0
13-98 blank	0	13-142 blank	0
13-99	0	13-143	0
13-100 blank	0	13-144 blank	0
13-101 – 13-103	0	13-145	0
13-104 blank	0	13-146 blank	0
13-105	0	13-147	0
13-106 blank	0	13-148 blank	0
13-107	0	13-149	0
13-108 blank	0	13-150 blank	0
13-109	0	13-151	0
13-110 blank	0	13-152 blank	0
13-111	0	13-153	0
13-112 blank	0	13-154 blank	0
13-113	0	13-155	0
13-114 blank	0	13-156 blank	0
13-115	0	13-157	0
13-116 blank	0	13-158 blank	0
13-117	0	13-159	0
13-118 blank	0	13-160 blank	0
13-119	0	13-161	0
13-120 blank	0	13-162 blank	0

Zero in this column indicates an original page.

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 740 consisting of the following:

Page No.	# Change No.
13-163	0
13-164 blank	0
13-165	0
13-166 blank	0
14-1 – 14-28	0
15-1 – 15-7	0
15-8 blank	0
16-1 – 16-12	0
A-1 – A-2	0
B-1 – B-16	0
C-1 – C-3	0
C-4 blank	0
D-1	0
D-2 blank	0
E-1 – E-8	0
Index 1 – Index 12	0

Zero in this column indicates an original page.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1-1. Scope.

This manual, issued expressly for organizational maintenance, is the official document for the Army Model YUH-1D, UH-1D and UH-1H helicopters, Serial No. 60-6028 through 60-6034, 62-2106 through 62-2113, 62-12351 through 62-12372, 63-8739 through 63-8859, 63-12956 through 63-13002, 64-13492 through 64-13901, 65-9565 through 65-9767, 65-9770 through 65-10113, 65-10117 through 65-10135, 65-12773 through 65-12776, 65-12847 through 65-12852, 65-12857 through 65-12895, 66-746 through 66-1210, 66-16000 through 66-17144, 66-8574 through 66-8577, 67-17145 through 67-17312, 67-17313 through 67-17859, 67-18411 through 67-18413, 67-18558 through 67-18577, 67-19483 through 67-19504, 67-19514 through 67-19537, 68-15214 through 68-15778, 68-16050 through 68-16628, 69-15292 through 69-15959, 69-16650 through 69-16670, 69-16692 through 69-16732, 70-15700 through 70-15874 and 70-15913 through 70-15932. The purpose of this manual is to familiarize you with the maintenance functions to be performed at the organizational maintenance level. A Table of Contents for this manual is provided to assist in determining the chapter in the manual in which individual functions are covered. The study and use of this manual will enable a maintenance crew of limited experience to perform the assigned functions with maximum efficiency. This manual provides all essential information for personnel to accomplish Army organizational maintenance on the complete airframe, its components, and systems with functions and related functions of the same general scope and magnitude, as prescribed for organizational maintenance activities in the Maintenance Allocation Chart. (Refer to Appendix B.)

NOTE

When information applies to a specific helicopter, a code system has been used and is as follows:

D UH-1D equipped with either a T53-L-9, -9A or -11 series engine.

H UH-1H equipped with a T53-L-13 series engine.

NOTE

Do not destroy any pages in this manual unless the data contained therein has been replaced, superseded, or included in the manual by a change or revision.

a. Definitions.

Notes, cautions, and warnings shall be used to emphasize important and critical instructions and shall be used for the following conditions:

NOTE

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

CAUTION

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

WARNING

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

1-2. Reporting Of Improvements.

Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to: Commanding General, U. S. Army Aviation Systems Command, ATTN: AMSAV-R-M, P.O. Box 209, St. Louis, Missouri 63166.

1-3. Summary Of Manual Contents.

a. Chapter 1 – Introduction. This chapter presents the scope of the manual as well as a summary of the manual contents. It also contains a general description of the entire aircraft, ground handling methods and procedures, servicing instructions, consumable materials, and a list of special tools and equipment and instructions for the retrieval of downed aircraft.

b. Chapter 2 – Lubrication Instructions. This chapter covers the lubrication requirements of the aircraft by inclusion of lubrication instructions and applicable lubrication charts.

c. Chapter 3 – Inspection Requirements. This chapter contains complete requirements for special inspections, test flight, overhaul and retirement schedule, and standards of serviceability applicable to the aircraft. When inspection items become due and are performed, the applicable forms, records, and worksheets pertaining thereto will be completed and updated as required (TM 38-750).

d. Chapter 4 – Aircraft and Alighting Gear. The function of this chapter is to provide all the essential information for maintenance personnel to accomplish organizational maintenance on the complete airframe and alighting gear.

e. Chapter 5 – Power Plant and Related Systems. The purpose of this chapter is to provide information as a basis for performing maintenance on complete power plant and its related systems.

f. Chapter 6 – Hydraulic and Pneumatic Systems. This chapter covers each major component of the hydraulic system.

g. Chapter 7 – Power Train System. This information includes a detailed description of mast, transmission, clutches, drive shafts and tail rotor gear boxes.

h. Chapter 8 – Main and Tail Rotor Group. This chapter contains instruction for maintenance of the main and tail rotor hub and blades, and main rotor system.

i. Chapter 9 – Flight Controls. This chapter covers all moveable and fixed flight control systems.

j. Chapter 10 – Instruments. The purpose of this chapter is to provide maintenance information on flight instruments, navigation instruments, engine and miscellaneous instruments.

k. Chapter 11 – Utility Systems. Information in this chapter covers the heating and ventilating system.

l. Chapter 12 – Electrical System. The purpose of this chapter is to provide essential information for maintenance personnel to accomplish maintenance on complete electrical system.

m. Chapter 13 – Wiring Diagrams. This chapter includes all power load charts and wiring diagrams.

n. Chapter 14 – Avionics, Photography and Armament. Avionics and photography are not applicable. This chapter provides maintenance instructions for the armament systems.

o. Chapter 15 – External Stores Non-Armament. This chapter provides maintenance instructions for all external stores.

p. Chapter 16 – Storage of Aircraft. This chapter contains a comprehensive procedure for preparing aircraft for flyable, temporary, and limited storage of components, outlining methods and equipment necessary for proper preservation. If a helicopter is not flown for a period of 3 days, it will be maintained similar to that of a helicopter placed in a storage status.

q. Appendix A – References. Consists of a list of official publications applicable to organizational maintenance.

r. Appendix B – Maintenance Allocation Chart. Reflects the maintenance functions to be performed at each echelon.

s. Appendix C – Aircraft Inventory Master Guide. Provides standard inventory procedures and furnishes the using activities with a master guide to determine the items that are to be inventoried of installed and loose equipment authorized and required by the specific aircraft in performance of its mission.

t. Appendix D – Weight and Balance. Forms required in the performance of the prescribed maintenance operation of the aircraft, are contained in the aircraft logbook. Assignment of responsibilities and instructions for preparation, and use of logbook forms are outlined in the TM 38-750 (Army Equipment Record Procedures) and TM 55-405-9 (Army Aviation Maintenance Engineering Manual, Weight and Balance).

u. Appendix E – Illustrated Field Manufacture Items List. This appendix includes complete instructions, including bills of material, for field manufacture of all items listed in TM 55-1520-210-34P, Direct Support, General Support, and Depot Maintenance Repair Parts and Special Tool Lists, bearing MF, MH, or MD source code. The part number index lists all items in part number order with a cross-reference to the figure in which the item appears. All materials necessary for manufacture of an item are listed by Federal Stock number, in the bill of material for the item.

v. Systems Description and Diagrams. This information can be found in procedural paragraph(s) requiring their use or in TM 55-1520-210-10.

w. Ground Support Equipment. Ground support equipment required for organizational maintenance is described and illustrated in Section II of this chapter.

x. Maintenance Data. Servicing information and a table of consumable materials used for servicing, lubrication, and other maintenance procedures are contained in Section II of this chapter. A lubrication chart is provided in Chapter 2, Section II.

1-4. External Power Requirements.

External power requirements of 650 to 800 amperes, 28.5 volts will be supplied by a suitable auxiliary power unit. A suitable hydraulic test unit, capable of a relief valve setting of 1300 psi, a pressure compensator setting of 1300 psi, and a volume output of 6 gpm, shall be used in testing the hydraulic system.

1-5. Electrical Load Data.

a. Refer to Chapter 13 for DC and AC electrical load analysis.

b. The DC Electrical Load Analysis Chart is used in determining the generator load demand during flight operation conditions. The amount of power consumed by each electrical unit is shown in addition to the total average amperes for each phase of flight. The EMERGENCY column is for consideration when using the starter-generator 30-volt, 200-ampere system for emergency power.

c. The AC Electrical Load Analysis Chart shows the electrical requirements of the AC units installed. The total load in volt-amperes and the power factor leading or lagging is also shown. Refer to this chart when additional electrical units are installed to determine power availability.

1-6. Jet Fuel Limitations.

Jet fuel (item 1, table 1-2) Grade JP-4, is intended for use in jet aircraft under all operating conditions. Experience to date indicates that no undue difficulties will be encountered in starting and operating the helicopter's turbine engine at low temperatures on Grade JP-4. Grade JP-5 fuel may be used as an alternate in the T53-L-11 series/-13 (and T53-L-9A with scoopless combustor) engine. In event low temperature starting difficulties are encountered using JP-5 fuel, refer to cold weather operation procedures in TM 55-1520-210-10.

1-7. Heater – Combustion.

Fuel filter and drain lines should be checked daily for accumulations of ice or water. During low temperature operation below 32°F water vapor in the combustion gases flowing through the drain line may condense and form ice. Water produced during combustion may collect on the fuel nozzles and igniter plug and form ice after the heater has been turned off. This ice may preclude starting the heater without preheating.

1-8. Synthetic Base Oil.

This oil (item 2 or 3, table 1-2) is to be used in preference to petroleum based oil because of its superior temperature characteristics. In addition to a synthetic chemical base, this oil contains oxidation inhibitors and antiwear additives. This oil may cause swelling of O-ring seals that are designed for use in petroleum based oils.

CAUTION

Synthetic oils, such as MIL-L-7808 and MIL-L-23699, may soften paint or stain clothing upon contact. If synthetic oil is spilled on painted surfaces, those surfaces should be cleaned immediately. Skin should be thoroughly washed after contact and saturated clothing should be removed immediately. Prolonged skin contact with synthetic oil may cause a skin rash. Areas where synthetic oils are used should have adequate ventilation to keep mist and fumes to a minimum.

1-9. Dusty Conditions.

More frequent oil changes are recommended for helicopters operating under unusually dusty conditions. The frequency of oil changes will depend upon the severity of the dust conditions. Failure to change oil more frequently in high dust areas can result in accelerated engine wear.

1-10. Contamination Of Oil.

This oil (item 2 or 3, table 1-2) is a synthetic turbine engine lubricant, and is extremely susceptible to contamination by water. In addition this oil has a limited storage life and must be tested periodically. Due to the susceptibility of this oil to contamination, it is purchased, stored and handled in hermetically sealed containers. These containers, once opened, must be emptied immediately, and must not be retained in opened condition for future use.

1-11. Tires And Tubes.

a. Tires and tubes should be stored under normal temperature conditions if at all possible. If it becomes necessary to store tubes at subnormal temperatures, partially inflate them in order to remove creases and folds. Tires and tubes should be warmed before mounting so that normal handling will not flex them to the point of cracking.

b. When not actually in use ground handling wheels should be removed from the helicopter and placed in warm storage. If tires should become frozen to the ground, they can be released by heat application or by overinflation.

Under no circumstances should the applied heat exceed a temperature of 160°F. The proper procedure should be determined by considering the individual problem. If the tires are to be released by overinflation, the tires may be inflated to one and one-half times normal pressure, provided the following precautions are observed:

c. Careful inspection should be made before inflation for evidence of wheel cracks or breaks in the tires.

d. In order to prevent injury to personnel in case of wheel rim failure, all persons should stand in line with the tire, rather than broadside of the wheel, during inflation.

e. Heat must not be applied to overinflated tires because of its action in further increasing tire pressure.

f. Tire pressure must be reduced to normal immediately after the tires are freed.

NOTE

When tires are overinflated, as described above immediate action cannot be expected. One-half to one hour may be required before tires are free because of the slow action of the frozen casings in responding to the increased tire pressure.

1-12. Maintenance Forms.

Maintenance forms required in the performance of the prescribed maintenance operation of the aircraft are contained in the aircraft log book. Refer to TM 38-750 and TM 55-405-9.

Section II. AIRCRAFT GENERAL

1-13. General Arrangement.

1-14. Description.

a. Army helicopter models YUH-1D, UH-1D and UH-1H are single-engine utility types which feature low silhouettes. (See figure 1-1.) Principal dimensions and detailed description will be found in TM 55-1520-210-10.

b. Forward fuselage section consists primarily of two longitudinal beams with transverse bulkheads and metal covering. The beams provide supporting structure for cabin, landing gear, fuel cells, transmission, engine, and tail boom. Work platforms are provided around engine and transmission and on top of cabin to afford maintenance personnel easy access to engine and transmission.

c. Avionics equipment and electronic equipment are located in left rear compartments and/or nose compartment. The battery is located in the nose or alternate location in the aft fuselage compartment. An external cargo suspension assembly is attached to forward fuselage at a single point, at approximate center of gravity of helicopter, and extends through an opening below transmission.

d. Main rotor is a two-blade semi-rigid type employing preconing and underslinging. Tail rotor is a two-blade assembly, delta-mounted for automatic pitch compensation of differential air flow over blades. Main and tail rotor blades are of all-metal construction with honeycomb core.

e. Power train consists of a free-turbine type power plant, transmission assembly, mast and drive shafts, and two tail rotor gear boxes. Engine assembly is equipped with quick-disconnect couplings to facilitate replacement of individual assemblies or complete engine. Engine and transmission are enclosed by cowling. Tail rotor drive shafts are located along top of tail boom and fin.

f. Landing gear is skid type, attached for forward fuselage at four points. Two sets of detachable handling wheels, with hand-operated hydraulic jacks incorporated, are provided for use on ground. Support tubes are provided which allow handling wheels to be left in place during flight as an optional practice.

g. Tail boom is a semi-monocoque structure with metal covering, attached to forward section by four bolts. Tail rotor, gear boxes, drive shafts, and synchronized elevator are supported on tail boom. A tail skid is provided on lower aft end to protect tail rotor.

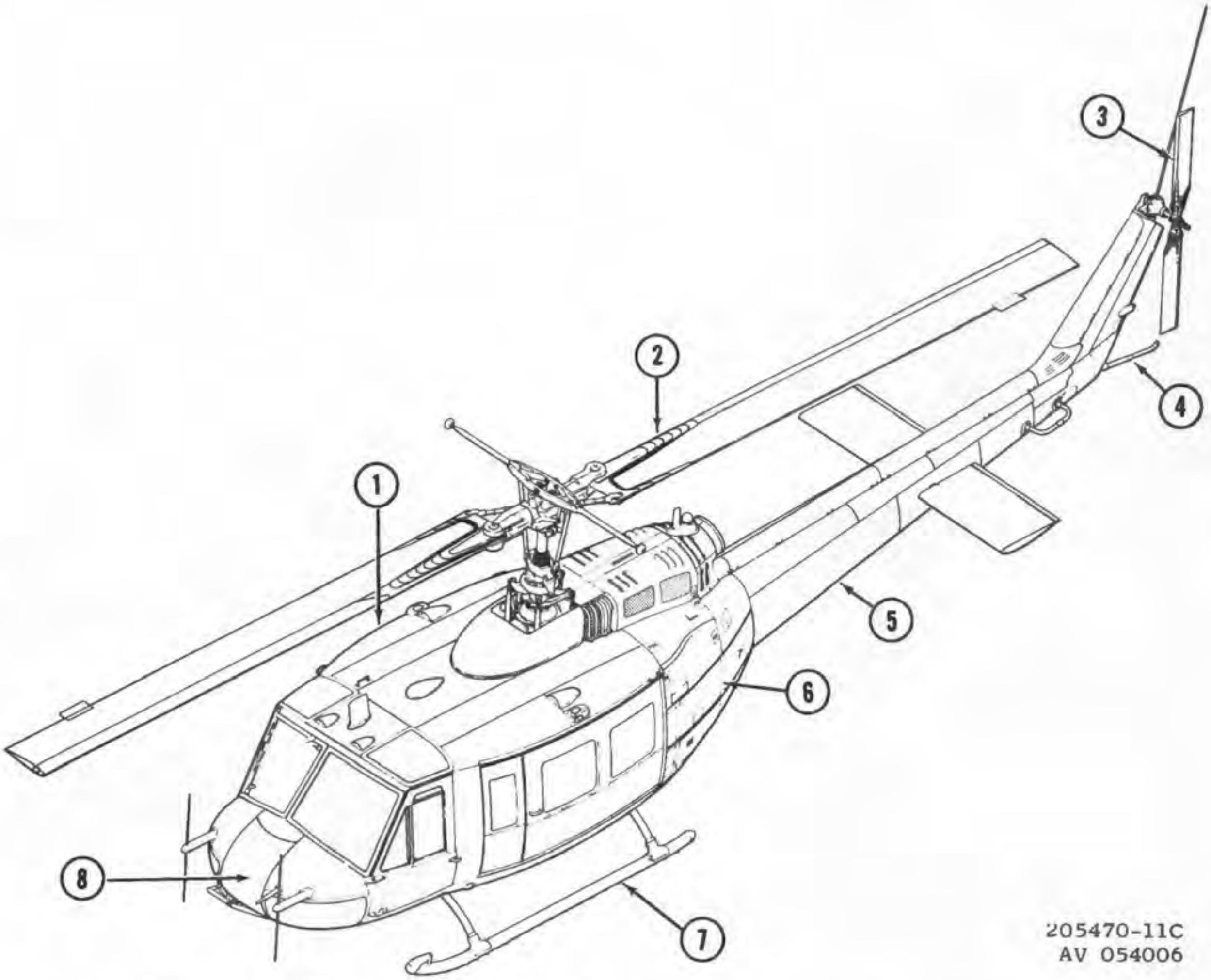
1-15. Ground Handling.

a. The following paragraphs contain information necessary for hoisting, jacking, mooring, parking, towing, the application of external power, leveling and the attaching of all weather covers.

b. The following special tool required to hoist helicopter components is listed in Table 1-1.

Table 1-1. Special Tools

PART NUMBER	NOMENCLATURE
T101452	Maintenance Hoist Assembly



1. Forward Fuselage Section
2. Main Rotor
3. Tail Rotor
4. Tail Skid
5. Tail Boom
6. Radio and Electrical Compartments
7. Landing Gear
8. Radio and Battery Compartment

Figure 1-1. UH-1D helicopter

1-16 Hoisting.

a. Hoist the helicopter as follows:

(1) Attach a hoisting clevis or cable to eye provided on retaining nut at top of main rotor mast. (See figure 1-2, Detail A.) Connect a suitable hoist and take up slack.

(2) Station a man at tail skid to steady helicopter when hoisted. If lifting beyond reach from ground, two men and two steadying ropes will be necessary.

(3) Hoist slowly with a steady lifting force.

(4) If transmission has been removed, attach hoist at pylon lift-link and apply same procedure to lift helicopter. (See figure 1-2.)

b. For hoisting or handling tail boom as a separate component on UH-1H helicopters prior to serial no. 68-16343, aft end is provided with stowed handling tubes (4, figure 1-2) which can be pulled out into position at each side. Near forward end of boom, a snap plug can be removed at each side to allow insertion of a one-inch diameter pipe or rod through boom structure at reinforced lift point (3).

c. To hoist engine, main rotor, or mast and transmission assemblies from the helicopter, use T101452, maintenance hoist as follows:

CAUTION

Hoist must be centered over component being hoisted.

NOTE

The maintenance hoist T101452 is provided to be mounted on airframe for field use to lift engine, main rotor, or mast and transmission assemblies. Maximum operating load of this hoist is 800 pounds. Hoist consists of a support tube equipped with a hand-operated winch, cable, and hook. (See figures 1-2 and 1-3.) Support tube has a hinged joint to fold for storage, a 48-inch section which can be removed to reduce height when required, and a selection of attachment holes for upper pulley to allow centering over unit being removed or installed. Mounting allows hoist to be rotated, with load, to reach over engine and pylon area or outboard from left side of helicopter.

(1) Remove cover at rear left side on cabin roof. Remove soundproofing blanket section in cabin, and plug button in floor fitting directly below.

(2) Lift hoist to position and insert lower support tube down through roof and engage pin at lower end in support fitting in cabin floor. In this procedure, hoist tube can be partially folded at hinge joint, and a man on ground or roof walkway can handle upper support tube in such manner as to assist a man on engine service deck or roof who is lowering hoist into place.

NOTE

Install hoist with hinge pin outboard and latch bolt and knob inboard. (See figure 1-3.)

(3) Raise upper end of hoist to normal position and secure latchbolt on hinge joint.

(4) Turn hoist to center its hook over component to be lifted. If necessary, change position of upper pulley to another attachment hole of support tube.

NOTE

Particular attention should be paid to the maintenance hoist, to ascertain that it is assembled correctly. Correct assembly should have the hinge halves of the mating casting, P/N 205-070-929-1, P/N 205-070-929-3 and hinge bolt, P/N AN6-60A on outboard side from closed curve of upper tube (205-782-943) and the latch bolt, P/N 205-070-932-1 and knob, P/N 205-070-933-1 on inboard side. (See figure 1-3.)

1-17. Jacking.

a. Place jacks under two forward jack pad fittings (1, figure 1-4) located just ahead of landing gear forward cross-tube at each side, and under two aft jack pads (3) on fuselage behind landing gear.

NOTE

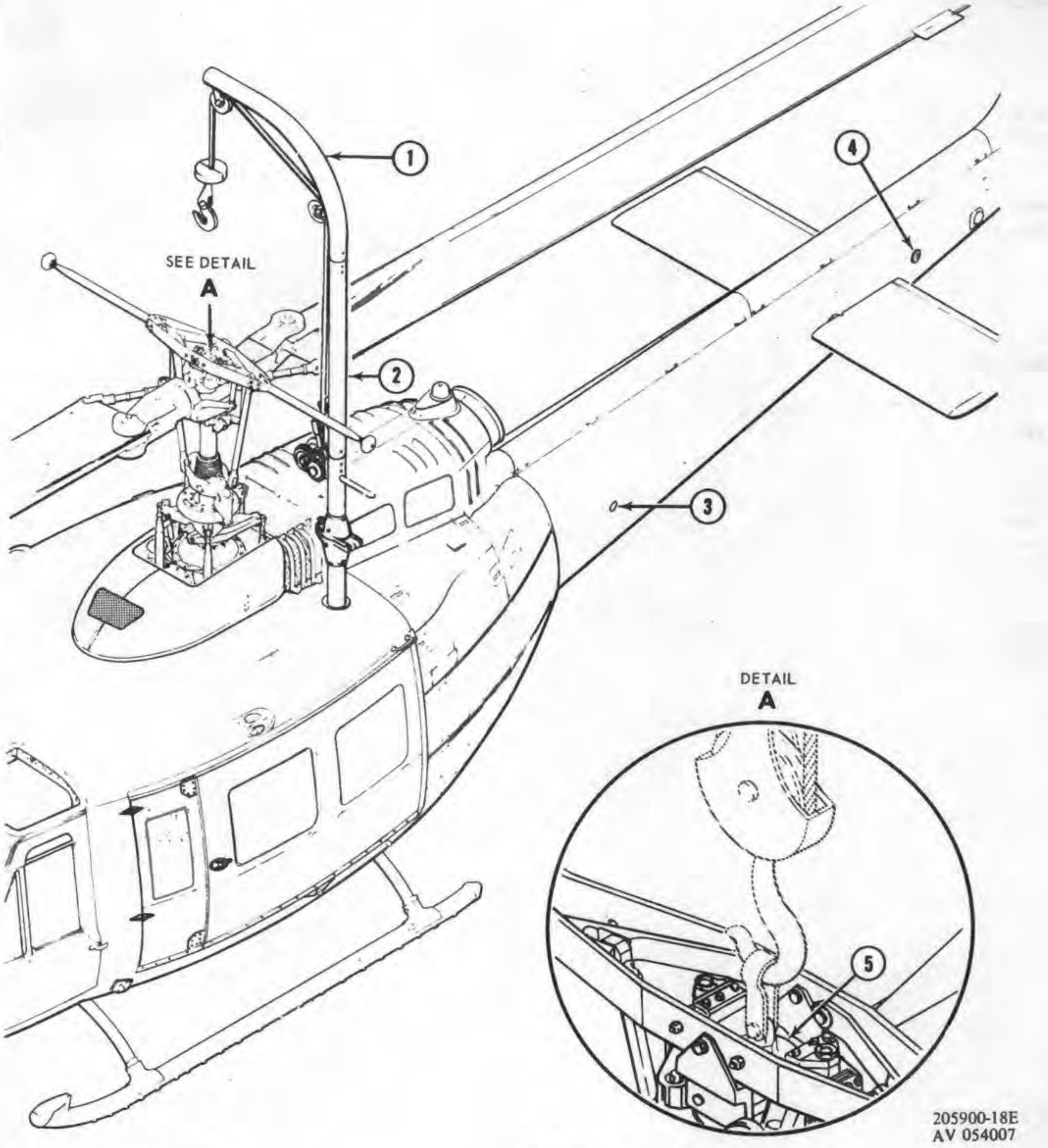
YUH-1D has only one rear jack pad, located near center line of fuselage.

b. Raise helicopter evenly. Observe following precautions while helicopter is supported on jacks:

CAUTION

If helicopter is being placed on jacks preparatory to removing landing gear, take up slack with hoist attached to rotor retaining nut. (See figure 1-2, detail A.)

(1) Do not climb on or enter helicopter.



1. Maintenance Hoist
2. Removable Section
3. Tail Boom Lift Point
   (UH-1H Prior to Serial No. 68-16343)
4. Stowed Handling Tubes
   (UH-1H Prior to Serial No. 68-16343)
5. Mast Nut

Figure 1-2. Hoisting diagram

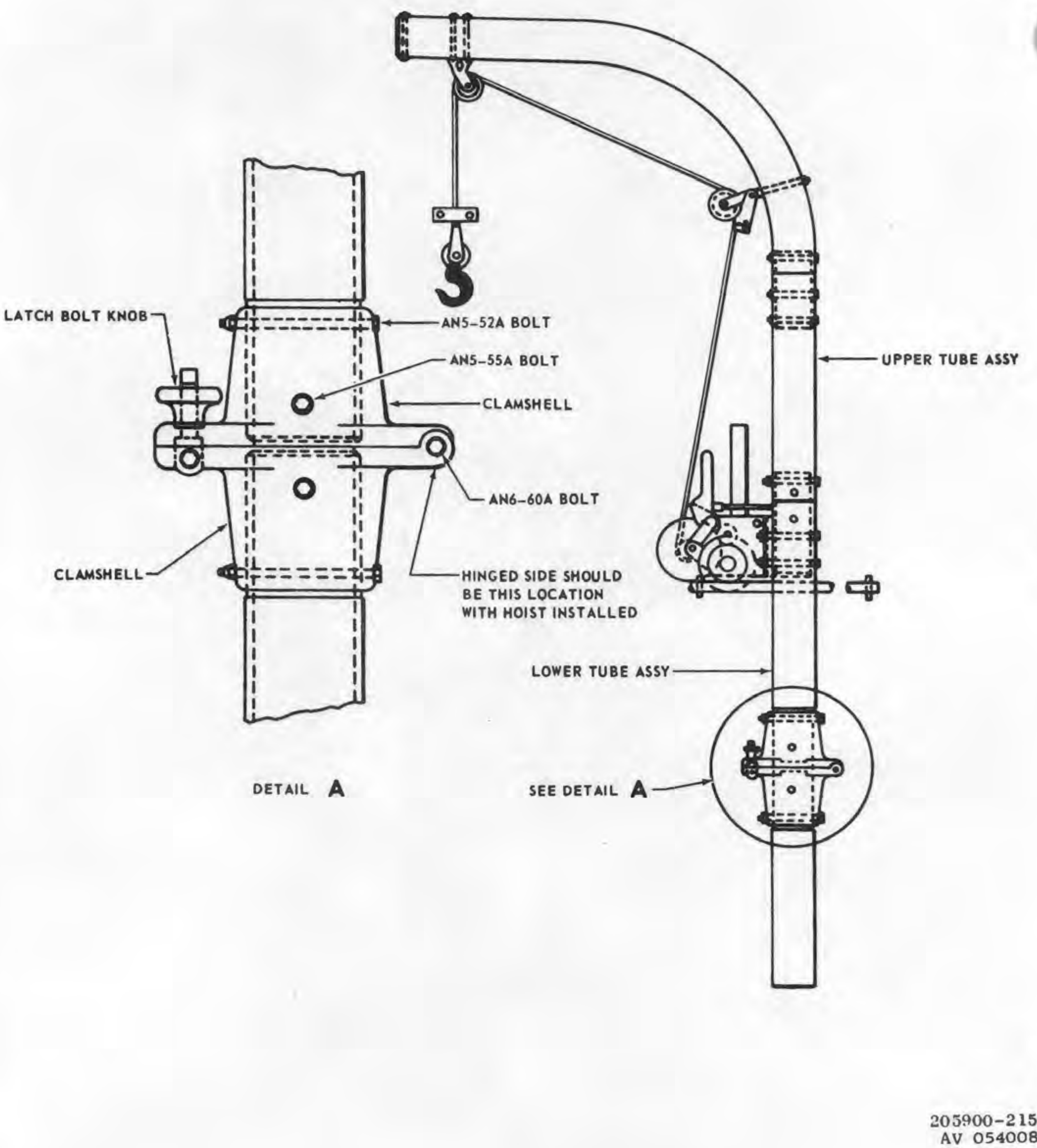
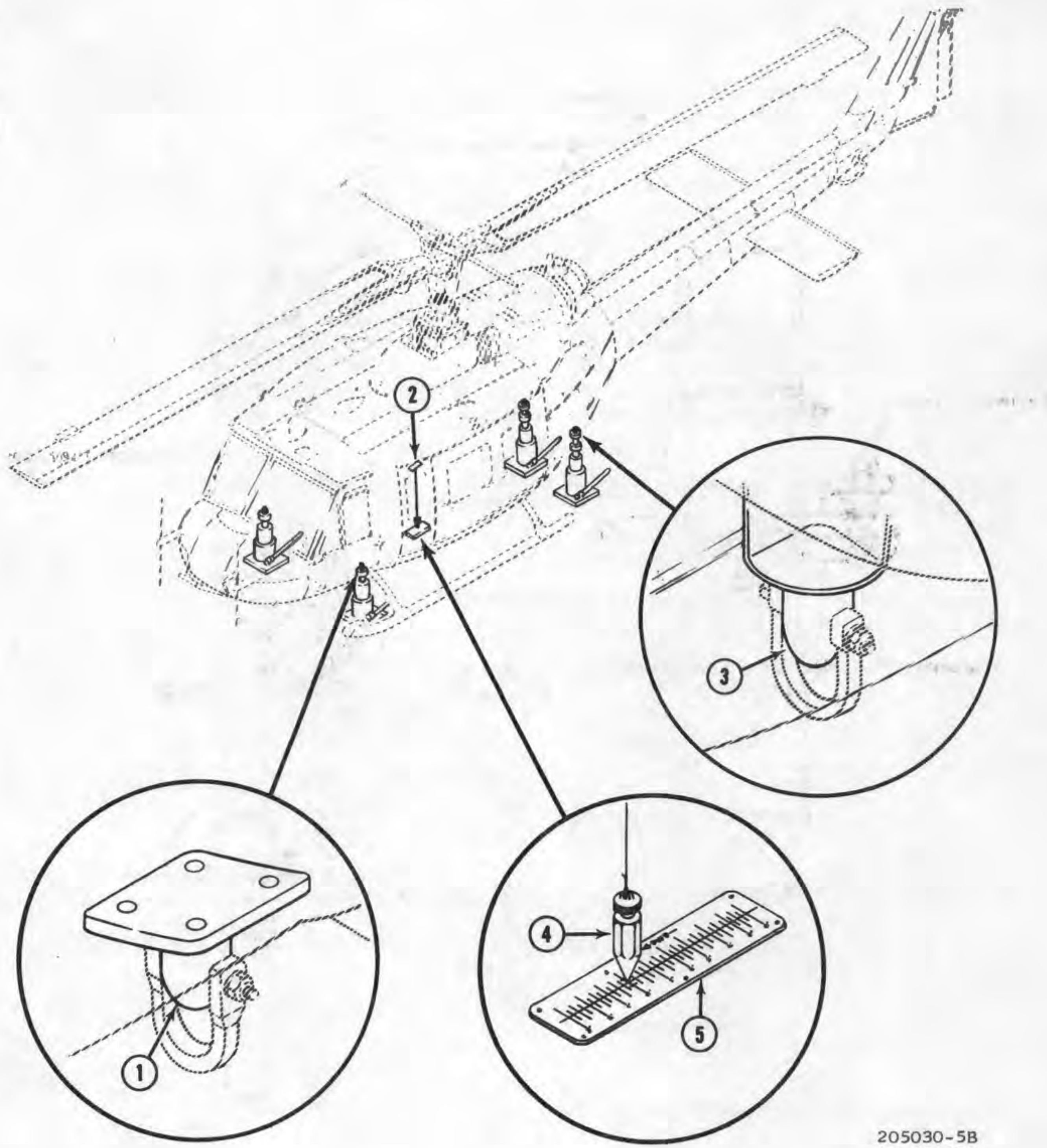


Figure 1-3. T101452 maintenance hoist assembly



1. Forward Jack Pad Fittings
2. Slotted Plate
3. Aft Jack Pads
4. Plumb Bob
5. Leveling Plate

Figure 1-4. Jacking and leveling diagram

(2) All personnel in immediate area shall exercise caution to avoid bumping or otherwise disturbing helicopter while on jacks.

(3) It is recommended that area around helicopter be roped off and signs prominently displayed to warn: CAUTION AIRCRAFT IS ON JACKS.

(4) When aircraft is on jacks in hanger, recommend hanger doors be closed.

1-18. Mooring.

Mooring is a process of securing parked helicopter to avoid damage by high winds or turbulent weather. Mooring fittings are provided on jack pad fittings; four on UH-1D/H, three on YUH-1D. Where properly spaced rings are not available, mooring can be accomplished with a standard mooring kit.

a. Park helicopter on unpaved parking area, headed in direction of highest winds forecast.

b. Screw anchor rod (1, figure 1-5) into arrow (3).

c. Slip driving rod (2) over anchor rod and into socket of arrow.

d. Turn cam of driving rod so that prongs of arrow are not spread by driving.

e. If necessary, loosen surface of ground with ground-breaking pin.

f. Position forward rods approximately one foot ahead of each forward mooring fitting (5) and slightly inboard of skid tubes. Position other rods approximately one foot behind each aft mooring fitting (6).

g. Drive each arrow into ground until driving rod handle is approximately three inches above surface.

h. Rotate driving rod handle approximately 90 degrees and give it a sharp blow to spread arrow prongs.

i. Return driving rod to driving position and remove it from anchor rod.

j. Align squared socket of eye assembly (4) with squared end of anchor rod. Fit in place and tighten knurled nut.

k. Set arrow prongs by pulling up on eye assembly.

l. Secure helicopter with quarter-inch cables or one-inch manila rope.

NOTE

When anchor rods are no longer needed, they may be removed by turning eye assemblies counterclockwise, leaving arrows in ground.

1-19. Parking.

Parking, as used in this manual, is defined as condition in which helicopter will be secured while on the ground. Direction of heading and location of helicopter is normally determined by ease of maintenance and servicing; to allow removal of any one helicopter from parking area; and to permit ready access of mobile fire fighting equipment within area. Maximum velocity of surface winds which can be withstood by helicopter when parked in following manner depends on gross weight of helicopter. Although parking arrangements may vary according to local facilities, the following general procedure should be observed.

a. Double-row lateral parking, with front and rear helicopter of each double row placed tail to tail, should be used where possible.

b. Helicopter should be parked not less than 750 feet from ends of center line of nearest runway, and not less than 250 feet from edge of connecting taxi strips.

c. Width of fire lanes between each double row should be slightly greater than rotor span of parked helicopters. This spacing will facilitate removal of any helicopter from parking area, as well as permitting greater ease of movement for mobile fire fighting equipment within area.

d. Fire lanes having a minimum width of 50 feet should be provided to cross main fire lanes and isolate blocks of 10 helicopters or less.

e. Helicopters parked on concrete ramps or aprons should be placed to utilize mooring rings when available.

f. Parked helicopters will be provided with a static ground.

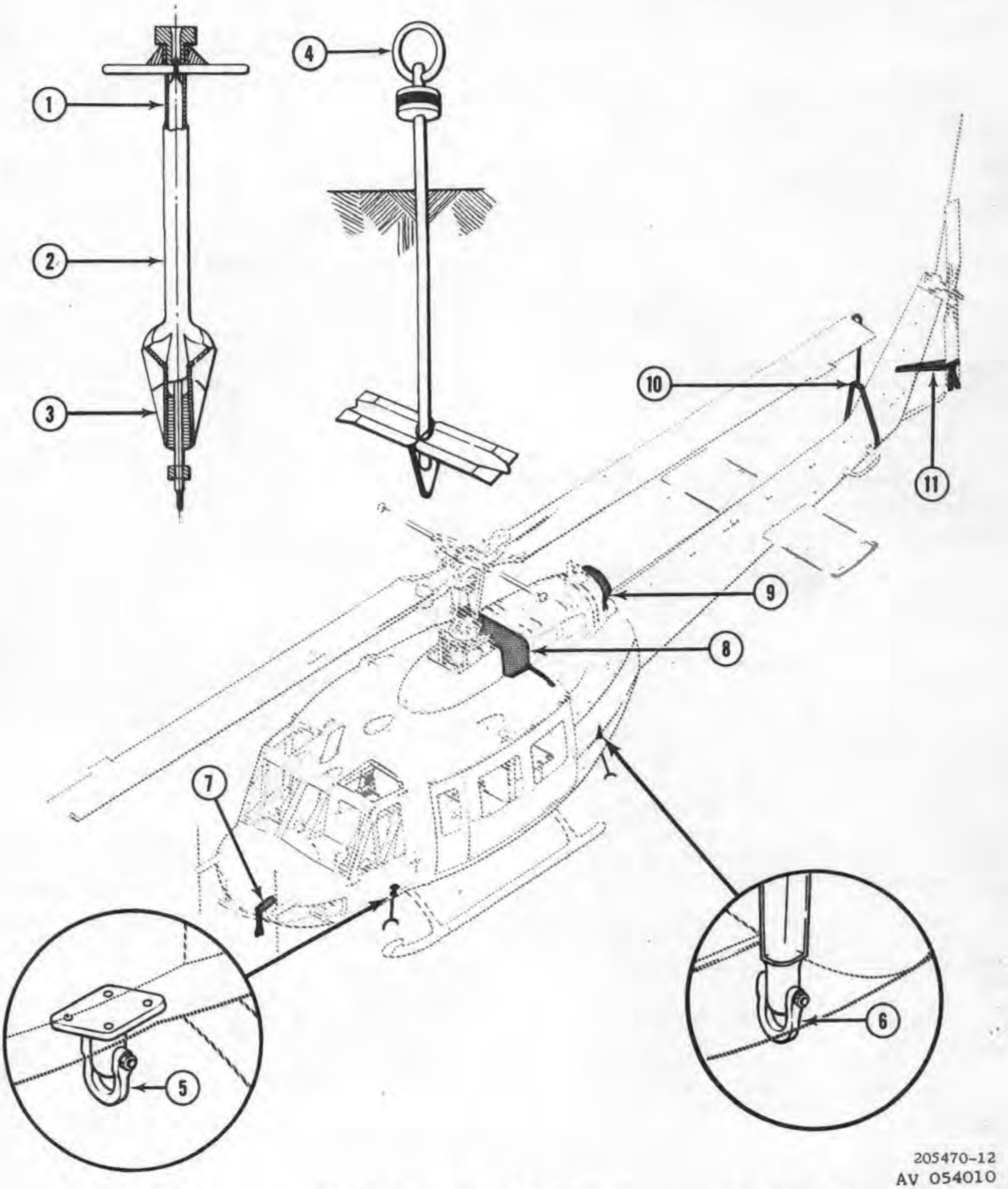
g. Under normal conditions park the helicopter as follows:

(1) Park helicopter on a level surface, whenever possible, so that load will be balanced.

(2) Retract or remove ground handling wheels to allow helicopter to rest on landing skids.

NOTE

If helicopter is to remain parked more than 14 days, use suitable blocks or shoring to raise skids slightly off supporting surface.



1. Anchor Rod
2. Driving Rod
3. Arrow
4. Eye
5. Forward Mooring Fitting (2)
6. Aft Mooring Fitting (2)
7. Pitot Tube Cover
8. Intake Cover
9. Exhaust Cover
10. Main Rotor Tie Down
11. Tail Rotor Tie Down

Figure 1-5. Parking and mooring diagram

(3) Align main rotor blades fore-and-aft, and tail rotor blades parallel to vertical fin.

(4) Engage hook of main rotor tie-down (10) in hole of fitting on end of rotor blade above tail boom. (If necessary, weighted end of tie-down strap can be tossed over blade to bring it down into reach.) Secure rotor by firmly cross-tying strap of tie-down around tail boom.

(5) Attach tail rotor tie-down strap (11) to tail rotor and secure to loop provided on left side of vertical fin.

(6) Install pitot tube cover (7), engine intake fairing cover (8), and exhaust tailpipe cover (9).

NOTE

If required and available, install all-weather covers. (Refer to paragraph 1-23.)

(7) Lock flight controls, check that all switches are OFF and external power disconnected, and close all doors, windows, and access plates.

h. Under turbulent weather conditions park the helicopter as follows:

CAUTION

Structural damage can occur from turbulent weather conditions. Anhoring and mooring should be accomplished when wind is expected to exceed 45 knots per hour. When possible, helicopter should be evacuated to a safe weather area if a tornado, hurricane, or wind condition above 75 knots is expected.

(1) Park helicopter. (Refer to paragraph 1-19.)

(2) Moor helicopter. (Refer to paragraph 1-18.)

(3) Fill fuel tanks to capacity if time permits.

(4) Disconnect battery. Secure all loose equipment. Moor all ground support equipment at safe distance from helicopter.

(5) After high winds have passed, inspect helicopter for damage from flying objects. If in flyable storage or flight status, reconnect battery before ground operation or flight.

1-20. Towing.

Tow rings are provided on forward end of each landing gear skid for attachment of a standard aircraft tow bar. Helicopter is towed on ground handling wheel assemblies mounted on landing skids. (See figure 1-6.)

CAUTION

Do not tow helicopter on rough surfaces with a gross weight in excess of 9500 pounds.

1-21. Application Of External Power.

External power receptacle (12, figure 1-8) for 28-volt DC is in lower left side of fuselage, below electrical equipment compartments. Access is through a small door, which is equipped with a limit switch to light EXTERNAL POWER caution panel when door is open and power connected. When applying power from external source, battery switch shall be OFF.

1-22. Leveling. (Figure 1-4.)

Hang a plumb line from slotted plate (2) so that plumb bob (4) just clears leveling plate (5). Adjust jacks under helicopter to align plumb bob exactly over intersection of two lines marked with zero on plate.

1-23. All Weather Covers.

A set of twelve all weather covers is provided for protection of cabin area and major components. Covers are fastened by cords and snap fasteners, and are to be installed in sequence as illustrated. (See figure 1-7.)

1-24. Ground Handling Gear.

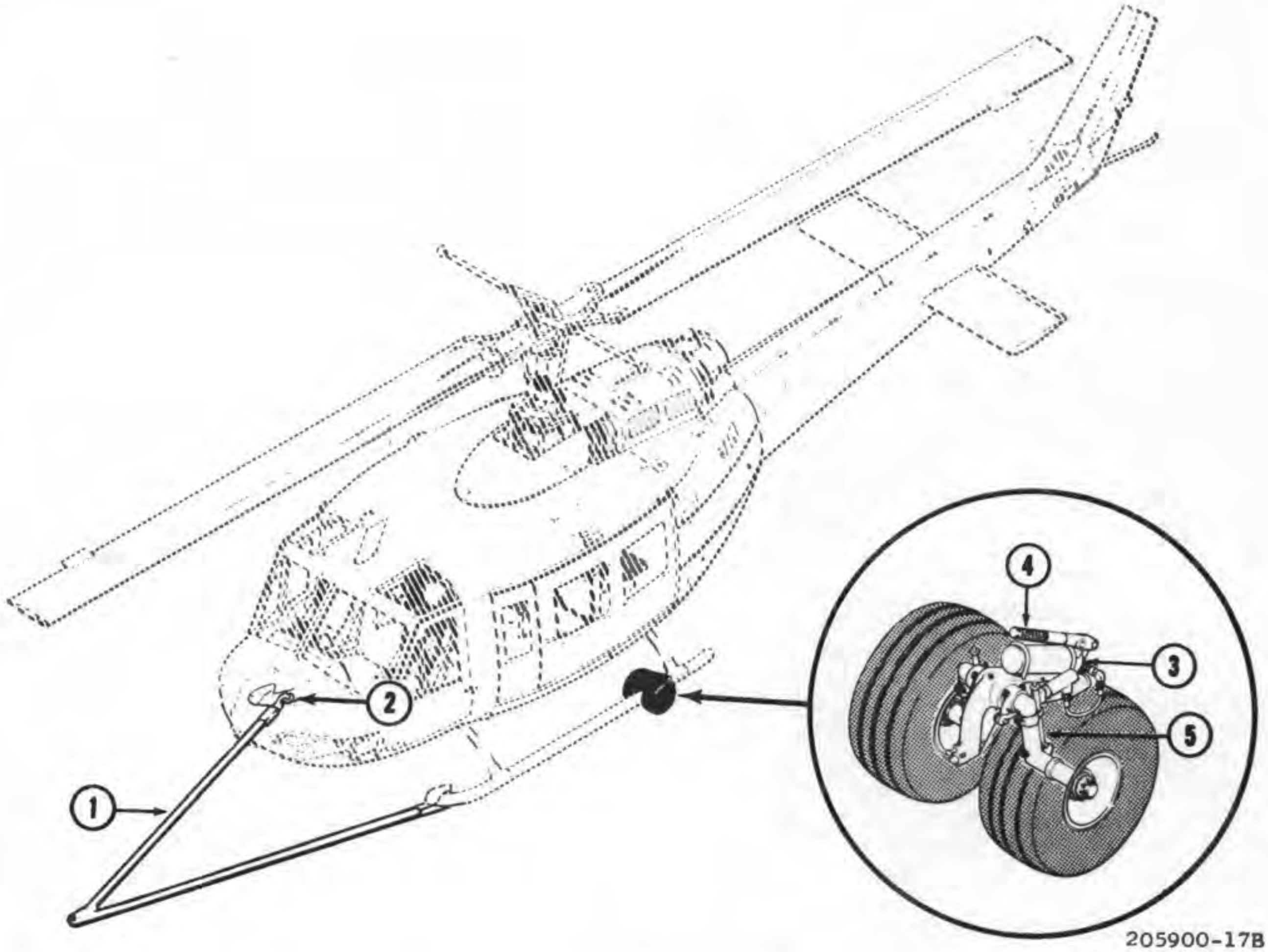
Two ground handling gear assemblies can be quickly attached on fittings of landing skids, and wheels are extended or retracted by means of hand-operated hydraulic pumps located on supporting cradle of each assembly. (See figure 1-6.) Ground handling gear is usually removed before flight, but can be left in place on skids if properly secured in retracted position by means of support rods provided on each side.

a. Position handling gear assembly over eyebolt fittings on landing skid. Insert fixed pin of cradle in rear fitting, then engage spring-loaded pin in forward fitting.

b. Actuate pump handle to extend wheels and raise landing skid from ground surface.

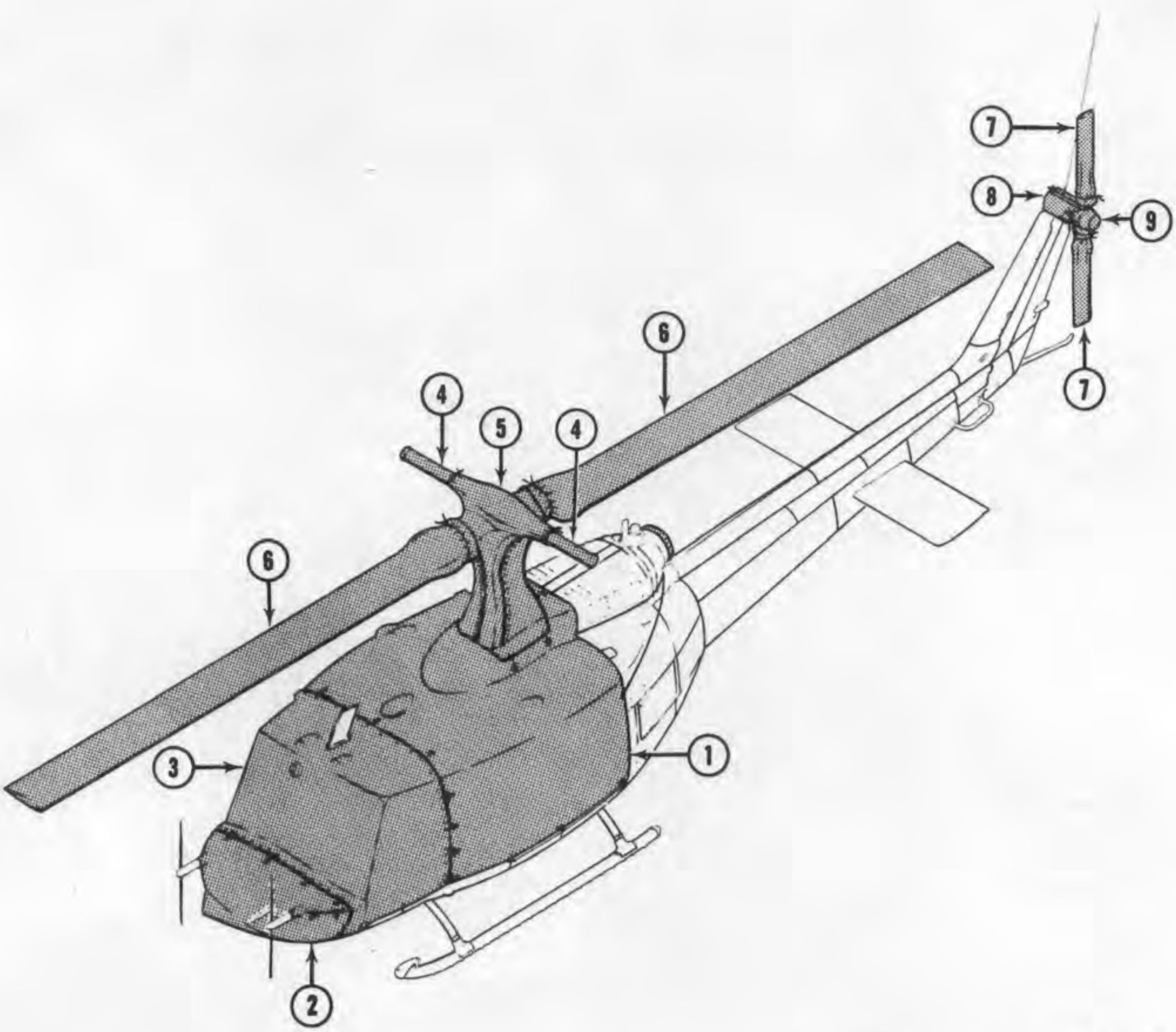
NOTE

To prevent possible damage to handling wheels the forward portion of the skids should be raised by pulling the tail skid down prior to extending wheels.



1. Tow Bar
2. Tow Ring
3. Release Valve
4. Pump Assembly
5. Support Cradle and Axle Assembly

Figure 1-6. Towing provisions diagram



1. Main Cabin Cover
2. Nose Cover
3. Forward Cabin Cover
4. Stabilizer Bar Cover
5. Pylon Cover
6. Main Rotor Blade Cover
7. Tail Rotor Blade Cover
8. 90° Gear Box Cover
9. Tee Head Cover

Figure 1-7. All weather covers

c. To retract wheels and lower skid to ground, release hydraulic pressure by turning T-handle of valve on pump.

d. To secure gear in place for flight: With wheels up, detach both support rods from stowing clips and insert ends in two quarter-inch holes provided on upper surface of skid, removing plugs if installed. Interchange rods if necessary for correct fit. Pump wheels down until supports are snug, using caution to avoid excessive strain on parts.

e. To remove handling gear assembly: If support rods are engaged, release hydraulic pressure and raise wheels to detach rods from skid and stow in clips. Press release pin on front of cradle to withdraw support pin from eyebolt. Lift off handling gear assembly.

1-25. Servicing.

a. Description. Instructions and information for complete servicing of the helicpopter with fuel, oil, hydraulic fluid, and other fluids are provided in the following paragraphs. Locations of fillers, sight gages, and drains are shown on Servicing Points Diagram, with indication of how frequently each reservoir should be checked and filled or drained and refilled. (See figure 1-8.) Instructions for use of greases and other lubrication not shown in servicing illustration will be found in Lubrication Chart, Chapter 2.

b. Servicing – Fuel System.

NOTE

If aircraft is equipped with closed circuit refueling system and fuel servicing vehicle is not equipped with related nozzle for closed circuit refueling, a gravity system may be used providing the servicing nozzle does not exceed 1.75 inches outside diameter. To refuel utilizing the gravity nozzle, it is necessary to position the intersleeve of receiver until slot is lined up with fuel port in bottom of receiver. Position nozzle into port in order to by-pass closed circuit valve.

Fuel tank filler (3, figure 1-8) is on right side of fuselage just aft of cargo door. Five cells are interconnected to act as a single tank. Receptacle (2) for static ground is aft of filler on YUH-1D, but is placed lower on UH-1D/H for clearance when cargo door is opened. Service with specified fuel. (See figure 1-8.)

FUEL TANK CAPACITY	U.S. GALLON
Normal Service	220.00
Total Capacity	224.0

NOTE

Fuel capacity of helicopters Serial No. 69-15292 and subsequent and helicopters with crashworthy fuel system incoporated is approximately 209 gallons. When specified fuel is not available, refer to TM 55-1520-210-10 and TB 55-9150-200-25 for information on other fuels and limitations on their use.

WARNING

Observe the following precautions in all servicing operations:

(1) Do NOT fuel or defuel during electrical storms.

(2) Do NOT fuel or defuel while ground or aircraft radar sets are operating within 300 feet of the helicopter.

(3) Servicing personnel shall not wear metal taps on their shoes.

(4) Ensure battery switch is in OFF position and external power is disconnected before fueling or defueling the helicopter.

(5) Ground the helicopter at the receptacle located aft of and below the fuel filler cap on the right-hand side of the helicopter.

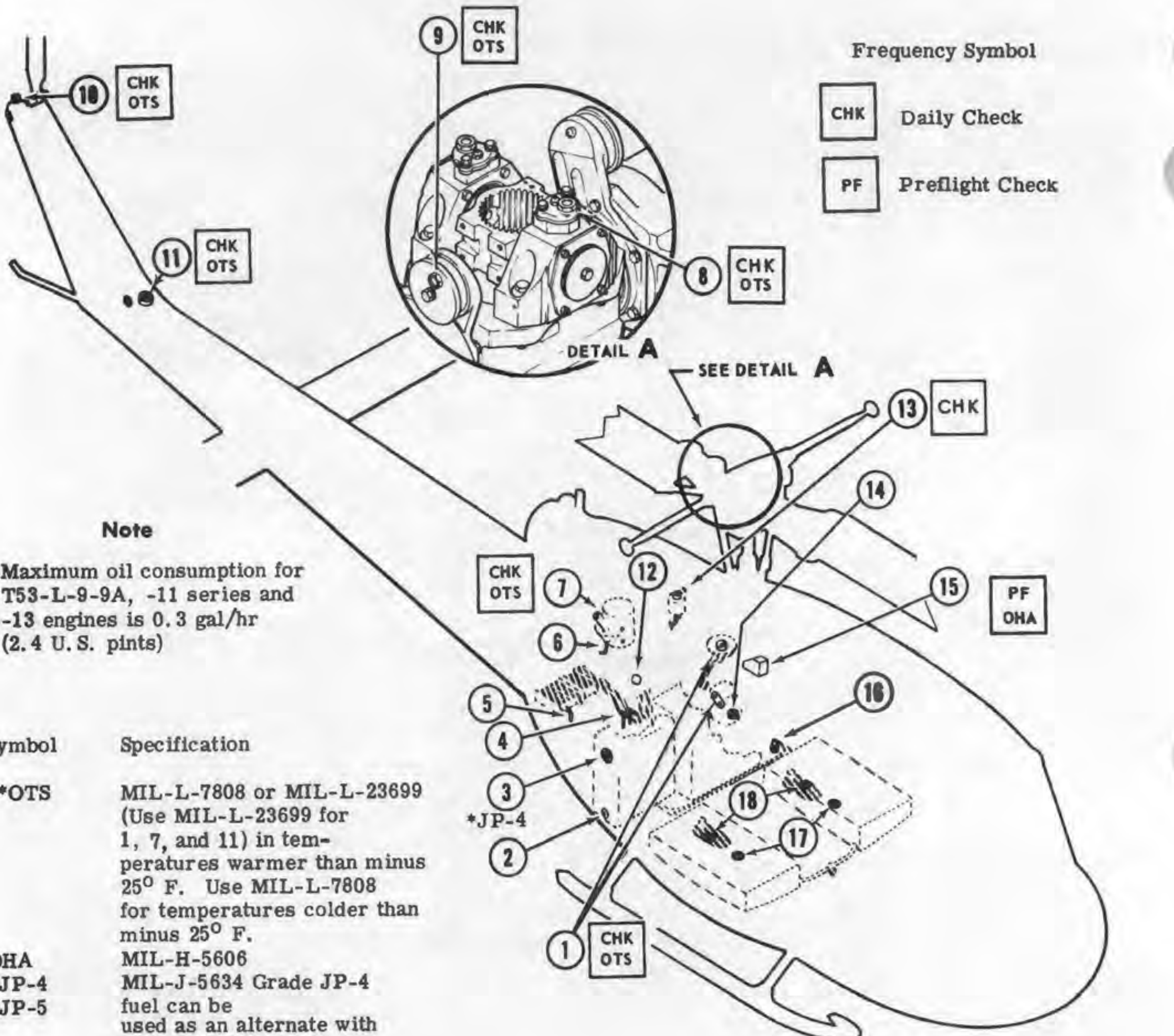
(6) Fuel truck shall be grounded. (Truck to ground and truck to nozzle.)

(7) Ground the truck filler-nozzle to the helicopter before removing the helicopter fuel tank filler cap. This will equalize static electrical potential.

(8) Do NOT use 'SPLASH' filling. Fill the tanks slowly and evenly.

(9) After completion of servicing, wash down and remove any spillover of jet fuel. This fuel does not evaporate as rapidly as gasoline, and constitues a fire hazard for a much longer time. Cleaning material or clothing which have become saturated with jet fuel shall be disposed of well away from the aircraft or hangar.

c. Recording of Alternate or Emergency Fuel. If the aircraft is serviced with fuel other than the specified fuel, the type of fuel, quantity and operating time shall be entered in DA Form 2408-13 (Aircraft Inspection and Maintenance Record). This record is for the purpose of scheduling any additional maintenance that may be required. (See figure 1-9.)



Note

Maximum oil consumption for T53-L-9-9A, -11 series and -13 engines is 0.3 gal/hr (2.4 U.S. pints)

Symbol	Specification
**OTS	MIL-L-7808 or MIL-L-23699 (Use MIL-L-23699 for 1, 7, and 11) in temperatures warmer than minus 25° F. Use MIL-L-7808 for temperatures colder than minus 25° F.
OHA	MIL-H-5606
*JP-4	MIL-J-5634 Grade JP-4
*JP-5	fuel can be used as an alternate with T53-L-11/13 engines and -9A scoopless type engines
**Ref	TB 55-9150-200-25

** 1. Transmission Filler and Sight Gage
2. Ground Receptacle
3. Fuel Tank Filler
4. Transmission Oil Cooler Drain
5. Engine Oil Cooler Drain
6. Engine Oil Tank Drain
** 7. Engine Oil Tank
8. Pillow Block Reservoir
9. Grip Reservoir
**10. Tail Rotor Gearbox
**11. Intermediate Gearbox
12. External Power Receptacle
13. Fuel Filter
14. Transmission Sump Drain
15. Hydraulic Reservoir
16. Defuel Valve for helicopters prior to serial No. 69-15292 which do not have MWO 55-1520-210-50/1 incorporated. (The gravity defuel valve for helicopters serial No. 69-15292 and subsequent and helicopters with MWO 55-1520-210-50/1 incorporated is located on the sump.)
17. Forward Fuel Cell Drain Valves
18. Sump Drain Valves

205900-16L
AV 054012

Figure 1-8. Servicing points diagram

TYPES OF FUEL AND PERMISSIBLE HOURS OF OPERATION ON EACH BETWEEN SCHEDULED HOT END INSPECTIONS

ENGINE MODEL	SPECIFIED FUEL	ALTERNATE FUEL Type	ALTERNATE FUEL Hours	EMERGENCY FUEL Type	EMERGENCY FUEL Hours
T53-L-9/9A (Scoop type combustor)	JP-4			Gasoline Unleaded	50
				Gasoline Leaded	10
				JP-5 type	10
T53-L-11 Series (and 9A Scoopless)	JP-4	JP-5	—	Gasoline Unleaded	50
		CITE MIL-F-46005	—	Gasoline Leaded	30
		Diesel Fuel	150		
T53-L-13	JP-4	JP-5	—	Gasoline All Types	10
		CITE	—		

AV 054296

Figure 1-9. Limitations on use of nonspecified fuels

d. Defueling Valves.

(1) Defuel helicopters prior to Serial No. 69-15292 that have not had crashworthy fuel system incorporated at defuel valve (16, figure 1-8).

(2) Defuel helicopters Serial No. 69-15292 and subsequent and helicopters with crashworthy fuel system incoporated at gravity defuel valves located on sumps adjacent to sump drain valves (18, figure 1-8).

(3) Drain trapped fuel at drain valves (17, and 18, figures 1-8).

NOTE

Each forward cell sump is equipped with a drain valve. On UH-1D/H, each forward cell has a second drain valve for front compartment, ahead of internal baffle.

(4) Electric boost pump has a drain valve.

(5) To drain mail fuel filter (13, figure 1-8) use valve in drain line from filter sump. Access is by opening lower left engine cowl. Drain line discharges through bottom of fuselage just ahead of aft landing gear cross-tube.

e. Servicing – Auxiliary Fuel System. Auxiliary fuel cells, when installed, are at rear of cabin and are accessible through cargo doors. Each cell is filled through a filler cap at top front as installed. Observe same precautions as for serivcing main fuel system. Each cell will contain 150 U.S. gallons, for a total capacity of 300 U.S. gallons of auxiliary fuel.

f. Draining – Auxiliary Fuel. Auxiliary fuel drain valves are located at cabin floor level, outboard of fuel cells. Drain lines discharge under cabin forward and inboard of valves. Observe same fuel handling precautions as for main fuel system.

g. Servicing – Engine Oil System. Engine oil tank (7, figure 1-8) is in engine compartment at right side. Oil level can be checked (through small door marked ACCESS FOR FIRE EXTINGUISHER) by viewing sight gage plugs on tank. Before servicing oil, determine whether system contains MIL-L-7808 oil (item 2, table 1-2) or MIL-L-23699 oil (item 3, table 1-2).

NOTE

It is not advisable to mix MIL-L-7808 and MIL-L-23699 oils except in cases of emergency. If this becomes necessary, it is required that the system be drained within 6 hours of operation according to procedures in Chapter 5, Section VI.

h. Oil Usage and Changing.

(1) Usage of oils:

(a) MIL-L-23699 oil is used in the engine, transmission, gear boxes and rotor hub and is authorized for ambient temperatures above minus 25 degrees F.

(b) MIL-L-7808 oil is used in engine, transmission, gear box, and rotor hub and is specified for operation in ambient temperatures below minus 25 degrees F. This oil may also be used when MIL-L-23699 is not available; however, change from MIL-L-7808 to MIL-L-23699 at next scheduled oil change.

(2) Changing engine oil:

(a) When changing from MIL-L-7808 oil to MIL-L-23699 oil in engine oil system refer to Chapter 5.

(b) When changing from MIL-L-23699 oil to MIL-L-7808 oil in engine oil system, refer to Chapter 5.

ENGINE OIL CAPACITY	U.S. GALLONS
System	3.8
Tank – Normal Level	3.0
Tank – Ferry Level	3.25

(3) When changing from MIL-L-7808 oil to MIL-L-23699 oil or from MIL-L-23699 to MIL-L-7808 oil in the transmission, gear box, and rotor hub proceed as follows:

(a) Drain oil.

(b) Change filter elements.

(c) Perform normal periodic inspection.

(d) Replenish with appropriate oil. (Refer to step (1) above.)

i. Draining – Engine Oil System.

(1) Drain engine oil tank by opening valve in drain line below tank which discharges over-board at lower left side of fuselage.

(2) Drain engine oil cooler by opening valve at fitting on front of cooler. Obtain access through rear compartment door on right side of fuselage below engine tailpipe.

(3) Consult maintenance instructions for further details of engine oil system. (Refer to Chapter 5.)

j. Servicing – Transmission Oil System. Transmission sump oil level sight gages (1, figure 1-8) can be checked by use of a small window and push-button switch for light, located either on front or right side of pylon structural island in cabin. Filler cap is located at upper right on transmission, accessible from walkway on cabin roof either with transmission fairing open or through a small door in closed fairing. Before servicing, determine whether system contains MIL-L-7808 oil (item 2, table 1-2) or MIL-L-23699 oil (item 3, table 1-2).

CAUTION

Do not over service transmission.

TRANSMISSION OIL CAPACITY		U.S. QTS.
	YUH-1D	UH-1D/H
System	10.6	11.0
Sump	8.6	9.0
Sump Refill	1.7	1.5

NOTE

It is not advisable to mix MIL-L-7808 and MIL-L-23699 oils except in cases of emergency. If this becomes necessary, it is required that the system be drained within 6 hours of operation.

k. Draining – Transmission Oil System.

(1) Drain transmission through valve (14, figure 1-8) under sump, accessible through cargo-sling compartment.

(2) Drain transmission oil cooler through two drains (4) located in lower left side of fuselage, accessible through door behind landing gear crosstube.

(3) Consult maintenance instructions for further details of transmission oil system. (Refer to Chapter 7.)

l. Servicing – Main Rotor Hub. Main rotor hub has two oil reservoirs on pillow blocks (8, figure 1-8) and two on grips (9), which are serviced with oil (item 3, table 1-2). Before servicing oil, determine whether system contains MIL-L-7808 oil (item 2, table 1-2) or MIL-L-23699 oil (item 3, table 1-2). Oil level can be checked by sight through transparent inserts, and reservoirs can be serviced as required, each through its own filler plug.

m. Filling Reservoirs.

(1) Fill pillow block reservoirs one-half full.

(2) Fill grip reservoirs hall-full.

(3) Reinstall and lock-wire filler plugs after servicing.

n. Servicing – Stabilizer Bar Dampers. Visually check both stabilizer bar dampers to be full of hydraulic fluid (item 4, table 1-2) to level above top of window on each damper. If level is only slightly (approximately 1/8 inch maximum) below top of window, refill through plug at top. Check for signs of leakage and record conditions on maintenance form, since further checks may be necessary. (Refer to Chapter 8.)

o. Servicing – Intermediate (42 Degree) and Tail Rotor (90 Degree) Gear Boxes.

CAUTION

Do NOT interchange filler caps between intermediate and tail rotor gear boxes, since this can cause intermediate gear box to be pumped dry.

Intermediate gear box (11, figure 1-8) and tail rotor gear box (10) have sight gage plugs for checking level of oil (item 3, tabel 1-2), and have filler caps for servicing when required. Before servicing oil, determine whether system contains MIL-L-7808 oil (item 2, table 1-2) or MIL-L-23699 oil (item 3, table 1-2). Oil level of intermediate gear box can be seen through a hole in fairing, but fairing must be removed for filling or access to magnetic plug.

NOTE

It is not advisable to mix MIL-L-7808 (item 2, table 1-2) and MIL-L-23699 (item 3, table 1-2) oils except in cases of emergency. If this becomes necessary, it is required that the system be drained, within 6 hours of operation.

p. Servicing – Gravity Feed Hydraulic Reservoir. Check sight gage of hydraulic reservoir through viewing hole provided on right side of transmission fairing. If fluid level shows in sight gage, reservoir servicing is required. Open transmission fairing for access. Remove cap and fill reservoir to overflow with hydraulic fluid (item 4, table 1-2). Reinstall filler cap. Close transmission fairing.

WARNING

To avoid contamination, do not use previously opened cans of hydraulic fluid. A new, sealed can of fluid must be opened and used.

HYDRAULIC FLUID CAPACITY	U.S. PINTS
System	10.0
Reservoir	5.3
Reservoir Refill	2.5

q. Draining – Gravity Feed Hydraulic Reservoir. Drain reservoir by removing plug from port marked DRAIN on lower aft side of reservoir.

r. Servicing – Ground Handling Gear Pump. Hold pump in an upright position, with oil hole and handle socket at top, and fill with hydraulic fluid (item 4, table 1-2) until fluid comes out filler hole. Check pump for leaks and proper operation. Refer to Chapter 4 for pump bleeding procedure.

s. Servicing – Ground Handling Gear Tires. Each ground handling gear assembly has two 7.00-6, 6-ply rating, Type III aircraft tires to be inflated to 45 psig air pressure.

t. Servicing – Battery. The battery does not normally require frequent service. Consult maintenance instructions for further information. (Refer to Chapter 12.)

u. Servicing – Smoke Generator Subsystem Tank. Refer to Chapter 14.

1-26. Cleaning.

Clean the helicopter and components as follows:

a. General. Cleaning the aircraft before preparing it for storage is important because residues from exhaust gases, dirt, and contamination of any kind will accelerate corrosion, whether coated with preservative compound or not. Aircraft must be grounded prior to any cleaning, maintenance, disassembly, or preservation.

NOTE

Additional cleaning procedures are covered in this manual under individual components.

b. Interior. Clean the interior of the aircraft to prevent debris from falling into the operating mechanism. If the upholstery needs cleaning, use mild soap and water. To remove grease or oil spots use solvent (item 323, table 1-2). Wipe dry with a clean cloth. Finally, thoroughly clean the aircraft with a vacuum cleaner.

WARNING

Although solvent (item 323, table 1-2) is very safe and is nonflammable, it still should be used with adequate ventilation and prolonged breathing of the vapors should be avoided. The solvent shall not be used near open flames or heat as the products of decomposition are toxic and very irritating. Contact with the skin should be avoided; rubber gloves shall be worn.

c. Exterior. Clean the exterior structure by applying a mixture of one part cleaning compound (item 324, table 1-2) and three to seven parts water. Use stronger mixtures for exhaust outlet areas and other very dirty surfaces. Wash a small area at a time making sure to rinse thoroughly with water under pressure. If allowed to dry or if not completely rinsed off, the compound could harm painted finishes.

CAUTION

Cleaning solution inadvertently splashed on plexiglass should be rinsed off with clear water before it becomes dry.

d. Plexiglass.

(1) Clean all transparent plastics with large quantities of mild soap and water.

(2) Gently free all caked mud or dirt with the pads of the fingers. Do not use sponges or coarse cloths. Rinse the area continuously while removing the mud.

(3) Remove grease or oil with aliphatic naphtha (item 304, table 1-2).

CAUTION

Do not use aliphatic naphtha TT-N-95 Type I.

CAUTION

Do not use compounds containing any abrasive material or solutions containing chlorinated carbons. Avoid excessive scrubbing of plastic panels during washing operation.

(4) Allow surfaces to drip dry.

(5) Minor scratches may be reduced or removed by application of a suitable plastic cleaner.

(6) A light coat of high quality wax may be applied to reduce scratching.

e. Rotor Blades. Wash rotor blades with mild soap and water.

f. Treatment of Aluminum and Magnesium Alloy Corrosion. Aluminum and magnesium alloy corrosion will be treated in accordance with Chapter 2, TM 55-1520-204-25/1. Apply the protective paint finish to the affected area immediately after drying of chemical treatment in accordance with TB 746-93-2.

1-27. Painting — Touch-Up.

(Refer to TB-746-93-2.) Special procedures for painting will be covered in this manual under individual component.

1-28. List Of Consumable Materials.

Refer to Table 1-2.

1-29. Torque Values.

a. Standard torque values are not called out for individual maintenance procedures in this manual. The standard torque table (see Table 1-3) may be used to determine the correct standard torque. In those instances where special torque values are required, the special torque is called out in the assembly instructions for the parts which require the special torque.

b. Note 3, on table 1-3, emphasizes the fact that standard torque for a nut may vary depending on the type of bolt. For instance: a 5/16-24 NAS679 nut installed on any of the bolts listed in column 1, should be torqued 100 to 140 inch-pounds. A 5/16-24 NAS679 nut installed on any of the bolts listed in column 2, should be torqued 120 to 145 inch-pounds.

1-30. Special Tools And Equipment.

Special tools and equipment provided for organizational maintenance will be found in TM 55-1520-210-20P.

1-31. Retrieval Of Downed Aircraft.

Retrieving downed aircraft is accomplished as outlined in figures 1-10 through 1-17. The information presented here is typical for all UH-1 helicopters.

Table 1-2. List of Consumable Materials

ITEM NO.	NOMENCLATURE	COLOR NO.	SPECIFICATION
	FUELS AND LUBRICANTS		
1.	Turbine fuel, Aviation, Grades JP-4 and JP-5		MIL-T-5624
2.	Lubricating Oil, Aircraft Turbine Engine, Synthetic base		MIL-L-7808
3.	Lubricating Oil, Aircraft Turbine Engine, Synthetic base		MIL-L-23699
4.	Hydraulic fluid, Petroleum base, Aircraft, Missile and Ordanance		MIL-H-5606
5.	Lubricating Oil, Jet engine (Grade 1010)		MIL-L-6081
6.	Graphite, Lubricating		MIL-G-6711
7.	Grease, Aircraft, Helicopter oscillating bearing		MIL-G-25537
8.	Lubricant, Drive shaft couplings (Tube pack)		Anderol L-786
9.	Corrosion preventive oil, Gas turbine engine, Aircraft, Synthetic base		MIL-C-8188
10.	Grease, Pneumatic system		MIL-G-4343
11.	Hydraulic fluid, Petroleum base, For preservation and testing		MIL-H-6083 (Type II)
12.	Lubricating oil, General purpose, Low Temperature		MIL-L-7870
13.	Petrolatum, Technical		VV-P-236
14.	Grease (Lubriplate)		FSCM 73219
15.	Shortening, Compound and lard		EE-S-321
16.	Castor oil, Technical		JJJ-C-86
17.	Plastilube, Moly No. 3		FSCM 02307
18.	Grease		MIL-G-23827
19.	Ease-off 990		FSCM 87889
20.	Molykote Anti-seize Thread Compound		FSCM 94499
21.	Penetrating Oil		VV-P-216
	PAINTS, PRIMERS, THINNERS AND MARKING COMPOUNDS		
	NOTE: ALL COLOR NUMBERS TO BE IN ACCORDANCE WITH FED STD 595		
100.	Epoxy primer (Super Koropon)		FSCM 22873
101.	Prussian blue color, Thinned with oil		TT-P-691
102.	Enamel, Aluminum, Heat resistant	XA147	FSCM 77359
103.	Lacquer, Acrylic, Insignia red (Gloss)	11136	MIL-L-81352
104.	Lacquer, Acrylic, Insignia White (Gloss)	17875	MIL-L-81352
105.	Lacquer, Acrylic, Black (Gloss)	17038	MIL-L-81352
106.	Primer coating, Zinc chromate, Low moisture sensitivity		MIL-P-8585
107.	Epoxy, Engine gray A.D. (Components A & B) (P/N E2833)		FSCM 16193
108.	Varnish, Spar, Phenolic, Resin		TT-V-119
109.	Primer Coating, Zinc Chromate		MIL-P-8585
110.	Locquic Primer, Grade Q		FSCM 05972
	ADHESIVES, CEMENTS AND SEALING COMPOUNDS		
200.	Putty, Zinc chromate, General purpose		MIL-P-8116
201.	Sealing, Locking and retaining compounds, Single component (Grade Q, Grade CV (4-10)		MIL-S-22473
202.	Anti-seize compound, High Temperature (Navy)		MIL-A-907
203.	Molybdenum disulfide, Technical, Lubrication grade		MIL-M-7866
204.	Sealing Compound, Temperature resistant, Integral Fuel tanks and fuel cell cavities, High adhesion		MIL-S-8802
205.	Metal-Set, A-4		MIL-A-8623
206.	Nuocure 28 Catalyst, Nudex Products Co., Heyden Chemical Corp., Elizabeth, N.J.		not available
207.	Sealing compound, Temperature resistant, Integral fuel tanks and fuel cell cavities, High adhesion		MIL-S-8802 (Type B-2)
208.	Filler, RP-1220		FSCM 02684
209.	Adhesive, 2216 (Scotch-weld)		FSCM 76381
210.	Adhesive, Heat resistant, Airframe structural, Metal to Metal		MMM-A-132
211.	Adhesive, Air-drying, Silicone rubber		MIL-A-25457

Table 1-2. List of Consumable Materials (Cont)

ITEM NO.	NOMENCLATURE	COLOR NO.	SPECIFICATION
	ADHESIVES, CEMENTS AND SEALING COMPOUNDS (Cont)		
211A.	Cement (EC 1357)		FSCM 04963
211B.	Adhesive (EC 2126) Type III		MIL-A-5092
211C.	Silastic 140		FSCM 71984
212.	Pro Seal		FSCM 83572
213.	Sealing, Locking and retaining compounds, Single component (Loctite Grade C)		MIL-S-22473
214.	Silicone Adhesive (RTV-106)		FSCM 01139
215.	EC 847 (Manufactured by Minnesota Mining and Mfg.)		None
216.	Sealant, Grade AA, green		MIL-S-22473
217.	Locquic Primer, Grade T		FSCM 05972
	CHEMICALS, COATINGS AND CLEANING COMPOUNDS		
300.	Trichlorethylene, Technical		O-T-634
300A.	Trichlorethylene		MIL-T-7003
301.	Tetrachloroethylene, Perchloroethylene, Technical grade		O-T-236
302.	Dry cleaning solvent		P-D-680 (Type I)
303.	Silastic, 589 RTV, Silicone rubber		FSCM 71984
304.	Naphtha, Aliphatic		TT-N-95 (Type II)
305.	Methyl-Ethyl-Ketone (For use in organic coatings)		TT-M-261
306.	Corrosion inhibitor (Rust Lick 606)		FSCM 14098
307.	Acetone, Technical		O-A-51
308.	Methanol, Methyl alcohol (Grade A or B)		O-M-232
309.	Corrosion preventive compound, Petrolatum Hot application		MIL-C-11796
310.	Desiccants, Activated, Bagged, Packaging use and static dehumidification		MIL-D-3464
311.	Chemical films and chemical film materials for aluminum and aluminum alloys		MIL-C-5541
312.	Corrosion preventive compound, Solvent cutback, Cold application (Grade 2)		MIL-C-16173
312A.	Corrosion preventive compound		MIL-C-16173C
313.	Corrosion preventive, Fingerprint remover		MIL-C-15074
314.	Coating, Sprayable, Strippable, Protective		MIL-C-6799 (Type II, Class 2)
315.	Sodium dichromate, Technical grade		O-S-595
316.	Nitric acid, Technical		O-N-350
317.	Vis-Strip (Paste), and Stripper S-A		FSCM 44389
318.	Turco compound No. 713		FSCM 61102
319.	Injection fluid, Anti-detonating		FSCM 94647
320.	Light water solution, FC-194		FSCM 76381
321.	Xylene		TT-X-916
322.	Toluene, Technical		TT-T-548
323.	Cleaning Compound, Solvent Trichlorotrifloroethane		MIL-C-81302 (Type II)
323A.	Hydrochloric (Muratic) Acid		O-H-765
324.	Cleaning Compound, Aircraft Surface Alkaline, Waterbase		MIL-C-25769
325.	Aircraft Engine Corrosion Preventive		MIL-C-6529 (Type III)
	FABRICS AND TAPES		
400.	Tape, Pressure sensitive adhesive, Waterproof, for Packaging		PPP-T-60 (Type II)
401.	Cloth, Coated, Vinyl or nylon, Acrylic and glass		MIL-C-7514
402.	Twill, Black, One side coated nylon, Style 665-002		
403.	Strip, Rub		209-030-203-43
404.	Tape, Anti-Chafe, 3M teflon		549
405.	Tape, Polyurethane Film		FSMC 04963

Table 1-2. List of Consumable Materials (Cont)

ITEM NO.	NOMENCLATURE	COLOR NO.	SPECIFICATION
	ABRASIVES, PAPER, PLASTICS AND MISCELLANEOUS		
500.	Cushioning material, Uncompressed bond fiber for packaging		MIL-C-7769 (Type IV)
501.	Thread, Cotton		V-T-276
502.	Thread, Nylon		V-T-295
503.	Grain, Abrasive, Soft, for carbon removal		MIL-G-5634 (Type III)
504.	Wax, Aircraft, Waterproof, Solvent Type		MIL-W-18723
505.	Barrier material, Grease-proofed, Water-proofed, Flexible (Grade A, Class 1)		MIL-B-121 (Type I)
506.	Barrier material, Water vaporproof, Flexible (Class 1)		MIL-B-131
507.	Hypodermic Syringe (Luer-Lok) 10cc capacity and No. 16 gauge by 1-1/4 inch long needle		FSCM 06531
508.	Fog Oil		MIL-F-12070 (Type SGF2)
508.	Cloth, Abrasive, Aluminum oxide and silicone carbide		P-C-451
508A.	Abrasive Paper (120 Grit)		P-P-101
509.	Cushioning, Material, Cellulose		PPP-C-843 (Type II)
510.	Cloth, Abrasive, Crocus		P-C-458
511.	Cloth, Fiber Glass, 120 or 127 weave (Volon A finish)		MIL-C-9084

Table 1-3. Standard Torque Table Excluding Engines

	1				2				3			
	BOLTS											
	STEEL TENSION				STEEL TENSION				ALUMINUM			
	AN3 thru AN20 AN42 thru AN49 AN73 thru AN81 AN173 thru AN186 MS20033 thru MS20046 MS20073 MS20074 AN509 MS24694 AN525 MS27039				MS20004 thru MS20024 NAS144 thru NAS158 NAS333 thru NAS340 NAS583 thru NAS590 NAS624 thru NAS644 NAS1303 thru NAS1320 NAS172 NAS174 NAS517		STEEL SHEAR NAS464		AN3DD thru AN20DD AN173DD thru AN186DD AN509DD AN525D MS27039D MS24694DD			
	NUTS											
	STEEL TENSION		STEEL SHEAR		STEEL TENSION		STEEL SHEAR		ALUMINUM TENSION		ALUMINUM SHEAR	
	AN310 AN315 AN363 AN365 NAS1021 MS17825 MS21045 MS20365 MS20500 NAS679		AN320 AN364 NAS1022 MS17826 MS20364		AN310 AN315 AN363 AN365 MS17825 MS20365 MS21045 NAS1021 NAS679		AN320 AN364 NAS1022 MS17826 MS20364		AN365D AN310D NAS1021D		AN320D AN364D NAS1022D	
	FINE THREAD SERIES											
Nut-Bolt Size	Torque Limits inch/lbs.		Torque Limits inch/lbs.		Torque Limits inch/lbs.		Torque Limits inch/lbs.		Torque Limits inch/lbs.		Torque Limits inch/lbs.	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
8 -36	12	15	7	9	-	-	-	-	5	10	3	6
10-32	20	25	12	15	25	30	15	20	10	15	5	10
1/4 -28	50	70	30	40	80	100	50	60	30	45	15	30
5/16-24	100	140	60	85	120	145	70	90	40	65	25	40
3/8 -24	160	190	95	110	200	250	120	150	75	110	45	70
7/16-20	450	500	270	300	520	630	300	400	180	280	110	170
1/2 -20	480	690	290	410	770	950	450	550	280	410	160	260
9/16-18	800	1,000	480	600	1,100	1,300	650	800	380	580	230	360
5/8 -18	1,100	1,300	660	780	1,250	1,550	750	950	550	670	270	420
3/4 -16	2,300	2,500	1,300	1,500	2,650	3,200	1,600	1,900	950	1,250	560	880
7/8 -14	2,500	3,000	1,500	1,800	3,550	4,350	2,100	2,600	1,250	1,900	750	1,200
1 -14	3,700	4,500	2,200	3,300	4,500	5,500	2,700	3,300	1,600	2,400	950	1,500
1 1/8 -12	5,000	7,000	3,000	4,200	6,000	7,300	3,600	4,400	2,100	3,200	1,250	2,000
1 1/4 -12	9,000	11,000	5,400	6,600	11,000	13,400	6,600	8,000	3,900	5,600	2,300	3,650
COARSE THREAD SERIES												
8 -32	12	15	7	9	-	-	-	-	-	-	-	-
10-24	20	25	12	15	-	-	-	-	-	-	-	-
1/4 -20	40	50	25	30	-	-	-	-	-	-	-	-
5/16-18	80	90	48	55	-	-	-	-	-	-	-	-
3/8 -16	160	185	95	110	-	-	-	-	-	-	-	-
7/16-14	235	255	140	155	-	-	-	-	-	-	-	-
1/2 -13	400	480	240	290	-	-	-	-	-	-	-	-
9/16-12	500	700	300	420	-	-	-	-	-	-	-	-
5/8 -11	700	900	420	540	-	-	-	-	-	-	-	-
3/4 -10	1,150	1,600	700	950	-	-	-	-	-	-	-	-
7/8 - 9	2,200	3,000	1,300	1,800	-	-	-	-	-	-	-	-
1- 8	3,700	5,000	2,200	3,000	-	-	-	-	-	-	-	-
1 1/8 - 8	5,500	6,500	3,300	4,000	-	-	-	-	-	-	-	-
1 1/4 - 8	6,000	8,000	4,000	5,000	-	-	-	-	-	-	-	-

Note 1: Divide inch-pounds by 12 to convert torque values to foot-pounds.
Note 2: Torque values listed are for turning nuts on stationary bolts.
Note 3: Variation of torque on identical nuts listed in column 1 and column 2 is based on type of bolt.

204900-252
AV 054232

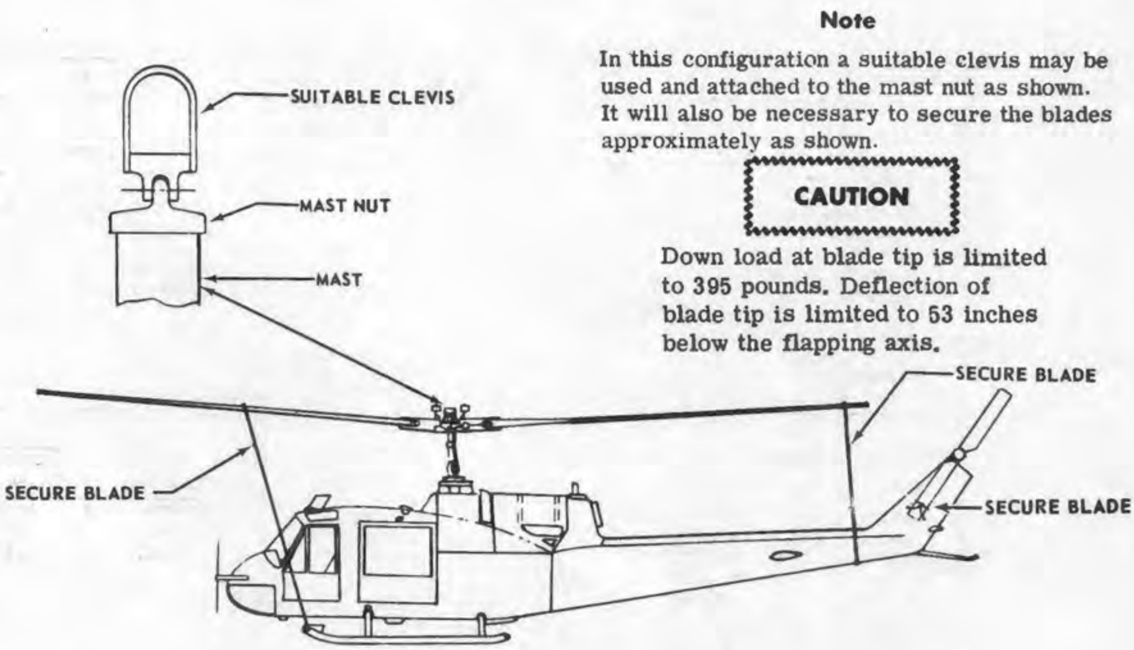


Figure 1-10. UH-1 retrieval with ship and rotor intact

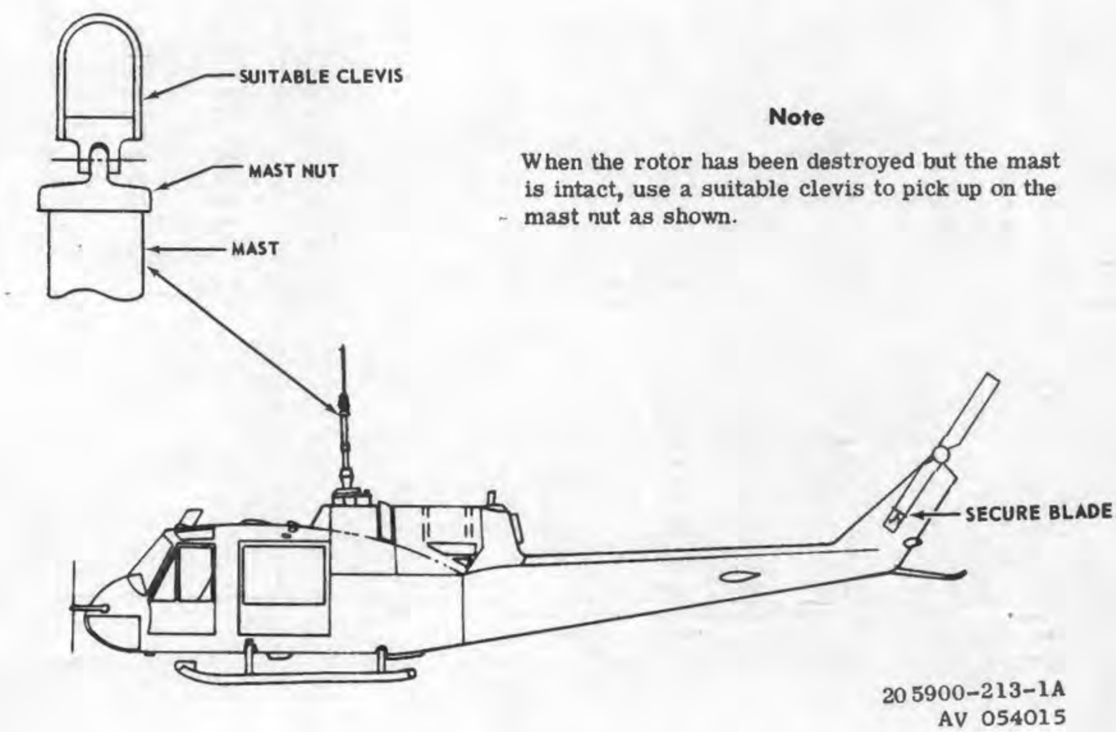


Figure 1-11. UH-1 retrieval with rotor destroyed but mast intact

Note

If the transmission or the transmission base remains intact it is advisable to wrap support cables about the base in a manner similar to that shown in the L/H sketch. If the transmission has been completely destroyed or removed, a support cable and fitting may be attached to the lift link beam as shown in R/H sketch.

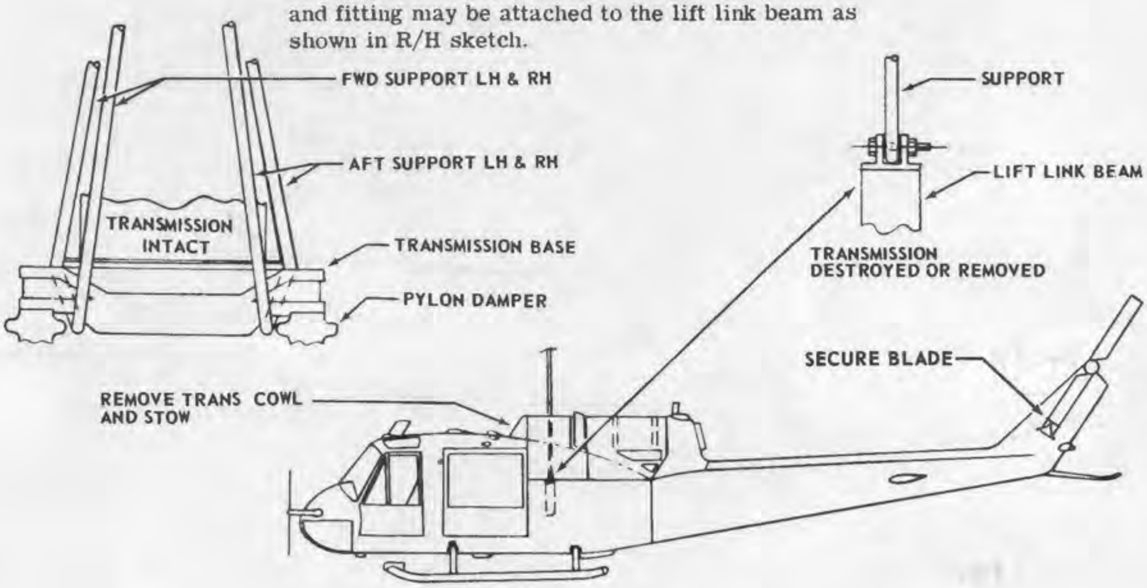


Figure 1-12. Retrieval of UH-1 with airframe intact but rotor and mast destroyed

Note

It is advisable that in this configuration a support cable and fitting be attached to the lift link beam as shown in sketch below. Remove transmission cowl and stow in cabin.

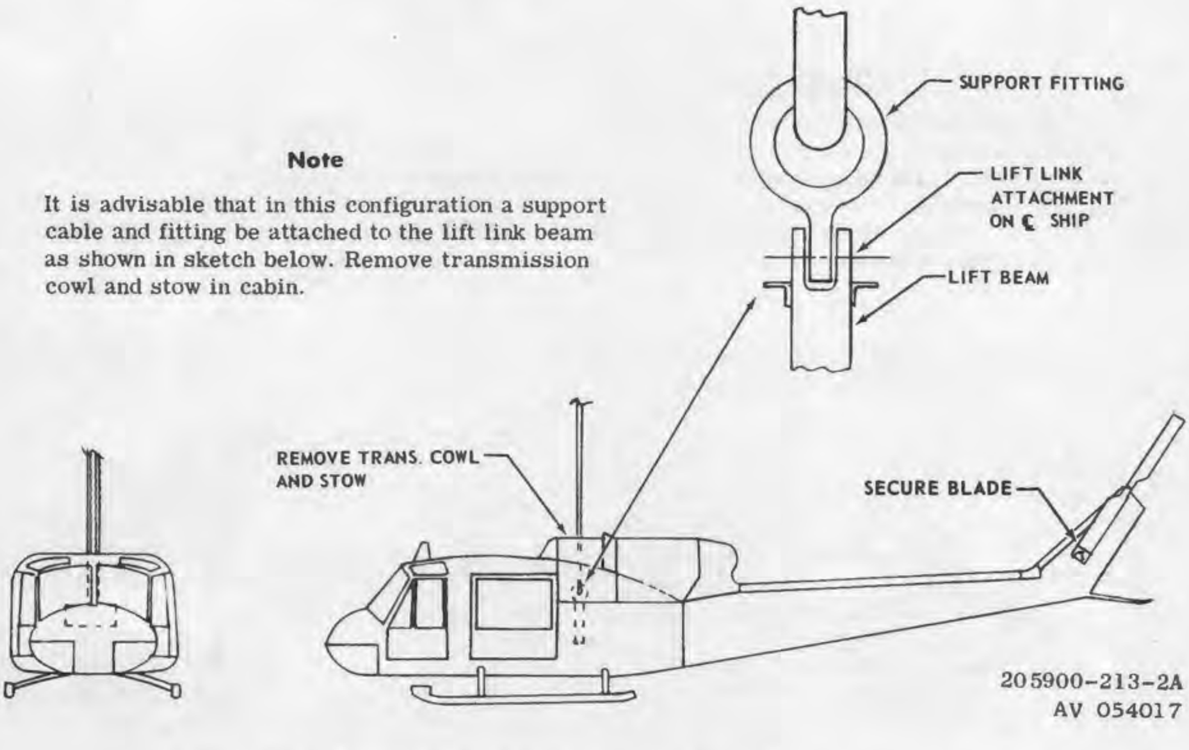


Figure 1-13. Retrieval of UH-1 with airframe damaged (tail boom and fuselage) with rotor and mast destroyed — preferred method

Note

An alternate method is to wrap support cables around the center of the lift link beam structure similar to sketch below and remove transmission cowl and stow in cabin.

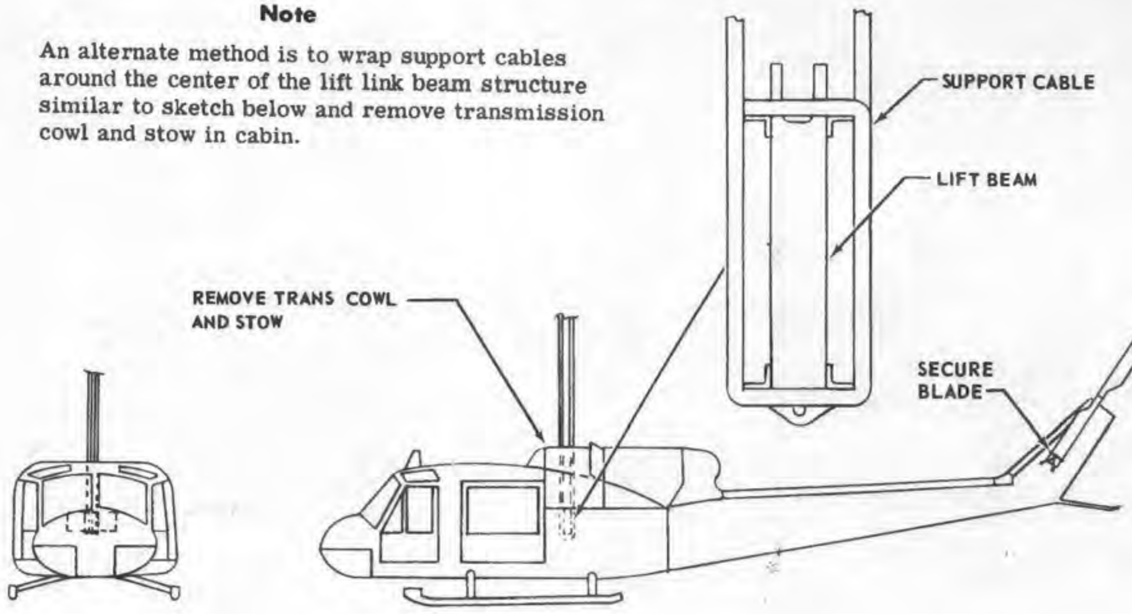


Figure 1-14. Retrieval of UH-1 with airframe damaged (tail boom and fuselage) with rotor and mast destroyed – alternate method

Note

This configuration shows the forward fuselage only. It is advisable to attach a cable support fitting to the lift link beam. To prevent pitching, attach a support cable through the skid tube towing ring and around the skid tube, both sides, as shown. Remove and stow transmission cowl.

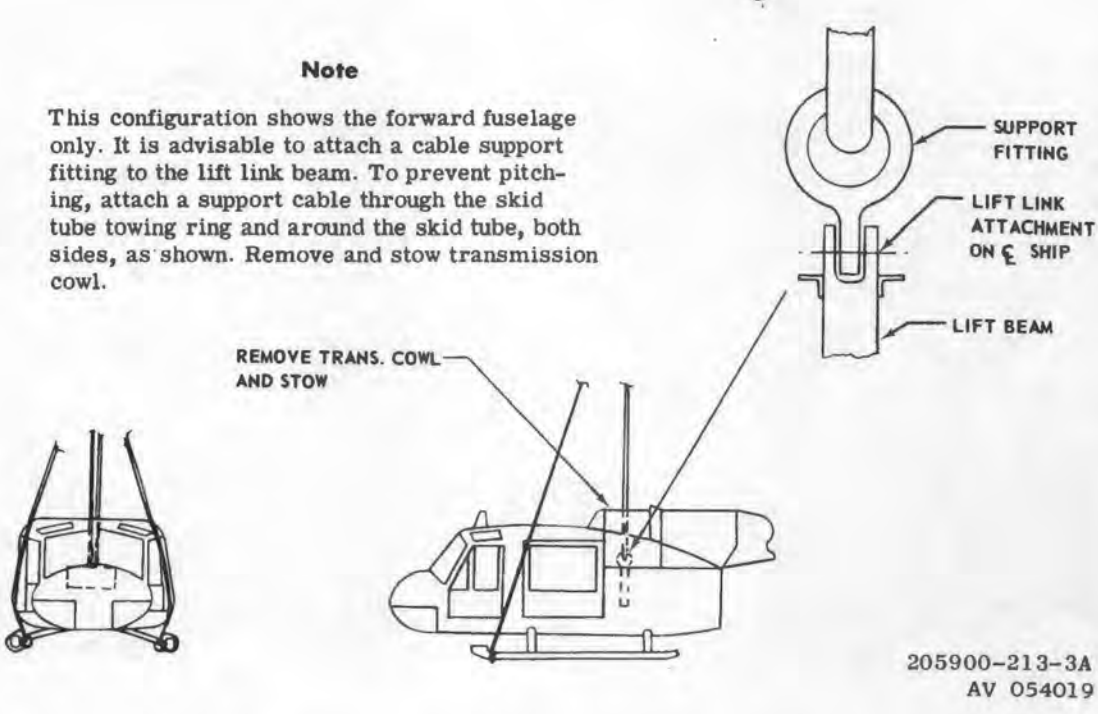
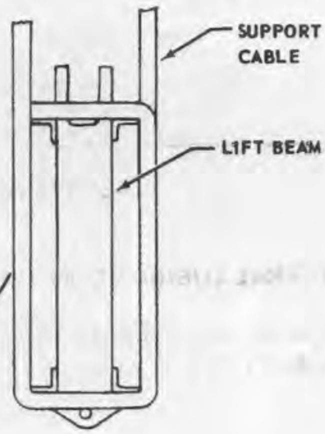


Figure 1-15. Retrieval of UH-1 with only forward fuselage intact (rotor, mast and tailboom destroyed) – preferred method

Note

Same as 1–15 except support cables may be sling wrapped around the lift link beam in lieu of the attach fitting (see sketch). Remove and stow transmission cowl.



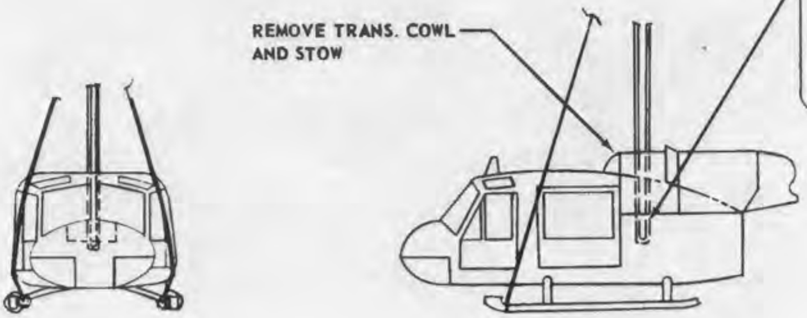
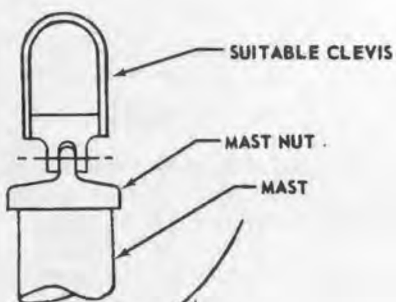


Figure 1-16. Retrieval of UH-1 with only forward fuselage intact (rotor, mast and tailboom destroyed) — alternate method

Note

In retrieving the forward fuselage with mast intact and tailboom removed, it is advisable to use a suitable clevis to pick up the mast nut and support cables be tied to the tow hook at the front of the cross tubes, typical both sides, to prevent forward pitching.



205900-213-4A
AV 054021

Figure 1-17. Retrieval of UH-1 forward fuselage with mast intact and tailboom removed

CHAPTER 2

LUBRICATION INSTRUCTIONS

SECTION I GENERAL LUBRICATION REQUIREMENTS

2-1. GENERAL LUBRICATION REQUIREMENTS.

This Chapter covers the lubrication requirements of the aircraft as shown on Lubrication Chart in Section II.

SECTION II LUBRICATION CHART

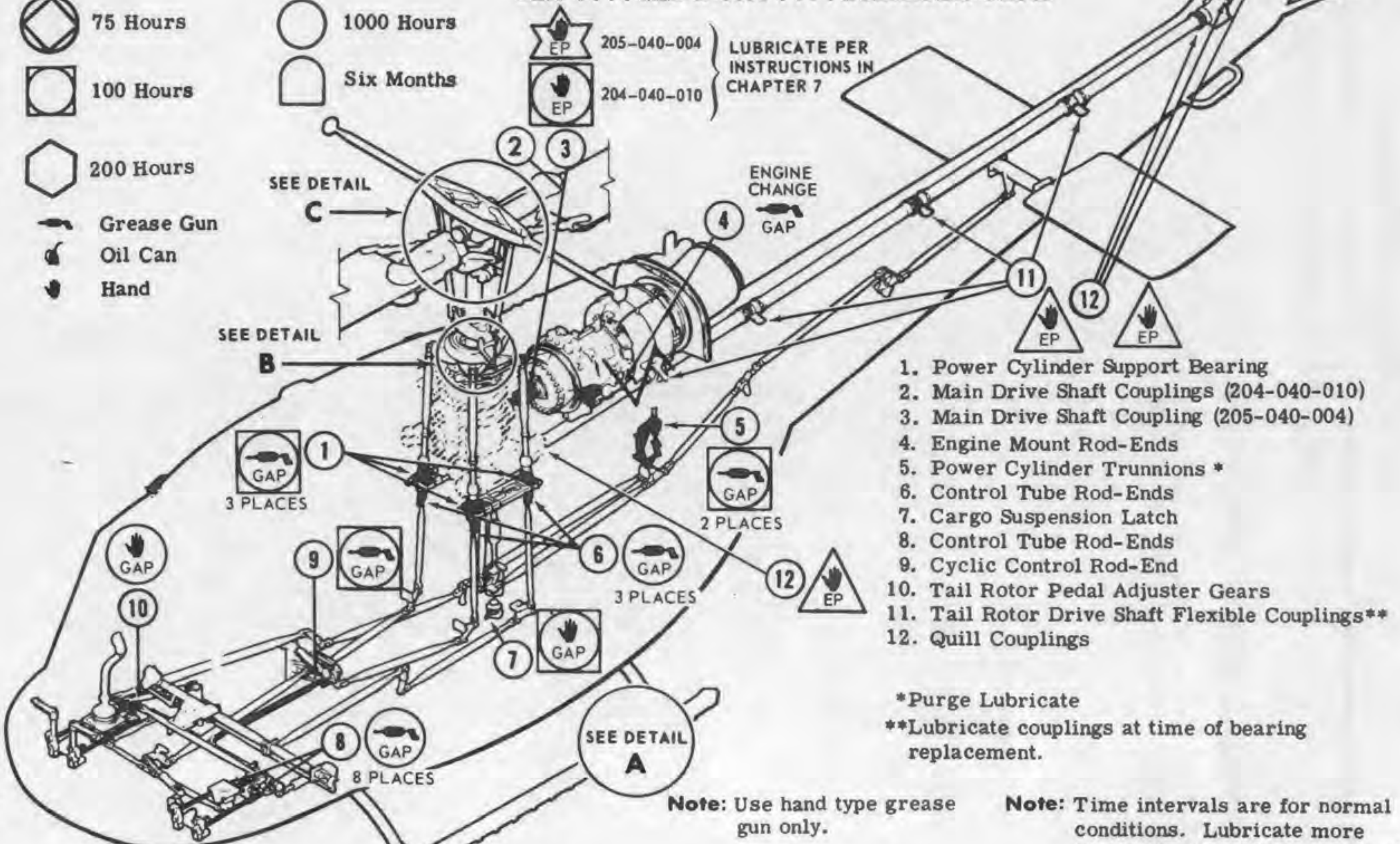
FREQUENCY SYMBOLS

- Daily
- 25 Hours
- 50 Hours
- 75 Hours
- 100 Hours
- 200 Hours
- 300 Hours
- 600 Hours
- 500 Hours
- 1000 Hours
- Six Months
- Grease Gun
- Oil Can
- Hand

TABLE OF LUBRICANTS

IDENTIFICATION LETTER	SPECIFICATION	TYPE OF LUBRICANT
GAP	MIL-G-25537	GREASE, AIRCRAFT, HELICOPTER OSCILLATING BEARING
FG	MIL-G-6711	GRAPHITE, LUBRICATING
EP	204-040-755-3	LUBRICANT, BHC
OHA	MIL-H-5606	HYDRAULIC FLUID

EP 205-040-004, EP 204-040-010: LUBRICATE PER INSTRUCTIONS IN CHAPTER 7



1. Power Cylinder Support Bearing
2. Main Drive Shaft Couplings (204-040-010)
3. Main Drive Shaft Coupling (205-040-004)
4. Engine Mount Rod-Ends
5. Power Cylinder Trunnions *
6. Control Tube Rod-Ends
7. Cargo Suspension Latch
8. Control Tube Rod-Ends
9. Cyclic Control Rod-End
10. Tail Rotor Pedal Adjuster Gears
11. Tail Rotor Drive Shaft Flexible Couplings**
12. Quill Couplings

*Purge Lubricate

**Lubricate couplings at time of bearing replacement.

Note: Use hand type grease gun only.

Note: Time intervals are for normal conditions. Lubricate more frequently if conditions warrant.

205900-20-1x
AV 054022-1

Figure 2-1. Lubrication chart (Sheet 1 of 3)

13. Axle Pivot Point
14. Actuating Cylinder Trunnions***
15. Wheel Bearings
16. Pin Assembly
17. Securing Pin
18. Collective Sleeve Bearings
19. Scissor Bearings
20. Collective Lever Trunnion***
21. Swashplate Bearings
22. Outer Control Plate Trunnions***
23. Control Plate Trunnions***
24. Scissors Pivot Cover Plate
25. Collective Sleeve Splines

***Disconnect the push-pull tube clevis and rotate the bearing while lubricating. Purge lubricate.

Note: Use hand type grease gun only

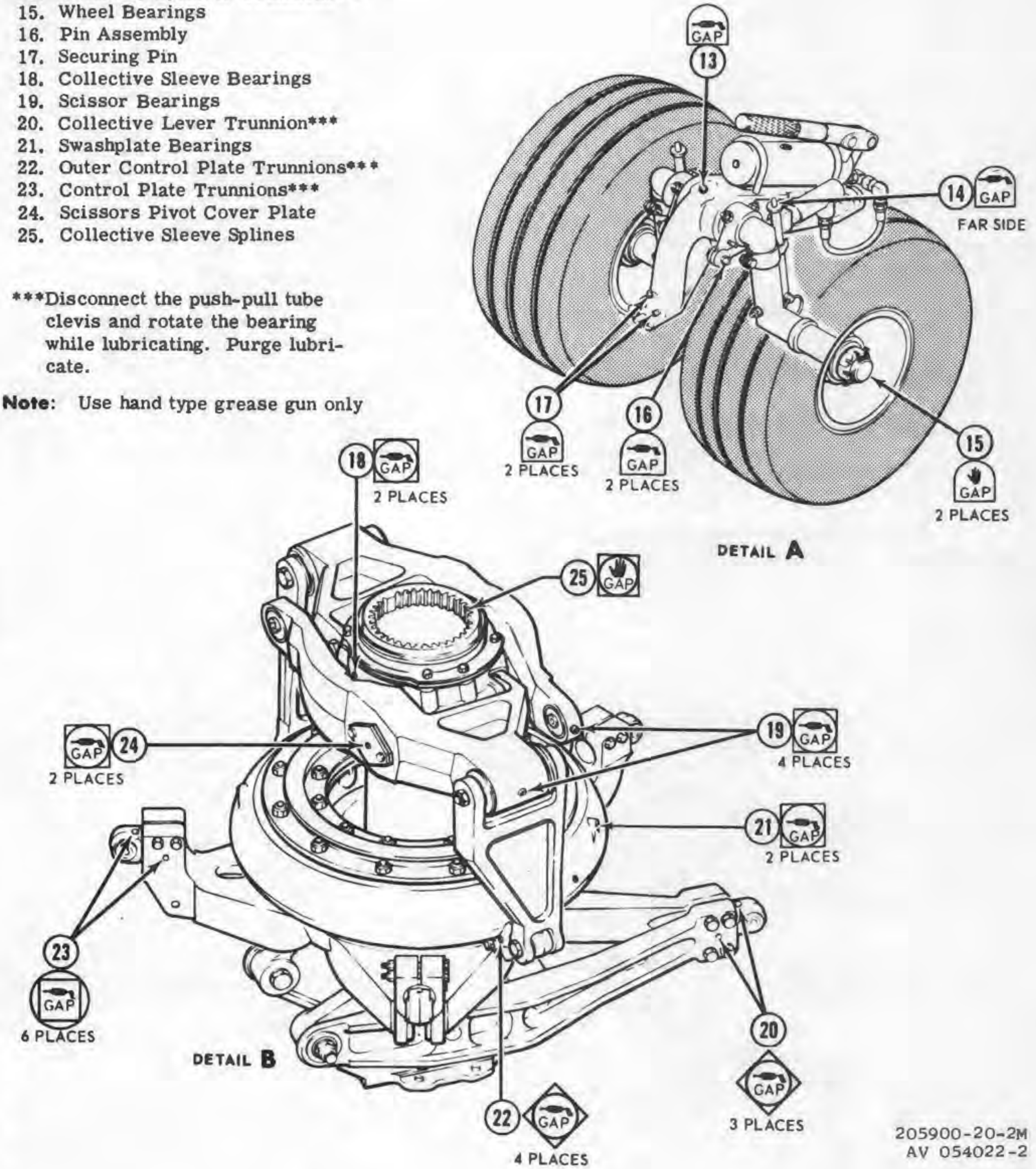


Figure 2-1. Lubrication chart (Sheet 2 of 3)

26. Trunnion Bearings
27. Grip Bearings (See Note 2, Below)
28. Crosshead Bearing
29. Pitch Change Link Universal
30. Outboard Mixing Lever Bearing*
31. Damper Link Rod Ends
32. Stabilizer Frame Bearing

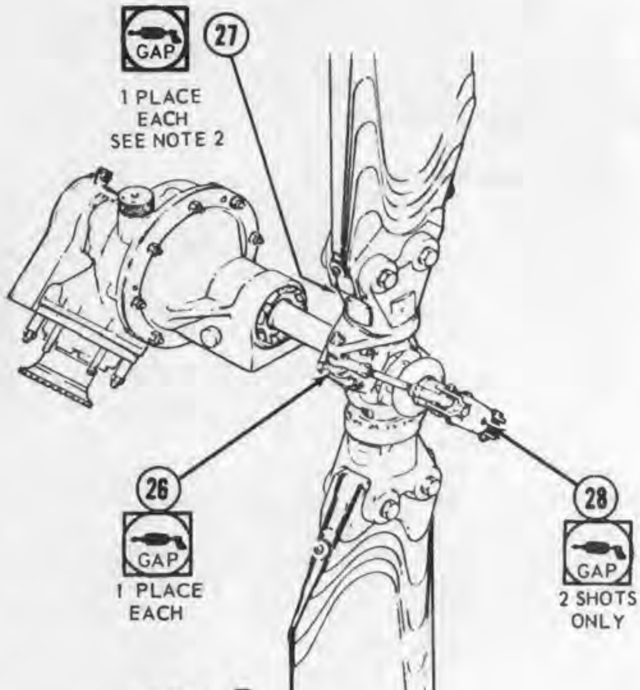
NOTE 1: Use hand type grease gun only.

NOTE 2: a. After initial installation of a tail rotor hub assembly and subsequent operation, existing grease is forced in an outboard direction as air is expelled. This condition, if unattended, could result in a lack of lubrication of the inboard bearing. In view of this, all using units shall lubricate on an as required basis in addition to the specific scheduled time interval.

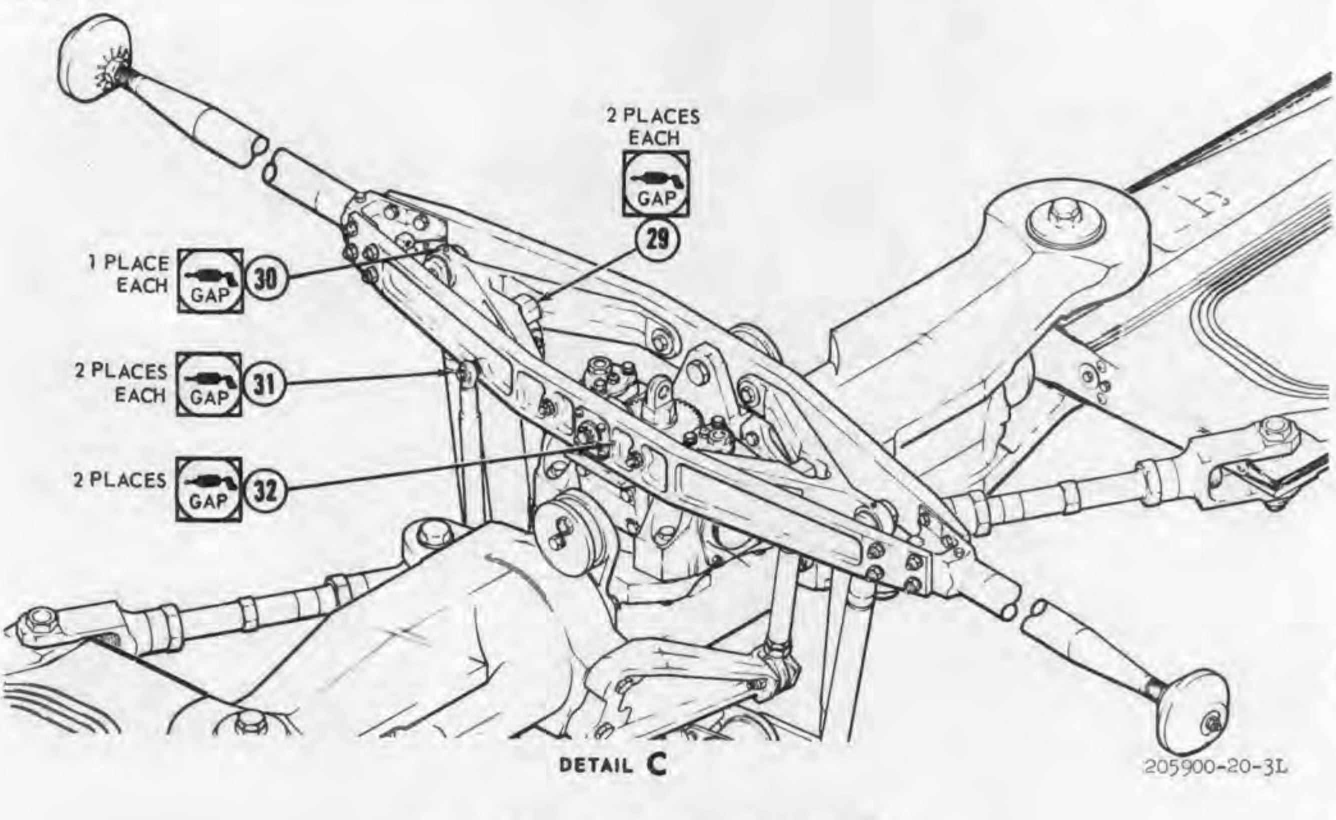
b. If conditions warrant, purge lubricate tail rotor hub and blade grip bearings (item 27) every 25 hours as follows:

(1) Disconnect pitch link at one side of tail rotor cross head and purge bearings with grease. Rotate grip several times in both directions. Repeat purging procedure and wipe off excess grease, reconnect pitch link.

(2) Disconnect pitch link on opposite side of tail rotor and purge bearings in accordance with step (1).



DETAIL D



DETAIL C

205900-20-3L

Figure 2-1. Lubrication chart (Sheet 3 of 3)

CHAPTER 3

INSPECTION REQUIREMENTS

Section I. GENERAL INFORMATION AND INTRODUCTION

3-1. General Information.

This chapter contains complete requirements for special inspections, test flight, overhaul and retirement schedule and standards of serviceability applicable to the aircraft.

3-2. Introduction.

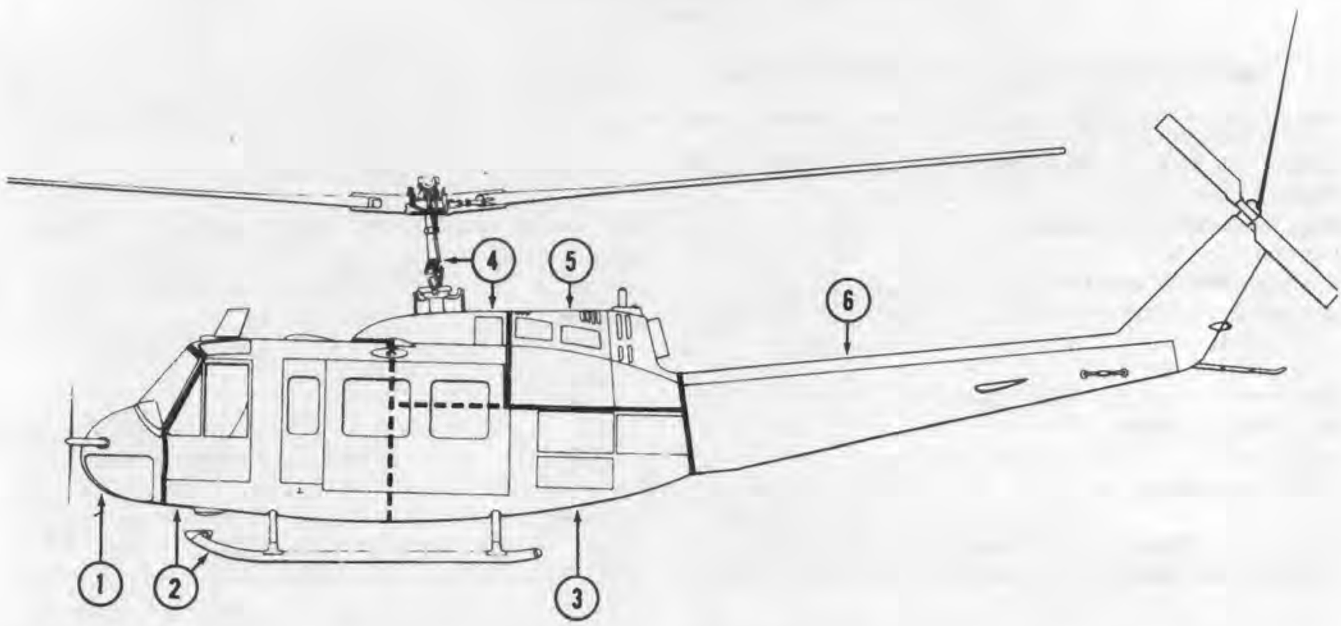
The inspections prescribed in this chapter will be accomplished at specified periods by organizational maintenance activities with the assistance of direct support activities when required. The following conditions will be noted during the performance of these inspections.

a. The inspection requirements are stated in such a manner as to establish what and when certain equipment is to be inspected and the condition to be sought. Compliance with the provisions outlined herein and with the Preventive Maintenance Inspection Checklists (TM 55-1520-210-PMD, -PMI and -PMP) are required in order to assure that latent defects are discovered and corrected before malfunctioning or serious trouble results. In order to arrange inspection requirements as bearly as possible according to the manner in which work will be assigned, the requirements in each section are divided into groups under area headings. (See figure 3-1.) This figure will be the same as the area diagram presented in the appropriate Preventive Maintenance Inspection Checklist. An area title indicates a specific aircraft location which may be comprised of several systems or groups of related components within this given area.

b. Inspection methods employed; environmental and geographical conditions; availability of specialized, skilled, or semi-skilled manpower; and facilities utilized are extremely variable; therefore, flexibility is provided with respect to the order of performance of the various inspections as required by efficient management of the inspection function assuring that the inspection requirements designated are adhered to and accomplished.

c. This manual pertains to all UH-1D/H series aircraft and may therefore contain inspection requirements applicable to specific equipment not installed on individual aircraft. When this situation is encountered, those requirements that are not applicable should be disregarded.

d. The inspection requirements contained herein are printed on inspection checksheets which will be locally reproduced and utilized while performing the respective inspection.



AREA No. 1	Nose Area	All surfaces, components, and equipment in nose compartment and on exterior ahead of crew doors.
AREA No. 2	Cabin and Landing Gear	All surfaces, components, and equipment inside cabin, and on cabin exterior between forward sides of crew doors and aft cabin walls and pylon island structure. Includes complete landing gear, but does not include forward fuel cell sumps on cabin underside.
AREA No. 3	Center Fuselage Area	All surfaces, components, and equipment in fuselage below engine deck level, between cabin area and tail boom attachment bulkhead. Includes fuel cells (also forward cells under cabin floor), compartment in pylon island below main transmission, and compartments accessible through side doors on fuselage.
AREA No. 4	Pylon Area	All surfaces, components, and equipment of the main rotor pylon group, from top of mast to bottom of transmission. Includes main rotor, mast and rotating controls, transmission with accessories and mounts, and main (input) drive shaft.
AREA No. 5	Engine Area	All surfaces, components, and equipment associated with engine installation, located above engine work deck and within engine cowling, tailpipe fairing, and intake fairing.
AREA No. 6	Tail Boom Area	All surfaces, components, and equipment located in or on the tail boom and vertical fin structure. Includes tail rotor, synchronized elevator, and control linkages; also the complete drive train of shafts and gear boxes between main transmission and tail rotor.

For: TM 55-1520-210 PMD
TM 55-1520-210 PMI
TM 55-1520-210 PMP

205900-29
AV 054023

Figure 3-1. Area inspection diagram

Section II. SPECIAL INSPECTION

3-3. Definition and General Information.

This section supplements the scheduled inspections as outlined in the Preventive Maintenance Inspection Checklists TM 55-1520-210-PMD, -PMI, and -PMP to include inspection of items which are required to be inspected at intervals not compatible with airframe operating time or airframe inspection intervals. Typical of this type inspection items are:

a. Inspection which is contingent upon specific conditions or incidents that arise, and only because of these conditions or incidents, immediate inspection is required to insure further safe flight; such as, hard landings, overspeed, sudden stoppage, etc.

b. Inspection of components or airframe, on a calendar basis; such as, first aid kits, weight and balance check, aircraft inventory, etc. This type inspection will be accomplished during the nearest intermediate or periodic inspection.

c. Specific definitive inspections on aircraft engines based strictly upon engine operating time.

NOTE

Progressive Inspection: (Definition) When performing a progressive inspection, each item in the chain of inspection will be inspected until no damage is found, then one more item will be inspected and if no damage exists, the inspection may be terminated.

d. Refer to TM 38-750 for applicable forms, records, and worksheets.

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 1	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIRE-MENT EVERY	ITEM	STA-TUS	RECORDED ON WORKSHEET
All Areas		AFTER A HARD LANDING a. Inspect landing gear skid tubes and cross tubes for damage or more than normal deflection. Inspect aft cross tube mounting area for damage. b. Check all cowling and doors for proper fit and alignment. Misaligned cowling may indicate a distorted fuselage resulting in major stresses and damage to components. c. Remove all cowling necessary to perform a complete visual inspection. d. Inspect airframe structure with a ten-power magnifying glass at the transmission mounting points. Particular attention should be given to the rubber mount attachment points. Inspect lift link and attaching parts. Inspect engine mount legs for bends or cracks. e. Inspect tail skid tube and mounting for damage. Inspect tail boom internally and externally for cracks, distortion and loose rivets. Inspect the tail boom attachment points for elongated bolts and damaged structure. f. Carefully inspect the flight control system from pilot's controls to rotor head for bent or damaged tubes, bellcranks, supports, and damaged bearings. Particular attention should be given to the mast control rods and collective sleeve assembly. g. Using hydraulic test unit, pressurize hydraulic control system and check for leaks, interference or binding, and satisfactory operation. h. Inspect mast for indentation caused by hard contact and static stop for flattened or distorted condition. i. Inspect main rotor blades for contact with tail boom. If damage is found, refer to inspection AFTER SUDDEN STOPPAGE - MAIN ROTOR. j. Inspect tail rotor blades for damage. If damage is found, refer to inspection AFTER SUDDEN STOPPAGE - TAIL ROTOR. k. Inspect fuel and oil systems for damage. Before flight, pressurize fuel and oil systems and check for leaks. l. Check accessory drive gear box for cracked flanges. m. Check overspeed governor and tachometer drive for distortion, cracks, and bent shafts. n. Inspect oil filter for loose bolts, damaged filter element, and metal particles.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 2	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		o. Inspect oil pump for loose bolts and cracked flanges.		
		p. Check fuel control for cracked flanges.		
		q. Check engine mounting pads for cracks.		
		r. Check oil and fuel hose connections for tightness.		
		s. Check all accessories for loose bolts, nuts, and connections.		
All Areas		AFTER A HARD LANDING: IF DAMAGE TO CENTER FUSELAGE STRUCTURE OR TAIL BOOM IS SUCH THAT A MAJOR REPAIR, REPLACEMENT OR ALIGNMENT IS NECESSARY, REPLACE THE FOLLOWING COMPONENTS:		
		Note Hard landings for the purpose of the evaluation criteria outlined below may be defined as any incident in which the impact of the helicopter with the ground causes severe pitching of the main rotor allowing static stops to severely contact the mast; or pitching resulting in cracking the aft lugs of the transmission lower case. This definition is confined only to those incidents not involving sudden stoppage.		
		a. Hard Landing Evaluation Criteria Established for Transmissions:		
		(1) Remove the transmission and return to depot for evaluation overhaul.		
		b. Hand Landing Evaluation Criteria Established for Input Driveshafts:		
		(1) Remove input driveshaft and return to depot for evaluation overhaul.		
		c. Hard Landing Evaluation Established for Masts:		
		(1) If inspection reveals yielding or deformation in the area which would be contacted by the main rotor static stops or other obvious damage, the mast assembly should be considered unserviceable and non-reparable, and condemned locally.		
		(2) If post inspection does not reveal the discrepancies above, the component should be returned to depot for evaluation overhaul.		
		d. Components Not Requiring Evaluation Criteria Due to Hard Landings:		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 3	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		(1) Thorough engineering investigation has determined hard landings, as defined above, do not adversely affect the following components. If thorough visual inspection does not reveal any discrepancies or obvious damage to components listed below, they may be retained in service for continued usage.		
		(a) Main Rotor Blades		
		(b) Tail Rotor Blades		
		(c) Main Rotor Hub		
		(d) Tail Rotor Hub		
		(e) 42 Degree Gear Boxes		
		(f) 90 Degree Gear Boxes		
		(g) Tail Rotor Driveshafts		
		(h) Driveshaft Hanger Assemblies		
		(i) Stabilizer Bar Assemblies		
		(j) Swashplates		
		(k) Scissors and Sleeve Assembly		
All Areas		AFTER A HARD LANDING: IF EXCESSIVELY HARD CONTACT OF MAIN ROTOR HUB STOP AGAINST MAST WAS EXPERIENCED, REPLACE AND ALIGN THE FOLLOWING COMPONENTS:		
		a. Main rotor blades and attachments.		
		b. Main rotor hub.		
		c. Transmission and mast assembly.		
		d. Transmission to fuselage lift link.		
		e. Conduct engine-to-transmission alignment check.		
All Areas		AFTER A HARD LANDING IF DAMAGE IS FOUND IN ROTATING CONTROLS, REPLACE THE FOLLOWING COMPONENTS:		
		a. Stabilizer bar.		
		b. Main rotor pitch horns.		
		c. Collective sleeve assembly.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 4	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		d. Swashplate and support assembly.		
		e. All connecting controls and control bolts.		
		f. Conduct engine-transmission alignment check.		
4		AFTER SUDDEN STOPPAGE (POWER ON OR POWER OFF)		
		DEFINITION: Sudden stoppage is defined as any rapid deceleration of the drive system, whether by internal seizure of the transmission or by main or tail rotor blades striking something which causes rapid deceleration or enough tail rotor damage to require replacement.		
		INSPECTION: Conduct a progressive inspection, replacing components according to the following criteria.		
4		a. Main Rotor.		
		(1) Visually inspect both blades for skin wrinkles and other evidence of damage.		
		(2) If either blade is damaged, replace both blades and the hub assembly. Send components to overhaul for evaluation.		
		(3) If neither blade shows damage, and there is no obvious damage to the hub, both blades and hub assembly may remain in service.		
		(4) Blades determined non-airworthy and non-repairable shall be condemned locally.		
4		b. Main Rotor Rotating Controls.		
		(1) Replace all bolts in rotating controls.		
		(2) Replace swashplate assembly, scissors and sleeve assembly, and stabilizer bar and send to overhaul for evaluation if any of the following conditions exist:		
		(a) Severe main rotor damage (blade bent, twisted or badly torn).		
		(b) Main rotor pitch horn failure.		
		(c) Yielded stabilizer bar tube.		
		(d) Control tube buckled or broken.		
		(e) Transmission main support case mounting lug broken.		
		(f) Any component determined unserviceable and non-repairable shall be condemned locally.		

AIRCRAFT INSPECTION CHECKSHEET			TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 5	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.			INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
4	c.	Mast Assembly.		
		(1) Replace and visually inspect mast assembly.		
		(2) If visual inspection reveals yielding or deformation of mast (give particular attention to areas which would be contacted by static stops), or if cracked or broken or otherwise obviously unserviceable, condemn mast as non-reparable locally.		
		(3) If mast does not show such discrepancies, send to overhaul for evaluation.		
4	d.	Transmission Assembly.		
		(1) Replace and visually inspect transmission assembly.		
		(2) If the mast assembly revealed torsional yielding, the transmission should be considered unserviceable and non-reparable and condemned locally.		
		(3) If mast did not show such damage, and there is no other obvious damage which makes transmission non-reparable, send transmission assembly to overhaul for evaluation.		
3	e.	Main (Input) Drive Shaft.		
		(1) Replace and visually inspect main drive shaft assembly.		
		(2) If inspection reveals yielding or deformation, the drive shaft assembly should be considered unserviceable and non-reparable and condemned locally. Otherwise, unless obviously non-reparable for other reasons, send drive shaft assembly to overhaul for evaluation.		
5	f.	Engines: Only after sudden stopping of main rotor with power on is it necessary for thorough over-torque and overspeed inspection and thorough inspection of the output reduction carrier and gear assembly in accordance with TM 55-2800-200-30/1.		
6	g.	Tail Rotor.		
		Note		
		Contact of tail rotor with soft ground, snow, water, or dense vegetation causing rapid deceleration requires this special inspection to the extent of condemning the tail rotor hub and blade assembly, and conducting an inspection of the tail rotor drive system. Automatic replacement of the main rotor components would not be required.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 6	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		(1) If sudden stoppage originated at main rotor, the tail rotor hub and blade assembly may remain in service providing there is no visible external damage. If there is obvious damage, replace and send tail rotor hub and blades to overhaul for evaluation.		
		(2) If sudden stoppage originated at tail rotor blades the tail rotor hub and blade assembly should be condemned as non-airworthy and non-reparable, and should be disposed of locally.		
		(3) If the sudden stoppage originated at the transmission or at the 42 or 90 degree gear box, replace tail rotor hub and blade assembly. Send removed hub and blade assembly to overhaul for evaluation.		
		(4) Remove transmission tail rotor drivequill and inspect for cracks and other damage.		
6	h.	Gear Boxes 42 Degree and 90 Degree.		
		(1) Remove and visually inspect gear boxes. If broken or mutilated so that parts cannot be salvaged, the gear box should be considered unserviceable and non-reparable and should be condemned locally. Otherwise, send gear box assemblies to overhaul for evaluation.		
6	i.	Tail Rotor Drive Shaft.		
		(1) Remove and visually inspect drive shafts.		
		(2) If a drive shaft shows any of the following, it should be considered unserviceable and non-reparable:		
		(a) Curvic faces distorted.		
		(b) Evidence of overload.		
		(c) Cracks.		
		(d) Loose or sheared rivets.		
		(e) Scratches exceeding damage limits. (Refer to Chapter 7.)		
6	j.	Tail Rotor Drive Shaft Hangers.		
		(1) If there was drive shaft failure as result of torsional overload, all tail rotor drive shaft hangers shall be considered unserviceable and non-reparable and should be condemned locally.		
		(2) If there was main rotor contact with tail rotor drive shaft, or if damage from other circumstances caused a failure of the drive shaft, the hanger assemblies to which the failed shaft was attached should be considered unserviceable and non-reparable and should be condemned locally.		
		(3) If the above conditions do not exist, send hanger assemblies to overhaul for evaluation.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 7	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
4 & 6		AFTER MAIN ROTOR OVERSPEED		

AFTER MAIN ROTOR OVERSPEED

Inspection and/or replacements are required after any report that main rotor has exceeded 339 RPM. When 356 RPM has been exceeded, additional requirements apply.

MAIN ROTOR OVERSPEED LESS THAN 356 RPM.

a. Inspect the following:

b. Main rotor blades for damage, bond separation and distortion.

c. Tail rotor blades for damage, bond separation and distortion.

MAIN ROTOR OVERSPEED EXCEEDING 356 RPM

a. Remove main rotor hub and return to overhaul facility for evaluation.

b. Visually inspect main retention bolts and drag brace bolts for shear offset.

c. Inspect main rotor blades as follows:

(1) Visually inspect blade skin. Any wrinkle or deformation is cause for blade removal and return to a higher echelon maintenance activity.

(2) Visually inspect for evidence of looseness of inertia weight inside blade spar. If blades have visible screws through the leading edge abrasion strip to attach inertia weight inside spar, inspect for loose screws or distorted holes. If screws are covered by the abrasion strip, remove tip cap to inspect weight. Tighten loose balance weight retention nuts to 40 to 45 inch pounds with 1/4 inch studs, 80 to 100 pounds with 5/16 inch studs.

(3) Blades which pass these inspections are acceptable for further service. Forward blades which do not pass inspection to higher maintenance echelon with complete report of discrepancies.

d. Inspect tail rotor blades as follows:

(1) If inspection reveals bond separation around tip block or crack in tip block through tip weight holes, remove blades and return to overhaul for evaluation.

(2) If inspection reveals laminate or grip plate separation condemn the blade locally as non-reparable.

e. Replace tail rotor retention bolts (4).

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 8	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		f. If thorough inspection reveals no discrepancies the tail rotor hub and blade assembly may be rebalanced and retained in service.		
		g. The following parts may remain in service, if thorough inspection after overspeed reveals no obvious damage.		
		(1) Transmission.		
		(2) 42 Degree gear box		
		(3) 90 Degree gear box.		
		(4) Mast.		
		(5) Input drive shaft.		
		(6) Tail rotor drive shaft.		
		(7) Drive shaft hanger assemblies.		
		(8) Stabilizer bar assembly.		
		(9) Swashplate.		
		(10) Scissors and sleeve assembly.		
		(11) Tail rotor hub.		
		AFTER EXCESSIVE ENGINE TORQUE.		
		Overtorque is defined as any incident in which torsional loads are introduced into the helicopter dynamic system in excess of 50 psi as determined on the engine torque meter.		
4		OVERTORQUE FROM 50 THROUGH 54 PSI.		
		a. Inspect transmission as follows:		
		(1) Inspect main transmission magnetic plugs.		
		(2) Inspect main transmission air maze oil screen.		
		(3) If metal particles are found indicating internal failure, remove transmission and return to overhaul for evaluation.		
		(4) If magnetic plugs and oil screen show no evidence of internal failure, continue to operate the transmission for five hours and repeat steps (1) and (2).		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 9	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIRE-MENT EVERY	ITEM	STA-TUS	RECORDED ON WORKSHEET
		(5) If metal particles or any evidence of internal failure are found after five hours of operation return the transmission to overhaul for evaluation.		
		(6) If no evidence of internal failure is indicated, normal operations should be resumed.		
4 & 6		b. The following parts may be retained in service, if thorough inspection after over torque of 50 through 54 psi, reveals no obvious damage:		
		(1) Main rotor blades.		
		(2) Tail rotor blades.		
		(2A) Main Rotor Hub		
		(3) Tail rotor hub.		
		(4) 42 Degree gear box.		
		(5) 90 Degree gear box.		
		(6) Tail rotor drive shafts.		
		(7) Drive shaft hanger assemblies.		
		(8) Stabilizer bar assembly.		
		(9) Swashplate.		
		(10) Scissors and sleeve assembly.		
		(11) Input drive shaft.		
		(12) Mast.		
		(13) Transmissions (all part numbers)		
4 & 6	OVERTORQUE FROM 54 THROUGH 61 PSI.			
		a. Inspect transmission as follows:		
		(1) Perform steps a. (1) through (6) as listed under overtorque from 50 through 54 psi.		
		b. Remove and replace main rotor pillow block bolts Part No. 205-011-171-1. Bolts Part No. 204-011-171-3 do not require replacement.		
		c. The following parts may remain in service, if thorough inspection after overtorque of 54 to 61 psi, reveals no obvious damage:		
		(1) Main rotor blades.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 10	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		(2) Tail rotor blades.		
		(3) Tail rotor hub.		
		(4) 42 Degree gear box.		
		(5) 90 Degree gear box.		
		(6) Tail rotor drive shaft.		
		(7) Drive shaft hanger assemblies.		
		(8) Stabilizer bar assembly.		
		(9) Swashplate.		
		(10) Scissors and sleeve assembly.		
		(11) Input drive shaft.		
		(12) Mast.		
4 & 6		OVERTORQUE IN EXCESS OF 61 PSI		
		a. Return the following assemblies to overhaul for evaluation.		
		(1) Transmission assembly.		
		(2) Input drive shaft assembly.		
		(3) Main rotor blades.		
		(4) Main rotor hub assembly.		
		(5) Mast assembly.		
		b. The following parts may remain in service if thorough inspection after overtorque in excess of 61 psi reveals no obvious damage:		
		(1) Tail rotor blades.		
		(2) Tail rotor hub.		
		(3) 42 Degree gear box.		
		(4) 90 Degree gear box.		
		(5) Tail rotor drive shaft.		
		(6) Drive shaft hanger assemblies.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 11	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

(7) Stabilizer bar assembly.

(8) Swashplate.

(9) Scissors and sleeve assembly.

Note

It is imperative that component removal record of dynamic components should reflect overtorque as reason for removal.

Engine Inspection Requirements: When the engine has exceeded the following overtorque limits, proceed in accordance with step b.

a. Output shaft torque limits:

(1)	Takeoff (5 minutes)	50 psi on T53-L-9/9A and -11 engines
(2)	Military (30 minutes)	64 psi on T53-L-13/13A engines 48 psi on T53-L-9/9A and -11 engines
(3)	Normal (continuous)	60 psi on T53-L-13/13A engines 46 psi on T53-L-9/9A and -11 engines
(4)	Transient operation (2 seconds or less)	86 psi on T53-L-13/13A engines 77 psi on T53-L-9/9A and -11 engines

Caution

Pilot monitoring may be necessary to prevent the engine from exceeding these limits.

b. Overtorque limits inspection procedures:

(1) Inspect output reduction carrier and gear assembly. (Request assistance from Direct Support Maintenance.)

(2) Inspect chip detector for metal chips.

(3) Inspect oil filter for metal chips or other foreign matter.

(4) If normal accumulation of foreign matter is observed, clean chip detector and oil filter; operate engine for 10 minutes and repeat steps (2) and (3).

(5) If excessive accumulation of metal or foreign matter is observed, perform Lubrication System Contamination Troubleshooting Procedure as outlined in Chapter 5, Section VI.

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 12	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

(6) Repeat step (4) increasing engine operating time to 30 minutes.

(7) Perform flight test and repeat steps (2) and (3). If no excessive accumulation of metal or foreign matter is noted, engine may be released for normal operations.

5 & 6 WHENEVER AN AIRCRAFT HAS BEEN SUBJECT TO A COMPRESSOR STALL (SURGE), THE FOLLOWING INSPECTION SHALL BE PERFORMED.

a. Inspect the engine inlet guide vane and first stage compressor rotor blades for evidence of severe erosion and/or foreign object damage. Check the root areas of compressor blades for cutback due to erosion. Check for dirty or obstructed inlet housing.

Note

If surge occurs below 85% complete steps a. through f. If surge occurs above 85%, complete steps a. through k.

Note

If foreign object damage is evident, refer the engine to Direct Support and General Support Maintenance for repair. Replace the engine if erosion is causing the stall.

D b. Perform acceleration check as outlined in Section III, item 4j. (Not authorized, T53-L-13 engine equipped helicopters.)

c. Disconnect the fuel control pressure sensing line from the inlet housing. Start engine, advance throttle and increase collective pitch until highest power without gaining flight attitude is obtained.

d. Operate engine at this speed for at least one minute and then decelerate as rapidly as possible toward flight idle. (Retard throttle.) When nI reaches 65%, advance throttle and accelerate to speed attained in preceding step c. If no surge is evident, reconnect fuel control pressure sensing line.

e. If compressor stalls (surges) are encountered in step d., D check operation of the bleed band, airbleed actuator, fuel control and inline valve to ensure they are not causing the stall. H Check operation of variable inlet guide vanes, bleed band, airbleed actuator and fuel

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 13	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		control to ensure they are not causing the stall. If, as a result of the above outlined investigation it is determined that genuine surge has occurred and cannot be corrected, it is recommended that engine be referred to a higher echelon of maintaince.		
		f. If surge occurs below 80% nI speed, check tail boom pylon (fin) for evidence of damaged skin panels and/or structure, and rivets for looseness and/or sheared heads. If inspection shows negative indications of damage, return aircraft to flight status. If positive evidence of damage, comply with the following steps.		
		g. If surge occurs at 85% nI speed or above, remove and disassemble tail rotor gear box (90 degree) in accordance with procedures outlined in the applicable reference manual and inspect the drive and driven gear for unusual load pattern on either the coast or drive side of gears. Inspect area of driven gear between lightening holes and gear teeth for cracks. Conduct this inspection, using a 10 power glass.		
		h. If the above outlined inspections present negative indications of damage, reassemble gear box in accordance with outlined manual procedures. Reinstall gear box, tail rotor hub and blade assembly, and rig tail rotor controls in accordance with procedures as outlined in the applicable referenced manual. Return helicopter to flight status.		
		i. If, as a result of the above inspections conducted, evidence of damage is indicated, comply with the following:		
		(1) Remove and replace the following items with serviceable item (annotate DA Form 2410 that component has been installed on aircraft subjected to compressor stall).		
		(a) 90 Degree gear box.		
		(b) Tail rotor hub and blade assembly.		
		(c) No. 6 tail rotor drive shaft.		
		(2) Inspect the 42 degree gear box output gear for unusual load pattern on either the coast or drive side of the gear. If no evidence of damage is noted, return the gear box to service. If the above inspections reveal discrepancies, remove and replace gear box assembly and comply with step (3) below.		
		(3) Remove the tail rotor drive output quill assembly from the transmission and inspect gear for unusual load pattern on either the drive or coast side of the gear teeth. If no evidence of damage is found, replace the quill assembly and return the transmission to service.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 14	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

j. If the above outlined inspection of the tail rotor drive output quill presents negative indication of damage, reinstall in accordance with instructions as outlined in appropriate technical manual and return helicopter of flight status. If inspection of the tail rotor output quill reveals discrepancies, remove transmission from service and return for overhaul. (Annotate DA Form 2410 as stated above.) If it is found necessary to replace the transmission, conduct the following inspection of the main rotor system and the fuselage.

(1) Remove inboard and outboard drag brace bolts. Check bolts for deformation, then magnaflux. If satisfactory, return to service.

(2) Visually inspect the stabilizer bar outer tubes for bending. (Allowable deflection is 0.150 inch in each tube.)

(3) Remove main rotor pillow blocks from main rotor yoke and check for deformation of bushings and bushing holes in pillow blocks and yoke.

(4) Perform close visual inspection of all other main rotor components.

(5) If any discrepancies are noted as a result of inspection in steps (1), (2), (3), and (4), remove and replace the main rotor hub and blade assembly, the stabilizer bar assembly, and mast assembly. (Annotate records as stated above.)

k. Fuselage. (If damaged per step f.)

(1) Remove the skin from the tail boom fin adjacent to the 90 degree gear box mounting. Inspect all support structures in this area and repair as required. Install new skin.

(2) Make close visual inspection of complete tail boom structure for distortion, buckles, skin cracks, and sheared or loose rivets, paying particular attention to tail boom attachment points at fuselage station 195 and adjacent fuselage to tail boom structure and the 42 degree gear box support structure.

(3) Make close visual inspection of main rotor pylon support and engine mount attachment structure for distortion, buckles, cracks, sheared or loose rivets, etc.

(4) If discrepancies found during inspections, steps (1), (2), and (3) cannot be repaired by standard procedure, make detailed report to the Commanding General, USAAVCOM, P.O. Box 209, St. Louis, Missouri, 63166.

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 15	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

AFTER HELICOPTER IS FLOWN IN A LOOSE GRASS ENVIRONMENT.

Any time the helicopter is flown in a loose grass environment, the engine shall be inspected for grass blockage as follows:

(1) Visually check each inlet guide vane for presence of grass.

(2) Completely remove any grass or foreign material that may be lodged on guide vanes, paying particular attention to lower (four through eight o'clock) portion of vane assembly.

Note

If FOD screen and sand and dust separator are installed, remove upper halves to accomplish this inspection. If blockage is evident, the lower half of the separator must be removed to ensure complete removal of grass or foreign material.

5 AFTER ENGINE OVER-TEMPERATURE.

Note

An engine over-temperature condition exists when exhaust gas temperature limits have been exceeded in any of the following ways.

a. Over 760°C egt at any time.

b. During start and acceleration.

H (1) T53-L-13 over 675°C egt more than 5 seconds.

(2) T53-L-9/9A and -11 series over 650°C egt more than 5 seconds.

Perform an engine over-temperature inspection. (Refer to TB55-2800-200-30/1, T53 Engine Inspection Guide.)

Note

If engine cannot be operated without exceeding egt limits as specified in TB 55-2800-200-30/1 "Engine Operating Limits Table", this is indication of engine malfunction or instrument error. Refer to trouble shooting (TM 55-2840-229-24) to determine cause and correct action, as overtemperature inspection is not required.

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 16	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

5 AFTER ENGINE OVERSPEED.

An engine overspeed exists under the following conditions:

a. When N1 speed exceeds 101.5 %.

b. When steady-state output shaft speed exceeds:

(1) 7180 rpm as a maximum limit.

D (a) 6640 rpm for more than 3 seconds and nI speed over 85%. (All engines except T53-L-13).

H (b) 6640 rpm may be exceeded for a period not to exceed 3 seconds up to a limit of 7165 rpm for T53-L-13.

Note

A steady state output shaft speed of 6900 rpm at an nI speed of 85% or less is acceptable for all engines except T53-L-13. For engine model T53-L-13 a steady state output shaft speed of 6750 rpm at an nI speed of 91 % or less is acceptable.

Caution

There is no overspeed control if ENGINE GOV switch is set on EMER, or if N2 adjustment is incorrect.

5 ENGINE OVERSPEED LIMITS EXCEEDED.

If overspeed limits are exceeded, perform the following inspection on the installed engine, with assistance of Direct Support Maintenance:

a. Check engine oil filter and chip detector for metal chips, or other foreign material.

b. If an excessive amount of chips are found in oil filter or chip detector, and output reduction gear and carrier assembly has freedom of movement without unusual noises, perform "Lubrication System Contamination Troubleshooting Procedure". (Refer to TM 55-2840-229-24/)

c. If nI limit of 101.5 percent rpm has been exceeded, proceed as follows:

(1) Perform a hot-end inspection. (Assistance from Direct Support Maintenance will be required.)

(2) Perform tip clearance check on gas producer turbine rotor assembly. (Perform check on second stage gas producer turbine rotor assembly on T53-L-13/13A engines.)

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 17	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		(3) Check compressor rotor assembly by rotating and listening for rubbing sounds. If rubbing is noted, inspect compressor and impeller housing. (Request assistance from Direct Support Maintenance.)		
		d. If output shaft (nII) speed has exceeded 6640 rpm for more than 3 seconds elapsed time at military power, proceed as follows:		
		Note At nI speed of 85 percent or less, a steady state output shaft speed of 6900 rpm is permissible on T53-L-9/9A and -11 series engines. At nI speed of 91 percent or less, a steady state output shaft speed of 6750 rpm is permissible on T53-L-13/13A engines.		
		(1) Visually inspect (by tailpipe access) power turbine rotor assembly for damaged or missing blades.		
		D (2) Perform tip clearance check on power turbine blades on T-53-L-9/9A and -11 series engines.		
		H (3) Perform tip clearance check on second stage power turbine blades at eight places, using bent 0.025 inch wire and reaching through exhaust diffuser on T53-L-13/13A engines.		
		e. If output shaft (nII) speed has exceeded maximum limit of 7180 rpm, proceed as follows:		
		(1) Perform hot-end inspection. (Assistance from Direct Support Maintenance will be required.)		
		(2) Perform fluorescent-penetrant inspection of power turbine discs. (Inspection includes first and second stage discs on T53-L-13/13A engines.)		
		f. Determine and correct cause of overspeed.		
		g. Perform initial check run. If no discrepancies are noted, engine is serviceable.		
5		INTERNAL INSPECTION OF ENGINE.		
		a. Perform internal inspection of engine at time specified for hot end internal inspection. (Refer to TB55-2800-200-30/1, T53 Engine Inspection Guide for inspection procedures.)		
		b. Perform functional test Exhaust Gas Temperature System, test temperature to be 600°C, system tolerance plus or minus 15°C. (Refer to TM 55-4920-244-15.)		

AIRCRAFT INSPECTION CHECKSHEET			TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 18	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.			INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

ENGINE POST-INSTALLATION INSPECTION.

This inspection shall be accomplished each time an engine is removed and reinstalled or replaced.

a. Perform vibration check (refer to TB55-2800-200-30/1).

b. Perform functional test exhaust gas temperature system. test temperature to be 600°C, system tolerance plus or minus 15°C. (Refer to TM 55-4920-244-15.)

c. Check all linkage (nI and nII) for proper adjustment, alignment, and damage.

d. Fuel control stops.

e. Calibration of power settings on fuel control with corresponding settings on collective twist grip control.

f. Twist grip for flight idle detent.

g. Energize the fuel boost pump and check for leaks at all connections, particularly fuel control.

h. Check engine mounts for cracks and security.

i. Perform a complete Daily Inspection on engine.

j. Operate engine for several minutes at ground idle and then shut down.

k. Inspect engine for leaks and security of mounting of hoses and accessories.

l. Start engine and run at ground idle for three minutes. Accelerate gradually until highest power is obtained and temperatures have stabilized, without gaining flight attitude.

m. Decelerate engine to ground idle and run until EGT stabilizes. Shut down engine.

n. Inspect engine for the following:

(1) Leaks and security of mounting provisions, hoses, and accessories.

(2) Inspect the main fuel strainer, fuel control inlet screen, fuel control pump discharge screen, servo filter, oil filter, magnetic plug, and externally accessible engine oil strainers for chips or foreign materials.

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 19	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		o. If there is no accumulation of metal chips, lint, or other foreign material, continue with engine ground operation checks.		
		p. If there is a slight accumulation of metal chips, lint, or foreign material, clean and reinstall the chip detector and oil filters. Restart engine and perform a second run for several minutes at highest power obtainable, without gaining flight attitude. If further accumulation is found, proceed to step q.		
		q. If there is an excessive accumulation of metal chips, lint, or other foreign material, the source of contamination must be determined. If the source of contamination is within the engine, another engine must be installed and the preparation and ground runup procedures repeated.		
		r. Remove, inspect, clean, and reinstall or replace fuel regulator filters.		
5		WHEN ENGINE ACCESSORY DRIVE GEARBOX HAS OIL PUMP DRIVE PAD WITH ONLY ONE LUBRICATION HOLE		
		This inspection is required on all T53-L-9 and -11 Series engines, Serial Number LE13129A and prior whose history indicates return to Depot or gearbox replacement in the field and all T53-L-13 engines prior to Serial Number LE 15150 and on engines LE 15174, LE 15180, LE 15200, LE 15253, and LE 15257, except when the accessory drive gearbox is marked with a scribed asterisk to indicate that engine does not require this inspection.		
		a. Schedule inspection of affected engine according to operating time since new or since last overhaul, as follows:		
		(1) Less than 300 hours, at 300-hour hot-end inspection.		
		(2) More than 300 hours, at next 25-hour intermediate inspection.		
		b. Inspect engine accessory drive gearbox oil pump drive pad in accordance with detailed instructions contained in TM 55-2840-229-24.		
5		ENGINES DROPPED DURING HANDLING.		
		a. If an engine is dropped during handling, make the following inspections and tests:		
		(1) Check accessory drive gear box for cracked flanges.		
		(2) Check overspeed governor and tachometer drive for cracks, distortion, and bent shaft.		
		(3) Inspect oil filter for loose bolts and damaged filter element.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 20	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET

(4) Inspect oil pump for loose bolts and cracked flanges.

(5) Check fuel control assembly for cracked flanges.

(6) Check engine mounting pads for cracks.

(7) Check air, oil, and fuel hose connections for tightness.

(8) Check all accessories for loose bolts, nuts, and connections.

b. If no visual damage is apparent, the engine will be functionally tested on the mobile engine test unit TE 12062, LTCT744 or airframe. A complete operational test run shall be made and shall include a vibration check, coast-down check, and post test inspection of oil filter, screens, and chip detector for metal chips, lint, or other foreign material.

Note

The minimum test time is 30 minutes. If no defects are noted, engine is considered serviceable. Refer to applicable Field Maintenance Manual for test instructions.

5 <u>UPON FIRST FLIGHT EACH DAY</u>

Perform Daily Engine Recording Check:

Note

Prior to performing the following check, the anti-icing and cabin heat and ECU will be in the OFF position.

a. Climb to a predetermined pressure altitude (29.92 inches Hg on copilot's altimeter). (Altitude established as standard for each unit.)

b. Cruise for one minute at predetermined torque and whatever airspeed necessary to maintain a constant pressure altitude. (Torque setting established as standard for each unit.)

c. Record outside air temperature (OAT), percent N1 and EGT in block 10c of DA Form 2408-13.

d. Analyze data. (Chapter 5)

1 <u>AFTER OVERFLOW OF BATTERY AND/OR BATTERY SUMP JAR (IF SUMP JAR IS INSTALLED).</u>

a. Sheet metal surfaces and overlaps, both internal and external, for damage.

b. Rivets, bolts, screws, and other hardware in area, internally and externally, for damage.

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 21	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
		c. Hidden areas in vicinity of battery and sump jar for damage.		
		d. All metal parts throughout contaminated area for damage.		
		EVERY 25 HOURS OF OPERATION		
		Inspect control tube assembly P/N 205-001-012-7 on all YUH-1D/UH-1 D/H S/N 60-6029 through 66-16340 in accordance with TB 55-1520-210-20/8.		
		Note: If above S/N aircraft have MWO 55-1520-210-30/19 complied, above inspection is not required.		
2		EVERY TWENTY-FOUR MONTHS		
		Replace nylon cloth seat covers. (Refer to TM 55-1500-204-25/1.)		
2		12 MONTHS		
		MAGNETIC COMPASS FOR DISCOLORATION OF LIQUID AND PROPER CALIBRATION; RECOMPENSATE IF NECESSARY.		
2		12 MONTHS		
		FIRST AID KIT FOR INSPECTION PER TB 55-1500-308-25.		
2		12 MONTHS		
		Replace cotton seat belt and shoulder harness. (Refer to TM 55-1500-204-25/1.)		
2		5 YEARS		
		Replace nylon and dacron seat belt and shoulder harness. (Refer to TM 55-1500-204-25/1.)		
1		AFTER WASHING HELICOPTER		
		Check pitot - static system for moisture (drain plug removed).		
All Areas		AFTER THE HELICOPTER HAS BEEN SUBJECTED TO SALT WATER OR SALT WATER SPRAY.		
		Wash entire helicopter with fresh water, particularly inside of engine compartment doors. Wash all compartments which were exposed to salt water. Make a detail check of all surfaces for corrosion. Apply corrosion preventive compound to exposed nonpainted, anodized, or cadmium plated assemblies. Clean engine compressor, using water wash method.		
4		HELICOPTERS WHICH ARE BEING OPERATED UNDER HIGH HUMIDITY (80%) OR SALT LADEN ATMOSPHERIC (50% HUMIDITY) ENVIORONMENTAL CONDITIONS WILL REQUIRE THE FOLLOWING MINIMUM DAILY BLADE INSPECTION.		
		Daily using a mild soap detergent wash blades thoroughly. Rinse with clear water and dry.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 21	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
2		PREFLIGHT AND/OR EACH USAGE a. Inspect rescue hoist hook (FSN 168υ-931-7084, P/N BL6280) for damage. Give special attention to hook keeper. b. Straighten bent clips. c. Bend weak springs as necessary to restore tension. d. Replace AN526C632-12 screws and MS21045C06 nuts that are damaged. e. Use safety strap with forest penetrator whenever possible.		

AIRCRAFT INSPECTION CHECKSHEET	TYPE OF INSP (Daily, Intermediate, etc.) SPECIAL	PAGE NO. 22	NO. OF PAGES 22
AIRCRAFT AND SERIAL NO.	INSPECTION NO.	DATE OF INSPECTION	

AREA NO.	REQUIREMENT EVERY	ITEM	STATUS	RECORDED ON WORKSHEET
4		EACH 25 HOURS OF OPERATION OR WEEKLY WHICH EVER OCCURS FIRST. ALL BLADES REGARDLESS OF OPERATIONAL ENVIORNMENT WILL REQUIRE THE FOLLOWING. Wipe blades with aliphatic naphtha Type 2. TT-N-95A, or dry cleaning solvent P-D-680 followed by a mild soap detergent wash. Thoroughly rinse with water and dry with clean cloths.		
2		EVERY 6 MONTHS CF3BR type extinguisher, weight check cylinder less value. If cylinder is within 4 ounces of stenciled weight, reassemble and reseal.		
2		EVERY 24 MONTHS Remove, then test the accuracy of altimeters every two years according to applicable repair manuals using a Hass A-1 barometer or equivalent. Recalibrate if necessary. (Testing and recalibration to be done at GS level.)		
5		AFTER THE HELICOPTER HAS BEEN OPERATED IN RAIN. Open engine inlet area and remove upper air filter assembly. Inspect and clean sand and dust separator parts.		
6		AFTER INSTALLATION OF TAIL ROTOR. Between five (5) hours and ten (10) hours of flight after installation of tail rotor, retorque tail rotor retaining nut (300 to 400 inch-pounds).		
All Areas		WHEN AVAILABLE INFORMATION INDICATES EXPOSURE TO RADIOACTIVITY. Accomplish the following: (Refer to TM 3-220.) a. Survey helicopter for level of radioactivity. b. Decontaminate helicopter as required.		
All Areas		UPON TRANSFER AND UPON RECEIPT OF A HELICOPTER, UPON EXPIRATION OF TWELVE MONTHS ELAPSED TIME SINCE LAST INVENTORY, AND UPON PLACING HELICOPTER IN STORAGE AND UPON REMOVING FROM STORAGE HELICOPTER NEED NOT BE INVENTORIED WHILE IN STORAGE/INVENTORY HELICOPTER FOR AVAILABILITY OF INVENTORIABLE PROPERTY. REFERENCE TM 38-750.		
All Areas		AFTER INSTALLATION, REMOVAL OR RELOCATION OF EQUIPMENT AND/OR MAJOR MODIFICATION WHICH RESULTS IN AN UNKNOWN CHANGE IN THE BASIC WEIGHT AND BALANCE; AFTER REPORT OF UNSATISFACTORY FLIGHT CHARACTERISTICS. Weigh helicopter and accomplish necessary entries in the Weight and Balance Data (DD Forms 365). (Refer to AR95-16 and TM 55-405-9.)		

Section III. TEST FLIGHT

3-4. Definition And General Information.

This section contains test flight inspection requirements peculiar to the UH-1D/H helicopter. Conditions requiring accomplishment of test flight shall be in accordance with TB 55-1500-311-25 and changes thereto. The requirements herein are established to ensure a thorough inspection of the helicopter before flight, during flight, and upon completion of test flight. When a test flight is performed for the purpose of determining if specific equipment or systems are in proper operating condition, requirements not related to such equipment or systems should be disregarded.

3-5. Test Flight Inspection Checksheet.

a. The test flight inspection checksheets are presented in a format for local reproduction. Continuation sheets shall be used when necessary for each part. Explanation of the checksheets is as follows:

Block 1	Aircraft Model and Series
Block 2	Complete Aircraft Serial Number
Block 3	Organizational Unit Performing Test Flight
Block 4	Day, Month, and Year
Block 5	Reason Test Flight is Being Performed
Block 6	Numerical Inspection Item Identification Number
Block 7	Inspection Requirements Arranged in Chronological Order
Block 8	Minimum and Maximum Operating Ranges
Block 9	Actual Indication entered at Time of Test Flight
Block 10	Enter satisfactory or unsatisfactory symbol (as shown in note) at time of test flight. All unsatisfactory symbols will be explained in remarks (Test Flight Checklist, Part IV).

b. Additional information, relative to recording of inspection on applicable forms and the use of this manual, may be obtained by consulting applicable technical directives listed in Appendix A.

3-6. Test Flight Requirements.

By definition a test flight is a functional check flight for which the primary mission is to determine whether the airframe, powerplant, accessories, and items of equipage are functioning in accordance with predetermined requirements while subjected to the intended environment.

a. The purpose of this guide is to state specifically what checks and maneuvers constitute a functional check flight on the UH-1D/H, what is adequate, and the warnings and cautions which should be observed if a safe test flight is to be performed without damage to the equipment or endangering the lives of the crew or future crews who will fly the aircraft.

b. A functional test flight is not an engineering evaluation of flight performance. It is simply a straight forward test of the aircraft and its systems operating under normal conditions, or under the conditions which the aircraft will be flown.

c. Often, test pilots feel that to adequately test the helicopter it is necessary to perform a series of severe maneuvers. If the helicopter holds up, it is then considered to be in good condition. This is not only unnecessary, but can be dangerous and shows an extreme lack of consideration for the welfare of the pilots and crews who will be flying the helicopter after the test flight.

d. Such things as extremely rapid pedal turns, rough control usage, operating the engine at higher than normal power, operating above maximum allowable airspeeds, excessive operation with abnormal vibrations, all contribute to premature malfunctions of the various helicopter components and do nothing towards determining airworthiness. Hovering autorotations, zero airspeed autorotations, autorotations to the ground, etc., have no useful purpose in the accomplishment of a functional test flight and lend themselves only to an atmosphere conductive to aircraft accidents, often with fatal results.

3-7. Normal Maintenance Test Flight Procedures.

a. For maintenance test flights following limited repairs, only the applicable portions of this procedure need be performed. After completion of periodic inspections, extensive maintenance, etc., the full procedure should be carried out. It is often desirable to perform the full test flight prior to the aircraft going into maintenance to fully ascertain the condition of the equipment and to allow the maximum number of corrections during the period the aircraft is grounded.

b. Prior to the actual test flight, the pilot should compute weight and balance and accomplish a thorough flight readiness inspection. The maxim that two eyes are better than one is indeed true and it is a wise test pilot who trusts no one other than himself to determine the condition of his aircraft prior to a test flight. It should be considered that there is no such thing as a routine flight and, in particular, there is certainly no such thing as a routine test flight.

c. A thorough check of the aircraft records should be accomplished to determine exactly what maintenance has been performed and that all RED X's have been corrected and properly signed off by a technical inspector.

NOTE

Although one pilot can accomplish a test flight on the UH-1D/H it is suggested that another crew member be on board to read the checklist and record data. Enlisted maintenance personnel can accomplish this duty if they are properly briefed prior to the flight. Those personnel on non-crew member flight status should be specially trained to perform this duty since they are generally the most knowledgable in a unit.

TEMPERATURE	SEA LEVEL	1000 FT.	2000 FT.	3000 FT.	4000 FT.	5000 FT.
50°F (10°C)	0.0	0.0	0.1	0.2	0.3	0.4
60°F (16°C)	0.0	0.1	0.2	0.3	0.4	0.5
70°F (21°C)	0.2	0.3	0.4	0.5	0.6	0.7
80°F (27°C)	0.4	0.5	0.6	0.7	0.8	0.9
90°F (32°C)	0.5	0.7	0.8	0.9	1.0	1.1
100°F (38°C)	0.7	0.8	0.9	1.0	1.1	1.2

NOTE: All time correction factors are given in seconds and must be added to time attained at standard day conditions

AV 054297

Figure 3-2. Acceleration time correction factors

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK					PAGE NO. 1		NO. OF PAGES 38
1. TYPE ACFT	2. SERIAL NO.		3. ORGANIZATION		4. DATE	5. PURPOSE OF TEST FLIGHT	
NOTE: Symbol for Block 10	(✓) Satisfactory		(X) Unsatisfactory			(Explain in Remarks)	

6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE		9. ACTUAL INDICATION	10. LEGEND (See note)
		MIN	MAX		
1	INTERIOR CHECK				
	a. Dome lights - OFF				
	b. First aid kits - Check, inspected last 12 months				
	c. Passenger seats - Check condition				
	d. Transmission oil level - Check				
	e. Fire extinguisher - Check, inspected last 6 months				
	f. Entrance doors - Secured for flight				
2	BEFORE STARTING ENGINE				
	a. Seats and pedals - ADJUST, freedom of adjustment				
	Note Kicking the pedal adjuster with the heel to adjust the pedals can break the shaft. Adjust the pedals by hand.				
	b. Seat belts and shoulder harness - Installed properly, inertia reel functions properly fasten.				
	Note Seat belt locking device should be installed on the left side. Check both front and rear belts. The shoulder harness should lock automatically when given a slight sharp pull.				
	c. Pedals - Freedom of movement thru range of travel, neutral				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 2	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note Check freedom of movement of both the cyclic and collective throughout their full range of travel. Leave cyclic in centered position. d. AC circuit breakers - IN e. Heater outlets (front and rear) - Condition free of foreign matter, fresh air ducts Note This includes the defroster and rear outlets. f. Radios - OFF g. GOV - AUTO Note The governor switch caution panel light is wired through the control switch. It is possible for the fuel control to be in the emergency mode and the caution light out under some circumstances. DE-ICE/HOT AIR OFF or closed. h. Internal AUX FUEL/TRANSFER pump - OFF i. LOW RPM AUDIO - OFF or check spring loaded ON Note The automatic type switch cannot be turned off until the battery has been turned on or APU power applied.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 3	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	j. MAIN and START FUEL - OFF				
	k. HYD Control - BOTH				
	l. Force trim - ON				
	m. CHIP DET - Spring loaded to BOTH				
	n. Compass slaving - IN or MAG				
	o. Omni compass indicator - Course selector free.				
	p. Turn and slip indicator - Fluid level full, no bubbles				
	q. Marker beacon - OFF				
	r. Clock - set and running				
	s. Standby compass - Fluid level full (no discoloration), calibrated last 12 months VSI - Needle zero RMI - ADF Position				
	t. GO - NO - GO decal - Correct for installed engine				
	u. Altimeter - Set field elevation Note Set to field elevation and do not adjust further. The altimeter will give a slightly different reading after the rotor commences turning but will read correctly in the air.				
	v. Airspeed indicator - Static indication, range markings, slippage marks: Red line		120 K		
	w. Yellow line	70 K			

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 4	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	x. Dual tachometer - Static indication, range markings, slippage marks:				
	Engine - Red line	6600	6600		
	Yellow arc	6000	6400		
	Green arc	6400	6600		
	y. Rotor - Red line		339		
	Green Arc	294	324		
	z. Torquemeter - Check static indication - Red line		50 psi		
	aa. Gas producer tach - Check static indication - Red line		101.5%		
	ab. EGT gauge (may indicate OAT) - Check range markings:		760 C		
	D L-9/11: Red line		640 C		
	Yellow arc	620 C	640 C		
	Green arc	390 C	620 C		
	H L-13/13A: Red line		760 C 675 C		
	Yellow arc	625 C	645 C		
	Green arc	390 C	625 C		
	ac. Voltmeters - Check static indication				
	ad. Loadmeters - Check static indication				
	ae. XMSN OIL PRESS - Check static indication, range markings:				
	Red lines	30 psi	70 psi		
	Green arc	40 psi	60 psi		
	af. XMSN OIL TEMP - Check static indication - Red line		110 C		
	ag. ENG OIL PRESS - Check static indication, limit markings:				
	D L-9/11: Red lines	25 psi	90 psi		
	H L-13/13A: Red lines	25 psi	100 psi		
	ah. ENG OIL TEMP - Check static indication - Red line		93 C		

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 5	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	ai. Fuel pressure - Check static indication, markings:				
	Green arc	5 psi	35 psi		
	aj. Compass correction card (RMI) - Installed, calibration within last 12 months.				
	Note Compasses must be compensated upon receipt of an helicopter, after each engine change, and after any change of electrical equipment or major structural changes which are likely to effect compasses.				
	ak. Copilot's VSI - Needle zero				
	al. Copilot's altimeter - Set field elevation				
	am. Copilot's airspeed indicator - Static indication, range markings, slippage marks:				
	Red line		120 K		
	Yellow line	70 K			
*	an. OAT gage - Check				
	ao. BATT switch - OFF				
	ap. STARTER/GEN - START position				
	aq. NON-ESS BUS - NORMAL ON				
	ar. DC VOLT selector - BATT, check voltage minimum	22 V			

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 6	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE		9. ACTUAL INDICATION	10. LEGEND (See Note)
		MIN	MAX		
	Note With low battery voltage, voltage may drop below 14 volts during engine start. Ignitors will cease to function below approximately 14 volts, but fuel will continue to go into the combustion chamber. As nI gains speed, voltage will increase and at approximately 14 volts the ignitors will again begin to function lighting off a large amount of fuel. This can result in a severe explosion in the combustion chamber or a excessive egt. as. MAIN GEN - ON at. AC VOLT selector - AC phase au. INV - OFF av. Instrument lights - OFF, condition of rheostats Note The caution panel bright/dim switch is wired through the pilot's rheostat. If the rheostat is not in the OFF position, caution panel lights could be inadvertently dimmed and not seen in daylight when an emergency occurs. aw. DC circuit breakers - IN (except special equipment not being used), condition of breakers ax. PITOT HEAT - OFF ay. Dome lights - OFF az. NAV lights - OFF ba. ANTI-COLL light - OFF bb. Windshield wipers - OFF				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 7	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	bc. CARGO REL - OFF				
	bd. Cabin heater control panel switches - OFF				
	be. BATT switch - ON (OFF for APU start)				
	bf. Engine inlet filter light - TEST				
	bg. Chip detector light - TEST (IF installed)				
	bh. Master caution light - Check ON				
	bi. RPM Warning light - Check ON				
	bj. Fire detector light - TEST				
	bk. Marker beacon light - TEST				
	bl. Cargo release armed light - TEST				
	Note The light should also be tested by placing the cargo release switch in the armed position.				
	bm. Caution panel lights - TEST and reset				
	bn. Engine/transmission temp gage - Check indications.				
	bo. MAIN and START FUEL - ON				
	bp. GOV INCR/DECR switch - Decrease for 10 seconds				
	bq. Searchlight switch - STOW then OFF				
	br. Landing light switches - OFF, retract then OFF				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 8	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	bs. Throttle - Friction OFF. Check amount of cushion 5 deg. ±2 deg. at full open and at idle cutoff. Check flight idle stop. Set throttle slightly below flight idle.				
3	STARTING ENGINE & RUN-UP				
	a. Rotor Blades (main & tail) - CLEAR and UNTIED				
	b. Starter - Energized and clock started				
	c. DC VOLT - Check minimum 14V, Voltage increasing as nI gains speed.				
	Caution				
	Abort start if voltage drops below 14V to avoid hot start.				
	d. ENG - Normal acceleration of compressor				
	Note				
	The L-13 normally accelerates slower than the L-11. L-11 40% in 18 to 22 seconds vs. L-13 40% in 20 - 25 seconds.				
	e. EGT - rising normally				
	EGT Limits				
	D L-9/11: Above 650 degs. C for less than 5 seconds		760 C		
	H L-13/13A: Above 675°C for less than 5 seconds.		760°C		

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 9	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Caution In the event a hot start is imminent, corrective action must be taken immediately. Note Start fuel - OFF at 400° C (if installed). Note EGT rise on the L-13/13A is normally much slower than on the L-11. Peak starting temperatures may be slightly higher, but up to 675° C is allowable. Caution Monitor EGT to avoid hot start. A hot start imminent on L-9/11 can be recognized by low nI speed (below 19%) EGT 400° C and rising rapidly. It will indicate by uneven acceleration and/or EGT rising rapidly on the L-13/13A. f. Starter - Release at 40% nI Starter limits - 40 seconds on, cool 3 minutes. Maximum of three 40 second start attempts in one hour period. g. Caution panel - ENG oil pressure light OUT as nI gains speed h. FIRE WARN light - OUT				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 10	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	i. Throttle - Flight idle, rotor turning normally before flight idle is reached				
	j. INV - SPARE ON, check caution panel light out. Simultaneously cage copilot's attitude indicator				
	k. FUEL PRESS	10 psi	25 psi		
	l. ENG OIL PRESS	25 psi			
	m. ENG OIL TEMP - Check for indication, rising				
	n. XMSN OIL PRESS - Check for indication				
	o. XMSN OIL TEMP - Check for indication, rising				
	p. Caution panel lights - ALL OUT, master caution light OUT				
	q. Start fuel switch - ON (if installed)				
*	r. Throttle - Check flight idle and nI speed				
	D T 53-L9/11 Series	55%	59%		
	H T 53-L-13/13A Series	70%	72%		
	Note To properly check nI speed at flight idle the throttle shall be rolled slightly into the cushion to insure contact with the flight idle stop. It is recommended that only two fingers and the thumb be used to make this check to prevent damaging the throttle bellcranks from the twisting action of excessive force.				
	s. Low RPM audio switch - ON, check level then OFF. Warning light - ON				
	t. Throttle - Slowly increase to full open, note nII RPM 6000 ± 50				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 11	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	u. Radios - ALL ON				
	v. Fuel quantity gauge - Check to zero and returns to initial reading				
	w. Gyro compass - Nulled				
	x. Pitot heater switch - ON, check loadmeter for rise then OFF				
	Note The loadmeter should read slightly higher indicating the pitot heater is functioning.				
*	y. AC VOLT (SPARE INV) - Check all phases. Average of three phases should be 115v ± 3v with maximum difference of 8v between phases.				
	z. INV - MAIN ON, Check voltage indication				
	aa. DC VOLT Selector:				
	(1) Check all positions 26-28v, leave in NON-ESS Bus position. STBY should read 1v lower than MAIN	26V	28V		
	(2) START/GEN switch - STBY position				
	(3) MAIN GEN switch - OFF, note loadmeter goes to zero (±0.1) and standby loadmeter registers the load.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 12	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note The loadmeters indicate the percentage of total generator output being used. Since the standby generator has a lower output than the main a higher percentage may be used and the loadmeter may indicate a higher reading. (4) DC VOLT - Check voltage near zero with NON-ESS BUS normal ON (5) NON-ESS BUS switch - MANUAL ON, voltmeter should indicate STBY/GEN voltage (6) NON-ESS BUS switch - NORMAL ON, voltage near zero (7) DC VOLT selector - MAIN GEN (8) MAIN GEN - ON, note main loadmeter registers load, standby zero (±0.1) ab. START/GEN switch - START ac. AC VOLT (MAIN INV) - Check all phases Average should be 115v ± 3v with maximum difference of 8 volts between phases ad. Torquemeter - Some indication Note There should be no fluctuation of the torquemeter if all other gages are steady. ae. De-ice switch - ON, note EGT rise then OFF, note EGT drop				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 13	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	af. Anti-ice circuit breaker - PULL OUT, note EGT rise, caution panel light ON. Circuit breaker IN, note EGT drop, caution panel light OUT. Light N/A with particle separator installed				
	ag. The above checks the automatic failsafe feature of the DE-ICE system. If no change in EGT is observed the hot air valve may be open at all times. Do not perform an acceleration check under these circumstances as it will cause slow acceleration and possibly an excessive EGT. The engine topping check will also be inaccurate.				
	ah. Bleed air heater - ON, check operation, thermostat set (if installed), defrost and aft outlets. Heater OFF or as desired.				
	Note The bleed air heater must be off during the acceleration and engine topping checks. Check heater operation by feeling the air coming out of the various outlets. With the heater on, EGT will rise slightly. The heater should not be noisy.				
	ai. RPM AUDIO warning switch - ON				
*	aj. GOV INCR/DECR switch - Carefully increase to maximum. Note warning light out at 6700, maximum RPM. Full decrease, note travel time (5 - 10 seconds) RPM warning light and audio ON at 6100 ± 50. Actuator should operate smoothly.	6700 5 SEC	± 50 RPM 10 SEC		

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 14	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note Engine RPM is used to determine when the audio and light comes on, since it is much easier to read exactly. At low RPM the audio and light will come on with either low engine or rotor RPM. At high RPM the light will come on with high rotor RPM. The maximum allowable L-13/13A engine RPM is 6750 and shall not be exceeded. Set the high rotor warning light to come on at this point on L-13/13A equipped aircraft.				
	ak. Throttle - Flight idle, switch GOV to EMER, carefully increase RPM to 6000.				
	al. High rotor RPM warning - Carefully increase nII RPM. Note warning light ON and limits:				
	L-9/11 6750 Engine RPM (335 ± 4 RPM)	335	±4 RPM		
	L-13/13A 6750 Engine RPM (330)		330 RPM		
	Caution Exercise extreme care not to overspeed engine or rotor maximum RPM.				
	ENGINE: L-9/11 - (below 55% nI)		6900 RPM		
	L-13/13A (Maximum)		6750 RPM		
	ROTOR: (All Models)		356 RPM		
	am. Throttle - Flight idle RPM, simultaneously switch GOV to AUTO and decrease throttle to flight idle stop.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 15	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	an. RPM - 6000 Force trim - OFF, check controls for any tendency to creep or motor, freedom. Note Keeping the fingers around the cyclic grip, but not touching it, lightly tap the cyclic in various directions with the fingertips. Movement should stop when pressure is stopped. Each pedal should be checked by tapping lightly with the foot with no pressure on the opposite pedal. The controls should not motor or creep when no pressure is applied. With force trim off the controls should operate smoothly (no creeping, binding or chattering) with no feedback or excessive friction, within about 1 inch of controls center. ao. Force trim - ON. Check cyclic gradient forces nearly the same in all directions no play. Recheck in various positions within 1 inch of cyclic center. Check the mag brakes release using cyclic button. Check pedals similarly. Note With force trim ON it should take approximately equal force to move the cyclic in all directions while making movements of approximately 1 inch. Force required to move the pedals should be about the same for either pedal. Using the cyclic release button, position the cyclic and pedals in various positions, within about 1 inch of neutral. The controls should hold the selected positions and the spring force should be the same in all directions.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)			PAGE NO. 16	NO. OF PAGES 38

6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	ap. Hydraulic Control - OFF				
	Caution				
	Be prepared for possible up forces on collective. If up forces are excessive, return switch to on position.				
	Note				
	Do not remove hand from the hydraulic switch until hydraulic pressure has been bled off by rotating the cyclic and no up force has occured. If the collective makes a sudden up movement, return the hydraulic switch to the on position. This is probably caused by the T-T bundles being adjusted to the extreme up position, and should be corrected before continuing the flight.				
	Check cyclic and pedal movement. No excessive force or feedback. Check that the collective can be moved up (to about mid-travel) and can be pushed down. Control switch ON.				
*	aq. Collective pitch lever - Adjustable friction completely free. Check built-in friction is:	8 lbs.	10 lbs.		

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 17	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note Move the collective up to about mid-travel and then back down. The force required to mve the collective should be 8 - 10 pounds and be about the same in each direction. It is recommended that a fish scale be used to make this check with greater accuracy. A constant load should be registered as the stick moves through neutral. Friction may be noticeably less on abnormally damp days. Friction adjusted on damp days may be too heavy on dry days.				
	ar. Collective pitch lever - Minimum, check - adjustable friction will adequately increase friction, set friction OFF.				
	as. GOV RPM - 6600				
4	BEFORE TAKEOFF CHECKS				
	a. Radios - Check. Obtain altimeter setting				
	b. Altimeters - Check tower setting against setting for field elevation. Note to have corrected if more than 50 foot error exist.				
	c. Slowly advance throttle to full open and check following:				
*	(1) ENG OIL PRESS - Check				
	D L-9/11	60 psi	80 psi		
	H L-13/13A	80 psi	100 psi		
*	(2) ENG OIL TEMP		93° C		
*	(3) XMSN OIL PRESS	40 psi	60 psi		
*	(4) XMSN OIL TEMP		110 C		
*	(5) FUEL PRESS 12 - 15 psi normal	5 psi	35 psi		

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 18	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	8. RANGE MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	d. With the engine at flight idle, pull sump pump circuit breaker. There should be no change in fuel pressure on aircraft Serial No. 69-15292 and sub. There could be a slight drop on prior Serial No. aircraft. Turn on de-ice and bleed air heater, note fuel pressure. Circuit breaker IN, note pressure, de-ice and bleed air heater OFF. Caution light OUT.				
	e. RPM 6600				
*	Torquemeter - Check PSI				
	D L-9/11	10 psi	15 psi		
	H L-13/13A	8 psi	12 psi		
	Note There are numerous reasons for the torque pressure to be either high or low at this point. Two of the most common, however, are main rotor blade angle set too high and the oil or electrical lines to the engine oil and torquemeter pressure transmitters being crossed. In the latter case, engine oil pressure will read low and torque pressure high.				
*	f. EGT Check: L-9/11	390C	588C		
	L-13/13A	400C	625C		
	g. N2 tachometer - Needles joined and steady.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 19	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note A small amount of fluctuation (25 RPM) is not abnormal. If the nI, nII, torque and EGT gages are also fluctuating, it could indicate a serious problem with the overspeed governor, fuel control engine deterioration, etc. Main rotor - Observe track of tip path plane Note This is simply a visual check of the main rotor track and does not call for moving the tip path plane with the cyclic. If the blades appear to be 6 to 8 inches out of track do not fly until corrected. Listen for any abnormal noises. Note Listen for a low pitched roar, which could indicate engine troubles, or any grinding noises, etc. Some normal noises are tape popping when working a lateral vibration, oil canning, window vibrations, and the like. h. Bleed band check - Retard throttle to flight idle. (1) Very slowly increase throttle, watching EGT gauge until sudden decrease of 5 -10 degrees EGT. (Indicates bleed band is closed) Note nI.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)				PAGE NO. 20	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	(2) Very slowly decrease throttle, watching EGT gage until sudden increase of 5 - 10 degrees EGT. (Indicates bleed band is open) Note nI. (3) Opening and closing nI readings should be as indicated on bleed band charts. Note The bleed band is temperature sensitive and opening and closing points will vary at different temperatures. Refer to bleed band opening/closing limits, Ch 5, Sec II. A more exacting method, if required, is to station an observer alongside the engine compartment to determine exactly when the bleed band has opened and closed. i. Throttle - Increase to full open: 6600 RPM j. Engine acceleration check: Caution Do not perform acceleration check on L-13/13A engine. Twisting of the main rotor mast or damage to other components may occur due to rapid acceleration. Caution De-ice must be off and bleed band functioning properly before acceleration check is performed on the L-9/11. Perform on nonslick surface well clear of other aircraft or objects.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)					PAGE NO. 21	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)	
	(1) Apply collective pitch (about 4 to 6 inches.)					
	(2) Retard throttle and stabilize nI at 60%. Let nII drop to 5000 RPM.					
	(3) As nII reaches 5000 RPM, rapidly open throttle to full open. Time acceleration with aircraft clock from 60 to 85% nI. Be prepared to apply pedal to prevent aircraft turning.					
	(4) Retard throttle when 85% nI is reached to prevent further rapid acceleration.					
	(5) Acceleration time should not exceed:					
	L-9/9A		5 sec			
	L-11		4 sec			
	Note Applying about six inches of pitch loads the nII system through the main rotor and will preclude the possibility of the nII overspeed governor reducing the fuel flow to the engine, as would happen if nII speed exceeded the selected governor speed before 85% nI speed was obtained. Throttle movement from 60% to full open should be accomplished in one rapid movement (about one second). Engine acceleration is both temperature and attitude sensitive.					
	(6) Throttle - Increase to full open, set RPM to 6600.					

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - GROUND CHECK (Continued)					PAGE NO. 22	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE		9. ACTUAL INDICATION		10. LEGEND (See Note)
		MIN	MAX			
5	PRELIMINARY NAVIGATION RADIO CHECKS					
	a. ADF CHECK					
	(1) Three channels, (check all channels if possible, one must be checked)					
	(2) ADF selector check					
	(3) ADF indicator needle (#1)					
	(4) Volume & Squelch of signal pick up					
	(5) Loop position check					
	(6) BFD - Sound & Tuning					
	b. VDR CHECK					
	(1) Sound & Squelch					
	(2) Needle direction (#2)					
	(3) To/From indication					
	(4) Course Selector					
	c. FM CHECK					
	(1) Tone - Volume - Squelch					
	(2) Homing - of Course Indicator if installed.					
	d. VHF EMERGENCY RADIO CHECK					
	Note The checks above are to be done before hover flight - tentative needle swing, I.E. proper audio/response. Further specific checks are done airborne.					

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - HOVER CHECK				PAGE NO. 23	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
6	HOVER CHECKS a. Cyclic - Move various direction. Note tip path plane for proper movement. b. Tail rotor pedals - Depress each slightly, feel that aircraft tries to turn in proper direction. c. Collective pitch - Increase smoothly, noting that CG feels normal until at a 3 - 5 foot hover. Note smooth power increase. Check droop cam rigging, note nII RPM constant within 40. Note The nII rpm should not have increased or decreased from 6600 and stabilized at more than ± 40 RPM. Deviation from 6600 indicates a worn or maladjusted droop cam. d. Observe control position in a stabilized hover, into the wind. Cyclic should be nearly centered, pedal position normal. Note vibrations. Caution Any excessive control displacement should be sufficient warning to require rigging check. Note The wind must be taken into consideration as well as fore and aft and lateral CG loading i.e. fuel, tools, personnel, etc.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - HOVER CHECK (Continued)				PAGE NO. 24	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	e. Control response - Check with small inputs, note any lack of response or binding. Warning Lack of proper response or binding is cause to terminate flight and determine cause. Note Control movements need not be more than 2 or 3 inches. Control response should be positive. f. Hover slowly to test area. g. Make hovering turns in both directions to check tail rotor response and rigging. Note Approximately 90 degrees in each direction is sufficient. Be alert for smoke from the engine area while making turns. Observe the ground over which the engine has been for evidence of oil leaks. h. Do sideward flight in both directions to check cyclic response and rigging. Note Hover speeds should be consistent with autorotation requirements, yet sufficient to determine control reaction.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - HOVER CHECK (Continued)				PAGE NO. 25	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	8. RANGE MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	i. Do backwards and forward flight into the wind to about 15 knots to check cyclic response and rigging. Caution Maintain sufficient clearance from the ground to prevent the tail stinger hitting the ground. j. Pylon mounts check - Move cyclic fore and aft rapidly several times (about 3 or 4 inches, one move per second) and then feel aircraft with cyclic stationary. Bumping should dampen out after 4 or 5 cycles. No abnormal vibrations or engine surges should occur. Note This movement is made primarily from the wrist and the cyclic need not be moved over 3 or 4 inches at a rate of about one per second. A solid bump will be felt in the airframe caused by the pylon mounts bottoming out. After cyclic movement has ceased, this bumping should stop after four or five cycles. Note any medium frequency vibration that could be caused by loose skids or components. k. Power cylinder check: Caution Should cyclic jam or get hard to move during the following turn, turn hydraulics OFF then ON.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - HOVER CHECK (Continued)				PAGE NO. 26	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Move cyclic smoothly 6 to 8 inches along a 45 degree line from left rear to right forward several times (at a rate of about 2 to 3 seconds per move.) No restrictions to movement should be felt. Check similarly from right rear to left forward. Note Total cyclic movement should be about 6 to 8 inches at rate of about 2 or 3 seconds per movement. If too rapid, it is possible to cause the same reaction that would occur with a hydraulics failure. One hand, or the observers hand, should be kept on the hydraulic control switch to immediately turn hydraulics off and then on again if necessary. You are checking that the hydraulic boost system will function properly in flight if moved at a rate more rapid than normal. l. Engine response check - Move collective up fairly rapidly then back down before excessive altitude is gained. Engine should respond smoothly and rapidly. Note During this check some transient droop may be evident, but the engine should accelerate smoothly and rapidly to compensate for the suddenly increased power requirement. Be alert for any evidence of compressor stall or lag in engine response. m. Torquemeter - Check indication of a 2 foot hover into the wind. Operates smoothly, correct PSI for conditions.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - HOVER CHECK (Continued)				PAGE NO. 27	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Caution An abnormal torquemeter reading should be investigated before continuing flight. n. Land aircraft. o. Hover in EMER Caution Throttle movements must be smooth and well coordinated. Too rapid movements can cause engine overspeed, compressor stall, flameout and excessive EGT. Note One or two pop stalls on switch over from automatic to emergency, or back to automatic is normal on some L-13/13A engines. If more than two pops occur with a rise in EGT, compressor stall has occured. (1) Move throttle to flight idle, switch GOV to EMER. Carefully open throttle to 6400 RPM and increase collective, holding 6400 RPM with throttle. Aircraft should hover normally in EMER. Land aircraft, throttle to flight idle and simultaneously switch to AUTO. Increase throttle to full open (6600 RPM).				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK	PAGE NO. 28	NO. OF PAGES 38

6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note A fluctuation of the torquemeter may occur between 6400 and 6500 RPM as a result of transient opening and closing of the bleed band and is not abnormal.				
	(2) Hover aircraft.				
	p. Low RPM hover - Decrease nII RPM to 6000 with beep and hover. Note controllability at low RPM control positions. Increase RPM to 6600 noting smoothness of increase.				
	Note Generally a lateral vibration will become more pronounced at low RPM and can be determined at this time. A lateral vibration of noticeable intensity should be corrected before continuing flight since it can manifest itself as a vertical vibration in flight.				
	q. Anti-collision light - ON				
	r. RPM audio switch - ON				
	s. Engine/transmission instruments - NORMAL				
7	TAKE-OFF AND CLIMB				
	a. Make normal takeoff and climb at 60 - 70 knots. Note control positions normal, engine and transmission instruments for abnormal indications.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK (Continued)				PAGE NO. 29	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note A normal take-off is used because it is the safest type. In the event of an engine failure the nose will drop, possibly to a point from which recovery could not be made during a nose low take-off. From any point in a normal take-off and climb a successful autoration can normally be made. This possibility must be considered on all maintenance flights in particular.				
*	b. Collective pitch - Adjust for level flight at 70 knots. Recheck all instruments normal, caution lights OUT.				
	c. Autorotation:				
	(1) Perform at 65 knots.				
	(2) Have suitable landing area in range.				
	(3) Simultaneously reduce throttle to flight idle and lower collective to minimum. Do not allow rotor RPM to exceed limits.				
*	(4) Note rotor RPM in stabilized autorotation. At average ambient conditions and light gross weight (2 persons, full fuel) rotor RPM should be 310 ±5.				
	(5) Note vibrations, sufficient right pedal remaining.				
	d. Airspeed - Adjust 60 - 70 knots at operating altitude.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK (Continued)				PAGE NO. 30	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
*	e. Hydraulic control switch-OFF, caution light-ON. Check that helicopter is easily controllable, no excessive forces to right front quadrant, cyclic, and pedal forces. Collective should go down to 10 psi and up to 35 psi without excessive force. Hydraulic switch ON, caution light OUT. Note There should be no excessive feedback in the controls. It will take slightly more force to move the cyclic right and forward than to the left and forward. A common cause for excessive pressure being required to the right and forward is a maladjusted or missing swashplate balance spring. Tail rotor pedal forces should be the same for both pedals. Without excessive pressure (i.e. leaning on the stick) the collective should go down to 10 psi. If 10 and 35 psi torque cannot be reached, the T-T bundles are probably out of adjustment. It is important to be able to reach both points. If the collective will not go down sufficiently, and both the engine and hydraulics fail, it is doubtful that a successful autorotation could be accomplished. Sufficient up travel should be available to maintain flight, and land the helicopter after a hydraulics failure.				
8	ENGINE TOPPING CHECK. Caution Do not exceed 50 PSI torque. Have suitable landing area in range.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK (Continued)				PAGE NO. 31	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note It is recommended that a vibration check be concurrently performed with topping check to give more complete information on engine condition. a. Set copilot's altimeter to 29.92 ± K factor. Heater and De-ice OFF b. Increase torque to 48 psi (or maximum attainable if less than 48), establish climb at 60 - 70 knots and 6600 RPM, hold until 6600 RPM cannot be maintained. Do not let EGT exceed limits. c. Apply collective to droop N2 RPM to 6400. Record: N 1%, EGT, Torque, OAT, and pressure altitude for later check. Further droop to 6200 RPM, noting N 1% remains constant. d. Note: fuel pressure remains normal. e. Check control positions and forces. Note that sufficient left pedal remains. Note vibration level. f. Smoothly reduce collective for normal flight, reset altimeter and descend to lower altitude if necessary. Caution Continually monitor EGT and torque to prevent an inadvertent out of limits condition. The topping check should always be performed at an altitude commensurate with accomplishing a safe autorotation if necessary.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK (Continued)				PAGE NO. 32	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note If nI increases between 6600 and 6500 RPM the droop cam is probably worn or out of adjustment, the engine is not topping out at 6600, and should be corrected. If nI again changes from 6400 to 6200 RPM the engine is probably not at maximum power and the droop must be adjusted before an accurate topping check can be completed.				
9	CONTROL RIGGING CHECK:				
	a. Increase airspeed to 100 knots using 30 - 35 psi torque, needle and ball centered. Note cyclic nearly centered, force trim holds controls in position. Right pedal should be 1/2 to 1 inch forward. Note Investigate rotor vibrations. Aircraft should fly smoothly through entire speed range. (Record on rotor smoothing record.)				
	b. Slow aircraft and accomplish a zero airspeed out-of ground-effect hover. Note any 1 per revolution vibration, sufficient left pedal remaining. Caution This check should be made at 1500 feet above the ground, if possible, for the best possible autorotation conditions.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK (Continued)				PAGE NO. 33	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note Usually, 1 per revolution vertical vibrations felt at zero airspeed are lateral vibrations caused by an out of balance condition of the main rotor system. If a lateral vibration exists it should be corrected prior to proceeding with vertical vibration corrections since a lateral can manifest itself as a vertical in forward flight. The hover should be performed at zero airspeed and zero vertical speed. c. Stabilize at 70 knots and note vibration level, make 10 psi - 70 knot descend. Note any increase in vibrations. Note Generally, 1 per revolution vibrations felt predominantly in a low power descent are caused by a basic difference in blade lift and can be corrected by rolling a blade grip. Note also any excess - 2 per revolution vibration. d. Level off and slowly increase airspeed from 70 up to VNE (unless vibrations get uncomfortably severe). Note any increase in 1 per revolution vibrations and airspeed at which it became evident. Note any excessive 2 per revolution vibration of higher frequency vibrations.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - FLIGHT CHECK (Continued)				PAGE NO. 34	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)
	Note Vertical 1 per revolution vibrations felt mostly in forward flight, that get worse as airspeed is increased, are usually due to one blade developing more lift as airspeed increases. This can most often be corrected by adjustment of trim tabs.				
10	Fly at different airspeeds and attitudes checking performance of flight instruments.				
	a. Airspeed indicators - Proper indication, nearly the same (± 5 knots). No excessive fluctuation (± 3 knots).				
	b. Attitude indicators - Correct indication, no excessive precession or vibrations.				
	c. Altimeters - Proper indication, nearly the same (within 50 feet), no large fluctuations.				
	d. Gyro compass - Correct heading, operates smoothly, no fluctuation.				
	e. Vertical speed indicators (VSI) - Proper indication, nearly the same (within 10%). No excessive fluctuations.				
	f. Standby compass - Nearly correct heading, no excessive fluctuation.				
	g. Turn and slip indicator - Proper indication, needle movement.				
	h. Clock - Still indicating correct time.				
	i. Instrument panel - No excessive vibration. Note any looseness or cracks at pedestal mounts.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - AFTER LANDING CHECK					PAGE NO. 35	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)	
	Communication/Navigation equipment - Check operation of all equipment as indicated in the appropriate TM.					
11	AFTER LANDING CHECKS					
	a. ANTI-COLL light - OFF					
	b. Controls - Collective full down, cyclic centered, pedals neutral, force trim ON.					
	c. Part power plunger check - Complete if Turbine Engine Analysis Check was not performed.					
	d. GOV RPM - Full decrease, 6000 ± 50.					
	e. Lighting systems - Check:					
	(1) Caution panel - Bright/dim switch, dim. Lights should stay bright. Pilot's rheostat ON, actuate dim switch, lights should dim, rheostat OFF, lights should go to bright.					
	(2) Interior lights - All rheostats ON, note all lights illuminate, rheostats function properly, then OFF. Check dome and map lights.					
	(3) Navigation lights - ON. Check all positions (bright/dim, flash/steady), then OFF.					
	(4) Landing light - ON, full extend, then retract, limit switches function properly then OFF.					
	(5) Searchlight - ON and extend. Move left and right rotation, limit switches retraction, stow then OFF.					
	f. Throttle - Flight idle, check N_1%:					

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - AFTER LANDING CHECK (Continued)				PAGE NO. 36	NO. OF PAGES 38
6. ITEM NO.	**7. INSPECTION ITEMS**	**8. RANGE MIN**	**MAX**	**9. ACTUAL INDICATION**	**10. LEGEND (See Note)**
*	D L-9/11 H L-13/13A	55% 70%	59% 72%		
*	g. RPM AUDIO switch - OFF.				
*	h. EGT - Check D L-9/11 H L-13/13A	390 C 400 C	620 C 625 C.		
*	i. ENG OIL PRESS	25 psi			
*	j. ENG OIL TEMP - Maximum.		93C		
*	k. XMSN OIL PRESS - Check indication.				
*	l. XMSN OIL TEMP		110 C		
	Note Ensure engine has idled for 1 - 2 minutes to allow EGT to stabilize before shutdown.				
12	ENGINE SHUTDOWN				
*	a. Fuel boost pump check (bleed air OFF)				
	(1) Sump pump circuit breaker - OUT. Note right boost pump caution light ON, fuel pressure remains in green.				
	(2) Press flight idle stop release and slowly decrease throttle, noting decrease in fuel pressure.				
	(3) Watch for left boost pump caution light ON. Light should not come on above 40% N1 and/or 5 psi fuel pressure.				
*	b. Throttle - Full OFF. Check nI coastdown time, listen for any abnormal noises, monitor EGT.				

AIRCRAFT TEST FLIGHT INSPECTION CHECKSHEET PART I - AFTER LANDING CHECK (Continued)					PAGE NO. 37	NO. OF PAGES 38
6. ITEM NO.	7. INSPECTION ITEMS	8. RANGE MIN	MAX	9. ACTUAL INDICATION	10. LEGEND (See Note)	
	L-9/11 L-13/13A (Time check not consistent)	25 sec	55 sec			
	c. MAIN and START Fuel - OFF.					
	d. Radios - OFF.					
	e. Electrical switches - OFF.					
	f. Battery - OFF (Note coastdown time when nI reaches near zero.)					
	g. GO-NO-GO decal - Update to latest topping check after computations.					
	h. Complete post - test flight inspection.					
	i. Record discrepancies on appropriate forms.					
	j. Debrief maintenance personnel as necessary.					

6. ITEM NO.	TEST FLIGHT INSPECTION CHECKSHEET PART I - REMARKS	PAGE NO. 38	NO. OF PAGES 38

TYPED OR PRINTED NAME OF PILOT	SIGNATURE
TYPED OR PRINTED NAME OF OBSERVER	SIGNATURE

Section IV. OVERHAUL AND RETIREMENT SCHEDULE

3-8. Scope.

This section lists units of operating equipment that are to be overhauled or retired at the period specified. Removal of equipment for overhaul may be accomplished at the inspection nearest the time when overhaul is due unless otherwise specified in TB 55-1500-300-25. Upon replacement of items listed in this chapter all applicable forms, records, and worksheets will be completed and updated as required in TM-38-750 and TB 55-1500-307-25.

3-9. Overhaul Interval.

The maximum authorized operating time or calendar interval of parts prior to removal for overhaul at category of maintenance authorized in accordance with the Maintenance Allocation Chart.

3-10. Retirement Schedule.

The operating time or calendar interval specified for removal, condemnation, and disposal of parts in accordance with TB 55-1500-304-25.

NOTE

Items replaced on a calendar basis (for the purpose of overhaul or retirement) will not be listed on DA Form 2408-16, Component Installation and Removal Record, but will be listed on DA Form 2408-18, Equipment Inspection List, for scheduling purposes.

OVERHAUL AND RETIREMENT SCHEDULE

Model UH-1D/H Helicopter

AREA	OVERHAUL INTERVAL (HOURS)	RETIREMENT INTERVAL (HOURS)	ITEM AND PART NUMBER	
4			**Main Rotor**	
		2500	Main Rotor Blade Assembly	204-011-250-5
	1100		Main Rotor Hub Assembly	204-012-101-3, -5
		2200	Inboard Strap Fitting	204-012-102-1, -5
		2200	Outboard Strap Fitting	204-012-103-1
		2200	Strap Pin	204-012-104-1, -3, -5
		2200	Retention Strap	204-012-112-5
4			**Transmission**	
	1100		Transmission Assembly	205-040-001-5, -11, -17
	1100		Transmission Assembly	204-040-016-1, -3, -5
	50		Mast Assembly	204-040-366-5
		50	Bearing	204-040-136-5
	1100		Mast Assembly	204-040-366-7

OVERHAUL AND RETIREMENT SCHEDULE (CONT)

Model UH-1D/H Helicopter

AREA	OVERHAUL INTERVAL (HOURS)	RETIREMENT INTERVAL (HOURS)	ITEM AND PART NUMBER	
4	1100		*Main Input Quill Assembly	205-040-263-3
	1500		Mast Assembly	204-040-366-9
		1500	Bearing	204-040-136-7
5 & 6			**Tail Rotor and Drive System**	
		1100	Blade Assembly	204-011-702-11, -15
		1100	Hub Assembly, Tail Rotor	204-011-701-11, -13 -19, -29
		1100	Hub Assembly, Tail Rotor	204-011-801-5/-9
		1100	Grip Assembly	204-011-706-9, -17
		1100	Grip Assembly	204-010-728-1, -19
		1100	Yoke Assembly	204-010-781-5, -9
		1100	Yoke Assembly	204-011-722-1/-5
	1500		Gear Box, 42°	204-040-003-7, -13, -19, -23, -29, -37
	1100		Gear Box, 90°	204-040-012-7/-13
	600		Gear Box, 90°	204-040-012-1
4			**Main Rotor Mast Controls**	
	1100		Swashplate & Support Assy	204-011-400-1, -3, -5, -7, -9, -11
		3300	Support	204-011-404-1, -5
		3300	Collective Lever	204-011-438-1
	1100		Scissors and Sleeve Assy	204-011-401-5, -7, -9, -11
4			**Rotating Control System Bolts Listed Below: (See figure 3-3.)**	
		600	Pitch Horn to Pitch Link	(Index No. 4) NAS464-6-26 (Index No. 4) NAS1306-31D

OVERHAUL AND RETIREMENT SCHEDULE (CONT)

Model UH-1D/H Helicopter

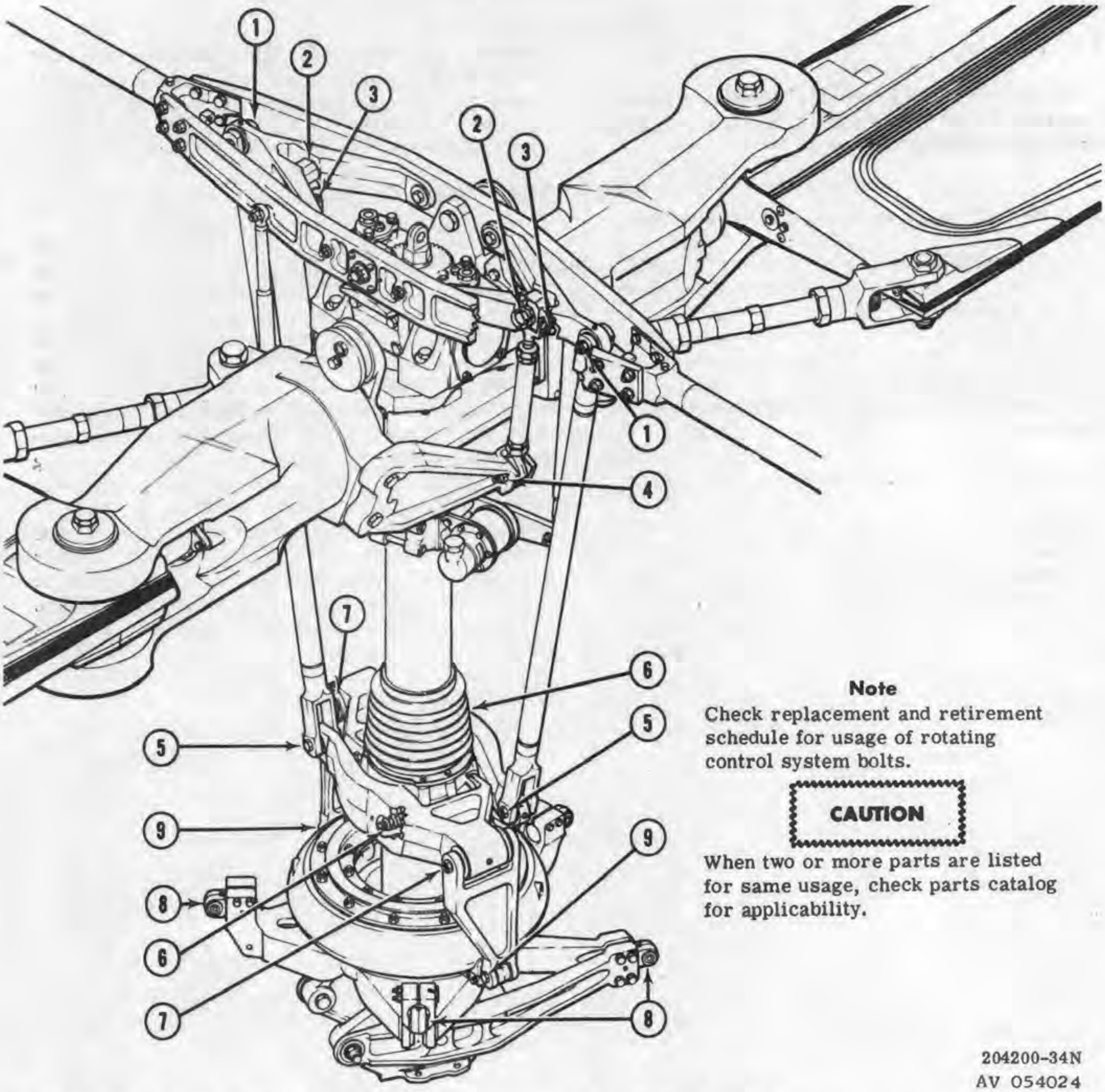
AREA	OVERHAUL INTERVAL (HOURS)	RETIREMENT INTERVAL (HOURS)	ITEM AND PART NUMBER	
		600	Pitch Link to Universal	(Index No. 3) NAS1306-27DH
		600	Universal to Mixing Lever	(Index No. 2) NAS464-6-35 (Index No. 2) NAS1306-34D
		600	Mixing Lever to Tube	(Index No. 1) NAS464-5-27 (Index No. 1) NAS1305-27D
		600	Tube to Scissors	(Index No. 5) NAS464-5-27 (Index No. 5) NAS1305-27D
		600	Scissors Pivot	(Index No. 6) NAS464P-8-90
		600	Scissors to Drive Link	(Index No. 7) NAS464P-8-69
		600	Drive Link to Swashplate	(Index No. 9 NAS464-5-30 (Index No. 9) NAS1305-30D
		600	Cyclic Tubes to Swashplate	(Index No. 8) AN175H16
		600	Collective Tubes to Lever	(Index No. 8) AN175H16
6			**Synchronized Elevator**	
		3000	Elevator Assembly	205-030-856-19, -21
		3000	Elevator Horn Assembly	205-001-914-1
5			**Power Plant**	
	1200		Engine	T53-L-9, -9A, -11, -11B
	1550		Engine	T53-L-11C, -11D
	1200		Engine	T53-L-13B
	1200		Engine	T53-L-13A

OVERHAUL AND RETIREMENT SCHEDULE (CONT)

Model UH-1D/H Helicopter

AREA	OVERHAUL INTERVAL (HOURS)	RETIREMENT INTERVAL (HOURS)	ITEM AND PART NUMBER	
	1200		Engine	T53-L-13 Ser. No. Suffix A
	1200		Rotor Turbine 1st Stage Gas Producer Wedged	1-100-490-01 1-100-490-02 1-100-490-03 1-100-490-04 1-100-490-06

*Unless otherwise known, the time since new on the quill assembly shall be established by assuming that the quill assembly has the same number of flight hours as the transmission, either time since new and/or time since last overhaul, whichever is applicable. Requirement for establishment of proper records in accordance with TB 55-1500-307-25 is directed.



Note

Check replacement and retirement schedule for usage of rotating control system bolts.

CAUTION

When two or more parts are listed for same usage, check parts catalog for applicability.

204200-34N
AV 054024

1. Bolt, NAS 464-5-27 or NAS 1305-27D
   Mixing Lever to Scissor Tube (2 Places)
2. Bolt, NAS 464-6-35 or NAS 1306-34D
   Universal to Mixing Lever (2 Places)
3. Bolt, NAS 1306-27D
   Pitch Link to Universal (2 Places)
4. Bolt, NAS 464-6-26 or NAS 1306-31D
   Pitch Horn to Pitch Link (2 Places)
5. Bolt, NAS 464-5-27 or NAS 1305-27D
   Scissor Tube to Scissors (2 Places)
6. Bolt, NAS 464-8-90
   Scissors Pivot (2 Places)
7. Bolt, NAS 464-8-69
   Scissors to Drive Link (2 Places)
8. Bolt, AN175-16 (2 Places)
   Cyclic Tubes to Swashplate (3 Places)
   Collective Tube to Collective Lever (1 Place)
9. Bolt, NAS 464-5-30 or NAS 1305-30D
   Drive Link to Swashplate (2 Places)

Figure 3-3. Mast control system bolts

Section V. STANDARDS OF SERVICEABILITY

3-11. Purpose.

This section provides a guide to all personnel engaged in the maintenance of Department of the Army aircraft in determining serviceability of aircraft.

3-12. Maintenance Functions And Inspections.

The availability of serviceable aircraft is contingent upon effective maintenance management; therefore, the maximum utilization of available capabilities, faithful and timely performance of assigned maintenance functions, and conscientious performance of specified maintenance inspections augmented by careful supervision and strict quality control will enhance aircraft availability and serviceability.

3-13. Standards Of Serviceability.

Serviceability can be determined only by actual inspection of the aircraft and can be determined at any time throughout the life cycle of the aircraft. Wear tolerance and maximum allowable deterioration, specified in maintenance and inspection requirements, have been designed to assure a high degree of serviceability, availability, and safety. These tolerances and limits are the basic standards for serviceability and are embodied in aircraft maintenance and inspection manuals; therefore, inspection for serviceability is performed during every maintenance inspection.

3-14. Degree Of Serviceability.

Transfer of aircraft generates administrative and technical problems for supply and maintenance management. To minimize the impact upon the receiving activity of a transferred aircraft, degrees of serviceability are established to supplement basic standards included in present maintenance and inspection requirements. The supplementary standards, contained in this section, have been designed to assure that sufficient reliable hours of flight are remaining on the aircraft and components to satisfy immediate operational and logistical receiving activity when the aircraft is being transferred within CONUS, overseas, or into combat operations. The degree of serviceability required for aircraft upon completion of overhaul will be to the same degree required for transfer within CONUS; except when aircraft is predetermined to be destined for overseas or into combat, in which case the overhauled aircraft will conform to the standard for the specific transfer condition.

STANDARDS OF SERVICEABILITY

Item No.	Item	Degree of Serviceability Required for Transfer Within Theater of Operations or from an Overseas Theater to CONUS	Degree of Serviceability Required for Transfer from One Theater of Operations to Another Theater of Operations	Degree of Serviceability Required for Transfer from a Non-Combat Theater to a Combat Theater of Operation
	General			
1	Inspection	Perform next Intermediate Inspection; when next Periodic Inspection is due within 25 operating hours, perform next Periodic Inspection	Perform next Periodic Inspection	Perform next Periodic Inspection
2	Modification	Accomplish all Urgent and Normal MWO & TCTM	Accomplish all Urgent MWO & TCTM. Accomplish all Normal MWO & TCTM which have an issue date of 3 months prior to date of transfer	Accomplish all Urgent MWO & TCTM. Accomplish Normal MWO and TCTM which have an issue date of 1 month prior to date of notice of transfer when aircraft is to be transferred and for which, more than 60 days notification was received.
3	Mission Essential Equipment	Assure mission essential equipment is installed	Assure mission essential equipment is installed and is completely operational	Assure mission essential equipment is installed and is completely operational
	Helicopter			
4	Helicopter Paint Condition	Touch up by area spraying as necessary to provide a protective seal on all required surfaces	Touch up by area spraying as necessary to provide a protective seal on all required surfaces. Completely repaint if condition of existing paint warrants. Paint necessary peculiar markings on helicopter required by the theater of operations	Touch up by area spraying as necessary to provide a protective seal on all required surfaces. Paint necessary peculiar markings on helicopter required by theater of operations

STANDARDS OF SERVICEABILITY (CONT)

Item No.	Item	Degree of Serviceability Required for Transfer Within Theater of Operations or from an Overseas Theater to CONUS	Degree of Serviceability Required for Transfer from One Theater of Operations to Another Theater of Operations	Degree of Serviceability Required for Transfer from a Non-Combat Theater to a Combat Theater of Operation
	Component Replacement			
5	a. Items having a scheduled replacement of retirement time below 500 hours	Replace if less than 50 hours of scheduled operating time remains	Replace if less than 100 hours of scheduled operating time remains	Replace if less than 300 hours of scheduled operating time remains
	b. Items having scheduled replacement time over 500 hours	Replace if less than 10% or 100 hours of scheduled operating time remains (whichever is least)	Replace if less than 25% or 200 hours of scheduled operating time remains (whichever is least)	Replace if less than 300 hours of scheduled operating time remains
	c. Items having a scheduled change based on calendar months	Replace only if change is due	Replace only if change is due	Replace if less than three months remain before change is required
	Control Cables			
6	a. 7 x 7 1/16 inch diameter 3/32 inch diameter	Replace when more than three wires are broken or coroded within a one inch distance	Replace when more than three wires are broken or corroded within a one foot distance	Replace when more than three wires are broken or corroded within a two foot distance
	b. 7 x 19 1/8 inch diameter	Replace when more than six wires are broken or corroded within a one-inch distance	Replace when more than six wires are broken or corroded within a one foot distance	Replace when more than six wires are broken or corroded within a two foot distance
	c.	Replace cables having "flat spots" as determined by a qualified inspector	Replace cables having "flat spots" as determined by a qualified inspector	Replace cables having "flat spots" as determined by a qualified inspector
7	Communications, Compass, Electronic & Navigation Equipment	Assure equipment is complete and fully operational	Assure type of equipment installed is compatible to type and system utilized at destination and equipment is fully operational	Assure type of equipment installed is compatible to type and system utilized at destination and equipment is complete and fully operational

CHAPTER 4

AIRFRAME AND ALIGHTING GEAR

Section I. SCOPE

4-1. Purpose.

The purpose of this chapter is to provide all the essential information for maintenance personnel to accomplish organizational maintenance on the complete airframe and alighting gear in accordance with maintenance allocation chart.

Section II. FUSELAGE SECTION

4-2. Description.

The fuselage section consists of two sections; the cabin and the tail boom.

4-3. Structural Panels.

All removable island structural access panels are marked with decals stating that the panel is a structural panel. Island access panels that do not have a decal stating that the panel is a structural panel are considered non-structural panels.

4-4. Inspection, Fuselage – General.

Inspect items listed below as indicated.

a. Inspect entire fuselage area for the following:

(1) Inspect for missing or loose rivets.

(2) Inspect skin covering for rips and tears caused by impact with an object.

(3) Inspect surface for evidence of distortion, failure of substructure, loose rivets, and canted, buckled or wrinkled covering.

(4) Inspect for overall cleanliness such as accumulation of dirt or other foreign matter near engine, rotor and other critical areas on the helicopter.

b. Inspect hand-holds and steps for cracks or corrosion, loose bolts, missing or loose rivets. Inspect hinges on steps for security.

c. Inspect engine deck surface for cracks and corrosion. Inspect engine deck drain holes and drain channels for possible obstructions.

d. Inspect forward and aft jack pads for security (loose bolts, rivets and pins). Inspect jack pads for accumulation of grease or other foreign matter that could cause jacks to slip.

e. Inspect cargo and cockpit floors for the following:

(1) Inspect floor surface for evidence of cracks or corrosion.

(2) Inspect drain holes for possible clogging.

(3) Check all tie rings and seat attaching points for cracks, structural weakness, or loose bolts, screws or rivets.

(4) Check entire floor area for any accumulation of moisture that could cause corrosion.

4-5. Cabin.

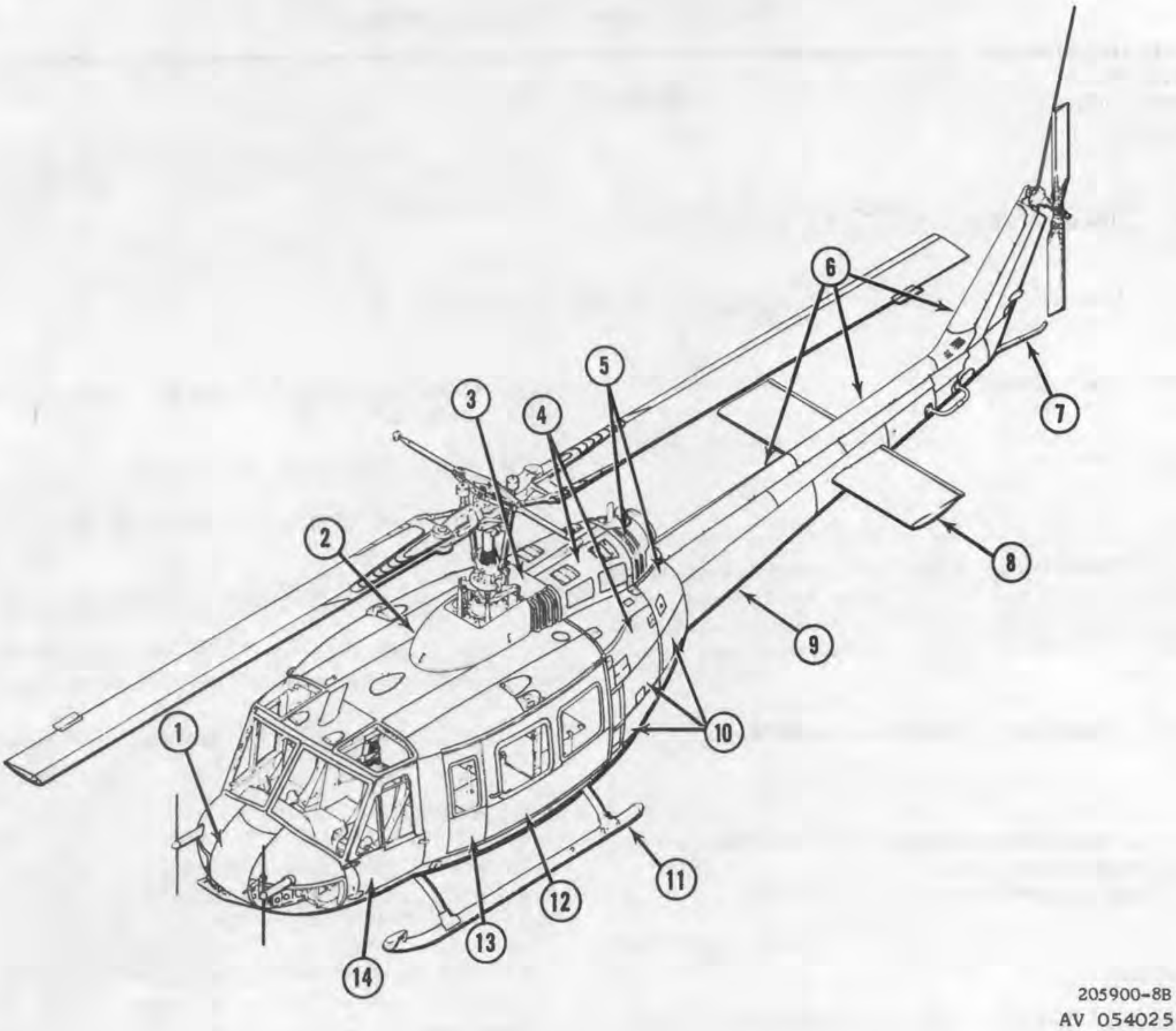
The cabin (see figure 4-1) consists of the pilot's compartment, cargo area, transmission mount, engine deck and fuel tanks. The cargo and crew doors have transparent plastic windows at the top. Transparent plastic windows are provided in the cabin roof above the pilot's and copilot's compartment and two forward and below the tail rotor control pedals.

4-6. Equipment And Electrical Compartment Access Doors.

Access to forward fuselage section compartments, other than the crew area, is obtained by use of hinged doors. These doors are secured, when not in use by means of latches. (See figure 4-2.)

a. Removal – Equipment and Electrical Compartment Access Doors. Relcase spring loaded latch and remove hinge pin attaching door to structure.

b. Inspection – Equipment and Electrical Compartment Access Doors. Inspect doors for damage, cracks; hinges and latches for serviceability, damage and wear.



1. Nose Compartment Door
2. Transmission Fairing
3. Engine Intake Fairing
4. Engine Cowling
5. Tailpipe Fairing
6. Drive Shaft Covers
7. Tail Skid
8. Synchronized Elevator
9. Tail Boom
10. Fuselage Compartment Doors
11. Landing Gear
12. Sliding Cargo Door
13. Hinged Panel Door
14. Crew Door

Figure 4-1. Airframe group

c. Repair or Replacement – Equipment and Electrical Compartment Access Doors. Replace unserviceable, worn or damaged hinges or latches.

d. Installation – Equipment and Electrical Compartment Access Doors. Position door in opening and insert attaching hinge pin. Close door firmly, forcing spring loaded latch to lock.

4-7. Miscellaneous Cabin Compartment Access Doors.

a. Removal – Miscellaneous Cabin Compartment Access Doors. (Refer to paragraph 4-6.) (See figure 4-2.)

b. Inspection – Miscellaneous Cabin Compartment Access Doors. (Refer to paragraph 4-6.)

c. Repair or Replacement – Miscellaneous Cabin Compartment Access Doors. (Refer to paragraph 4-6.)

d. Installation – Miscellaneous Cabin Compartment Access Doors. (Refer to paragraph 4-6.)

4-8. Pilot's And Copilot's Doors.

Access to crew compartment is gained through two swingout doors (14, figure 4-1), which are hinged on the forward side. Each door incorporates three transparent plastic windows, which may be termed the forward, upper and adjustable windows. A latch assembly, which may be operated from either side of each door, secures the door in the closed position. In an emergency, doors may be jettisoned by pulling EMERGENCY RELEASE handle mounted inside cabin forward of each door.

a. Removal – Pilot's and Copilot's Doors. Open door, pull EMERGENCY RELEASE handle, and lift from the helicopter.

b. Inspection – Pilot's and Copilot's Doors.

(1) Visually inspect seal strips around inner edge of door for deterioration and damage.

(2) Examine door hinges (10, figure 4-3) for cracks, condition of spring assemblies, rubber bumper and shim. Door hinges may be inspected by Fluorescent Penetrant method.

(3) Visually inspect sliding window stop assembly, located at forward end of lower window channel.

(4) Visually inspect latch tube clevis ends and internal threads.

(5) Inspect latch release spring (6) for initial tension of 0.30 pound, spring rate of 3.54 pounds per inch, and a load of 2.0 pounds (plus or minus 0.30 pound) at 1.75 inches extended length.

(6) Manually check bellcrank (7) for bushing wear. If bushing appears to be worn and bellcrank is loose on mounting bolt, remove bellcrank and replace bushing.

(7) Visually inspect aft vertical latch tube (3) rod end and internal threads.

(8) Check roller assemblies (2) for smoothness of operation in channel and for condition of threads.

NOTE

With door in locked position, tops of roller assemblies (2) should clear channel by 0.08 inch.

(9) Inspect ejection handle assembly components. Perform 100 pounds pull test of cable and terminals.

(10) Visually inspect all components of the ejection mechanism. Adjust emergency jettison device so rounded end of pins are visible above the upper hinge and below the lower hinge.

NOTE

Actuate emergency jettison device to make certain pins clear hinges and door can be properly jettisoned. If door does not jettison, readjust as necessary.

(11) Inspect door for cracks, dents and damage.

c. Repair or Replacement – Pilot's and Copilot's Doors.

Replace worn or unserviceable hinges.

d. Installation – Pilot's and Copilot's Doors.

Position door on hinges and insert hinge pins.

e. Adjustment.

(1) With door handle in locked position, adjust latch tubes as follows:

(a) Adjust aft vertical latch tube so a clearance of 0.08 inch is obtained between top of door roller assembly (2, figure 4-3) and bottom of channel.

(b) Adjust forward vertical latch tube so a clearance of 0.08 inch is obtained between top of door roller assembly and bottom of channel.

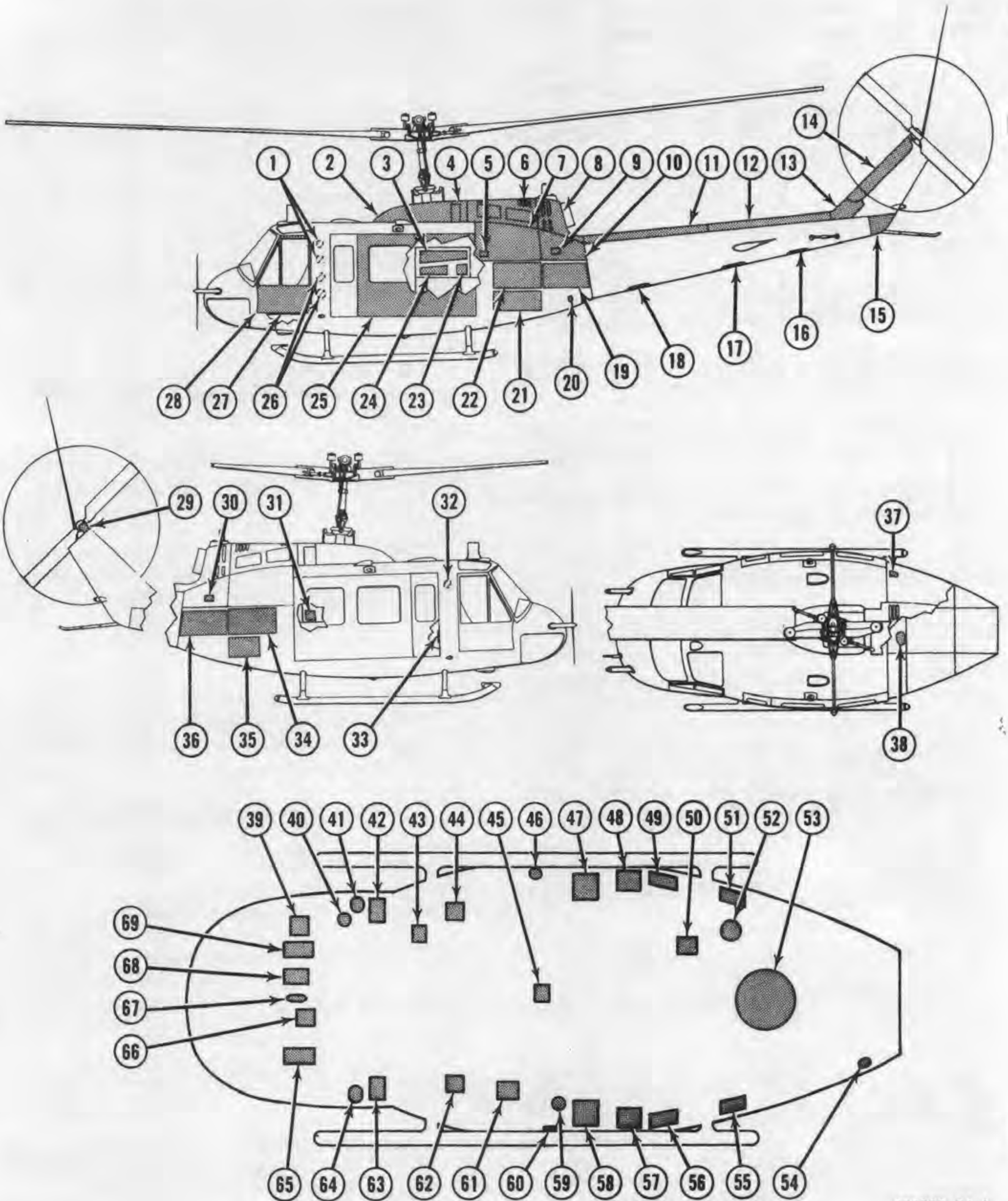
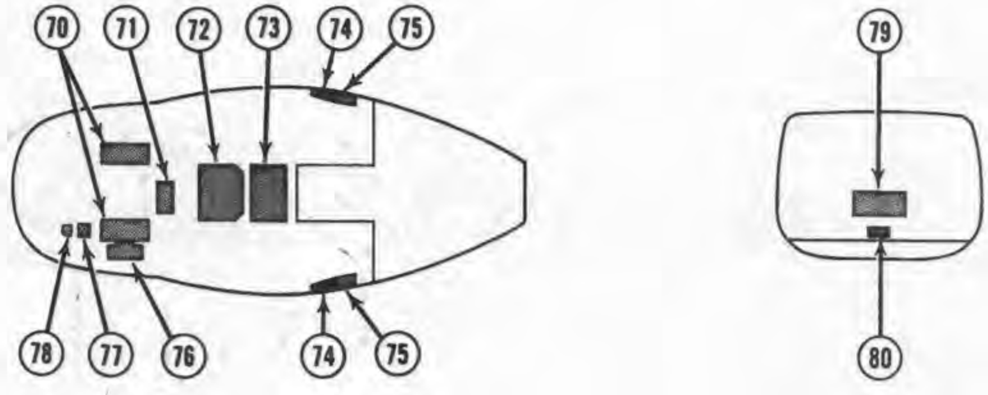
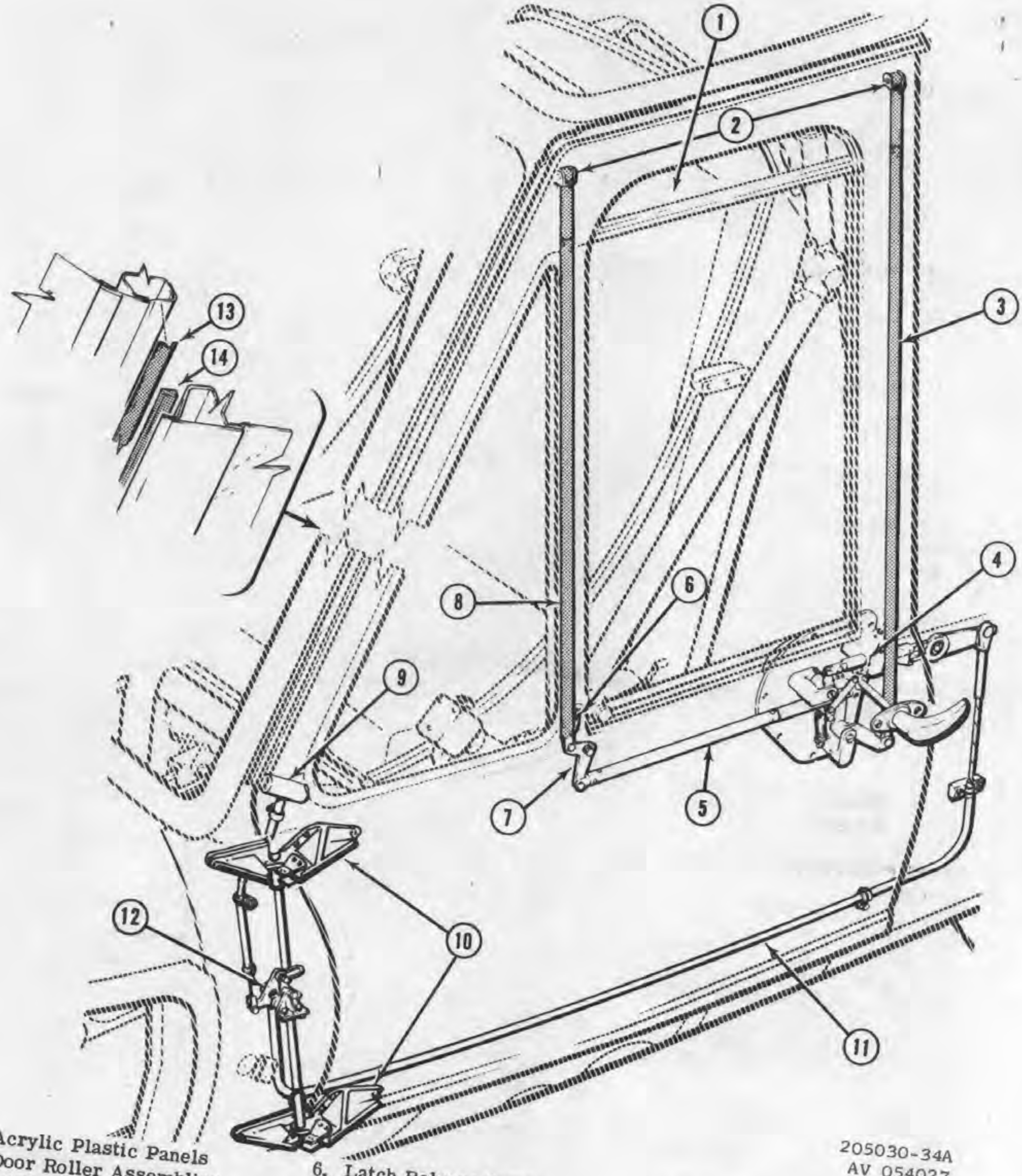


Figure 4-2. Model UH-1D/H access and inspection provisions (Sheet 1 of 2)



1. Stowage Access Door
2. Transmission Fairing
3. Pylon Access Door
4. Engine Cowl
5. Fire Extinguishing Access Door
6. Upper Engine Cowl
7. Lower Engine Cowl
8. Tailpipe Fairing (Upper)
9. Driveshaft and Electrical Disconnect Access Door
10. Tailpipe Fairing (Lower)
11. Forward Tail Rotor Shaft Access
12. Aft Tail Rotor Shaft Access
13. Intermediate (42°) Gear Box Access
14. Vertical Fin Driveshaft Access
15. Ventral Fin Fairing
16. General Access
17. Flight Controls Access Door
18. Flight Controls Access Door
19. Electrical Controls Access Door
20. External Power Access Door
21. Electronic Equipment Access Door
22. General Access Door
23. Fuel Control Access Door
24. Lower Pylon Access Door
25. Cargo Door
26. Emergency Door Release Cover Plate
27. Lower Window Access Door
28. Crew Door
29. Tail Rotor Chain Access Cover
30. Driveshaft Access Door
31. General Access Door
32. General Stowage Access Door
33. General Access Cover Plate
34. Cargo Hook Mirror Access Door
35. General Access Door
36. General Access Door
37. Engine Oil Tank Access Door
38. Fuel Cell Access Door
39. Flight Controls Access Door
40. Flight Controls Access Door
41. Flight Controls Access Door
42. Flight Controls Access Door
43. Flight Controls Access Door
44. General Access Door
45. Fuel Lines Access Door
46. External Stores Jettison Cable Access Door
47. External Stores Disconnect Access Door
48. Fuel Lines Access Door
49. Ammunition Chute Access Door
50. Fuel Lines Access Door
51. Cabin Heater Duct Access Door
52. Fuel Lines Access Door
53. General Access Door
54. General Access Door
55. Cabin Heater Duct Access Door
56. Ammunition Chute Access Door
57. Fuel Lines Access Door
58. External Stores Disconnect Access Door
59. Fuel Lines Access Door
60. External Stores Jettison Cable Access Door
61. General Access Door
62. Cabin Heater Duct Access Door
63. Cabin Heater Duct Access Door
64. Flight Controls Access Door
65. Flight Controls Access Door
66. Flight Controls Access Door
67. Antenna Access Cover
68. General Access Door
69. Flight Controls Access Door
70. Controls Access Door
71. Controls Access Door
72. General Access Door
73. General Access Door
74. Auxiliary Fuel Tank Fittings Cover Plate
75. Gun Chute Tunnel Cover Plate
76. Dual Collective Stick Cover
77. Dual Cyclic Stick Access
78. Cyclic Stick Electrical Access Door
79. Hydraulic Controls Access Door
80. Armament Provisions Access Cover

Figure 4-2. Model UH-1D/H access and inspection provisions (Sheet 2 of 2)



1. Acrylic Plastic Panels
2. Door Roller Assemblies
3. Aft Vertical Latch Tube
4. Door Latch
5. Lower Horizontal Latch Tube
6. Latch Release Spring
7. Bellcrank
8. Forward Vertical Latch Tube
9. Ejection Handle Assembly
10. Door Hinges
11. Striker Ejection Cable
12. Ejection Mechanism
13. Seal
14. Seal

Figure 4-3. Typical pilot's and copilot's door assembly *(c)* Adjust emergency jettison hinge pins so rounded end of pins is visible above the upper hinge and below the lower hinge.

NOTE

Actuate emergency jettison device to make certain pins clear hinges and door can be properly jettisoned. If door does not jettison, readjust as necessary.

(2) For final adjustment of door, peel shims on upper or lower door hinges as necessary.

(3) Safety ejection handle after installation with 0.020 copper wire.

4-9. Pilot's And Copilot's Door Latch.

The latch may be operated from either side of the door.

a. Removal – Pilot's and Copilot's Door Latch.

(1) Remove screw holding inner handle to shaft and remove handle.

(2) Remove access plate and disconnect two tube assemblies from bellcrank.

(3) Remove retaining ring from outer handle and remove handle from shaft.

(4) Remove door handle plate attachment screws and remove plate. Lift latch from door.

b. Inspection – Pilot's and Copilot's Door Latch.

Inspect for damage, wear, binding, and serviceability.

c. Repair or Replacement – Pilot's and Copilot's Latch.

Replace worn, damaged, or unserviceable latch.

d. Installation – Pilot's and Copilot's Door Latch.

(1) Position latch in door and install outer door handle plate.

(2) Install outer handle on shaft.

(3) Connect two tube assemblies in latch bellcrank and install access plate.

(4) Install inner handle on shaft.

4-10. Cabin Nose Radio Access Door.

The cabin nose radio access door (1, figure 4-1) provides access to the radio compartment.

a. Removal – Cabin Nose Radio Access Door.

(1) Remove hardware attaching eyebolts on plungers to door hinges.

(2) Remove hardware attaching door hinges to aircraft. (Remove hardware from right side hinge first.)

(3) Raise door to approximately 3/4 open position or until eyebolts align with holes in hinges.

(4) Remove door.

b. Inspection – Cabin Nose Radio Access Door. (Refer to paragraph 4-6.)

c. Repair or Replacement – Cabin Nose Radio Access Door. (Refer to paragraph 4-6.)

d. Installation – Cabin Nose Radio Access Door.

(1) Position door (approximately 3/4 open) so that eyebolts align with holes in hinges.

(2) Slip one washer, previously removed, onto each eyebolt attached to left and right plungers. (Contoured side of washers fit against surfaces of hinges.)

(3) Insert eyebolts through hinges.

(4) Secure plungers to hinges with two contoured washers and two nuts previously removed.

(5) Raise radio compartment door to full open position and install hinges to aircraft with hardware previously removed and secure with two cotter pins.

(6) Square up nose radio compartment door, adjust latch retainers, and check swing of door. Tighten latch retainer nuts.

4-11. Hinged Panel Door.

A hinged panel (removable door post YUH-1D) just ahead of sliding door will provide a wider opening for cargo loading. (See figure 4-1.)

a. Removal – Hinged Panel Door.

(1) Open sliding cargo door.

(2) Operate latch handle of panel door to release pins from upper and lower channels of door opening. Swing door open.

(3) Disengage stop spring from stud at top of opening.

(4) Remove quick-release pins from hinges. Lift off door panel.

NOTE

On YUH-1D with non-hinged removable door post, omit instructions above. Release latches at upper and lower forward corners, pull removable door post slightly aft and raise to release assembly from structure.

b. Inspection – Hinged Panel Door. Inspect door for dents, cracks or damage; hinges and latches for wear or damage.

c. Repair or Replacement – Hinged Panel Door. Replace worn or unserviceable hinges and latches.

d. Installation – Hinged Panel Door.

(1) Align panel door on hinges and install pins.

(2) Swing door partly closed and engage slotted stop spring on stud at top of door opening.

(3) Close door and operate handle to extend latch pins into holes in upper and lower structural channels of frame.

(4) Close sliding door to check for proper latching.

NOTE

On YUH-1D with non-hinged removable door posts, omit instructions above. Position panel to engage hangers and hook in upper and lower frame channels, and pull down to seat. Push assembly forward and secure latches to fixed door post.

4-12. Cabin Inspection Plates.

Inspection plates, secured with screws or fasteners, are provided whenever needed for inspection and maintenance of the helicopter. (See figure 4-2.)

a. Removal – Cabin Inspection Plates. Remove screws attaching plates to structure.

b. Inspection – Cabin Inspection Plates. Inspect for dents, cracks, elongated mounting holes and other obvious damage.

c. Repair or Replacement – Cabin Inspection Plates. Replace inspection plates which do not meet inspection requirements.

d. Installation – Cabin Inspection Plates. Position inspection plate in opening and attach to structure with screws.

NOTE

All fasteners shall be installed in structural panels. Non-structural panels may have every third fastener missing, however, no panel shall have more than fifty percent of the total number of fasteners missing.

4-13. Cargo Doors.

A large sliding door operating on rollers and tracks gives access to cargo-passenger area on each side of cabin. (See figure 4-1.) Each sliding door has a latch for closed position, and two jettisonable windows which can be used as emergency escape hatches. On YUH-1D, the door can be secured in open position by manually releasing the lock of a spring-loaded plunger at top front corner, which engages a guide in upper frame. Plunger is automatically retracted, by means of a cable, when door latch is operated. On UH-1D/H, the door can be secured in open position by a retractable stop located on rear bulkhead of cabin.

a. Removal – Cargo Door.

(1) Unlatch door. Check that open-position stop is retracted.

(2) Remove screw and rubber stop from aft end of lower track on fuselage behind door.

(3) Slide door aft, guiding rollers and slider out of tracks.

b. Inspection – Cargo Door.

(1) Inspect door for dents, damage and cracks.

(2) Inspect latch for binding, wear or damage.

(3) Inspect slider, P/N 204-030-220-1, for excessive wear.

c. Repair or Replacement – Cargo Door.

(1) Replace unserviceable latch. (Refer to paragraph 4-14.)

(2) If slider, P/N 204-030-220-1, is excessively worn it may be rotated 180 degrees and reinstalled, or replaced, as necessary.

d. Installation – Cargo Door.

(1) Position door with forward edge in line with aft end of door tracks.

(2) Start rollers and slider through cut-outs at aft ends of tracks. Push door forward.

(3) Install rubber bumper with screws at aft end of lower track on fuselage.

e. Adjustment – Cargo Door. Both sliding cargo doors must be properly aligned to be secure in all flight conditions and to operate correctly. Check and adjust fit of each door according to procedure outlined below:

(1) Place door to full closed and latched position. Check upper edge of door for being parallel to top of cabin door frame.

(2) If door is out of alignment, loosen screws attaching roller support and slider (or roller) support on rear edge of door. Adjust slider support (lowest of two supports on rear edge) to raise or lower door to align upper edge parallel to door frame. Tighten slider support screws.

(3) Adjust roller support (upper of two on rear edge) so that roller is fully engaged in track. Tighten attaching screws.

(4) Operate door through full travel while checking that all rollers on upper edge are fully engaged in track at all positions. Adjust roller supports as required.

(5) With door fully closed and latched, check that lower door track is engaged not less than 0.25 inch in cabin door channel. If required, loosen screws attaching lower track on door and adjust track to provide maximum engagement in cabin door channel without restricting door travel through full range from closed to open positions. Be sure door track attaching screws are tightened after adjustment.

(6) Check door latch for proper operation and adjust if required. (Refer to paragraph 4-14.)

4-14. Cargo Door Latch.

A latch is provided for both sides of the cargo door.

a. Removal – Cargo Door Latch.

(1) Unhook tension spring (1, figure 4-4) from latch hook (10) and from hanger directly below on door structure.

(2) Remove outer handle (6) of latch.

(a) Remove set-screw (5) which secures handle to latch shaft (9).

(b) On YUH-1D/H only, pull handle off end of shaft.

(c) On UH-1D/H, remove two screws to detach door handle plate (7) from door. Pull handle and door handle plate assembly off end of shaft. When necessary, remove retaining ring (8) to separate parts.

(3) Withdraw latch shaft to remove inner handle (12) and hook (10), with washers. On YUH-1D, disconnect cable fork terminal (14) from rear end of handle by removing cotter pin, flat head pin, and washer.

NOTE

Mark hole in handle (10) to which cable (14) was attached so that cable can be installed to same hole. Do not remove lockwire from cable terminal.

(4) Leave latch adjustment set-screw (5) and handle stop (4) in place in support channel (2), unless replacements are necessary. On YUH-1D, shaft bushing (13) with retaining ring and washer can be removed for replacement.

b. Installation – Cargo Door Latch.

(1) Check that hook adjustment set-screw and angle fitting which serves as stop (4, figure 4-4) for inner handle (12) are installed in support channel (2) of door. On YUH-1D, install shaft bushing (13) through outboard side of channel (2) and secure with thin washer and retaining ring.

(2) Place latch hook (10) in fork of inner handle (12). Insert a washer between hook and handle at outboard side of UH-1D/H; at inboard side on YUH-1D.

(3) Place hook and handle assembly into support channel (2) of door, with hook through guide slot. Align holes and insert latch shaft (9) from inboard side.

(4) On UH-1D/H, check that door handle plate (7) is secured on outer handle (6) with retaining ring (8).

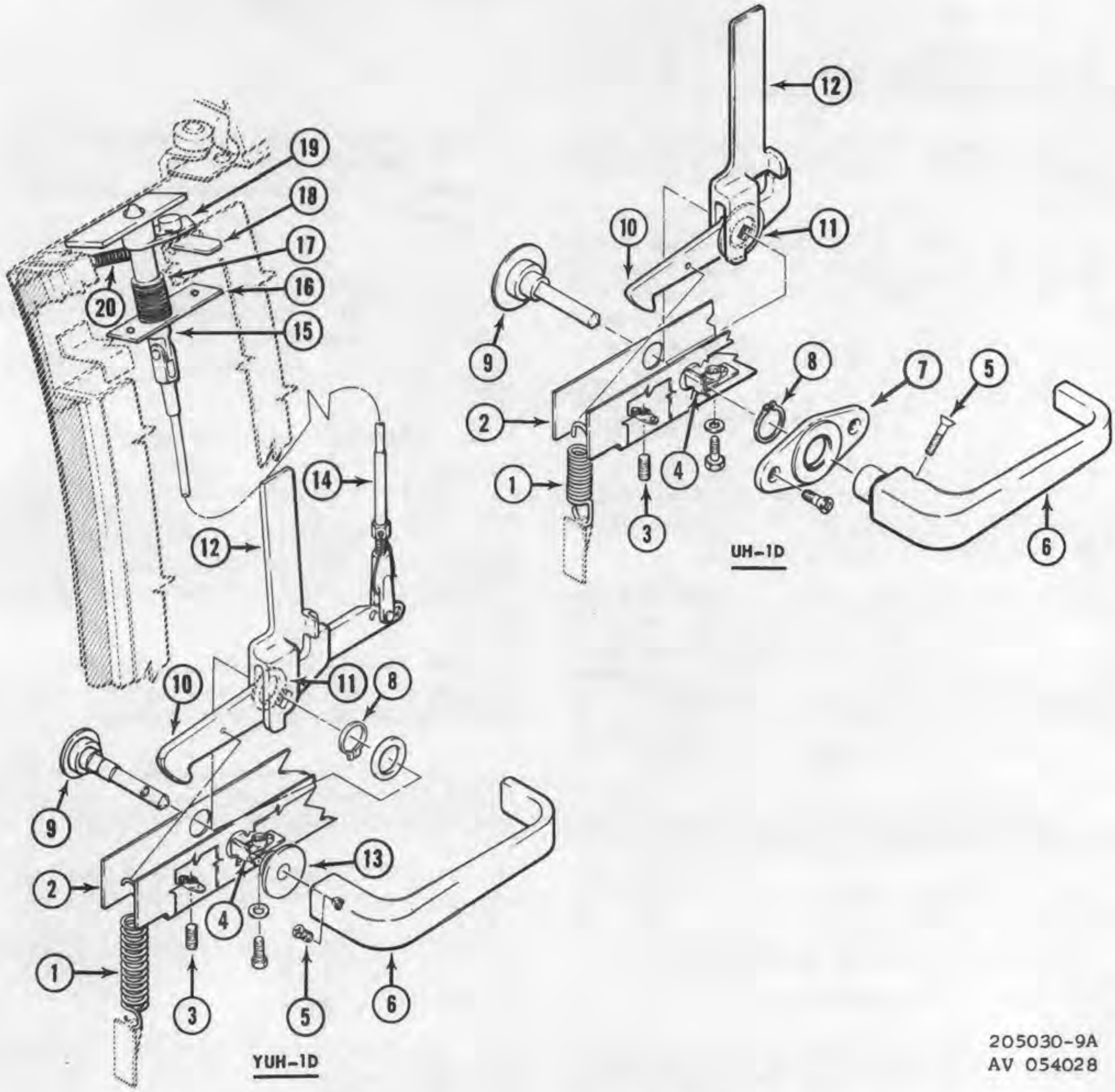
(5) Place outer handle (6) over end of latch shaft (9). Check alignment of parts before installing set-screw through handle into shaft.

(a) Outer handle (6) should be pointing aft and horizontal when inner handle (12) is upright, with stop (4) face against angle fitting in bottom of support channel (2). If necessary, change position of latch shaft (9) to align holes for set-screw, and adjust position of stop fitting.

(b) On UH-1D/H, secure door handle plate (7) to door with two screws.

(c) On YUH-1D, check gap between latch bushing (13) and shoulder on latch shaft (9) for 0.040 inch maximum. If necessary, install washer to reduce gap.

(6) Connect tension spring (1) between latch hook (10) and hanger located below on door structure.



1. Tension Spring
2. Door Structure Channel
3. Hook Adjusting Screw
4. Stop
5. Set-Screw
6. Outer Handle
7. Door Handle Plate (UH-1D)
8. Retaining Ring
9. Latch Shaft
10. Hook
11. Washer
12. Inner Handle
13. Shaft Bushing (YUH-1D)
14. Actuating Cable (YUH-1D)
15. Plunger (YUH-1D)
16. Retainer (YUH-1D)
17. Plunger Spring (YUH-1D)
18. Lock (YUH-1D)
19. Guide (YUH-1D)
20. Release Spring (YUH-1D)

Figure 4-4. Cargo door latches – typical

(7) On YUH-1D, connect cable from plunger of position lock (18) to rear arm of inner handle (12) with flat head pin, washer, and cotter pin.

(8) Check operation of latch. Adjust set-screw under latch hook so that hook will positively engage striker in panel door.

(9) On YUH-1D, also check operation of position lock (18) at top of door. If necessary, adjust cable (14) terminal or change attachment hole. Lock-wire cable (14) terminal through fork.

4-15. Cowling.

Cowling and fairings are used to protect and provide easy maintenance access to engine compartment, intake and exhaust tailpipe areas, and top of main transmission.

4-16. Engine Cowling.

Engine compartment between front and rear firewalls is covered by side and upper cowling assemblies. (See figure 4-1.) Each side cowl opens by swinging aft on hinges of rear firewall, and can be secured open by a web strap snapped to a stud on fuselage. Upper cowl sections swing upward on hinges of a beam between tops of firewalls, and are held open by rods. Flush-type spring-locking latches provide closure.

a. Removal – Engine Cowling.

(1) Unlatch and open each side cowling. Pull pins from hinges on rear firewall to remove cowling sections.

(2) Unlatch upper cowl and raise to open position at each side.

(3) Disconnect fire detector wiring at connectors near top of front firewall.

(4) Disconnect flexible duct with clamp from starter-generator cooling air intake on cowling support beam.

(5) Pull out pins at each end of beam to detach from firewall. Remove beam with upper cowl sections attached.

b. Inspection – Engine Cowling. Inspect cowling for major cracks, dents and damage.

c. Repair or Replacement – Engine Cowling. Replace engine cowling which does not meet inspection requirements, or repair per 55-1500-204-25/1

d. Installation – Engine Cowling.

(1) Lift upper cowling assembly to position. Align ends of beam in brackets on front and rear firewalls and install pins.

(2) Engage support rods to hold upper cowling open.

(3) At right side of engine, connect flexible duct from starter-generator cooling blower to air intake on bottom of cowling support beam. Secure duct with clamp.

(4) Connect fire detector wiring from both cowl sections to connectors near top of front firewall.

(5) Align side cowling sections to hinges on rear firewall and install hinge pins.

(6) Close upper cowling, with support rods stowed in clips. Close side cowlings.

4-17. Engine Intake Fairing Or Air Filters.

The engine air intake area, above cabin roof level and between the transmission fairing and the engine compartment cowling, is enclosed either by a fairing with side louvers (3, figure 4-1) or by a three-section air filter installation. As original equipment (subject to field modification) the following configurations may be encountered:

a. Through Serial No. 62-12372: Three-piece fairing, consisting of a top panel and two side louvers. Panel is secured to tops of induction baffle and engine firewall by cowling fasteners. Side louvers are secured at bottom by bolts to plate-nuts in cabin roof structure, and at top to sides of panel by cowling fasteners.

b. On Serial No. 63-8739 through 65-9810: Fairing similar to that described above, but with side louvers hinged to top panel and secured to cabin roof by cowling fasteners. Side louvers can be opened upward and held open by rods, for access to engine inlet area.

c. On Serial No. 65-9811 and subsequent, or on earlier aircraft so modified: Three-piece air inlet filters, secured by cowling fasteners.

4-18. Transmission Cowling.

A one-piece cowling (2, figure 4-1) over front and sides of transmission upper area, is secured by three latches and two hinge assemblies. For access, the unlatched fairing can be swung forward to rest on cabin roof.

a. Removal – Transmission Cowling.

(1) Disengage three latches and swing cowling to open position.

(2) Detach hinges from three fittings on cabin roof by removing bolts with nuts and washers. Lift off cowling assembly. If hinges are detached from cowling, observe position of washers used for alignment, for reassembly in same manner.

b. Inspection – Transmission Cowling.

(1) Inspect hinges, latches and fitting for wear, damage and serviceability.

(2) Inspect seals for cracks, tears, deterioration and security of bonding.

(3) Inspect major cowling for dents, cracks and damage.

c. Repair or Replacement – Transmission Cowling.

(1) Replace hinges, latches, fittings and seals if unserviceable.

(2) Replace cowling if damaged or repair per TM 55-1500-204-25/1.

d. Installation – Transmission Cowling.

(1) Position cowling hinges to fittings on cabin roof and install bolts with washers and nuts.

(2) Swing cowling to closed position. Check alignment for secure latching and for clearance with control linkages or other parts on transmission pylon.

4-19. Tailpipe Fairing.

A three-piece fairing (5, figure 4-1) covers exhaust tailpipe area behind engine rear firewall, and is secured by cowl fasteners. An antenna and anti-collision light are mounted on top of upper fairing.

a. Removal – Tailpipe Fairing.

(1) Through door in lower left fairing, disconnect antenna and anti-collision light wiring at deck connectors.

(2) Open drive shaft cover which overlaps upper fairing. Release fasteners and remove upper and two lower tailpipe fairings.

b. Inspection – Tailpipe Fairing. Inspect for major damage, cracks or dents.

c. Repair or Replacement – Tailpipe Fairing. Replace fairing if inspection requirements are not met, or repair per TM 55-1500-204-25/1.

d. Installation – Tailpipe Fairing.

(1) Install and fasten lower fairings and upper fairing. Close drive shaft cover.

(2) Through door on lower left fairing, connect antenna and anti-collision light wiring at deck connectors.

4-20. Pilot's And Copilot's Seats.

Crew seats are adjustable, non-reclining type, mounted on tracks fixed to cabin floor. (See figure 4-5.) Lubricate pilot's and copilot's seat tracks with lubricant (item 6, table 1-2) as required.

a. Removal – Pilot's and Copilot's Seats.

(1) Remove stopbolts or quick-release pins at aft ends of seat tracks.

(2) Lift handle, located on left side of seat, to release position pin. Slide seat aft off tracks.

b. Installation – Pilot's and Copilot's Seats.

(1) Engage rollers on aft end of tracks. Lift handle on left side of seat. Slide seat forward on tracks to normal position.

(2) Install stopbolts or quick-release pins at aft ends of tracks.

c. Adjustment – Pilot's and Copilot's Seats. Vertical adjustment is provided by a lever on right side of each seat. Fore and aft adjustment lever is located on left side of seat. Tightening or loosening of the seat (bottom) net is accomplished by adjustment of turnbuckles. The back net tension can be controlled by use of the nylon cord lacing.

4-21. Pilot's And Copilot's Armored Seat.

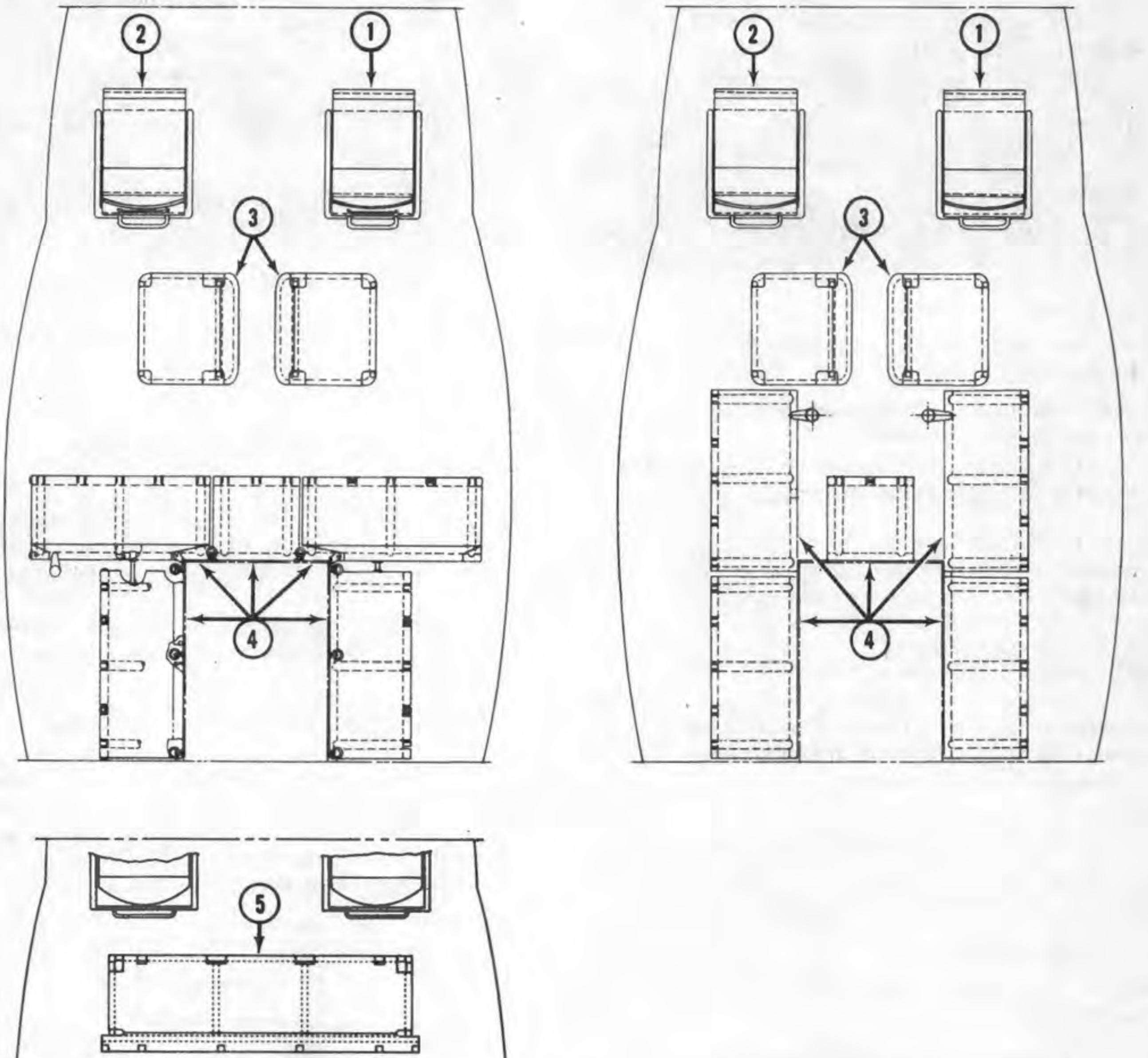
The seat armor, constructed from a composite ceramic-metal material, is designed to protect pilot and copilot against small arms ball and armor piercing ammunition. A segmented construction is used to permit the replacement of any damaged components.

CAUTION

Armored seats are equipped with a quick release; activating the quick release will recline seats to aid in removal of injured personnel. (See figure 4-6.)

NOTE

Armored seats cannot be used in the helicopter without the armored shell.



1. Pilot's Seat
2. Copilot's Seat
3. Passenger Seats (Folding)
4. Passenger Seats
5. Passenger Seats (Non-folding)

Figure 4-5. Seating arrangement

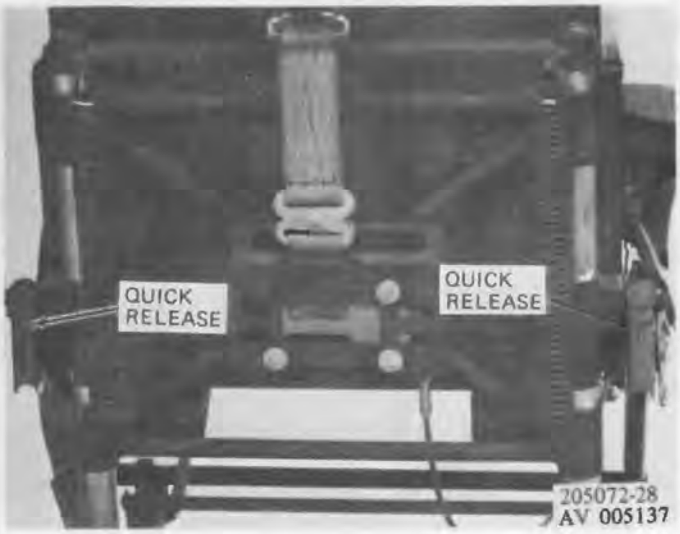


Figure 4-6. Armored seat reclining quick release

Pilot's and copilot's armored seats which may be installed in this helicopter are part numbers:

PILOT'S	COPILOT'S
177787-1	177755-1
177787-3	177755-3
178061-1	178062-1
*178061-3	*178062-3

*Latest Model, Supersedes Earlier Models

a. Removal – Pilot's and Copilot's Armored Seat.

NOTE

When changing from armored seats to standard seats or vice versa, inertia reel must be repositioned either on helicopter cabin floor for standard seat or attached to back of armored seat.

NOTE

Retain removed hardware and serviceable parts for reinstallation.

(1) Remove bolts holding shoulder straps to tension reel.

(2) Remove adjustment buckles from both halves of seat belt.

(3) Remove both halves of seat belt through slots provided in armored seat.

(4) Remove inertia release lever.

(5) Remove inertia reel release cable.

(6) Remove the inertia reel from box on armored seat.

(7) Remove rear seat stops from ends of seat track.

(8) Place seat in full down position and remove from helicopter.

b. Inspection – Pilot's and Copilot's Armored Seat.

(1) Inspect armor for damage from enemy fire and other unserviceable conditions.

(2) Inspect for proper movement and locking of side panels.

(3) Inspect quick release for condition and proper safety. Use 0.20 copper wire to safety the quick release. (See figure 4-6.)

c. Repair or Replacement – Pilot's and Copilot's Armored Seat. Replace any segment that is damaged or shows unserviceable condition.

d. Installation – Pilot's and Copilot's Armored Seat.

(1) Attach inertia release lever to seat.

(2) Install inertia reel into box provided.

(3) Install release cable.

NOTE

Test operation of tension reel at this time.

(4) Install shoulder straps into armored seats and bolt to tension reel.

(5) Install both halves of seat belt through slots provided with belts going over the tubes of the seat frame.

(6) Place seat in full down position. Install on seat rails and install seat stops. When installing lightweight seats, seat stops, P/N 204-072-085-3, shall be installed on outboard and inboard tracks using 2 each AN3-12A bolts, AN960PD10L washers and NAS43DD-3-31 spacers. Install stops utilizing nut plates vacated by removal of 2 aft, track attachment screws.

(7) Install adjustment buckles on seat belts.

4-22. Armored Seat Headguard.

The headguard attaches to the lightweight armored seat to provide additional ballistic protection. (Figure 4-7.)

NOTE

Headguards are optional equipment authorized for air ambulance UH-1's only.

a. Removal – Armored Seat Headguard and Support Bracket. Remove inboard and outboard shoulder panels, seat cushion, then headguard support bracket.

b. Inspection – Armored Seat Headguard. Visually inspect headguard for shattered, cracked, or unbonded ceramic tiles.

c. Repair or Replacement – Armored Seat Headguard. Replace the headguard panel if any portion of the ceramic facing is damaged.

d. Installation – Armored Seat Headguard and Support Bracket.

(1) Attach the headguard support bracket with the long screws at the shoulder harness guide location.

(2) Fasten the seat cushion, using the long screws at the two upper attachment flanges and the short screws at the lower flanges.

(3) Bolt headguard to the support bracket, shimming with as many washers as necessary between the spacer plates and the support clamps to provide a firm clamping action on the back panel. See Figure 1.

(4) Install shoulder panels.

4-23. Crew Seat Covers.

Crew seat metal frames are covered with nylon mesh material. Metal eyes are provided in seat back cover for lacing with nylon cord. Metal strips are attached to tabs of lower seat cover with eyelets for attachment of turnbuckles.

a. Removal – Crew Seat Covers.

(1) Remove seat back cover as follows:

(a) Lift flap on aft side of seat back cover for access to nylon cord.

(b) Untie nylon cord and loosen as necessary to remove cover.

(2) Remove lower seat cover as follows:

(a) Cut lockwires and loosen turnbuckles underneath seat.

(b) Disconnect turnbuckles from metal reinforcing strips in seat cover tap.

b. Installation – Crew Seat Covers.

(1) Install seat back cover as follows:

(a) Position cover on seat back.

(b) Use nylon cord laced through reinforcing eyes to tighten cover to desired tension.

(c) Secure in position by tying nylon cord.

(2) Install lower seat cover as follows:

(a) Position cover on lower seat.

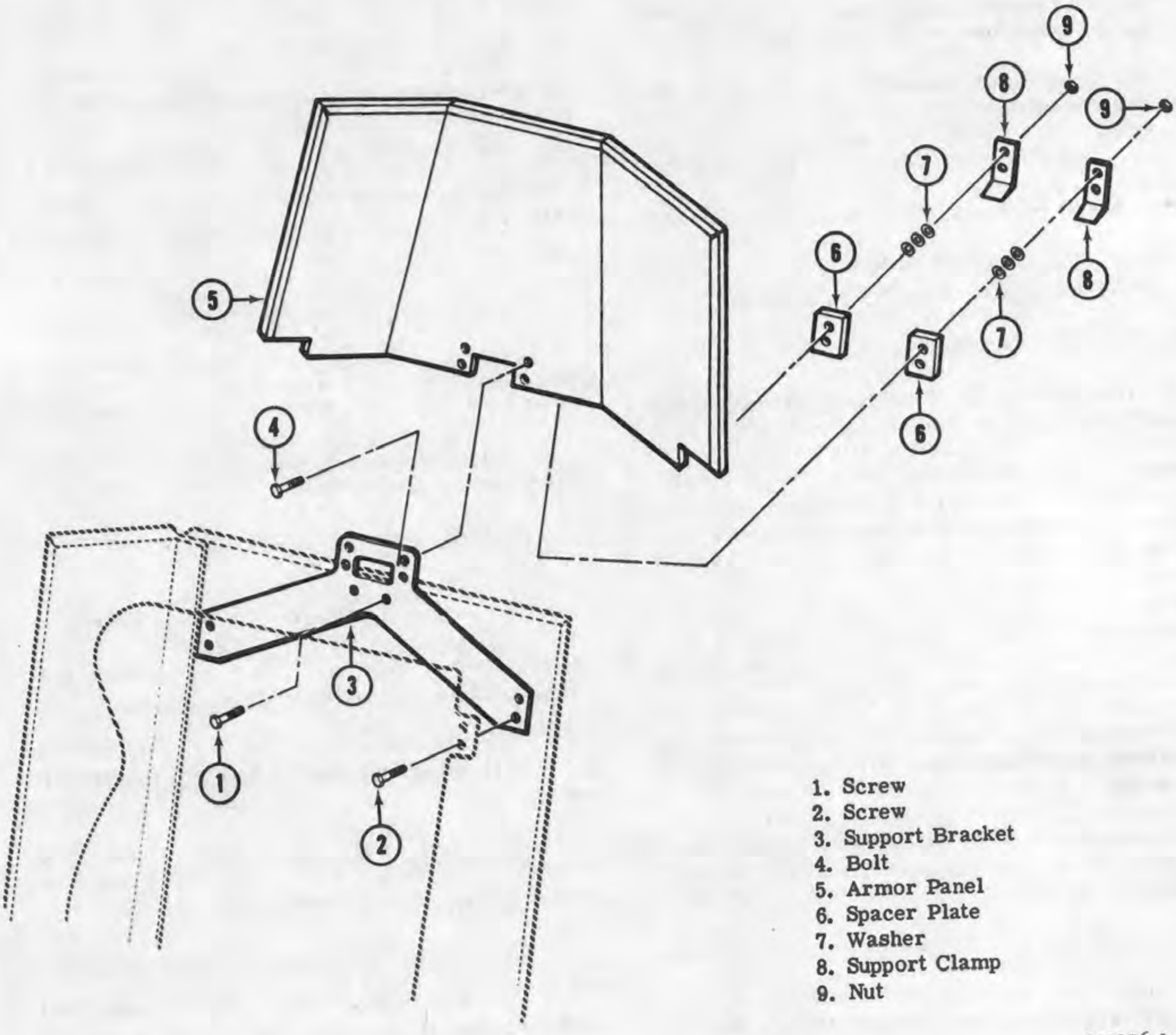
(b) Attach turnbuckles to metal reinforcing strips in seat cover through slots provided in material.

(c) Adjust seat cover to desired tension by tightening turnbuckle. Lockwire turnbuckles together for security.

c. Adjustment – Crew Seat Covers. If turnbuckle has reached its extreme position and further tightening is desired, the seat cover may be tightened further as follows:

(1) Cut lockwire securing turnbuckle.

(2) Loosen and disconnect turnbuckles from metal reinforcing strip in seat cover tab.



1. Screw
2. Screw
3. Support Bracket
4. Bolt
5. Armor Panel
6. Spacer Plate
7. Washer
8. Support Clamp
9. Nut

205156-1
AV 089056

Figure 4-7. Armored seat headguard

(3) Turn metal reinforcing strip one-half turn.

NOTE

Roll tab material evenly.

(4) Connect turnbuckles to metal reinforcing strips through slots provided in material.

(5) Adjust seat covers to desired tension by tightening turnbuckles.

(6) Lockwire turnbuckles together for security.

4-24. Troop Seats.

Arrangements have been made in aft section of the forward fuselage section for seating eleven passengers. Either of the two following arrangements may be used for passenger seating.

a. Three seats facing forward, and accommodating five passengers, may be placed across cabin immediately forward of the transmission support structure. A one-passenger seat, without back rest, is located between two two-man seats (4, figure 4-5) which have backs. Two more two-man seats (4), without backs, are located parallel to the helicopter center line aft of the five passenger seats. Passengers in these seats face outboard. Two single-passenger folding seats, with backs (3), are located just aft of the crew seats.

b. Four two-man seats, facing outboard, may be placed, two on each side of the helicopter center line, approximately in line with the side faces of the transmission support structure. The two forward seats (4) are equipped with backs. A one-passenger seat, without back rest, is located immediately forward of the transmission support structure on the helicopter center line and faces forward. Two single-passenger folding seats, with backs (3), are located aft of the pilot's and copilot's seats.

NOTE

Single troop seats (3) can be installed facing forward, aft, or towards either side of the helicopter.

c. A three-man non-folding troop seat kit is provided to use in place of the two single-passenger folding seats, located just aft of the crew seats.

d. Removal – Troop Seats.

(1) Remove one-man seat without back as follows:

(a) Slide collar of each leg attachment fitting upward from the floor to release fittings from floor studs.

(b) Disengage aft tube assembly from spring-loaded lock fittings and remove seat assembly from the helicopter.

(2) Remove one-man seat with back as follows:

(a) Slide collar of each leg attachment fitting upward from the floor to release fittings from floor studs.

(b) Pull the quick-release pin attaching seat back support tubes to each side of the seat bottom, and fold seat back forward onto seat bottom.

(c) Pull the quick-release pin attaching diagonal leg brace to forward leg and fold each leg inboard against seat bottom.

(d) Remove seat assembly from helicopter.

(3) Remove two-man seat without back as follows:

(a) Slide collar of each leg attachment fitting upward from the floor to release fittings from floor studs.

(b) Disengage aft tube assembly from fittings and fold seat legs against seat bottom.

(c) Remove seat assembly from the helicopter.

(4) Remove two-man seat with back as follows:

(a) Pull upper and lower quick-release pins attaching seat back to stanchion assembly fittings.

(b) Remove nuts, washers, and bolts attaching seat back to fittings and fold seat back forward onto seat bottom.

(c) Slide collar of each leg attachment fitting upward from the floor to release fittings from floor studs and fold seat assembly legs against bottom of seat.

(d) Remove seat from helicopter.

(e) Slide collars of upper and lower attachment fittings on stanchion assemblies toward center of assembly to release stanchions from roof and floor studs, and remove stanchion assemblies from the helicopter.

(5) Remove three-man troop seats with back as follows:

(a) Slide collar on each leg attachment fitting upward from the floor to release fittings from floor studs.

(b) Remove seat from helicopter.

e. Installation – Troop Seats.

(1) Install one-man seat without back as follows:

(a) Position seat assembly in helicopter and engage aft tube assembly in spring-loaded lock fittings.

(b) Position seat assembly support legs on floor studs and secure legs to floor by sliding attachment fitting collars downward as far as possible.

(2) Install one-man seat with back as follows:

(a) Unfold diagonal leg brace and attach to forward leg with quick-release pin.

(b) Raise seat back to vertical position and attach seat back support tubes to each side of seat bottom by installing quick-release pins.

(c) Position seat assembly support legs on floor studs and secure legs to floor by sliding attachment collars downward as far as possible.

(3) Install two-man seat without back as follows:

(a) Position seat assembly in helicopter and engage aft tube assembly in fittings.

(b) Unfold seat assembly support legs and position on floor studs. Slide leg attachment fitting collars downward as far as possible to secure legs to floor.

(4) Install two-man seat with back as follows:

(a) Position stanchion assemblies in helicopter between roof and floor studs and slide attachment fitting collars as far as possible toward studs to secure stanchion assemblies to roof and floor.

(b) Unfold seat assembly support legs and position on floor studs. Slide leg attachment fitting collars downward as far as possible to secure legs to floor.

(c) Raise seat back to vertical position and install bolts, washers, and nuts attaching seat back to fittings.

(d) Position seat back in stanchion assembly fittings and install upper and lower quick-release pins.

(5) Position seat assembly support legs on floor studs and secure legs to floor by sliding attachment fitting collars downward as far as possible.

4-25. Troop Seat Belts.

Individual lap-type seat belts are provided for all troop seats. The same belts, with web extensions, are provided for litter patients when helicopter is used for rescue missions.

a. Removal – Troop Seat Belts.

(1) To remove seat safety belts, unsnap both ends of the belt from rings and remove belt.

(2) To remove safety belts and extensions from litters, disconnect belt from extension and remove from litter.

b. Inspection – Troop Seat Belts. Inspect belts for fraying, wear, and loose stitching.

c. Repair or Replacement – Troop Seat Belts. Replace worn or unserviceable belts.

NOTE

Seat belts are replaced at 60 month intervals. (Refer to TM 55-1500-204-25/1.)

d. Installation – Troop Seat Belts.

(1) To install seat safety belts, position belt across seat bottom and attach both ends by snapping to rings.

WARNING

Assemble each belt with release handle pointing left.

(2) To install safety belts and extension on litters, connect one end of belt to extension. Pass belt and extension combination around litter and connect other ends.

NOTE

Two safety belt and extension combinations are required for each litter.

4-26. Crew Seat Belts.

Lap-type seat belts are installed on crew seats. On YUH-1D, seat belts are attached to structure of seat. On UH-1D/H, seat belts are attached to fittings on cabin floor.

a. Removal – Crew Seat Belts. Remove bolts, washers and nuts holding seat belt to fittings.

b. Inspection – Crew Seat Belts. Inspect belts for fraying, wear and loose stitching.

c. Repair or Replacement – Crew Seat Belts. Replace worn or unserviceable seat belts.

NOTE

Seat belts are replaced at 60 month intervals. (Refer to TM 55-1500-204-25/1.)

d. Installation – Crew Seat Belts. Position belts on fittings and install nuts, washers and bolts.

4-27. Shoulder Harness And Inertia Reel.

An inertia reel shoulder harness, with a manually operated control handle is incorporated on each pilot seat. The inertia reel is a mechanical restraining device that is designed to hold pilot in a normal seated position during any maneuver which would tend to pitch the pilot forward. Each reel is connected to a shoulder harness with a web strap. An automatic locking mechanism, a webbing roller, and a manual control are incorporated in each unit. (See figure 4-8.)

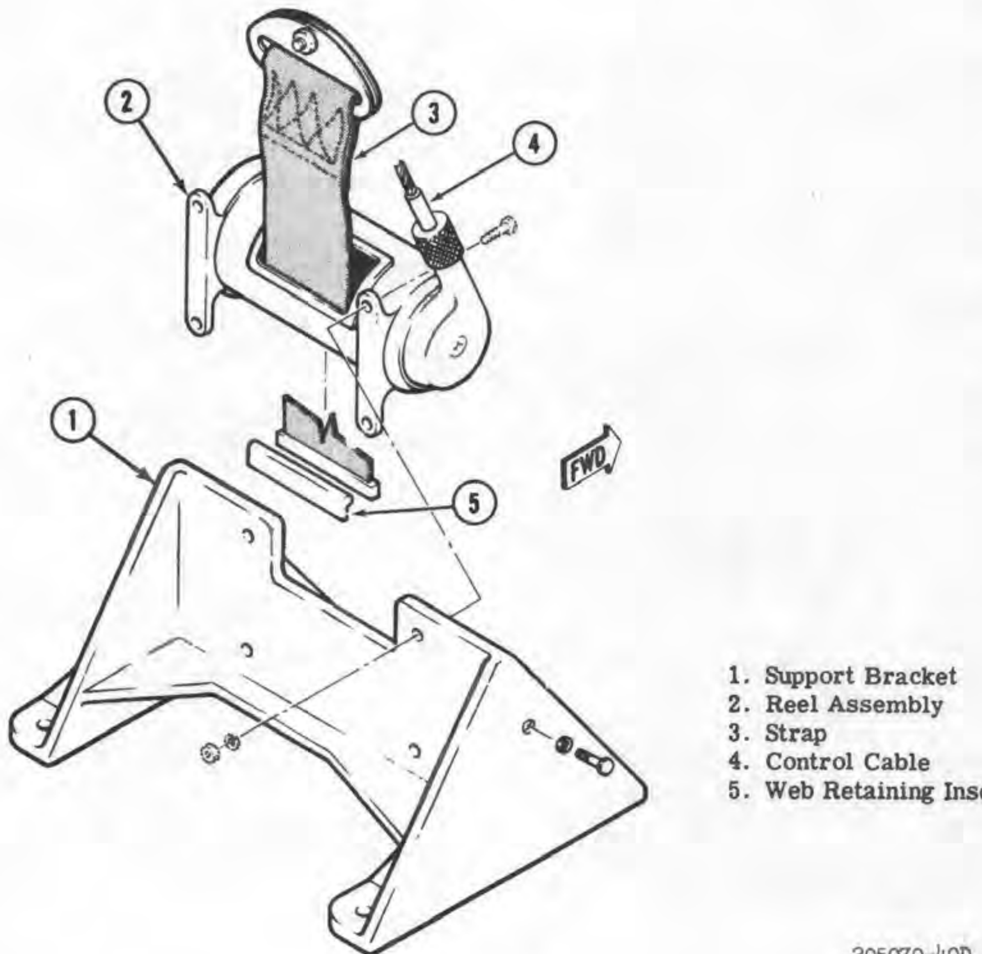
NOTE

Shoulder harness shall be replaced at 60 month intervals. (Refer to TM 55-1500-204-25/1.)

a. Operational Check – Inertia Reel.

(1) Inspect shoulder harness for wear and security of attachment to reel webbing. Inspect inertia reel for security of mounting and attachment to floor structure.

(2) Place manual control handle to AUTO position. Disconnect shoulder harness from reel webbing, attach spring scale to end of reel webbing and, while watching scale, slowly pull length of webbing out of inertia reel. The tension indicated shall be not less than two pounds initially nor more than six pounds when the final increment is pulled out of the reel.



1. Support Bracket
2. Reel Assembly
3. Strap
4. Control Cable
5. Web Retaining Insert

Figure 4-8. Inertia reel

(3) Cycle control handle from AUTO to MANUAL several times as the reel webbing is being reeled in and out. The reel shall positively lock and hold each time the handle is moved to MANUAL.

b. Removal – Inertia Reel. (See figure 4-8.)

(1) Detach shoulder harness from inertia reel strap by removing bolt with nut and washer.

(2) Remove manual control handle from seat.

(3) Remove attaching hardware.

(4) Remove four nuts, washers, and bolts to detach inertia reel from mounting bracket.

c. Repair or Replacement – Inertia Reel. Replace if inertia reel fails operational check. (Refer to paragraph 4-27 a.)

d. Installation – Inertia Reel.

(1) Position inertia reel in mounting bracket. Install four bolts, washers, and nuts.

(2) Install manual control handle on seat.

(3) Attach shoulder harness to inertia reel strap with bolt, nut and washer.

4-28. Inertia Reel Strap.

Web straps are used for connecting each inertia reel to shoulder harness.

a. Removal – Inertia Reel Strap.

(1) Move inertia reel control handle to AUTO position and pull out slowly on strap assembly (3, figure 4-8) until web retaining insert (5) is visible through lower slot in reel housing (2), then move control handle to MANUAL to lock reel.

NOTE

Reel must remain positively locked until new strap (3) assembly is installed. If the reel is inadvertently released while the strap is removed, replace the entire reel assembly.

(2) Remove web retaining insert (5) and withdraw strap (3) from reel.

b. Inspection – Inertia Reel Strap. Inspect strap for fraying, wear, and loosened stitches.

c. Repair or Replacement – Inertia Reel Strap. Replace strap if frayed, worn or unserviceable.

d. Installation – Inertia Reel Strap.

(1) Insert end of new strap through upper slot in reel housing and through slot in main shaft until end of strap (3, figure 4-8) protrudes through lower slot in reel housing.

(2) Install web retaining insert (5), then pull upward on strap (3) with at least six pounds force. Maintain force until reel lock is released.

(3) Move control handle to AUTO position and allow strap (3) to rewind onto main shaft.

4-29. Windshields.

Windshields are made of transparent plastic. They are set in weathertight sealer, and are mounted to the cabin structure with dural screws, washers, and nuts.

a. Removal – Windshield.

(1) Cut lockwire, loosen Allen head screw, remove bolt at wiper shaft, and lift wiper assembly from shaft.

(2) Remove free air temperature gage. (Pilot's windshield only.)

(3) Remove nuts, washers, and screws attaching windshield to fuselage.

(4) Separate windshield from sealing compound and remove windshield from helicopter.

b. Cleaning – Windshield. (Refer to TM 55-1500-204-25/1.)

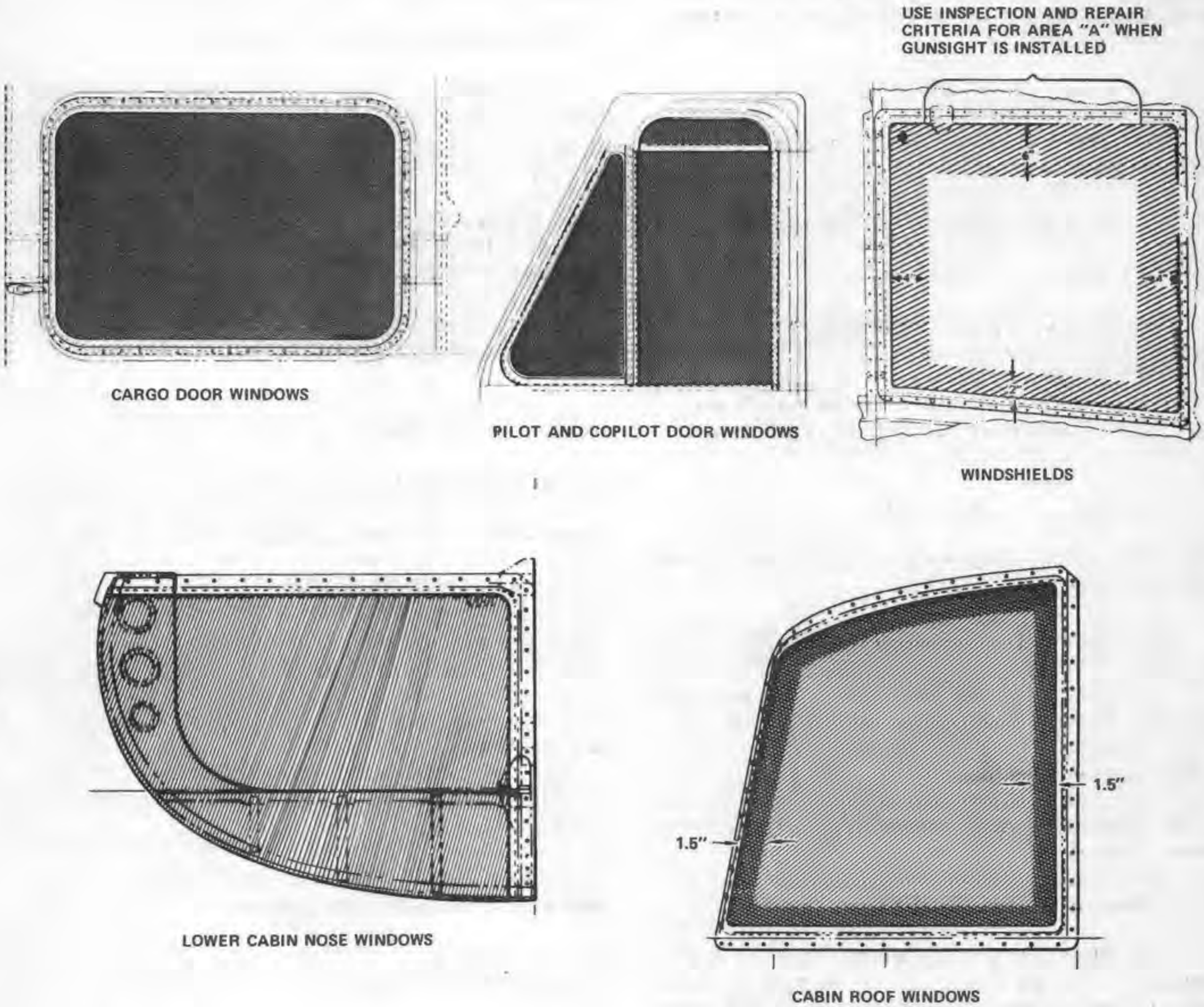
c. Inspection – Windshield. Inspect windshield for cracks or damage that might impair pilot's vision. See figure 4-9 for critical areas and repair limits.

d. Repair or Replacement – Windshield. Replace windshield if damage is greater than practical to repair. Repair damaged windshield in accordance with instructions contained in TM 55-1500-204-25/1. Replace windshield if critical areas are damaged. (See figure 4-9.)

e. Installation – Windshield.

(1) Remove old sealing compound from mounting flange with putty knife, spatula, or other suitable tool.

(2) Wipe and clean mounting flange with cloth dampened with naphtha, (item 304, table 1-2).



Area "A": Scratches and pits may be polished out to the extent that vision is not distorted. Distortion of vision is cause for replacement. Cracks, holes or other damage may be temporarily repaired, if vision of crew members will not be impaired, by stop drilling, patching or other approved methods (refer to TM 55-405-4), but window must be replaced at the earliest opportunity.

Area "B": Scratches and pits are permitted in this area provided they are not so numerous or form such a pattern as to be objectionable to the viewer. Cracks, holes or other damage may be temporarily repaired by stop drilling, patching or other approved methods (refer to TM 55-405-4), but window must be replaced at the earliest opportunity.

Area "C": Scratches and pits are permitted in this area, providing the structural integrity of the window is not impaired. Cracks, holes or other damage may be repaired by stop drilling, patching or other approved methods provided structural integrity is not impaired (refer to TM 55-405-4).

AV 054302

Figure 4-9. Windows critical areas diagram

(3) Position windshield over opening. Trim surplus edge to permit windshield to be in mounting position against flange.

NOTE

Do not trim windshield to final size until all mounting holes have been drilled.

(4) Position windshield against mounting flange, and using a 0.190 to 0.196 inch drill, back drill two holes on each edge of windshield. Use holes in mounting flange as template.

(5) Secure windshield to mounting flange with four dural screws, washers, and nuts, lightly tightened. Finish drilling holes in windshield.

(6) Determine proper edge distance, mark windshield and remove. Trim windshield edge to proper size.

(7) Remove all dust and foreign matter from windshield mating area and from windshield mounting flange.

(8) Apply a 0.125 inch bead of water-tight sealing compound (item 200, table 1-2), on windshield mating area.

(9) Position windshield in mounting flange, align holes and install screws, washers and nuts.

(10) Remove excess sealing compound from around windshield and repaint as necessary.

(11) Install windshield wiper assembly.

(12) Install a free air temperature gauge on pilot's windshield, clean mating area, seal with sealing compound.

4-30. Upper Door Windows – Pilot's And Copilot's.

Refer to paragraph 4-8 for description.

a. *Removal – Upper Door Windows – Pilot's and Copilot's.* Perform steps (3) and (4), paragraph 4-29 a.

b. *Cleaning – Upper Door Windows – Pilot's and Copilot's.* (Refer to TM 55-1500-204-25/1.)

c. *Inspection – Upper Door Windows – Pilot's and Copilot's.* (Refer to paragraph 4-29 c.)

d. *Repair or Replacement – Upper Door Windows – Pilot's and Copilot's.* (Refer to paragraph 4-29 d.)

e. *Installation – Upper Door Windows – Pilot's and Copilot's.* (Refer to paragraph 4-29 e.)

4-31. Adjustable Windows – Pilot's And Copilot's Door.

(Refer to paragraph 4-8 for description.)

a. *Removal – Adjustable Windows – Pilot's and Copilot's Door.*

(1) Remove screws attaching plastic handle to window.

(2) Remove screws holding cover plate to bottom door channel, in door frame, below the window.

(3) Guide window downward through slot in bottom of door assembly and remove from door.

b. *Cleaning – Adjustable Windows – Pilot's and Copilot's Door.* (Refer to TM 55-1500-204-25/1.)

c. *Inspection – Adjustable Windows – Pilot's and Copilot's Door.* Inspect windows for damage that might impair pilot's vision. See figure 4-9 for critical areas and repair limits.

d. *Repair or Replacement – Adjustable Windows – Pilot's and Copilot's Doors.* Replace windows if damage is greater than practical to repair. Repair damage in accordance with TM 55-1500-204-25/1. Replace windows if critical areas are damaged. (See figure 4-9.)

e. *Installation – Adjustable Windows – Pilot's and Copilot's Doors.*

(1) Guide window upward through slot in bottom of door channel, and into side window channels.

NOTE

Check progress through opening in aft edge of door.

(2) Place window in partially closed position and attach window handle and bottom door channel cover plate with screws.

4-32. Cabin Roof Windows.

Refer to paragraph 4-5 for description.

a. *Removal – Cabin Roof Windows.* Perform steps (3) and (4), paragraph 4-29 a.

b. *Cleaning – Cabin Roof Windows.* (Refer to TM 55-1500-204-25/1.)

c. *Inspection – Cabin Roof Windows.* Inspect windows for damage that might impair pilot's vision. See figure 4-9 for critical areas and repair limits.

d. Repair or Replacement – Cabin Roof Windows. Replace windows if damage is greater than practical to repair. Repair damage in accordance with TM 55-1500-204-25/1. Replace windows if critical areas are damaged (see figure 4-9.)

e. Installation – Cabin Roof Windows. (Refer to paragraph 4-29 e.)

4-33. Lower Forward Cabin Windows.

Refer to paragraph 4-5 for description.

a. Removal – Lower Forward Cabin Windows.

(1) Remove rear view mirror. (Refer to paragraph 4-41 a.)

(2) Remove window. (Perform steps (3) and (4), paragraph 4-29 a.)

b. Cleaning – Lower Forward Cabin Windows. (Refer to TM 55-1500-204-25/1.)

c. Inspection – Lower Forward Cabin Windows. Inspect windows for damage that might impair pilot's vision. See figure 4-9 for critical areas and repair limits.

d. Repair or Replacement – Lower Forward Cabin Windows. (Refer to paragraph 4-32 d.)

e. Installation – Lower Forward Cabin Windows.

(1) Install window. (Refer to paragraph 4-29 e.)

(2) Install and adjust rear view mirror. (Refer to paragraph 4-41 b.)

4-34. Cargo Door Windows.

a. Removal – Cargo Door Windows.

(1) During removal of each window, support it from outer side to avoid damage by accidental dropping.

(2) At inner side, pull window latch handle up and aft to withdraw latch plates from lower guides.

(3) Push window outward at bottom, then lower it until free from upper guides.

b. Cleaning – Cargo Door Windows. (Refer to TM 55-1500-204-25/1.)

c. Inspection – Cargo Door Windows. Inspect for abrasions, scratches, cracks, holes, or other damage. See figure 4-9 for critical areas and repair limits.

d. Repair or Replacement – Cargo Door Windows. Replace window if inspection requirements are exceeded. Replace if critical areas are damaged. (See figure 4-9.)

e. Installation – Cargo Door Windows.

(1) Raise window to position from outer side of door. Engage upper guides.

(2) With latch handle at full aft position, push bottom of window inward to seat on seals.

(3) Engage latch plates in lower guides by placing handle full forward and down. Secure handle to door frame with lockwire small enough to break if handle is intentionally pulled.

4-35. Soundproofing Blankets.

Cabin interior is covered with blankets of soundproofing material to reduce noise level for crew and passengers during operation. Blankets are attached to structure by hook-and-pile and snap-type fasteners, and can be detached for maintenance access.

a. Removal – Soundproofing Blankets. Release snap fasteners and hook-and-pile attachments holding blankets to structure. Remove blankets.

b. Inspection – Soundproofing Blankets. Visually inspect blankets for cuts and tears. Inspect for missing and damaged buttons and sockets.

c. Repair or Replacement – Soundproofing Blankets. Replace blanket if inspection requirements are not met.

d. Installation – Soundproofing Blankets. Position blankets in helicopter and attach to structure with snap fasteners and hook-and-pile attachments.

4-36. Blackout Curtains.

A blackout curtain may be installed behind pilot's and copilot's seats, between forward and aft cabin sections. Other blackout curtains may be installed over both cargo door windows and window in removable door post.

a. Removal – Blackout Curtains. Release fasteners and screws attaching curtains to structure. Remove curtains.

b. Inspection – Blackout Curtains. Inspect curtains for cuts, tears, missing attachment buttons and sockets. Inspect slide fastener for operation and damage.

c. Repair or Replacement – Blackout Curtains. Replace curtain if inspection requirements are exceeded.

d. Installation – Blackout Curtains. Position blackout curtains in helicopter and attach with screws and fasteners.

4-37. Work Platforms.

Fixed work platforms are provided by walkways on cabin roof and by engine compartment deck under cowling. Steps for access are on each side of fuselage below engine and on right door post of cabin between crew door and cargo doors.

a. Inspection – Work Platforms.

(1) Inspect for minor ruptures.

(2) Inspect for bonding separation by tapping metal covered surfaces with sounding device. Panel will produce a dead or flat sound where bond separation (void) exists.

(3) Inspect for punctures, wrinkles and buckles.

b. Repair or Replacement – Work Platforms. For repair of bond separation, refer to next higher level of maintenance. Minor ruptures and punctures are repaired as follows:

NOTE

Immediate action should be taken to prevent deterioration of the honeycomb by entry of moisture, oil, hydraulic fluid, etc. This repair may be done by plugging or filling with metal-set A-4 or equivalent.

4-38. Cargo Tie-Down Equipment.

Cargo tie-down rings are provided on cabin aft bulkhead and pylon island structure, and in recessed fittings on cabin floor aft of crew seats. A three-piece cargo net is also available, as loose equipment, for use in securing cargo to rings. Net is made of nylon web straps treated with latex, 7.5 inches between centers. Each piece of net is lettered to indicate its position. Adjustable non-swiveling hooks with keepers are used on forward and outboard edges, and on two aft straps of center net. Fixed hooks are used on aft and inboard edges of right and left nets. Reefing rings and hooks are provided on nets for adjustment to size and shape of cargo. Maintenance and repair will be in accordance with TM 55-1500-204-25/1.

4-39. External Cargo Suspension.

A suspension assembly for carrying external cargo loads hangs at approximate center of gravity from a structural cross beam under transmission pylon. Cargo release hook, on lower end of suspension assembly, extends through a padded opening in lower skin of fuselage. Hook unit is a horizontal loading type with an automatic pickup latch, and has both electrical and mechanical load release provisions. On YUH-1D, suspension assembly used as original equipment incorporates a swivel head and a self-aligning bearing at attachment to lift beam. Cargo hook has a guard over its hand lever. On UH-1D/H, the suspension has no swiveling action, being for use with a load connector which has a swivel or other device to relieve torsion effects due to a load twisting or turning. Cargo hook assembly is guarded by a bumper ring with nylon outer surface. Beginning with UH-1D/H Serial No. 63-8739, suspension shaft is secured to lower yoke by a shear pin (instead of four bolts) and by a fail-safe retaining collar, two washer-type thrust bearings, and a nut threaded and bonded into shaft end.

a. Removal – Cargo Suspension.

(1) Remove access door from front of pylon island in cabin.

(2) With electrical power off, disconnect electrical cable (1, figure 4-10) of suspension assembly at connector located on right underside of structural lift beam.

(3) Detach upper control cable (7) of suspension assembly from support clamp (8) on beam. Remove cotter pin and detach ball terminal of cable from connector (6) inboard of pulley bracket.

1. Electrical Cable
2. Actuating Cable
3. Cargo Release Relay
4. Pulley and Spring Bracket
5. Spacer
6. Connector
7. Upper Control Cable
8. Support Clamp
9. Suspension Bracket
10. Clamp Set
11. Restraint Springs
12. Lower Yoke
13. Cargo Release Hook Assy.
14. Pedal Stop
15. Cargo Release Pedal
16. Load Beam

205070-35B

Figure 4-10. Cargo suspension installation – typical (Sheet 1 of 2)

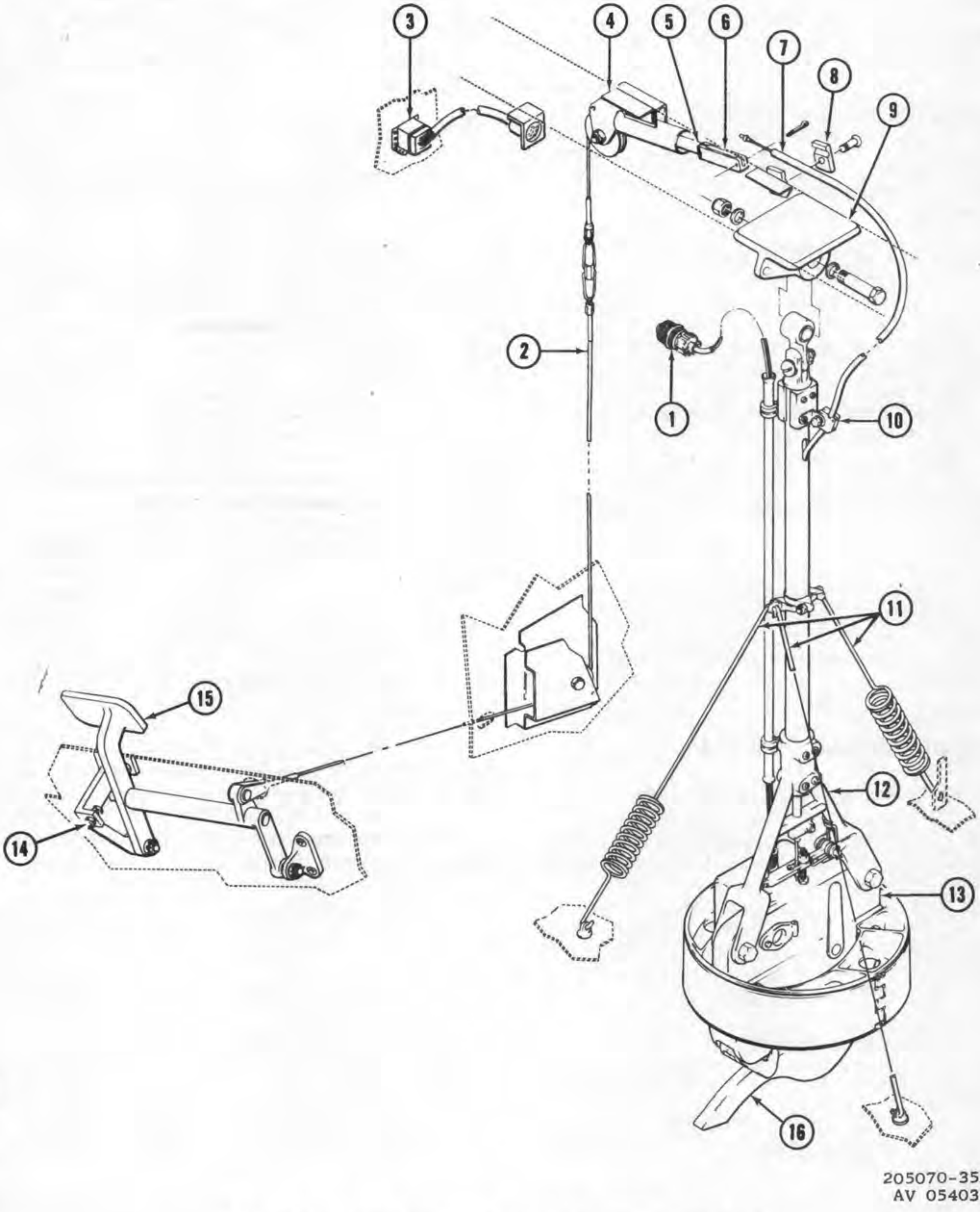


Figure 4-10. Cargo suspension installation – typical (Sheet 2 of 2)

(4) Unhook three restraint springs (11) from fittings on suspension shaft.

(5) Remove cotter pin, bolt, nut and washers, to detach suspension link from bracket (9). Remove suspension assembly.

b. Inspection – Cargo Suspension.

(1) Inspect bolts, fittings, and restraint springs for damage, wear and serviceability.

CAUTION

Wear of bolts, screws or pins in the cargo suspension assembly can change the rigging of the mechanical release; and, if they are sufficiently worn, an inadvertent release of external cargo can result. Wear of the hardware attaching the cargo suspension yoke to the cargo suspension shaft can be determined by removing two of the machine screws or the pin.

(2) Inspect brushes, spring and guides for wear and serviceability.

(3) On non-swiveling type assembly, inspect shear pin for damage.

(4) Check electrical operation. Check continuity of circuits. (Refer to Chapter 13.)

c. Repair or Replacement – Cargo Suspension.

(1) Replace any damaged or unserviceable attachment bolts, fittings, clamps, or restraint springs on suspension assembly as necessary.

(2) On YUH-1D suspension which has a swivel head, excessively worn or unserviceable brushes can be replaced as assemblies, or can be repaired by replacing spring or guide with attached brush in phenolic cover. When installed in upper housing lock-wire brush covers to hole provided in adjacent web of housing.

(3) On a suspension with fail-safe yoke attachment, replace shear pin as necessary in attachment of lower yoke to suspension shaft. Remove damaged pin, align holes through yoke and shaft, insert new pin, and secure with cotter pin.

d. Lubrication – Cargo Suspension. When cargo hook is in daily use, apply a small amount of grease (item 7, table 1-2) each day to end of load beam (16, figure 4-10) where it engages latch, and wipe off excess grease.

e. Installation – Cargo Suspension.

(1) Position suspension assembly with open side of hook load beam forward and with upper link aligned in bracket (9, figure 4-10). Install bolt, washers, nut and cotter pin.

(2) Install three restraining springs (11), hooked into fittings on structure and on shaft of suspension assembly.

(3) Route free end of suspension upper control cable (7), aft and to right of support bracket. Engage ball terminal in cable connector (6) and secure with cotter pin. Attach cable conduit in clamp (8) secured by a screw to bracket on beam.

(4) Rig and check operation of upper control cable. (Refer to paragraph 4-40 e.)

(5) Connect electrical cable (1) of suspension assembly to connector located on right underside of lift beam. Check operation with electrical power on.

4-40. Mechanical Cargo Release Cable And Pedal.

Mechanical release control cable of cargo suspension assembly is connected to a two-section actuating cable, which is routed through pulleys and fairleads down inside right wall of pylon island structure and forward under cabin floor to a MANUAL CARGO RELEASE pedal at pilot's station. Actuating cable is spring-loaded to hook-closed position by a coil spring in upper pulley bracket.

a. Removal – Cargo Release Cable and Pedal.

(1) Remove access doors from front of pylon island in cabin, and from cabin lower skin at right of center in line with pedal.

(2) Disconnect upper control cable (7, figure 4-10) of suspension assembly from connector (6), by removing cotter pin and lifting out ball terminal.

(3) Cut lockwire and disconnect turnbuckle of actuating cable (2).

(4) To remove upper section of actuating cable, proceed as follows:

(a) Upper pulley bracket (4) may be left in place or may be removed with two attaching screws, nuts and washers, from bracket on lift beam.

(b) Detach cable ball terminal from connector (6) by removing cotter pin.

(c) Remove spacer (5) split guide and spring from pulley bracket and end of cable.

(d) Remove cable guard pin with cotter pin and pull cable from bracket. Pulley with bolt, nut, washer, and cotter pin may be removed and replaced as necessary.

(5) To remove lower section of actuating cable, proceed as follows:

(a) Disconnect cable fork terminal from arm on pedal (15) by removing pin, with cotter pin and washers.

(b) Remove cable guard pins at lower pulley in cargo suspension compartment and three pulleys under cabin floor. One pulley is located just aft of fuselage Station 52 bulkhead; two pulleys are just ahead of Station 102.

(c) On helicopters Serial No. 68-15214 and subsequent, remove nut, washer, screw and clamp from end of boot on forward side of Station 123.0 bulkhead.

(d) Carefully pull cable section forward through bulkhead grommets.

(e) Remove and replace pulleys, with attaching bolts, nuts, and washers, as necessary.

(6) Remove pedal assembly by removing three bolts and two screws, with nuts and washers, to detach support fittings from Station 23 bulkhead.

b. Inspection – Cargo Release Cable and Pedal.

(1) Inspect cables for frayed wires and wear.

(2) Inspect pulleys for wear and freedom of rotation; brackets for damage.

(3) Inspect fume-tight boot and cable grommets for cracks and deterioration.

c. Repair or Replacement – Cargo Release Cable and Pedal.

(1) Replace worn and unserviceable cables.

(2) Replace brackets, pulleys, grommets and boot if unserviceable.

d. Installation – Mechanical Cargo Release Cable and Pedal.

(1) Align pedal assembly (15, figure 4-10), if removed, on front of Station 23 bulkhead in cabin ahead of pilot's seat. Attach right support to structure with three bolts, washers, and nuts. Attach left support with two screws, washers, and nuts. Check for snug fit of pedal assembly in supports; adjust shims on pivot bolts as necessary to eliminate end play and to align pedal with stop.

(2) Install lower section of actuating cable as follows:

(a) Insert threaded terminal of cable through hole in Station 23 bulkhead into area under cabin floor.

(b) Route cable through bulkhead grommets and three pulleys below floor, and through lower pulley in cargo suspension compartment. Install cable guard pins, with cotter pins, at pulleys.

NOTE

On helicopters Serial No. 68-15214 and subsequent, route cable through boot on forward side of Station 123.0 bulkhead and install clamp, screw, washer and nut.

(c) Attach fork terminal of cable to arm on pedal with flathead pin, washer, and cotter pin.

(3) Install upper section of actuating cable as follows:

(a) Insert ball terminal of cable from outboard side over upper pulley and completely through tube of bracket assembly (4).

(b) Assemble spring, split guide, spacer (5) and connector (6) on end of cable, inboard of pulley bracket. Seat spring and guide inside tube on bracket. Secure cable ball terminal in connector with cotter pin.

(c) Install cable guard pin through bracket next to pulley and secure with cotter pin.

(d) If removed, place pulley bracket on aft side of support bracket at right underside of lift beam. Secure with two screws, washers, and nuts.

(4) Connect upper and lower sections of actuating cable with turnbuckle.

(5) Connect mechanical release control cable of suspension assembly, rig and check operation.

(6) Reinstall access doors.

e. Adjustment – Mechanical Cargo Release.

(1) With pedal (15, figure 4-10) full aft and with control cable (7) of suspension assembly loose in clamp (8) on lift beam, adjust actuating cable (2) at turnbuckle to provide 20 to 24 pounds tension. Lockwire turnbuckle.

(2) Check at cargo hook for correct position of parts with load beam (16) latched. Stopbolt of cable lever should be in contact with top of cargo hook case, holding lever parallel to plane of two yoke attachment bolts, and adjusted to provide correct slack in the short lower cable.

(a) For hook assembly with lower cable extending inside case, open hinged access door on cover of hook and check that ball terminal of cable is 0.43 to 0.50 below seat of latch lever. (See figure 4-11, detail A.)

(b) For hook assembly with lower cable outside of case, check that ball terminal of cable is 0.12 to 0.18 inch beyond seat of latch lever. (See figure 4-11, detail B.)

(3) Adjust slack of upper cable conduit between clamps (8 and 10, figure 4-10) so that cable terminals are snug at connector (6) and at lever on top of hook.

(4) Check that electrical and mechanical cables have enough slack to allow full swing of suspension assembly.

(5) Check operation of mechanical release, with at least 20 pounds load on cargo hook load beam.

(a) With pedal pushed forward, cargo hook load beam should be released, but cable spring in upper pulley bracket (4) should not bottom out. Adjust pedal stop (14) as necessary.

(b) With pedal forward, external lever at top of cargo hook should be full up but not bottomed against end of cable conduit or clamp.

(c) When pedal is released, cable should return to locking position. (Refer to step (2).)

4-41. Rear View Mirror.

The helicopter is equipped with an adjustable rear view mirror located outside the forward cabin below the pilot's lower window. This mirror, when properly adjusted, enables the pilot to visually check the operation of the external cargo suspension hook. When the helicopter is

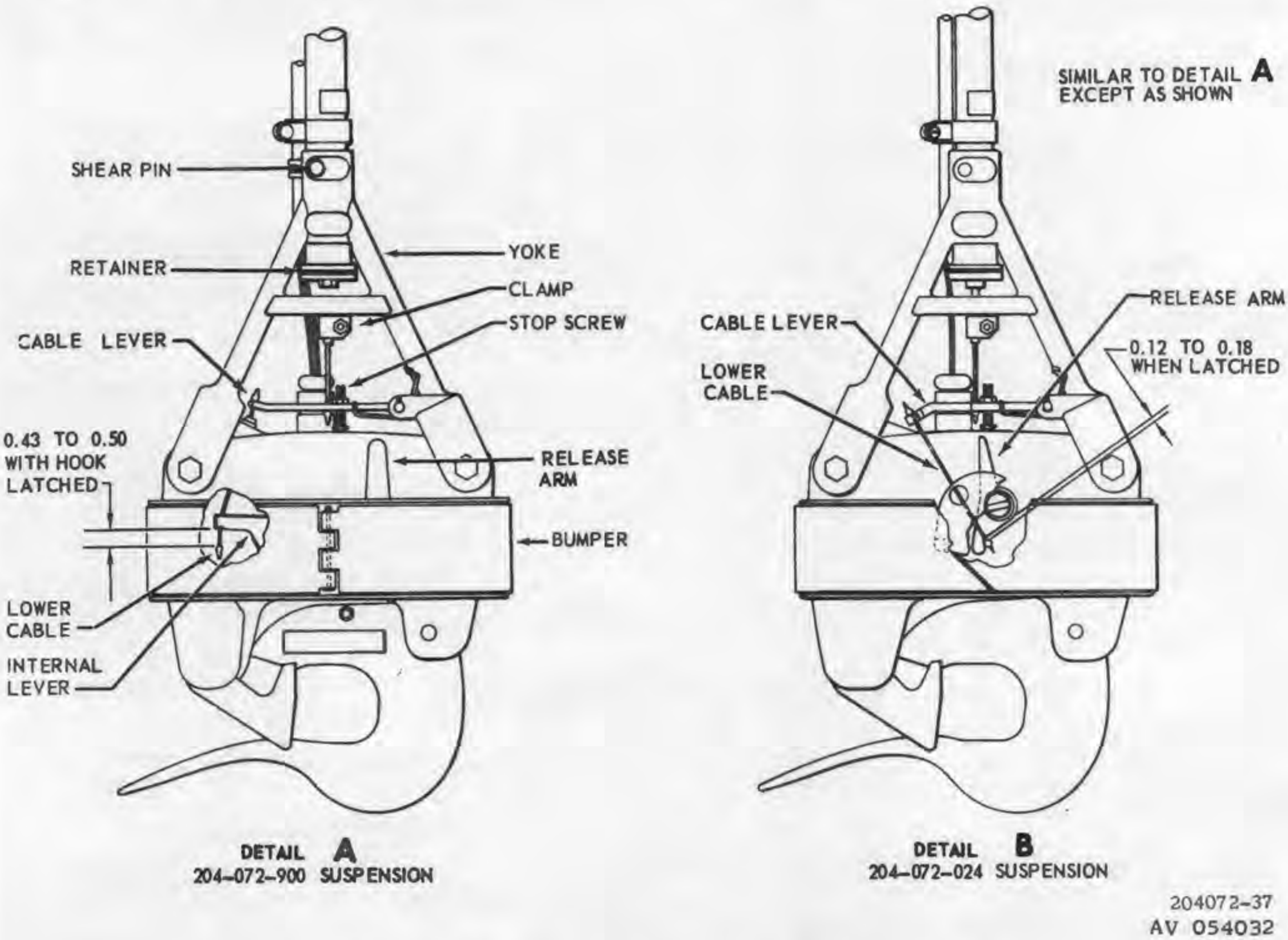


Figure 4-11. Typical hooks on cargo suspension assemblies

employed on missions which do not require use of the external cargo suspension, the rear view mirror may be covered or removed and stowed.

a. Removal – Rear View Mirror.

(1) Remove bolts, washers, nuts and/or quick-release pins, which attach braces and supports to structure and remove mirror assembly from helicopter.

(2) To remove mirror from brace assembly, remove mirror cover, spring pins from adjustment handles.

b. Installation – Rear View Mirror.

(1) Install braces and supports to structure, using previously removed bolts, washers, nuts and/or quick-release pins.

(2) Position rear view mirror and align mounting holes.

(3) Screw adjustment handles through mounting holes. Adjust mirror to desired angle, tighten adjustment handles, and insert spring pins in threaded ends of handles.

(4) Slide protective cover over mirror and fasten holding snap.

c. Adjustment – Rear View Mirror.

(1) Remove spring pin and loosen adjustment handles.

(2) Manually adjust mirror to desired angle.

(3) Tighten adjustment handles and insert spring pins.

4-42. Map And Data Case.

A case with a hinged, lock-down cover is installed with four screws on aft end of lower pedestal between crew seats.

a. Inspection – Map and Data Case. Inspect hinges, screws, and mounting brackets for security.

b. Removal – Map and Data Case. Remove four screws attaching case to mounting brackets.

c. Installation – Map and Data Case. Position case on bracket and install four screws.

4-43. Litter Racks.

Two different litter rack installations may be used in UH-1D/H helicopters. One installation accommodates six litters (three on a side, one above the other) parallel to cabin center line in aft cabin passenger compartment, and outboard transmission support structure. (See figure 4-12.) The other installation accommodates three litters (one above the other) parallel to, and just forward of, the aft cabin passenger compartment aft bulkhead. (See figure 4-13.) Litters can be quickly installed for transporting patients, or rapidly removed for carrying cargo or personnel.

a. Removal – Litter Racks.

(1) Compress tension fittings (1, figure 4-12 and 4-13) at eah end of strap assemblies (2) and detach strap assemblies from roof fittings and hold-down rings on floor. Remove strap assemblies.

(2) Release stanchion stud locks (3) at each end of stanchion (4).

(3) Apply enough downward pressure to top of stanchion to permit upper end of stanchion to clear cabin roof fitting. Remove stanchion assembly from helicopter.

(4) Remove litter support brackets (5) from transmission support structure.

b. Installation – Litter Racks.

(1) Install litter support brackets (5, figure 4-12 and 4-13) on transmission support structure.

(2) Depress upper end of stanchion (4) and position lower end over hold-down stud in floor. Align upper end of stanchion with cabin roof fitting. Pull up on slotted end of stanchion to position in roof fitting. Secure both ends of stanchion.

(3) Install strap assemblies (2) to roof fittings and hold-down rings on cabin floor.

NOTE

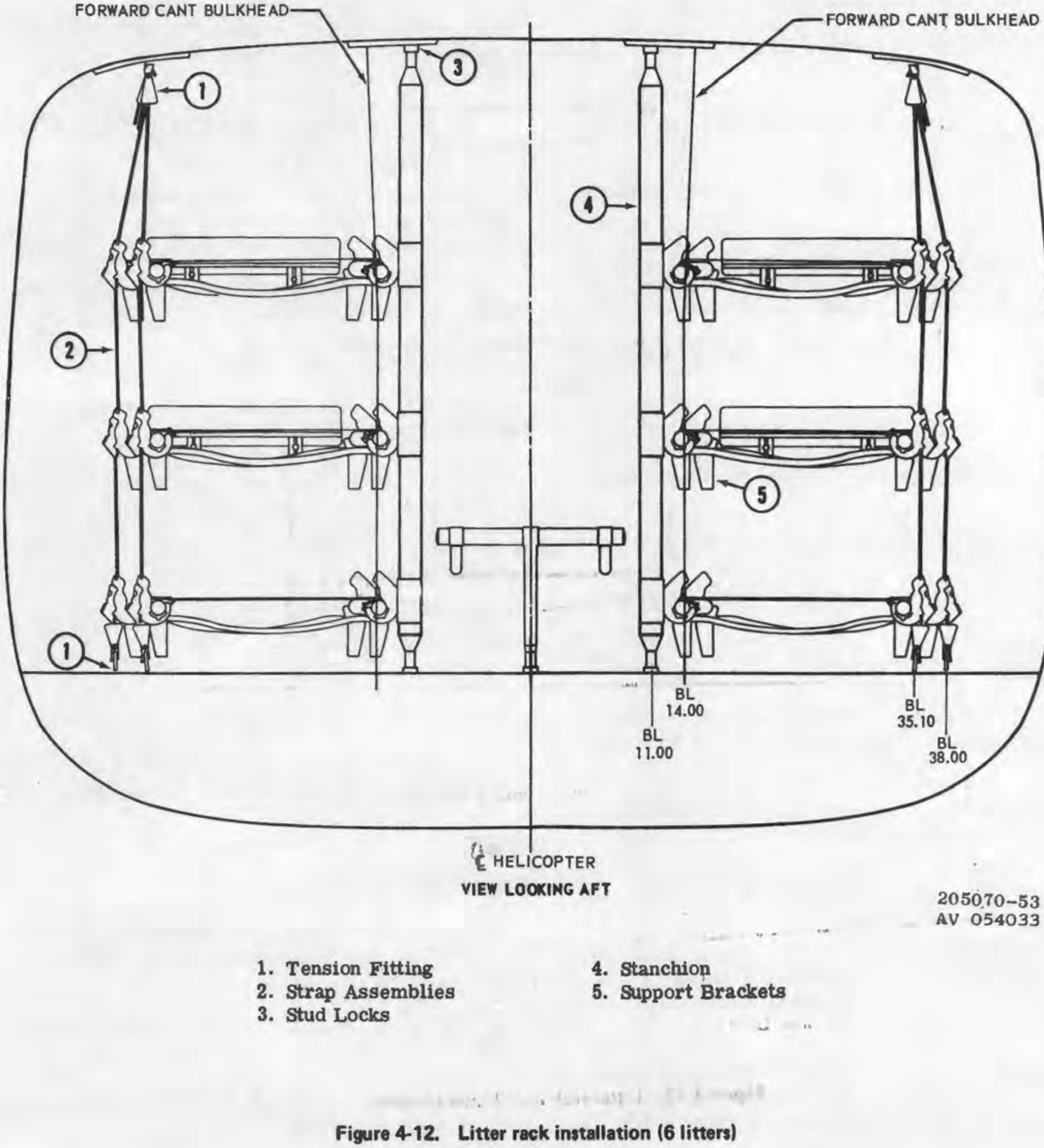
Tension fitting (1) on upper end of strap assembly has hole in end for attaching to stud in cabin roof.

4-44. First Aid Kits.

Provisions for installing four aeronautical type first aid kits, are incorporated on right and left door posts. Refer to TB 55-1500-308-25 for inspection.

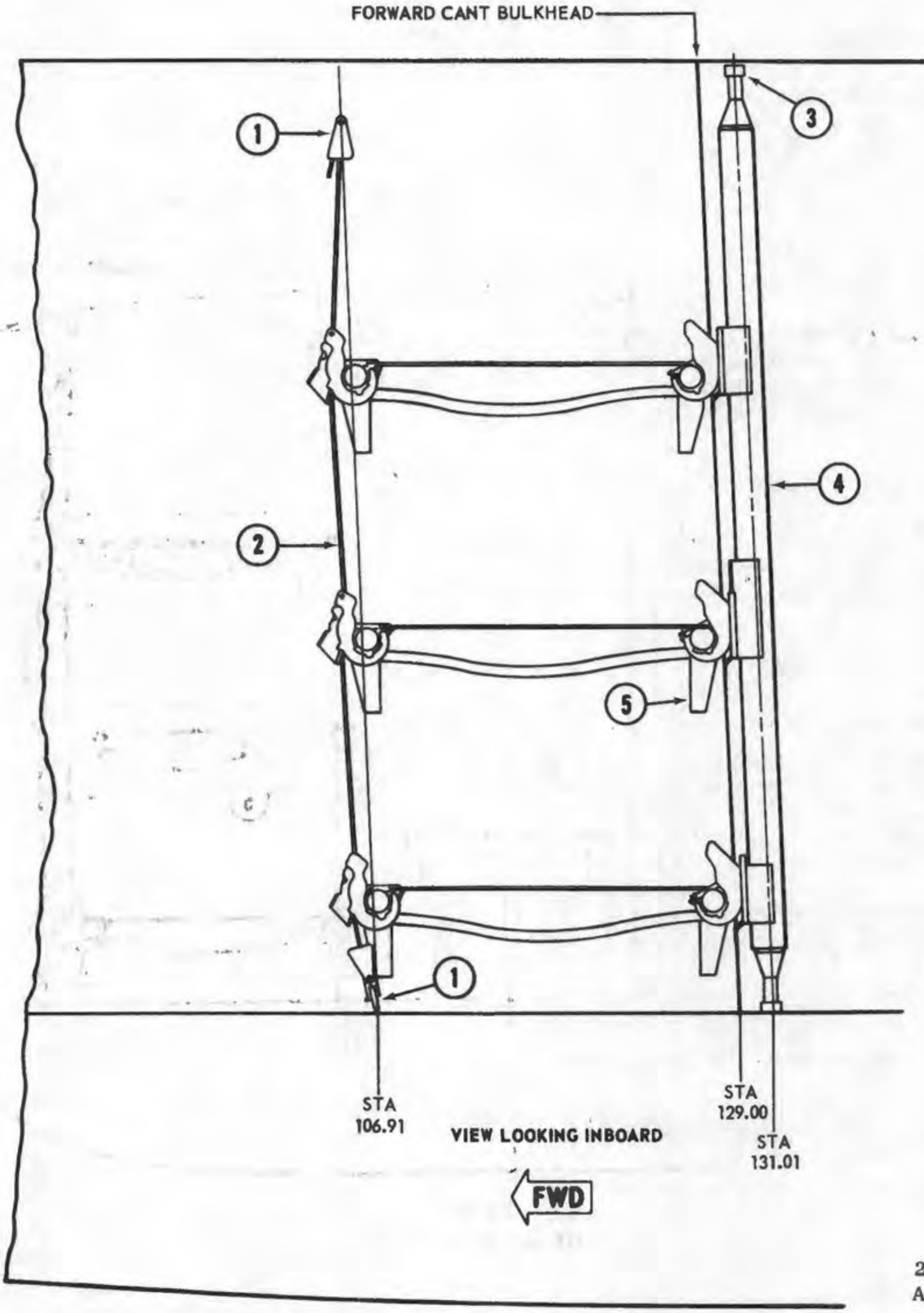
a. Removal – First Aid Kits. Pull outward on kit to release from snap fasteners.

b. Installation – First Aid Kit. Position kit on snap fasteners and push to engage fasteners.



1. Tension Fitting
2. Strap Assemblies
3. Stud Locks
4. Stanchion
5. Support Brackets

Figure 4-12. Litter rack installation (6 litters)



1. Tension Fitting
2. Strap Assemblies
3. Stud Locks
4. Stanchion
5. Support Brackets

Figure 4-13. Litter rack installation (3 litters)

4-45. Blood Bottle Hooks.

Six blood bottle hooks (three on each side of the island) are mounted in the cabin above the litters.

4-46. Fire Extinguisher.

The fire extinguisher bottle on the YUH-1D is located on the left-hand side of the pedestal adjacent to the copilot's seat. The UH-1D/H has the fire extinguisher located on the cabin floor to the right of the pilot's seat. Fire extinguisher may also be located between seats aft of console.

a. Removal – Fire Extinguisher and Bracket.

(1) Loosen retaining clamp from around upper section of the extinguisher by pulling the hinged lever aft. Tension on the extinguisher will be released so that the catch on the hinged lever will be disengaged from the attaching ring.

(2) Grasp the fire extinguisher by the handle and remove from the hanger bracket.

(3) Remove screws, washers and nuts attaching hanger bracket to left-hand side of instrument pedestal and remove hanger bracket.

b. Inspection – Fire Extinguisher.

(1) Pressure gage reading should be within the green arc.

(2) All CF3BR type fire extinguishers should be weighed every six months to determine that they are fully charged. The fully charged weight of fire extinguisher should not be less than four ounces below the gross weight stamped on the nameplate.

(3) Inspect all fire extinguishers for broken or missing seals.

c. Repair or Replacement – Fire Extinguisher. If inspection requirements are not met, extinguisher should be recharged.

d. Installation – Fire Extinguisher and Bracket.

(1) Position hanger bracket on left-hand side of instrument pedestal, on cabin floor to the right of the pilot's seat, and install attaching nuts, washers and screws.

(2) Position fire extinguisher in hanger bracket with extinguisher handle opposite bracket.

(3) Hook the latch of the retaining clamp handle through ring on inboard section of the retaining clamp. Force free end of a clamp handle to the left and forward. This will close the clamp and secure the fire extinguisher in the hanger bracket.

4-47. Cable – Paratroop Static Line Cable.

A paratroop static line cable may be installed on the center of the aft cabin bulkhead. This installation consists of a cable (1, figure 4-14), a compression tube (2), attach plates (3), fitting (4) and attaching hardware.

a. Removal – Paratroop Static Line Cable.

(1) Remove cotter pins and washer attaching cable (1, figure 4-14) to fitting (4) and remove cable.

(2) Remove nuts, washers and bolts securing attach plates (3) to fittings (4) and remove attach plates.

(3) Remove bolts and washers securing fittings (4) to aft cabin bulkhead and remove fittings and compression tube (2) from bulkhead.

(4) Remove nuts (5) and washers on end of compression tube (2). Remove pins (6) from compression tube and separate tube from fittings (4).

b. Installation – Paratroop Static Line Cable.

(1) Install nut (5, figure 4-14), lock-washer and flat washer on compression tube (2). Position fittings (4) on compression tube. Align holes in tube and fittings and insert pins (6).

(2) Position static line cable (1) on pins (6) and install washers and cotter pins.

(3) Install flat washer, lock-washer and nut (5) on end of compression tube.

(4) Position compression tube (2) and fittings (4) to aft cabin bulkhead and install attaching washers and bolts. Tighten both nuts (5) on compression tube against fitting.

(5) Position attach plates (3) to fittings (4) and install bolts, washers and nuts.

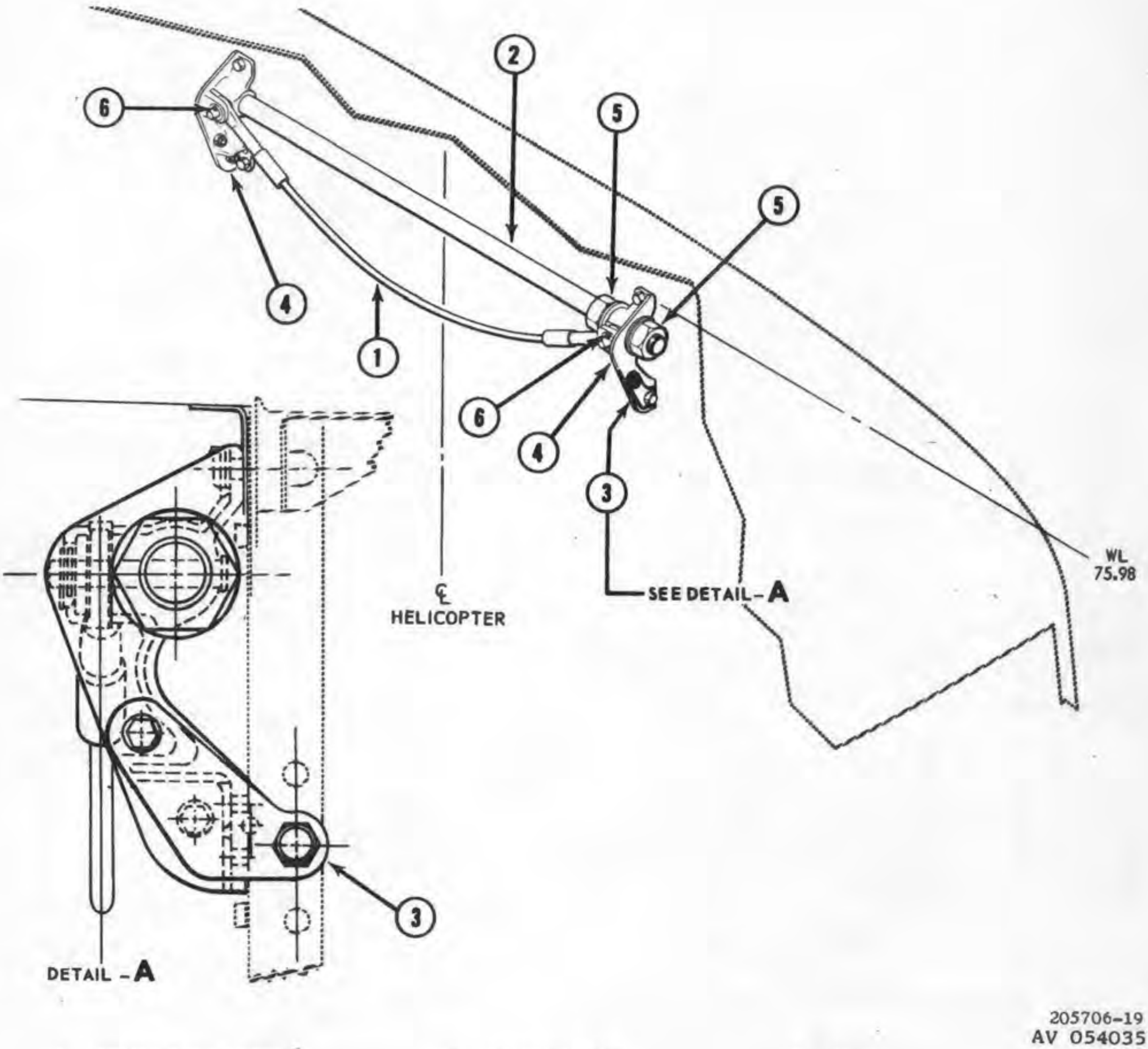
4-48. Internal Manual Release Mechanism.

A series of cables, actuated by a manually operated jettison lever located beside the pilot's seat, enables the pilot to mechanically jettison externally carried kits and equipment. These cables are equipped with adjustable fittings which facilitate final rigging and adjustment.

a. Removal – Internal Manual Release Mechanism.

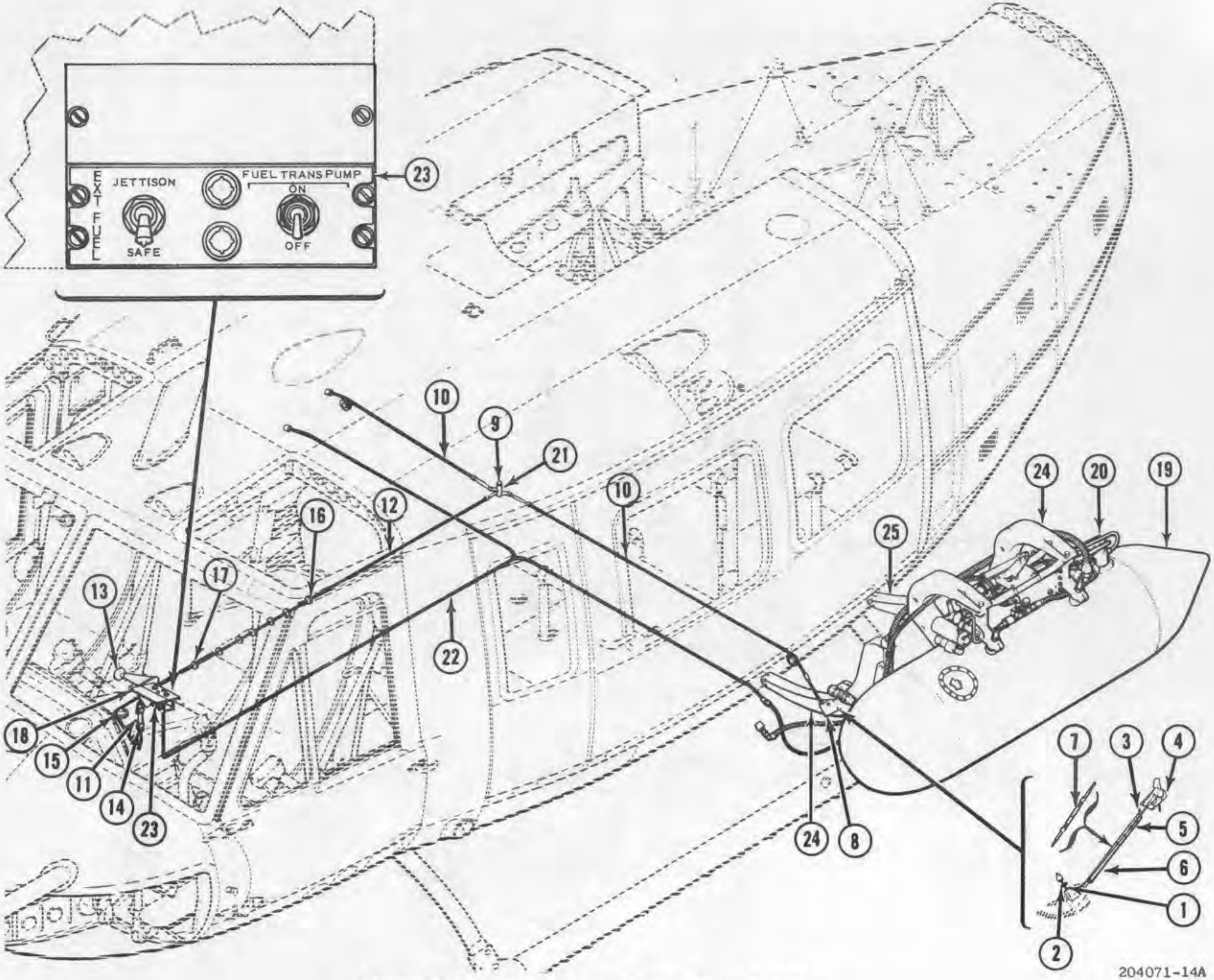
(1) Remove access plate from lower fuselage skin below external stores forward support beam.

(2) Disconnect inboard end of lower cable assembly (1, figure 4-15) from quick-disconnect on outboard end of emergency jettison cable assembly.



1. Static Line Cable
2. Compression Tube
3. Attach Plates
4. Fittings
5. Nuts
6. Pins

Figure 4-14. Paratroop static line cable



204071-14A
AV 054036

Figure 4-15. Manual release mechanism (Sheet 1 of 2)

1. Lower Cable Assembly
2. Grommet
3. Cable Assembly
4. Pulley Brackets
5. Upper Guard Tube
6. Lower Guard Tube
7. Barrel
8. Lateral Release Cable Pulleys
9. Bellcrank
10. Lateral Release Cable Assemblies
11. Cable Guard
12. Longitudinal Release Cable Assembly
13. Emergency Release Lever Assembly
14. Grommet
15. Longitudinal Release Cable Pulleys
16. Fairlead
17. Grommets
18. Support Assembly
19. Auxiliary Fuel Tank
20. Pylon Assembly
21. Manual Release Mechanism
22. Electrical Release Controls
23. Control Panel
24. Pylon Support
25. External Stores Support Assembly

204071-14A

Figure 4-15. Manual release mechanism (Sheet 2 of 2)

(3) Remove grommet (2) from fuselage skin and pull lower cable assembly (1) outboard.

(4) Remove cotter pin, washer and flat head pin attaching cable assembly (3) to mechanical release actuating lever.

(5) Remove cotter pins, pins, nuts, washers and bolts holding pulleys in pulley brackets (4) and remove pulleys.

(6) Remove nuts, washers, screws and clamps attaching upper (5) and lower (6) guard tubes and remove guard tubes.

(7) Remove cable assemblies and cut safety wire at barrel (7) to separate.

(8) Remove cotter pins, pins, nuts, washers and bolts holding lateral release, cable pulleys (8) in pulley brackets and remove pulleys.

(9) Remove three cotter pins, washers and flat head pins attaching cable assemblies to bellcrank (9). Remove two lateral release cable assemblies (10) and cut safety wire on barrels.

(10) Remove cotter pin, nut, washer and screw attaching bellcrank (9) and remove bellcrank.

(11) Remove nuts, washers, spacers, screws, and clamps attaching cable guard (11) to pedestal. Remove cotter pin and pin attaching longitudinal release cable (12) to emergency release lever assembly (13). Remove cable guard and grommet (14).

(12) Remove cotter pins, pins, nuts, washers and bolts holding longitudinal release cable pulleys (15) to pulley brackets and remove pulleys.

(13) Remove fairlead (16) and six grommets (17) which guide longitudinal release cable (12) and remove release cable.

(14) Remove cotter pin, nut, washer and clevis bolt attaching lever assembly (13) to support assembly (18).

(15) Remove three nuts, washers and bolts attaching support assembly (18) to pedestal and remove support assembly.

b. Inspection – Internal Manual Release Mechanism.

(1) Inspect pulleys for wear, damage and freedom of rotation.

(2) Inspect cables for broken or frayed wires.

(3) Inspect grommets for wear.

(4) Inspect lever assembly for serviceability and damage.

(5) Inspect support assembly bushing for wear.

c. Repair or Replacement – Internal Manual Release Mechanism.

(1) Replace worn and unserviceable pulleys and grommets.

(2) Replace frayed or unserviceable cables.

(3) Replace damaged or unserviceable lever assembly.

(4) Replace support assembly if bushing is worn or unserviceable.

d. Installation – Internal Manual Release Mechanism.

(1) Position support assembly (18, figure 4-15) on pedestal and install three attaching bolts, washers, and nuts.

(2) Position emergency release lever assembly (13) on support assembly (18) and install attaching clevis bolt, washer, nut and cotter pin.

(3) Thread longitudinal release cable (12) through bulkhead openings and install fairlead (16) and grommets (17).

(4) Position longitudinal release cable pulleys (15) and cable (12) in pulley brackets and install attaching bolts, washers, nuts, pins and cotter pins.

(5) Thread forward end of longitudinal release cable (12) through cable guard (11) and attach to emergency release lever assembly (13) by installing pin and cotter pin.

(6) Position cable guard (11) and install grommet (14) and attaching clamps, screws, spacers, washers and nuts.

(7) Position bellcrank (9) and install attaching screw, washer, nut and cotter pin.

(8) Position aft end of longitudinal release cable (12) and inboard end of lateral release cable assemblies (10) on bellcrank (9), and attach with flat head pins, washers and cotter pins.

(9) Position lateral release cable pulleys (8) and cable (10) in pulley brackets and install attaching bolts, washers, nuts, pins, and cotter pins.

(10) Position upper (5) and lower (6) guard tubes and install attaching clamps, screws, washers and nuts.

(11) Connect external support cable assemblies (1 and 3) by means of barrel (7) and thread through guard tubes (5 and 6).

(12) Position external support cable pulleys and cables (1 and 3) in pulley brackets (4) and install attaching bolts, washers, nuts, pins and cotter pins.

(13) Connect cable assembly (3) to mechanical release actuating lever by installing flat head pin, washer and cotter pin.

(14) Thread inboard end of lower cable assembly (1) through opening in fuselage skin and install grommet (2).

(15) Connect inboard end of lower cable assembly (1) to quick-disconnect on outboard end of emergency jettison cable assembly.

(16) Rig manual emergency jettison controls as follows:

(a) Place emergency release lever assembly (13) in full forward position.

(b) Make certain that the mechanical release actuating lever is in the full down (locked) position.

(c) Loosen attaching parts of upper guard tube (5) and slide guard tube down over lower guard tube (6) to expose barrel (7).

(d) Adjust cable barrels to obtain a 1.30 inch dimension between the inside edge of lower helicopter skin and center of the terminal on the inboard end of the lower cable assembly (1).

NOTE

The 1.30 inch dimension is to be held when the system is in full locked (armed) position.

(e) Safety wire all cable barrels.

(f) Slide upper guard tube (5) up from lower guard tube (6) and tighten attaching parts.

(17) Install access plates and covers.

4-49. Rescue Hoist. (Figure 4-16.)

The rescue hoist is an electrically powered device with a maximum capacity of 600 pounds and usable cable length of 256 feet. Mounting of the hoist, which is completely internal, is provided for by fittings in the cabin roof and floor. The actuator lever and actuator plate are convertible to allow installation of the hoist in four alternate positions. The hoist is operated by means of a control pendant or by controls on the right-hand cyclic stick. The cyclic stick controls will override the pendant controls. A headset, wired through the hoist control box and controlled by a switch on the pendant, gives the hoist operator interphone communication with the flight crew. An electrically powered traction sheave assembly, mounted on the end of the hoist boom aids in lowering the hoist cable and prevents snarling of cable in boom while being reeled out. The traction sheave free wheels while the cable is being retrieved. A cable cutting guillotine, employing a pressure charge, provides a means of cutting the cable free of the helicopter in an emergency. The cutter is electrically actuated by switches, protected by lock-wired guards, and located on the hoist control box and on the pilot's pedestal.

CAUTION

Rescue hoist is life support equipment and shall be kept clean and in good operating condition. Hook must be checked for bent safety latches and latch pins, at regular intervales.

a. Installation – Rescue Hoist. The hoist may be installed in any one of four locations in the cabin. (See figure 4-17.)

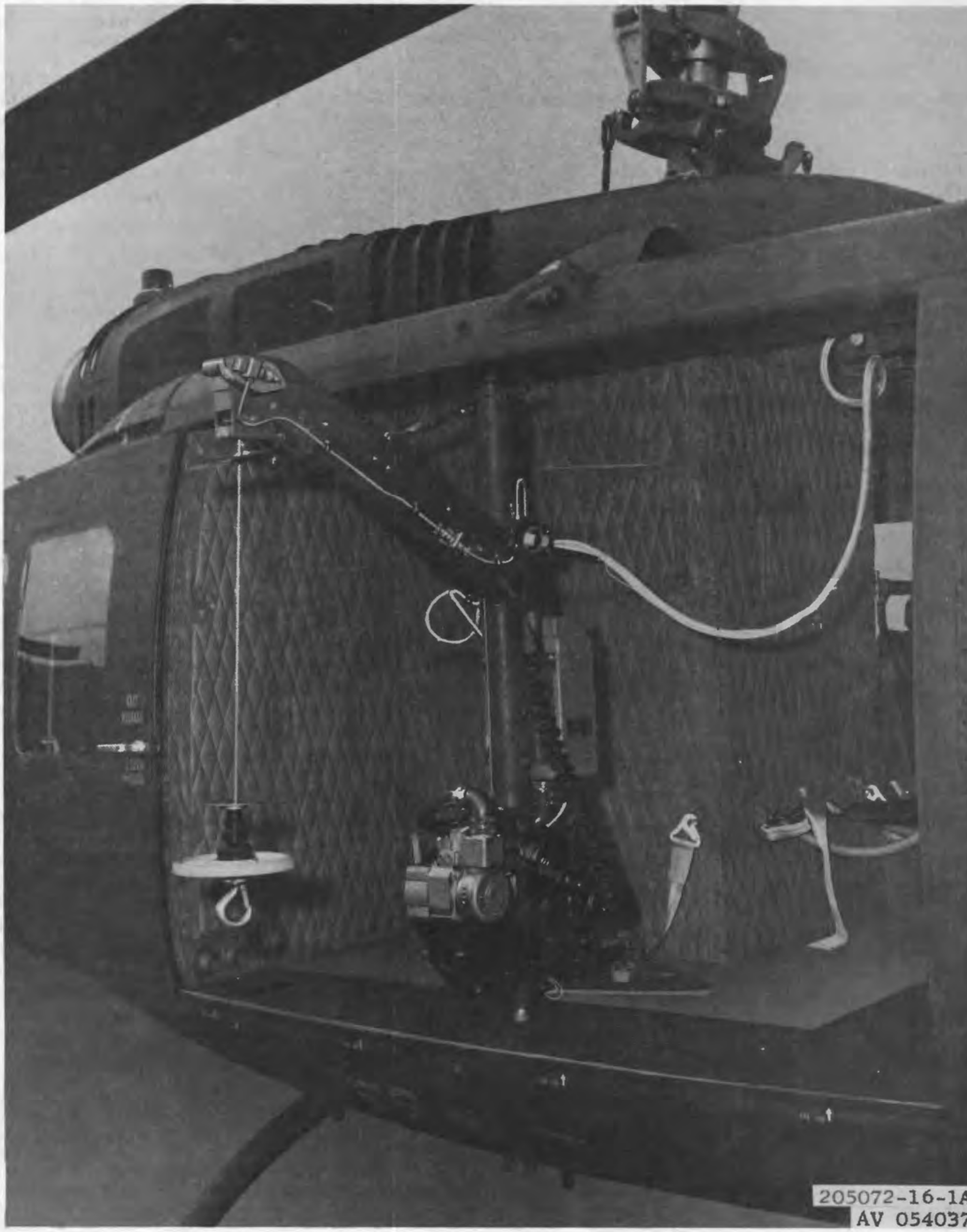


Figure 4-16. Rescue hoist

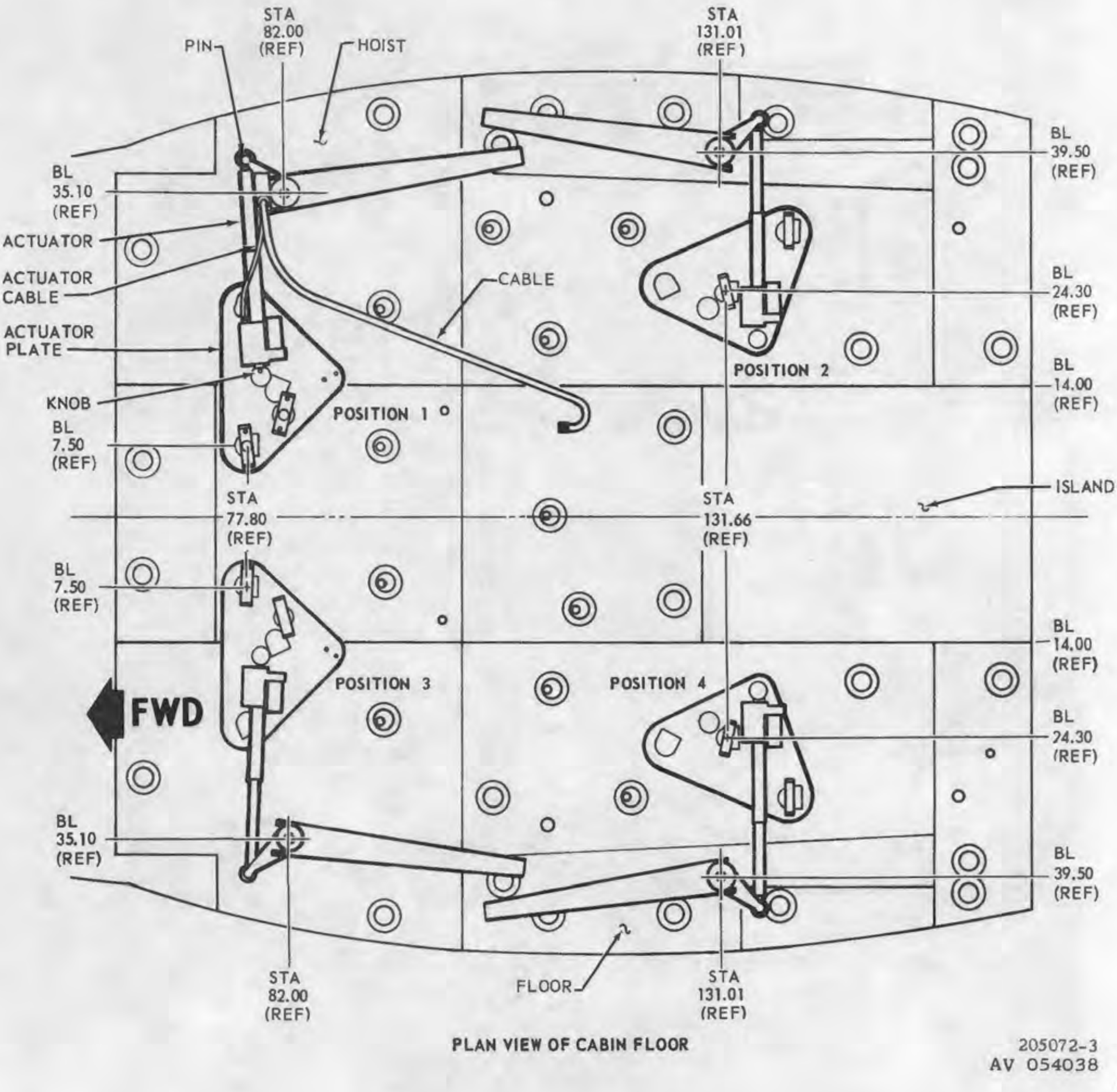


Figure 4-17. Rescue hoist positions

NOTE

Helicopters equipped with personnel rescue hoist provisions and subject to frequent installation of the rescue hoist kit should be rigged to provide maximum left cyclic control capability. See figure 9-8, for swashplate setting.

(1) Disconnect battery and external power.

(2) Place hoist upright on cabin floor stud and align top end of hoist directly under mounting stud in cabin roof. Adjust height of hoist, if necessary, by loosening locknut (12, figure 4-19) and lowering support (11).

CAUTION

Do not use tools or extension bars to turn locknut. Turn only by hand. Excessive force applied in turning nut may result in damage to the roof structure.

(3) Remove two stud adapters from actuator plate and install on floor studs to be used. (See figure 4-17.)

(4) Determine correct configuration of actuator plate according to hoist installation position (see figure 4-18). Reposition stud adapter fittings and motor actuator fitting on actuator plate as necessary.

(5) Position actuator plate on floor over adapters, secure plate to adapters, and tighten locknut.

(6) Determine correct position of actuator lever according to hoist installation position. (See figure 4-18.) If necessary, reposition lever (23, figure 4-19) on post (13).

(7) Install motor actuator, (either side may be up), between actuator plate and hoist lever and secure with knob and pin.

(8) Uncover power receptacle in cabin roof by opening soundproofing blanket at Station 112. Connect hoist power cable to receptacle and hand-tighten.

(9) Connect plug of boom actuator cable (17).

(10) Remove pin (14), place boom in extended position, and reinstall pin.

(11) Reconnect battery. Check oil level in hoist drive unit (24). (Refer to paragraph 4-49 e.)

(12) Test operation of hoist using the following steps:

(a) BAT Switch – ON.

(b) NON-ESS BUS Switch – MANUAL – ON.

(c) Operate hoist using both controls and note proper functioning of traction sheave and cable up limit switch. (Refer to paragraph 4-50.)

NOTE

If external power is used, position BAT switch to OFF and NON-ESS BUS Switch to NORMAL – ON.

CAUTION

Make certain cargo doors are fully open before operating hoist.

CAUTION

If hoist is not fitted with a traction sheave (1, figure 4-19) maintain a minimum of five pounds tension when extending cable, since a slack cable will run out of winch grooves. The hook provides this tension when its full weight is suspended on the cable.

b. Removal – Rescue Hoist.

(1) Disconnect hoist power cable at cabin roof receptacle and disconnect boom actuator cable at actuator.

(2) Pull pin at actuator lever (18, figure 4-19), knob at actuator plate (figure 4-17), and remove actuator.

(3) Remove nut from two stud adapters, remove adapters, and remove actuator plate.

NOTE

The hoist boom is normally left in the extended position.

(4) Release hoist adapters at cabin floor and roof, loosen locknut (12, figure 4-19), and lower support (11).

(5) Remove hoist from cabin.

CAUTION

Stow in upright position if possible. Lay the hoist down with the cable stowage drum up. Weight of the hoist on the drum may bend the drum side frames.

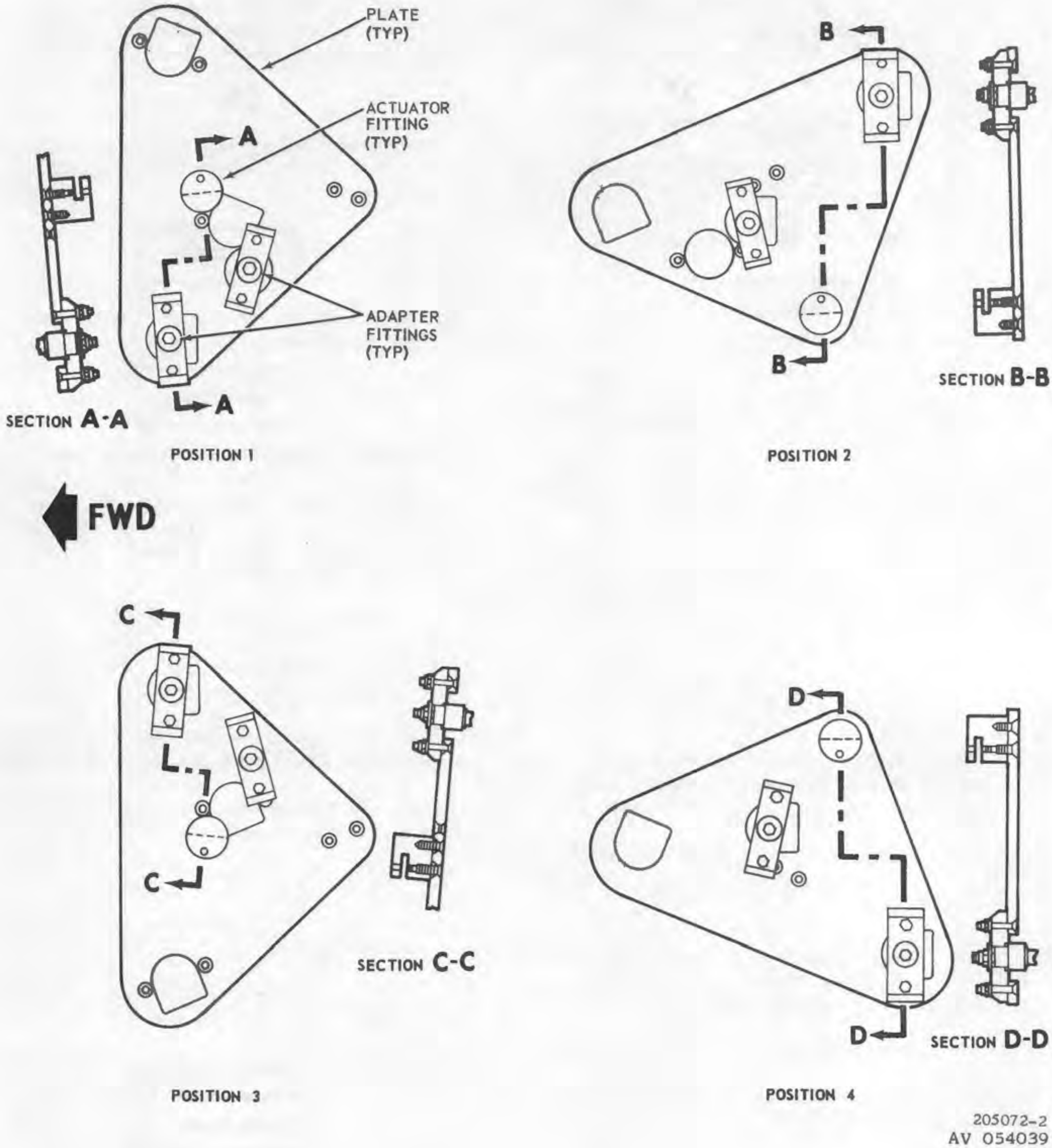


Figure 4-18. Actuator plates

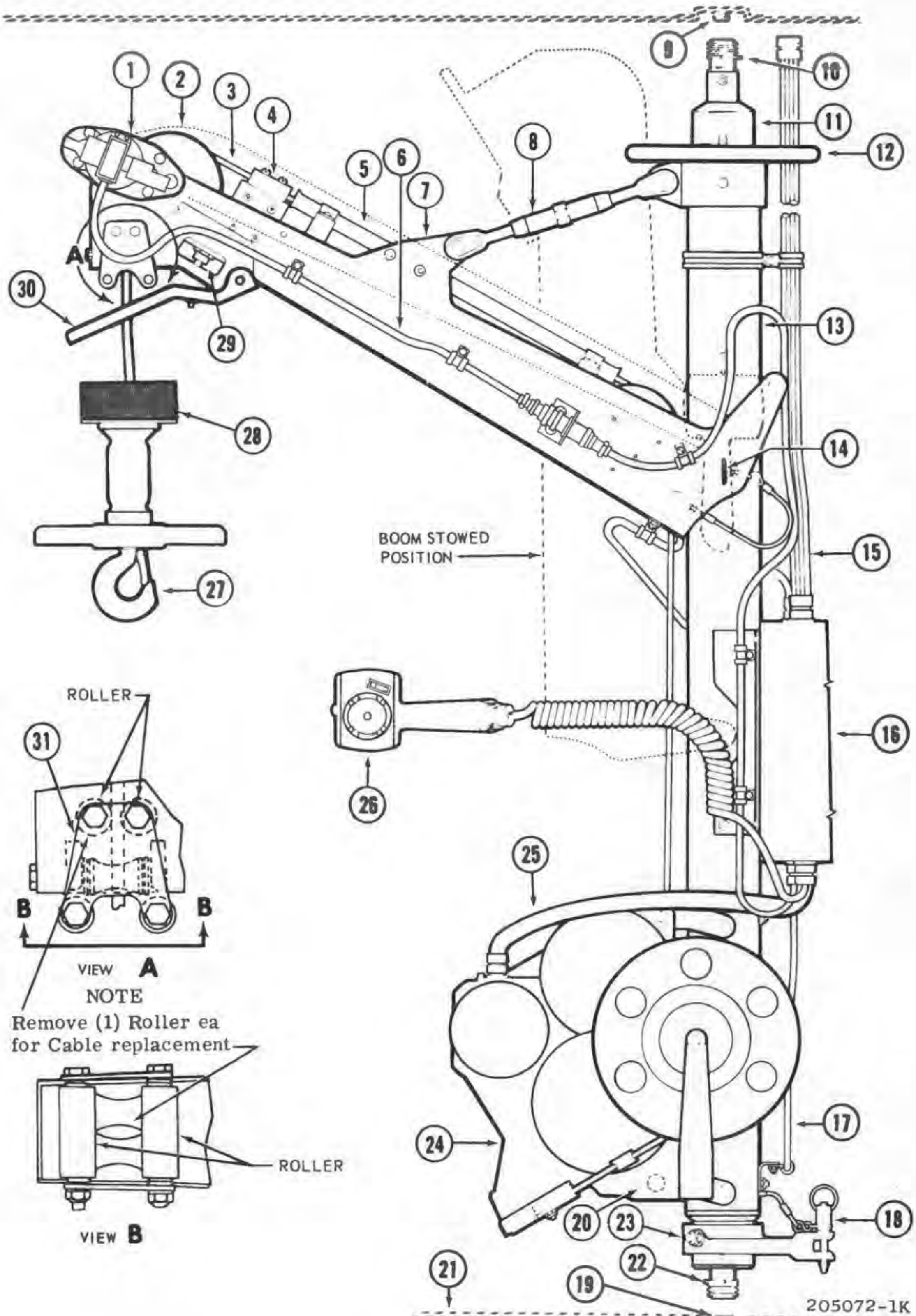


Figure 4-19. Rescue hoist installation (Sheet 1 of 2)

1. Traction Sheave Assembly
2. Boom Cover
3. Hoist Cable
4. Guillotine Assembly and Support
5. Guide Tube
6. Sheave Motor Cable
7. Boom
8. Turnbuckle
9. Roof Stud
10. Adapter
11. Support
12. Locknut
13. Post
14. Boom Retaining Pin
15. Hoist Power Cable
16. Control Box
17. Boom Actuator Cable
18. Pin
19. Floor Stud
20. Rubber Pressure Roller
21. Deck
22. Adapter
23. Actuator Lever
24. Hoist Drive Unit
25. Hoist Motor Cable
26. Control Pendant
27. Hook Assembly
28. Bumper Assembly
29. Limit Switch
30. Trigger Assembly
31. Side Plate

205072-1K

Figure 4-19. Rescue hoist installation (Sheet 2 of 2)

c. Inspection – Rescue Hoist.

(1) Hoist cable for cleanliness, broken or kinked wires, and interference anywhere along its routing.

NOTE

No broken wires allowed in hoist cable.

(2) Cable stowage drum side frames for wobble while hoist is operating and for uniform and flat winding of cable.

(3) All rollers and pulleys for damage and freedom of rotation. Check pressure roller at traction sheave for proper spring pressure.

(4) Pilot's and operator's guillotine switch guard for proper lockwiring.

(5) All electrical wiring and harnesses for condition and security of connections. Check continuity of circuits. (Refer to Chapter 13.)

(6) Security and installation of hardware, cotter pins and lockwire.

d. Repair or Replacement – Rescue Hoist.

(1) Tighten loose nuts, bolts, or screws and replace missing, loose, or broken lockwire.

(2) As conditions indicate, repair or replace defective electrical wiring and harnesses.

e. Lubrication – Rescue Hoist.

NOTE

To properly check oil supply level of winch, the system must be operated and the cable run out and reeled in 25 feet. This will be accomplished by two men; one to operate the hoist and the other to walk the cable while maintaining a constant load or tension on the cable. The oil level in the hoist gear box should be checked at the time that the hoist is running and the cable is either being payed out or rewound.

a. The hoist unit gear box is lubricated with oil (item 12, table 1-2), serviced through a filter port on the side of the gear case. With the hoist in operating position, fill the gear box to the top of the sight glass located below the filter port.

NOTE

Do not use the filler port dip stick to measure oil level in this installation.

4-50. Adjustment – Cable Up Limit Switch.

Adjust with up limit switch in the full down position. Adjust screw to clear switch approximately 0.010 inch and secure jamnut. (See figure 4-19.)

4-51. Inspection – Rescue Hoist Control Box.

a. Check security of mounting screws and washers attaching control box (16, figure 4-19) to mounting angles attached to hoist post.

b. Check security of switches on control box.

c. Check security of cable connectors.

d. Check cables for fraying and wear.

4-52. Inspection — Rescue Hoist Boom and Post.

a. Insure that latch in adapter collar snaps are locked into position.

b. Check for clearance between cabin roof and boom.

c. Check all hardware, screws, and safety pin for installation and security.

d. Check electrical wiring for fraying and wear.

4-53. Rescue Hoist Hook Assembly.

a. Removal — Rescue Hoist Hook Assembly. (See figure 4-20.) Disconnect cable from hook as follows:

(1) Pull cotter pin and remove retaining pin from ring assembly.

(2) Withdraw split insert from ring and separate halves from cable ball-end and hook.

(3) Remove ring assembly by pulling cable through boot and bumper plate.

b. Installation — Rescue Hoist Hook Assembly. (See figure 4-20.) Connect cable to hook as follows:

(1) Pass the ball on cable through rubber bumper and the ring and boot assembly from top end.

(2) Assemble cable to hook with split insert and slide assembly into ring.

(3) Align holes in ring and insert retaining pin, washer, and cotter pin.

c. Inspection — Rescue Hoist Hook Assembly.

(1) Energize hoist and check that bumper engages limit switch trigger (29, figure 4-19) to stop hoist motor. (Refer to paragraph 4-50 for adjustment.)

(2) Check security of retaining pin and cotter pin in ring. (See figure 4-20.)

(3) Check boot for wear and tears.

4-54. Inspection — Rescue Hoist Pendant Control.

a. Inspect coil wire end and plug for security.

b. Inspect rubber boot for security.

NOTE

If pendant switch will not return to center and motor continues to run; rubber boot is not secure.

c. Inspect switch for security.

4-55. Repair Or Replacement — Rescue Hoist Pendant Control.

Repair rubber boot as follows: (26, figure 4-19.)

a. Remove retaining ring that secures boot and remove boot.

b. Secure boot to pendant control with a suitable adhesive, insuring that boot is centered.

c. Replace retaining ring.

4-56. Rescue Hoist Overload Sensing Control.

The overload sensing control is mounted near the hoist power relay and serves to sense hoist overload current surges, and opens circuit to hoist power relay holding coil, thus removing electrical power from hoist motor. Sensing control will reset automatically.

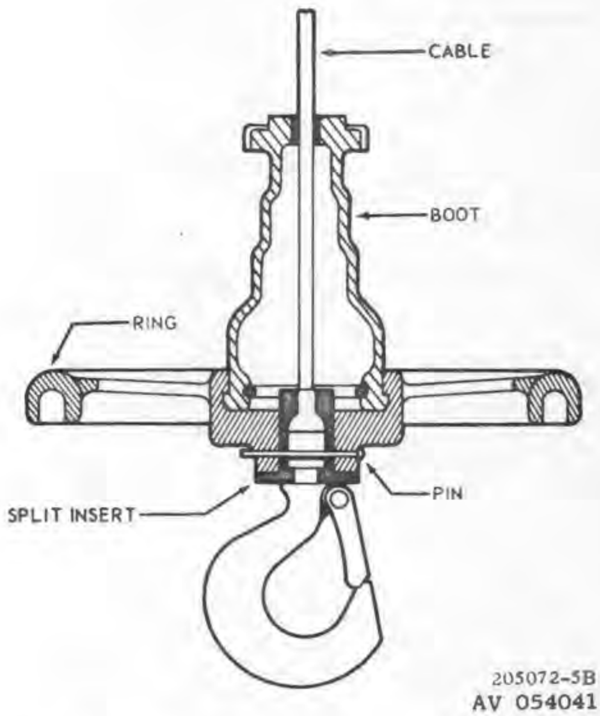


Figure 4-20. Rescue hoist hook assembly

a. Removal – Rescue Hoist Overload Sensing Control.

(1) Disconnect battery and external power.

(2) Remove electrical wires from overload sensing control terminal.

(3) Tape ends of disconnected wires.

(4) Remove mounting screws and washers from overload sensing relay.

(5) Remove relay.

b. Installation – Rescue Hoist Overload Sensing Control.

(1) Remove protective tape from overload sensing control wire terminals.

(2) Electrically ground sensing control mounting hole and contact surface.

(3) Position sensing control on mounting bracket, install mounting screws and washers.

(4) Place wire terminals on sensing control terminal post and secure with existing washers and nuts.

(5) Reconnect battery.

Section III. TAIL BOOM

4-57. Description.

The tail boom (9, figure 4-1) includes the synchronized elevator. Four special high tension bolts attach the tail boom to the forward fuselage by engaging floating barrel nuts. Tail boom assemblies remain essentially the same except for necessary adapters and extensions for the wiring harnesses, drive shaft, and control cables. Tail boom panels are all structural panels.

4-58. Inspection – Tail Boom.

a. Open right-hand, aft access door on forward fuselage to inspect tail boom attachment fittings. Use a flashlight or other suitable light source to inspect fittings.

NOTE

Special emphasis should be given to the upper left-hand fitting.

b. Inspect fuselage tail boom to angle attachment fittings for loose rivets, cracks, damage and corrosion.

c. Check aft fuselage bulkhead for cracks, dents, damage and corrosion.

d. Inspect data plate for security and proper data.

e. Inspect slippage marks on tail boom attaching fitting.

NOTE

Should any doubt exist to presence of a crack in a fitting, a dye penetrant check should be accomplished (removal of zinc chromate primer from fittings is not required). Refer to General Support Maintenance.

4-59. Repair Or Replacement – Tail Boom.

Small cracks, one to two inches in length may be stop drilled, provided the hole does not extend into stiffeners, etc. For more extensive repairs, or removal and replacement of attachment point doublers, refer to General Support Maintenance.

4-60. Tail Boom Access Doors And Inspection Plates.

Access doors and inspection plates are provided wherever needed on the tail boom for fast, efficient maintenance and inspection of the area. (See figure 4-2.)

4-61. Access Doors And Inspection Plates.

a. Removal – Access Doors and Inspection Plates. Remove screws and washers, or disconnect fasteners, and remove access doors or inspection plates from the tail boom.

b. Installation – Access Doors and Inspection Plates. Position access doors or inspection plates on tail boom and install attaching washers and screws, or connect fasteners.

4-62. Drive Shaft Covers.

The tail rotor drive shaft is enclosed by four covers (6, figure 4-1) two of which are located between the tailpipe fairing and the 42-degree gear box. The third is a separate cover for the 42-degree gear box, while the fourth cover extends up the vertical fin to the 90-degree gear box attaching point. With the exception of cover over the 42-degree gear box, the covers are hinged along the right-hand side, and are secured, in the closed position by fasteners on the left-hand side.

a. Removal – Drive Shaft Covers.

(1) Disconnect fasteners along left-hand side of door and swing door to open position.

(2) Pull hinge pin on right-hand side of door, and remove door from tail boom.

b. Inspection – Drive Shaft Covers. Inspect for damage, dents, and cracks; hinges and fasteners for serviceability.

c. Repair or Replacement – Drive Shaft Cover.

(1) Replace damaged or unserviceable hinges or fasteners.

(2) To prevent chafing of the drive shaft cover and the tail boom, use rub strip (item 403, table 1-2). For access cover on leading edge of vertical fin, use anti-chafe tape (item 404, table 1-2).

d. Installation – Drive Shaft Covers.

(1) Position door on tail boom and install hinge pin on right-hand side.

(2) Swing door to closed position, and secure fasteners on left-hand side.

4-63. Synchronized Elevators.

Synchronized elevator installation consists of two elevator assemblies, a horn assembly, two support sets, and attaching parts. Horn assembly is mounted horizontally through sides of tail boom, and is secured to structure by supports which serve as bearings for rotational movement. A control arm on horn provides attachment for linkage from fore-aft cyclic control system at swashplate. Each elevator is a horizontal airfoil section built up on a spar tube, which is inserted into a projecting end of horn assembly and secured by a single bolt.

a. Removal – Synchronized Elevator.

(1) To remove either elevator: Remove special bolt (2, figure 4-22) with washer to detach elevator fitting from lug (4) on horn assembly (5). Withdraw elevator straight outward until spar tube (3) is pulled free.

NOTE

Horn assembly can be left in place, except when replacement of parts is necessary.

(2) To remove horn assembly, after removal of both elevators, proceed as follows:

(a) Remove access door, with 18 bolts and washers, from tail boom below elevator installation.

(b) Disconnect control tube from arm (6) on elevator horn.

(c) At each end of horn inside tail boom remove two bolts with nuts, washers, and shims (8) between upper and lower retainers (7) of support. Keep parts in sets for each location.

(d) Carefully remove each support set with shims (9), attaching bolts, and washers from brackets (10) in tail boom. Keep parts in sets.

NOTE

Handle support retainers with care to avoid damaging inner surfaces of bushings, which are dry bearing material bonded in place.

(e) Remove horn assembly through access opening.

b. Inspection – Synchronized Elevator.

(1) Inspect for damage, dents, and cracks. Inspect support retainer bushings for damage and wear.

(2) Inspect synchronized elevator support brackets for loose rivets. Apply enough vertical pressure to elevator at outboard end to provide normal deflection. Inspect rivets visually and by hand contact for signs of movement.

(3) Inspect tip cap for security of bonding.

(4) Check lateral chuck (axial play) of elevator horn assembly in bearings as follows (figure 4-21):

(a) Mount a dial indicator on tail boom placing the stylus against inboard edge of the elevator at the pivot point.

(b) Move elevator inboard and outboard (span-wise) and observe the total indicator reading. A minimum of 0.005 inch and a maximum of 0.030 inch play should be indicated.

NOTE

Apply a moderate force when moving the elevator and use care not to bend the elevator thus causing false indications.

(c) If the indicator readings are not within tolerance, adjust shims under support retainers as necessary.

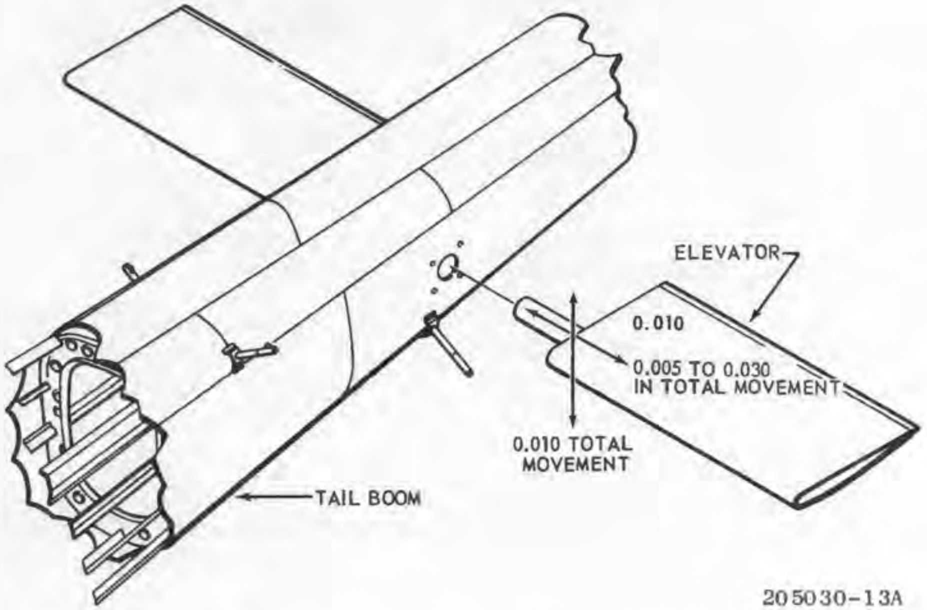


Figure 4-21. Synchronized elevator bearing limits

(5) Check radial play as follows:

(a) Mount dial indicator on tail boom with stylus in contact with the upper surface of elevator near the inboard edge of the pivot point.

(b) Lightly move elevator up and down and observe total reading on dial indicator. A maximum reading of 0.010 inch is permissible.

NOTE

Heavy force in moving the elevator will cause flexing of elevator spar tube thus producing false indications of excessive radial play.

(c) If dial indicator readings are not within tolerance, adjust shims as necessary.

c. *Repair or Replacement – Synchronized Elevator.*

(1) Replace unserviceable support retainer sets.

(2) Replace elevator if damaged.

(3) Replace tip cap (11, figure 4-22) as follows:

(a) Clean elevator tip area with aliphatic naphtha, (item 304, table 1-2).

(b) Inspect new cap (11) to insure that it is free of oil, grease, dirt, etc. Cap may be cleaned with toluene (item 322, table 1-2).

(c) Brush a thin coat of adhesive (item 211, table 1-2) (approximately 0.010 inch thick) on the elevator tip (cleaned area) and the inside of the cap.

(d) Allow approximately one hour drying time until adhesive attains an aggressive tack. Then, install the cap on the elevator tip as shown in figure 4-22.

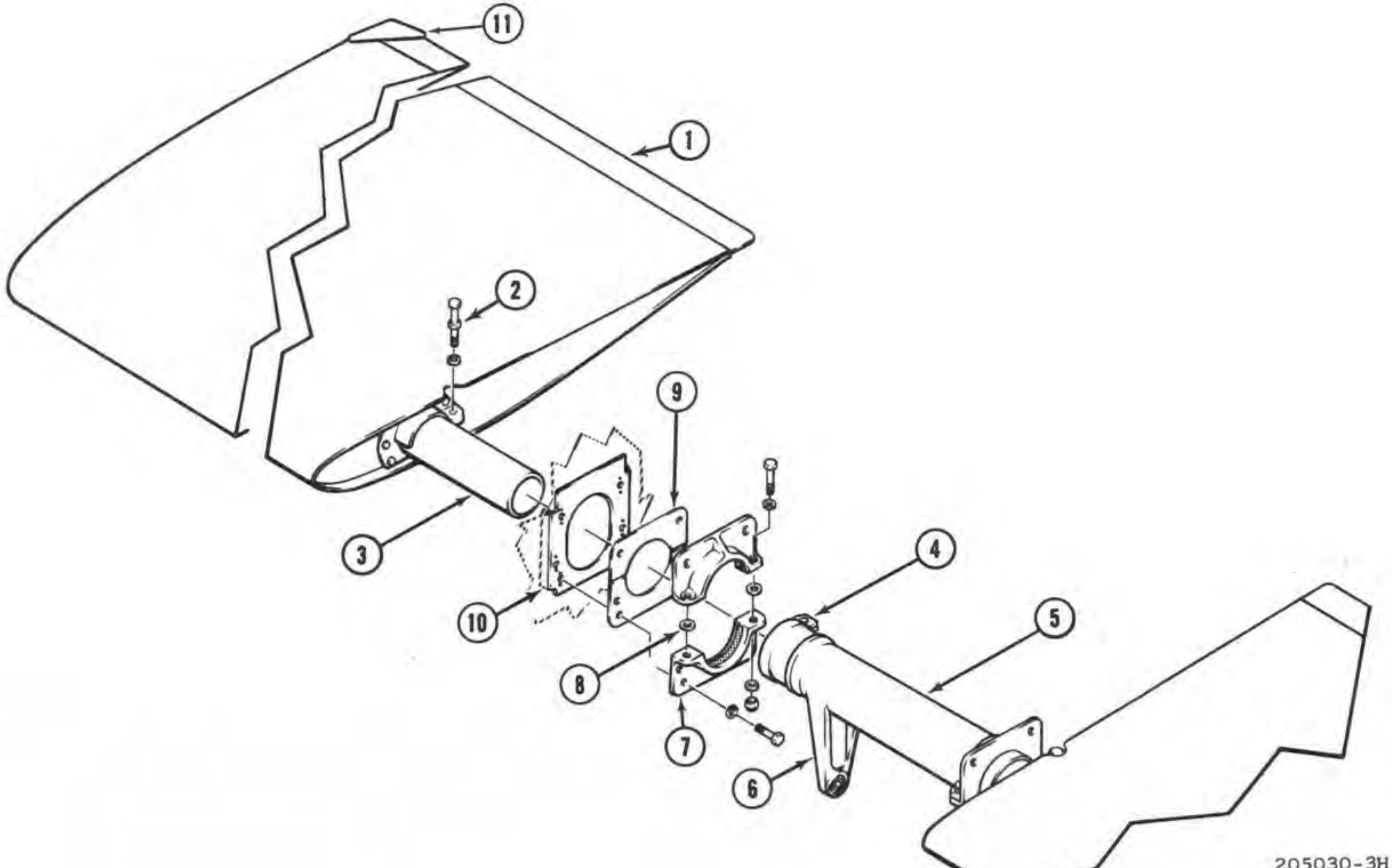
(e) Hold cap in place for a minimum of 15 seconds.

(f) Allow a minimum of 24 hours drying time before releasing the aircraft for flight.

d. *Installation – Synchronized Elevator.*

NOTE

Prior to installing elevator assemblies, coat the horn assembly with corrosion preventative compound (item 309 or 312, table 1-2). No lubrication is required on the elevator spars prior to installation as they are coated with electrofilm dry lubricant. Do not use zinc chromate (item 200, table 1-2) as a substitute for corrosion preventative compound. If zinc chromate has been applied to the horn or spars, remove the chromate with methyl-ethyl-ketone (item 305, table 1-2) and a soft rag. Do not saturate the spar assembly with methyl-ethyl-ketone as it may remove the electrofilm coating.



1. Elevator Assembly
2. Retaining Bolt
3. Spar Tube
4. Mating Lug for Retaining Bolt
5. Horn Assembly
6. Control Arm
7. Support Retainers Set
8. Shims
9. Shim Set
10. Tail Boom Bracket
11. Cap

Figure 4-22. Synchronized elevator installation

(1) Insert horn assembly (5, figure 4-22) into tail boom through access door. Place assembly with ends through support brackets (10) at each side, and with control arm (6) at right of center pointing down.

NOTE

If horn assembly was not removed, proceed to step e., below.

(2) Attach lower and upper support retainers (7) and shim sets (9) with bolts and washers to matching holes and plate nuts of brackets in tail boom. Peel shims as required for 0.005 to 0.030 inch lateral chuck of horn.

NOTE

Handle support retainers with care to avoid damaging bearing surfaces of bushings.

(3) At each support, secure upper and lower retainers together with two bolts, with thin aluminum alloy washers next to both heads and nuts with shims (8) between retainers.

(a) First adjust shims to provide 7-1/2 to 10-3/4 pounds drag.

(b) Add shims between retainers, increasing diameter of each support by 0.0015 to 0.0030 inch, to obtain a slight even drag on rotation of horn without chatter or binding.

(4) Connect elevator control tube to arm of horn assembly.

(5) Install each elevator by inserting spar tube (3) into end of horn, aligning mating holes of elevator fitting and horn, and installing special bolt (2) with washer. Tighten bolt with 100 to 140 inch-pounds torque.

NOTE

Bolt is 2.53 inches overall length. Do not try to use similar bolt, approximately 0.25 inch longer, which is used on Model UH-1B elevators.

(6) Check rigging of elevator.

NOTE

Approximately 1 degree (± 1/2 degree) droop in the right-hand elevator is acceptable.

(7) Install access door, with 18 bolts and washers, on underside of tail boom.

4-64. Vertical Fin Fairing.

The vertical fin fairing is located at the junction of the vertical fin and tail boom, and provides access to the tail skid attachment point.

a. Removal – Vertical Fin Fairing. Remove screws attaching fairing, and remove fairing from helicopter.

b. Inspection – Vertical Fin Fairing. Inspect for cracks and damage; fasteners for serviceability.

c. Repair or Replacement – Vertical Fin Fairing. Replace unserviceable fasteners.

d. Installation – Vertical Fin Fairing. Position fairing on helicopter, and install attaching screws.

4-65. Tail Skid.

A tubular steel tail skid (7, figure 4-1) is attached on lower aft section of tail boom. The purpose of the tail skid is to warn the pilot of a tail-low attitude when landing.

a. Removal – Tail Skid.

(1) Remove screws attaching two covers to lower tail boom fin, at aft end of tail boom, and remove covers.

(2) Remove nut, washer, and bolt attaching forward end of skid tube to tail boom structural member, and pull tube out through support block.

b. Inspection – Tail Skid. (See figure 4-23.)

(1) Inspect tail skid for deflection beyond maximum limit due to tail low landings or other causes. The painted strips illustrated in figure 4-23 may be applied at the aft end of the tail boom for quick reference to determine whether tail skid is bent beyond limits.

(2) Inspect for minor nicks, scratches, and dents; cracks or permanent buckles. Maximum allowable deflection of the tail skid is approximately 4 inches vertical.

c. Repair or Replacement – Tail Skid. Repair minor nicks, scratches or dents by polishing out. Replace cracked or permanently buckled tail skid.

d. Installation – Tail Skid.

(1) Insert tail skid tube through support block. Align holes in forward end of tail skid with holes in tail boom structural member, and install attaching bolt, washer, and nut.

(2) Position covers on lower tail boom fin, at aft end of tail boom, and install attaching screws.

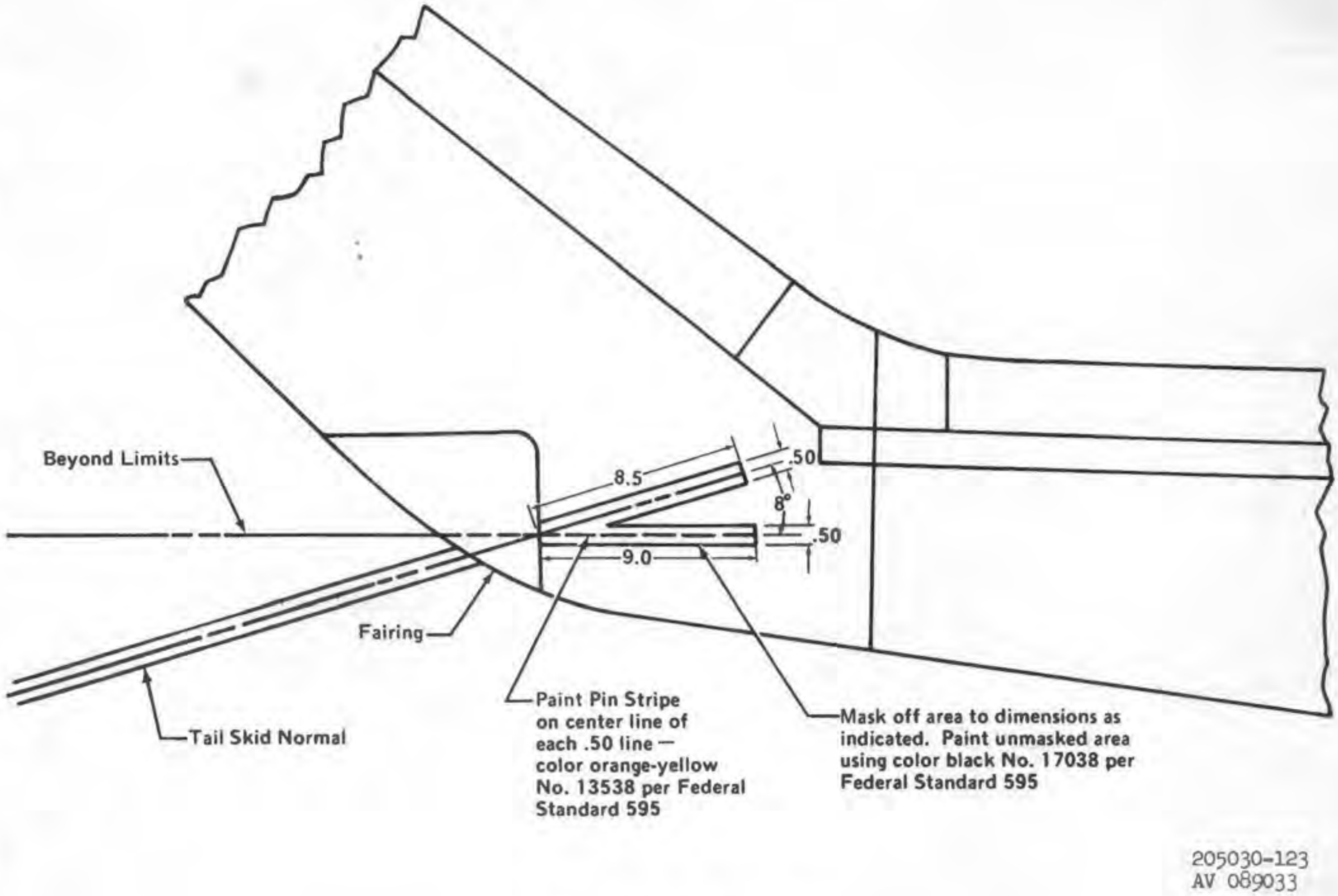


Figure 4-23. Tail skid

Section IV. PYLON SECTION

(Not Applicable)

Section V. WING SECTION

(Not Applicable)

Section VI. ALIGHTING GEAR

4-66. Description.

Landing gear (11, figure 4-1) is of formed aluminum alloy tubes, consisting of two skids attached on ends of two arched cross tubes which are secured to fuselage structure by four padded caps. Each skid tube is fitted with a forward end step, a two-ring fitting, two saddles with sockets for cross tubes, a two-piece shoe along bottom, a rear end cap, and two eyebolt fittings for mounting of ground handling wheel assemblies. Cross tubes are fitted with bearing straps at mounting points.

a. Removal – Landing Gear. Complete landing gear can be removed as an assembly, or skids and cross tubes can be removed separately.

(1) *To remove complete landing gear:* With helicopter supported but not raised on hoist or jacks, remove six bolts and washers at each of four caps which secure cross tubes to structure. Identify caps for location. Raise helicopter off landing gear.

(2) *To separate skids from cross tubes:* Remove bolts with washers at saddles of skids. Pull ends of cross tubes from sockets of saddles.

b. Inspection – Landing Gear.

(1) Visually inspect steps and fittings for obvious damage.

(2) Inspect landing gear skid shoes for damage, wear and suitability for continued service.

(3) Inspect landing gear skid tubes as follows:

(a) Inspect tubes for slight scratches, scuffs, nicks and dents.

(b) Inspect area between cross tube saddles for scratches, dents and holes.

NOTE

Smooth dents, not exceeding 0.25 inch in depth and 1.0 to 1.2 inches in diameter. The area between the cross tube saddles may be disregarded. Scratches, dents and holes in the skid tubes forward of forward cross tube saddle and aft of aft cross tube saddle may be repaired at discretion of local maintenance officer.

(4) Inspect cross tubes for light scratches, scuffs, nicks, dents or other obvious damage.

(5) Inspect cross tube bearing plates for looseness.

(6) Inspect rubber bumper pad on landing gear retention cap assemblies for looseness and deterioration.

(7) With landing gear installed on helicopter, inspect cross tubes for proper deflection as follows:

(a) Position the helicopter on a smooth surface.

(b) Raise the helicopter off the surface with hydraulic jacks (refer to Chapter 1), removing all weight from the landing gear.

(c) Level the helicopter. (Refer to Chapter 1.)

(d) Measure the distance between the cross tube bearing plates, and divide that distance to determine helicopter center line.

(e) Drop a plumb line from helicopter center line to ground or floor surface. (See figure 4-24.) Measure from plumb line to center line of each skid tube at cross tube locations.

NOTE

Distance should be 48 inches from center line of skid tube to plumb line. If distance exceeds 50 inches from center line, or 100 inches between skid tube center lines, replace defective cross tube. (See figure 4-24.)

(f) Lower helicopter to surface and remove hydraulic jacks.

c. Repair or Replacement – Landing Gear.

(1) Replace damaged steps and fittings.

(2) Replace landing gear skid shoes which are considered unserviceable due to damage or wear.

(3) Replace skid tubes which show excessive wear or damage.

(4) Scratches up to 0.03 inch deep and 1.0 to 1.2 inches long, running directly across top of skid tube between cross tube saddles, shall be repaired by Direct Support personnel.

(5) Scratches more than 0.03 inch deep and 1.0 to 1.2 inches long, running directly across top of skid tube shall be repaired by Direct Support personnel.

(6) Dents over 0.25 inch deep and 1.0 to 1.2 inches in diameter between the cross tube saddles shall be repaired by Direct Support personnel.

(7) Holes in skid tubes shall be repaired by Direct Support personnel.

(8) Minor scratches, scuffs and nicks in the landing gear cross tubes may be polished out to depth of damage, but not to exceed 10 percent of cross tube wall thickness, by Direct Support personnel.

(9) Replace cross tubes if deflection dimension exceeds inspection requirements. (Refer to paragraph 4-66 b.)

(10) All other damage (refer to paragraph 4-66 b.) requires replacement of cross tubes.

d. Replacement – Skid Shoes. Raise skid clear of ground by use of jacks, hoist, or ground handling wheels. Detach front and rear shoe sections by removing bolts and washers along each side of skid. Align new rear shoe to mounting holes and install bolts with thin steel washers.

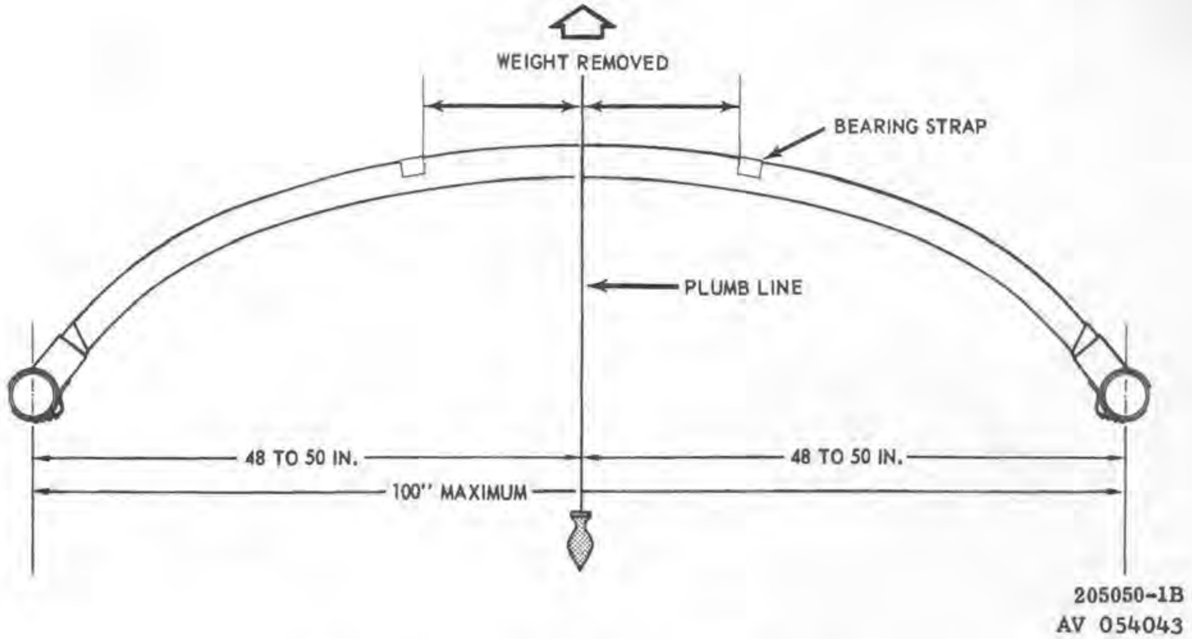


Figure 4-24. Checking landing gear cross tubes

Install front shoe, overlapping end of rear shoe, in same manner.

e. Installation – Landing Gear.

(1) If separated, assemble skids and cross tubes by inserting ends of cross tubes into sockets of skid saddles and installing bolts with washers.

NOTE

Through bolts are not an authorized repair for loose nut plates. Therefore, through bolts will not be used.

(2) Position landing gear and carefully lower helicopter to seat four mounting points of structural beams on bearing straps of cross tubes. Install four cap assemblies, and secure each assembly to plate nuts in fuselage by four short and two long bolts with washers. Tighten bolts to snug fit while aircraft is still supported by hoist or jacks.

(3) Lower aircraft fully and remove hoist or jacks. Make sure aircraft settles on cross tubes correctly before tightening bolts through cap assemblies to proper torque.

CAUTION

Insure bearing plates are centered and fully seated in cross tube saddles. On forward and aft cross tubes, viewing from outside, no more than two bearing plate studs should be seen at each position. If more than two studs are seen, the aircraft is unsafe to fly.

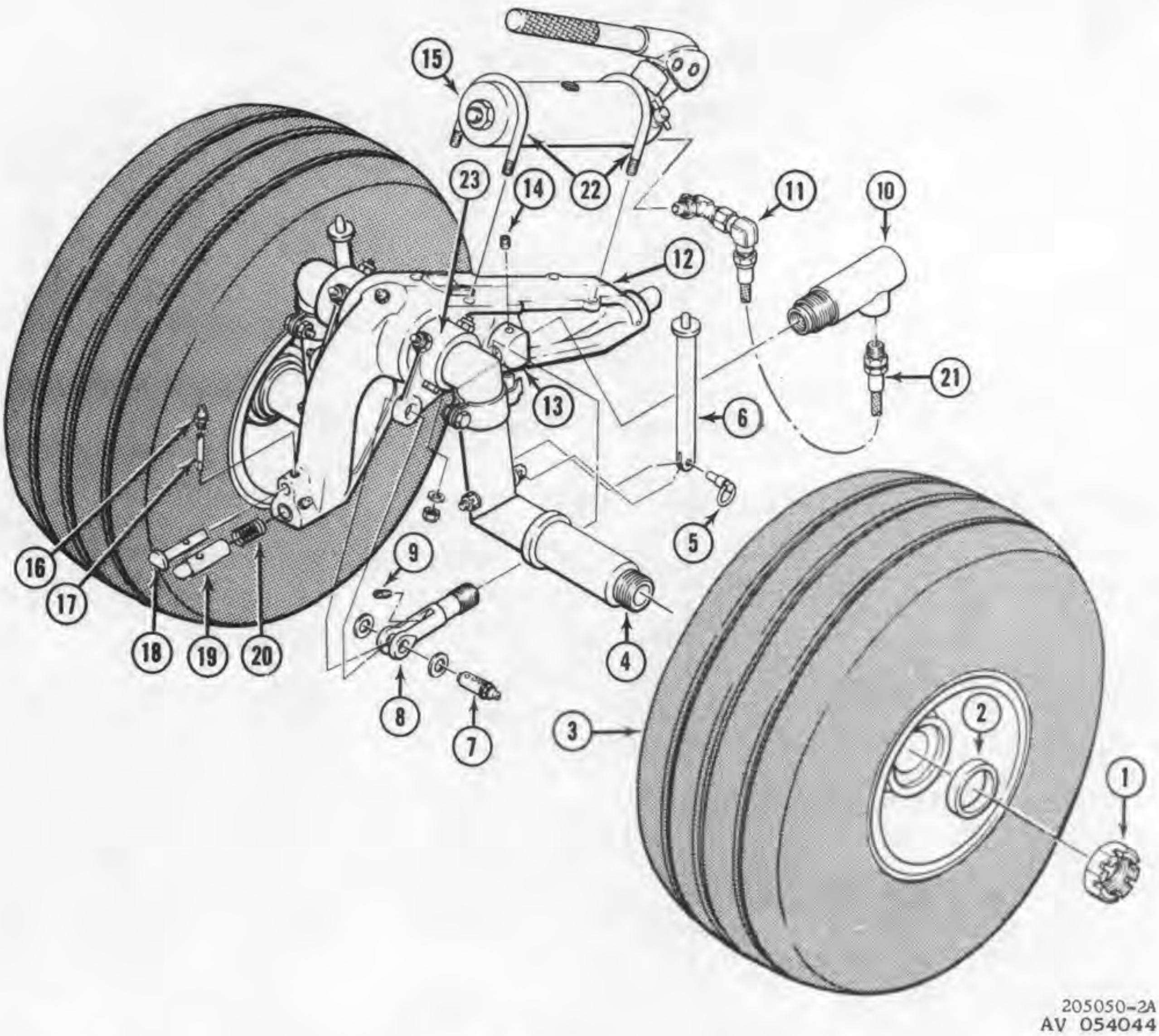
4-67. Ground Handling Gear.

Two ground handling gear assemblies are provided for quick mounting on landing skids to allow moving helicopter on ground. Each assembly consists of two wheels on an offset axle, a supporting cradle, and a hand-operated hydraulic jack with two rams which actuate axle to extend or retract wheels. (Figure 4-25.) Cradle is mounted to eyebolts on landing skid by means of a fixed rear pin and a spring-loaded front pin. Two support rods stowed on axle can be engaged in holes on skid to secure assembly with wheels up, when handling gear is left in place during flight.

NOTE

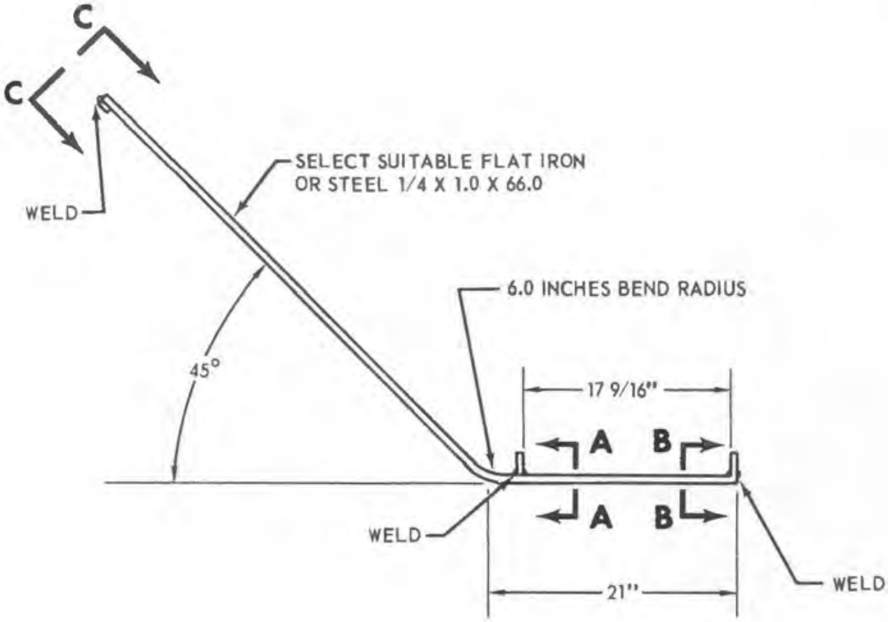
To prevent possible damage to handling wheels the forward portion of the skids should be raised by pulling the tail skid down while extending the wheels.

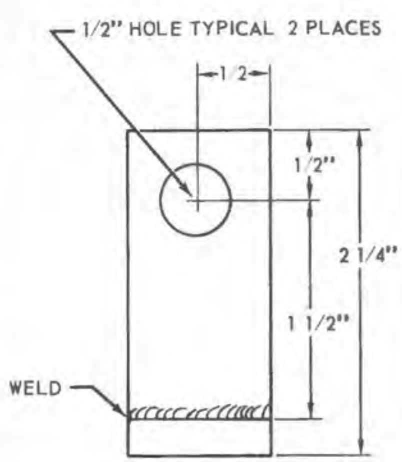
a. Work Aid for Ground Handling Gear. A work aid, for moving ground handling gear assemblies to and from parked helicopters can be locally fabricated. (See figure 4-26.) The device is a small tow bar, with lugs to fit on mounting pins of ground handling gear which can then be pulled or pushed on its own wheels.



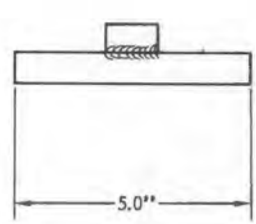
1. Nut
2. Retainer
3. Wheel Assembly
4. Axle
5. Ball-Lock Pin
6. Support Rod
7. Lubricator Pin
8. Clevis
9. Set-Screw
10. Hydraulic Ram
11. Hose and Fittings
12. Cradle Assemblv
13. Trunnion
14. Set-Screw
15. Hydraulic Pump
16. Lubricator Fitting
17. Connecting Pin
18. Release Pin
19. Support Pin
20. Spring
21. Hose
22. U-Bolts
23. Ram Arm

Figure 4-25. Ground handling gear





SECTION **A-A**
B-B SAME



SECTION **C-C**

204900-187
AV 054233

Figure 4-26. Work aid for towing ground handling gear

b. Removal – Ground Handling Gear. For removal procedures refer to Chapter 1.

c. Inspection – Ground Handling Gear.

(1) Inspect tires for proper inflation, cuts and excessive wear.

(2) Check hydraulic pump for proper operation.

(3) Inspect structure for loose and missing bolts, nuts, and general condition.

d. Repair or Replacement – Ground Handling Gear.

(1) Inflate tires to 45 psi air pressure. Replace if badly cut or worn excessively.

(a) With ground handling gear removed from skid, remove either wheel from axle by removing cotter pin, nut (1, figure 4-25) and retainer (2).

(b) Repair or replace tire as required. (Refer to TM 55-1500-204-25/1.)

(c) Place wheel (3) on axle (4) and secure with retainer (2), nut (1) and cotter pin.

(2) Replace hydraulic pump, if necessary, as follows:

(a) Release hydraulic pressure by turning T-handle valve on pump (15) to open.

(b) Place suitable vessel to catch fluid. Disconnect hydraulic hoses from tee fitting on pump. Cap hoses. Remove fitting and reducer (11) from pump, and install plug.

(c) Remove four nuts and washers from U-bolts to detach pump from cradle. Keep U-bolts with pump.

(d) On replacement pump, remove pipe plug from outlet and drain fluid. Install reducer and tee fitting (11) in outlet, aligning open ends of tee across end of pump cylinder.

(e) Place pump, with outlet aft, on cradle (12). Install two U-bolts over pump and through flange of cradle, and secure with washers and nuts.

(f) Connect hydraulic hoses from each ram (10), to outlet tee of pump.

(g) Refill pump with hydraulic fluid (item 4, table 1-2).

(h) Pump handle several strokes.

(i) Crack hose at tee on pump.

(j) Pump until no air can be expelled. Tighten hose connection.

(k) If air is still present in ram (10), refill pump and repeat procedure.

(3) Tighten or replace bolts, nuts and hardware as necessary.

e. Lubrication – Ground Handling Gear. Lubricate assemblies in accordance with Lubrication Chart. (Refer to Chapter 2.)

f. Installation – Ground Handling Gear. For installation procedures refer to Chapter 1.

CHAPTER 5

POWER PLANT AND RELATED SYSTEMS

Section I. SCOPE

5-1. Purpose.

The purpose of this chapter is to provide all essential information for maintenance personnel to accomplish organizational maintenance on the complete power plant and related systems. This information includes a detail description and chronological instructions as to methods and procedures. It also includes special tools and equipment required for accomplishment of these maintenance phases in accordance with the Maintenance Allocation Chart. Special tools required for performance of organizational maintenance will be found in TM 55-1520-210-20P, Organizational Maintenance Repair Parts and Special Tools List Manual.

NOTE

Refer to TM 55-2840-229-24, ENGINE, SHAFT TURBINE for applicable engine data.

Section II. POWER PLANT

5-2. Power Plant Installation.

Power plant installation consists of a shaft turbine engine equipped with adapting parts and connections to fuel, oil, electrical, instrument, and engine control systems. Engine is horizontally mounted above a service deck behind main rotor pylon. Hinged cowling provides access to engine compartment between forward and rear firewalls. Exhaust area, at rear end, is covered by removable fairing. Air intake and output shafts to main transmission are under a louvered fairing or air filters, and are also protected by an induction baffle and screen with detachable sections for access. Hoses and electrical cables between engine and fuselage have quick-disconnect couplings and connectors. Other connections, such as control linkages, firewalls, drive shaft couplings, and engine mounts, have simple, rapid means of attachment so that engine with its fittings can be considered a quick-change assembly.

5-3. Engine Models And Use.

As original equipment, the T53-L-9 engine is used on YUH-1D, T53-L-9A, and T53-L-11 series engines are used on the UH-1D. When the T53-L-13 or T53-L-13/-13A engine is installed, the aircraft is designated UH-1H. The various engine models are successively improved versions of the same basic engine, and are physically interchangeable in the field.

5-4. Engine Orientation.

Directions and locations of equipment on and around the engine are stated as viewed from the rear of the engine, looking forward. Main sections of the engines and directional rotation of principal parts are as shown on diagrams. (See figures 5-1)

a. Engine Model Differences. A brief comparison of engine models is presented below, as to differences in features significant to Organizational Maintenance. Further details are contained in maintenance instructions for the systems where applicable.

NOTE

When using the T53-L-9/9A/-11/-11C engines in lieu of the T53-L-13/-13A or T53-L-11B/D engines use driveshaft adapter P/N 204-040-630-5. When using T53-L-11B engine and T53-L-13/-13A engine, use driveshaft adapter P/N 204-040-612-13.

b. Engine Output Shaft.

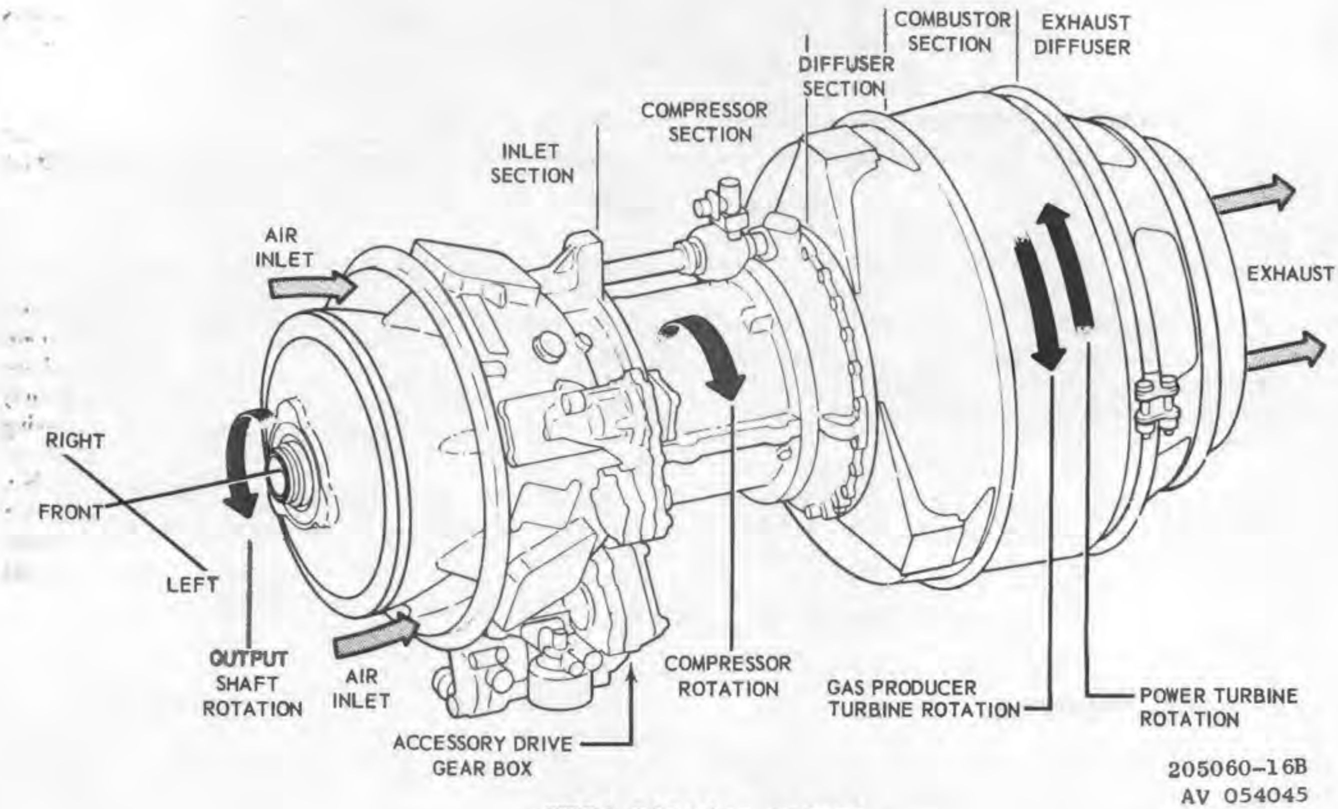
(1) On T53-L-9/-9A/-11/-11C: Requires drive shaft adapter with 24 splines.

(2) On T53-L-11B/D-/-13, -13A: Required drive shaft adapter with 26 splines.

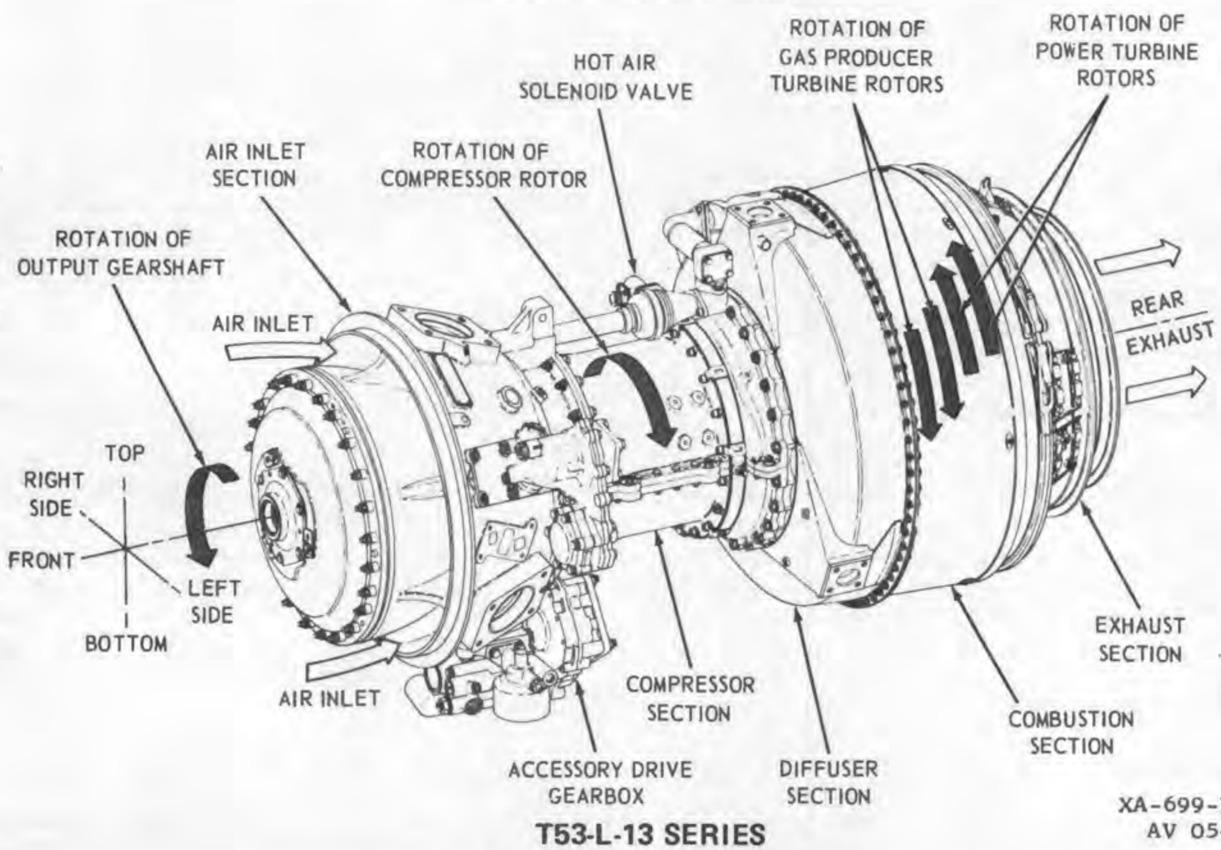
c. Compressor Inlet Guide Vanes.

(1) On T53-L-9, -9A, -11 series: Inlet guide vanes rigidly mounted, at same angle of incidence throughout operation.

(2) On T53-L-13, -13A: Inlet guide vanes are pivoted, allowing variable angle of incidence during operation. The externally mounted actuator is controlled by the sensing line and linkage from the fuel control.



T53-L-9/-9A/-11 SERIES



T53-L-13 SERIES

Figure 5-1. Engine orientation diagrams

d. Interstage Airbleed System.

(1) On T53-L-9, -9A: Bleed band actuator has a controller valve assembly, with a pressure sensing line from engine inlet housing, which aids acceleration in starting cycle.

(2) On T53-L-11 series, -13, -13A: Controller valve assembly eliminated. Actuator controlled by sensing line from fuel control, responsive to transient speed changes in operation as well as in starting.

e. Engine Bleed Air Connection (for cabin defrosting and to drill oil cooling blower and left fuel boost pump).

(1) On T53-L-9: Source between axial and centrifugal compressors.

(2) On T53-L-9A, -11, -13, and -13A series: Source on engine diffuser, after centrifugal compressor. Hotter and greater volume of air required two different fittings in external lines.

f. Combustion Section:

(1) On some T53-L-9, 9A: Combustion changer incorporates a scoop and shroud assembly, limited to JP-4 fuel (except in emergency). Main fuel manifold has an inlet strainer, feeds eleven vaporizers. Has five starting fuel nozzles, two igniter plugs. (Possibly modified to resemble T53-L-11 combustion section.)

(2) On some T53-L-9A and all T53-L-11 series: Combustion changer is scoopless design, capable of using JP-4 or JP-5 fuel. Main fuel system like -9, -9A except has a bypass strainer in main fuel line instead of in manifold. Has two starting nozzles on a starting fuel manifold around lower side of support cone.

(3) On T53-L-13, -13A: Has scoopless-type combustion chamber. Gas producer turbine and power turbine assemblies each has two-stage turbine wheels and nozzles. Main fuel system has no strainer aft of fuel control, has a flow divider assembly and a two-section manifold with primary and secondary flow passages to 22 dual-orifice atomizers. Starting system has four nozzles, four igniter plugs.

g. Fuel Control.

(1) On T53-L-9, -9A: Has no connection to interstage airbleed system. Starting fuel is scheduled by regulator (unless modification has not been performed). Requires use of LTCT6763 cold-weather stop for ground run check of takeoff power.

(2) On T53-L-11 series: Has connection for interstage airbleed actuator sensing line. Starting fuel is scheduled by regulator, has alternate connection for unscheduled starting fuel if required for cold-weather starts on alternate fuel. Has part-power plunger at power lever for use in ground run check of takeoff power.

(3) One T53-L-13, -13A: Essentially like T53-L-11. Also has sensing line and linkage to variable inlet guide vane actuator. Starting fuel is not scheduled.

h. Engine Modifications.

(1) T53-L-11 serial number suffixed A and T53-L-11B engines modified to a long life configuration are designated T53-L-11C and T53-L-11D respectively and are permitted a greater interval between internal (hot end) inspections. These engines contain the following components: gas producer nozzle (1-110-303-34 or 1-110-303-36), No. 2 bearing housing (1-110-310-07), No. 2 bearing retainer (1-110-314-08), gas producer rotor (1-100-490-08), fifth stage compressor disc assembly (1-110-450-09), cast vaporizer seals (1-130-094-05), and combustion chamber curl (1-110-440-02).

CAUTION

In order to maintain the T53-L-11C/11D long life configuration and extended in inspection interval, any replacement for a component listed above must be of the same part number. The incorporation of any other part number component reverts the engine to a normal inspection interval.

(2) T53-L-13A engines incorporate the following modifications and components: second stage compressor disc assembly (34 blades, 1-100-710-05), No. 2 bearing forward seal (1-300-173-01), No. 2 bearing housing (1-110-590-02), No. 2 bearing retaining plate (1-110-181-06), No. 2 bearing seal and retainer (1-110-600-02), oil lubricated fuel control drive splines, air diffuser (1-110-230-08) and accessory drive gearbox (1-080-250-16) for improved oil scapvenge, and exhaust thermocouple assembly (six probe, 1-300-177-01).

5-5. Engine Over-Limit Conditions.

In any case where engine is operated over normal limits, be sure exact circumstances are recorded properly on DA Form 2408-13 (Pilots and Mechanics Remarks column). Notify proper authority to initiate action for special inspeciton, when required, to be accomplished by qualified personnel.

5-6. Engine Mounts.

Engine is suspended at three points by supports made of steel tubing. These supports are attached to fittings on service deck. Bipod support, on right-hand side, and tripod support on left-hand side, both have pillow blocks with hinged bearing caps. These caps retain bearings of two trunnion fittings installed on mounting pads at each side of engine diffuser housing. (Figure 5-1A)

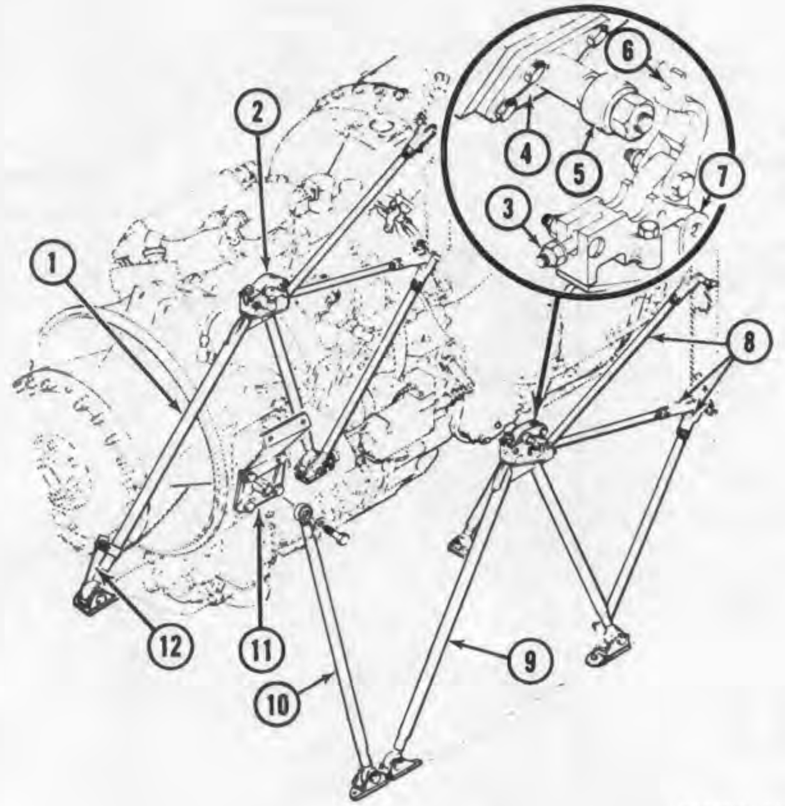
5-7. Removal — Engine Mounts.

a. Before engine is removed, open pillow block caps to release rear trunnion bearings, and detach forward support tube from trunnion fitting by removing retaining bolt and washer.

b. Remove forward support tube and attaching bolt from deck fitting.

c. Remove bellcrank from bracket or tripod block. Remove tripod and attaching bolts from deck fittings.

d. Remove bipod, support spring, and attaching bolts from deck fittings.



1. Bipod
2. Pillow Block
3. Latching Eyebolt
4. Engine Mount Fitting
5. Bearing
6. Bearing Cap
7. Bellcrank Bracket
8. Rear Firewall Brace Rods
9. Tripod
10. Support Tube
11. Trunnion
12. Support Spring

Note

The right forward engine mount (safety leg) has been deleted from all UH-1E helicopters.

Figure 5-1A. Engine mount installation

e. Leave deck fittings in place except when removal is required for inspection replacement, or changė of shims to correct drive shaft alignment. To remove fittings and shims, remove bolts and screws through deck.

f. If necessary to remove an engine trunnion, remove the four attaching bolts and washers. Removal of the bolts from left forward trunnion will also release the bracket which is secured by the same bolts.

5-8. Inspection — Engine Mounts And Components.

a. Attach the engine sling to the engine, take up slack until the sling is supporting the weight of the engine.

b. Open the pillow block caps.

c. Remove the trunnion mounts with the bearings attached from the engine.

d. Remove the bearings from the trunnion and inspect for cracks, wear, and excessive play, (0.006 inch radial — 0.012 inch axial).

e. Inspect trunnion for scored or damaged shaft. Inspect trunnion bearing cap for damage.

f. Inspect all rod end bearings for cracks, wear, and excessive play (0.005 inch radial - 0.010 inch axial). All 204-060-160-1/ 3 Rod End Bearings have a maximum axial play of .020 inch.

g. Inspect all support arms, brace rods, bipod and tripod assemblies for bent, cracked, scratched or damaged tubes.

(1) Permanent bends (bends which do not straighten after load is removed) are not permitted.

(2) Scratches not exceeding 0.010 inch depth may be polished out with abrasive cloth (item 508, table 1-2). Transverse scratches longer than 0.3125 inch are not acceptable.

(3) Scratches or dents adjacent to welded areas are not acceptable.

(4) No dents are permitted in the middle 1/3 of tube. Smooth dents of large diameter which do not cause bending of the tube (end to end) are permitted, provided there is no crimping or cracking in the dent, and there is no visible deformation adjacent to the dents.

h. Inspect all engine floor mount attaching brackets and all fittings for security, cracks and general condition.

i. Assemble trunnion bearings and trunnion caps on the trunnion mounts.

j. Reinstall trunnion mounts on the engine, close and secure pillot block caps, slack off and remove engine sling from the engine.

5-9. Repair Or Replacement — Engine Mounts.

The following limits apply to the engine mount tripod and bipod assemblies. Nicks, chaffing, wear, and pitting may be reworked to a maximum depth of 0.010 inches. Length of bend along the tube shall be at least 30 times the depth of the damage but not longer than 2.25 inches overall and shall not exceed 5/16 inch total peripheral dimension at any one section. Dents may not exceed a total depth of 0.030 inch. Cracked or broken support spring will be replaced to maintain bipod alignment. Replace all parts that do not meet inspection requirement.

5-10. Installation — Engine Mounts.

a. Install two main trunnions (see figure 5-1A) or mount pads of engine diffuser housing, each secured by four bolts and thin washers. On lower forward bolt of left trunnion, install stand-off clip for electrical cable support clamp. Lock-wire bolt heads in pairs.

b. Install forward trunnion with four bolts on mount pad at left side of engine inlet housing.

(1) On two upper bolts, secure droop compensator cambox bracket with a bracket for hose support clamps on forward bolt.

(2) On lower aft bolt, secure support for fuel control vent hose.

(3) Use thin washers on lower forward and upper aft bolts. Lock-wire all bolt heads in pairs.

c. Check installation of deck fittings. Place rod ends of tripod in three fittings at left and rear of deck. Install close tolerance bolts with washers under heads and nuts.

d. In similar manner, install bipod in right deck fittings. Attach spring under bolt head on outboard side of rear fitting, and attach upper end of spring with a bolt to clamp on bipod leg.

e. Install forward support tube in left forward fitting.

f. Open hinged bearing caps on pillow blocks. Lower engine to seat main trunnion bearings. Close bearing caps and secure with latching eyebolts.

g. Align rod end of support tube on forward left trunnion fitting and install retaining bolt with washer. Lock-wire bolt head with upper aft bolt of trunnion.

h. Accomplish main drive shaft alignment check, if required.

Section III. AIR INDUCTION SYSTEM

5-11. Description – Air Induction System.

(Helicopters Serial No. 60-6028 through 66-16867.) (See figure 5-2.) The engine air inlet section draws in air through a bellmouth which is fitted with a coarse wire screen and an ice detector probe. The bellmouth extends through the forward firewall into an air induction area protected by baffles. In original configuration of helicopters through 65-9810, the induction area is covered by a set of louvered fairing. On 65-9811 through 66-16867 serial numbers (and on earlier UH-1D by field modification) the fairing is replaced by a three-piece set of air inlet filters using double layers of porous foam plastic material to protect the engine from foreign matter. A pressure switch on the firewall will actuate a warning light on the instrument panel if filters become clogged.

5-12. Air Inlet Filters.

The three filter sections have metal frames and are secured in place by cowling fasteners or bolts. The top section is made up of hinged panels with actuating levers, but in this installation the panels are always secured in closed position by means of metal channels and links.

a. Removal – Air Inlet Filters.

(1) Remove each of two side sections of inlet filters by releasing fasteners or bolts at top and bottom edge.

(2) Remove top filter section by releasing fasteners or bolts along forward and aft edges.

(3) Protect induction area from entry of dirt and foreign objects while filters are not in place.

b. Cleaning – Air Inlet Filters. Wash filters in a water solution of detergent soap. Flush from inside with clear water. Allow filters to drain and air dry thoroughly. Do not use compressed air drying.

c. Inspection – Air Inlet Filters. Examine filter assemblies for visible damage or shifting of filter material from normal position. Check condition and security of seals around edges.

d. Repair or Replacement – Air Inlet Filters. Replace filter assemblies which cannot be made serviceable by cleaning and repair of edge seals by replacing foam tape.

e. Installation – Air Inlet Filters.

(1) Check that induction area is clear of foreign objects and dirt. (See figure 5-2.)

(2) Check that panels of top filter assembly are held securely in closed position by channels installed on upper side over two forward panel joints, and on under side by two links bolted to aft pairs of actuating levers.

(3) Align top filter assembly on upper edges of induction baffle and firewall. Secure cowling fasteners or bolts.

(4) Align each side filter assembly to mounting holes. Secure fasteners at upper end, and fasteners (or bolts) to cabin roof.

5-13. Induction Baffles, Intake Screen And Bellmouth.

The induction baffles are sheet metal panels secured by cowling fasteners to mounting brackets on cabin structure and pylon supports, removable for access to drive shafts. The intake bellmouth is secured on the engine inlet housing flange by a V-band clamp, and to the engine forward firewall by means of a retainer ring secured in place over the bellmouth mounting flange in such manner as to form a slip-joint to accomodate variations of engine alignment. The intake screen is a two-piece assembly, secured by bolts to nut-plates on the end of the bellmouth, and rests on shock pads against the engine nose around the main drive shaft. The upper left section of screen can be readily removed for drive shaft access.

a. Removal – Intake Screen, Bellmouth, and Baffles.

(1) Open transmission fairing. Remove air inlet filters from fairing.

(2) Remove access section of intake screen and top section of forward induction baffle by releasing fasteners.

(3) Remove main drive shaft. (Refer to Chapter 7.)

(4) Remove mounting screws to detach remaining section of intake screen from end of bellmouth.

(5) Disconnect and remove ice detector probe from brackets at top of bellmouth.

(6) Open engine compartment cowling. Remove V-band clamp to release bellmouth from engine inlet housing.

(7) Remove screws from back of firewall to detach retainer ring and bellmouth from front of firewall.

(8) Cover front of engine inlet housing to keep out dirt and foreign objects.

(9) Remove remaining sections of induction baffle as necessary.

b. Cleaning – Engine Air Intake. Remove all obstructions, deposits and dirt. Detached parts can be cleaned with solvent (item 302, table 1-2). Clean engine as necessary by appropriate cleaning procedures.

c. Inspection – Engine Air Intake.

(1) Inspect all parts for condition and for any indications that foreign objects have entered engine.

(2) Inspect engine inlet housing ducts carefully for signs of internal damage, oil streaks, and for accumulated dirt which may occur as a coating conforming to contour of air flow.

NOTE

In areas where operational experience shows grass and foliage accumulation to be a problem, it is recommended that this inspection be performed before each flight.

d. Repair or Replacement – Engine Air Intake. Replace damaged components.

e. Installation – Air Intake Bellmouth, Screen and Baffles. (See figure 5-2.)

(1) Remove protective covers from engine inlet.

(2) Place retainer ring, with plate nuts forward, on bellmouth ahead of slip-joint flange. Insert bellmouth through forward firewall from front, align to mating flange on engine inlet housing, and secure temporarily with V-band clamp. Be sure mounting hole and brackets for ice detector probe are at top.

(3) Align bellmouth retainer ring to mounting holes of firewall. Install screws loosely, with thin washers under heads, from back of firewall. Tap with a soft mallet around V-band clamp from middle toward ends to seat securely, while tightening nut with 40 to 50 inch-pounds torque. Tighten retainer ring screws.

(4) Install lower sections of induction baffle, omitting upper section of forward baffle.

(5) Install intake screen, without removable section, on end of bellmouth with screws.

(6) Install main drive shaft. (Refer to chapter 7.) Install remaining section of intake screen and forward baffle.

(7) Install and connect ice detector probe.

(8) Install air inlet filters on fairing. Close engine cowling and transmission fairing.

5-14. Air Induction System.

(Helicopters Serial No. 66-16868 and subsequent.) (See figures 5-3 and 5-4.) On these helicopters and on earlier serial numbered helicopters so modified, the engine inlet air section draws air in through three baffle screen filter sections. A sand and dust separator unit, mounted on the inlet housing, separates sand and dust particles from the air entering the engine. This reduces erosion of engine parts.

a. Air Inlet Filter. (Helicopters Serial No. 66-16868 and subsequent.) Refer to paragraph 5-13 for description, removal, cleaning, inspection, repair or replacement, and installation. (See figure 5-2.)

NOTE

For data on sand and dust separator on helicopter Serial No. 68-16066 and subsequent, refer to steps k. through o.

b. UH-1H helicopters prior to Serial No. 68-16066 are equipped with a sand and dust separator which is an inertial type particle separator made in two halves. Engine inlet air enters the separator through a curved, annular, radial inflow opening. Particles entering with the air are pulled out of the airstream, and follow along the curved inner wall. (See figure 5-3.) A lip extending into the airstream deflects the particle-laden air into a large chamber, where the air velocity decreases. The larger particles in the air settle in the chamber; fine particles are removed as the air is drawn through a 230-mesh screen on the filter assembly. Removed particles are held in box assemblies which contain porous plastic foam inserts. The box assemblies can be easily removed and cleaned. Other components used with the sand and dust separator are ENG AIR FILTER CONT circuit breaker on overhead console, an engine air differential pressure switch on the firewall, and an ENGINE INLET AIR warning light on the instrument panel.

c. Removal – Sand and Dust Separator (Prior to Helicopter Serial No. 68-16066).

(1) Remove stainless steel mesh filter screen if installed. Open transmission fairing and remove right and left access doors. Remove air inlet filter screens from fairing. (Refer to paragraph 5-13.)

(2) Remove top section of forward induction baffle by releasing fasteners. (See figure 5-2.)

(3) Remove remaining sections of induction baffle.

CAUTION

Do not attempt to open catch without holding safety latch.

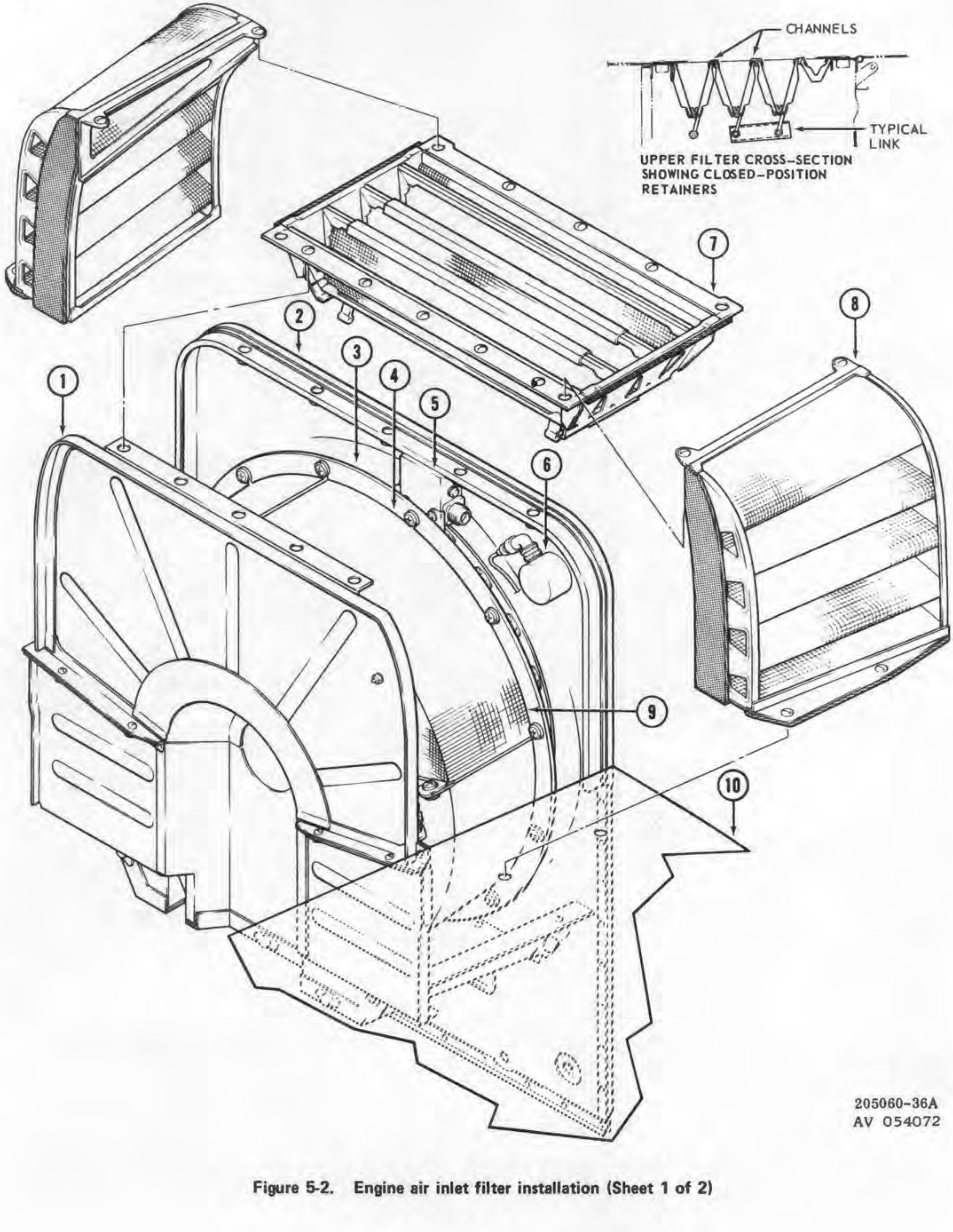


Figure 5-2. Engine air inlet filter installation (Sheet 1 of 2)

1. Induction Baffle
2. Engine Firewall
3. Intake Bellmouth
4. Intake Screen
5. Ice Detector
6. Pressure Switch
7. Upper Filter Assembly
8. Side Filter Assembly
9. Ring Assembly
10. Cabin Roof

205060-36A

Figure 5-2. Engine air inlet filter installation (Sheet 2 of 2)

(4) Release latches (21 and 23, figure 5-4) on front and rear faces of air filters (1 and 19). Press safety latch up and hold before attempting to pull on release catch. (See View A.)

(5) Release fasteners (6) at top of upper assembly air filter and remove assembly.

(6) Remove gasket assemblies (10 and 11).

CAUTION

Filter assemblies shall be pulled vertically or inboard, maintaining form of curve. Pull on hard plastic tab provided at each end adjacent to screening. Handle assemblies with care to prevent damage to screen.

(7) Remove filter assemblies (12). Push on one end while pulling at other end.

(8) Using tab on box for fingerhold, remove box assemblies (13 through 16) from lower assembly air filter.

(9) Remove main drive shaft as a complete assembly, and engine curvic coupling adapter from engine. (Refer to Chapter 7.)

(10) Remove nuts (17) and washers (18). Remove lower assembly air filter (19) and deflector assembly (28).

(11) Remove nuts (30), washers (31), and spacers (32). Remove ring assembly (33). Loosely install spacers, washers, and nuts on engine.

(12) Remove washers and screws that secure split ring assembly to firewall and remove split ring assembly. Loosen V-band coupling clamp and remove flange assembly (34, figure 5-4).

(13) Cover front of engine inlet housing to keep out dirt and foreign objects.

d. Cleaning – Sand and Dust Separator (Prior to Helicopter Serial No. 68-16066).

(1) Empty box assemblies (13 through 16, figure 5-4) of sediment and moisture. Wash mud from plastic box and foam insert with water. Shake off excess water. Allow to air-dry or wipe with clean cloth.

(2) Remove any sand or water accumulation from well of lower assembly air filter (19). Wipe the well with a clean cloth. When filter assemblies (12) are in place, use care to prevent damage to the screen.

(3) Shake filter assemblies (12) to remove loose dirt from screen. If necessary, wash in clean water, and scrub with soft-bristle brush. Shake off excess water; allow to air-dry or wipe with clean cloth.

(4) If equipped with stainless steel mesh filter screens, use hot water solution of detergent soap to remove heavy contamination.

e. Inspection – Sand and Dust Separator (Prior to Helicopter Serial No. 68-16066).

(1) Inspect gasket assemblies (10 and 11, figure 5-4) for severe rubber separation from backing plate and for cuts.

(2) Inspect gasket on mounting ring assembly (33) for cuts or looseness.

(3) Inspect gasket (29) on deflector assembly for cuts or looseness.

(4) Inspect filter assemblies (12) for tears in screen.

(5) Inspect for loose rivets on air filters (1 and 19).

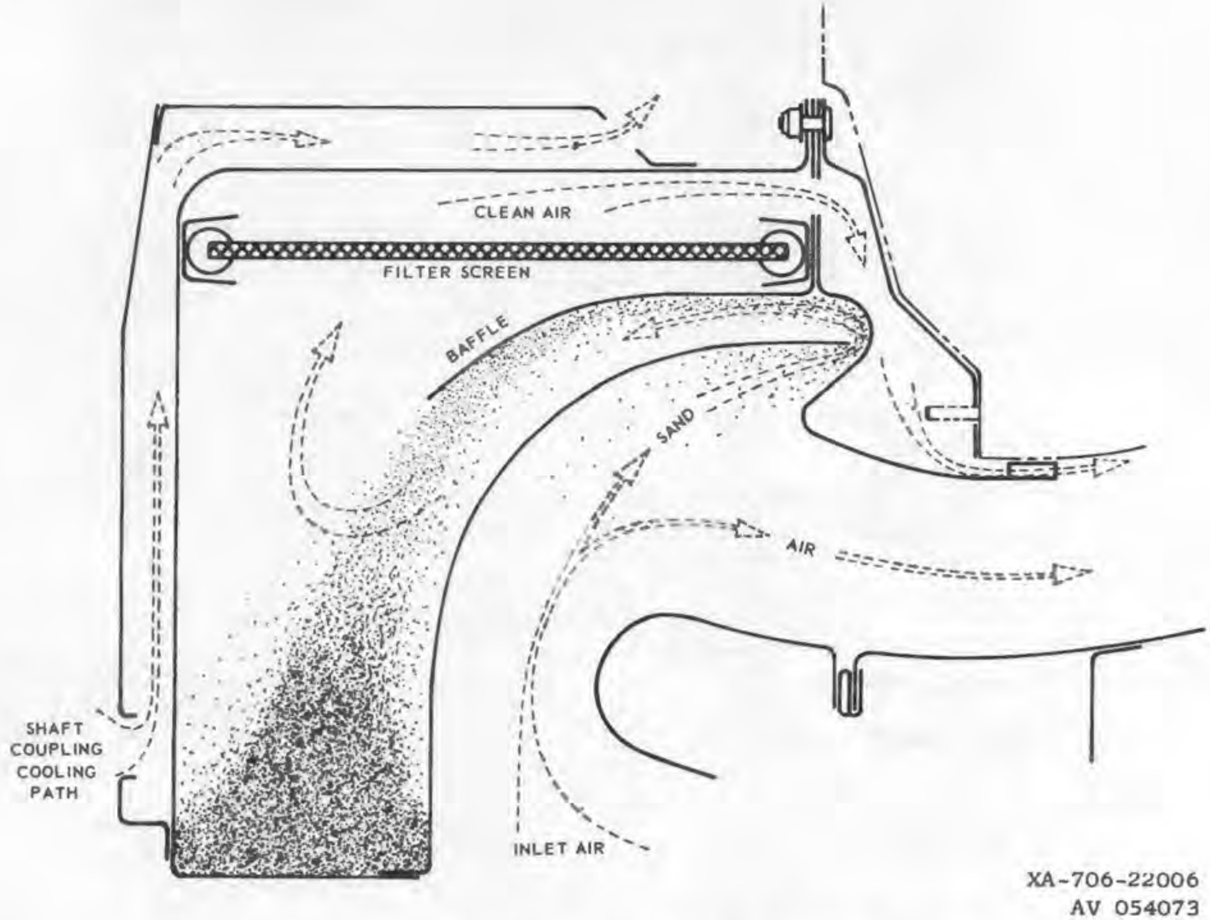


Figure 5-3. Diagram of air flow paths (UH-1H prior to serial no. 68-16066)

(6) Inspect seal (35) on mounting flange assembly for cuts or looseness.

(7) Inspect all metal parts for cracks and damage.

NOTE

Cracks in metal parts are acceptable provided there is no chance of fractured segments entering engine.

f. Repair or Replacement – Sand and Dust Separator (Prior to Helicopter Serial No. 68-16066). Replace all parts not meeting inspection requirements. Small tears and holes in screen or filter assemblies, not exceeding 0.25 square inches per filter screen, may be repaired as follows:

(1) Apply small amount of adhesive (item 213 or 214, table 1-1) at tear or hole. Spread adhesive to bridge and cover hole. Application shall be on side opposite metal guard.

(2) Allow adhesive to cure 24 hours at 75°F before installing screen.

(3) If screen cannot be repaired to (1) above, obtain new screen and bit, to gasket. Use adhesive Dow Corning A-4000 or equivalent to secure gasket to screen.

g. Installation – Sand and Dust Separator (Prior to Helicopter Serial No. 68-16066).

(1) Remove cover from front of engine inlet housing.

(2) Wipe engine inlet housing clean with cloth moistened with dry cleaning solvent (item 302, table 1-2).

(3) Place ring assembly (9, figure 5-2) around flange assembly (34, figure 5-4) and install flange in position on inlet housing of engine. Secure loosely with V-band coupling clamp.

(4) Using ring assembly (9, figure 5-2), position forward section of flange assembly to firewall. Install washers and screws from rear of firewall to secure ring.

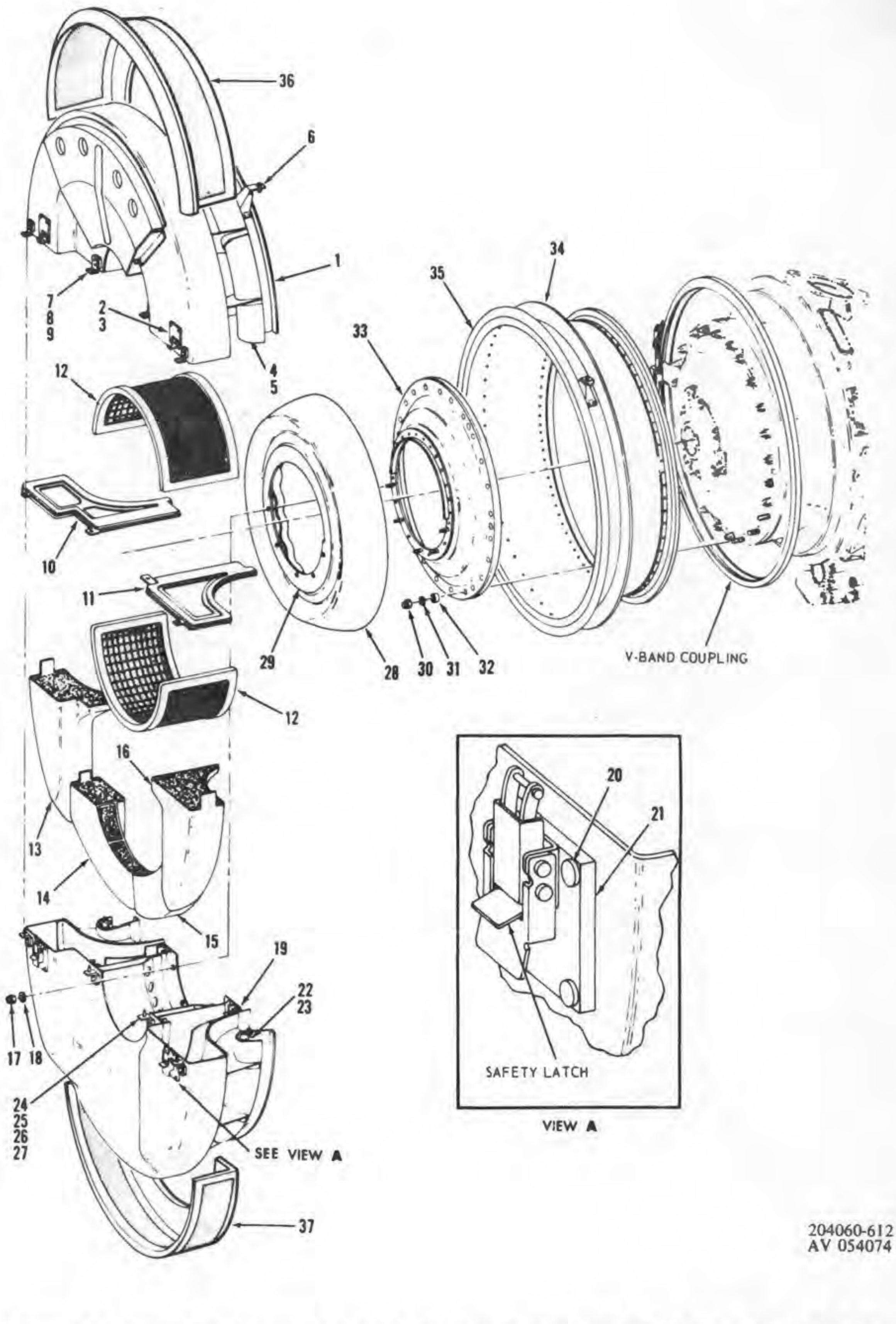


Figure 5-4. Sand and dust separator (UH-1H helicopters prior to serial No. 68-16066) (Sheet 1 of 2)

1. Upper Assembly Air Filter
2. Rivet
3. Hook Assembly
4. Rivet
5. Hook
6. Fastener Assembly
7. Rivet
8. Angle Bracket
9. Spacer
10. Gasket Assembly
11. Gasket Assembly
12. Filter Assembly
13. Box Assembly
14. Box Assembly
15. Box Assembly
16. Box Assembly
17. Nut
18. Washer
19. Lower Assembly Air Filter
20. Rivet
21. Latch Assembly
22. Rivet
23. Latch
24. Rivet
25. Angle Bracket
26. Spacer
27. Positioning Pin
28. Deflector Assembly
29. Gasket
30. Nut
31. Washer
32. Sleeve Spacer
33. Mounting Ring Assembly
34. Flange Assembly
35. Seal
36. Upper Inlet Screen
37. Lower Inlet Screen

204060-612

Figure 5-4. Sand and dust separator (UH-1H helicopters prior to serial no. 68-16066) (Sheet 2 of 2)

(5) Install mounting ring assembly (33, figure 5-4) on 24 studs of engine inlet housing so that the five studs on the ring assembly are at the bottom with center stud at 6 o'clock position. Secure with sleeve spacers (32), washers (31), and nuts (30). Torque nuts to 70 to 80 inch-pounds.

CAUTION

Carefully install deflector assembly to avoid cutting rubber seal of ring assembly.

(6) Position deflector assembly (28) in place on the five ring assembly studs, and press in until firmly seated.

(7) Position lower assembly air filter (19) on five studs of ring assembly. Secure with washers (18) and nuts (17). Torque nuts to 30 to 35 inch-pounds.

(8) Position upper assembly air filter (1) on lower assembly.

NOTE

Do not install gasket assemblies (10 and 11) at this time.

(9) Rotate mounting flange assembly (34) on inlet housing to align receptacles with fasteners (6) on filter assembly.

(10) Secure flange assembly with V-band coupling. Torque coupling nut to 40 to 50 inch-pounds. Tap around coupling from middle toward each end with mallet to seat properly. Lock-wire nut.

(11) Remove upper assembly air filter.

(12) Install engine curvic coupling adapter in output shaft of engine. Torque bolt to 100 to 140 inch-pounds.

(13) Install main drive shaft between engine and transmission. (Refer to Chapter 7.)

(14) Install baffle panels.

CAUTION

Do not use oil or grease in track when installing screen filter assemblies. Push from back end while pulling into position.

(15) Install filter assemblies (12, figure 5-4) in upper and lower assembly air filters, with backing screen on inside diameter. The filters should protrude equally at each end. If necessary, lubricate tracks with trichloroethylene (item 300, table 1-2).

(16) Install four box assemblies (13 through 16) into lower assembly air filter.

(17) Position gasket assemblies (10 and 11) over pins on lower assembly air filter.

(18) Position upper assembly air filter on lower assembly air filter. Tip top slightly forward to place on four positioning pins (27) first.

(19) Secure air filter to flange assembly with fasteners (6) at top.

CAUTION

Secure front latches before securing rear latches.

(20) Engage latches (21) on front face of air filters; then lock.

CAUTION

Ensure that safety latch on latches is engaged by exerting a slight pull on release catch. Catch will not open. (See View A, figure 5-4.)

(21) Engage latches (23) at rear of filters; then lock.

(22) Check for proper seating by appearance of seals. Approximately 0.125 inch of rubber on gasket assemblies will be uniformly exposed. Seal (35) on flange will be approximately half compressed.

(23) Secure engine and transmission cowling.

(24) Install stainless steel mesh filter screen, if so equipped.

h. Sand and Dust Separator Inlet Screen. (See figure 5-4.) The sand and dust separator inlet screen is a stainless steel wire woven screen which covers the inlet area of the particle separator. The screen is comprised of two independent portions, each portion having a mesh size of 5-1/2 square per linear inch. The purpose of this inlet screen is to prevent engine damage from large foreign objects being injected into the engine intake.

i. Removal – Sand and Dust Separator Inlet Screen. (See figure 5-4.)

(1) Open right and left transmissions and engine cowl.

(2) Remove baffle door. Remove top section of forward induction baffle by releasing fasteners.

(3) Remove remaining sections of induction baffle.

(4) Open latches located on left and right hand side of inlet screen.

(5) Remove top screen.

(6) Remove bottom screen.

j. Installation – Sand and Dust Separator Inlet Screen. (See figure 5-4.)

(1) Open right and left transmissions and engine cowl.

(2) Remove baffle door. Remove top section of forward induction baffle by releasing fasteners.

(3) Remove remaining sections of induction baffle.

(4) Install bottom screen sections with aft molding engaging filter split flange and butt molding engaging the adjacent filter inlet vanes.

(5) Install top screen section with aft molding engaging filter split flange and cut out centered over filter latch at 12 o'clock position.

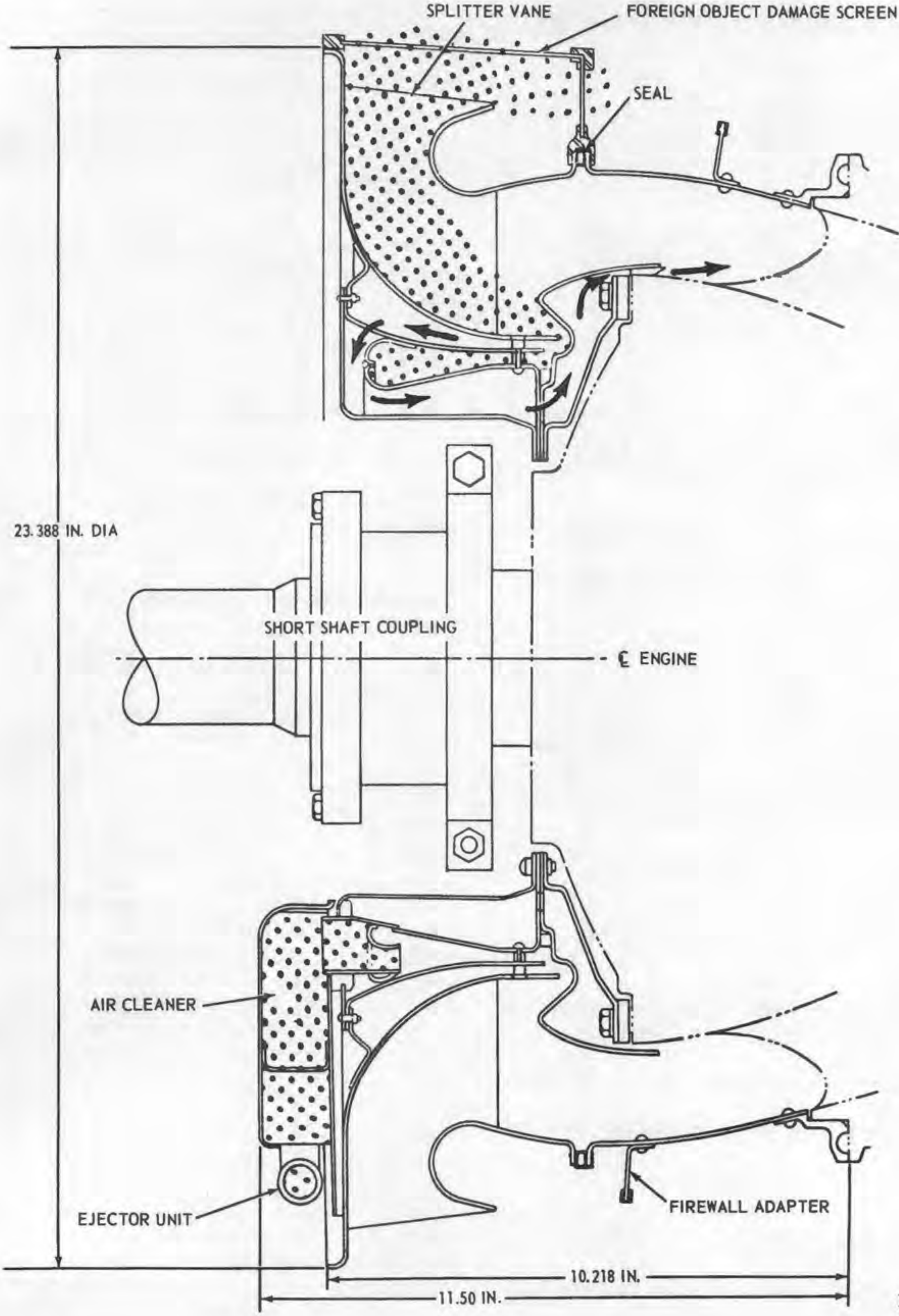
(6) Secure screens section by latching. Latches located on left and right hand side.

(7) Install induction baffle assembly and secure.

(8) Install baffle door.

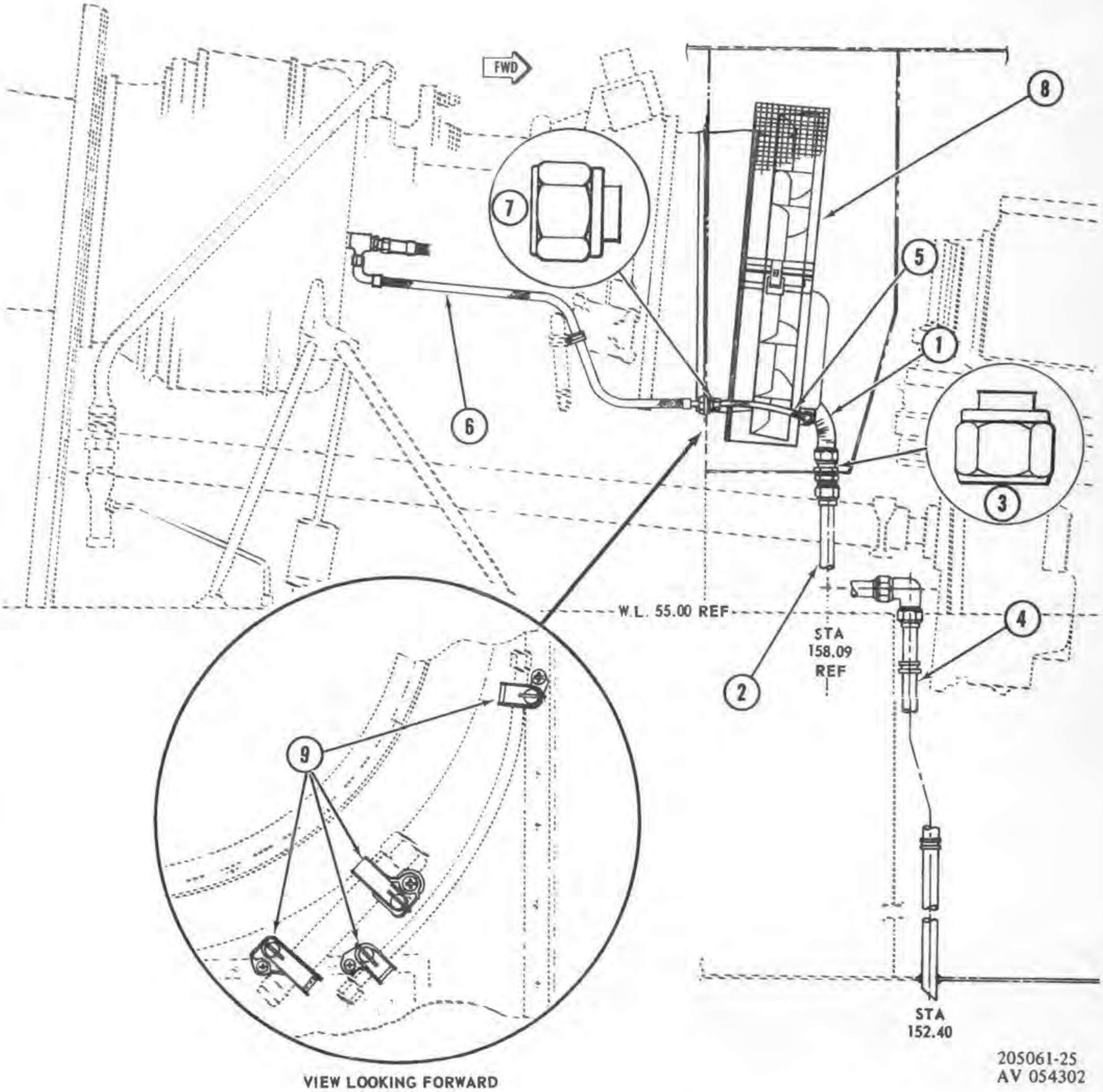
(9) Close right and left transmission and engine cowl and secure.

k. Sand and Dust Separator (Helicopter Serial No. 68-16066 and Subsequent). UH-1H helicopters Serial No. 68-16066 and subsequent have a sand and dust separator that is an inertial-type separator consisting of an upper and lower assembly half, a deflector, a mounting ring assembly, a flange assembly and seal, gaskets, and attaching hardware. (See figure 5-5 and 5-6.) Removal of the upper assembly half permits maintaining the aircraft drive shaft and inspecting the engine inlet. The lower assembly half mounts the air cleaner which collects particles removed from the engine inlet air and ejects them overboard. A flange assembly provides means of attaching the separator to the engine inlet housing. The foreign object damage screen consists of two halves which fit around the sand and dust separator inlet to prevent large foreign objects from entering the engine. Two latch assemblies hold the halves together. (See figure 5-5.) Engine inlet air passes through the FOD screen, where any large particles are caught immediately, and enters the separator through a curved, annular, radial inflow bellmouth provided in the upper and lower assembly halves. Separation occurs when the contaminated air is drawn through a turn, causing particles to be forced to the concave inner flow wall and caught by a protruding lip of the deflector assembly. Clean air continues into the engine inlet area while contaminated portion of the air is drawn through a second turn causing further separation. The clean air resulting from the second turn is returned to the engine inlet area while particle-laden air flows into a large annular chamber and through an air cleaner mounted on the lower half of the separator. Engine compressor discharge (P3) air from a fitting mounted on the engine air diffuser flows through the venturi effect ejector and carries the particles overboard through airframe plumbing. (Figure 5-7.)



X-835-24385
AV 054312

Figure 5-5. Air flow diagram



1. Hose Assembly LH
2. Discharge Tube Assembly
3. Cap Assembly
4. Overboard Discharge Tube Assembly
5. Hose Assembly RH
6. Air Bleed Hose Assembly
7. Cap Assembly
8. Particle Separator
9. Stowage Clamps

Figure 5-6. Sand and dust separator (UH-1H helicopter serial no. 68-16066 and subsequent)

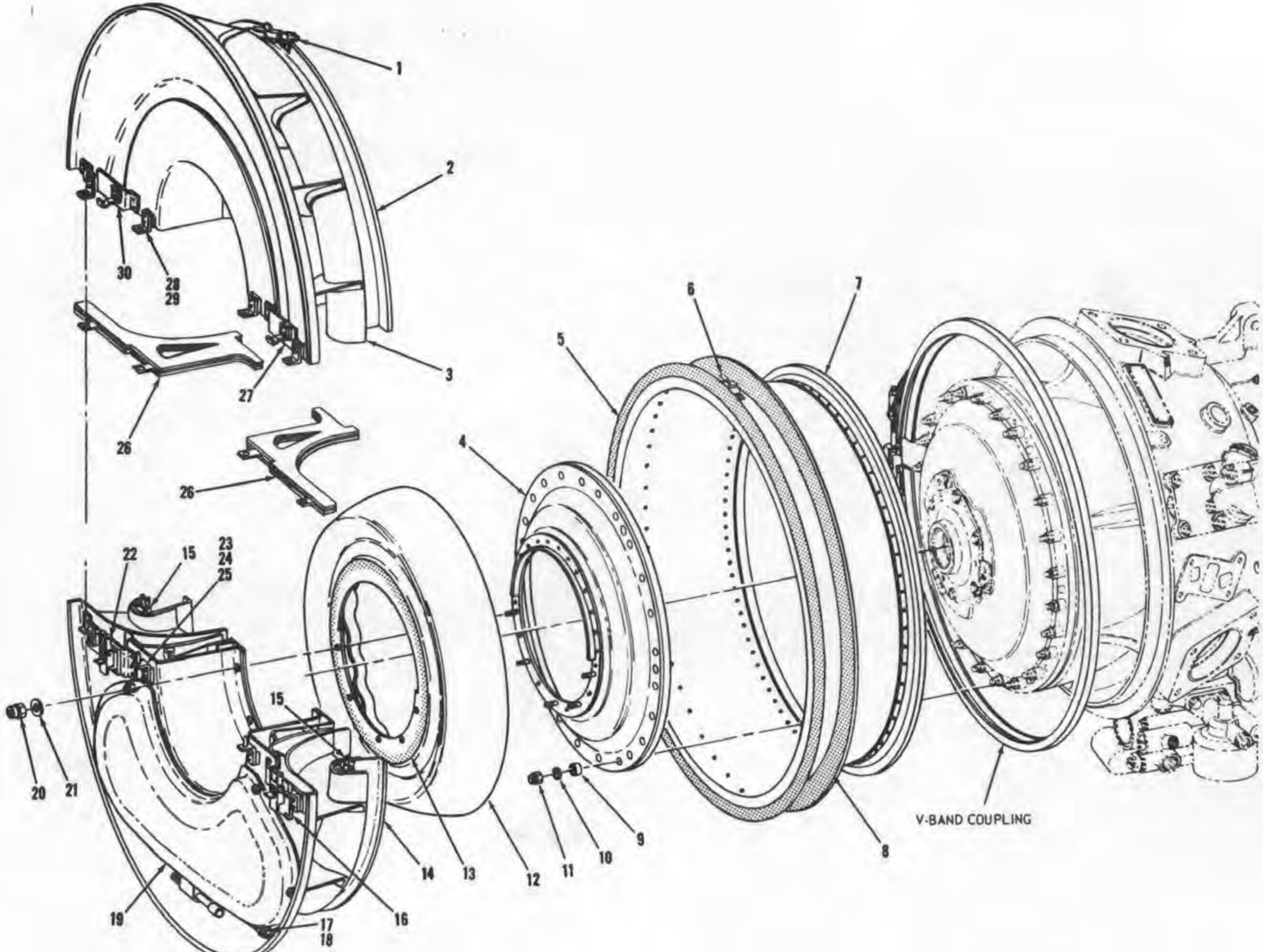


Figure 5-7. Sand and dust separator — exploded view (Sheet 1 of 2)

1. Latch
2. Upper Assembly Half
3. Hook
4. Mounting Ring Assembly
5. Seal
6. Hook Assembly
7. Mounting Flange Assembly (Use with 1-010-500-07) Mounting Flange Assembly (Use with 1-010-500-08)
8. Gasket
9. Sleeve Spacer
10. Washer
11. Nut
12. Deflector Assembly
13. Gasket
14. Lower Assembly Half
15. Latch
16. Latch Assembly (RH)
17. Nut
18. Washer
19. Air Cleaner
20. Nut
21. Washer
22. Latch Assembly (LH)
23. Positioning Pin
24. Angle Bracket
25. Spacer
26. Gasket Assembly
27. Hook Assembly
28. Angle Bracket
29. Spacer
30. Hook Assembly

Figure 5-7. Sand and dust separator – exploded view (Sheet 2 of 2)

l. Removal of Foreign Object Damage Screen. (Refer to figures 5-8 and 5-9.)

(1) Remove top half of FOD screen from the sand and dust separator as follows:

(a) Unlock both latches.

(b) Disengage hook portions.

(c) Lift screen free of the sand and dust separator.

NOTE

Do not remove lower half of screen during periodic inspection unless additional inspection is required.

(2) If required, remove upper assembly half of sand and dust separator. (Refer to step e.)

(3) Remove bottom half of FOD screen from the sand and dust separator as follows:

(a) Lift forward split portion of the butt molding free of the vane and hold in that position.

(b) Lift rear (notched) portion free of the curled inlet of the sand and dust separator.

(c) Repeat preceding steps (a) and (b) for the other side.

(d) Withdraw bottom half of FOD screen from under the sand and dust separator.

m. Inspection, Foreign Object Damage Screen.

(1) Clean all parts as required to facilitate inspection, using dry-cleaning solvent (item 302, table 1-2.)

(2) Inspect exterior of FOD screen for damage which would permit foreign object entry.

(3) Inspect aft molding for cuts or other damage.

(4) Inspect latch assemblies for damage as follows:

(a) Erosion or damage that may cause tightness or binding.

(b) Cracks.

(c) Loose or missing rivets.

(5) Inspect FOD screen for deformation.

n. Repair and Replacement – Foreign Object Damge Screen.

(1) Reshape deformed parts, if feasible. If reasonable conformity cannot be obtained, replace either half or both as required.

(2) Replace parts having severe damage or mutilation.

(3) Replace screen halves with missing or loose rivets.

o. Installation of Foreign Object Damage Screen. (Refer to figures 5-8 and 5-9.)

(1) Position bottom half of the foreign object damage screen, aft molding side toward engine inlet, under the sand and dust separator so butt molding is approximately 2-1/4 inches below horizontal centerline,

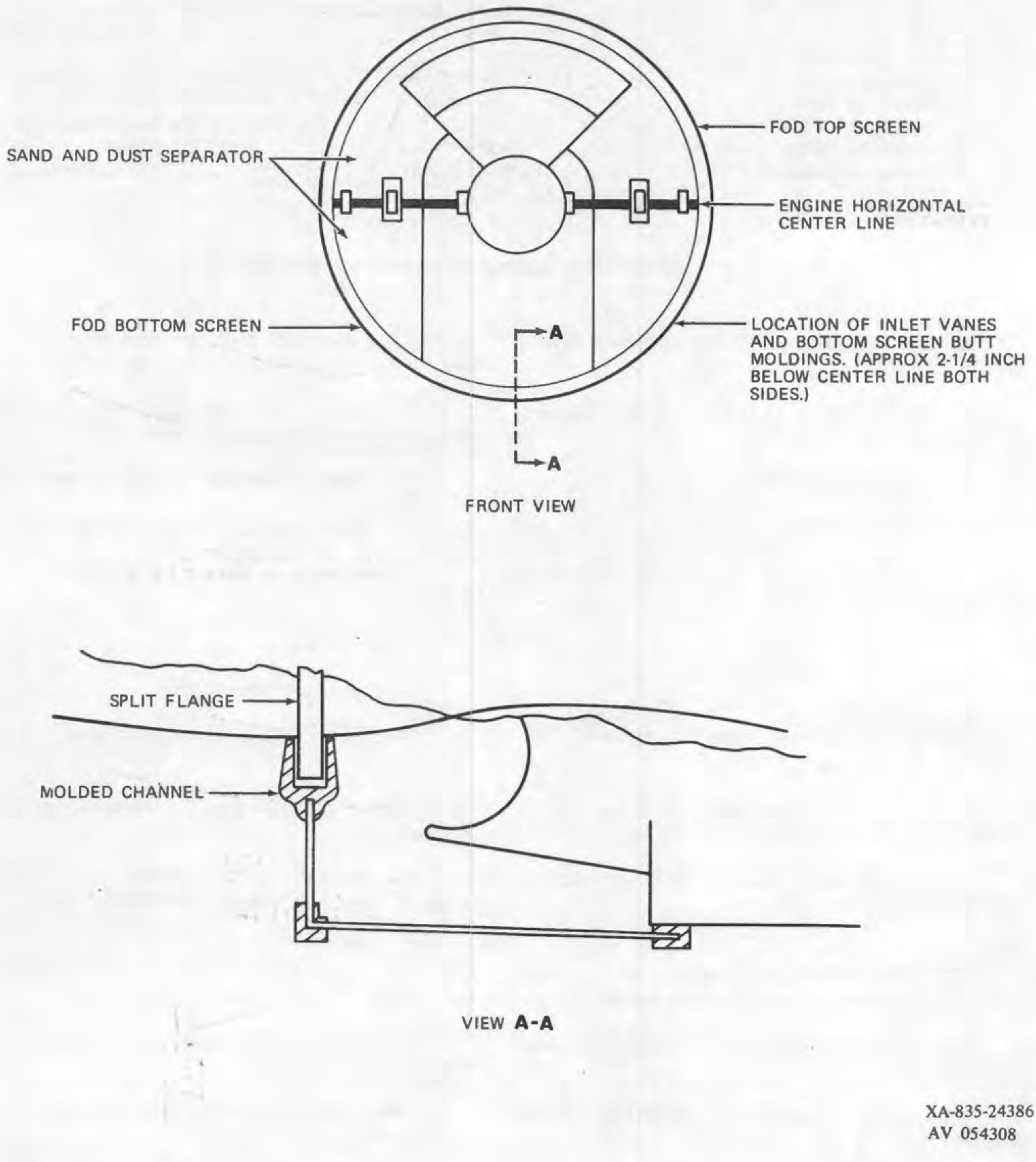


Figure 5-8. Removal/Installation foreign object damage screen

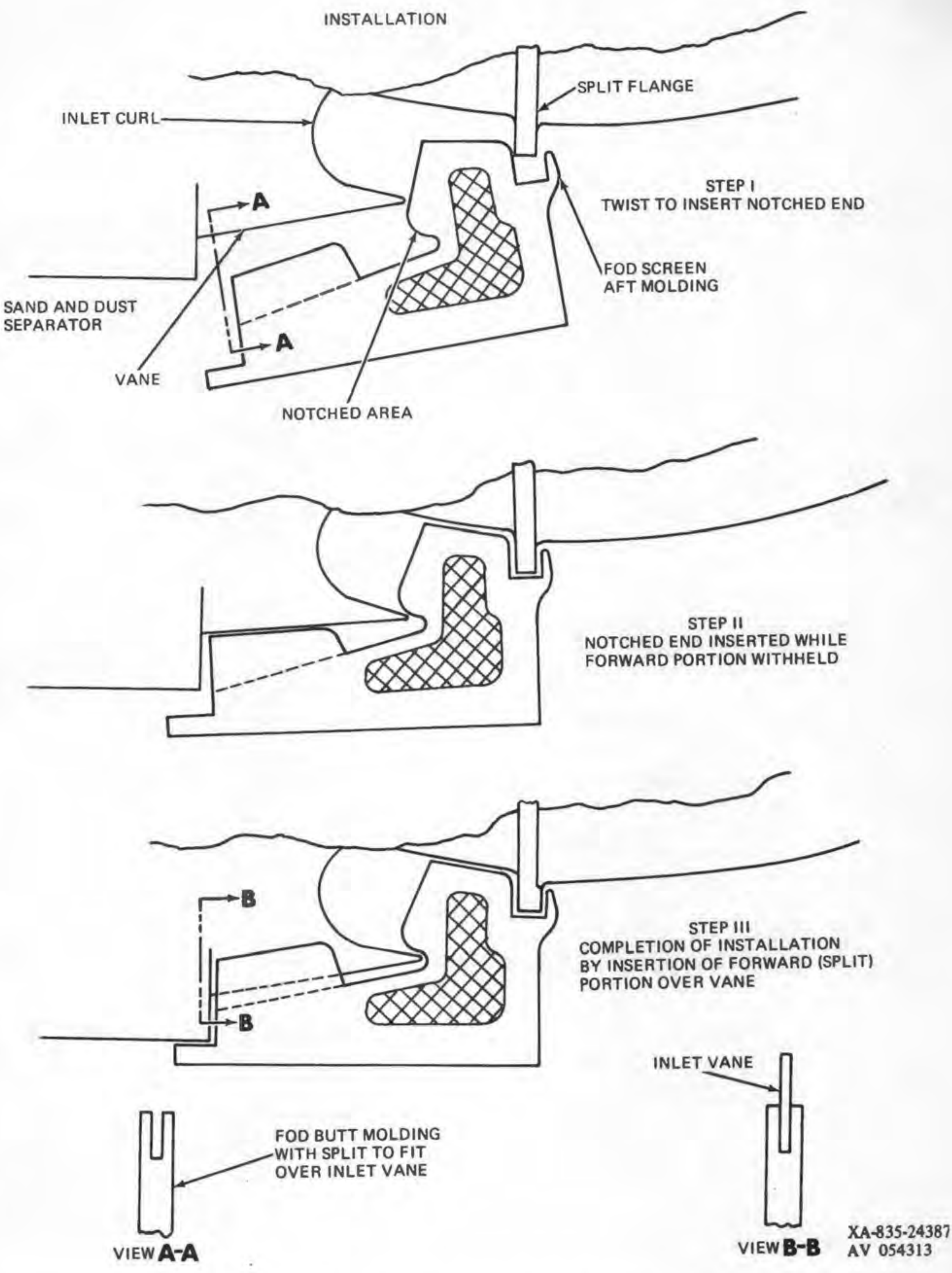


Figure 5-9. Procedural steps installing foreign object damage screen (bottom half)

and aft molding is seated over the sand and dust separator split flange.

CAUTION

Improper seating of the aft molding over the separator split flange can result in cuts or other damage to the molding as well as placing excessive stress on all portions of the screens and latches. To check for proper seating, run hand along the lower split flange to ensure that the molded channel is properly fitted over both sides of the split flange. (See figure 5-8.)

(2) Insert aft molding while holding butt molding away from the vane in the separator. (Refer to steps I and II, figure 5-9.)

(3) Line up the slot in forward portion of butt molding with the vane over which it is to be fitted, and press into place. (Refer to step III, figure 5-9.)

NOTE

When properly installed, the notched area of the butt molding should be positioned behind the sand and dust separator inlet curl, and the forward portion of the molding should have one part of the split on the top of the vane and one part underneath the vane as shown in figure 5-9.

(4) If removed, install top half of the sand and dust separator.

(5) Position top half of the FOD screen so as to engage the aft screen molding slot over the separator split flange. Position the screen cut-out over the latch at the 12-o'clock position of the separator.

(6) Secure top half to the bottom by engaging and locking both latches.

NOTE

Both latches must be engaged with the mating hooks before closing either latch to a locked position.

p. Removal – Sand and Dust Separator (Helicopter Serial No. 68-16066 and Subsequent).

(1) Remove top half of foreign object damage screen.

(2) Release two latches (15, figure 5-7) and latch assemblies (16 and 22) on front and rear faces of upper and lower separator halves (2 and 14) by simultaneously pressing the safety latch up and lifting up on the release catch. Release latch (1) on top or separator upper half and remove the upper half.

(3) Remove gasket assemblies (26).

NOTE

It is not necessary to further disassemble the separator unless the inspection procedures indicate that gaskets and seals may be damaged. If further inspection is required, proceed with the following steps.

(4) Remove the lower half of the foreign object damage screen.

(5) Remove main drive shaft from aircraft as a complete assembly, and remove curvic coupling adapter from engine output shaft.

(6) Disconnect pressure and overboard plumbing from air cleaner fittings.

(7) Remove five nuts (20, figure 5-7) and five washers (21). Remove lower half of separator (14) and deflector assembly (12).

(8) Remove 24 nuts (11), 24 washers (10), 24 sleeve spacers (9), and remove mounting ring assembly (4).

NOTE

Loosely install spacers, washers, and nuts on engine inlet housing studs.

(9) Remove washers, screws, and split ring assembly that secure mounting flange assembly (7) to aircraft.

(10) Loosen V-band coupling and remove mounting flange assembly.

q. Cleaning – Sand and Dust Separator (Helicopter Serial No. 68-16066 and Subsequent). Clean parts only as required to facilitate inspection using dry-cleaning solvent (item 302, table 1-2).

r. Inspection – Sand and Dust Separator (Helicopter Serial No. 68-16066 and Subsequent).

(1) Inspect seal (5, figure 5-7) on mounting flange assembly (7) for tearing and/or ripping at the edges and for lack of adhesion.

(2) Inspect gasket (8) on each side of mounting flange assembly (7) for damage or lack of adhesion.

(3) Inspect gasket assemblies (26) for a permanent set and lack of adhesion.

(4) Inspect all metal surfaces for cracks or other damage.

NOTE

Cracks are acceptable provided there is no chance of fractured segments entering the engine.

(5) Inspect for loose or missing rivets. If rivets are loose or missing in upper or lower assembly half, replace the assembly half. Forward damaged part to field maintenance for repair.

(6) Inspect for weld cracks or weld separation (particularly in the area of the inlet vanes in both the upper and lower assembly halves). If cracks or separation is evident, replace affected assembly half. Forward damaged part to field maintenance for repair.

(7) Inspect for damaged or inoperable safety latches, damaged positioning pins (23), and angle brackets (24 and 28). If damage is evident, replace the affected assembly half. Forward damaged part to Field Maintenance for repair.

(8) Inspect air cleaner (19) for evidence of erosion.

(9) Inspect all other parts for evidence of erosion. Replace damaged parts.

s. Repair or Replacement — Sand and Dust Separator (Helicopter Serial No. 68-16066 and Subsequent).

(1) Repair loose seal and gaskets as follows:

(a) Repair loose gasket (8, figure 5-7) by recementing gasket to mounting flange assembly with cement (item 211A, table 1-2). Clean mating surfaces with methyl-ethyl-ketone (item 305, table 1-2).

(b) Repair loose gaskets (13 and 26, figure 5-7) by recementing gaskets to mating surface with adhesive (item 211B, table 1-2). Clean mating surfaces with methyl-ethyl-ketone (item 305, table 1-2).

(c) Repair loose seal (5, figure 5-7) by recementing seal to mating surface, using Silastic 140 (item 211C table 1-2). Clean mating surfaces with trichloroethylene (item 300, table 1-2) and then with methyl-ethyl-ketone (item 305 table 1-2).

(2) Replace damaged gaskets (13) as follows:

(a) Remove defective gasket and oil adhesive from deflector assembly.

(b) Wipe all metal surfaces to be bonded with lint-free gauze moistened (not dripping) with methyl-ethyl-ketone (item 300, table 1-2). Continue wiping surface, changing gauze frequently, until gauze remains clean.

CAUTION

All grease, oil, or other surface contaminants must be removed from the bonding surface.

(c) Using clean, stiff brush, remove contaminants from surface of new gasket.

CAUTION

Porous surfaces which have been contaminated with oil or grease cannot be satisfactorily cleaned to ensure proper bonding and shall be discarded.

(d) Using clean applicator (finger may be used), apply a continuous uniform film of adhesive (item 211B, table 1-2) to surfaces to be bonded. Allow adhesive to thoroughly air dry for approximately 3 hours.

(e) After adhesive coating has dried, apply a second uniform, continuous film of adhesive to surfaces to be bonded. Allow adhesive to thoroughly air dry for approximately 3 hours.

(f) Align surfaces to be bonded to obtain contact over entire surface.

(g) Apply light compressive load (1/4 to 1/2 psi) to surfaces being bonded. Allow adhesive to cure under this pressure for a minimum of 4 hours.

(3) Replace damaged seal (5, figure 5-7) on mounting flange assembly (7) as follows:

(a) Remove defective seal. Remove old adhesive film from metal surfaces with a knife blade. Then use a wire brush or abrasive paper (item 508A table 1-2).

(b) Wipe metal surfaces to bonded with lint-free gauze, moistened (not dripping) with trichloroethylene (item 300, table 1-2) followed by methyl-ethyl-ketone

(item 305, table 1-2). Continue wiping, changing gauze frequently, until gauze remains dry.

CAUTION

To ensure proper bonding of seal, ensure that all grease, oil, or other surface contaminants are removed.

NOTE

Determine whether new seal is proper size by fitting it to metal mating flange of mounting flange assembly. Do not stretch seal when installing it for fit. If the seal is too large, it may have developed an oversize set during shipment. If so, cut the seal to the required circumferential length and adhere as a strip with the "butt joint" located at either the 6- or 12-o'clock position.

(c) Using abrasive paper (item 508A table 1-2), roughen seal surfaces to be bonded.

(d) Using lint-free gauze, thoroughly clean all surfaces to be bonded with trichloroethylene (item 300, table 1-2).

(e) Apply a uniform layer (0.010 to 0.030 inch thick) of Silastic 140 (item 211C, table 1-2) to surfaces to be bonded.

(f) Fit seal to flange of the mounting flange assembly and press surfaces together.

NOTE

Use only enough pressure to displace air, but not so much that the adhesive is forced out of the joint.

(g) Allow adhesive to cure undisturbed.

NOTE

Under light pressure, the adhesive will take 24 hours to cure. Under warm, damp conditions the adhesive may cure sufficiently in 4 hours to permit reinstallation of mounting flange assembly.

(4) Replace damaged gasket (8, figure 5-7) on each side of support of mounting flange assembly (7) as follows:

(a) Remove gasket material.

(b) Wipe metal surfaces to be bonded with lint-free gauze moistened (not dripping) with methyl-ethyl-ketone (item 305, table 1-2). Continue wiping and changing gauze frequently, until gauze remains clean.

CAUTION

For proper bonding of gasket, ensure that all grease, oil, and other surface contaminants are removed.

(c) Fit new gasket (0.047 inch thick) to mounting flange assembly.

(d) Using abrasive paper (item 508A, table 1-2), roughen surface of gasket to be bonded.

(e) Wipe all gasket surfaces to be bonded with lint-free gauze moistened (not dripping) with methyl-ethyl-ketone (item 305, table 1-2) to remove all powder and surface contaminants. Allow gasket to dry for 15 minutes.

(f) Apply a continuous uniform film of cement (item 211A, table 1-2) to both metal and rubber surfaces to be bonded. Allow approximately 2 to 3 hours drying time.

(g) Wipe the surface of one adhesive film with gauze moistened with methyl-ethyl-ketone, one section at a time. The reactive surface should immediately become tacky.

(h) Align mating surfaces, one section at a time, to obtain contact over entire surface, and press tacky surface to dry surface. Allow adhesive to cure under light pressure for a minimum of 4 hours.

(5) Replace air cleaner (19, figure 5-7) as follows:

(a) Remove six nuts (17) and six washers (18). Remove air cleaner from lower assembly half.

(b) Position new air cleaner on lower assembly half and secure with six washers (18) and six nuts (17).

t. Installation – Sand and Dust Separator (Helicopter Serial No. 68-16066 and Subsequent).

(1) Wipe engine inlet housing clean with clean cloth moistened with dry-cleaning solvent (item 302, table 1-2).

(2) Position mounting flange assembly (7, figure 5-7) in front of airframe firewall and on engine inlet housing. Retain mounting flange loosely with V-band coupling and on firewall with split ring assembly, P/N 204-060-868-1. Insert screws with washers from back of firewall to secure ring assembly.

NOTE

Leave mounting flange assembly (7) loose enough to be rotated.

(3) Remove spacers, washers, and nuts from engine inlet housing studs and discard.

(4) Position mounting ring assembly (4) on engine inlet housing studs.

NOTE

Ensure that five studs on ring assembly are at the bottom, with the center stud located at the 6 o'clock position.

(5) Secure mounting ring assembly with 24 sleeve spacers (9), 24 washers (10), and 24 nuts (11). Tighten nuts to 70 to 80 inch-pounds torque.

(6) Position deflector assembly (12) over locating pins and studs on mounting ring assembly (4) and press in until firmly seated.

NOTE

Secure lines to ejector inlet and discharge ports before installing lower assembly half (14).

(7) Position lower assembly half (14) on locating pins and studs on mounting ring assembly (4). Secure with five washers (21) and five nuts (20). Tighten nuts to 30 to 35 inch-pounds torque.

(8) Position upper assembly half (2) on lower assembly half (14).

NOTE

Do not install two gasket assemblies (26) at this time.

(9) Rotate mounting flange assembly (7) on inlet housing to align hook assembly (6) with latch (1) on upper assembly half (2). Secure mounting flange assembly (7) with V-band coupling. Tighten V-band coupling nut to 40 to 50 inch-pounds torque. Tap around coupling from middle toward each end with a soft-faced mallet to seat properly. Lockwire V-band coupling nut.

(10) Tighten screws to secure flange assembly to firewall.

(11) Remove upper assembly half (2).

(12) Install curvic coupling in output shaft of engine and install main drive shaft.

(13) Connect pressure and overboard plumbing to air cleaner fittings.

(14) Install baffle panels.

(15) Position gasket assemblies (26) over positioning pins (23) on lower assembly half.

(16) If FOD screen is to be installed, install lower half.

(17) Position upper assembly half (2) on lower assembly half (14).

NOTE

Tilt top slightly forward to position assembly on four positioning pins (23).

(18) Engage upper assembly half (2) to mounting flange assembly (7) with latch (1).

(19) Engage latch assemblies (16 and 22) on front face and latch assemblies (15) on rear curl of separator.

CAUTION

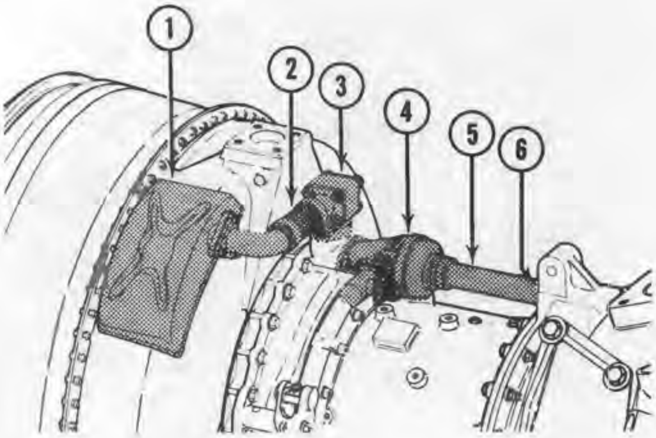
Ensure that safety catch on latches is engaged by exerting a slight pull on release catch. Catch should not open.

(20) Check for proper seating of seals by appearance. Approximately 1/8 inch of rubber on gasket assemblies will be uniformly exposed. Seal (5) on flange assembly will be approximately half way compressed.

(21) If FOD screen is to be installed, install top half.

5-15. Engine Anti-Icing.

Engine anti-icing system uses air heated by compression to prevent ice formation in air inlet passages during engine operation. On T53-L-9 engines, internal passages admit air from exit end of impeller into hollow impeller housing, from which it can be drawn off for anti-icing and for external system uses. On T53-L-9A, -11, -13, and -13A series engines, air is taken from a collection chamber located at upper right on diffuser housing and is delivered into impeller housing through an external manifold and adapter, which also provides connection for external bleed air usage. (See figure 5-10.) On all engines, anti-icing air flows forward through a solenoid-operated valve and external tube to inlet housing. Internal passages direct air through all housing struts (except lower strut which is warmed by internal flow of scavenge oil), through hollow inlet guide vanes, and to mounting pad of fuel control



1. Bleed Air Chamber
2. Connecting Manifold
3. Bleed Air Adapter
4. Anti-Icing Valve
5. Tube
6. Inlet Housing Port

Figure 5-10. Anti-icing system components

temperature sensing element. Small holes through inlet housing provide air exit from each strut. (See figure 5-11.)

NOTE

The engine ice detector system is not operative with sand and dust separator installed, on UH-1D/H helicopters serial no. 66-16868 through 66-17144 and 66-8574 through 66-8577; and helicopters so modified.

Anti-icing air valve is fail-safe loaded to OPEN position whenever solenoid is not electrically energized, for continuous air flow in event of electrical failure. Valve closes when electrical power is applied to circuit. When ice detector probe in intake air stream senses ice forming on its upstream side, ENGINE ICING caution panel will be lighted until probe is rid of ice or clogging. Manual operation of a toggle switch is required for valve to open. A caution panel lettered ENGINE ICE DET will be lighted if detector circuit fails or circuit breaker is open.

a. Removal – Anti-Icing Air Valve.

(1) Remove lockwire and disconnect electrical harness connector from connector of solenoid on valve (4, figure 5-10).

(2) Remove two bolts to detach rear flange of valve from impeller housing.

(3) Spread retaining ring to disengage from groove at forward end of tube (5). Slide ring toward rear.

(4) Push tube forward into inlet housing until free of valve.

(5) Remove valve and gasket.

(6) Remove tube.

(7) Remove packing from valve and from inlet housing. Cover open ports.

b. Cleaning – Anti-Icing Air Valve.

(1) Remove corrosion with crocus cloth (item 510, table 1-2) and cleaning solvent (item 302, table 1-2). Do not submerge valve in cleaning solvent.

(2) Rinse tube in dry-cleaning solvent (item 302, table 1-2) and air dry.

c. Inspection – Anti-Icing Air Valve.

(1) Inspect electrical connector on solenoid valve for corrosion, damaged threads, cracked insulator, and bent or broken pins.

(2) Inspect tube for cracks.

d. Repair or Replacement – Anti-Icing Valve.

(1) Replace valve if insulator is cracked or pins are bent or broken.

(2) Replace tube if cracks are found.

e. Installation – Anti-Icing Air Valve.

(1) Insert a packing into inlet housing port, and another packing into forward port of valve (4, figure 5-10).

(2) Place retaining ring loosely on tube (5). Insert large end of tube into inlet housing port. Push tube forward, with a twisting motion, far enough into housing to allow installation of valve.

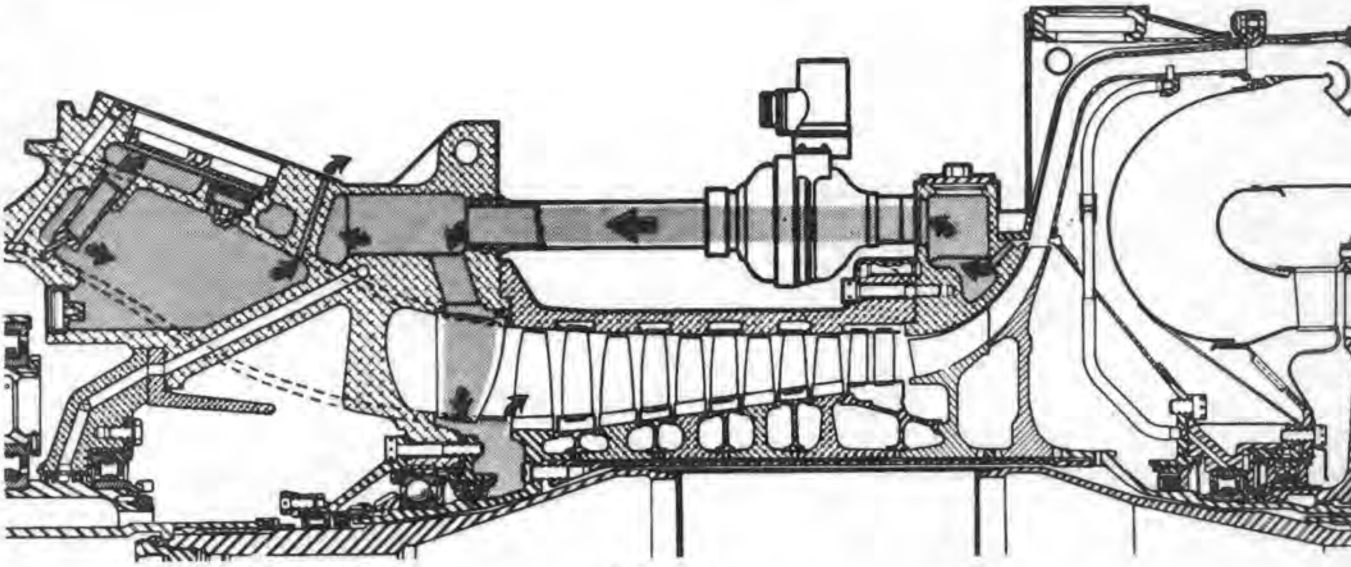
(3) Attach rear flange of valve, with gasket, to mounting pad on impeller housing with two bolts.

(4) Slide tube rearward, with twisting motion, into port of valve. Install retaining ring in groove at forward end of tube firmly against inlet housing. Tighten and lockwire bolts at rear flange of valve.

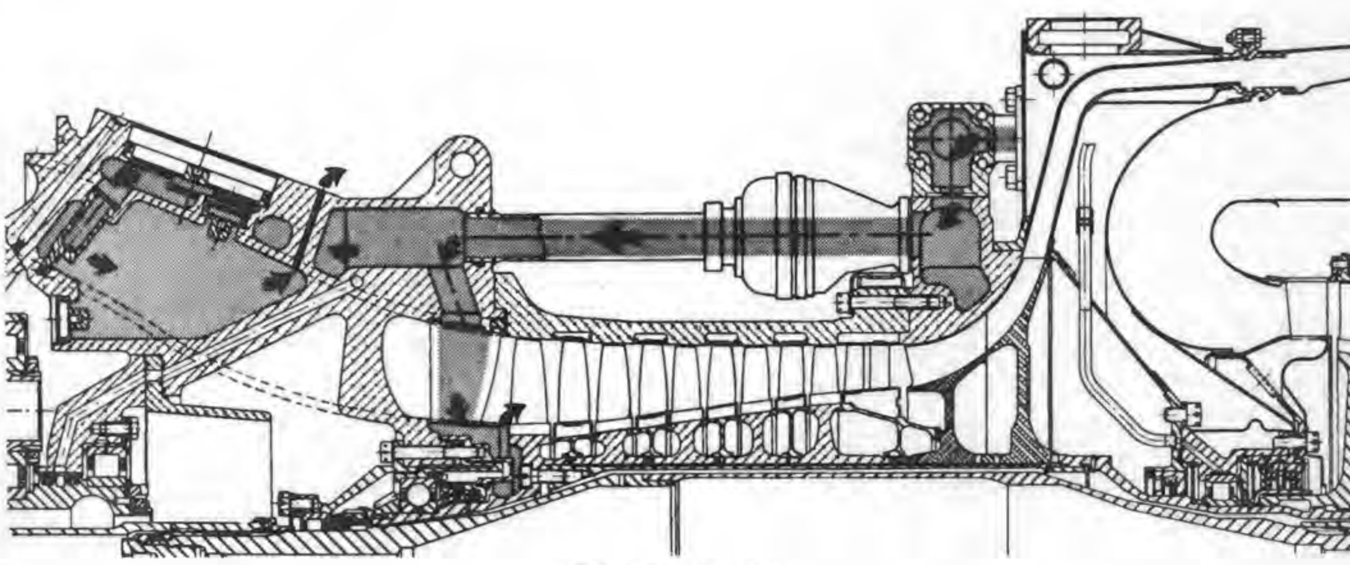
(5) Connect electrical harness connector to valve solenoid connector. Secure with lockwire.

f. Removal – Ice Detector.

(1) Open transmission fairing. Open or remove fairing over engine intake area.



T53-L-5, -9



T53-L-9A, -11, -11B

LEGEND

ANTI-ICING AIR

X-707-126
AV 054181

Figure 5-11. Anti-icing air flow – T53-L-9A, -11 and -11B engines

(2) Cut lockwire and disconnect electrical connector from ice detector, located at top of intake bellmouth ahead of firewall.

(3) Remove lockwire and three bolts with washers which secure detector in bracket. Remove detector assembly and gasket.

g. Installation – Ice Detector.

(1) Place gasket over probe on ice detector. Insert probe through hole in top of intake bellmouth, and align detector in support bracket with electrical connector to left.

(2) Install three bolts with thin washers. Lockwire bolt heads.

(3) Connect and lockwire electrical connector to detector.

(4) Close or reinstall engine intake fairing. Close transmission fairing.

NOTE

Information on other units of engine anti-icing system will be found in electrical systems and wiring diagrams. (Refer to Chapters 12 and 13.)

Section IV. EXHAUST SYSTEM

5-16. Exhaust System.

a. Description – Exhaust System. Engine exhaust diffuser has inner and outer housings, separated by hollow struts across exhaust passage. Inner housing, which supports power turbine assembly, is capped by a cover plate. A tailpipe, clamped on outer diffuser flange, directs has exhaust gases aft and slightly up away from tail boom. Pipe has a drain hose from lowest point. A rigid harness with either three or six thermocouple probes attached and inserted through diffuser into the path of exhaust gases, is connected through flexible cable to cockpit exhaust gas temperature indicator. A support cone, around diffuser, provides mounting for rear firewall.

b. Removal – Exhaust Tailpipe.

(1) Open access door at lower left on tailpipe fairing, disconnect antenna and anti-collision light wiring at deck connectors. Open section of drive shaft access door which overlaps end of tailpipe fairing. Release fasteners and remove fairing.

(2) Disconnect drain hose coupling.

(3) Remove V-band clamp from mating flanges of engine exhaust diffuser and tailpipe. Lift off tailpipe.

(4) To remove cover plate from inner housing flange, cut lockwire and remove eight bolts.

(5) Protect exhaust diffuser opening with fabric cover normally used on tailpipe.

c. Inspection of Tailpipe. Inspect tailpipe for cracks, dents, burned out, or buckled areas.

d. Repair or Replacement of Tailpipe. Shallow dents and scratches may be disregarded. Refer to TM 55-1500-204-25/1 and request assistance from next higher maintenance level for repair of cracks. Large dents which cannot be straightened without deforming tailpipe contour, burned out areas, buckling, or similar damage is cause for replacement of tailpipe.

e. Installation – Exhaust Tailpipe.

(1) Remove protective cover from engine exhaust diffuser.

(2) Position cover plate over center opening of diffuser. Install eight bolts through cover into captive nuts of mounting flange, using anti-seize compound suitable for high temperatures.

NOTE

P/N 1-150-059-02, bolts, shall be safetied by either of the following methods.

1. Safety wire per applicable instructions.

2. Install tab washer P/N STD3023K2 or equivalent, under head of bolt with tab hooked over outer edge of exhaust diffuser housing. After final torque of bolts, bend both tabs up tight against side of bolt head in such a manner as to prevent bolt from backing out or losing torque.

CAUTION

Use new self-locking nuts every time when installing V-Band coupling clamps.

(3) Position tailpipe on outer flange of diffuser, with drain fitting down and locating dowels engaged. Make sure inside of pipe is aligned with exhaust diffuser. Secure with V-band clamp around flanged joint. Seat clamp by tapping with soft mallet from middle toward ends, while tightening nuts on clamp bolts with 100-130 inch-pounds torque. Repeat this procedure at least twice to ensure

proper seat and torque application. Check torque again after test flight or engine ground check.

(4) Connect drain hose from tailpipe to coupling on fuselage.

(5) Install tailpipe fairing, connecting antenna and anti-collision light wiring at deck connectors. Close drive shaft access door.

(6) Place protective cover on tailpipe.

Section V. FUEL SYSTEM

5-17. Fuel System.

a. Description – Fuel System.

(1) Fuel supply is contained in five cells interconnected to act as a single tank. (See figures 5-12 and 5-13.) Three cells are located across fuselage below engine deck, with system filler cap on right-hand cell. Two forward cells, located under cabin floor and gravity fed from aft cells, are each provided with a fuel boost pump. On helicopters prior to Serial No. 69-15292, the right pump is electrically operated and the left pump is driven by bleed air from engine compressor. Helicopters Serial No. 69-15292 and subsequent have electrically operated boost pumps in both the right and left forward cells. Fuel under pressure is delivered from pumps through separate lines to a check valve manifold on front of engine forward firewall. Passing through two check valves and single outlet of manifold, fuel flows through an electrically controlled shutoff valve to main fuel strainer in engine compartment for delivery to engine through fuel control inlet hose. Fuel shutoff valve and each check valve of manifold have internal bypass valves, to relieve thermal expansion of trapped fuel when system is inoperative. Transmitter for fuel pressure gage is connected to a tap on check valve manifold.

(2) On Model UH-1D/H, each forward cell is divided into compartments by a lateral baffle fitted with a flapper valve to allow fuel flow from front to rear. (See 11, figure 5-13.) Boost pump is mounted on a sump assembly near aft end of cell, connected by hose to pressure line outlet. Part of pump output is diverted forward by a tee fitting through a check valve, a flow switch and hose to ejector type pumps at front of cells. Induced flow of ejector continously sends fuel through a hose back over top of baffle into rear compartment of cell, so that no significant quantity of fuel will be unusable in any flight position. Flow sitches are electrically connected to caution panels for warning of failure of either boost pump. A float switch, for 20 MINUTE FUEL caution panel circuit, is on left cell sump. Right cell has two quantity gage tank units, interconnected with another located in center aft cell. A defueling valve is provided on crossover fitting at rear of left forward cell, with an access cover on lower skin. Each forward cell has two drain valves, for sump and for forward compartment. On model YUH-1D, boost pumps and sumps are near front of forward fuel cells. (See figure 5-12.) Each pump has a drain valve, and a defueling valve is provided on forward crossover line between sumps. Right cell sump has float switch for 20 MINUTE FUEL caution panel. Fuel quantity gage tank units are in both forward cells and in center aft cell, interconnected through a monitor unit in left forward cell. Two pressure switches, in caution panel circuits, are connected at taps on check valve manifold to provide warning of failure of either boost pump.

b. General Maintenance – Fuel System. Organizational maintenance will consist of visual inspections, ground operational checks, cleaning of filter and strainers, specified adjustment of control linkage systems and fuel control unit as required, and replacements of piping, fittings, seals, and units which are accessible without extensive disassembly. Observe general notes and precautions below, and procedures for replacement or adjustment of principal components in subsequent paragraphs.

(1) Conduct any defueling or drainage of fuel in accordance with applicable directives, and with extreme care to avoid fire hazards.

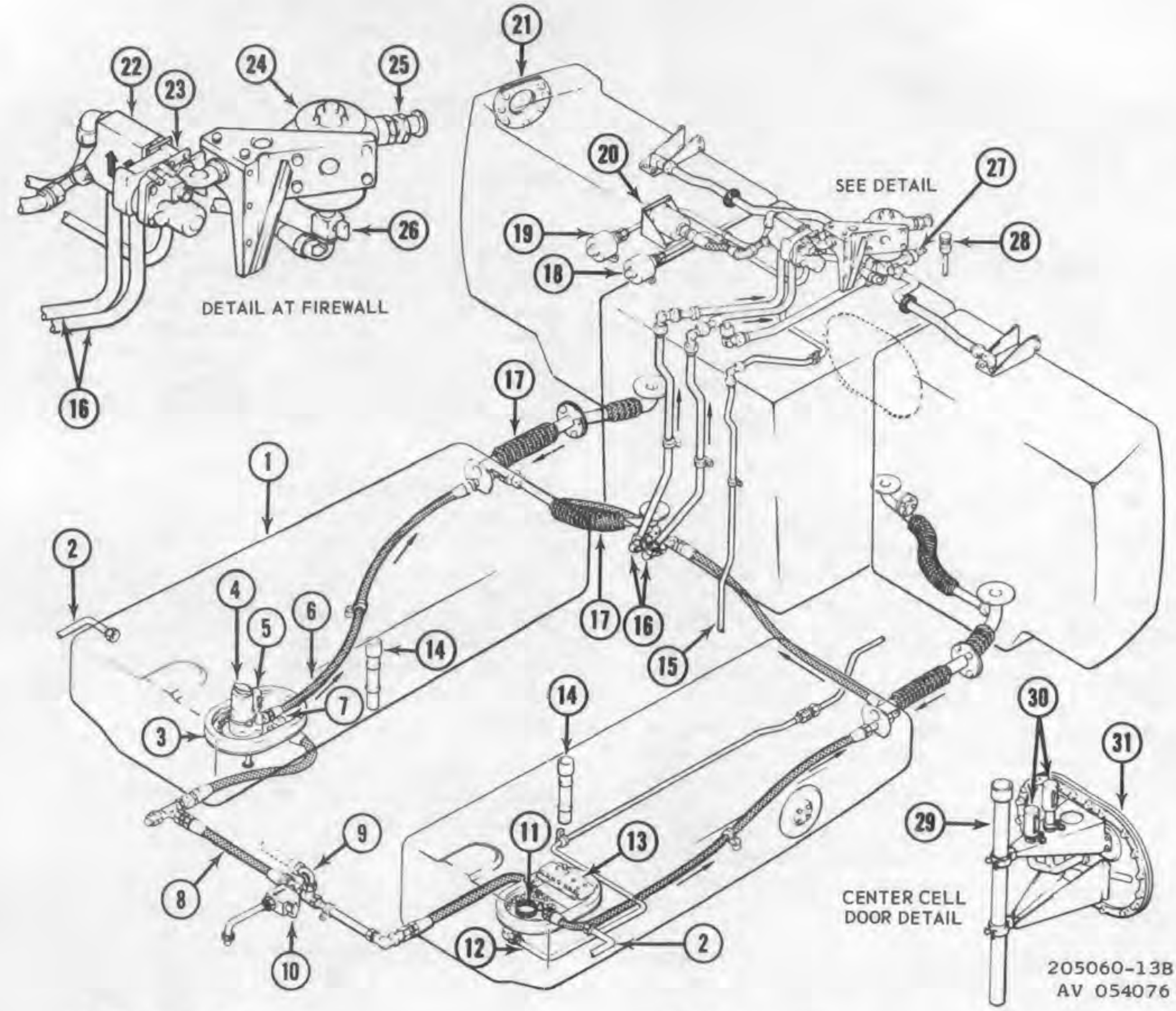
NOTE

Defuel helicopters Serial No. 69-15292 and subsequent and helicopters with crashworthy fuel system incorporated at defuel valves located on sump in forward fuel cells. Defuel helicopters prior to Serial No. 69-15292 which have not had crashworthy fuel system at defuel valve (14, figure 5-13).

(2) Before removing any line or hose, be sure it is properly identified and its route understood for replacement in same manner.

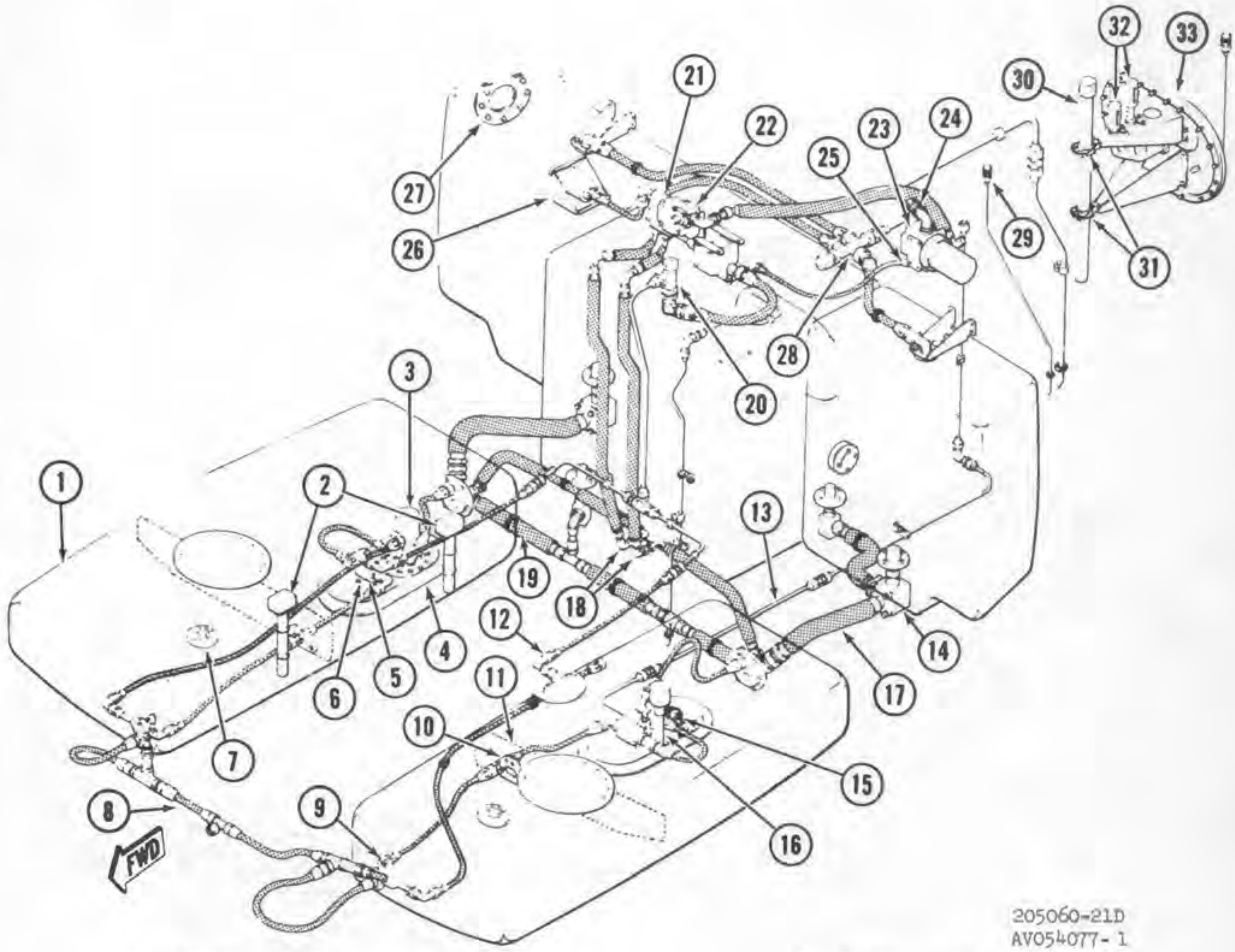
(3) Cap or cover any open lines, fittings, or exposed opening in units (other than normal vents and drains) to protect fuel system from contamination. Be sure vent lines are not obstructed.

(4) 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. (Refer to Chapter 13.)



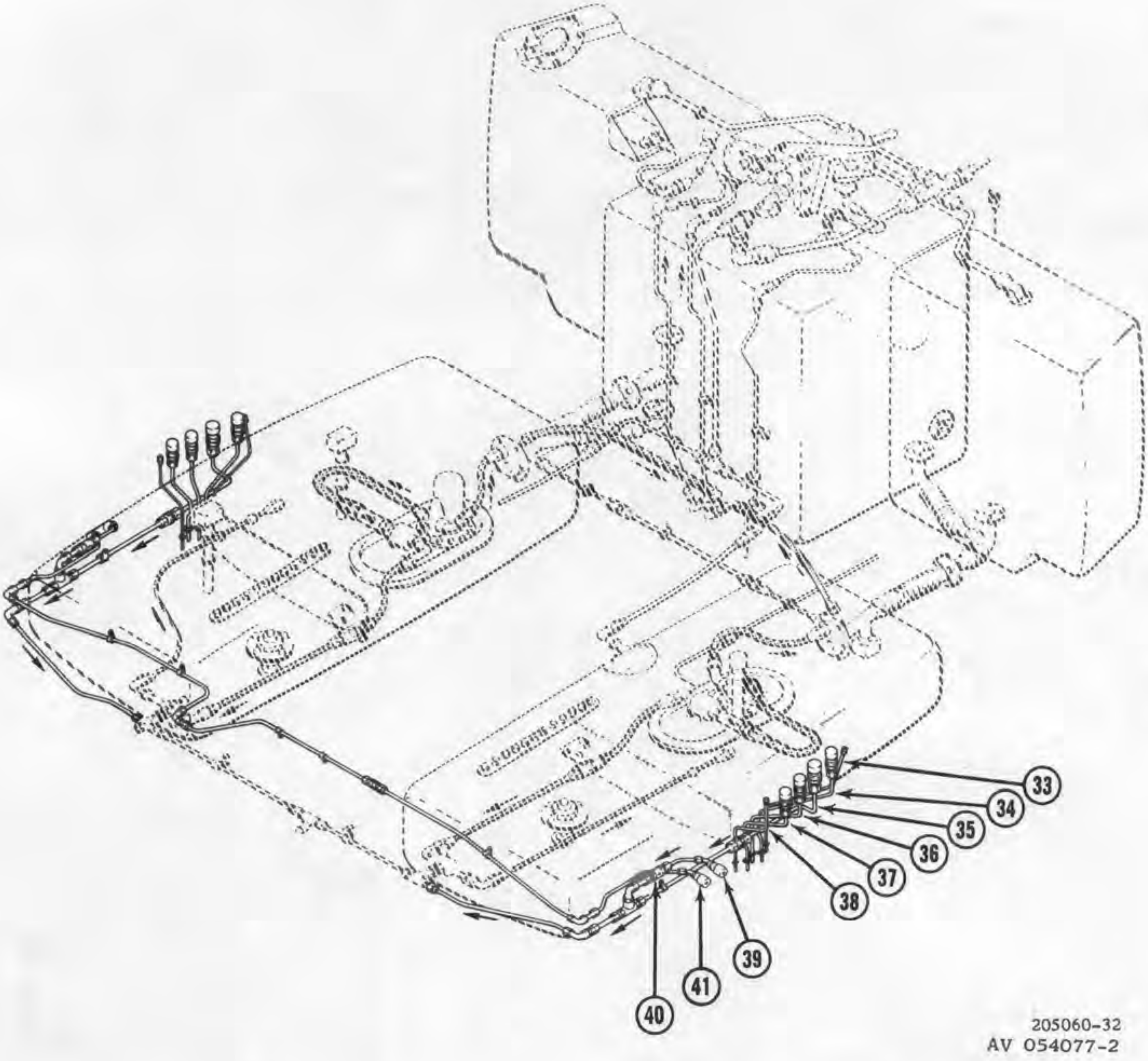
1. Forward Cell
2. Vent Line
3. Sump Assembly
4. Electric Boost Pump
5. Float Switch (20 MINUTE FUEL)
6. Pump Outlet Hose
7. Sump Drain Valve
8. Cross Feed Line
9. Heater Fuel Connection
10. Defuel Valve
11. Air Driven Boost Pump
12. Bleed Air Line From Engine
13. Fuel Quantity Tank Units
14. Fuel Quantity Tank Units
15. Strainer Drain Line
16. Fuel Lines - Tanks to Valve Manifold
17. Crossovers
18. Pressure Switch (RIGHT FUEL BOOST)
19. Pressure Switch (LEFT FUEL BOOST).
20. Pressure Gage Transmitter
21. Filler Cap
22. Check Valve Manifold
23. Fuel Shutoff Valve
24. Main Fuel Strainer
25. Coupling for Engine Fuel Hose
26. Strainer Drain Valve
27. Vent Manifold
28. Fuel Control Vent Line
29. Fuel Quantity Tank Unit
30. Float Switches - Auxiliary Fuel Transfer Pump Control
31. Cell Access Door

Figure 5-12. Fuel supply system – YUH-1D typical



1. Forward Cell
2. Fuel Quantity Transmitters
3. Electric Boost Pump
4. Sump Assembly
5. Flow Switch with Check Valve
6. Sump Drain Valve
7. Drain Valve
8. Crossfeed Line
9. Ejector Pump
10. Flapper Valve
11. Baffle
12. Vent Line
13. Bleed Air Line from Engine (Prior to S/N 69-15292)
14. Defuel Valve
15. Air Driven Boost Pump (Prior to S/N 69-15292) Electric Boost Pump (S/N 69-15292 and Sub)
16. Float Switch
17. Crossovers
18. Fuel Lines - Tanks to Valve Manifold
19. Crossfeed Line
20. Siphon Breaker Valve
21. Check Valve Manifold
22. Fuel Shut-off Valve
23. Main Fuel Strainer
24. Coupling for Engine Fuel Hose
25. Strainer Drain Valve
26. Pressure Gage Transmitter
27. Filler Cap
28. Vent Manifold
29. Fuel Control Vent Line
30. Fuel Quantity Transmitter
31. Strap
32. Float Switches - Auxiliary Fuel Transfer Pump Control
33. Center Cell Access Door

Figure 5-13. Fuel supply system – UH-1D/H typical (Sheet 1 of 2)



AUXILIARY INTERNAL FUEL TANK CONNECTIONS:

33. Scupper Drain Line
34. Tank Drain Line
35. Fuel Line
36. Tank Vent Line
37. Pump Seal Drain Line
38. Scupper Drain Line

AUXILIARY EXTERNAL FUEL TANK CONNECTIONS:

39. Fuel Line
40. Check Valve
41. Pressure Balance Line

Figure 5-13. Fuel supply system – UH-1D/H typical (Sheet 2 of 2)

c. *Fuel Cell Fittings.*

(1) Externally accessible fittings on fuel cells include filler cap adapter, two crossover tubes, and tank outlet. Each cell port has an integral fitting with an O-ring seal groove and threaded inserts for attachment bolts.

(2) Inspection – fuel cell fittings.

(a) Inspect fuel cell fittings and fuel filler cap for defective and leaking O-ring seals.

(b) Inspect fittings, fuel filler cap, and access covers for corrosion.

d. *Replacement – Seals at Fuel Cell Fittings.*

(1) Replace defective O-ring seal under any fuel cell port fitting by general procedure outlined below.

(2) Drain fuel to level below cellport to be opened.

(3) Disconnect attached lines or clamps to allow fitting to be moved enough to expose O-ring.

(4) Remove O-ring. Ensure seal groove and mating face of fitting are clean and free of burrs or nicks. Scratches or burrs on the mating faces of fittings less than 0.005 inch deep can be burnished out with crocus cloth (item 510, table 1-2) and treated with a brushable type alodine surface treatment.

(5) Install serviceable O-ring in seal groove.

(6) Reinstall fitting. Tighten bolts evenly with 45 to 50 inch-pounds torque.

e. *Main Fuel Strainer, Mechanical Bypass Indicator Type.* A main fuel strainer equipped with a mechanical bypass indicator is used to YUH-1D helicopters Serial No. 60-6031 through 60-6034, and is mounted on a bracket aft of forward firewall in left side of engine compartment. On YUH-1D Serial No. 60-6028 through 60-6030, strainer is at front of firewall in pylon support compartment. Strainer is a cylindrical unit, with a detachable sump bowl connected to a drain line through a manual valve. In normal flow, fuel enters inlet from shutoff valve and passes through a stainless steel wire cloth screen element before delivery through outlet coupling to fuel control inlet hose. (See figure 5-14.) If strainer element becomes clogged, flow is through an internal bypass valve which pushes a red indicator up into a transparent dome for visual warning of faulty condition. Bypass indicator can be manually reset only when strainer element is removed for cleaning.

(1) *Removal – fuel strainer, mechanical bypass indicator type.*

(a) Disconnect fuel control inlet hose at strainer outlet coupling. Drain strainer by opening valve. (See figure 5-14.)

NOTE

Use a suitable tool to depress self-closing valve in outlet coupling of strainer, to admit some air and allow drainage.

(b) Remove V-band clamp to detach sump bowl, with O-ring from strainer. Either place sump out of way on deck with drain hose attached, or disconnect.

(c) Remove three screws and withdraw screen element, with bypass valve, from strainer body.

CAUTION

Do not attempt to change setting of bypass valve.

(2) *Cleaning – fuel strainer mechanical bypass indicator type.*

(a) Clean strainer when scheduled by inspection requirements and at any time red bypass indicator appears in strainer dome, using following procedure. (See figure 5-14.)

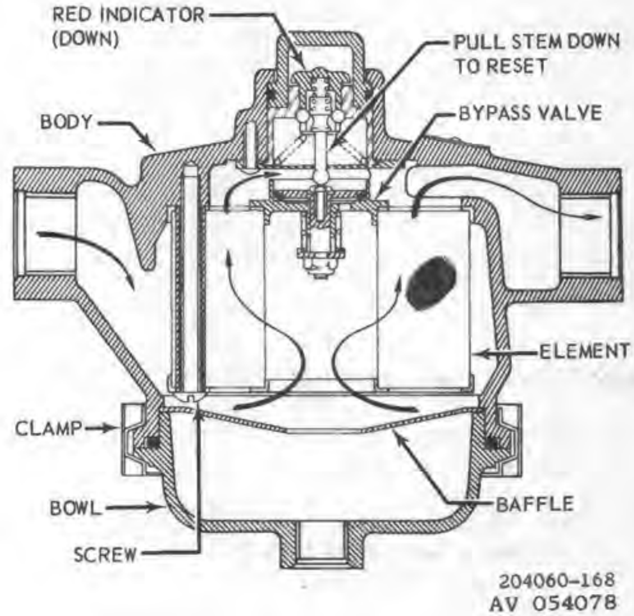


Figure 5-14. Main fuel strainer cross section

(b) Wash strainer element, bypass valve, and sump bowl with dry cleaning solvent, (item 302, table 1-2). Use soft bristle brush as necessary. Drain and dry parts thoroughly.

(3) *Repair or replacement – fuel strainer mechanical bypass indicator type.* Replace unserviceable parts.

(4) *Installation – fuel strainer mechanical bypass indicator type.*

(a) Reset bypass indicator by reaching through bottom of strainer body to pull down indicator stem under dome.

(b) Insert element, with bypass valve up, into strainer body. Secure with three screws. Check that bypass indicator remains down in normal position.

(c) Place new O-ring on lip of sump. Seat sump in bottom of strainer body and secure with V-band clamp. Lock-wire clamp.

(d) Connect drain hose, if detached. Connect fuel control inlet hose to strainer outlet coupling.

f. Fuel Check Valve Manifold. A valve manifold, located at left front of engine forward firewall, is connected into fuel pressure lines ahead of shutoff valve. Manifold contains two separate valve elements at inlet ports, each consisting of a check valve which prevents reverse flow except through its thermal relief bypass of trapped fuel. Manifold also has an outlet port and a tap for fuel pressure gage transmitter at outlet side of check valves. Two taps on inlet side of check valves are plugged on UH-1D/H, but are used on YUH-1D for connection of pressure switches in RIGHT FUEL BOOST and LEFT FUEL BOOST caution panel circuits.

(1) *Removal – fuel check valve manifold.*

(a) Remove fuel shutoff valve.

(b) Disconnect fuel line tubes from fittings on valve manifold. Cap open lines and fittings.

(c) Remove nuts from two bolts through valve body. Remove valve assembly. Reinstall nuts to keep bolts, spacers, and washers in place as sets.

(2) *Replacement – fuel check valve manifold.* Transfer all fittings to replacement manifold.

(a) Attach manifold to firewall with two bolts, spacers, washers, and nuts.

(b) Connect fuel line tubes to fittings on manifold as follows:

1. Fuel line tubes from forward cells to two inlet fittings at bottom of manifold.

2. Pressure gage transmitter line tube to elbow fittings, equipped with restrictor plug, at upper right on manifold.

3. On YUH-1D only, connect tube from nearest pressure switch at lower right manifold fitting, and tube from outboard pressure switch at lower left fitting.

(c) Install fuel shutoff valve.

g. Main Fuel Filter, Electrical Bypass Indicator Type. On UH-1D/H helicopters main fuel filter has a micronic type element and electrical means of indicating any impending bypass condition which may occur. Filter is a cylindrical unit, horizontally mounted on forward firewall in left side of engine compartment. (See figure 5-15.) Piping connections to filter head are, an inlet line from shutoff valve of supply system, a drain line with manual valve, and an outlet coupling for engine fuel control hose. Filter element and other parts, except head assembly, are interchangeable with those used in external filter of transmission oil system. If a clogging condition should develop in filter element, a normally-open switch would be closed by differential pressure, lighting FUEL FILTER caution panel as warning that further clogging may cause fuel to flow through bypass valve without filtration.

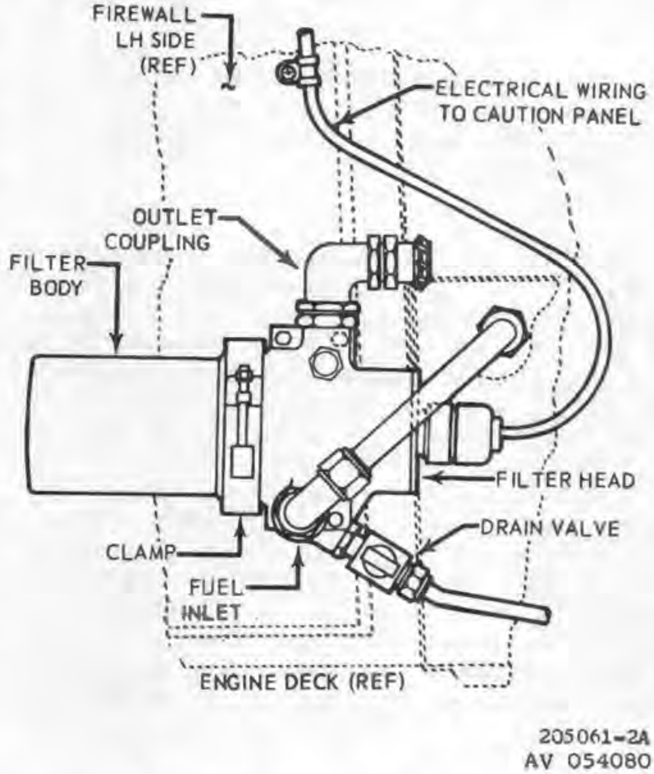


Figure 5-15. Fuel filter with electrical bypass indicator

(1) *Removal – fuel filter, electrical bypass indicator type.*

(a) Open engine compartment cowling at left side.

(b) Disconnect fuel hose from outlet coupling on filter. (See figure 5-15.) Drain fuel from filter by opening valve located under head.

NOTE

Use suitable tool to depress self-closing valve in filter outlet coupling, to admit some air and allow drainage.

(c) Remove filter element for inspection and replacement as follows:

1. Open V-band clamp.

2. Remove filter body and element from head assembly.

3. Separate element and O-rings from filter body.

4. Filter head will normally remain in place but can be removed when necessary by disconnecting electrical cable plug, fuel line and drain line, and removing four bolts with washers which secure head to firewall.

(2) *Cleaning – fuel filter, electrical bypass indicator type.* Clean filter body and head as necessary with cleaning solvent, (item 302, table 1-2). Protect electrical connections when cleaning head.

(3) *Inspection – fuel filter, electrical bypass indicator type.* Inspect filter element for contamination to determine if any corrective action is needed beyond replacement of element and O-ring.

(4) *Repair or replacement – fuel filter, electrical bypass indicator type.* Replace element if unserviceable or damaged.

(5) *Installation – fuel filter, electrical bypass indicator type.*

(a) If removed, reinstall filter head. Secure to firewall with four bolts and washers. Lock-wire bolt heads. Connect fuel line tube to filter inlet fitting, and drain line to valve at bottom of filter head. Connect and lock wire electrical cable plug.

(b) Install filter element and body.

1. Place new O-ring on boss in bottom of filter body.

2. Place clean filter element in body, seated firmly on boss.

3. Install new O-ring around upper lip of filter body, next to flange.

4. Place new O-ring around center boss in filter head.

5. Install body assembly into filter head, pressing firmly to seat.

6. Install V-band clamp around mating flanges of filter head and body. Tighten nut to a torque of 50 inch-pounds.

CAUTION

Do not overtorque to prevent leakage; use new O-ring or filter if leakage persists.

(c) Connect hose from engine fuel control inlet to outlet coupling on filter.

(d) During next ground run-up, check fuel filter and connections for leaks. Also ensure FUEL FILTER caution panel does not light.

(e) Engine inlet system quick disconnect couplings are hand torqued.

h. Fuel Shutoff Valve. A motor-operated pullout type gate valve, in main fuel line before strainer, is mounted on front of engine forward firewall and is accessible through a door on left side of pylon structural island. Valve is controlled by MAIN FUEL switch, and has a manual override handle which also serves as a visual position indicator. A thermal relief valve allows internal bypass of fuel trapped on outlet side of shutoff valve, being set to crack at 90 to 120 psig and to reseat at 80 psig minimum.

(1) *Removal – fuel shutoff valve.*

(a) Open left engine cowl door and disconnect engine fuel inlet hose from coupling on main strainer.

(b) Remove access door at left side of pylon island in cabin. Manually open shutoff valve. Also open strainer drain valve to release trapped fuel. Close both valves after short period of drainage.

(c) Disconnect electrical wiring plug from connector on shutoff valve.

(d) Remove two upper bolts through retaining flanges of valve inlet and outlet fittings. Loosen two lower bolts. Remove screw which secures forward end of bracket

to valve. Lift valve out of bracket. Reinstall screw in valve. Cover open valve ports and fittings.

(2) *Installation – fuel shutoff valve.*

(a) Be sure valve handle is at closed position. Remove covers from valve ports and from fittings in mounting bracket.

(b) Position valve, with O-rings in ports, between fittings in bracket with motor to left. Attach forward end of bracket on existing screw of valve, install two upper bolts through retaining flanges of fittings and tighten to two lower bolts.

(c) Connect and lock wire electrical cable plug to connector on valve.

i. Forward Fuel Cell Sump Assembly. Fuel cell sump assemblies are mounted in openings on the underside of each forward fuel tank. Removal of the sump assemblies from the tanks permits access for maintenance and replacement of the boost pump, flow switch, check valve, cross fitting, and sump drain valve. (See figures 5-12, 5-13, 5-16, 5-17 and 5-18.)

(1) *Removal – fuel cell sump assembly.* Helicopters prior to Serial No. 69-15292 which have not had crashworthy fuel system incorporated:

(a) Disconnect battery and any external power source. Defuel system.

(b) Remove sump access panel from underside of cabin by removing screws. Mark access panel so it can be installed in same position.

(c) Open sump drain valve (9, figure 5-16) to drain trapped fuel into suitable container. On righthand cell only drain sump through valve provided.

(d) Disconnect tubes and electrical leads of units attached to sump (5).

(e) Remove 12 bolts and 12 washers around sump plate. Lower sump assembly (5) and support it below mounting port. Reach through opening to disconnect hoses from boost pump (2) outlet, flow switch (4) outlet, and disconnect fuel quantity gage tank unit electrical leads as necessary.

(f) Remove sump assembly (5). Remove O-ring seal from groove around cell opening. Cover opening immediately to prevent entry of foreign matter.

(2) *Removal – fuel cell sump assembly.* Helicopters Serial No. 69-15292 and subsequent and those helicopters which have had crashworthy fuel system incorporated:

(a) Disconnect battery and any external power source. Defuel system.

(b) Remove sump access panel from underside of cabin by removing screws. Mark access panel so it can be reinstalled in same position.

(c) Open sump drain valve (figure 5-17 or 5-18 as applicable) to drain trapped fuel.

(d) Disconnect tubes and electrical wiring attached to sump. (See figures 5-17 and 5-18.)

NOTE

Helicopters Serial No. 69-15292 and subsequent have electrically driven boost pumps in both RH and LH sumps. Helicopters prior to No. 69-15292 have a bleed air driven pump in the left sump and an electrical driven pump in the right sump.

(e) Index location of four retainers for reinstallation and remove screws (10 and 12, figure 5-17) or (13, figures 5-18) as applicable. Lower the sump assembly and reach through opening between sump and fuel cell to disconnect three electrical leads from fuel quantity system tank probes at connectors (17, figure 5-17) (the fuel quantity system tank probes are located in the RH fuel cell only). Disconnect hoses from boost pump outlet and flow switch outlet. Remove sump assembly. Remove packing (5, figure 5-17) or (8, figure 5-18) as applicable. Cover opening in fuel cell and cap boost pump and flow switch fittings to prevent entry of foreign materials.

(3) *Inspection – fuel cell sump assemblies.*

(a) Inspect drain valve for leaking O-ring or seal washers. (See figure 5-16.)

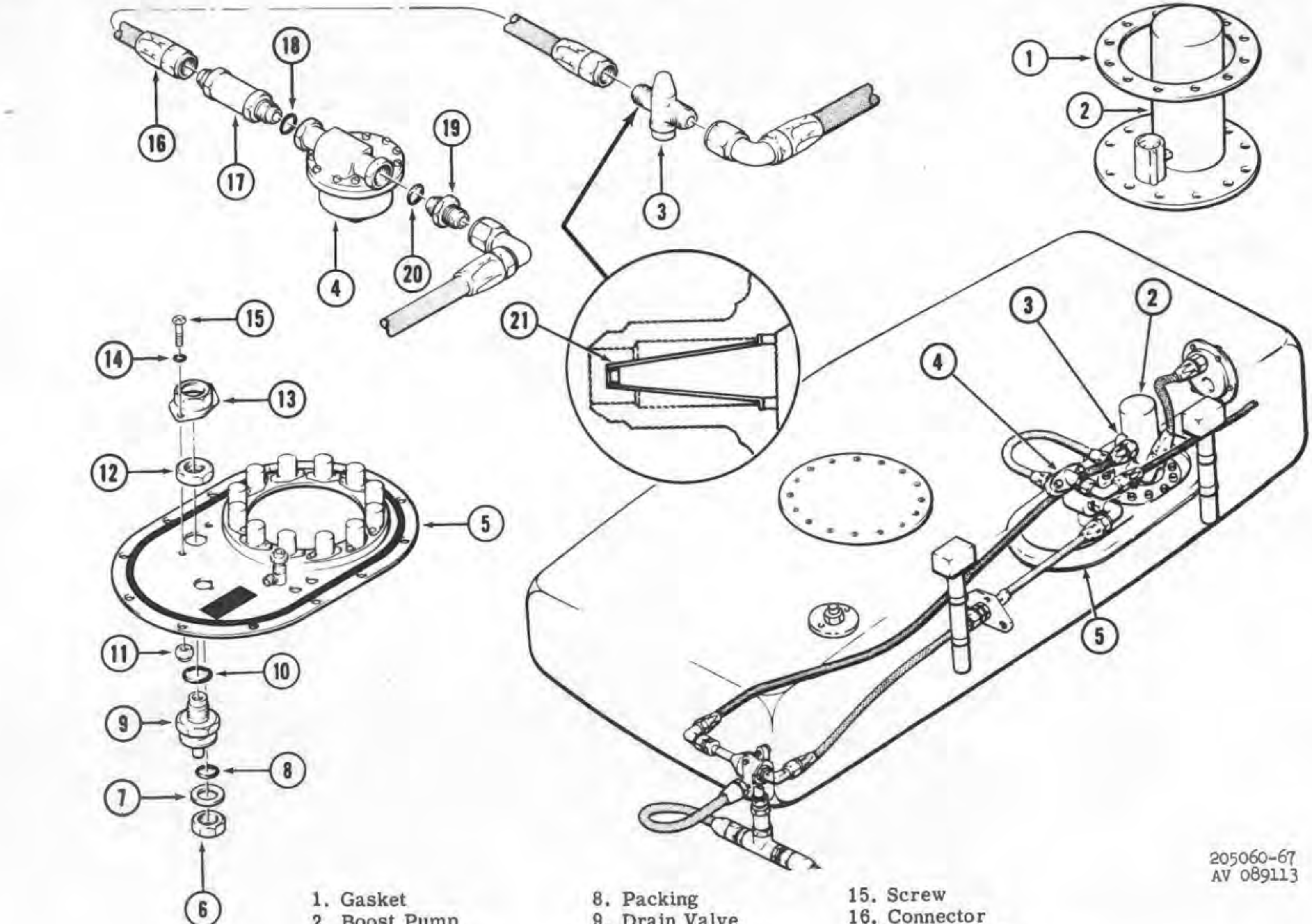
(b) Inspect flow switch, flow switch gaskets, and O-rings for evidence of leakage.

(c) Inspect fuel quantity indicating system electrical connectors on right-hand sump for damage.

(4) *Repair or replacement – fuel cell sump assembly.*

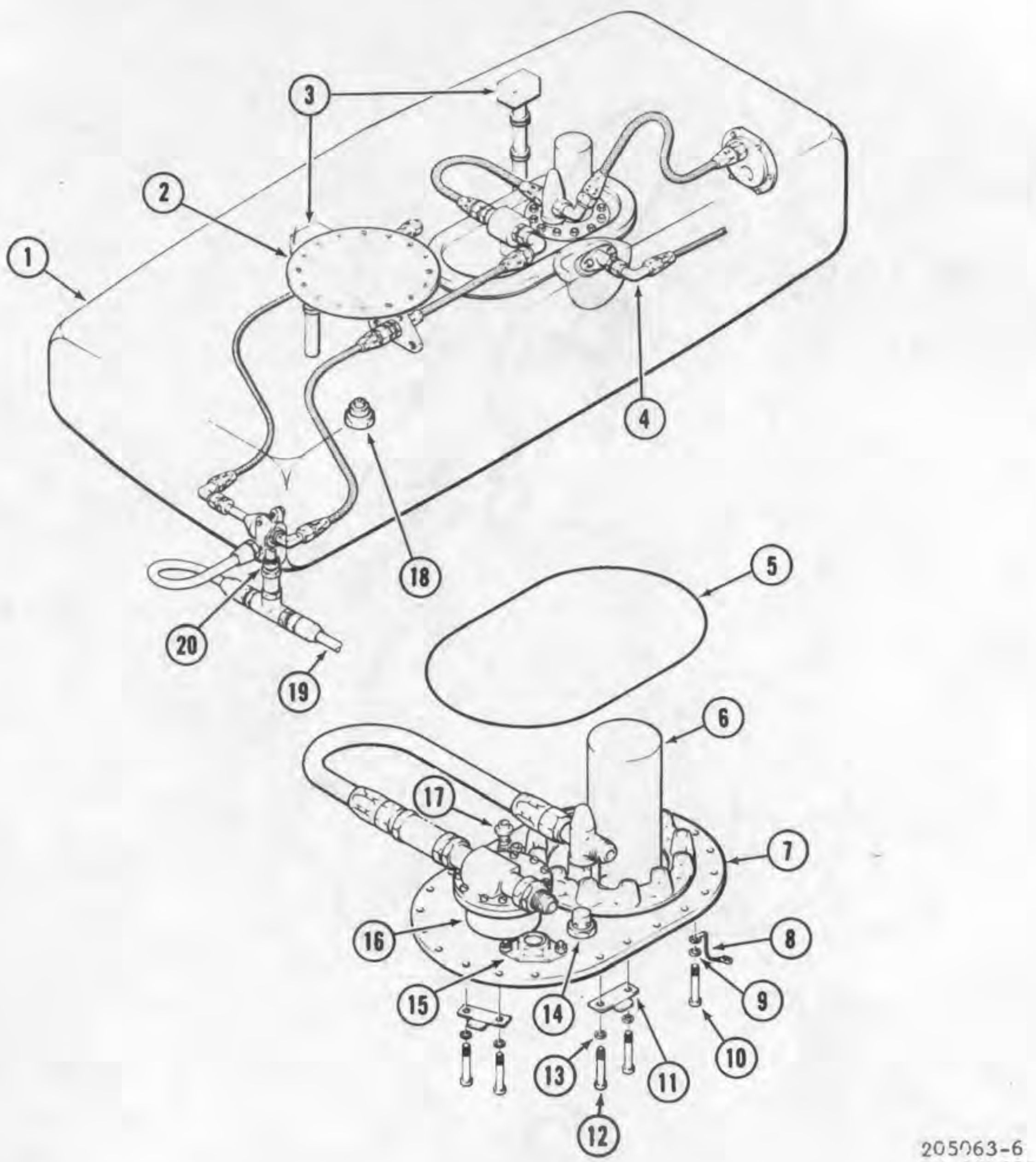
(a) See figures 5-16, 5-17 and 5-18 for illustrations at sump assemblies.

(b) Replace components which show evidence of damage or have been found to be faulty during troubleshooting procedures.



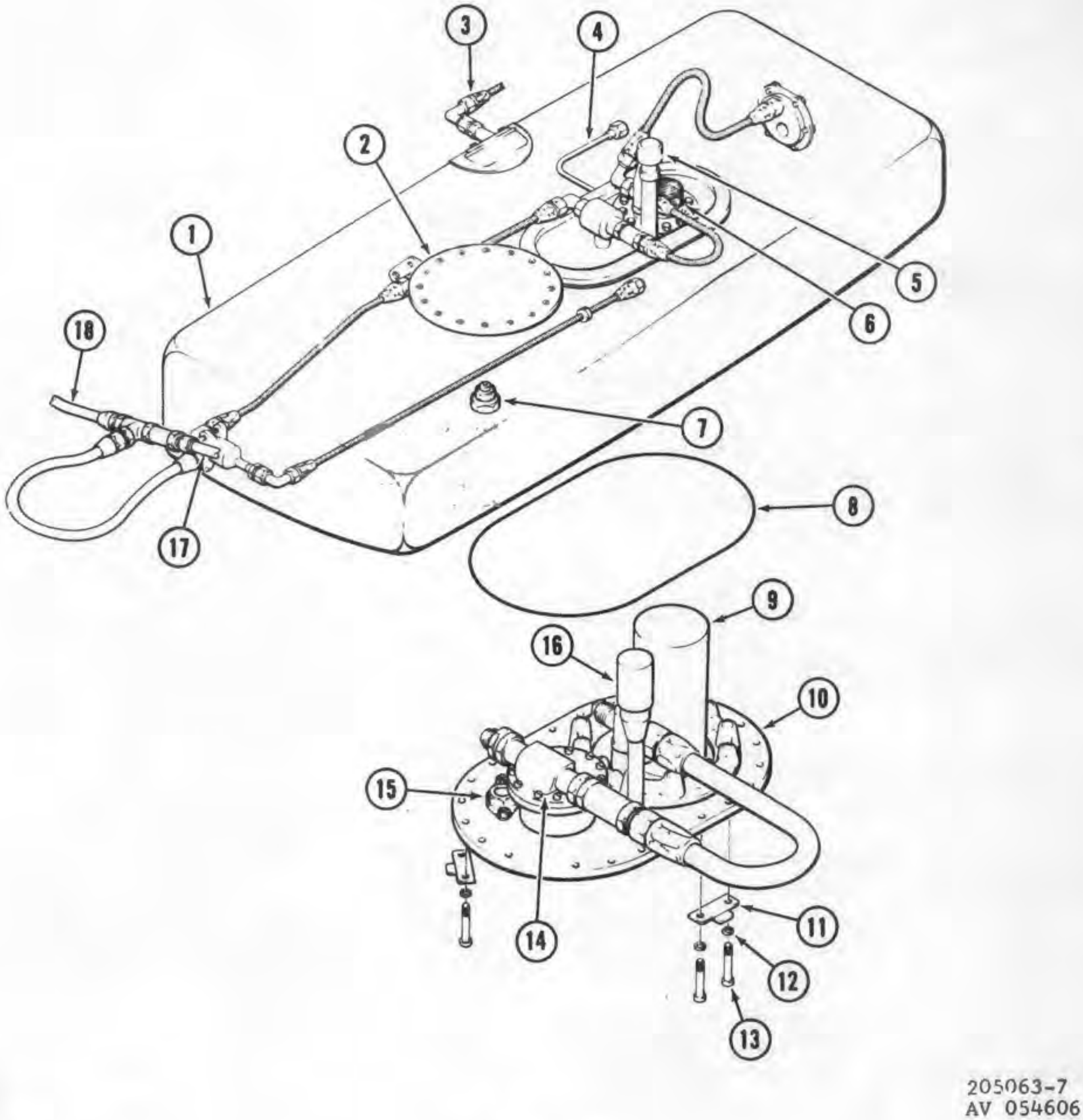
1. Gasket
2. Boost Pump
3. Cross Fitting
4. Flow Switch
5. Sump Assembly
6. Nut
7. Washer
8. Packing
9. Drain Valve
10. Packing
11. Nut
12. Nut
13. Nut Retainer
14. Washer
15. Screw
16. Connector
17. Check Valve
18. Packing
19. Nipple Tube
20. Packing
21. Screen

Figure 5-16. Forward fuel cell sump assembly, helicopters prior to serial no. 69-15292 which have not had crashworthy fuel system incorporated



1. Fuel Cell
2. Access Cover
3. Fuel Quantity Probes
4. Fuel Cell Vent
5. Packing, Fuel Cell to Sump
6. Boost Pump
7. Sump
8. Ground Wire
9. Washer
10. Screw
11. Retainer
12. Screw
13. Washer
14. Drain Valve
15. Sump Drain Valve
16. Flow Switch
17. Fuel Quantity Indicating System Connectors
18. Forward Cell Drain Valve
19. Interconnect to Left-Hand Cell
20. Interconnect to Auxiliary Fuel System

Figure 5-17. Forward right-hand fuel cell sump installation, helicopters serial no. 69-15292 and subsequent and helicopters with crashworthy fuel system



1. Fuel Cell
2. Access Cover
3. Fuel Cell Vent
*4. Bleed Air Line
5. Low Level Fuel Switch
*6. Boost Pump, Bleed Air Driven
7. Forward Cell Drain Valve
8. Packing, Fuel Cell to Sump
**9. Boost Pump, Electric
10. Sump
11. Retainer
12. Washer
13. Screw
14. Flow Switch
15. Sump Drain Valve
16. Low Level Fuel Switch
17. Interconnect to Auxiliary Fuel System
18. Interconnect to Right-Hand Cell

* Engine bleed air driven boost pumps are used in the left-hand cells of helicopters prior to Serial No. 69-15292.
** Electric boost pumps are used in the left-hand cells of helicopters Serial No. 69-15292 and subsequent.

Figure 5-18. Forward left-hand fuel cell sump installation, helicopters serial no. 69-15292 and subsequent and helicopters with crashworthy fuel system incorporated

(5) *Installation – fuel cell sump assembly.* Helicopters prior to Serial No. 69-15292 which have not had crashworthy fuel system incorporated.

(a) Locate free ends of hoses which attach to boost pump and to flow switch inside fuel cell. Locate fuel quantity probe leads if a right-hand fuel cell sump is being installed.

(b) Install backing in groove around cell opening. Use a small amount of EC847 (item 215, table 1-2) to hold packing in place.

(c) Position clean, properly assembled sump assembly, with boost pump (2), flow switch (4), check valve (17), cross fitting (3), and sump drain valve (9) properly installed, slightly below opening. Reach inside and connect outlet hose to pump fitting. Connect outlet hose to flow switch (4) and cross fitting (3) and attach fuel quantity tank unit leads to connectors.

(d) Raise sump plate to normal position and secure with 12 bolts and 12 washers. Tighten bolts evenly to a torque of 40 to 50 inch-pounds.

(e) Connect external lines and electrical leads of pump and other units of sump assembly.

(f) Check for leaks and for proper functioning of indicators when system is being refilled.

(g) Reinstall access panel.

(6) *Installation – fuel cell sump assembly.* Helicopters Serial No. 69-15292 and subsequent and helicopters with crashworthy fuel system incorporated.

NOTE

Refer to figure 5-17 or 5-18 as applicable for right or left-hand sump installation.

(a) Inspect fuel cell at area where sump mates with cell for damage and cleanliness. Ensure that groove provided for packing is free of any particles which could prevent proper sealing. Locate the fuel hoses within the cell that must be connected to the boost pump and flow switch. Locate the fuel quantity system electrical leads if a sump is being installed in the right-hand cell. Identify the lead which attaches to each of the three connectors (17, figure 5-17).

(b) Inspect the sump assembly to be installed for cleanliness and proper attachment of boost pump, flow switch, sump drain valve and defuel valve, on right-hand sumps, inspect fuel quantity electrical lead connectors. On left-hand sumps, inspect low level fuel switch installation.

(c) Position packing in groove in fuel cell sump opening. Use small amount of adhesive EC847 (item 215, table 1-2) to hold the packing in place.

(d) Position sump just below opening in fuel cell with flow switch forward. Attach hoses to flow switch and to boost pump. If a right-hand sump is being installed, attach three fuel quantity indicating system wires to connectors (17, figure 5-17). Check packing installed in step c to be sure it is in groove and move sump upward to contact cell. Install screws and washers to secure sump to cell. Install four retainers at indexed location. Install ground wire (8, figure 5-17).

(e) Connect external electrical leads to sump components. Right-hand sumps have electric boost pumps and fuel quantity indicating system electrical connections. Left hand sumps have low level fuel switch electrical connections and either an electric or bleed air driven boost pump (see figure 5-18).

(f) Test installation for leaks. Request assistance of higher level of 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 boost pump operation one time only. It is necessary to check operation of the low fuel level warning system when fuel level is below that required for twenty minutes flight and again when fuel level is above that quantity.

j. Electric Fuel Boost Pump. On helicopters prior to Serial No. 69-15292, an electrically operated fuel boost pump is mounted on a plate on the sump assembly in the right forward fuel cell. The left forward cell includes a bleed air operated boost pump. On helicopters Serial No. 69-15292 and subsequent, both fuel cells contain an electrically operated boost pump.

(1) *Troubleshooting – fuel boost pump.* On helicopters Serial No. 69-15292 and subsequent, right-hand troubleshooting data is applicable to both right and left-hand fuel boost pumps.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Right-hand boost pump warning light illuminated, no pressure indicated on fuel pressure gage.	Electrical boost pump inoperative	Replace fuel pump.
Right-hand boost pump warning light illuminated, pressure indicated on fuel pressure gage.	Ejector pump malfunction.	Clean foreign material from ejector pump and/or hoses
	Check valve malfunction.	Replace check valve.
	Flow switch malfunction.	Replace flow switch.
	Cross fitting screen clogged with foreign material.	Replace cross fitting.
Left-hand boost pump warning light illuminated, fuel pressure low or zero.	Bleed air fuel boost pump is inoperative.	Replace fuel pump.
Left-hand boost pump warning light illuminated, pressure normal on fuel pressure gage.	Ejector pump malfunction.	Clean foreign material from ejector pump and/or hoses
	Check valve malfunction.	Replace check valve.
	Flow switch malfunction.	Replace flow switch.
	Cross fitting screen clogged with foreign material.	Replace cross fitting.

(2) *Removal – fuel boost pump.*

(a) Remove fuel cell sump assembly (5, figure 5-16).

NOTE

Mark position of fuel boost pump before removal to aid in reassembly.

(b) Disconnect flow switch hose from pump fitting.

(c) Remove 12 bolts and 12 washers to detach boost pump (2) mounting flange and gasket from sump plate.

(3) *Repair or replacement – fuel boost pump.*

(a) Replace boost pump (2, figure 5-16) as an assembly, if malfunctioning.

(b) Replace gasket, unserviceable fittings, O-ring seals, or attaching parts.

(4) *Installation – fuel boost pump.*

(a) Install fittings on replacement fuel boost pump (2, figure 5-16).

(b) Position boost pump (2) in mounting port of sump plate and with gasket in place secure boost pump to sump plate with 12 bolts and 12 washers.

(c) Connect flow switch (4) hose to pump fitting.

(d) Replace cross fitting (3) with new cross fitting.

(5) *Functional check – fuel pump and ejector system.*

NOTE

Data contained in following 2. (a) is applicable to both left and right fuel boost pumps on helicopters Serial No. 69-15292 and subsequent. Data contained in step (b) is applicable to left fuel boost pumps, only, on helicopters prior to Serial No. 69-15292.

(a) Right hand fuel pump.

1. Turn electrical power ON.

2. Turn main fuel switch ON.

3. Activate fuel boost circuit breaker.

4. If right hand fuel boost light is on, check fuel pressure gage for correct pressure.

5. If pressure is not indicated, electric boost pump is inoperative.

6. If pressure is indicated, check for malfunction of ejector pump, check valve flow switch, or clogged cross fitting screen.

(b) Left hand fuel pump.

1. Ground run helicopter engine.

2. Turn right hand electrical fuel boost pump circuit breaker to "OFF" position.

3. If left fuel boost light is illuminated, check fuel pressure gage for correct pressure.

4. If pressure is low or zero, the bleed air fuel boost pump is inoperative.

5. If pressure is normal, the ejector pump is malfunctioning; check valve or flow switch is inoperative, or cross fitting screen is clogged with foreign material.

k. *Cross Fitting.* The cross fitting (3, figure 5-16) is mounted on the forward fuel tank sump assembly.

(1) *Removal – cross fitting.*

(a) Remove the fuel tank sump assembly (5, figure 5-16).

(b) Disconnect the fuel lines from inlet and outlet ports of cross fitting (3).

(c) Cut lockwire and remove bolt securing cross fitting to boost pump flange.

(d) Remove rubber plugs from lower end of cross fitting.

(2) *Repair or replacement – cross fitting.*

(a) Replace cross fitting (3, figure 5-16) if screen is clogged or at any time it is necessary to replace fuel boost pump.

(b) Install new rubber plug and two new "O" rings in bottom of cross fitting at reassembly.

(3) *Installation – cross fitting.*

(a) Install bolt previously removed through boost pump (2, figure 5-16) flange into cross fitting (3) and secure fitting to boost pump. Lock-wire bolt.

(b) Connect fuel lines to each side of cross fitting.

(c) Replace forward fuel tank sump assembly (5).

l. *Flow Switch.* The flow switch (4, figure 5-16) is attached to the sump plate on the underside of each forward fuel tank.

(1) *Removal – flow switch.*

(a) Remove sump assembly (5, figure 5-16).

(b) Disconnect fuel line from check valve (17) and fuel line from outlet of flow switch (4).

(c) Disconnect electrical terminals and cover ends with tape.

(d) Cut lockwire and remove nut and washer securing flow switch (4) to sump plate; remove flow switch (4), and check valve (17) from sump plate.

(e) Remove check valve (17) from flow switch (4).

(f) Remove "O" ring from flow switch electrical unit.

(2) *Repair or replacement – flow switch.*

(a) Replace flow switch (4, figure 5-16) if malfunctioning.

(b) Replace "O" ring with like serviceable item.

(3) *Installation – flow switch.*

(a) Install check valve (17, figure 5-16) in inlet port of the flow switch (4).

(b) Install new "O" ring on electrical outlet.

(c) Position flow switch (4) and check valve (17) on sump plate with electrical inlet projecting through plate.

(d) Install washer on electrical outlet and secure flow switch to sump plate with nut previously removed. Lock-wire nut.

(e) Connect electrical terminals.

(f) Replace sump assembly (5).

m. Check Valve. The check valve (17, figure 5-16) is installed in the inlet port of the flow switch (4).

(1) *Removal – check valve.*

(a) Remove sump assembly (5, figure 5-16).

(b) Disconnect hose from inlet port of check valve (17).

(c) Unscrew check valve (17) from inlet port of flow switch (4).

(d) Remove gasket between flow switch (4) and check valve (17).

(2) *Repair or replacement – check valve.*

(a) Replace check valve (17, figure 5-16) if malfunctioning.

(b) Replace gasket between flow switch (4) and check valve (17) with like serviceable item.

(3) *Installation – check valve.*

(a) Install new gasket between check valve (17, figure 5-16) and flow switch (4).

(b) Install check valve (17) in inlet port of flow switch with direction of flow toward flow switch (4).

(c) Connect hose to inlet port of check valve (17).

(d) Replace sump assembly (5).

n. 20 Minute Fuel System. A float switch (16, figure 5-13), located on the left fuel cell sump assembly, activates the system which illuminates the 20 MINUTE FUEL panel in the pedestal mounted caution panel. Should the system activate with higher than normal desired quantity of fuel approx. 170 lbs remaining in the fuel cells, inspect the flapper valve installation in the left forward fuel cell. If the system activates with a lower than normal quantity of fuel remaining, inspect the flapper valve installation in the right forward fuel cell.

o. Inspection – Fuel Cell Flapper Valves.

(1) Remove left or right forward fuel cell sump assembly as indicated above.

(2) Using a suitable explosion-proof light and inspection mirror, actuate flapper valve (10, figure 5-13). Valve must close and provide an even sealing surface with no pressure applied to the valve.

(3) Replace flapper valves if not sealing properly. (Request assistance from Direct Support Maintenance.)

p. Auxiliary Fuel Provisions. Permanently installed provisions for use of auxiliary fuel tanks include drain, vent, and fuel transfer connections and a stowed transfer pump relay circuit, with two float switches in center aft fuel cell, to limit fuel level during transfer. Complete instructions for auxiliary fuel tank installation will be found under Utility Systems. (Refer to Chapter 11.)

Section VI. OIL SYSTEM

5-18. Oil System.

Oil is supplied from a tank mounted on forward firewall at right side of engine compartment, the oil flowing through a quick-disconnect hose to inlet of engine-driven dual-element pump on front of accessory gear box. Pump, which is equipped with a pressure relief valve and a thermobulb for oil-in temperature gage, delivers oil through internal passages to a filter on left side of accessory gear box, for distribution through engine lubrication system. Oil pressure gage transmitter and pressure switch, for ENG OIL PRESS LOW caution panel light, are mounted at top of engine inlet housing and connected by external hose to pressure tap on filter. (See figure 5-19.)

a. Torquemeter Pressure System. The torquemeter, incorporated in reduction gearing to provide continuous gage readings of engine output torque, requires oil at higher than normal pressure. A boost pump on overspeed governor and tachometer drive gear box supplies oil to torquemeter through internal passages at boosted pressure regulated by an adjustable bypass valve. A second element of boost pump scavenges oil from governor drive assembly. Torque gage transmitter mounted at top of inlet housing, has two hose connections: from pressure port of transmitter to torquemeter tap above right mount pad of inlet housing; from vent port to a tap on cover of an unused drive pad at right front on accessory drive gear box.

b. Oil Scavenge and Return. Scavenge oil drains into accessory drive gear box from inlet housing and through external lines from aft end of engine, passing through a screen and transfer tube into gear box. Scavenge element of engine-drive pump circulates this oil through external lines to a thermal bypass valve and oil cooler, in fuselage compartments below deck, and returns it to supply tank.

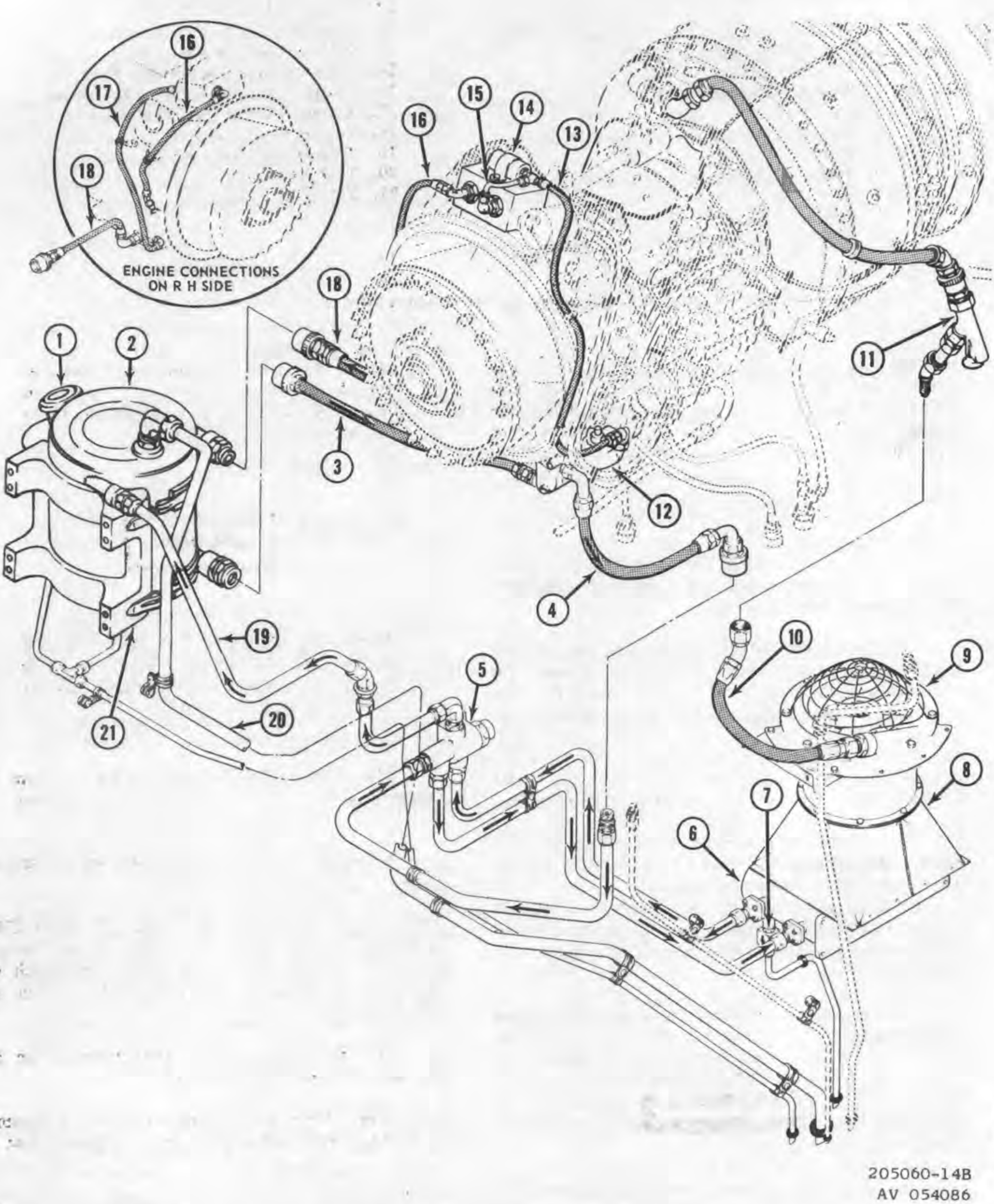


Figure 5-19. Oil supply and external lines diagram (Sheet 1 of 2)

1. Filler Cap
2. Oil Tank
3. Pump Inlet Hose
4. Scavenge Pump Outlet Hose
5. Thermal Bypass Valve
6. Oil Cooler
7. Cooler Drain Valve
8. Duct
9. Turbo Blower
10. Blower Air Inlet Hose
11. Engine Bleed Air Valve
12. Engine Oil Filter
13. Pressure Tap Hose
14. Oil Pressure Switch
15. Oil Pressure Transmitter Tube
16. Torque Transmitter Pressure Hose
17. Torque Transmitter Vent Hose
18. Engine Breather Hose
19. Tank Return Oil Line
20. Tank Vent Line
21. Tank Drain Valve

205060-14B

Figure 5-19. Oil supply and external lines diagram (Sheet 2 of 2)

Separate drain lines, with manual valves, are provided at cooler outlet and at supply tank. A breather hose from right side of accessory drive gear box is vented into tank through a quick-disconnect coupling. A chip-detector type drain plug is located at lower right on accessory gear box.

c. *General Maintenance of Oil System.*

(1) Replace any unserviceable external lines, hoses, fittings, units, gaskets, and seals which are accessible without unauthorized disassembly.

(2) Before removing any tube or hose, be sure it is properly identified and its route understood for replacement in same manner. When possible, leave supporting brackets in place to simplify reinstallation.

(3) Cap or cover openings immediately when disconnected, and take all possible precautions to prevent contamination or dirt from entering oil system.

(4) Follow procedures below for replacement and adjustment of units in oil system. (See wiring data, Chapter 13 for electrical and instrument circuits.)

(5) Follow schedules in Inspection Requirements for inspection and cleaning of filter and strainers. (Refer to Chapter 3.)

d. *Changing From MIL-L-7808 to MIL-L-23699 Lubricating Oil.*

WARNING

Prolonged contact with lubricating oil (item 2 or 3, table 1-2) may cause a skin rash. Those areas of skin and clothing that come in contact with lubricating oil should be thoroughly washed immediately. Saturated clothing should be removed immediately. Areas in which lubricating oil is used should be adequately ventilated to keep mist and fumes to a minimum.

CAUTION

Lubricating oil (item 2 or 3, table 1-2) may soften paint upon contact. If lubricating oil is spilled on painted surfaces, these surfaces should be thoroughly washed.

(1) Drain MIL-L-7808 lubricating oil from the engine oil tank, oil cooler, and accessory drive gearbox.

(2) Inspect and clean all engine oil strainers and filter.

(3) Fill the engine oil system with MIL-L-23699 lubricating oil and operate engine from 30 minutes to 1 hour to heat oil to operating temperature which will promote dislodging residual MIL-L-7808 carbon and lacquer deposits.

(4) Shut down engine and inspect, clean and reinstall engine oil filter and strainers.

(a) If heavy contamination of filter and strainers is present, proceed with steps (5) and subsequent below.

(b) If little or no contamination of filter and strainers is present, release helicopter for service use and comply with steps (7), (8), and (9) below.

(5) Drain all oil from engine oil system and dispose of oil.

(6) Fill engine oil system with new MIL-L-23699 oil and release helicopter for service use.

(7) After 5 hours of operation, inspect and clean all engine oil strainers and filter.

(8) After 15 hours of operation since last oil change, inspect and clean all engine oil strainers and filter.

(9) Revert to normal scheduled interval of inspection for engine oil strainers and filter.

NOTE

It is not advisable to mix MIL-L-23699 and MIL-L-7808 oil except in cases of emergency. If this becomes necessary, it is required that the system be drained within 6 hours of operation according to steps (1) through (6) above.

e. Changing from MIL-L-23699 to MIL-L-7808 Lubricating Oil.

(1) Drain MIL-L-23699 lubricating oil from the engine oil system.

(2) Inspect and clean all engine oil strainers and filter.

(3) Fill the engine oil system with MIL-L-7808 lubricating oil and operate engine until oil reaches operating temperature.

(4) Shut down engine and inspect, clean, and reinstall engine oil strainers and filter. Release helicopter for service use.

(5) After 5 hours of operation, inspect and clean all engine oil strainers and filter.

(6) After 15 hours of operation since last oil change, inspect and clean engine oil strainers and filter.

(7) Revert to normal interval of inspection for engine oil strainers and filter.

NOTE

It is not advisable to mix MIL-L-7808 and MIL-L-23699 except in cases of emergency, If this becomes necessary, it is required that the system be drained within 6 hours of operating according to steps (1) through (4) above.

f. Lubrication System Contamination Trouble Shooting Procedure. If an excessive amount of chips are found on the engine oil filter element and/or chip detector, but the output reduction carrier and gear assembly has freedom of movement and emits no unusual noises, proceed as outlined in steps (1) through (10). If contamination is caused by carbon particles, refer to following step (11).

(1) Remove chips from oil filter element and retain for analysis. Clean filter element and reinstall.

(2) Drain all oil from accessory drive gearbox, oil tank and oil cooler.

(3) Remove chips, if any, from chip detector and retain for analysis. Clean chip detector and reinstall.

(4) Remove and inspect strainer for number 2 bearing and strainer for numbers 3 and 4 bearings for presence of metal chips. If chips are present, request assistance from Direct Support Maintenance; remove and inspect three reduction gear oil transfer tube strainers and overspeed governor and tachometer drive oil throttle strainer. Forward engine to overhaul if metal chips have clogged more than one third of the flow area of any one of the strainers. If the amount of metal chips is not excessive, clean and reinstall strainers and proceed to step (5).

(5) Presence of chips in previously mentioned strainers indicates bypass of the oil filter has occurred. Proceed as follows:

(a) Remove and disassemble oil filter. Flush parts and passages and inspect for wear or damage.

(b) Replace parts as required, reassemble and install oil filter.

(6) Disconnect oil scavenge hose assembly for number 2 bearing and for numbers 3 and 4 bearings and determine whether residual oil in the hose assemblies is contaminated with chips. If so, request assistance from Direct Support Maintenance for replacement of affected bearings.

(7) Fill oil tank to capacity with new oil (item 2 or 3, table 1-2). (Refer to paragraph 1-72.)

(8) Start engine and run at flight idle until temperatures have stabilized. Check instruments for proper engine operation. Increase speed to 70 to 80 percent nI and maintain for 5 minutes.

CAUTION

Any oil pressure fluctuation in excess of plus or minus 5 psi, or any rapid rise in oil temperature at any preset power setting, is cause for immediate engine shut-down.

(9) Shutdown engine and again inspect oil filter elements, chip detector and strainers.

(10) If quantity of chips remains the same after second engine run, do not clean filter, strainers or chip detector. Request assistance from Direct Support Maintenance and forward engine, oil tank and oil cooler to next higher maintenance echelon for additional inspection. Flush all airframe mounted engine oil lines.

NOTE

Chips in oil filter may come from oil tank; chips on chip detector come from engine.

(11) If amount of carbon particles found on filter element is excessive proceed as follows:

(a) Drain all oil from accessory drive gearbox, oil tank and oil cooler.

(b) Remove and inspect oil strainers for number 2 bearing and for numbers 3 and 4 bearings. If carbon particles are present the oil filter has bypassed. Request assistance from Direct Support Maintenance and remove, clean, and reinstall reduction gear oil transfer tube strainers and overspeed governor and tachometer drive oil throttle strainer. Clean and reinstall number 2 and numbers 3 and 4 bearing strainers.

(c) Clean and reinstall engine oil filter assembly in accordance with step (5) above.

(d) Replenish engine oil system.

(e) Start engine and run at 70 to 80 percent nI RPM for 15 minutes.

(f) Shut down engine. Remove, inspect, clean and reinstall oil filters and strainers.

(g) If contamination is excessive, repeat procedure until filter is clean after run.

5-19. Engine Oil Tank.

Engine oil supply tank is a welded metal container equipped with filler neck and cap, two oil level sight plugs, a scupper with drain, and fittings for connection of outlet, return, vent, drain, and engine breather lines. Filler neck and vent have internal screens, and oil return port has an internal baffle. Tank is secured by straps in a padded support on right side of forward firewall.

a. Removal – Engine Oil Tank.

(1) Open right engine cowling. Drain tank by opening valve (below tank) in drain line which discharges at left aft side of fuselage.

(2) Disconnect all lines from tank. Cap or cover openings.

(3) Cut lockwire, loosen tank strap turnbuckles, and remove tank from support.

b. Cleaning – Engine Oil Tank. Flush out tank with cleaning solvent, (item 302, table 1-2), removing cap and fittings as necessary. Be sure screens in filler neck and vent port are clean and undamaged. Drain thoroughly. Filtered compressed air may be used for drying.

c. Inspection – Engine Oil Tank.

(1) Inspect tank for the following:

(a) Punctures or leaks.

(b) Torn or punctured internal screens.

(c) Damaged threads in fittings.

(d) Damage which affects capacity or function.

(e) Inspect for loose, missing or improperly installed hardware.

(2) Inspect sight plugs for discoloration, damage and proper safetying. Inspect removable fittings for damage.

(3) Inspect tank support straps and strap pads for damage.

(4) Inspect tank support (removed from firewall) for cracks or damage at mounting points.

d. Repair or Replacement – Engine Oil Tank.

(1) Replace tank for punctures or leaks, torn or punctured internal screens, damaged threads in fittings, or any damage which affects capacity or function.

(2) Replace O-rings at reinstallation. Replace any damaged sight plugs or other removable fittings.

NOTE

Tighten top sight plug to 150 to 175 inch-pounds torque. Tighten bottom sight gage plug to 100 to 125 inch-pounds torque.

(3) Replace unserviceable pads on tank straps and support. Replace support assembly if straps are unserviceable.

e. Installation – Engine Oil Tank.

(1) Check that pads are in place on tank support and straps. Open straps to place tank in support, with filler neck to right. Connect straps around tank, with turnbuckles loose enough to permit alignment.

(2) Install fittings and connect tubes to tank ports.

(3) Tighten tank strap turnbuckles to a torque of 10 to 14 inch-pounds and install lockwire.

5-20. Engine Oil Cooler Installation.

A cooler for engine oil is mounted in bottom of fuselage behind engine, and is connected into oil return line through a thermal bypass valve. Cooling air flow is provided by a turbo blower driven by bleed air taken from engine centrifugal compressor housing (on T53-L-9 engine) or from engine diffuser housing (on T53-L-9A, -11, -13 and -13A series engines). Another cooler, for transmission oil, is mounted side by side with engine oil cooler, but there is no functional connection between these two oil systems. Bleed air source on T53-L-9A, -11, -13 and -13A series engines provides compressed air in greater volume and at higher temperature than on T53-L-9 engine. To avoid overspeed of oil cooler turbo blower, it is therefore necessary to use a more restricted inlet fitting on blower with those engine models which take air from engine diffuser housing than with an engine which supplies air from centrifugal compressor housing. A similar situation exists as to the fitting on selector valve of bleed air heater-defroster system. On helicopters through serial no. 65-9604, alternate fittings are stowed in a bracket on engine forward firewall at left side, for use in event of engine model change. A decal at the bracket reads as follows:

WARNING

Install 204-060-494-1 fittings in turbo fan inlet housing and 205-060-494-1 fitting in bleed air heater valve outlet with T53-L-9A or T53-L-11 engine. Install 919-23D fitting in turbo fan inlet housing and 205-060-409-1 fitting in bleed air heater valve outlet with T53-L-9 engine installation. Stow removed fittings in clip provided.

NOTE

The neoprene seal on bleed air line quick disconnect fitting part number 375240-16 becomes brittle from bleed air heat, and shall be replaced with silicone seal when line is disconnected. Ensure parts from old seal do not fall into bleed air line and blower.

a. Removal – Turbo Blower and Duct.

(1) Open access door at right side of fuselage below engine tailpipe.

(2) Remove blower screen.

(3) Disconnect air hose from blower inlet fittings.

(4) Remove three bolts, with nuts and washers, to detach blower from support bracket on fuselage bulkhead.

(5) Remove eight bolts and washers to detach blower from duct. Remove blower assembly.

(6) Remove eight bolts and washers which secure upper flanges of cooler and mount to sides of duct. Remove duct.

b. Removal – Engine Oil Cooler.

(1) Drain cooler and connected oil lines by opening valve below cooler outlet.

(2) Disconnect inlet, outlet, and drain tubes from cooler fittings and valve.

(3) Remove four bolts and washers at lower side flange to detach engine cooler from support. Remove bolts securing two coolers together. Remove oil cooler.

c. Removal – Engine Oil Thermal Valve.

(1) Be sure lower part of oil system has been drained through valve at engine oil cooler outlet.

(2) Enter compartment under engine deck through access opening in bottom of fuselage.

(3) Disconnect four oil tubes from fittings on valve body, located on beam at right side of compartment.

(4) Remove two screws and washers to detach valve assembly from structural beam.

d. Inspection – Engine Oil Cooler.

(1) Inspect oil cooler for unserviceable or damaged fittings, gaskets, O-rings, tubes, support clamps and bracket.

(2) Inspect blower, screen, thermal valve for damage or malfunction.

(3) Inspect oil cooler for cleanliness of air passages.

e. Repair or Replacement – Engine Oil Cooler Installation.

(1) Replace unserviceable fittings, O-ring packings, tubes, and support clamps or bracket as required.

(2) Replace blower, screen, duct, oil cooler, or thermal valve, each as an assembly, for malfunction or excessive damage. In event of engine internal failure, replace cooler and flush out all connecting lines and fittings before reinstallation.

(3) Inspect and clean air passages of oil cooler in accordance with inspection requirements, or as frequently as operating conditions warrant.

f. Installation – Engine Oil Thermal Valve.

(1) Check for proper assembly.

(a) Valve installed or lock-wired in largest port of body.

(b) Reducers with O-rings in two ports on same side of body, and inlet at opposite end from valve.

(c) Elbow with O-ring and nut in remaining side port of body, with open end of elbow facing away from valve.

(2) Enter compartment below engine deck through access hole in lower skin of fuselage.

(3) Hold valve assembly with valve end aft and two reducer fittings downward. Align two mounting holes of valve body with threaded inserts on right beam, approximately ten inches below deck and midway between lateral bulkheads. Install two screws with washers.

(4) Connect four oil tubes to fittings on valve body:

(a) Oil-in from engine scavenge pump to fitting on front end.

(b) Valve-to-cooler tube on forward lower fitting.

(c) Cooler-to-valve tube on aft lower fitting.

(d) Valve-to-tank tube on upper elbow fitting.

g. Installation – Engine Oil Cooler.

(1) Assemble gasket and fitting on cooler inlet, secured by nuts and washers on four studs. Assemble fitting on cooler outlet in same manner. Install drain valve, with O-ring and nut, in port below cooler outlet.

(2) Position cooler assembly, with inlet and outlet forward, in support at bottom of fuselage compartment below engine tailpipe. Install bolts, with thin aluminum alloy washers under heads, through slotted holes in lower side flanges of cooler into plate-nuts of support.

NOTE

If there are any voids between the oil cooler mounting flange and the mating flange of the oil cooler support assembly, use filler P/N 205-060-110-1. This will prevent the flanges from being secured under stress, resulting in cracks to the oil cooler mounting flanges.

(3) Install bolts through mating flanges of engine and transmission oil coolers.

(4) Connect oil tubes to cooler inlet and outlet fittings, and connect drain tube to valve.

(5) Position duct between upper flanges of cooler and mount. Install eight bolts, with thin aluminum alloy washers under heads, through mounting flanges into plate-nuts of duct.

h. Installation – Turbo Blower.

(1) Install reducer, with O-ring in blower inlet.

(2) Check that support bracket is secured with three screws and washers on fuselage bulkhead above oil cooler location.

(3) Position blower assembly, with inlet pointing forward at left side, to align mounting holes with duct flange and support bracket.

(4) Attach blower to duct with eight bolts and thin aluminum alloy washers.

(5) Attach blower to support bracket with three bolts, using thin aluminum alloy washer under each bolt head and nut.

(6) Connect hose from bleed air valve line to blower inlet.

(7) Install screen on blower flange in following sequence: nut, washer, grommet, screen edge, grommet, washer, blower, flange, washer and nut. Ensure nuts are tightened and grommets compressed to 0.400 between nut and flange.

5-21. Chip Detector.

A chip detector is mounted on the bottom side of the accessory drive gear box. On Serial No. 66-746 and subsequent this unit is wired into the caution panel.

a. Removal – Chip Detector.

(1) If installed, disconnect electrical wiring from chip detector.

(2) Unscrew and remove chip detector and packing. Discard packing.

b. Inspection – Chip Detector. Inspect threads for damage and for contamination in accordance with Inspection Requirements. (Refer to Chapter 3.)

NOTE

If contamination is evident upon removal of chip detector, record type and amount on the engine historical record. Determine source of contamination.

c. Cleaning – Chip Detector. Clean with dry-cleaning solvent, (item 302, table 1-2).

d. Repair or Replacement – Chip Detector. Replace chip detector if damaged.

e. Installation – Chip Detector.

(1) Place packing on chip detector. Install chip detector in accessory drive gear box. Torque 90 to 100 inch-pounds and lock-wire.

(2) Connect electrical wiring, if so equipped.

5-22. Engine Oil Strainers.

Two oil strainers in the engine assembly can be inspected and cleaned in Organizational Maintenance. The rear bearing housing oil strainer is located in a fitting on lower right side of the engine diffuser housing, at the pressure oil inlet to No. 2 main bearing. The power turbine oil strainer is located in a fitting at top left on the engine exhaust section, at the pressure oil inlet to No. 3 and 4 main bearings.

a. Removal – Engine Oil Strainers.

(1) Cut lockwire from hexagon head of rear (No. 2) bearing housing oil strainer. Unscrew and remove strainer and metal gasket. Remove packing from strainer. Cover opening. Note part number of rear bearing housing oil strainer. If strainer is to be replaced, it must be replaced with one having the same part number.

(2) Disconnect pressure oil hose from power turbine oil strainer housing.

(3) Unscrew and remove housing and power turbine oil strainer. Cover opening. Remove packing and strainer from housing (on T53-L-13/-13A only, power turbine oil strainer must be unscrewed from housing adapter).

b. Cleaning – Engine Oil Strainers.

(1) Prior to cleaning, inspect strainers for metallic chips.

(2) Clean strainers and attaching parts with a fiber brush. Rinse with dry cleaning solvent (item 302, table 1-2.)

c. Inspection – Engine Oil Strainers. Inspect strainers for clogging or damage. Inspect power turbine oil strainer housing adapter for stripped or damaged threads.

d. Repair or Replacement – Engine Oil Strainers. Replace strainers if clogging cannot be removed, or if damaged. Replace power turbine oil strainer housing adapter if damaged.

Section VII. IGNITION SYSTEM

5-23. Ignition System.

a. The ignition system is of the capacitor discharge type, and consists of an ignition exciter unit, and output leads assembly (which includes a "spark-splitter" coil), and surface-gap igniter plugs. T53-L-9/-9A/-11 series engines has two igniter plugs; T53-L-13/-13A, engines have four plugs. System is activated simultaneously with starting fuel solenoid valve and starter by use of trigger switch on pilot's cyclic control stick.

b. Input from 28-volt DC electrical system is stepped up in exciter unit to 2500 volts and discharged through igniter plugs in combustion chamber at a spark rate of two to eight per second. Ignition exciter unit, coil and leads assembly, and igniter plugs are rated equal to service lift of engine, are not repairable or adjustable, and must be replaced when inoperative.

WARNING

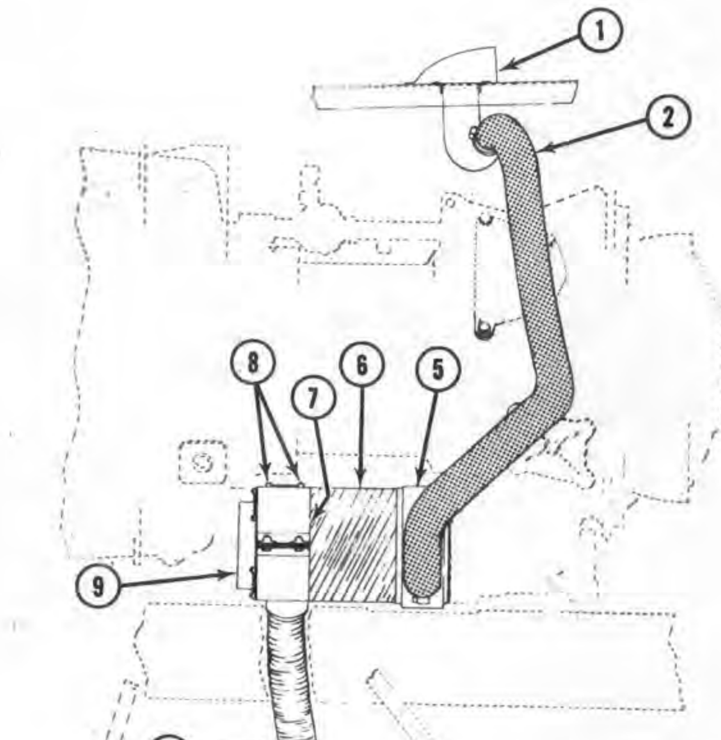
The ignition exciter contains a very small amount of radioactive material (Cesium-Barium 137) and normally requires no handling precautions. However, severely damaged units that have been broken open, must be handled with forceps or lead gloves and disposed of in accordance with AR755-380, Disposal of Supplies and Equipment.

5-24. Starter-Generator and Cooling System.

A starter-generator, mounted to rear side of accessory drive gear box and connected into 28-volt DC electrical system, serves to drive compressor rotor during engine starting cycle and also functions as an engine-driven standby generator at normal engine speeds. Cooling provisions (if installed) consist of air intake on beam above engine, connecting ducts, starter-generator shrouds and end cover, and a duct to exit through deck into fuselage compartment. (See figure 5-20.)

a. Removal – Starter-Generator.

(1) Disconnect battery. Disconnect electrical leads from starter-generator.



1. Intake Fairing and Duct
2. Flexible Hose
3. Deleted
4. Deleted
5. Inlet Shroud
6. Starter - Generator
7. Outlet Shroud
8. Locating Screws
9. End Cover
10. Outlet Duct

Figure 5-20. Starter-generator cooling system

(2) Pull end of outlet duct (10, figure 5-20) from outlet shroud (7) on aft end of starter-generator.

(3) Remove clamp and detach flexible hose (2) from inlet shroud (5) on forward end of starter-generator. Loosen two bolts on left side and slide shroud aft on starter-generator to gain access to mounting studs.

(4) Loosen nuts on mounting studs. Carefully turn starter-generator counterclockwise and pull straight aft until unit is free of mounting studs and drive shaft engagement. Cover mounting pad to prevent entrance of foreign material.

(5) Remove inlet shroud (5) from starter-generator. Loosen bolts on outlet shroud (7) and remove shroud.

NOTE

If starter-generator is equipped with end cover (9) and locating screws (8), these items must be removed before removing outlet shroud (7).

b. Repair or Replacement – Starter-Generator Driveshaft.

NOTE

Starter-generator assemblies, P/N 204-060-220-1, serial no. 136 and subsequent, will have improved shaft, P/N 23064-1011, incorporated. Other identification will include white stencil 3/8 inch letters "Physical Change No. 1" adjacent to nameplate.

(1) Remove starter generator.

(2) Remove screws securing cover plate to aft end of starter-generator.

(3) Hold armature from turning and remove two piece nut securing driveshaft to armature shaft.

(4) Push or tap failed driveshaft forward out of armature.

(5) Replace failed driveshaft with higher shear strength shaft P/N 23064-1011.

(6) Reassemble new driveshaft through armature shaft, secure with nut and torque inner nut 180 to 200 inch-pounds. Torque outer nut 125 to 150 inch-pounds.

(7) Reinstall rear cover plate using hardware previously removed. Apply anti-seize compound (item 202, table 1-2) to screw prior to installation.

(8) Reinstall starter-generator on aircraft.

c. Installation – Starter-Generator.

(1) Position outlet shroud (7, figure 5-20) on aft end of starter-generator, secured with stainless steel bolts and thin washers at clamping joint on right side.

NOTE

When replacement starter generator is requisitioned, the possibility exists of receiving a different manufacturer's component. If this occurs, wiring diagram and interchangeability chart (figure 5-21) is to be utilized. Only starter generator, Part No. 204-060-200-5, shall be used on helicopters equipped with T53-L-13, -13A engines.

(2) If starter-generator has provisions for end cover (9, figure 5-20) and locating screws (8), these items must be installed as follows:

(a) Align outlet shroud with locating holes in starter-generator and install stainless steel screws, with thin washers. Lock-wire screws.

(b) Position end cover and install six screws, with aluminum alloy washers. Lock-wire screws in pairs.

(3) Place inlet shroud (5) on forward end of starter-generator. Slide shroud far enough aft to permit positioning starter-generator on mounting studs. Install stainless steel bolts, with thin washers, at clamping joint of shroud. Tighten bolts only enough to temporarily hold shroud in position, with inlet pointing to right.

(4) Remove mounting pad cover. Install new gasket. Coat starter-generator shaft, and pack female splines of shaft in gearbox 2/3 full, with lubricant (item 17, table 1-2).

(5) Carefully position starter-generator on mounting studs, making sure that shaft meshes properly with splines of shaft in gearbox. Turn clockwise and tighten mounting nuts.

(6) Slide inlet shroud (5) forward to normal position. Connect flexible hose (4) to inlet shroud and secure with clamp. Tighten bolts at clamping joint.

(7) Install new packing in groove around upper end of outlet duct (10). Insert duct into shroud (7).

(8) Connect electrical leads. (See figure 5-21.) (Refer to Chapter 13.) Connect battery.

Wire as shown when Bell Helicopter unit, Part No. 204-060-200-5, is installed.

Disconnect and stow wire K18A20N from terminal X1 when General Electric unit, Part No. STU6/A, is installed.

Disconnection and stowing of wire K18A20N from terminal X1 is optional when Lear Siegler unit, Part No. STU6/A, is installed.

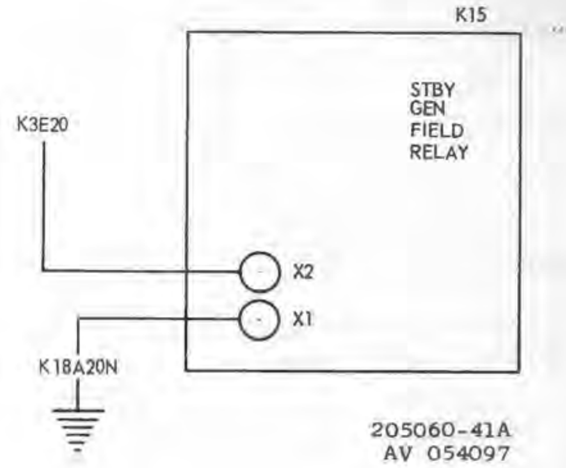


Figure 5-21. Starter-generator wiring

NOTE

When making electrical installation on Bendix manufactured starter-generator, if terminal stud length is found to be insufficient for proper installation, remove furnished washer and replace with washer P/N AN960D616L.

d. Removal – Starter-Generator Cooling Fan.

(1) Disconnect flexible duct hoses from fan inlet and outlet by removing clamps. (Refer to figure 5-22.)

(2) Remove lockwire and four bolts at corners of fan mounting base. Lift fan assembly carefully until shaft is clear of drive pad.

(3) Remove O-ring packing from underside of fan base.

(4) Install O-ring on cover plate, and check that O-ring is in place at oil port of drive pad. Install cover on drive pad, and secure by four bolts. Lock-wire bolt heads in pairs.

e. Inspection – Starter-Generator Cooling Fan Assembly. Perform the following inspection on all helicopters equipped with the 200 amp starter-generator. The 200 amp starter-generator is installed on helicopters serial number 60-6029 through 65-12895. Inspect as follows:

NOTE

When replacing 200 A generator with 300 A generator, remove cooling fan assembly and install shipping plate. Connect loose ends of hose in accordance with applicable TB.

(1) Thoroughly clean fan blades and housing.

(2) Visually inspect for apparent wear, damaged or noisy bearings, bent or loose shaft, and cracked housing.

(3) Replace cooling fan if obvious defects are found.

(4) Cover mounting pad to prevent entrance of foreign material during inspection of generator cooling fan.

f. Installation – Starter-Generator Cooling Fan.

(1) Remove lockwire, four bolts, and cover plate from drive pad at upper right side of engine inlet housing.

(2) Remove O-ring packing from underside of cover. Install packing on underside of fan mounting base. Check that packing is in place around oil port of drive pad.

(3) Position fan assembly over drive pad, inserting fan shaft carefully to engage with internal gear splines. Install four bolts, with thin steel washers, at corners of mounting base. Lock-wire bolts in pairs.

(4) Connect flexible hose from intake duct on beam to inlet on fan, and connect hose from starter-generator inlet shroud to fan outlet. Secure with clamps.

(5) On those engines equipped with 300 AMP generator the blower fan will be permanently removed and the shipping cover, with two preformed packings, installed.

1. Intake Fairing and Duct
2. Flexible Hose
3. Cooling Fan
4. Flexible Hose
5. Inlet Shroud
6. Starter - Generator
7. Outlet Shroud
8. Locating Screws
9. End Cover
10. Outlet Duct

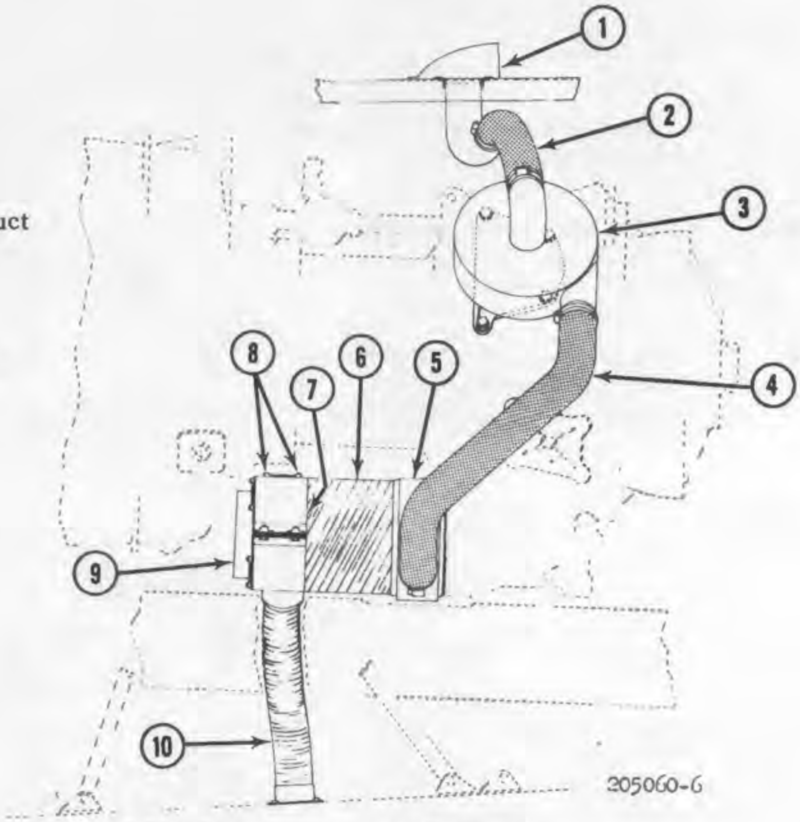


Figure 5-22. Starter-generator cooling system

Section VIII. COOLING SYSTEM

(Not Applicable)

Section IX. FUEL CONTROL

5-25. Fuel Control.

NOTE

Refer to TM 55-2840-229-24, ENGINE, SHAFT TURBINE for applicable Fuel Control data.

5-26. Power Turbine Governor RPM Controls.

An electrically operated linear actuator, remotely controlled by a GOV RPM INCR/DECR switch on each collective pitch control stick, moves a lever on overspeed governor of fuel control unit to accomplish settings of power turbine (N2) rpm, indicated on dual tachometer. Droop compensation, to stabilize rpm as engine load fluctuates with changes in main rotor pitch, is provided by mounting actuator to cambox which is mechanically linked to a bellcrank in collective pitch control system. (See figure 5-23.) Compensator linkage consists of two control rods and a torque tube, which has a shear pin in its forward arm to assure unhindered operation of collective pitch controls if compensator linkage should become fouled.

a. Removal – Actuator and Control Lever.

(1) Open engine compartment cowling at left side.

(2) Remove terminal cover with attaching screws from top of actuator (16, figure 5-23). Disconnect and stow electrical leads. Reinstall cover.

(3) Detach actuator jackshaft end-fitting from control lever (17) on governor, and forward end-fitting from slider of cambox (14), by removing bolts with nuts and washers. Use care to avoid losing spring washer, installed between actuator clevis and cambox slider.

(4) Remove lockwire and clamping bolt to pull lever from serrated shaft (18) at top of overspeed governor.

b. Inspection – Actuator and Control Lever.

(1) Inspect actuator for damage or evidence of malfunction.

(2) Inspect control lever for elongated pivot bolt hole, worn control shaft serrations, and other unserviceable condition.

(3) Inspect for corrosion and loose, missing or improperly installed hardware.

c. Repair or Replacement – Actuator and Control Lever.

(1) Replace actuator as an assembly if damage is found or malfunction occurs.

(2) Replace control lever if faulty conditions are present.

d. Installation – Actuator and Control Lever.

(1) Place control lever (17, figure 5-23) on governor control shaft (18) as nearly at 90 degree angle to centerline of shaft stop-arm (19) as serrations permit. Install retaining bolt, with washer, from aft side into lever and through shaft groove. Lock-wire bolt head to shank of lever.

(2) Align actuator front end-fitting clevis on end of cambox slider. Insert spring washer between clevis and underside of slider, and install bolt from top, secured with washer and nut. Torque nut 5 to 15 inch-pounds and insert cotter pin.

(3) Attach actuator shaft rod-end in clevis of governor control lever with bolt, washer, and nut. Omit cotter pin until rigging is complete. If necessary, loosen bolts attaching cambox bracket on engine to align actuator to lever. After installing actuator, tighten and lock-wire bracket bolt.

(4) Remove actuator terminal cover. Connect electrical leads on terminals. (See wiring diagrams, Chapter 13.) Reinstall terminal cover.

e. Removal – Cambox and Linkage.

(1) Disconnect control rod (12, figure 5-23) from bellcrank of cambox (14) by removing bolt with nut and washer. Disconnect rod from torque tube arm at support (11).

(2) Remove cambox and bracket as an assembly by removing lockwire and two bolts at top of forward engine mount trunnion. Reinstall bolts to secure mount trunnion.

NOTE

If cambox is removed from bracket, be sure shims remain in place on bellcrank pivot bolt between inner race of bearing and sides of housing.

(3) To remove control tube (2): Enter fuselage through opening below pylon to disconnect tube clevis from collective pitch control bellcrank by removing bolt with nut, washers, and cotter pin. Disconnect upper end of tube from torque tube bellcrank (6) in same manner.

(4) To remove bellcrank and shear pin (7) from torque tube: Remove retaining nut and washer from torque tube fitting at forward side of bracket (3). Remove four screws and washers to detach bracket base from structure. Remove bracket assembly, washer, retaining washer (9), shims (8), bellcrank, and shear pin from shear fitting (5) of torque tube.

(5) When complete removal of torque tube (4) is necessary: Remove screws to detach support (11) from deck. Place an index mark, with suitable crayon or marking material, on shear fitting (5) and end of tube. Remove two bolts, with nuts and washers, and pull fitting from forward end of tube. Remove tube aft through firewall seal (10).

f. Inspection – Cambox and Linkage.

(1) Inspect cambox assembly and bracket or attaching parts for evidence of damage, fouling, corrosion and for loose, missing or improperly installed hardware. Inspect cam for wear, binding and smooth operation.

(2) Inspect linkage for damage, evidence of fouling, corrosion or other faulty condition. Inspect for loose, missing or improperly installed hardware.

(3) Inspect torque tubes, control rod, bellcranks, rod ends, and attaching parts for lost motion, excessive looseness, damage and corrosion. Inspect for missing or improperly installed hardware.

g. Repair or Replacement – Cambox and Linkage.

(1) Replace cambox assembly, bracket, or attaching parts found to be unserviceable.

(2) If necessary, replace cam as follows:

(a) Remove cotter pin, nut, washer (11, figure 5-24), shims (10) and bolt (6). Remove bellcrank assembly (2), cam (3) and slider assembly (4) from housing (5) and bracket as an assembled group.

(b) Remove nut, serrated lockwasher (12), flat washer and bolt (1). Remove rivet (7) and detach bellcrank assembly (2) from cam (3).

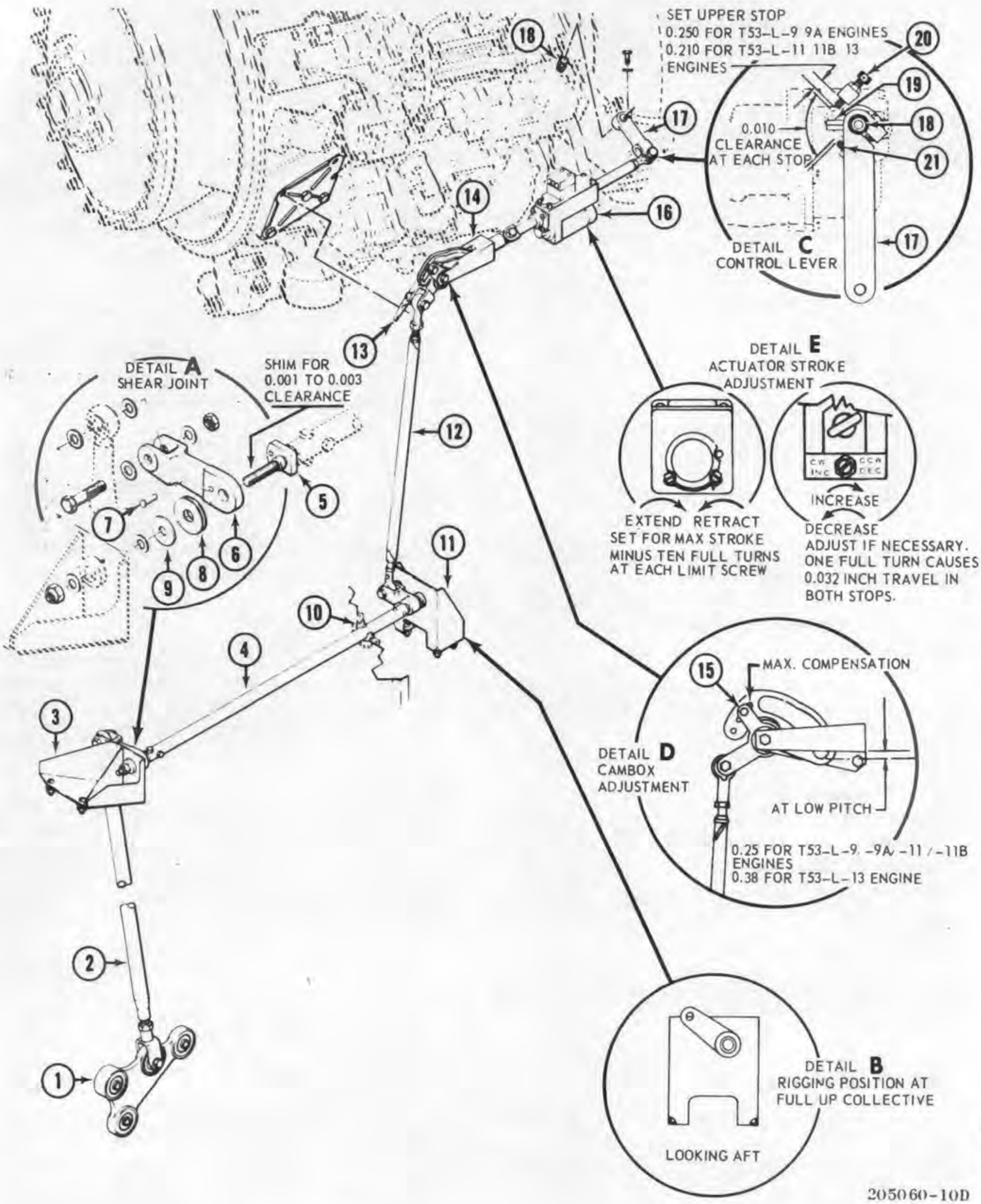


Figure 5-23. Power turbine governor rpm controls (Sheet 1 of 2)

1. Collective Pitch Bellcrank
2. Control Tube
3. Bracket Assembly
4. Torque Tube
5. Shear Fitting
6. Bellcrank
7. Shear Pin
8. Shims
9. Retaining Washer
10. Firewall Seal
11. Support
12. Control Rod
13. Cambox Bracket
14. Cambox Assembly
15. Cam Adjustment
16. Linear Actuator
17. Control Lever
18. Governor Control Shaft
19. Shaft Stop-Arm
20. High RPM Stop
21. Low RPM Stop

205060-10D

Figure 5-23. Power turbine governor rpm controls (Sheet 2 of 2)

(c) Remove pin (8) and separate cam (3), bearing (9) and slider assembly (4).

NOTE

For replacement use cam, Part No. 204-061-709-1, if cam box assembly is to be installed on T53-L-11 series engine. Use cam Part No. 204-061-705-1, if cam box is to be installed on T53-L-13 or -13A engine.

(d) Assemble cam (3), bearing (9) and slider assembly (4) with pin (8).

(e) Position bellcrank assembly (2) on cam (3) and install rivet (7).

(f) Install bolt (1) with flat washer under head and serrated side of lockwasher (12) facing cam (3) under nut.

(g) Position assembled bellcrank assembly, cam and slider assembly in housing (5). Install bolt (6), shims (10), washers (11), nut and cotter pin. Use a maximum of four shims to obtain 0.001 to 0.003 inch clearance before torquing bolt. Torque bolt.

(3) Replace shear pin in forward arm of torque tube in event of failure. Investigate cause of failure, and correct any fouling of linkage or other faulty condition.

(4) Replace damaged or unserviceable torque tube, control rods, or removable rod-ends, or attaching parts.

(5) Check rigging and operation of system after replacement of parts.

NOTE

Cam box assembly, Part No. 204-060-787-9 (with cam, Part No. 204-061-705-1), must be used with T53-L-13, and -13A engines. Cam box assembly, Part No. 204-060-787-3 (with cam, Part No. 204-061-709-1) must be used with T53-L-11 series engines.

h. Installation – Cambox and Linkage.

(1) Install cambox bracket (13, figure 5-23) on two upper bolts of forward mount trunnion at left side of engine inlet housing. Use thin steel washers.

NOTE

Lower forward bolt hole of bracket is oversize for alignment of actuator to governor control lever. Accomplish final tightening and lock-wiring of bracket mounting bolts after connecting actuator to lever.

(2) If cambox (14) is separated from bracket: Attach cambox with two bolts through housing and bracket and secure by nuts at inboard side. Use shims on bellcrank pivot bolt, between bearing and housing at each side to provide 0.001 to 0.003-inch clearance before tightening bolt, with thin steel washers next to bearing to prevent wear of laminated shims.

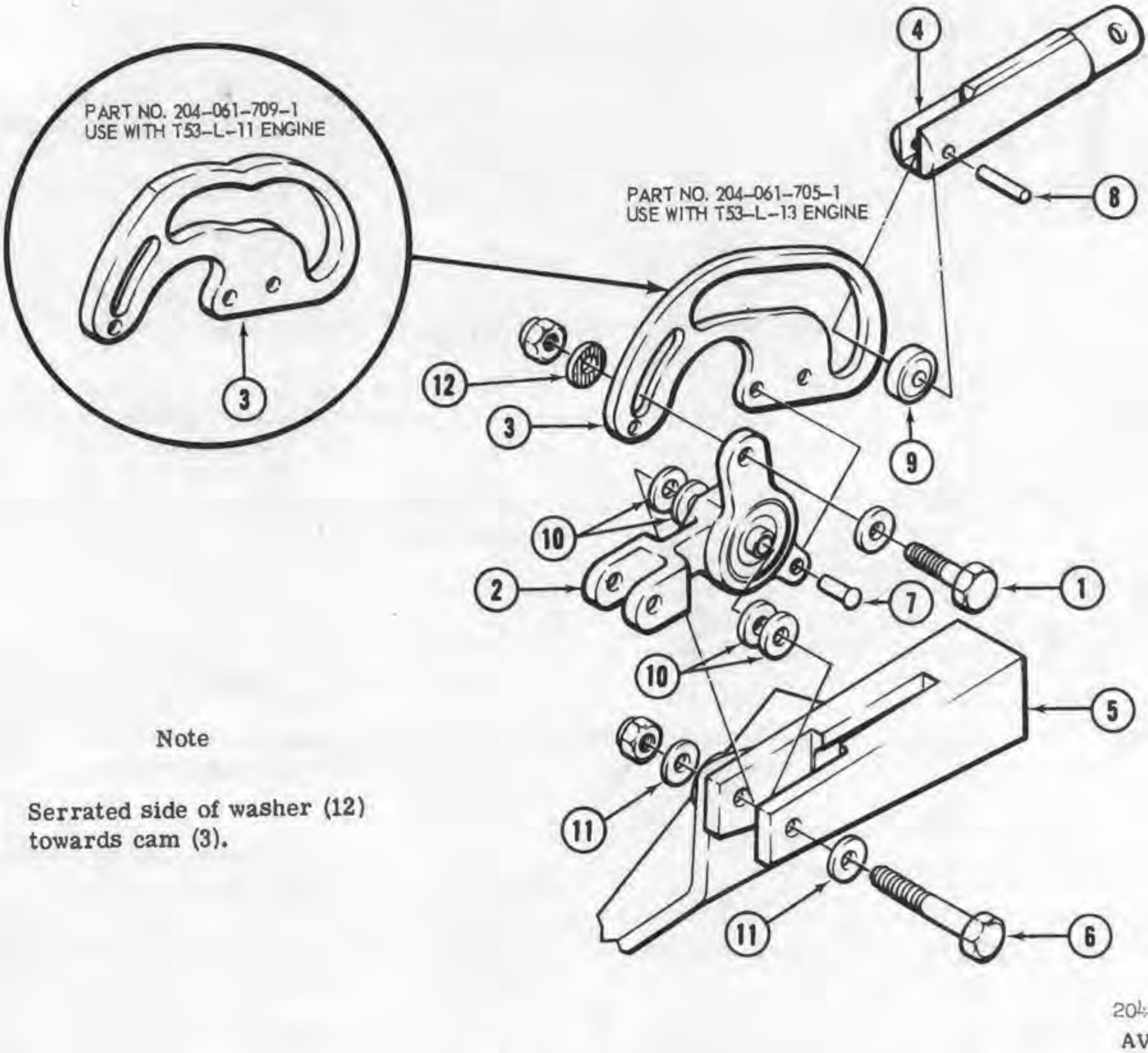
(3) If torque tube (4) was completely removed: Insert end of tube through firewall seal (10) from rear side. Place shear fitting (5) in end of tube, align index marks and bolt holes, and install two bolts secured by washers and nuts. Position support (11) to mounting holes in engine service deck and secure with torque tube in support bearing.

NOTE

Replacement shear fitting may be received without the two holes drilled for attachment to torque tube. These two holes should be drilled at the time of assembly, hole size 0.1895/0.1915 to match holes in torque tube. Holes to be drilled as shown in figure 5-25.

CAUTION

Shear pin (7) substitution is not authorized.



Note

Serrated side of washer (12) towards cam (3).

1. Bolt
2. Bellcrank Assembly
3. Cam
4. Slider Assembly
5. Housing
6. Bolt
7. Rivet
8. Pin
9. Bearing
10. Shim
11. Washer
12. Serrated Lockwasher

Figure 5-24. Droop compensator cam replacement

(4) Place bellcrank (6, figure 5-23) on end of shear fitting (5), align holes, and install shear pin (7) with head seated in counterbore recess on front of bellcrank.

(5) Assemble shims (8), retaining washer (9), washer, bracket, washer and retaining nut on threaded stud of shear fitting. Check for 0.001 to 0.003-inch clearance between bellcrank (6) and shear fitting (5). Change shim thickness if necessary.

(6) Position bracket (3) to mounting holes at left side of pylon supporting structure, and secure with four screws and washers.

(7) Connect clevis end of control tube (2) on collective pitch system bellcrank (1), using washers between bearing and sides of clevis, and thin washers under bolt head and nut. Install cotter pin.

(8) Adjust control tube to position torque tube arm correctly. Connect tube to torque tube bellcrank, using

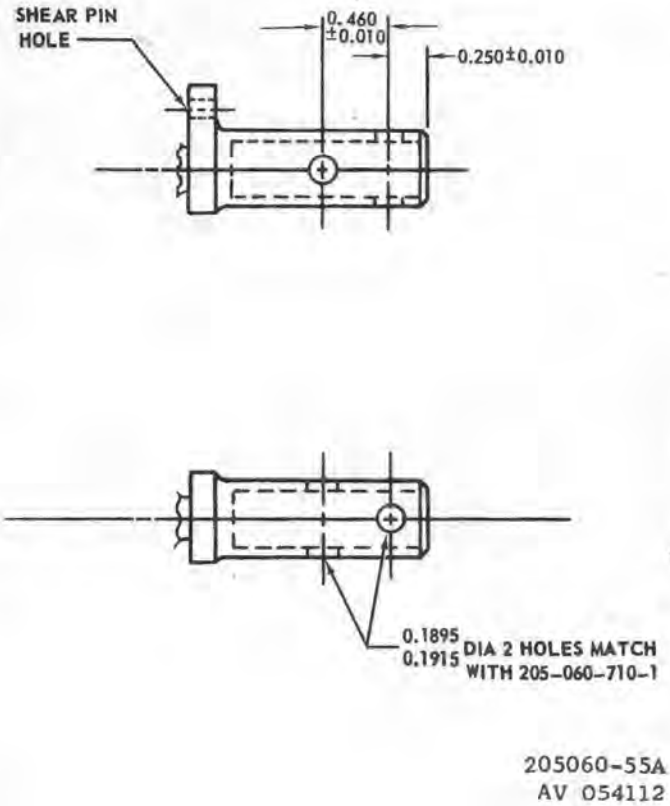


Figure 5-25. Shear fitting hole location

thin steel washers between bearing and sides of bellcrank clevis and thin alloy washers under bolt head and nut. Install cotter pin.

(9) Connect nonadjustable end of control rod (12) to arm at rear end of torque tube with bolt, two washers, nut and cotter pin. Connect upper end of control rod to cambox bellcrank during rigging procedure.

i. Adjustment – Power Turbine Governor RPM Controls.

(1) Be sure collective pitch control system rigging has been completed.

(2) Lock collective pitch control stick in full up position, and adjust droop compensator control tube (2, figure 5-23) to align center of bolt hole in aft arm of torque tube (4) approximately level with top of support bracket (11). Due to shimming, manufacturers tolerance, etc., variation of 0.250-inch from top of support bracket is possible and acceptable. (See detail B.)

(3) Set cam adjustment (15) to middle of slot. (See detail D.)

(4) Move collective pitch control stick to full down position and lock.

(5) Adjust control rod (12) attached to cam bellcrank so that approximately 0.25-inch of cam slot is visible below cambox housing for T53-L-9, -9A, -11, and -11B engines; 0.38-inch for T53-L-13, and -13A engines.

NOTE

This is a nominal setting and is subject to change, if necessary, in following steps.

(6) Check installation of governor control lever (17) as nearly at 90 degree angle to stop arm as serration alignment permits. (Refer to paragraph 5-26.)

(7) Adjust upper governor stop screw to 0.250-inch for T53-L-9 and -9A engines; 0.210-inch for T53-L-11, -11B, -13, and -13A engines, measured from inner side of mounting boss. (See detail C.) Remove and discard lead seal on lockwire, if existing.

NOTE

Never shorten either stop screw on governor to less than 0.060 inch length from inner side of boss.

(8) Disconnect actuator shaft from governor control lever (17) by removing bolt.

(9) Electrically position actuator shaft to approximate midpoint of stroke.

(a) If actuator with two adjusting screws is installed, turn both positive stop adjusting screws to obtain maximum stroke (see detail E). Reduce stroke by turning each screw ten full turns away from maximum adjustment to obtain actuator nominal position.

(b) If actuator with single adjusting screw is installed it is not necessary to adjust positive stop screw to obtain nominal position. Positive stops can be adjusted, if necessary, for travel of 0.500 inch to 1.75 inch without change in nominal position.

NOTE

One full turn of the adjusting screw will cause a change in both the retract and extend position of .032 inch. (See detail E.)

NOTE

Set actuator travel to: 1.38-inch for T53-L-9, -9A engines; 1.25-inch for T53-L-11 series engines; 1.20-inch for T53-L-13 and -13A engines.

(10) Fully retract actuator shaft by holding GOV RPM switch to INCR. Move collective stick to full up position.

(11) Reinstall bolt connecting actuator to governor control lever, adjusting actuator shaft rod-end to obtain 0.010 inch clearance between governor stop arm and upper stop screw, measured with a feeler gage. (See detail C.) If necessary, reposition control lever one serration on governor shaft to accomplish this adjustment while keeping safe thread engagement of rod-ends.

NOTE

When tightening jamnut on actuator shaft, center rod-end in clevis of lever so that self-aligning bearing will absorb any rotation of shaft.

(12) Fully extend actuator shaft by holding GOV RPM switch to DECR. Lock collective pitch control stick in full down position.

(13) Adjust lower stop screw for 0.010 inch clearance with governor stop arm, measured with a feeler gage. Remove and discard lead seal on lockwire, if existing. Observe minimum length limitation. (Refer to Note under step (7).)

(14) On initial ground run, with collective pitch control stick full down, check for 6000 to 6700 (±50) rpm range controlled by GOV RPM switch. If necessary, readjust actuator stroke length to obtain required range, repeating clearance checks and adjustment at both governor stop screws.

(15) Make final adjustments of droop compensator cam as required by flight checks. Set cam to maintain 6600 N2 rpm (plus or minus 40) from full low pitch to full power. If rpm droop occurs, rotate cam clockwise toward maximum compensation. If maximum compensation adjustment does not correct droop, lengthen control rod (12) to increase amount of cam slot showing below housing. Be sure roller does not bottom out at end of cam slot in either extreme of travel.

NOTE

Readjust governor stop screws for clearance after any change in rigging.

Section X. POWER CONTROLS

5-27. Power Controls.

A mechanical linkage system, actuated by twist-grips on collective pitch control sticks, provides manual control of power lever on fuel control unit, modulating engine from zero to full power by controlling gas producer (N1) turbine rpm. Linkage is a series of control rods, bellcranks, and a torque tube, with adjustable tubes at each end of series and between control sticks. One bellcrank has an adjustment to provide correct travel of entire airframe-mounted linkage. Power lever shaft is serrated and grooved to accept a control arm, and has a quadrant marked with power settings in travel range between stops pre-adjusted by engine manufacturer or overhaul facility. (See figure 5-26.)

a. Flight Idle Stop and Release. An adjustable stop, on bellcrank below engine deck, contacts plunger of a solenoid to arrest travel of control linkage at flight idle position when power is reduced from higher settings. Stop release is accomplished by use of ENGINE IDLE STOP REL pushbutton switch on pilot's collective stick to retract solenoid plunger.

b. Removal – Power Control Linkage. Parts of control system can be removed as necessary for inspection, lubrication, or replacement. To facilitate reinstallation, identify removed parts as to location and keep attaching hardware in place or in sets.

(1) Obtain access to forward linkage by removing access doors along center of cabin floor, and on structural pylon island. Obtain access to linkage aft of cabin through openings in lower side of fuselage, and by opening engine compartment cowling on left-hand side.

(2) To remove torque tube (7, figure 5-26) disconnect control rods from both arms. At each end of tube, remove four screws and washers which secure bearing cup and shims (8) to mounting pad on structural beam. Remove torque tube assembly. Separate bearing cup and shims from left end of tube. Remove shims, retaining nut, washer, and bearing cup from right end.

(3) To remove any bellcrank in fuselage, disconnect control rods by removing bolts, nuts, washers, and spacer (15). Remove cotter pin, nut, and washer to pull bellcrank (14, typical) from mount (12). To detach mount from structure, remove three screws and washers.

(4) To remove boot (22), disconnect control rod from bellcrank on engine mount. Loosen clamp or clamps and detach boot (22) from housing assembly (21), or plate, and retainer (23). Remove snap ring and split bushing (24), and slip retainer and boot off upper end of control rod.

(5) To remove bellcrank (25), disconnect both control rods. Remove pivot bolt and nut to detach

bellcrank and spacer from bracket on pillow block of engine mount.

(6) To remove control arm (27) from power lever shaft on fuel control, cut lockwire and remove retaining screw. Pull control arm off splined shaft. Reinstall screw in arm.

c. *Inspection – Power Control Linkage.*

(1) Inspect bearings for wear and roughness.

(2) Inspect parts for wear, elongated bolt holes, cracks, nicks, and surface damage.

d. *Installation – Power Control Linkage.*

(1) Assemble bearing cup, washer, and retaining nut on pin at right-hand end of torque tube (7, figure 5-26). Tighten until 0.032-inch clearance exists between inboard side of bearing and shoulder of torque tube lever.

(2) Place bearing cup on opposite end of torque tube, and position tube assembly between mounting pads on structural beams. Install shims as required, to a maximum of six at each end, for 0.032-inch clearance of bearings at each end of tube. (See figure 5-27.) Secure each bearing cup and shims to beam inserts with four screws and thin washers.

NOTE

Clearance of 0.032 inch is a minimum requirement. Greater clearance is acceptable if no end play exists which results in lost throttle motion. If such end play is noted, additional shims will be required to maintain 0.032 to 0.060-inch clearance. The clearance reading shall be taken with the torque tube chucked against the opposite end while clearance is being measured.

NOTE

On UH-1D/UH-1H helicopters prior to serial no. 68-15518 check bellcrank mounts for looseness and proper length screws. Screws should be 5/8-inch long, except for top-aft mount which requires 1/2-inch screws. Replace screws shorter than 5/8-inch with part number AN520-10R10; replace top-aft mount screws shorter than 1/2-inch with part number AN520-10R8. (If mounts have not been removed during disassembly of power control linkage check screw length by removing one screw from each mount.)

(3) If removed, install mounts (12, figure 5-26) and bellcranks (9, 13, 14, 16 and 20) as shown. To install bellcrank (25), use spacer on pivot bolt between bracket and pillow block of engine mount tripod, and secure with nut and cotter pin on bolt at inboard side of pillow block.

(4) Reinstall any nonadjustable control rods, using spacers between bellcranks and rod-ends as shown. Install boot (22) and retainer (23) before connecting both ends of rod between bellcranks (20 and 25). Insert split bushing through retainer and secure with snap ring at upper side. On helicopters prior to Serial No. 68-15490, secure boot on retainer (23) and housing assembly (21) with clamps. On helicopters Serial No. 68-15490 and subsequent, secure boot on retainer (23) with clamp and install to plate with five washers and bolts.

(5) Set pilot's twist grip control at mid-travel. Set copilot's control at same position, checking that gear on lower end of control stick is centered on mating gear sector. Install inter-connect rod (4) between control stick lever arms. Actuate controls through full range to check for correct gear engagement and freedom of operation.

(6) Connect adjustable control rods (5 and 26) and install control arm (27) during rigging procedure.

e. *Adjustment – Power Lever Controls.*

(1) Be sure flight idle stop (19, figure 5-26) is removed and that control rod (26) is disconnected from power lever control arm (27) on power lever shaft of fuel control.

(2) Install control arm (27) on power lever shaft of fuel control, positioned as nearly parallel to shaft stop-arm as serrations will permit. Install retaining screw through control arm, engage in groove around shaft. Lock-wire screw head.

(3) Position control arm (37) (on fuel control) against the stop, turn twist grip to its stop in the corresponding direction. Adjust length of control rod (26) with equal over-travel in each direction of the free rod-end slightly past the bolt hole in control arm, as limited by shaft stops. Attach control rod (26) to control arm (37) with bolt, washers, nut, and cotter pin. Tighten rod-end jam nut. Travel may be increased in either direction by adjusting length of control rod (5).

NOTE

The rod-end adjustments must be kept as near nominal as possible to ensure safe thread engagement.

(4) Adjust serrated attachment of upper control rod on bellcrank (9) so that control arm (27) will bottom out on stops at fuel control, short of extreme positions of twist-grip by approximately five degrees.

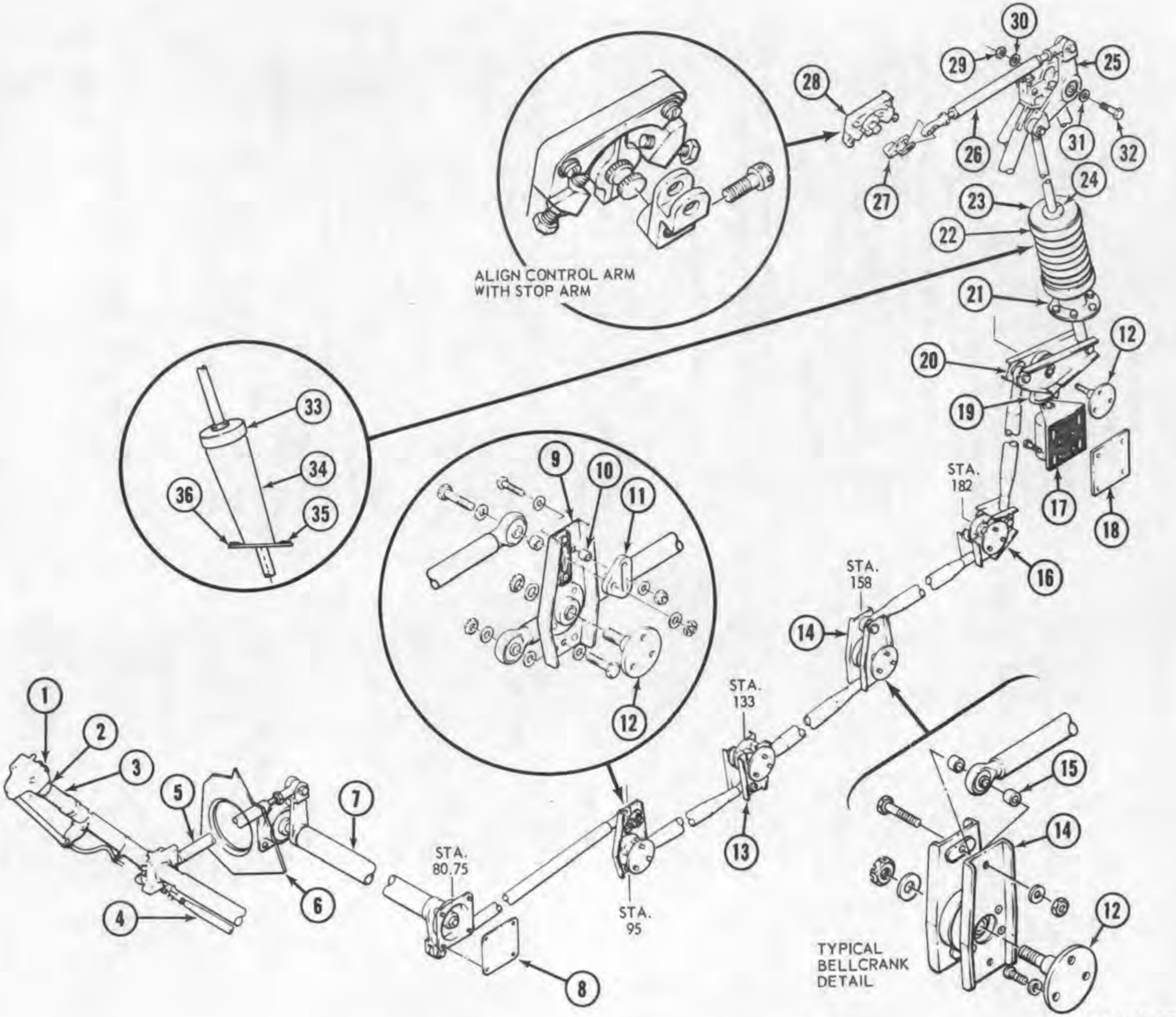


Figure 5-26. Power control lever system (Sheet 1 of 2)

1. Idle Stop Release Switch	14. Bellcrank	26. Adjustable Rod
2. Friction Adjustment	15. Spacers	27. Control Arm
3. Twist Grip Control	16. Bellcrank	28. Fuel Control Power Lever Shaft and Stops
4. Interconnect Rod	17. Solenoid and Bracket	29. Nut
5. Adjustable Rod	18. Serrated Base	30. Washer
6. Bulkhead (Station 74.25)	19. Flight Idle Stop	31. Spacer
7. Torque Tube	20. Bellcrank	32. Bolt
8. Shims	21. Housing	33. Clamp
9. Adjustable Bellcrank	22. Boot	34. Boot
10. Spacer	23. Retainer	35. Bolt
11. Serrated Plate	24. Split Bushing and Ring	36. Plate
12. Mount	25. Bellcrank on Engine Mount	
13. Bellcrank		

205060-9C

Figure 5-26. Power control lever system (Sheet 2 of 2)

NOTE

If binding occurs, recheck entire installation for correct linkage and length of control rods.

f. Adjustment — Flight Idle Stop and Release Solenoid.

(1) Check that plunger of solenoid operates freely through bracket bushing. (See figure 5-28.) If necessary, shim on four mounting screws between solenoid and bracket to obtain plunger alignment.

NOTE

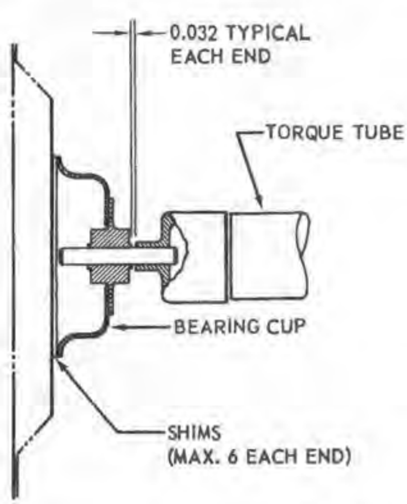
Shims are required when bracket P/N 204-060-797-1 is installed. Shims are not required when bracket P/N 204-060-797-5 is installed.

(2) Attach flight idle stop (19, figure 5-26) on extended spacer of bellcrank (20), with stop projection aft. Secure stop with two bolts and serrated washers.

(3) Position solenoid on serrated base plate to obtain 0.040 (±0.010) inch clearance between tip of plunger and surface of stop projection when solenoid is in actuated position. (See figure 5-28.) Secure by tightening four bolts, with thin aluminum washers under heads, through slotted holes in bracket into mounting pad.

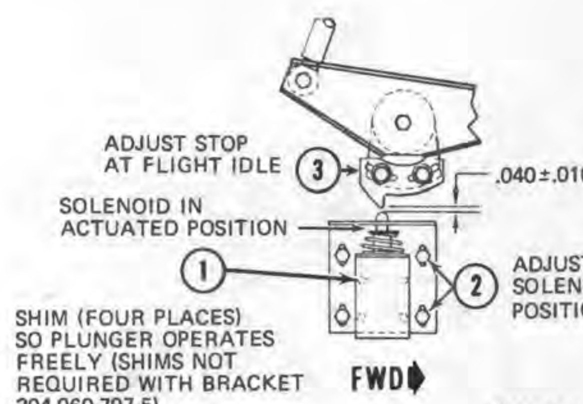
(4) Use twist-grip to position power lever shaft stop arm at 38-degree mark on fuel control quadrant. This is approximate flight idle position.

(5) Adjust stop so that projection rests against side of solenoid plunger. Tighten bolts to engage mating serration of lockwashers and stop face.



205060-11B
AV 054114

Figure 5-27. Shimming torque tube power lever control



205060-12A
AV 054115

Figure 5-28. Adjusting flight idle stop

CAUTION

Do not attempt to obtain proper flight idle speeds through adjustment of engine fuel control. Aircraft flight idle speed does not necessarily correspond to fuel control flight idle position.

(6) Check operation of flight idle stop during ground run. If necessary, readjust stop on T53-L-9 and -11 series engines to obtain 56 to 58 percent rpm indicated on the gas producer N1 tachometer. On -13 and -13A engines, adjust stop to obtain 70 to 72 percent rpm. Check release by actuating the solenoid. Recheck clearance dimension of 0.040 (±0.010) inch between top and solenoid plunger in return position.

NOTE

Check flight idle rpm by rolling the twist grip against the stop and applying friction.

(7) Inspect throttle friction lock for positive locking.

Section XI. ENGINE ANALYSIS

5-28. Turbine Engine Analysis Check.

Each engine received new or newly overhauled has, with it, a data sheet giving the N1 speed and EGT at which the engine will produce military rated power at standard day sea level conditions. This data is the standard of performance for the engine and actual performance is compared to this standard during a Turbine Engine Analysis Check (TEAC).

a. Check the engine's maximum power in flight. Increase power to maximum torque available or 48 PSI, whichever is lower. Climb, maintaining 48 PSI torque or maximum available until N11 begins to droop. At the next 1000 foot increment of pressure altitude (29.92 inches Hg on copilot's altimeter), droop N11 to 6400 and record: N1, torque, EGT, pressure altitude and OAT.

b. Correct engine data sheet performance figures for the ambient conditions recorded in the flight check as follows:

T53-L-11, Engine

(1) N1: Add three degrees centigrade to the OAT recorded. Using the appropriate check (Figure 5-29), determine the percent N1 speed correction factor for this temperature, and apply the correction to the N1 speed listed on the engine data sheet.

(2) Torque: Torque available varies with altitude and temperature. Using the pressure altitude and OAT (+3 deg C) recorded during the flight check, determine the required torque available from the torque available check (Figure 5-30).

(3) EGT: Determine the difference between OAT (+3 deg C) recorded in the flight check and standard day conditions (15 deg C). Apply this difference (plus for above 15 deg, minus for below 15 deg) to engine data sheet EGT.

EXAMPLES:

Refer to the engine data sheet, rated power is produced at standard day sea level of 98.3% N1 with an EGT at 558 deg C. The engine is topped 4000 feet pressure altitude and 20 deg C OAT.

1. Go to Figure 5-29. Enter chart at 23 deg c. (OAT +3 deg C) Speed correction factor is +0.5%.

2. 98.3% plus 0.5% = 98.8%. Result - 98.8% N1 required at 20 deg C OAT.

3. Go to torque available chart, Figure 5-30. Using 23 deg C and 4000 feet pressure altitude, read 39 PSI torque available.

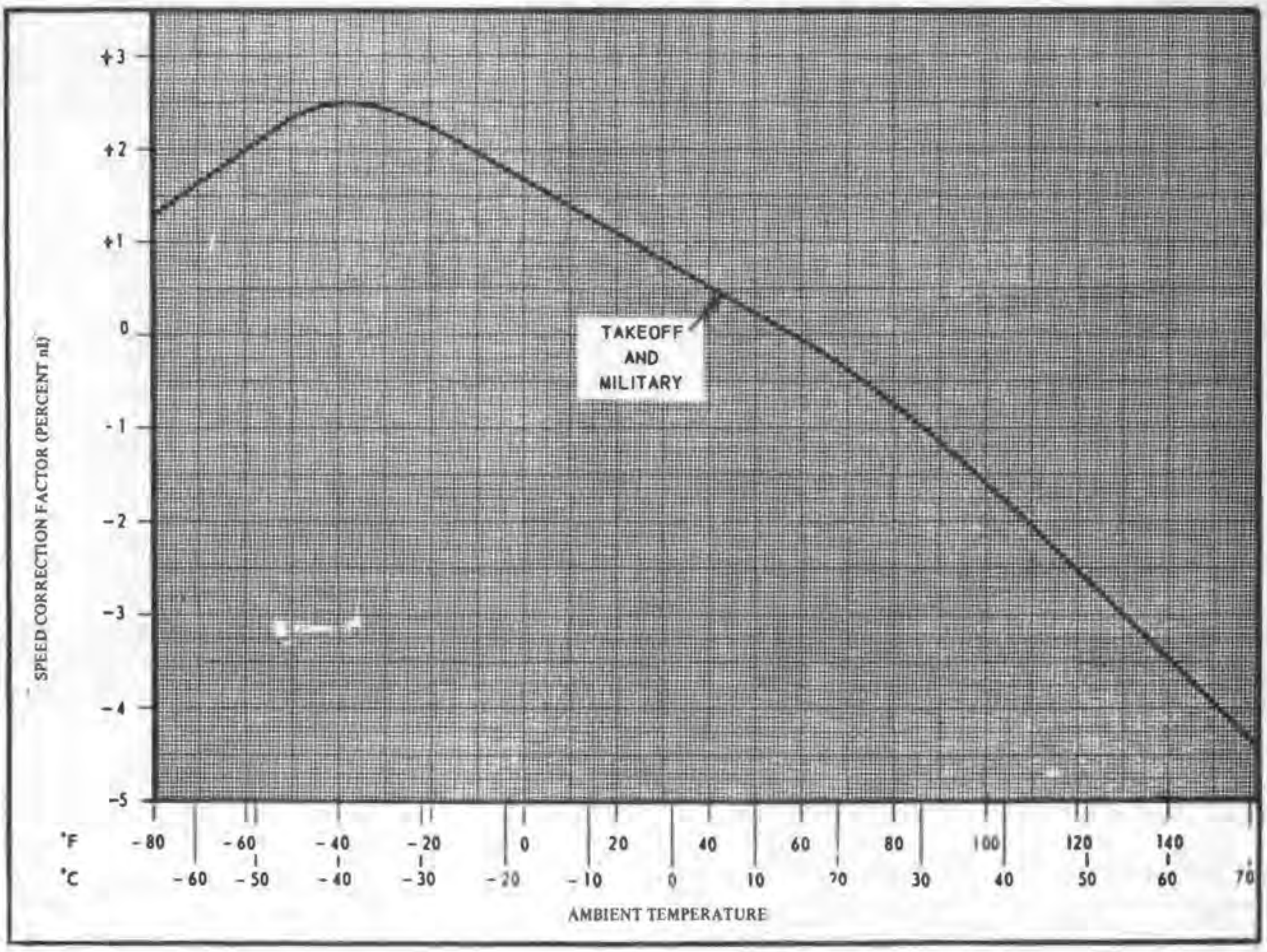
4. EGT is adjusted for 23 deg C. (OAT +3 deg C) 23 deg C is 8 deg C above standard day (15 deg C). Therefore, add 8 deg C to 558 deg C; the engine should have an EGT of 566 deg C at 20 deg C OAT.

T53-L-13, Engine

(1) N1: If the ambient/temperature at test altitude is below -20 deg C or above 30 deg C, add 0.5% to N1 speed recorded.

(2) Torque: Torque available varies with altitude and temperature. Using the pressure altitude and OAT (+3 deg C) recorded during the flight check (and data plate torque), determine the required torque available from the power adjustment chart (Figure 5-31).

(3) EGT: Determine the difference between OAT (+3 deg C) recorded in the flight check and standard day conditions (15 deg C). Apply this difference (plus for above 15 deg C, minus for below 15 deg C) to engine data sheet EGT.



AV 005057

204060-637

Figure 5-29. Deviation in regulated gas producer speed vs. ambient temperature – T53-L-11 engine

EXAMPLES:

Refer to the engine data sheet, military power is produced at standard day sea level at 97.2% N1 with an EGT of 554 deg C. The engine is topped 3000 feet pressure altitude and 26 deg C OAT. Engine data plate torque value is 61.5 PSI.

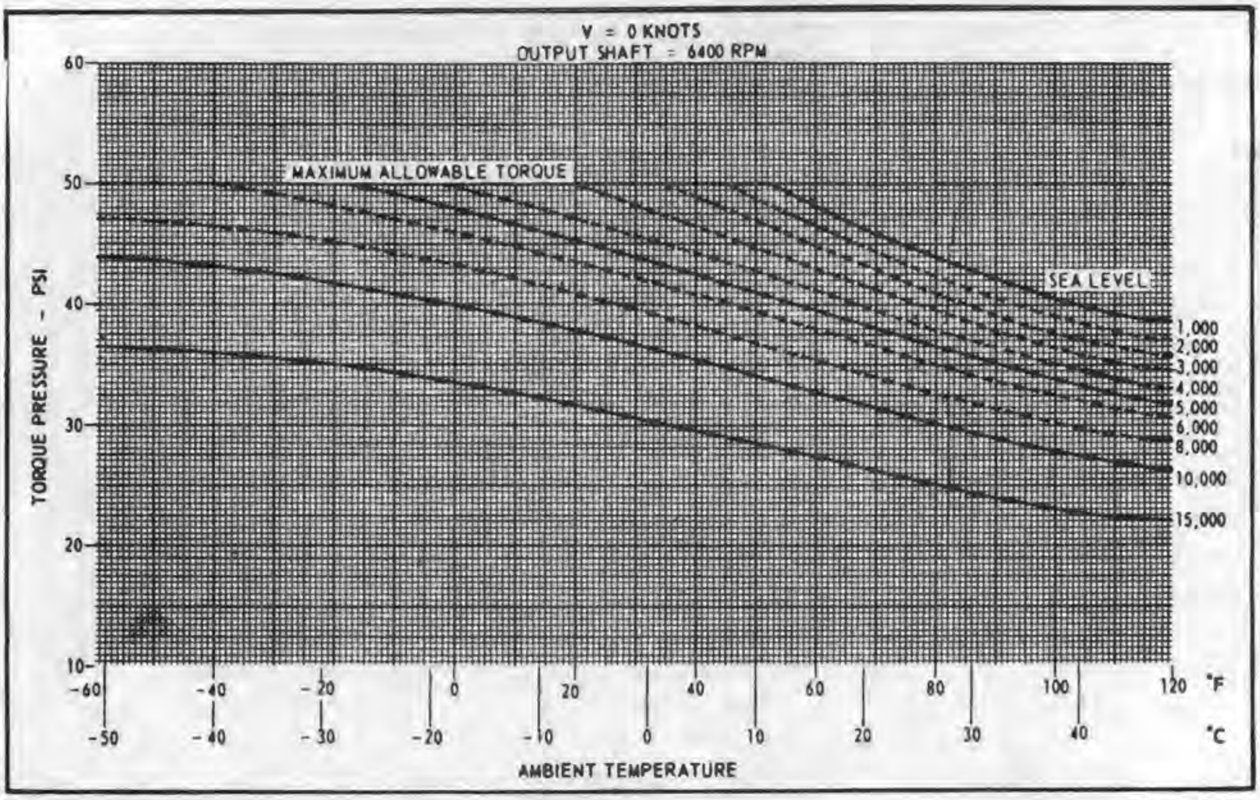
1. For 29 deg C there is no correction required for N1 speed.

2. Result: 97.2% N1 required at 26 deg C OAT.

3. Go to power adjustment chart. Using 29 deg C and 3000 feet pressure altitude and a data plate torque value of 61.5 PSI, we read 45.3 PSI torque available.

4. EGT is adjusted for 29 deg C (OAT +3 deg C). 29 deg C is 14 deg C above standard day (15 deg C). Therefore, add 14 deg C to 554, the engine should have an EGT of 568 at 26 deg C OAT.

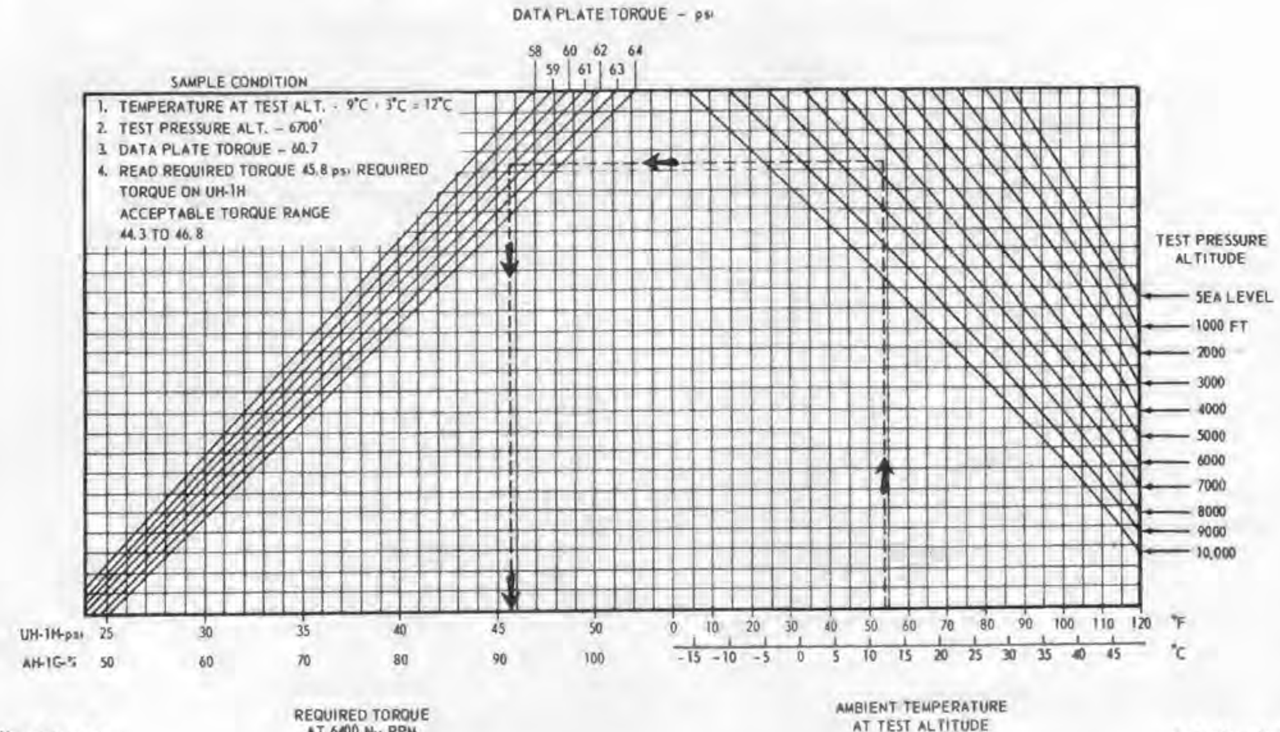
c. *Analysis of engine performance.* Compare the actual performance of the engine with the figures calculated above. The figures should agree within the following tolerances: ±0.7% N1 ±1.0 PSI torque, and ±20 deg C EGT. Generally, if two of the performance parameters are correct within tolerances. the indicating system of the third is probably bad. If, however, two parameters are off beyond allowable tolerances, possible engine trouble is indicated. A chart of possible symptons and probable cause is included below.



AV 005098

204060-635

Figure 5-30. Torque available (T53-L-11 engines)



AV 005138

204060-636

Figure 5-31. Power adjustment chart (T53-L-13 engine)

%N1	TORQUE PSIG	EXHAUST GAS TEMPERATURE	PROBABLE CAUSE
Correct (Within tolerance)	Low 2-3 PSI	High 25-45 deg	Dirty inlet and/or compressor Bleed band leaking Leaks in anti-icing or customer air FOD Erosion Damaged combustor section
Low	Low	Low	Calculation error Engine not properly topped N1 not rigged properly Fuel control take-off trim adjustment
High	High	High	Calculation error Fuel control take-off trim adjustment
Correct (Within tolerance	High 2-3 PSI	High 30-50 deg	N1 system indicating error
Correct (Within tolerance	Low 5-8 PSI	High 50-80 deg	Bleed band stuck open Severe FOD or erosion in compressor Excessively dirty inlet and/or compressor Severe damage in combustor section
Correct (Within tolerance)	Low 2-3 PSI	High 50-80 deg	Anti-icing valve open Damaged combustor section EGT indicating system Combustor chamber drain valve open
Correct (Within tolerance)	Low	Correct (Within tolerance)	Low torque boost pump pressure Torquemeter valve clearance Torquemeter sealing ring broken or damaged VIGV'S set at wrong angle when full open (L-13)

NOTE

Trimming adjustments have approximately the following effect in a good engine: T53-L-11, 1% N1 = 2 PSI torque, = 15 deg C EGT; T55-L-13, 1% N1 = 4 PSI torque, = 15 deg c EGT.

5-29. Daily Engine Performance.

Daily recordings of engine performance will be made by aviators in accordance with Chapter 3. Recordings will be analyzed by maintenance personnel as follows:

a. The initial DER will be obtained during a maintenance test flight. Successive recordings will be compared to previous valid DER's.

b. Determine the difference between Block 10-C of DA Form 2408-13 and 15 deg C (standard day OAT). Then adjust EGT accordingly (1 deg C change in OAT results in approximately a 1 deg C change in EGT). Adjust N1 speed (15 deg C change in OAT accounts for a 1% change in N1 speed).

c. Any change in EGT of more than 20 deg C or of N1 speed in excess of 7% which cannot be accounted for by a change in OAT may be considered a significant change which would indicate a potential engine problem.

EXAMPLES:

From Block 10-C of DA Form 2408-13

OAT	–	20 deg C
N1	–	90.2%
EGT	–	480 deg C

Then - 20 deg C - 15 deg C = 5 deg C

so adjusted EGT is determined -

480 deg C - 5 deg C = 475 deg C

and adjusted N1 speed is determined -5 deg C/15 deg C - 0.33

0.33 x 1% = 0.33%

90.2% +0.33% = 90.53%

or, if Block 10-C shows

OAT	–	12 deg C
N1	–	89.8%
EGT	–	465 deg C

then - 15 deg C - 12 deg C = 3 deg C

so adjusted EGT is determined -

465 deg C + 3 deg C = 468 deg C

and adjusted N1 speed is determined - 3 deg C/15 deg C = 0.2

0.2 x 1% = 0.2%

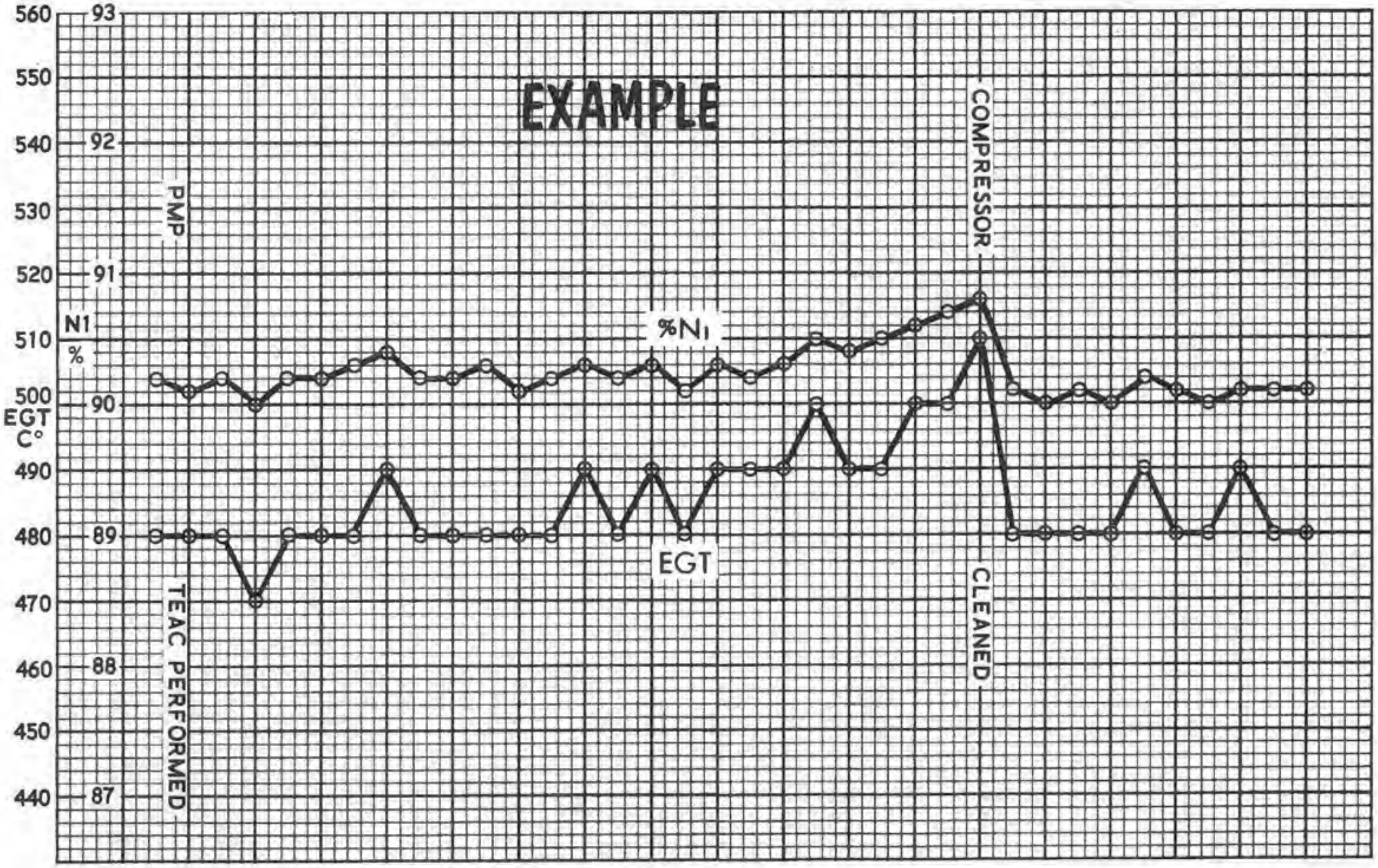
89.8% + 0.2 = 90.0%

d. A sheet of standard graph paper (FSN 7530-286-6918) will be utilized to plot adjusted DER data and will show all checks made since the last PMP. This chart will permit the observation gradual performance deterioration, should it occur (experience has shown that such gradual changes may indicate circumferential cracks in nozzles or other progressive type failures). This chart will be kept attached to the DA Form 2408-15 for each engine. A sample chart is shown as figure 5-32.

e. If a shaft occurs in adjusted EGT is excess of 20 deg C, or in adjusted N1 speed in excess of 0.7%, perform a visual inspection of the engine for possible causes (dirty inlet and compressor, erosion, FOD, indications of over-temperature operation). If the cause cannot be determined, perform a Turbine Engine Analysis Check (TEAC)

NOTE

It is recommended that the instructions for DER be typed on a 3 x 5 card and inserted in the outside pocket of DA Form 2408 binder. This gives all pilots easy access to the correct procedure as DER is performed by pilots in conjunction with normal missions.



204060-638
AV 089112

Figure 5-32. Daily engine data chart

CHAPTER 6

HYDRAULIC AND PNEUMATIC SYSTEMS

Section I. INTRODUCTION

6-1. General.

The purpose of this chapter is to provide the essential information for maintenance personnel to accomplish organizational maintenance on the hydraulic system.

Section II. HYDRAULIC SYSTEM

6-2. Hydraulic System.

a. Hydraulic System Installation.

(1) The flight control hydraulic system provides power to operate flight control power cylinders. On UH-1D/H a gravity feed reservoir is used. The basic system includes a variable delivery axial-piston pump, reservoir, filter, relief valve, solenoid valve, directional flow check valves, servo valves, irreversible valves, power cylinders, pressure switch, low pressure caution light, couplings for connection of a ground test stand and connecting lines and a control switch located on the pedestal. (See figure 6-1.)

(2) The pump is located on the transmission sump case and is accessible through a removable panel on right side of pylon island. Access to the gravity feed reservoir is by opening transmission fairing on cabin roof. The ground test stand couplings are located in the engine compartment on the right side.

NOTE

Adjust test stand pressure to 1175 psig for UH-1D/H.

(3) Additional equipment for helicopters with provisions for external stores includes a solenoid valve in the pressure line, a filter and check valve in the return line, and couplings with quick-disconnect fittings for connection of external stores and aramament. The components are located in the pylon aft of the basic system equipment. The external stores couplings are located on the right and left sides of the fuselage just above the landing skid attachment points.

b. Operation – Hydraulic System.

(1) System pressure of 950 to 1000 psig is produced by the variable delivery, pressure compensated pump mounted on the main transmission and driven at 0.65 engine drive shaft speed. Fluid is drawn from the reservoir by the hydraulic pump and pumped to the system through a check valve and a filter to a normally-open, solenoid-operated system shutoff valve. When the HYD CONTROL switch is ON, this valve is open and system pressure is supplied to all four of the flight control power cylinders. Each power cylinder assembly includes a servo valve which is mechanically controlled by the flight control linkages. When the linkage moves any servo valve control lever down, the cylinder retracts and vice versa. When the lever is centered, system pressure is applied equally to both sides of the cylinder piston but the system return port is shut off and cylinder does not move in either direction. Irreversible valves are provided for each main rotor power cylinder to prevent feedback. When system pressure drops to approximately 500 psi, a spring loaded sequence valve in the irreversible valve closes and blocks both the system pressure and system return ports trapping fluid under 500 psi in the power cylinder servo valve and irreversible valve. Each irreversible valve incorporates a check valve to isolate surge pressures produced in the power cylinders from the system pressure lines. A differential relief valve opens automatically to relieve pressures in excess of 500 psi differential. The irreversible valves also incorporate another feature which allows the power cylinders to be operated manually. The same function is performed by the check valve which interconnects the system pressure line to the system return line adjacent to the tail rotor power cylinder. When no system pressure is available and the power cylinders are operated manually, fluid flows directly through the irreversible valve or the tail rotor check valve from the cylinder return port to the cylinder pressure port. Hence the cylinder pumps fluid from one side of the piston to the other without attempting to pump fluid through the entire system. The pressurized reservoir hydraulic system is no longer approved for use on UH-1D/H helicopters.

(2) A line-mounted pressure switch is provided in the system pressure line to sense the system pressure. The switch closes a circuit to the caution panel when the system pressure drops below 500 psig and causes the HYD

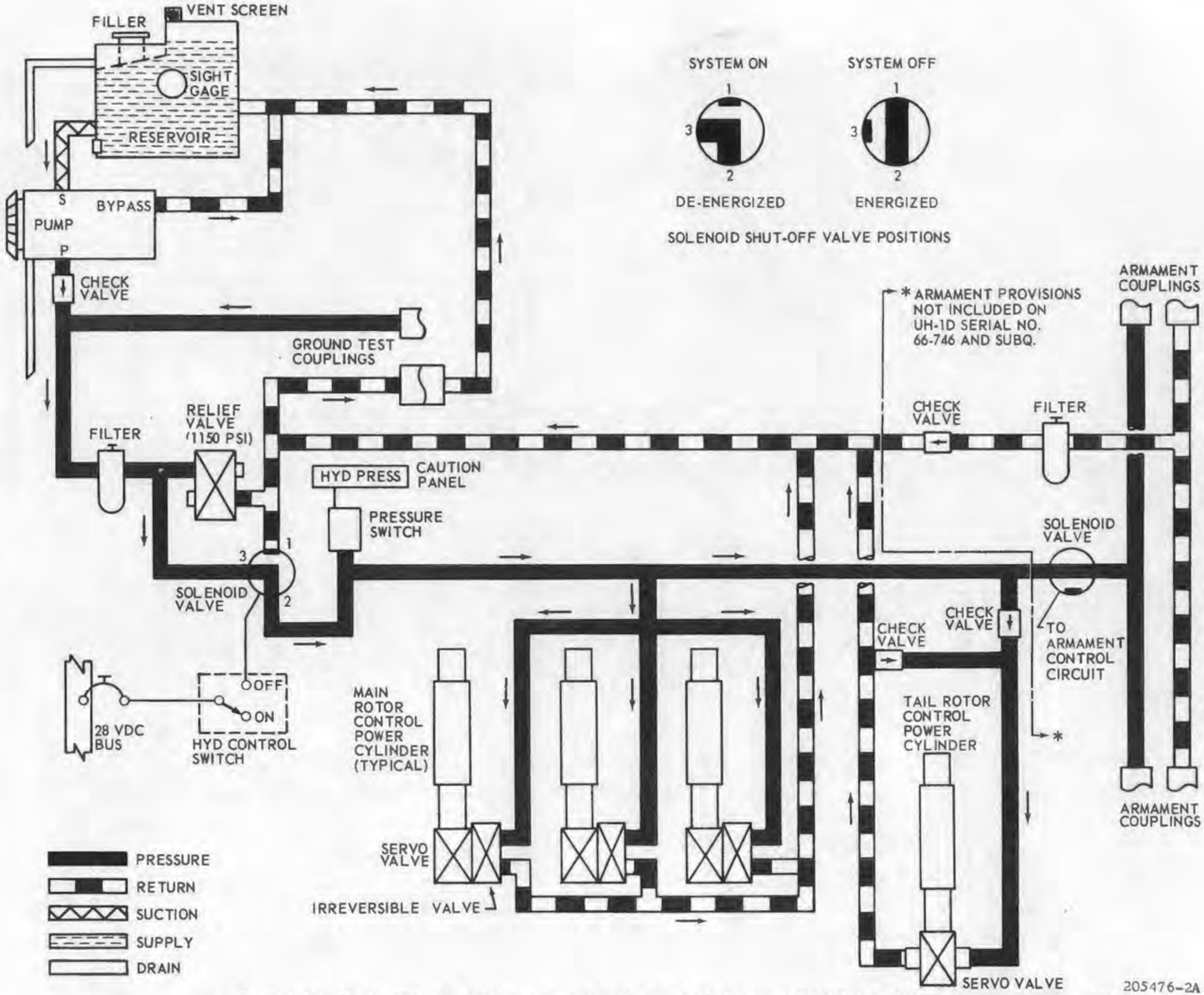


Figure 6-1. Flight controls hydraulic system with gravity feed reservoir (Sheet 1 of 3)

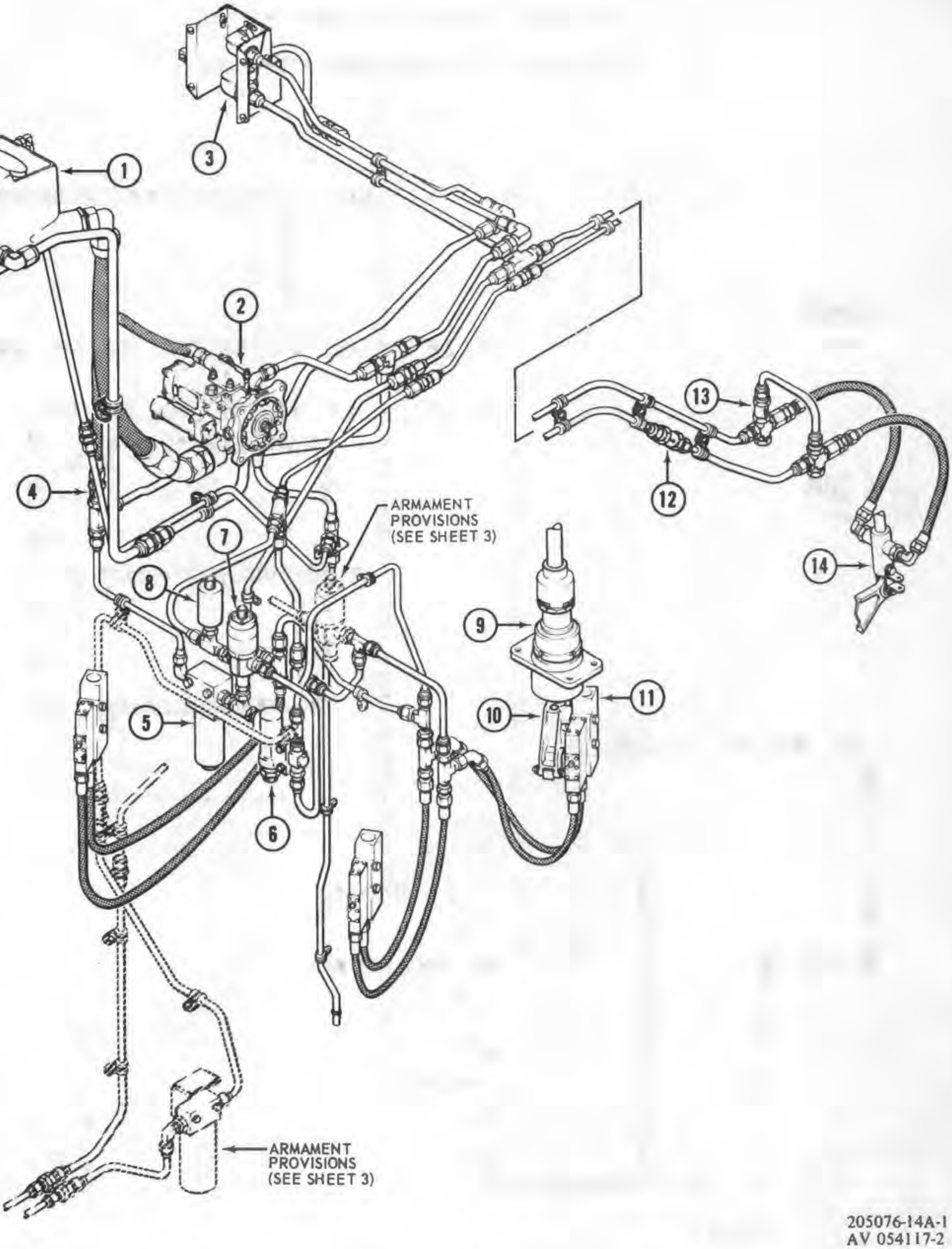
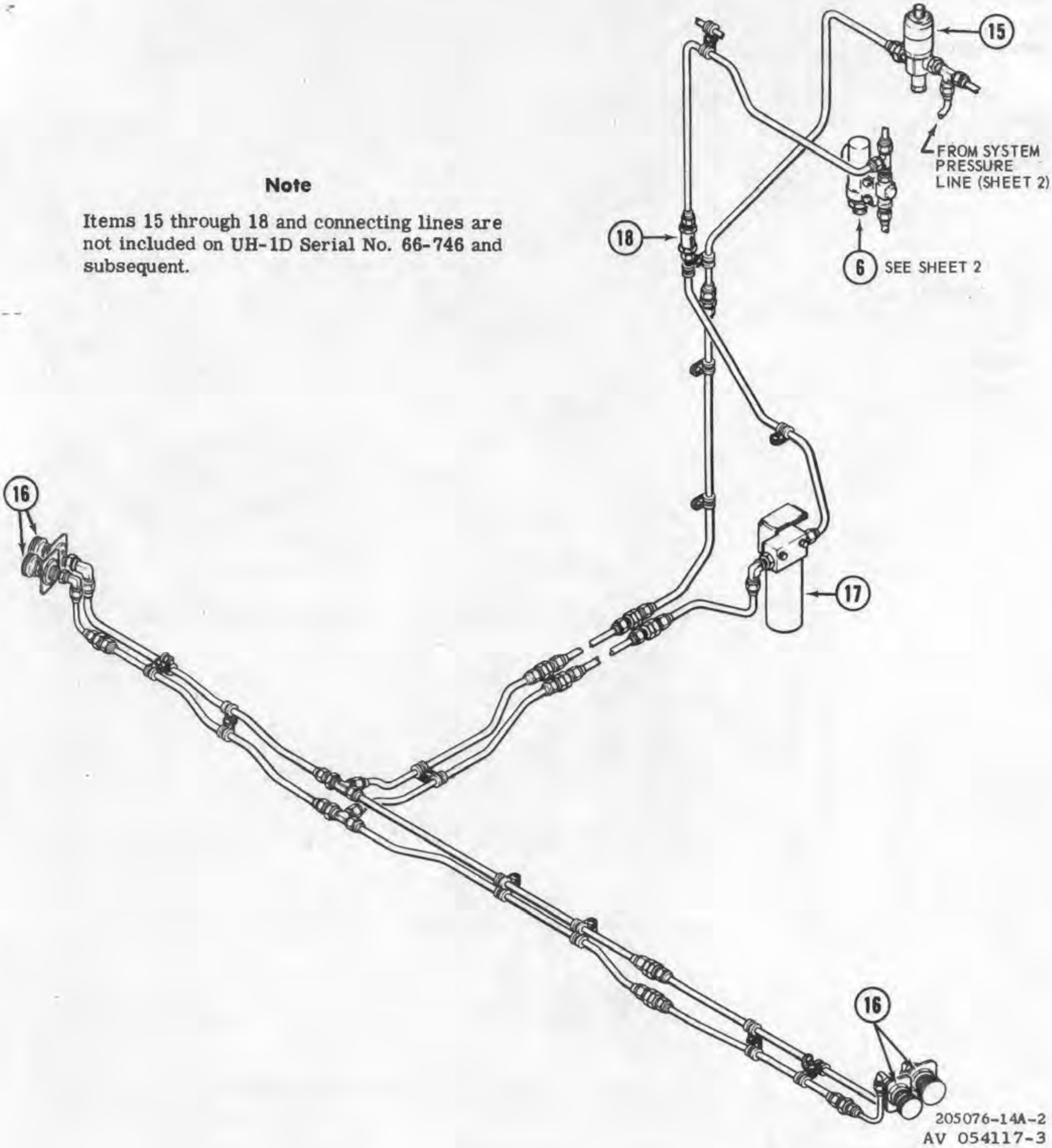


Figure 6-1. Flight controls hydraulic system with gravity feed reservoir typical (Sheet 2 of 3)

Note

Items 15 through 18 and connecting lines are not included on UH-1D Serial No. 66-746 and subsequent.



1. Reservoir
2. Pump
3. Test Couplings
4. Check Valve
5. Filter
6. Relief Valve
7. Solenoid Valve
8. Pressure Switch
9. Power Cylinder (Typical 3 Places)
10. Servo Control Valve
11. Irreversible Valve
12. Check Valve
13. Check Valve
14. Tail Rotor Cylinder Valve
15. Armament Shut-off Solenoid Valve
16. Couplings for External Armament
17. Armament Line Filter
18. Check Valve

Figure 6-1. Flight controls hydraulic system with gravity feed reservoir (Sheet 3 of 3)

PRESSURE caution light and the master caution light to be illuminated. When pressure is increasing, the switch should open at 800 psig minimum.

(3) 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.

c. Troubleshooting – Hydraulic System. Indications, probable causes, and corrective action for trouble in the hydraulic system are as follows:

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Rotor tends to turn when operating with ground test hydraulic stand (On YUH-1D and UH-1D/H 60-6028 through 64-13901 only)	Check valve in pressure line of pump not seating or installed backward	Replace check valve or remove and replace with correct flow direction
Pump noisy	Pump case drain incorrectly installed on bottom of pump, causing air entrapment.	Install properly. Refer to paragraph 6-4, step b.
Excessive feedback to controls	Air in system	Bleed system
	Rotor not properly adjusted	Track and adjust rotor
	Loose cylinder support bearing retaining nut or loose bushing set adjustment nut	Check torque on cyclic and collective cylinder support retaining nuts
		Check adjustment on cyclic and collective cylinder bushing set adjustment nut
	Internal leakage in irreversible valve	Replace irreversible valve
	Loose or worn hydraulic cylinder bearing housing mounting studs	Tighten nuts and/or replace mounting studs
Cyclic/collective cylinder binds or does not operate smoothly	Excessively tight cylinder support bushing set adjustment nut	Lubricate cylinder support bearing, or adjust retainer nut
	Servo valve requires more than 12 ounce force to operate	Rod end bearing too tight. Replace cylinder assembly
Collective control stick will not stay in position	Friction adjusted too low on collective stick	Adjust friction
Tail rotor feedback in pedals	Tail rotor servo mounting bearing loose or worn	Replace bearing
High frequency vibration or chatter	Damper bearing in bellcrank to tail rotor quadrant worn or deteriorated	Replace bearing

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Hydraulic system too hot	Broken line	Repair line and replace pump
	Pump delivers excessive pressure	Replace pump
	Relief valve stuck open	Replace valve and pump
	Pump case drain incorrectly installed	Install properly. Refer to paragraph 6-4, step b.
	Check valve in irreversible valve sticking open	Replace irreversible valve and pump
HYD CONTROL switch	Defective switch	Replace switch
Inoperative	Faulty connections	Repair connections
	Defective wiring	Replace wiring
	Defective solenoid valve	Replace solenoid valve
	No hydraulic pressure	Refer to caution panel worded segment "HYD PRESSURE" lighted indication of trouble
Caution panel worded segment HYD PRESSURE illuminated	Caution light system malfunction	Perform operational check of hydraulic pressure lights. Refer to Chapter 12.
	Hydraulic pump failure	Replace hydraulic pump

d. Testing Hydraulic System With Ground Test Stand. A portable hydraulic test stand can be used to provide pressure to test or bleed the hydraulic system without operation of the helicopter engine. Prior to use, the test stand shall be thoroughly clean and serviced with hydraulic fluid (item 4, table 1-2). The stand shall be equipped with a 10-micron filter and a calibrated pressure gage with a capacity of 1500 psig. The stand shall be capable of producing pressure to 1500 psig and have a minimum flow rate of 6 gallons per minute.

e. Preparation for Test.

(1) Position ground test stand by right-hand side of engine compartment.

(2) Open right side engine cowling, remove cap and break disconnect at ground test couplings located on a bracket at forward firewall of engine compartment. (Use portable hydraulic test reservoir.)

(3) Cover end of removed hose to prevent entrance of foreign matter.

(4) Connect test stand hoses.

(5) Apply electrical power to helicopter.

(6) Position HYD CONTROL switch to ON.

NOTE

A complete visual inspection of the hydraulic system shall be accomplished before the functional test is performed to insure that all components and lines are attached, secure, and appear capable of satisfactory operations.

f. Bleeding Hydraulic System Using Ground Test Stand.

(1) Decrease test stand pressure to 1000 psig.

(2) Cycle tail rotor pedals and cyclic and collective controls a full stroke a minimum of 10 times to bleed air from system.

(3) Fill reservoir to overflow with hydraulic fluid, (item 4, table 1-2).

NOTE

The above procedure allows a possibility of air remaining in the system. The gravity feed system is selfbleeding. Therefore, before flight, the system must be bled by cycling tail rotor pedals and cyclic and collective controls a full stroke a minimum of 10 times with main rotor turning at flight idle. Refill reservoir.

g. Flushing Hydraulic System.

(1) The complete system must be thoroughly cleaned.

(2) Fill the helicopter reservoir to capacity and keep filled during system flushing.

(3) Disconnect hoses from irreversible valves and from tail rotor control boost cylinders. Connect hoses together using MS219196D5-4 reducers. Remove screens from pressure port of irreversible valves, clean with solvents, air dry and reinstall. Cap ports to boost cylinder valves to prevent entry of dirt.

(4) Remove filter element from filter assembly.

(5) Connect hydraulic test stand hoses to inlet and outlet test fittings on the helicopter.

(6) Inspect the complete hydraulic system for attachment and security of components.

(7) Set test stand pressure to 1175 psig and flush for five minutes to clean the system.

(8) Throughout the operation observe all portions of the system for evidence of external leakage.

(9) Shut down test stand and connect hoses to the irreversible valves and cylinders.

(10) Replace filter element.

(11) Bleed system in accordance with paragraph 6-2, step g or step f.

h. Functional Tet of Hydraulic System With Ground Test Stand.

(1) Apply 1050 psig pressure to system and maintain for at least 15 minutes; meanwhile make following checks.

(a) Leakage: Observe all portions of system for external leakage. Repair as necessary.

(b) Clearance: Slowly cycle all controls to limits of stroke and observe movement of hydraulic servo cylinders. Clearances of all moving parts should be such that no fouling can occur. Check flexible connections carefully to be sure chafing or pinching of hoses does not occur, and that vibration does not loosen attaching fittings.

(2) Check operation of HYD PRESSURE caution panel light.

(a) Slowly decrease test stand pressure. Light should illuminate when pressure reaches 600 to 400 psig.

(b) Slowly increase pressure. Caution panel light should extinguish when pressure reaches 700 to 900 psig.

(3) With system pressure at 1050 psig, place HYD CONTROL switch to OFF to test operation of solenoid valve. Actuate cyclic, collective, and tail rotor controls. Caution panel light should illuminate, and more force should be required to operate controls if valve closed properly to shut off hydraulic power assistance.

(4) Check operation of pressure relief valve in hydraulic system. While operating pressure is slowly increased, place hand on relief valve to determine when it opens. Valve should open between 1100 and 1200 psig.

(5) Check operation of each irreversible valve.

(a) Slowly increase hydraulic pressure until it can be determined that control systems are functioning with hydraulic power. Changeover from mechanical to hydraulic operation should occur at 500 psig minimum.

(b) Reduce pressure to zero.

(c) Check for irreversibility by moving each servo valve control lever to up (extend) or down (retract), then apply approximately 100 pounds force to the power cylinder extension tube and try to move cylinder in direction opposite to servo valve position. Cylinder should not move.

(d) After pressure has been reduced to zero for 3 minutes, examine irreversible valve and servo valve on each cylinder for evidence of leakage.

(6) When test is complete, refill and bleed system as necessary.

(7) Disconnect test stand from ground test coupling.

(8) Attach return line from reservoir to ground test coupling.

WARNING

The above 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 full stroke a minimum of 10 times with main rotor turning at flight idle.

i. Testing Hydraulic System With Transmission-Driven Pump. When a ground test stand is not available, the transmission-driven hydraulic pump can be used to perform operational checks and to bleed the hydraulic system. Operation of the engine shall be performed in accordance with instructions contained in TM 55-1520-210-10.

j. Operational Check – Hydraulic System.

(1) Start and ground-run the helicopter.

NOTE

Ensure the hydraulic system has been bled and filled.

(2) Increase engine rpm until flight-idle speed is reached. Maintain flight idle speed for at least 15 minutes.

(3) While speed is maintained, place HYD CONTROL switch to ON and make the following checks:

(a) Observe all hydraulic fittings and components for evidence of external leakage.

(b) Repair or replace components and fittings as necessary to correct leakage.

(c) Slowly cycle all controls to limits of stroke and observe movement of hydraulic servo cylinders. No fouling should occur.

(d) Check flexible hoses and connections to ensure that pinching and chafing of hoses does not occur.

(e) Place HYD CONTROL switch to OFF. Solenoid valve should energize and close. Caution panel HYD PRESSURE light should illuminate, and more force should be required to operate the controls.

(4) Refill and bleed system as necessary.

k. Bleeding Hydraulic System Using Transmission-Driven Pump.

(1) Cycle tail rotor pedals and cyclic and collective controls a full stroke a minimum of 10 times with main rotor turning at flight idle.

(2) Fill reservoir to overflow with hydraulic fluid (item 4, table 1-2).

l. Pressure Test – Hydraulic System – Gravity Feed Reservoir System.

NOTE

When troubleshooting requires a more complete test of hydraulic system pressure than can be accomplished without pressure gages, calibrated gages can be used as follows:

(1) Connect a gage with 0 to 1500 psig range at pressure ground test coupling.

(2) Operate helicopter at flight idle. (Refer to paragraph 6-2, step i.) Hold all controls at fixed positions and check test gages.

(3) Test gage on pressure ground test coupling should indicate 980 to 1080 psi.

(4) When test is completed, remove gage from ground test coupling and install cap.

WARNING

The above procedure allows the possibility of air becoming entrapped 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 full stroke a minimum of 10 times with main rotor turning at flight idle.

6-3. Hydraulic Pump.

The hydraulic system pump (2, figure 6-1) is a variable-delivery axial-piston type, mounted on a geared drive pad at right side of transmission accessory drive and sump case. Pump has four connections: suction, pressure outlet, pump lubrication, and seepage drain.

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

a. Removal – Hydraulic Pump.

(1) Open access panels at right side and front of pylon island. Provide suitable container to catch hydraulic fluid.

(2) Drain reservoir.

(3) Disconnect four hoses from pump. Cap or cover ends of hoses and pump fittings.

(4) Remove four nuts which secure pump mounting flange on drive pad studs. Working through cargo sling compartment, pull pump free of drive pad and remove from helicopter.

b. Installation – Hydraulic Pump.

NOTE

Prior to installing pump, lubricate shaft splines with anti-sieze compound (item 202, table 1-2), or grease (items 7 or 18, table 1-2.)

NOTE

When preparing replacement pump for installation ensure that all tubing and fittings are clean and that connecting hoses are not frayed or cracked. Refer to table 6-1.

NOTE

Inherent noise of the newer pump (PV3-044-8) is considerably greater than the older yoke type. The noise does not indicate a pump malfunction, but is characteristic of the design.

(1) Remove case drain plug from pump, and drain shipping fluid.

(2) Install case drain plug. Refill pump with clean hydraulic fluid (item 4, table 1-2).

(3) Position gasket and pump on studs of drive pad on right side of transmission sump case, engaging pump shaft in splined gearshaft. Install four nuts with washers on mounting studs.

(4) Connect pressure line to outlet fitting at top of pump, suction line to inlet fitting at lower front of pump, pump case drain line to top fitting, and seal drain line to inboard fitting at underside of pump.

(5) Refill hydraulic reservoir to normal level.

(6) On gravity feed system, locate and remove placarded plug from top of pump piston chamber. Trapped air will be expelled from piston chamber when hydraulic fluid drains from plug port. At this point, replace plug,

Table 6-1. UH–1D/H Hydraulic Pump Installation Data

	Pump Line Locations			
Pump	Case Drain	Seal Drain	Pressure Line	Pump Inlet
AA60321R	Top	Bottom-Inboard	****Top-Outboard	***Bottom-right
AA60321RA	Top	Bottom-Inboard	****Top-Outboard	***Bottom-right
AA65321RA	Top	Bottom-Inboard	****Top-Outboard	***Bottom-right
PV3-044-8	Top	Bottom-Inboard	Top-Outboard	Bottom
AP2U-77	Top	Bottom-Inboard	Top-Outboard	Bottom
57049	**Top	*Bottom-Inboard	Top-Outboard	Bottom

* Connect to inlet marked UH-1D.

** Connect to case drain marked UH-1B.

*** Remove pump inlet fitting from pump and reinstall fitting facing to the right when required.

**** Assemble an MS 21916-D/6-12 reducer and an MS 28778-12 preformed packing in pressure line before installation in helicopter.

torque and lockwire. Refill hydraulic reservoir to normal level.

NOTE

With pump installed, placarded plug is located on top, left-hand, outboard portion of piston chamber.

(7) Test and bleed system.

6-4. Hydraulic Filter. (AN6235-2A)

The hydraulic system line filter (5, figure 6-1) used on YUH-1D and UH-1D/H, Serial No. 60-6028 through 68-15778, helicopters is a standard type located behind access panel at front of pylon island.

NOTE

Replace filters (AN6235-2A) at every Periodic Inspection. If indicator type filter is installed, refer to paragraphs 6-5.

a. Removal – Hydraulic Filter Housing.

(1) Turn battery switch to "OFF" position and disconnect external power.

(2) Disconnect hydraulic lines from filter and cap openings.

(3) Remove nuts, washers, and bolts holding filter to mounting bracket, and lift filter from helicopter.

b. Installation – Hydraulic Filter Housing.

(1) Position filter on mounting bracket and install mounting bolts, washers and nuts.

(2) Connect hydraulic lines to filter. Bleed hydraulic system. (Refer to paragraph 6-2, step f.)

c. Removal – Hydraulic Filter Element. Remove lockwire and screw body from filter head. Remove filter element.

d. Installation – Hydraulic Filter Element. Position filter element in body with new packing in place. Screw body in filter head and secure with lockwire.

6-5. Hydraulic Filter. (205-076-034-3)

The hydraulic system line filter (5, figure 6-1) used on UH-1H, Serial No. 68-16050 and subsequent, helicopters is located behind an access panel on the front of the pylon structure. It has a filtering capability of at least 15 micron absolute. A red indicator is raised when the differential pressure across the element exceeds 70 ±10 psi. The indicator will not actuate below 35°F (3°C) ±15°F fluid temperature. The indicator button is visible through a window in the pylon structure.

a. Removal – Hydraulic Filter.

(1) Turn battery switch to "OFF" position and disconnect external power.

(2) Disconnect hydraulic lines from filter and cap openings.

(3) Remove nuts, washers and bolts holding filter to mounting bracket and lift filter from helicopter.

(4) Cut lockwire and unscrew body from filter head. Remove filter element.

b. Inspection – Hydraulic Filter. Inspect filter daily for appearance of red indicator button.

c. Repair or Replacement – Hydraulic Filter.

(1) The hydraulic oil filter element will be a condition component, to be removed, inspected, and if serviceable, reinstalled every 10th Periodic Inspection.

NOTE

The filter element will be unserviceable if any of the following is present: cracks, tears, separation, deterioration, corrosion, crushed or collapsed.

(2) This filter element P/N 205-076-034-3 is to be used until the 10th Periodic Inspection is due or until the red indicator button extends at which time remove filter element, inspect, and if serviceable reinstall. Reset the button; operate the hydraulic system until normal operating temperature is obtained. If the red indicator button extends again, the filter element will be considered unserviceable and will be removed and replaced.

d. Installation – Hydraulic Filter.

(1) Position filter element and new packing in filter body and screw body into filter head. Secure with lockwire.

(2) Position filter on mounting bracket and install mounting bolts, washers and nuts.

(3) Uncap openings and connect hydraulic lines to filter. Bleed hydraulic system. (Refer to paragraph 6-2, step f.)

6-6. Hydraulic Reservoir.

The gravity feed hydraulic reservoir (figure 6-2) is mounted on the cabin roof, under the right side of

1. Reservoir
2. Packing
3. Ring
4. Nut
5. Elbow
6. Tube
7. Packing
8. Plug
9. Hose
10. Union
11. Packing
12. Tube
13. Baffle
14. Screen

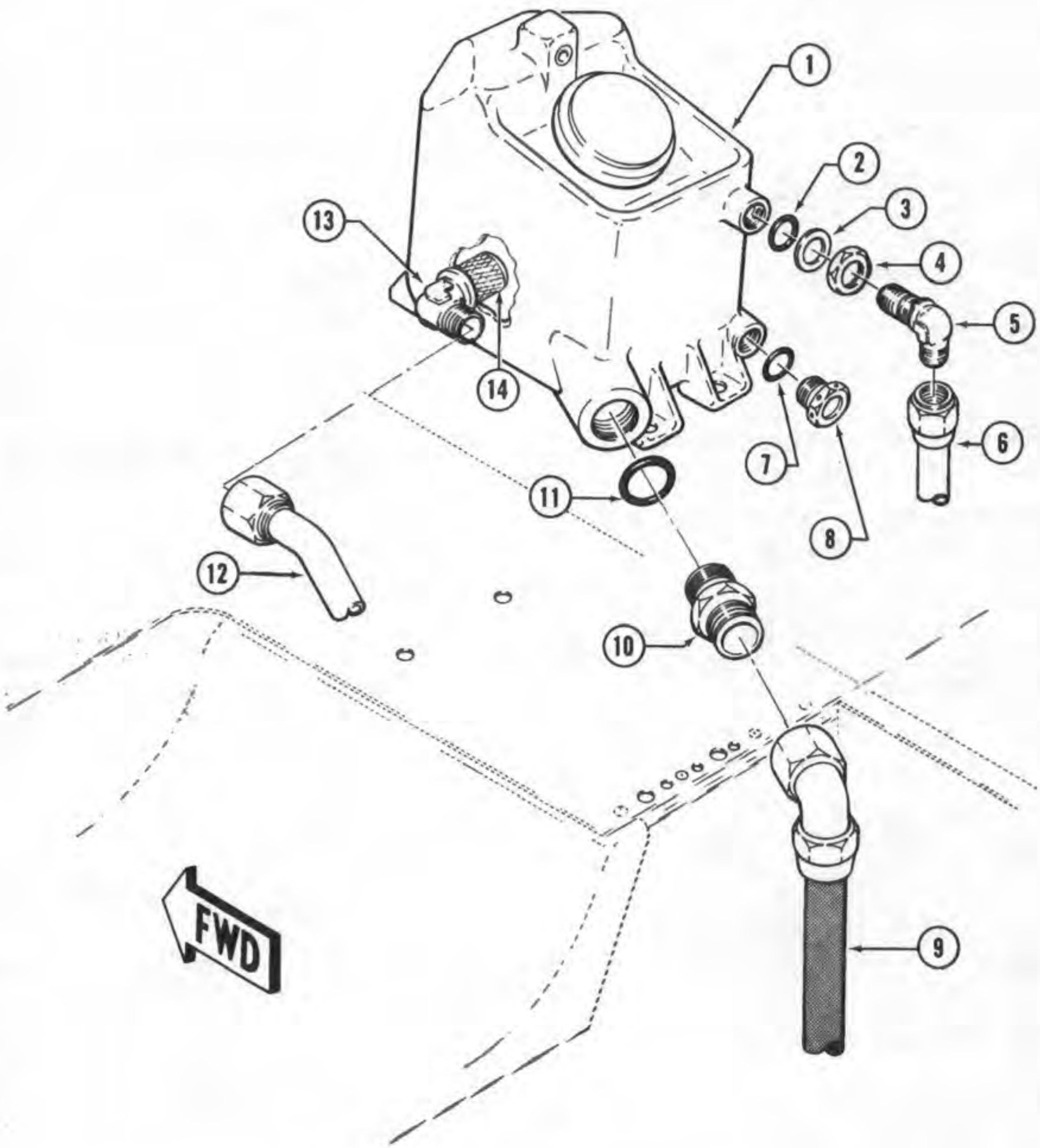


Figure 6-2. Hydraulic reservoir UH-1D/H

transmission fairing. The reservoir has a filler cap, a filler screen, an internal baffle, a fluid level sight gage plug, a vent screen, an overflow scupper, a drain plug, and connections for suction, return, and pump bypass lines.

a. Removal – Hydraulic Reservoir.

(1) Open transmission fairing for access.

(2) Remove lockwire and drain plug with packing. Drain reservoir, using a suitable container.

(3) Disconnect suction, return, bypass and scupper drain lines from reservoir fittings. Cap or cover open lines and fittings.

(4) Detach reservoir from cabin roof by removing four bolts.

b. Cleaning – Hydraulic Reservoir. Thoroughly flush interior of reservoir with hydraulic fluid (item 4 or 11, table 1-2).

c. Inspection – Hydraulic Reservoir.

(1) Inspect reservoir body, filler cap, sight gage plug and all fittings for damage.

(2) Inspect filler cap screen and vent screen for rust, corrosion, cleanliness, cuts, and breaks. Clean screens with solvent (item 302, table 1-2) and brush. Air dry.

(3) Inspect system for leaks and drain plugs and filler cap for proper locking and safetying. Inspect drain lines for obstructions.

(4) Inspect sight gage for crack and discoloration.

(5) Inspect lines, fittings and valves for cracks, dents, leaks, corrosion and loose, missing or improperly installed hardware.

(6) Inspect quick disconnect fittings for proper locking and lock spring for cracks and distortion.

(7) Drain small quantity of hydraulic fluid from bottom of reservoir and inspect for contaminants. If contaminants are evident, flush system. (Refer to paragraphs 6-2, step f.)

d. Repair or Replacement – Hydraulic Reservoir. Replace any damaged or unserviceable parts and fittings.

e. Installation – Hydraulic Reservoir.

(1) Position reservoir, with filler cap and drain plug facing aft, over four mounting holes on cabin roof just forward and to right of main transmission. Secure two forward mounting lugs with bolts threaded into plate nuts in roof structure. Secure two aft lugs to holes in edge of roof with bolts, washers, and nuts.

(2) Connect lines to suction, bypass, return, and scupper drain fittings of reservoir.

(3) Check that drain plug is properly installed. Lockwire plug to aft outboard reservoir mounting bolt head.

(4) Fill reservoir to overflow with hydraulic fluid (item 4, table 1-2).

(5) Bleed hydraulic system. (Refer to paragraph 6-2, step e. or step f.)

6-7. Collective Pitch Control Hydraulic Cylinder.

A hydraulic cylinder is used in conjunction with an irreversible valve to reduce feed back forces and assist collective pitch control of the main rotor. A protective boot is installed on the cylinder assembly.

a. Removal – Collective Pitch Control Hydraulic Cylinder.

(1) Disconnect control tube (6, figure 6-3) from servo valve lever of power cylinder (4).

(2) Disconnect tube (2) of cylinder assembly from trunnion collective lever on swashplate support.

(3) Unscrew two bolts attaching irreversible valve to servo valve, and remove irreversible valve with bolts in place. Cover open ports.

NOTE

Unnecessary loss of hydraulic fluid is prevented by allowing lines to remain attached to irreversible valve.

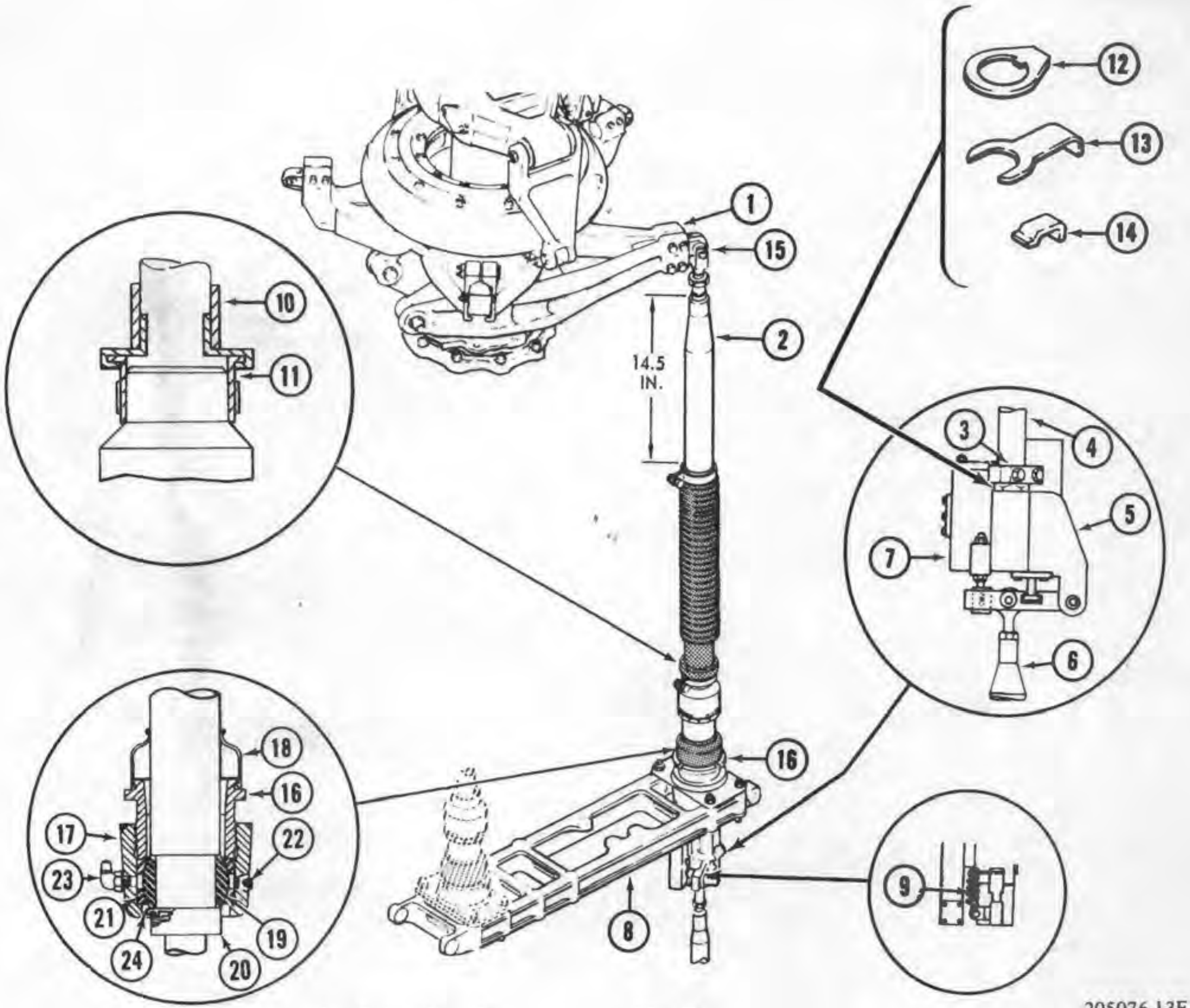
(4) Remove four nuts which secure cylinder bearing housing on studs of support (8).

(5) Remove cylinder assembly.

(6) If stripped, excessively worn, or damaged stud threads are found, request repair by Direct Support Maintenance.

(7) If so equipped, remove upper and lower clamps and slide boot and swivel-joint flange off over top of cylinder tube. Compress flange to detach lip from collar on boot.

b. Inspection – Collective Pitch Control Hydraulic Cylinder.



1. Collective Lever
2. Cylinder Tube
3. Stop
4. Hydraulic Cylinder
5. Servo Valve
6. Control Tube
7. Irreversible Valve
8. Support
9. Spring
10. Boot
11. Swivel-Joint Flange
12. Lock Washer
13. Cover
14. Skirt
15. Clevis
16. Nut Assembly
17. Housing
18. Boot
19. Bearing
* 20. Bearing Retaining Nut
21. Bushing Set
22. Plug
23. Grease Fitting
24. Tab Washer

* Note
Torque 200 to 250 inch-pounds
Minimum of one tab on lockwasher
must be bent after torque.

Figure 6-3. Collective pitch hydraulic cylinder installation

(1) Inspect all parts for damage, corrosion or pitting. Check threads for distortion.

(2) Inspect piston rods 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.

(3) Inspect nut (20, figure 6-3) for evidence of loosening. A minimum of one tang of tab washer (24) should be bent against flat of nut (20) and a small amount of torque lacquer should be intact on tang of tab washer and nut. If there is evidence that nut (20) has loosened, remove hydraulic cylinder assembly and return to Field Maintenance for inspection of assembly and retorque of nut.

CAUTION

Tab washer tangs making contact with rounded corners of nut (20) will not provide locking action.

(4) Disconnect the collective hydraulic cylinder upper cylinder tube (2, figure 6-3) from the collective lever. Disconnecting the control tube from the bottom of the hydraulic cylinder assembly is optional. Bottom the cylinder in the full up position. Attach a pound-reading spring scale to clevis (15) and check the force required to move the cylinder assembly laterally through full travel of support bearing (19). If force required is not within tolerance of 1 to 2.5 pounds, retorque nut (16) as follows:

(a) Lubricate support bearing at fitting (23). Torque upper bearing retaining nut (16) to 400 - 450 inch-pounds and rotate the cylinder assembly through full travel several times to ensure proper seating of the bearing surfaces.

(b) Lockwire nut (16) in two places, one positive safety to prevent loosening and one negative safety to prevent further tightening.

(c) Connect control tube at bottom of the cylinder assembly and connect the cylinder assembly to the collective lever (1). Install cotter pins.

(5) Inspect linkage part for wear, elongated bolt holes, cracks, nicks, and surface damage.

(6) Inspect power cylinder servo valve for serviceability. Check selector set for sticking or binding. Inspect housing for cracks. Inspect lever stop for distortion. Inspect bolts through the arm lever for wear and distortion; bolts to be finger tight only. Check cotter pins for security. Inspect bearing housing and flange for cracks and elongation of holes.

(7) Inspect boots and attaching parts for damage.

(8) Inspect the cylinder assembly for leaks at all connections and fittings. Seepage around piston rod seals is permissible but not to exceed one drop for every twenty-five cycles.

(9) For inspection of the upper cylinder tube at time of replacement of collective pitch control hydraulic cylinder, refer to paragraph 6-9, step d.

(10) Inspect moisture seal on control tube for looseness of cracking.

c. Repair or Replacement — Collective Pitch Control Hydraulic Cylinder.

(1) Replace all unserviceable parts or assemblies that fail to meet inspection requirements above. Replace servo valve if unserviceable. (Refer to paragraph 6-10.)

(2) At time of servo cylinder replacement, inspect the internal sections of upper and lower tube fittings. (Area A and B, figure 6-4.) Replace tube if corrosion is found. If no corrosion is noted at time of inspection, flush tube assembly with zinc chromate primer (item 109, table 1-2) as follows:

(a) Plug one end and pour chromate into opposite end of tube.

(b) Rotate tube several times to ensure full coverage of primer on both end fittings.

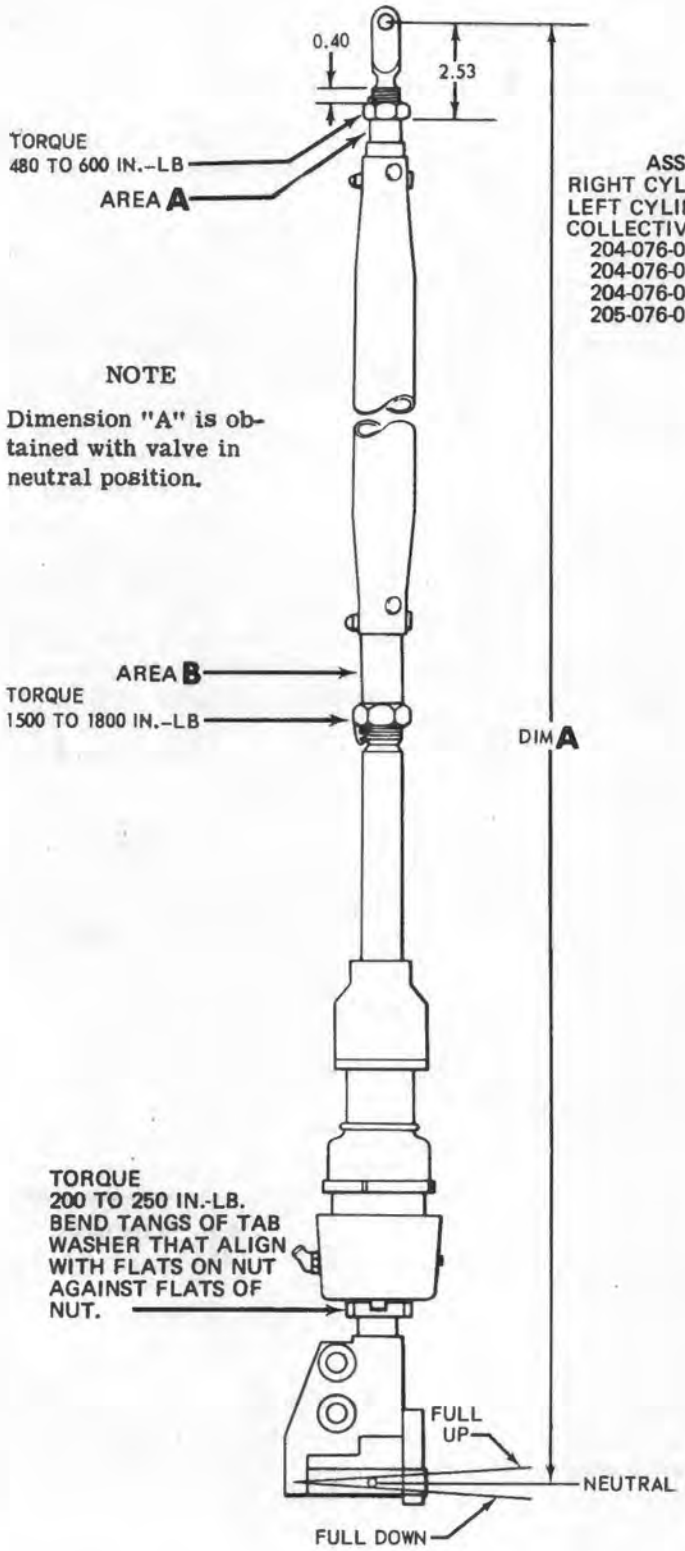
(c) Drain for 10 - 20 minutes prior to installation.

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 or clevis from upper end of tube and proceed with flushing operation as outlined above.

(3) In the event a replacement tube is not available, the tube may be continued in service by applying corrosion preventive compound (items 312A, table 1-2) to the inner circumference of the end fittings. By this application, the corrosion will be temporarily retarded until a replacement tube becomes available.

(4) Check rigging and proper operation of system after removal and installation of cylinders. (Refer to paragraph 6-2, step i.)



ASSEMBLY	DIMENSION A (INCHES)
RIGHT CYLINDER ASSEMBLY	53.72
LEFT CYLINDER ASSEMBLY	53.47
COLLECTIVE CYLINDER	
204-076-026	48.33
204-076-064	48.10
204-076-070	48.10
205-076-038	48.10

204076-5S
AV 054120

Figure 6-4. Power cylinder dimensions

d. Installation – Collective Pitch Control Hydraulic Cylinder.

NOTE

Before installing a replacement hydraulic power cylinder, check that assembly is correct for applicable pitch control system. (See dimension A, figure 6-4.) Also, prior to installing a new cylinder tube assembly (2, figure 6-3) flush tube.

(1) Check overall length with clevis set at 2.53 inches (see figure 6-4). This is an initial dimension, which may be slightly changed in rigging.

(2) Check installation of spring (9, figure 6-3) on servo valve (5).

(3) Check installation of stop (3) on lower end of piston above control valve. Stop consists of two halves secured together by two bolts and nuts, and is to be seated firmly on nut.

(4) Position bearing housing of cylinder assembly (4) on studs of support (8). Install washers and nuts. Tighten nuts evenly. Use standard torque.

(5) Install irreversible valve (7) on cylinder servo valve. (Refer to paragraph 6-12.)

(6) Install protective boot as follows: Compress and insert swivel-joint flange into lower end of boot, and engage flange lip in collar. Slip flange and boot down over cylinder tube with boot top 14.5 inches below upper edge of tube. (See figure 6-3.) Install clamps to secure flange on cylinder cap and top of boot on tube.

(7) Connect and rig control linkage (see COLLECTIVE PITCH CONTROL LINKAGE, Chapter 9, Section III), and check operation of system. (Refer to paragraph 6-2, step i.)

CAUTION

Three bolts (items 1, 2, and 3, figure 6-5) in the power cylinder valve adjustment, and four bolts (items 1, 2, 3, and 4, figure 6-6) in lever assembly of wire drive type servo cylinder should be finger tight only. Bolts and nuts should rotate as an assembly.

e. Adjustment – Collective Pitch Control Hydraulic Cylinder.

(1) Adjust cylinder and rod assembly with clevis set at 2.53 inches. (See figure 6-4.)

NOTE

Lost motion develops due to normal wear between the servo valve spool and pilot's input lever. (See figure 6-5.) This condition may be corrected by performing steps (2) through (5).

(2) Break safetywire and loosen jam nut.

(3) Insert a 0.002 inch feeler gage or wire between the horseshoe washer and lever assembly. Using a flashlight or penlight as a background, slowly advance the screw until the slightest indication of contact with the feeler gage. If at all possible, turn adjustment screw with fingers.

CAUTION

This is a precision adjustment and the adjustment screw must not be advanced beyond this point. It is possible to break or crack the slide assembly circular disk immediately after firm contact. Minimum clearance is plus 0.001 inch with a maximum of 0.004 inch permissible. Preferred clearance is 0.002 inch.

NOTE

Care must be exercised when adjustments are made on a badly brinelled screw, as a side force on the servo valve may result in excessive servo valve wear and a higher valve operating force. Valve should operate freely, with no binding.

(4) After adjustment is complete, lock screw with jam nut.

CAUTION

The adjustment screw must not turn with the jam nut. Hold it firmly with a screw driver.

(5) After adjustment screw has been locked with jam nut, minimum clearance should be checked. (Refer to step (3).) If minimum clearance has been exceeded, cylinder should be replaced.

NOTE

If screw is being replaced, exercise care as ball is not secured to screw.

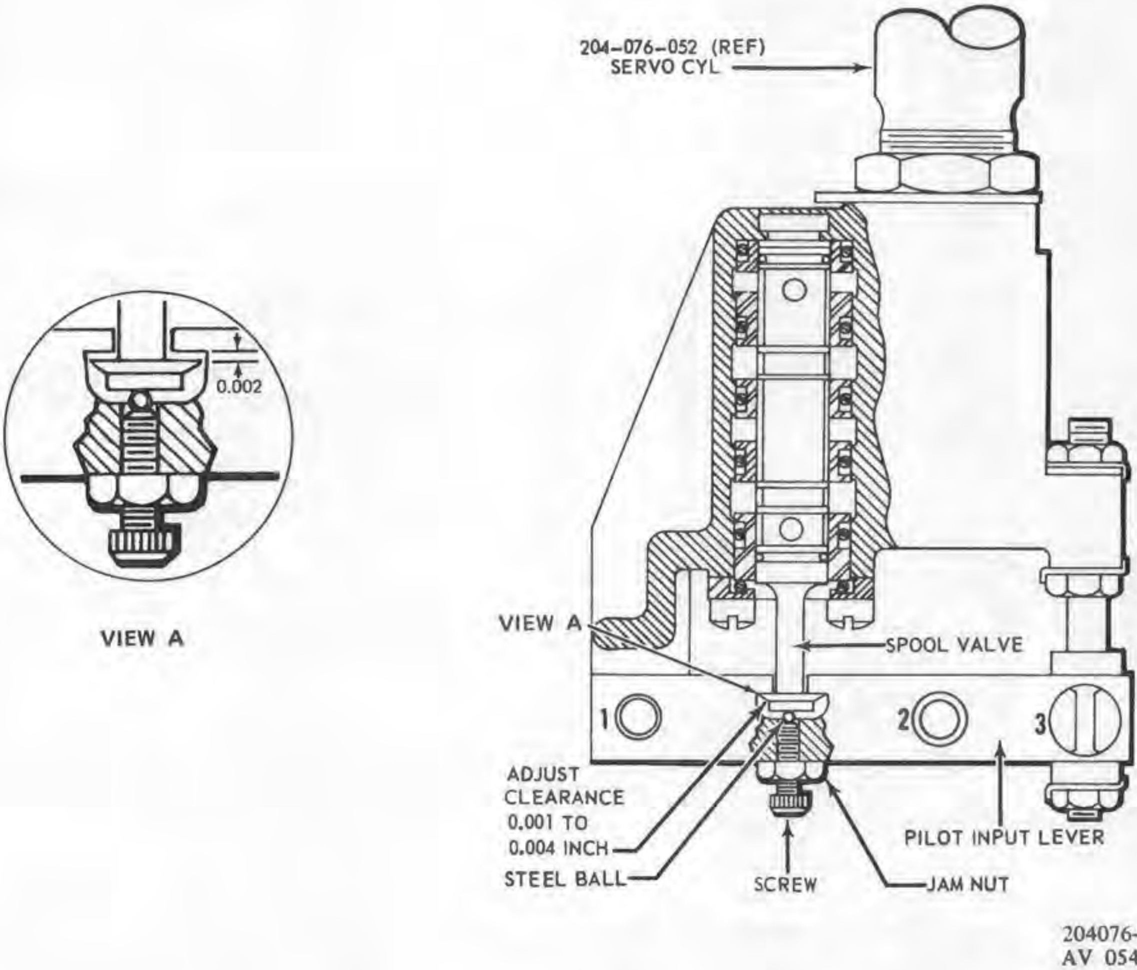


Figure 6-5. Power cylinder servo valve adjustment

(6) Final adjustment of hydraulic cylinder will be made concurrent with rigging.

6-8. Power Cylinder Servo Valve.

The collective pitch control linkage can be divided into pilot-operated linkage and hydraulically-operated linkage. The pilot-operated linkage terminates at the power cylinder servo valve (5, figure 6-3) when hydraulic power is ON. This valve is supplied with and is part of the power cylinder assembly. Overhaul of the valve is not authorized for organizational maintenance; however, servo valves on power cylinders of the same part number are interchangeable. Consequently, individual replacement of servo valves is authorized when replacement of the entire cylinder assembly and rigging of the system would otherwise be required.

a. Removal – Power Cylinder Servo Valve.

(1) Remove two bolts attaching irreversible valve (7, figure 6-3) to servo valve (5). Cover open hydraulic ports and set irreversible valve aside.

(2) Remove stop (3) (on collective cylinders only) from piston rod.

(3) Disconnect tube (6) from servo valve lever.

(4) Loosen jam-nut sufficiently to lift cover and skirt assembly and lock-tab washer out of recess on top of servo valve, then screw valve from piston rod.

b. Installation – Power Cylinder Servo Valve.

(1) Select a relatively dirt-free work area. This is most important as minute particles of dirt can prevent spool valve from functioning properly.

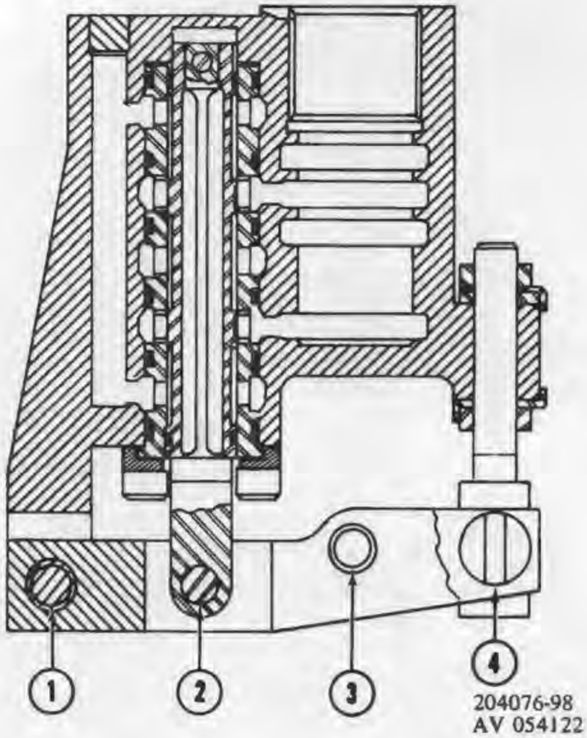


Figure 6-6. Wire drive type servo valve

(2) Inspect chamfered end of piston rod for sharp edges. Stone edge if sharpness is evident. Place cover assembly and lock tab washer on the piston rod, lubricate polished surface of the piston rod with system hydraulic fluid (item 4, table 1-2), insert piston rod into the servo valve (5, figure 6-3) taking care not to injure the O-rings within the valve body. When the threads engage, screw the servo valve onto the piston rod until the rod bottoms on the valve. Back the valve off 1/2 to 1 turn to align the servo valve with the locktab washer.

(3) Align the cover assembly, hold the servo head securely with a strap wrench and tighten the jam-nut to 200 to 225 inch-pounds of torque. A minimum of one tab must be bent on lock-tab washer after jam-nut has been torqued. Safety wire the jam-nut to the lock washer.

(4) Install stop (3) on collective cylinder only. (Refer to paragraph 6-9, step d.)

6-9. Cyclic Control Hydraulic Cylinders.

Two hydraulic power cylinders (4 and 8, figure 6-7) are incorporated to reduce effort required for control and to reduce feedback of forces from main rotor.

a. Removal — Cyclic Control Hydraulic Cylinders.

NOTE

Removal of both cyclic control hydraulic cylinders is the same.

(1) Disconnect control tube (7 and 12, figure 6-7) from servo valve (6) on cylinder.

(2) Disconnect cylinder tube (1 or 9) from trunnions on swashplate horn.

(3) Unscrew two bolts attaching irreversible valve to servo valve, and remove irreversible valve with bolts in place. Cover open ports.

NOTE

Unnecessary loss of hydraulic fluid is prevented by allowing lines to remain attached to irreversible valve.

(4) Remove four nuts and washers which secure cylinder bearing housing on studs of support (5 or 10).

(5) Remove hydraulic cylinder assembly.

(6) If stripped, excessively worn, or damaged stud threads are found, request repair by Direct Support Maintenance.

(7) Remove upper and lower clamps and slide boot and swivel-joint flange over top of cylinder tube.

b. Inspection — Cyclic Control Hydraulic Cylinders.

(1) Inspect all parts of power cylinders for damage, corrosion or pitting, and distorted threads.

(2) Inspect piston rods of cylinders for nicks, scratches and scoring. Check for smooth operation within cylinders.

(3) Inspect bearing support area of each cylinder for looseness, wear and proper installation. There must be no indication of binding.

(4) Inspect nut (18, figure 6-7) for evidence of loosening. A minimum of one tang of tab washer (20) should be bent against flat of nut (18) and a small amount of torque lacquer should be intact on tang of tab washer and nut. If there is evidence that nut (18) has loosened, remove hydraulic cylinder assembly, and return to field

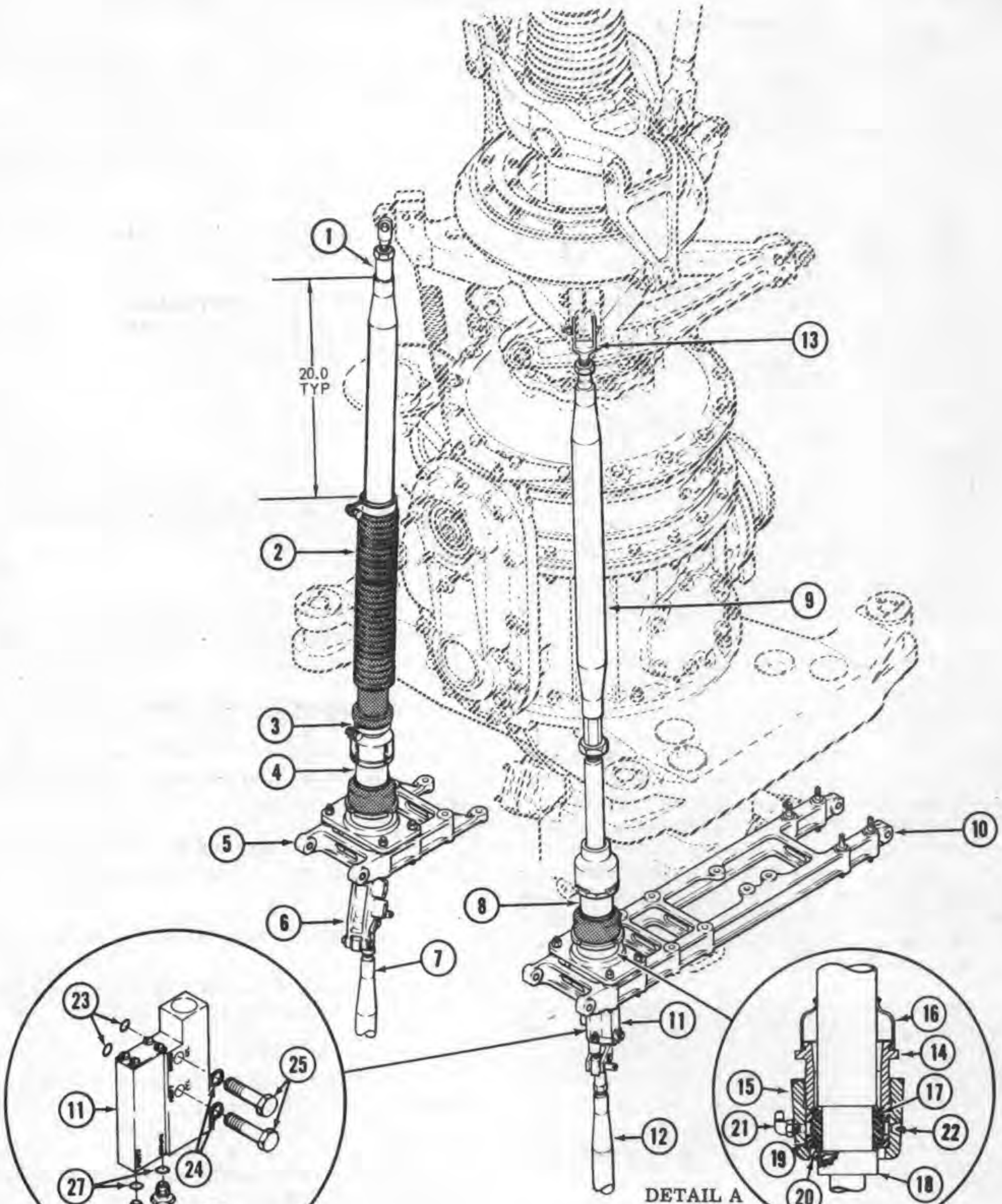


Figure 6-7. Cyclic control hydraulic cylinder installation (Sheet 1 of 2)

1. Cylinder Tube	10. Support	19. Bushing Set
*2. Boot	**11. Irreversible Valve	20. Tab Washer
*3. Swivel-Joint Flange	12. Control Tube	21. Grease Fitting
4. Hydraulic Cylinder	13. Clevis	22. Plug
5. Support	14. Nut Assembly	23. Inner O-rings
**6. Servo Control Valve	15. Housing	24. Outer O-rings
7. Control Tube	16. Boot	25. Bolts
8. Hydraulic Cylinder	17. Bearing	26. Fittings
9. Cylinder Tube	***18. Bearing Retaining Nut	27. Fitting O-rings

*Boot (2) and flange (3) are typical on both cyclic cylinders.

**Valves (6 and 11) typical on both cyclic cylinders. Irreversible valve not shown on right-hand cylinder to provide clear view of servo control valve.

***Torque to 200 to 250 inch-pounds. Minimum of one tab on lock washer must be bent after torque.

Figure 6-7. Cyclic control hydraulic cylinder installation (Sheet 2 of 2)

maintenance for inspection of assembly and retorque of nut.

CAUTION

Tab washer tangs making contact with rounded corners of nut (18) will not provide locking action.

(5) Disconnect the cyclic hydraulic cylinders from the swashplate, and from control tubes (7 and 12, figure 6-7). Bottom cylinders in the full up position. Attach a pound-reading spring scale to clevis (13) and check the force required to move the cylinder assembly laterally through full travel of support bearing (17). If force required is not within 1 to 2.5 pounds, retorque nut (14) as follows:

(a) Lubricate support bearing at fitting (21). Torque upper bearing retaining nut (14) to 400 - 450 inch-pounds, and rotate the cylinder assembly through full travel several times to ensure proper seating of the bearing surfaces.

(b) Loosen nut (14) and retorque to obtain 1 to 2.5 pounds drag on support bearing. Measure with spring scale as described above. Lockwire nut (14) in two places, one positive to prevent loosening and one negative safety to prevent further tightening.

(c) Connect central tube at bottom of cylinder assembly, and connect the cylinder tube to the swashplate. Install cotter pins.

(d) Repeat steps (1) through (3) for opposite cylinder assembly.

(6) Inspect linkage parts for wear, elongated bolt holes, cracks, nicks, and surface damage. Inspect bearings for wear or roughness.

(7) Inspect power cylinder servo valve for serviceability. Check selector set for sticking or binding. Inspect housing for cracks. Check bolts and cotter pins for security; bolts to be finger tight only. Inspect lever stop for distortion.

c. Repair or Replacement – Cyclic Control Hydraulic Cylinder.

(1) Replace all unserviceable parts or assemblies that fail to meet inspection requirements above.

(2) Replace power cylinder servo valve if unserviceable. (Refer to paragraph 6-10.)

(3) Check rigging and proper operation of system after removal and installation of cylinders. (Refer to paragraph 6-2, step i.)

d. Installation – Cyclic Control Hydraulic Cylinders.

NOTE

Before installing replacement hydraulic power cylinders, be certain each assembly is correct for its location in cyclic controls system. (See dimension A, figure 6-4.)

(1) Check overall length with clevis fitting set at 2.53 inches. (See figure 6-4.) This is an initial dimension, which may be slightly changed in rigging.

(2) Place bearing housing of cylinder (4 or 8, figure 6-7) on studs of support (5 or 10). Install washers and nuts. Tighten nuts evenly and use standard torque.

(3) Install protective boot (2), if so equipped, as follows: Compress and insert swivel-joint flange (3) into lower end of boot, and engage flange lip in collar. Slip flange and boot down over cylinder tube with boot top 20

inches below upper edge of tube. Install clamps to secure flange on cylinder cap and top of boot on tube.

(4) Install irreversible valve (11) on servo control valve (6). (Refer to paragraph 6-12.)

(5) Connect control tubes (7) or (12), and tighten nuts finger tight and install cotter pins.

NOTE

Four bolts in lever assembly of wire drive type servo cylinder should be finger tight only. Bolts and nuts should rotate as an assembly.

(6) Connect and rig control linkage.

e. Adjustment – Cyclic Control Hydraulic Cylinder. Adjustment is the same as for collective pitch control hydraulic cylinder. (See figure 6-5.) (Refer to paragraph 6-9, step e.)

6-10. Irreversible Valves.

An irreversible valve is attached to each servo valve with two hollow bolts. System pressure and return lines are attached to the bottom of the irreversible valve. Fluid under pressure is routed through one hollow bolt to the servo valve for use at the power cylinder and returned through the other hollow bolt to the system return line.

a. Removal – Irreversible Valve.

(1) Disconnect pressure and return hoses from valve fittings. Cap open ends of hoses.

(2) Remove lockwire from two bolt heads on side of valve. Loosen both bolts evenly and remove irreversible valve with bolts in place.

(3) Remove O-rings (23, figure 6-7) from bolts (25) at inner side of valve. Remove bolts 25 and outer O-rings (24).

(4) Remove fittings (26) and O-rings (27) from pressure and return ports at bottom of valve. Cover open ports.

b. Installation – Irreversible Valve.

(1) Install union fittings with new O-ring in pressure and return ports in bottom of irreversible valve.

(2) Place new O-ring packing on each valve attachment bolt, in groove next to bolt head.

(3) Insert both bolts through valve ports.

(4) Hold bolt heads firmly against valve. Install O-ring packings on bolts at inner side of valve, in grooves behind bolt threads.

CAUTION

Use care to avoid damage to O-rings between valve bodies during installation. When installing O-rings on bolts, wrap threads on bolt with thin plastic tape, lubricate O-ring and slide into position on bolt. Make sure O-ring size is correct.

(5) Carefully position irreversible valve to ports of servo control valve on hydraulic cylinder. Start both bolts into servo valve.

(6) Tighten both bolts evenly to dray valve bodies together and seat O-rings. Use final torque of 100 to 120 inch-pounds. Lock-wire bolt heads together.

(7) Connect hoses to fittings on bottom of irreversible valve. Fill and bleed hydraulic system. Check for leaks and proper operation. (Refer to paragraph 6-2, step d, through 6-2, step f, and 6-2, step h through 6-2, step k.)

c. Serviceability Test – Irreversible Valve.

(1) -Disconnect the servo extension tube from the collective levers and from the swashplate horns. Connect an external hydraulic power source to hydraulic test fittings. Increase hydraulic pressure until panel warning low pressure light goes out.

NOTE

Bleed all air from valve assembly before applying fluid pressure. Unless otherwise specified, a three-minute seating period is permissible prior to each measurement for interport leakage. For setup convenience, the test operations do not necessarily have to follow the sequence called out. Irreversible valve accumulator bore weep hole leakage shall not exceed the equivalent of 1 drop in 25 cycles during actuation or 1 drop in 24 hours during static conditions.

(2) Make certain servo extension tubes are clear of ships structure; slowly move cyclic stick to fully extend servo piston. Reduce hydraulic pressure to zero. Holding cyclic stick in position, apply 100 pounds of hand force to top of extension tube. The extension tube should not move. Should tube retract, remove and replace irreversible valve assembly.

(3) Check the opposite cyclic and the collective servo irreversible, using the same procedure as outlined above.

6-11. Tail Rotor Control Hydraulic Cylinder.

A hydraulic power cylinder in tail rotor control linkage is vertically mounted in a support on Station 211 fuselage bulkhead, accessible through a door on right-hand side.

a. Removal – Tail Rotor Control Hydraulic Cylinder.

(1) Disconnect hydraulic pressure and return hoses from control valve (1, figure 6-8). Cap open hoses and fittings.

(2) Disconnect cylinder rod adapter (5) from link by removing bolt with nut, washers and sleeves. Keep attaching parts with link.

(3) Remove balance spring (8) with bolt, nut, and washers. Disconnect lower clevis of cylinder from bellcrank (7) by removing bolt with bracket, nut, and washers.

(4) Remove bolts to detach arms (3) from support (6) and cylinder trunnions. Remove cylinder assembly (2).

b. Inspection – Tail Rotor Control Hydraulic Cylinder and Support.

(1) Inspect hydraulic cylinder for cleanliness, damage, freedom of movement and evidence of leaks. Allowable leakage for this cylinder is one drop per 25 cycles.

(2) Inspect arm set (3, figure 6-8), support assembly (6) and bellcrank (7) for wear, elongated bolt holes, cracks, nicks, surface damage and bearing wear.

c. Repair and Replacement – Tail Rotor Control Hydraulic Cylinder. Replace parts that do not meet inspection requirements. (Refer to paragraph 6-13, step b.)

d. Installation – Tail Rotor Control Hydraulic Cylinder.

(1) Position cylinder assembly (2, figure 6-8) with trunnions engaged in arms (3) and align arms on upper end of support (6). Install two bolts through arms and support, with washers under heads and nuts.

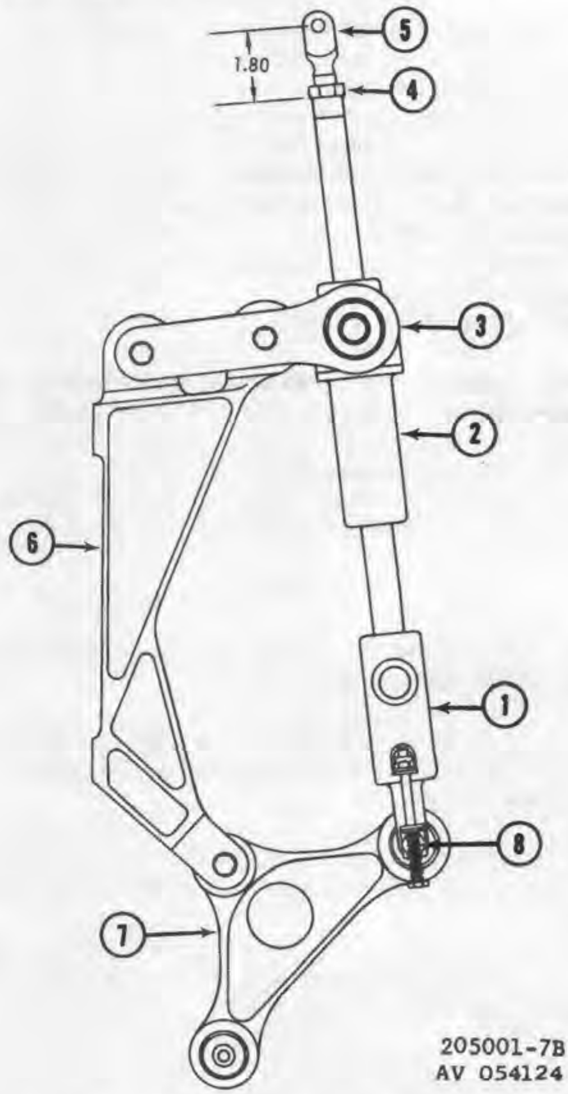
(2) Check trunnions for free movement in bearing of arms.

(3) Be sure pressure port of control valve (1) is at left side. Align lower clevis of cylinder on bearing of bellcrank (7), and install bolt from left side, with bracket for balance spring under head.

(4) Assemble balance spring (8) and washer on bolt. Insert bolt through lower and upper brackets, and secure with nut and washer.

NOTE

Balance spring tension must be adjusted to prevent either control pedal from creeping forward or aft. Increasing spring tension will prevent left pedal from creeping forward. Decreasing spring tension will prevent left pedal from creeping aft. Adjust spring tension by tightening or loosening nut on spring attaching bolt.



1. Control Valve
2. Cylinder Assembly
3. Arm Set (Matched)
4. Nut
5. Adapter
6. Support
7. Bellcrank
8. Balance Spring

Figure 6-8. Power cylinder and support - tail rotor controls

NOTE

If motoring persists, after adjusting the balance spring tension, check the hydraulic hoses to control valve (1) to ensure that there is ample slack to permit smooth operation of the control valve. Any tension on the control valve by the connecting hoses can cause motoring.

(5) Adjust rod-end adapter (5) to 1.80 inch dimension as shown, and tighten nut (4). Attach adapter to control link with bolt, sleeves, washers, nut, and cotter pin.

(6) Connect hydraulic pressure and return hoses to fittings on cylinder control valve (1).

(7) Check control valve and cylinder for tightness or binding. Valve should be free to move on shaft. Be sure hydraulic hoses do not restrict valve movement.

(8) Fill and bleed hydraulic system. Check for leaks and proper operation.

6-12. Repair Or Replacement — Hydraulic Components.

Repair or replacement procedures.

NOTE

Repair or replace components of the hydraulic system as necessary to prevent leakage or correct a malfunction. Note the following steps in conjunction with repair and replacement procedures.

a. Verify that replacement part number is same as part being replaced or that it is completely interchangeable part.

b. Ensure that caps and plugs remain on open ports, fittings, and lines until part is ready to be installed.

c. 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.

d. Inspect part to be installed for thorough cleanliness.

e. Refer to Chapter 13, for hydraulic system wiring diagrams.

f. Perform procedures listed in paragraph 6-2, step d through 6-2, step f and 6-2, step h through 6-2, step k after removing and replacing any components.

g. Replace any lockwire and cotter pins removed.

Section III. PNEUMATIC SYSTEM

(Not Applicable)

CHAPTER 7

POWER TRAIN SYSTEM

Section I. INTRODUCTION

7-1. General.

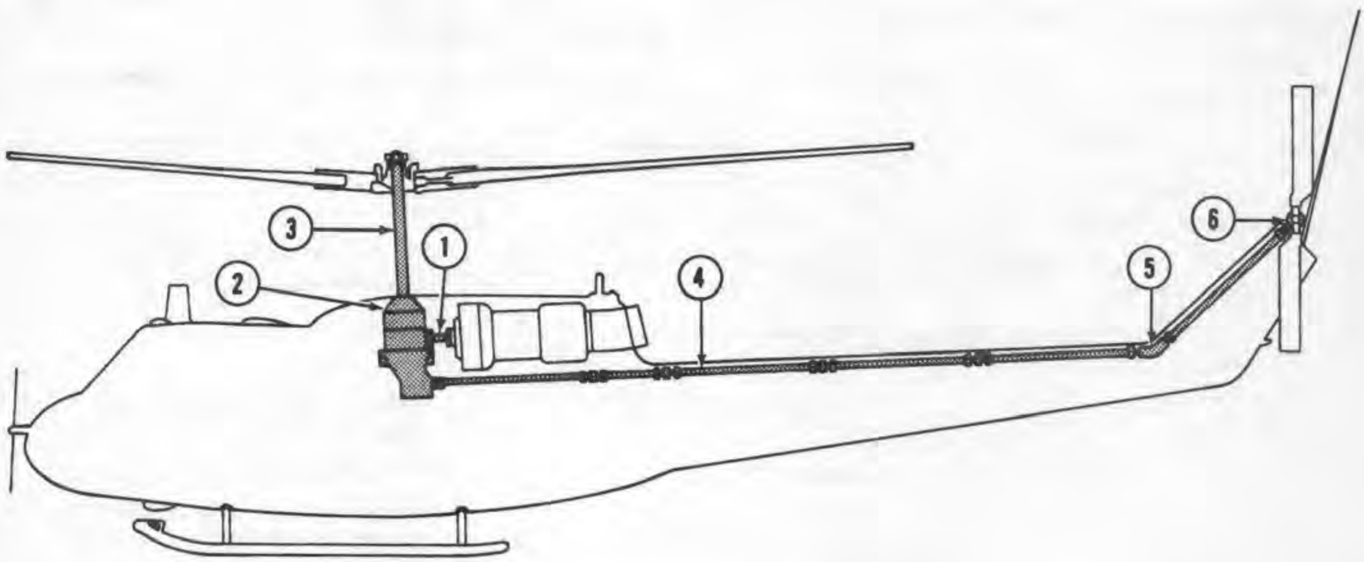
a. This chapter provides all the instructions and information necessary for maintenance authorized to be performed by organizational maintenance activities on the power train system.

b. The power train is a system of shafts and gear boxes through which the engine drives main rotor, tail rotor, and accessories such as DC generator and hydraulic pump.

c. The system consists of a main drive shaft, a main transmission which includes input and output drives and the main rotor mast, and a series of drive shafts with two gear boxes through which the tail rotor is driven. (See figure 7-1.)

7-2. Troubleshooting – Power Train.

a. Chart below is a brief summary of power train troubles which may be encountered in organizational maintenance. Conditions and possible causes listed have been limited to those reasonably probable (though not necessarily frequent in normal service) which could become known through pilot reports or by inspection methods applicable in organizational maintenance, and which would be subject to some evaluation at this level, although final corrective action by a higher level might be required in some instances. Conditions involving obvious major damage are omitted, as are those caused by accident or an unusual chain of events which would require evaluation by a competent authority. Notes below provide information in addition to that available in troubleshooting chart and in maintenance instructions for systems and components of power train.



1. Main Drive Shaft
2. Transmission
3. Mast
4. Tail Rotor Drive Shafts
5. Intermediate Gear Box
6. Tail Rotor Gear Box

205900-14A
AV 054125

Figure 7-1. Power train diagram

b. Troubleshooting Precautions.

(1) In transmission troubleshooting, observe the following:

(a) Low oil level will not cause a low oil pressure indication, provided sump contains enough oil to cover pump inlet. Oil temperature might rise, however.

(b) Effects of an oil leak will depend on its location in system and rate of leakage. An external leak can eventually allow sump to be pumped dry, causing internal failure of transmission. While oil remains to supply pump, the pressure relief valve would tend to maintain normal system pressure, compensating for leakage. This applies especially to leaks located between pump and relief valve. Leaks occurring beyond relief valve could cause some indication of low oil pressure. Leakage to interior of transmission, while not affecting oil level, could starve lubrication areas beyond the leak and might affect indicated oil pressure and temperature.

(c) Cumulative clogging of oil filter screens will not be shown by a gradual drop of indicated oil pressure as it may on some other aircraft or automobile oil systems. Pressure relief valve would maintain normal system pressure even if filter screens became so clogged as to force oil flow through filter bypass valve.

(d) "Use of wrong oil" is omitted from causes of trouble on chart because any such event would be a special problem as to possible damage and corrective action. As to detecting such a condition, little can be said except that most oils which might be available to use by error would tend to cause high oil pressure and high oil temperature indications or excessive seal leakage.

(2) For main drive shaft troubleshooting, apply the following:

(a) Trouble conditions of main drive shaft can seldom be detected in operation, since there are no reliable indications except possibly in an extreme condition. "Suspected vibration" is only partially accurate as a term for such conditions as dynamic out-of-balance or faulty coupling action. Vibration would result, as well as abnormal stresses and wear, but would be absorbed in structure and pylon mounts or effectively masked by normal vibrations of the helicopter, providing no distinct indication to pilot.

(b) Drive shaft trouble indications are, therefore, usually those revealed by careful inspection.

(c) Principal causes of drive shaft trouble are faulty installation procedures and improper lubrication of spherical tooth couplings.

(3) For tail rotor drive system troubleshooting, apply same principles as for main drive shaft.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
TRANSMISSION: Low oil pressure		
(1) On caution panel or pressure gage, but not both	Faulty caution panel or gage circuit or unit	Repair electrical circuit or replace faulty unit
(2) Shown by both caution panel and gage	Pressure relief valve malfunction	Adjust or replace valve
	Clogged pump screen	Clean screen, check oil for chips or contamination
	Faulty oil pump	Replace pump
	Leakage or restriction between pressure relief valve and transmitter	Repair oil line connections or replace seals
No oil pressure		
(1) With normal oil level	Faulty gage or transmitter or circuit	Repair circuit or replace faulty unit
	Oil pump failure	Replace transmission or if transmission is not internally damaged, replace pump only
(2) No oil supply	Leak in system or failure to service	Replace transmission. Also replace cooler, flush and repair external lines

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Grease leakage at tail rotor drive coupling	Damaged seal	Replace seal in quill
High oil pressure	Faulty gage or transmitter or circuit	Repair circuit or replace faulty unit
	Pressure relief valve malfunction	Adjust or replace
High oil temperature	Pressure relief valve malfunction	Adjust or replace valve
(1) On caution panel or temperature gage, but not both	Faulty caution panel or gage circuit or unit	Repair circuit or replace faulty unit
(2) Shown on both caution panel and gage	Obstructed air flow around transmission	Clear cowl opening and sump area
	Clogged oil jets	Clean or replace jets, or replace transmission for internal damage. Check external oil filter
	Seized bearings or other internal transmission failure	Replace transmission. Also replace cooler and flush external oil lines. Check external oil filter.
	Oil cooler clogged or obstructed	Clean cooler core air passages. Replace cooler if internally clogged, and flush oil lines. Check transmission filters, pump screen, and magnetic plug
	Cooler bypass valve malfunction	Replace valve
	Oil cooling blower malfunction (if engine oil temperature also high)	Replace blower or repair bleed air connection
Metal chips on magnetic sump plug or pump screen	Internal transmission failure of gears or bearings	Refer to figure 7-2. If found to be excessive, replace transmission, oil cooler and flush piping. Replace external oil filter element.
Excessive pylon motion	Pylon mounts worn or installed wrong	Repair or replace mounts
	Faulty pylon mount dampers	Replace friction dampers
MAIN DRIVE SHAFTS:		
Abnormal coupling wear	Faulty lubrication or wrong lubricant	Clean and lubricate coupling, or replace drive shaft
	Fifth mount failure	Replace fifth mount.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Misalignment	Align engine and transmission, replace drive shaft and associated parts as required.
Lubricant breakdown in forward coupling	Misalignment, wrong or partial loss of lubricant and inadequate lubricant.	Align engine and transmission, replace drive shaft and associated parts as required.
	Improper cleaning of couplings	Clean and lubricate couplings per instructions.
Suspected vibration	Coupling clamps loose or improperly installed or unmatched	Install clamp sets by instructions
	Loose engine adapter	Replace adapter and any worn associated parts
Grease leakage	Cut or torn O-ring seal	Replace O-ring, assemble with care
	Misalignment	Align engine and transmission, replace drive shaft and associated parts as required.
TAIL ROTOR DRIVE SYSTEM:		
Grease leakage	Damaged seal in coupling	Replace seal
Vibration	Loose clamps	Torque or replace clamps
	Wrong hanger bearings or couplings	Replace hanger assembly
	Shaft balance weights lost or shaft bent	Replace shaft section
	Clamps not positioned correctly	Reposition 90° to one another (Refer to paragraph 7-26.)
	Clamp halves mismatched	Replace clamp sets
Binding or roughness when manually checked	Dry or faulty bearing	Isolate faulty hanger by disconnecting shafts; replace hanger assembly
	Defective gear box	Check gear boxes; replace defective unit
	Faulty lubrication of flexible couplings	Replace hanger, gear box, or gear quills
Metal chips on gear box magnetic plug	Internal failure of gears or bearings	Replace gear box

7-3. Metal Particles Contamination Of Gear Boxes.

a. Metal particles found on gear box oil strainer screens, oil filters or chip detector plugs may indicate failure of an internal part of the gear box. The presence of metal particles, however, is not necessarily an indication that the gear box is no longer serviceable. The quantity, source, form and type of metal found, together with the service history of the particular gear box, must be taken into consideration. The time accumulated since the gear box was new or overhauled, previous failures and the type of operation are important factors in determining the further serviceability of the unit. The particles found may be steel, tin, lead, aluminum, magnesium, copper (bronze) or phenolic in various shapes and quantities. For a detailed explanation of the action made necessary by the presence of each of the possible types of particles in the gear box, see figure 7-2.

WARNING

When any particles found are readily identifiable as fragments of gear box parts, such as gears, nuts, bearings, oil slingers, thrust washers, snap-rings, safety wire or other components, replace gear box.

b. Identification of Metal Particles.

NOTE

A visual inspection of color and hardness will occasionally suffice to identify the particles (see figure 7-2). When visual inspection does not positively identify the particle, the kind of particle present may be determined by a few simple tests. Equipment to perform tests includes a permanent magnet, electric soldering iron, and concentrated nitric acid (item 316, table 1-2). Proceed as follows:

(1) *Steel.* Isolate steel particles with permanent magnet.

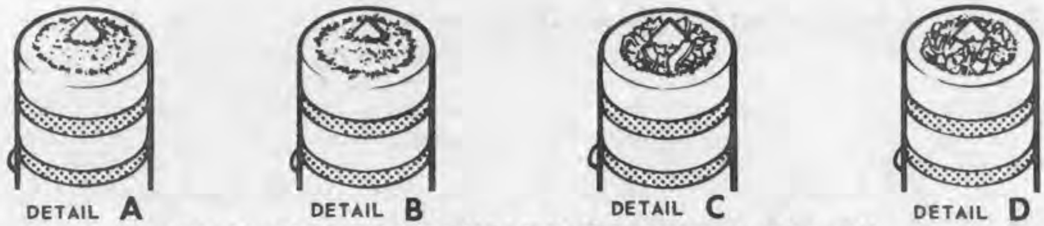
(2) *Tin and lead.* Distinguish tin and lead by their low melting points. Clean soldering iron; heat it to about 500°F; then tin it with 50-50 solder (50 percent lead and 50 percent tin). Wipe off excess solder. Tin or lead particles dropped onto hot, soldering iron will melt and fuse with solder. Do not overheat iron.

(3) *Aluminum.* Determine aluminum particles by their reaction to hydrochloric acid. When a particle of aluminum is dropped into hydrochloric (muriatic) acid it will fizz with a rapid emission of bubbles. The particles will gradually disintegrate and form a black residue.

NOTE

Since magnesium and aluminum react similarly in hydrochloric acid, when in doubt drop particle into nitric acid (item 316, table 1-2). Aluminum does not react noticeably in nitric acid.

(4) *Copper or bronze and magnesium.* Differentiate copper or bronze and magnesium by their respective reactions to nitric acid (316, table 1-2). When a particle of copper or bronze is dropped into nitric acid it forms a bright green cloud in the acid. When a particle of magnesium is dropped into nitric acid it fizzes with a rapid emission of bubbles. Phenolic and aluminum do not react noticeably to nitric acid.



METAL PARTICLES CONTAMINATION-GEAR BOX OIL

KIND OF METAL	QUANTITY AND/OR SIZE	ACTION REQUIRED	NOTES
Steel	Fuzz, fine hair-like particles. (See detail A.)	None	Result of normal wear. May have exaggerated appearance because of oil.
	Particles in splinter or granular form. (See details B and C.)	**Disassemble gear box, as required,to determine extent of damage. Replace gear box if necessary	Usually indicates failure.
	Thin flakes not exceeding 1/64 (0.015) inch in thickness and 1/16 (0.060) inch in length. Quantity not to exceed 10 flakes. (See detail D.)	**Disassemble gear box, as required,to determine extent of damage.	Small quantity may not indicate bearing failure.
	More than 10 flakes not exceeding 1/64 (0.015) inch in diameter and 1/16 (0.060) inch in length; and quantity of flakes exceeding the above dimensions.	**Disassemble gear box, as required,to determine extent of damage. Replace gear box if necessary.	Usually indicates failure. May be bearing in one of accessory quills.
Aluminum or Magnesium	Particles in granular form, or like miniature lathe turnings.	**Disassemble gear box, as required.to determine extent of damage.	May be result of use of these materials as mallets or drifts during assembly. May indicate wear of oil pump interior surfaces or abnormal interference.
Copper (Bronze)	Particles in granular form.	**Disassemble gear box, as required, to determine extent of damage. Replace gear box if necessary.	May indicate excessive wear of bearing cages as result of bearing failure.
Phenolic		None	Result of the use of mallets and drifts during assembly or same as Copper (Bronze) above.

** Disassembly of drive quills is third maintenance level function.

204040-116-1G
AV 054126

Figure 7-2. Identification of metal particles

Section II. MAIN DRIVE SHAFT

7-4. Main Drive Shaft.

a. Description.

(1) A main drive shaft (see figures 7-3 and 7-4) with flexible splined couplings is installed between an adapter on engine output shaft and the freewheel coupling on transmission input drive quill.

(2) Two coupling clamp sets, of split V-band type, hold mating curvic-splined faces of couplings in secure contact.

(3) Flexibility of couplings is provided by a floating-splined method of attachment on shaft, to accommodate movement of transmission on pylon mounts.

(4) A spring in each coupling assists centering of shaft during operation and tends to hold shaft assembly in place if clamps are removed during maintenance.

(5) The following special tools required to perform organizational maintenance on the main drive shaft are listed in Table 7-1.

Table 7-1. Special Tools

PART NUMBER	NOMENCLATURE
T101306	Splined Wrench
T101419	Alignment Tool Set
T101420	Holding Fixture
T101440	Leveling Jacks
T101452	Maintenance Hoist

NOTE

When using the T53-L-9/9A-11 engines in lieu of the T53-L-11B or T53-L-13 engines, use driveshaft adapter P/N 204-040-630-5. When using T53-L-11B engine and T53-L-13 engine, use driveshaft adapter P/N 204-040-812-3.

b. Removal – Main Drive Shaft.

(1) Open cowling and remove parts necessary for access to main drive shaft.

(a) Open left side engine cowling to use service deck.

(b) Open transmission fairing.

(c) Remove engine intake fairing or filters by releasing fasteners at front and rear edges of top panel and fasteners which secure side louvers or filters to cabin roof.

(d) Remove induction baffle upper panel by releasing fasteners.

(e) Remove intake screen access section at upper left by releasing fasteners. If particle separator is installed remove upper half of particle separator.

(2) Remove coupling clamps at each end of main drive shaft, keeping parts together as sets after removal.

(3) Push shaft toward either end to shift one coupling inward and disengage coupling at other end. Remove shaft assembly.

(4) To remove engine shaft adapter: Remove lockwire, retaining bolt, and key washer. Pull adapter out of engine output shaft.

c. Cleaning – Main Drive Shaft. Clean shaft assembly, adapter, and attaching parts by wiping with clean cloth. For external parts and surfaces only, cloth can be moistened with cleaning solvent (item 302, table 1-2) but this solvent shall not be used inside shaft couplings.

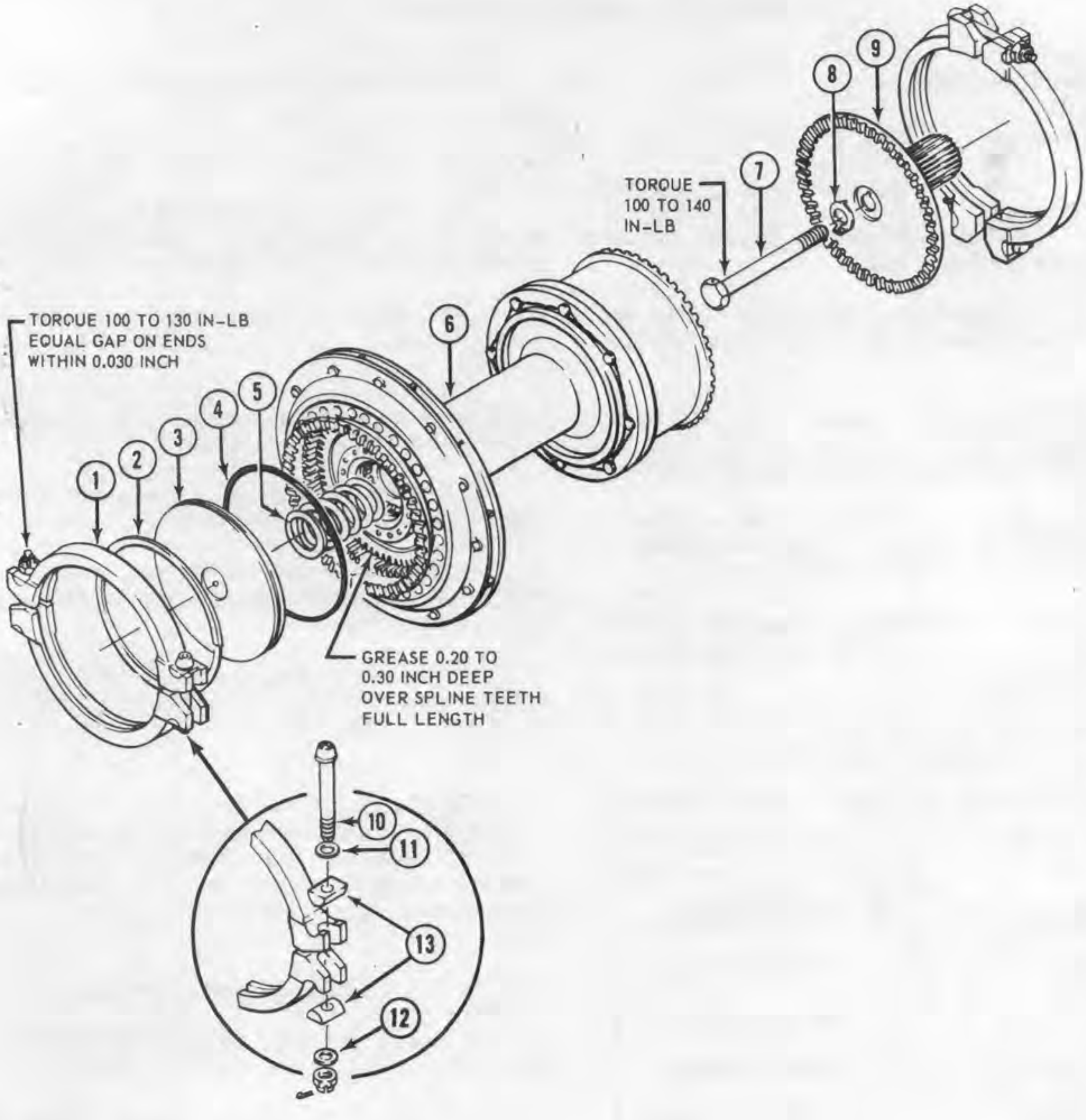
d. Inspection and Repair – Main Drive Shaft.

(1) Inspect the outer surface of the main drive shaft for nicks and scratches to the following limits:

(a) Nicks and scratches, running within 15 degrees of shaft axis, which are not in excess of 0.005 inch in depth are permissible without polishing out.

(b) Nicks and scratches, running within 15 degrees of shaft axis, which are not in excess of 0.010 inch in depth, are permissible if polished out, provided total polished area does not exceed 20 percent of circumference of shaft at any point.

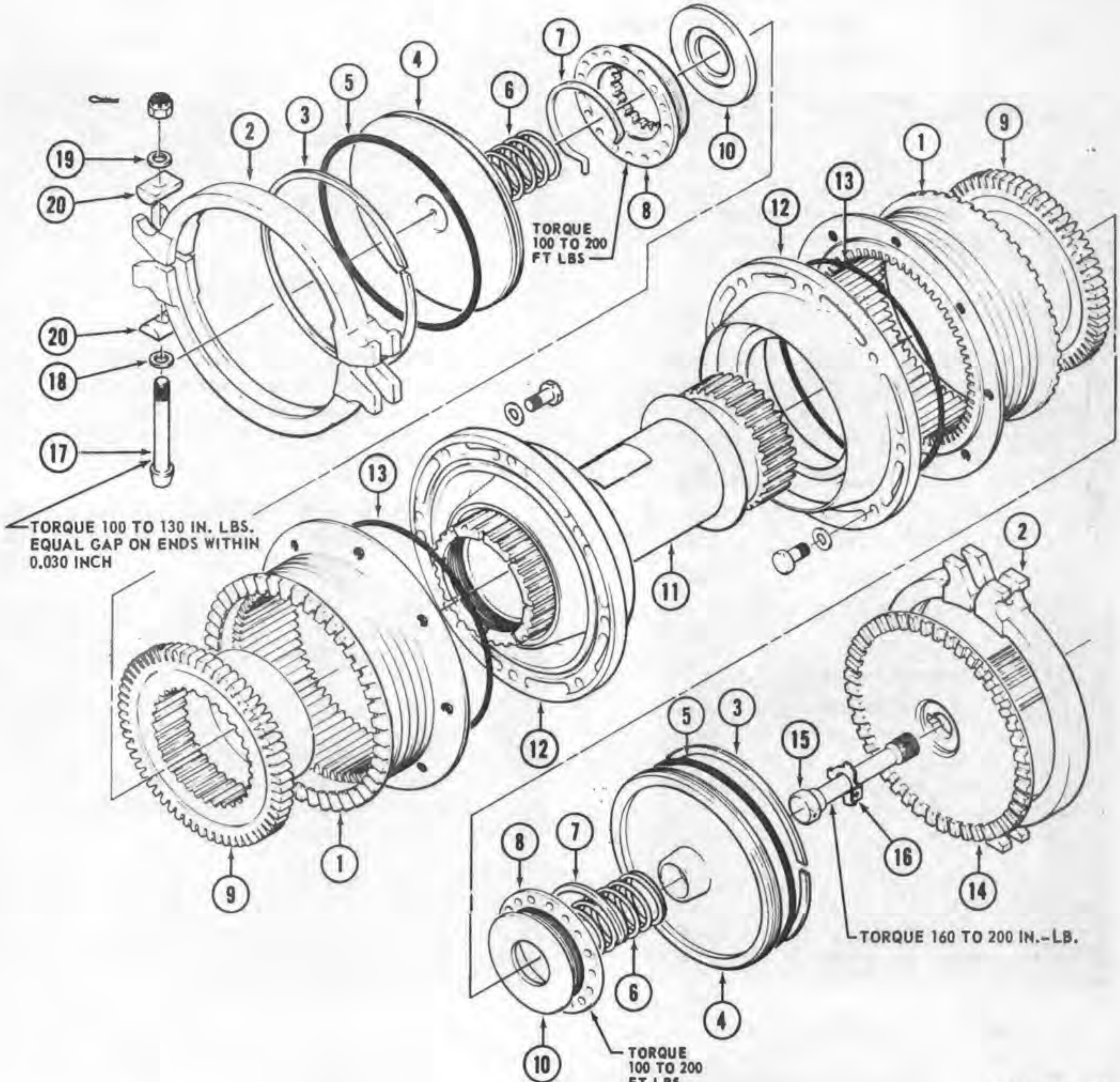
(c) Nicks and scratches not running within 15 degrees of shaft axis must be polished out. A maximum depth of 0.005 inch may be polished out on 100 percent of shaft circumference. A maximum depth of 0.010 inch may be polished out provided the total polished area does not exceed 20 percent of shaft circumference at any point.



1. Coupling Clamp Set
2. Spiral Lock-ring
3. Retainer
4. O-Ring
5. Spring
6. Shaft Assembly
7. Retaining Bolt
8. Key Washer
9. Adapter
10. Clamp Bolt
11. Special Washer
12. Washer
13. Pivot Spacers

AV 054127

Figure 7-3. Main drive shaft – 204-040-010



1. Outer Coupling
2. Coupling Clamp Set
3. Spiral Lock-ring
4. Retainer
5. Packing
6. Spring
7. Locking Spring
8. Splined Nut
9. Inner Coupling (Spherical)
10. Retainer
11. Shaft Assembly
12. Boot
13. O-ring
14. Adapter
15. Retaining Bolt
16. Key Washer
17. Clamp Bolt
18. Special Washer
19. Washer
20. Pivot Spacers

Figure 7-4. Main drive shaft – 205-040-004

(2) A minimum radius of 1/2 inch should be used in polishing out nicks and scratches. Polished area must be refinished with two coats of zinc chromate primer (item 106, table 1-2).

e. Inspection and Lubrication – Main Drive Shaft Couplings (204-040-010).

NOTE

Check and lubricate couplings on main drive shaft at prescribed inspection periods. (See figures 7-3, 7-5, 7-6 and 7-7.)

(1) Place shaft assembly in a suitable cradle.

(2) Open either coupling by removing spiral lock-ring (2, figure 7-3) and retainer (3) with O-ring seal (4). Hold retainer against pressure of spring (5) while removing lock-ring, then remove retainer and spring.

(3) Move outer coupling inward on shaft until male-splined inner coupling is disengaged and clear of outer coupling. Take necessary precautions to avoid surface damage to shaft while coupling is disassembled.

(4) Remove all old grease from inner and outer couplings.

CAUTION

Do not use cleaning solvent inside shaft couplings.

(5) Inspect each spline tooth of inner coupling for excessive wear. (See figure 7-6.) If coupling is worn beyond acceptable limits as illustrated, replace drive shaft and tag unserviceable assembly for overhaul by higher maintenance level.

(6) Check to see if the lock spring can be seen in one of the aligning holes. Check the nut for security. (See figure 7-7, detail A.)

(7) If coupling is in serviceable condition, check that inner and outer couplings are clean before reassembly. Also check area on outer coupling over which O-ring must pass to reach its groove, and remove any burrs or sharp edges by careful use of a fine Arkansas hand stone. (See figure 7-7, detail B.)

(8) Apply a thin layer of grease (item 8, table 1-2) on inboard surface of male (inner) coupling. (See figure 7-7, detail C.) Mate parts and move outer coupling to full outward position, with inner coupling bottomed. (See figure 7-7, detail D.)

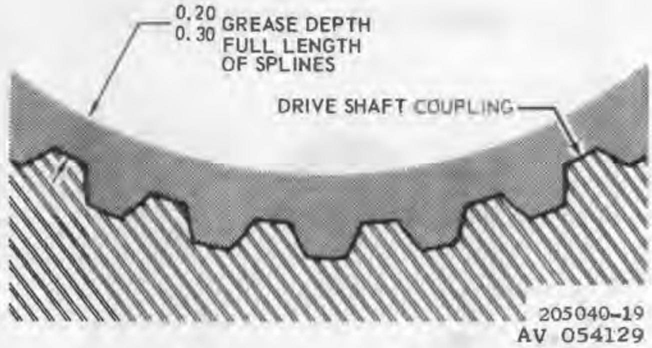


Figure 7-5. Lubrication of male coupling

(9) Coat splines of female coupling with grease. Use a spatula to work out all air pockets from grease. (See figure 7-7, detail E.) Continue using grease until a wall 0.20 to 0.30 inch above top of splines has been built up. (See figure 7-7, details F and G.)

(10) With drive shaft in upright position, position centering spring in center of drive shaft. (See figure 7-7, detail H.)

(11) Place a new O-ring seal (4, figure 7-3) in groove around retainer (3). Apply a coating of grease (item 8, table 1-2) on O-ring. (See figure 7-7, details I and J.)

(12) Place retainer on coupling so as to engage centering spring and gently push with thumbs till O-ring is eased past ends of teeth on the outward face of the female coupling. Exert steady and even pressure on the retainer as shown in figure 7-7, detail K, as the O-ring slides over entry chamfer to position.

(13) Using a small screw driver or similar tool, carefully clean lock-ring groove. (See figure 7-7, detail L.) Look carefully for any small slivers of rubber from the O-ring. If any sign of damage is found reinspect for sharp edges and replace O-ring. (See figure 7-7, detail M.)

(14) Clean all grease from outside of coupling and retainer. Install lock-ring. (See figure 7-7, detail N.)

(15) Inspect and lubricate opposite end coupling in the same manner.

f. Inspection and Lubrication – Main Drive Shaft Couplings (205-040-004).

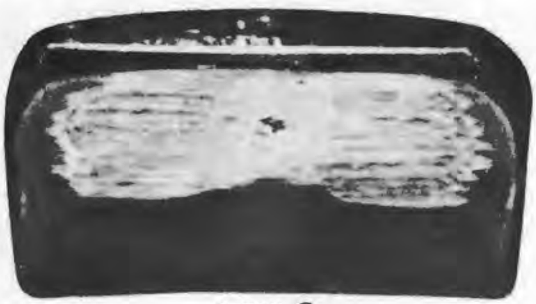
NOTE

Check and lubricate couplings on main drive shaft couplings at 600 hour inspection intervals. Check for leakage and damage at prescribed intervals. (See figures 7-4, 7-8 and 7-9.)

DETAIL A

DETAIL B

Details A and B show typical acceptable patterns of wear on spherical teeth of male coupling. Patterns will vary due to differences in time in service, alignment, and extent of operation at high power.



DETAIL C

Small defects as shown in Detail C can occur in either Detail A or B. This type of defect is not detrimental to the coupling.

DETAIL D

Grooves, as shown in Detail D, of any length are acceptable on not more than twelve consecutive teeth or twenty-four teeth total.

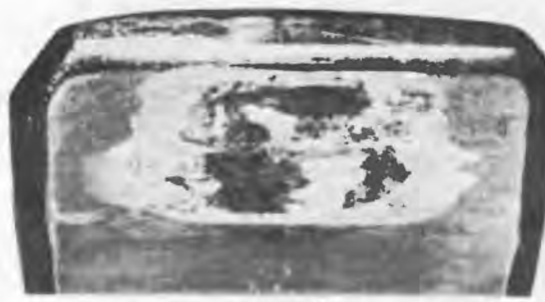
DETAIL E

DETAIL F

Condition as shown in Detail E or F are acceptable on not more than five consecutive teeth or twelve teeth total.

Note

When male coupling is replaced for defects like Detail E or F, female coupling may require honing to remove any build-up of transferred metal.



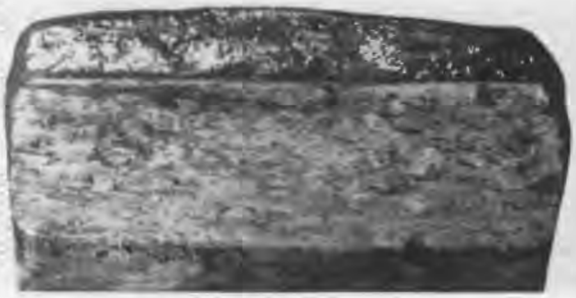
DETAIL G

Defects as in Detail G which cover over 1/2 the tooth length and 1/2 the tooth depth are to be rejected. Care should be taken in inspection of the female. If metal build-up is not excessive it may be honed down.

204040-83H-1
AV 054130-1

Figure 7-6. Inspection criteria for spherical (male) couplings on main drive shaft — 204-040-010 (Sheet 1 of 2)

DETAIL H



DETAIL I

Conditions shown in Detail H or I are not acceptable. This type of failure has only been found when an improper lubricant had been used. These photos show that the entire tooth surface has been spalled. All or at least 30 of the 60 teeth will exhibit this failure. Check for the proper kind of lubricant, and be sure the proper amount of lubricant is installed.

Normally if the male coupling is as shown in Details H, I, or J the surface of the female will be damaged and should be scrapped.

DETAIL J

Detail J shows a group of teeth from a coupling which was run with an improper lubricant. The type of failure as shown in Details H and I.

204040-83F-2
AV 054132-2

Figure 7-6. Inspection criteria for spherical (male) couplings on main drive shaft -- 204-040-010 (Sheet 2 of 2)

(1) Attach holding fixture T101420 on either curvic coupling with clamp set (2, figure 7-4). Secure bar of fixture in a vise.

(2) At other end of shaft, remove spiral retainer ring (3), grease retainer (4) with O-ring (5) and centering spring (6). Remove locking spring (7) from nut (8). Remove grease from coupling. Use splined wrench T101306 to break torque of nut (8). Do not remove nut. Do not push outer coupling off the inner coupling. (See figure 7-9, details A through D.)

(3) Remove holding fixture and install on partially disassembled coupling using grease retainer (10) as a spacer to keep inner coupling (9) in place. Open opposite coupling and break torque of nut as in step (2) (see figure 7-9, details E and F).

(4) Remove fixture from coupling and remove retainer plate.

(5) Remove coupling retaining nut (8, figure 7-4) and spring retainer (10) from each end of the shaft. (See figure 7-9, details G and H.)

(6) Remove couplings from shaft (see figure 7-9, detail I).

(7) Carefully remove inner coupling (9, figure 7-4) from outer coupling (1) (see figure 7-9, detail J). Record serial numbers of mating inner and outer couplings. Clean grease from coupling with clean cloth.

(8) Thoroughly clean grease from all parts.

(9) Inspect couplings (1 and 9, figure 7-4) for defective, burned or pitted teeth. Use a white card or tongue depressor at root of tooth to deflect light (see figure 7-9, detail K). If any defects are noted on inner couplings, the outer coupling teeth will also be damaged. See figure 7-8 for allowable damage. Splines with local damage not exceeding 0.002 inch in depth and/or 10% of the total effective spline surface area may be dressed with a fine India stone. No rework is allowed on the external teeth of the inner coupling and/or the internal splines of the outer coupling which would result in removal of base material. Inspect outer couplings for overheating. Case discoloration

DETAIL **A**

DETAIL **B**

DETAIL **C**

DETAIL **D**

DETAIL **E**

DETAIL **F**

205040-21-1
AV 054131-1

Figure 7-7. Input drive shaft — 204-040-010 lubrication (Sheet 1 of 4)

DETAIL **G**

DETAIL **H**

DETAIL **I**

DETAIL **J**

DETAIL **K**

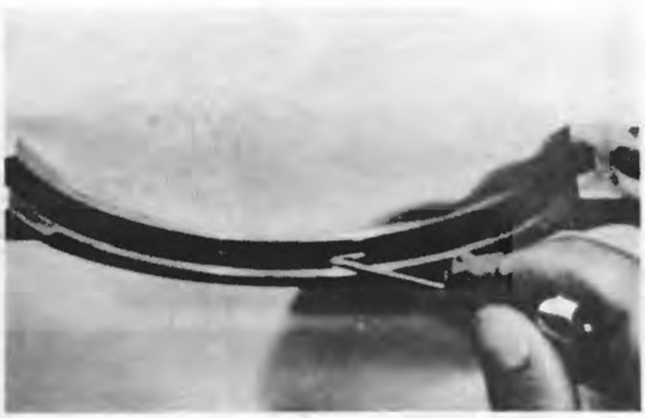
DETAIL **L**

205040-21-2
AV 054131-2

Figure 7-7. Input drive shaft — 204-040-010 lubrication (Sheet 2 of 4)

DETAIL **M**

DETAIL **N**



DETAIL **O**

DETAIL **P**

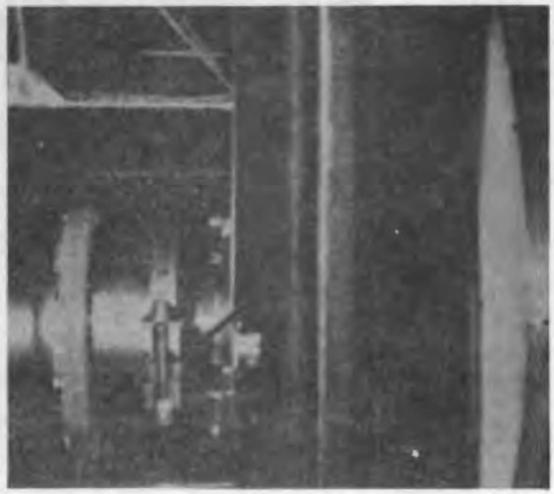
DETAIL **Q**

DETAIL **R**

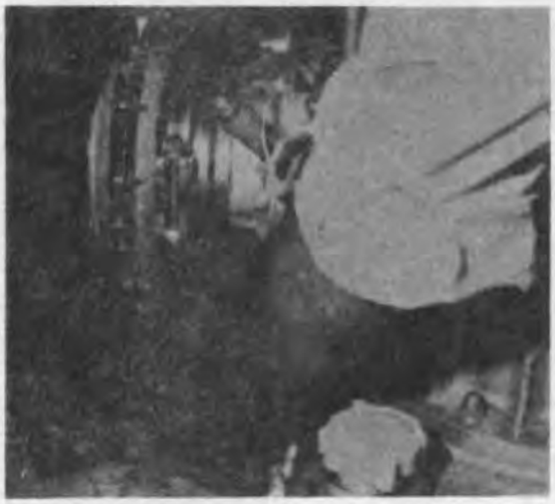
205040-21-3
AV 054131-3

Figure 7-7. Input drive shaft — 204-040-010 lubrication (Sheet 3 of 4)

DETAIL **S**

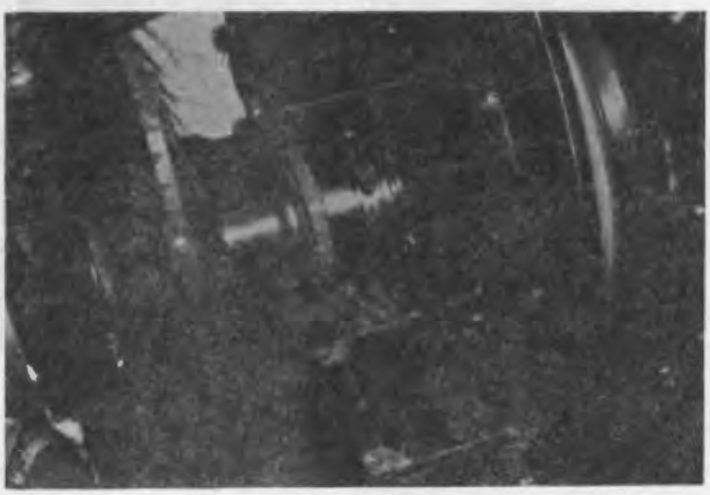


DETAIL **T**



DETAIL **U**

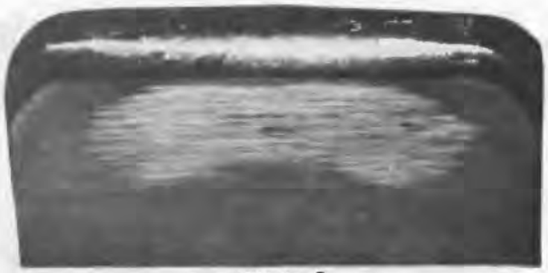
DETAIL **V**



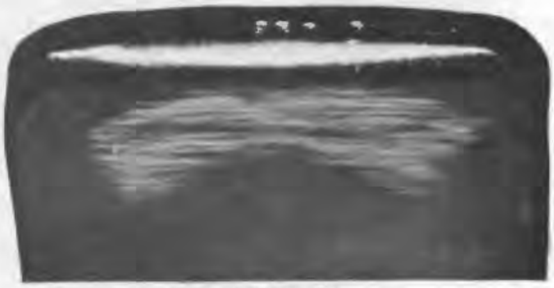
DETAIL **W**

205040-21-4
AV 054131-4

Figure 7-7. Input drive shaft – 204-040-010 lubrication (Sheet 4 of 4)



DETAIL A

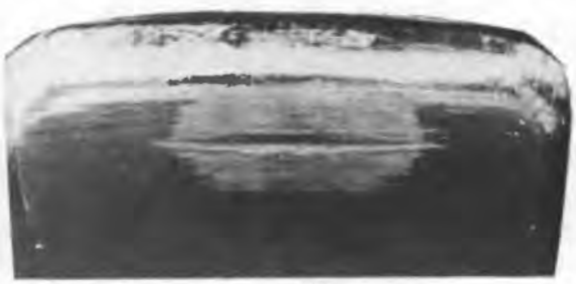


DETAIL B

Details A and B show typical acceptable patterns of wear on spherical teeth of male coupling. Patterns will vary due to differences in time in service, alignment, and extent of operation at high power.

DETAIL C

Small defects as shown in Detail C can occur in either Detail A or B. This type of defect is not detrimental to the coupling.



DETAIL D

Grooves, as shown in Detail D, of any length are acceptable on not more than twelve consecutive teeth or twenty-four teeth total.

DETAIL E

DETAIL F

Condition as shown in Detail E or F are acceptable on not more than five consecutive teeth or twelve teeth total.

Note

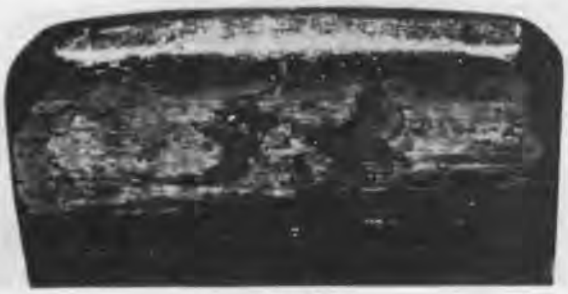
When male coupling is replaced for defects like Detail E or F, female coupling may require honing to remove any build-up of transferred metal.

DETAIL G

Defects as in Detail G which cover over 1/2 the tooth length and 1/2 the tooth depth are to be rejected. Care should be taken in inspection of the female. If metal build-up is not excessive it may be honed down.

204040-83H-1
AV 054130-1

Figure 7-8. Inspection criteria for spherical (male) couplings on main drive shaft — 205-040-004 (Sheet 1 of 2)



DETAIL H

DETAIL I

Conditions shown in Detail H or I are not acceptable. This type of failure has only been found when an improper lubricant had been used. These photos show that the entire tooth surface has been spalled. All or at least 30 of the 60 teeth will exhibit this failure. Check for the proper kind of lubricant, and be sure the proper amount of lubricant is installed.

Normally if the male coupling is as shown in Details H, I, or J the surface of the female will be damaged and should be scrapped.

DETAIL J

Detail J shows a group of teeth from a coupling which was run with an improper lubricant. The type of failure as shown in Details H and I.

204040-83F-2
AV 053130-2

Figure 7-8. Inspection criteria for spherical (male) couplings on main drive shaft – 205-040-004 (Sheet 2 of 2)

is evidence of overheating and will require replacement of the outer and inner couplings.

NOTE

No rework is allowed for removing corrosion pits. Superficial corrosion may be removed using Scotchbrite by hand only.

(10) Inspect O-ring groove in retainer plate (4, figure 7-4) and outer coupling (1) for nicks and burrs. Dress off burrs with abrasive cloth (item 508, table 1-2). If retainer plate has nick(s) deep enough to allow grease passage, replace retainer.

(11) Inspect boot (12) for cracks, tears or wrinkles. Replace boot and O-ring if defects are found. To replace boot, cut lockwire and remove bolts and washers securing boot to outer coupling. Install boot on outer coupling making sure large holes in boot mate with the tapped holes in the outer coupling. Install bolts and washers. Torque bolts and install lockwire.

(12) Position outer coupling (1) with boot down and squeeze one fourth tube of grease (item 8, table 1-2) into each coupling. (See figure 7-9, detail L.)

(13) Carefully install inner coupling into outer coupling. Ensure that the proper outer and inner couplings are mated according to serial numbers recorded in step g. (see figure 7-9, detail J). Install couplings on shaft; install retainer (10, figure 7-4) and nut (8) finger tight on each coupling.

CAUTION

Before torquing nut (8) ensure that outer and inner coupling teeth are fully engaged, to avoid damage to boot (12).

(14) Clamp holding fixture T101420 to coupling and place bar of fixture in vise. Torque nut (8) 100 to 200 foot-pounds. Install lock spring (7) on nut. Check that lock spring tangs engage mating holes in nut and shaft. Remove holding fixture and perform step (14) for the other coupling.

(15) Fully extend outer couplings. Cut a piece of corrugated cardboard 8 by 16 inches and wrap around shaft. Secure with several wraps of tape as illustrated in figure 7-9, detail M.

DETAIL A

DETAIL B

DETAIL C

DETAIL D

DETAIL E

205040-34-1
AV 054133-1

Figure 7-9. Input drive shaft — 205-040-004 lubrication (Sheet 1 of 3)

DETAIL F

DETAIL G

DETAIL H

DETAIL I

205040-34-2
AV 054133-2

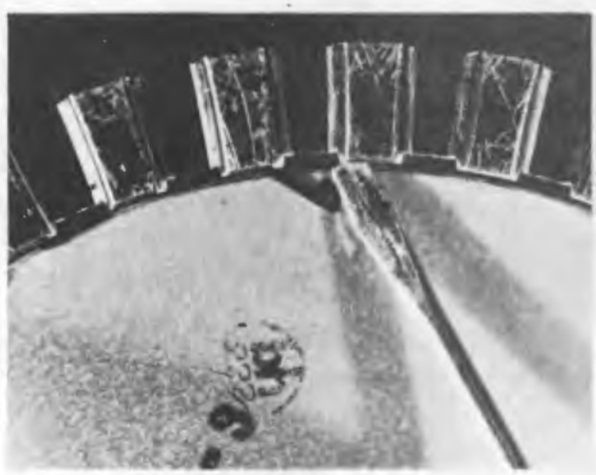
Figure 7-9. Input drive shaft — 205-040-004 lubrication (Sheet 2 of 3)

DETAIL J

DETAIL K

DETAIL L

DETAIL M



DETAIL N

205040-34-3
AV 054133-3

Figure 7-9. Input drive shaft — 205-040-004 lubrication (Sheet 3 of 3)

(16) Squeeze the remaining three-quarters tube of grease (item 8, table 1-2) into outer coupling. (See detail M.)

NOTE

Six ounce tube of grease provides correct amount of grease in one end of shaft.

(17) Put a light film of grease in the O-ring groove of retainer plate (4, figure 7-4) and install a new O-ring (5).

(18) Install spring (6) in outer coupling and carefully press retainer plate (4) into position. Inspect plate to ascertain that O-ring was not damaged.

(19) Install retainer ring (3) in groove of outer coupling. Check that ring is seated in groove.

(20) Perform steps (16) through (19) for opposite coupling.

(21) Remove cardboard from shaft and clean all traces of grease from exterior of drive shaft assembly with clean dry cloth.

(22) Inspect coupling boots for damage that may have occurred during assembly. Wrinkles are caused by misindexing of coupling teeth; tears are usually caused during torquing of retaining nut because the inner and outer coupling teeth were not engaged.

g. Installation – Main Drive Shaft.

NOTE

Before installing drive shaft CAREFULLY wipe clean the area surrounding the drive shaft, especially the intake screen, fifth mount beam, synchronized elevator tube and collective tube. (See figure 7-7, details R and S.)

CAUTION

When the T53-L-9, -9A, -11 or 11C engine is installed in the helicopter, be sure to use 24 spline adapter, P/N 204-040-630, retaining bolt, P/N 204-040-631 and key washer, P/N 204-040-634. When the T53-L-11B/D or T53-L-13 engine is installed in the helicopter, be sure to use 26 spline adapter P/N 204-040-812-3, retaining bolt P/N 204-040-813 and key washer P/N 204-040-814.

(1) Insert adapter (9, figure 7-3; 14, figure 7-4) into engine shaft. Install retaining bolt (7, figure 7-3; 15, figure 7-4) and key washer (8, figure 7-3; 16, figure 7-4) with short tab of washer in adapter slot. Torque bolt (7, figure 7-3) with 100 to 140 inch-pounds torque and lockwire bolt head to outer tab of key washer. Torque bolt (15, figure 7-4) with 160 to 200 inch-pounds torque and lockwire bolt head to outer tab of key washer.

CAUTION

When installing drive shaft, P/N 204-040-010, (see figure 7-3) be sure that coupling with cooling fins is at forward end, to reduce possibility of damage due to overheating during operation. Drive shaft, P/N 205-040-004 (see figure 7-4) may be installed in either direction.

(2) Place drive shaft assembly (with cooling fins at forward end if installing P/N 204-040-010) between engine adapter (9, figure 7-3; 14, figure 7-4) and transmission input drive coupling (see figure 7-7, detail T for P/N 204-040-010 installation).

NOTE

Do not compress shaft couplings more than necessary, as this will tend to force grease past the micarta inboard seal rings.

(3) Install coupling clamp sets (1, figure 7-3; 2, figure 7-4) to secure both ends of shaft as follows:

(a) Carefully wipe inside grooves of clamps clean off all traces of grease, as shown on figure 7-7, details O and P. Fit clamp halves around coupling joint, checking to make sure that serial numbers on both clamp halves are alike and on same side. (See figure 7-7, detail Q.) Clamp halves should fit snug.

(b) Install clamp bolts (10, figure 7-3; 17, figure 7-4) with heads toward shaft rotation. Install bolts with two half-round pivot spacers (13, figure 7-3; 20, figure 7-4) next to clamp ends. Flat sides of pivot washers must face out. Special countersunk steel washer (11, figure 7-3; 18, figure 7-4) shall be next to bolt head with countersink toward bolt head. A steel washer (12, figure 7-3; 19, figure 7-4) shall be under nut. Thin washers can be added under nut as required if an equal quantity is added under opposite nut to maintain balance.

(c) Position the two clamp sets (1, figure 7-3; 2, figure 7-4) around shaft with slots 90 degrees from each other.

(d) Torque clamp bolts (10, figure 7-3; 17, figure 7-4) evenly with 100 to 130 inch-pounds torque, keeping equal gaps at ends of clamp sets within 0.030 inch. Tap around outside of clamps to insure good seating, and recheck bolt torque. Secure nuts with cotter pins.

(4) Carefully wipe any grease from shaft exterior and areas around forward coupling.

(5) After first ground run-up, or first flight following reassembly of drive shaft couplings or installation of new drive shaft, inspect areas around both main drive shaft couplings, in line with coupling clamps, for evidence of grease slinging. (See figure 7-7, details U, V and W for typical inspection.) If grease leakage is evident, proceed as follows:

(a) Remove clamp sets to check for grease in grooves.

(b) If no grease is found, reinstall clamp sets. Watch for further evidence of leakage at next run-up.

(c) If grease is found in clamp grooves, remove shaft and inspect couplings for lubrication and proper installation of O-rings. (Refer to paragraph 7-4, step e. or f.)

h. Alignment – Main Drive Shaft.

(1) Check alignment of the main drive shaft installation between the transmission input drive quill coupling and the engine output shaft adapter when any one of the following conditions apply:

(a) Main drive shaft inspection reveals excessive wear of coupling spline or indications of excessive heating during operation.

(b) Major repair in center fuselage, tail boom, or pylon support structure.

(c) Drive shaft misalignment is suspected for any reason.

NOTE

When engine is replaced, drive shaft alignment check is not required provided engine mount and/or shim stack-up is not changed.

(2) Remove the main drive shaft assembly, leaving the engine output shaft adapter installed in the end of the engine output shaft.

(3) Position transmission pylon to best position, corresponding to operation, as follows: (See figure 7-10.)

(a) Release fasteners attaching lower access doors to pylon support and remove doors. Remove screws attaching upper access doors to pylon support and remove doors.

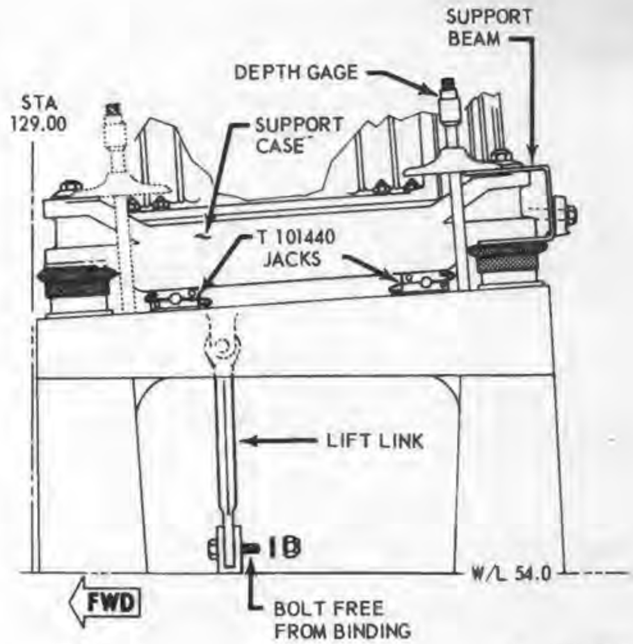


Figure 7-10. Positioning pylon for drive shaft alignment

(b) Use maintenance hoist T101452 to raise pylon to position where lower bolt of lift link can be moved freely with nut and washer removed. Replace bolt, if binding occurs due to corrosion or galling.

(c) Install four transmission leveling jacks T101440 (two at each side) between transmission support case and top of pylon support and remove cotter pin, nut, and washer from lower end of lift link.

CAUTION

Do not attempt to raise or lower transmission with jacks only. Use a suitable hoist in conjunction with jacks.

NOTE

Use shim plates of jacks to obtain necessary height.

(d) With maintenance hoist slackened, and nut and washer removed from lower bolt of lift link, adjust jacks to tilt transmission with jacks until all four corners are within 0.020 inch of each other, keeping bolt free until bolt can be freely moved with fingers.

NOTE

Insure that lower lift link bolt moves freely throughout the remaining pylon positioning procedures.

(e) Determine that transmission support points are symmetrically parallel with pylon support structure by measuring at each mount with a micrometer depth gage (see figure 7-10).

(f) Use micrometer depth gage to measure from the top surface of the support case mounting plates to the top of the pylon support. This measurement is to be taken at each of the four mounts.

(g) Subtract thickness of support beam from the measurements obtained at the two aft mounts. This action will allow for thickness of the fifth mount support beam channel which covers the mounting plates at these two points. All four measurements should now be equal within 0.020 inch.

NOTE

Lower thickness of the fifth mount support beam channel need not be considered, since it has been compensated for by a difference in the filler plates.

(h) When all four points cannot be adjusted to the same dimension, take the average of the two front points and adjust the two rear points accordingly.

(i) Upon completion of transmission pylon positioning, recheck the lower bolt of the lift link to make sure that it can be freely moved with the fingers.

(4) Set the target plate with the arrow of the center disc indexed at 3.5 on the inner scale, and secure by tightening the two washer-head screws at back of plate. Position the plate on the coupling with the 1.75 index of the outer scale at the top of the vertical center line, and secure with coupling clamp set. (See figure 7-11.)

(5) Install the target plate of the engine-to-transmission drive shaft alignment tool set T101419 on the transmission input quill coupling. (See figure 7-11.)

(6) Install alignment gage of tool set on the engine output shaft adapter, and secure with coupling clamp set.

NOTE

Both alignment checks (steps (7) and (8)) must be accomplished to determine if alignment is correct.

(7) Check horizontal and vertical alignment by inserting a suitable tool through access holes in the alignment gage housing and pushing the plunger forward, against the retracting spring tension, toward the target plate hole.

(a) To indicate correct alignment, largest diameter of plunger must enter hole in target plate.

(b) If misalignment is indicated, observe and note amount and direction of such misalignment.

NOTE

No correction of misalignment should be attempted before completion of angularity check outlined in the following step (8). Shim requirements can be best determined on basis of both checks.

(8) Perform angularity check as follows:

(a) Mount a dial indicator on the forward end of the alignment gage plunger as shown in figure 7-11.

(b) Position the dial indicator for contact at 2.5 inch radius (just inside outer scale numerals) on target plate. Rotate the gage through a full turn to determine area of target plate nearest the engine. This area should be found on the left-hand side of the target plate between the 8 and 10 o'clock positions. Zero the dial indicator in this area. Check run-out through a full turn of the gage. Runout must be within 0.016 inch maximum total indicator reading.

(9) Make correction of engine alignment by use of shims under engine mount deck fittings as required. (See figure 7-11.)

(a) Loosen screws around intake bellmouth in forward firewall, and around attachment ring in rear firewall, to allow engine to shift as necessary during alignment.

(b) Do not exceed 0.250 shim thickness under any fitting.

(c) Repeat alignment and angularity checks after any change of shims.

(10) When alignment is correct, remove T101419 tool set and T101440 jacks. Retighten screws in firewalls as necessary.

(11) Install nut, washer, and cotter pin on lower bolt of lift link. Install access doors on pylon island structure.

(12) Install main drive shaft.

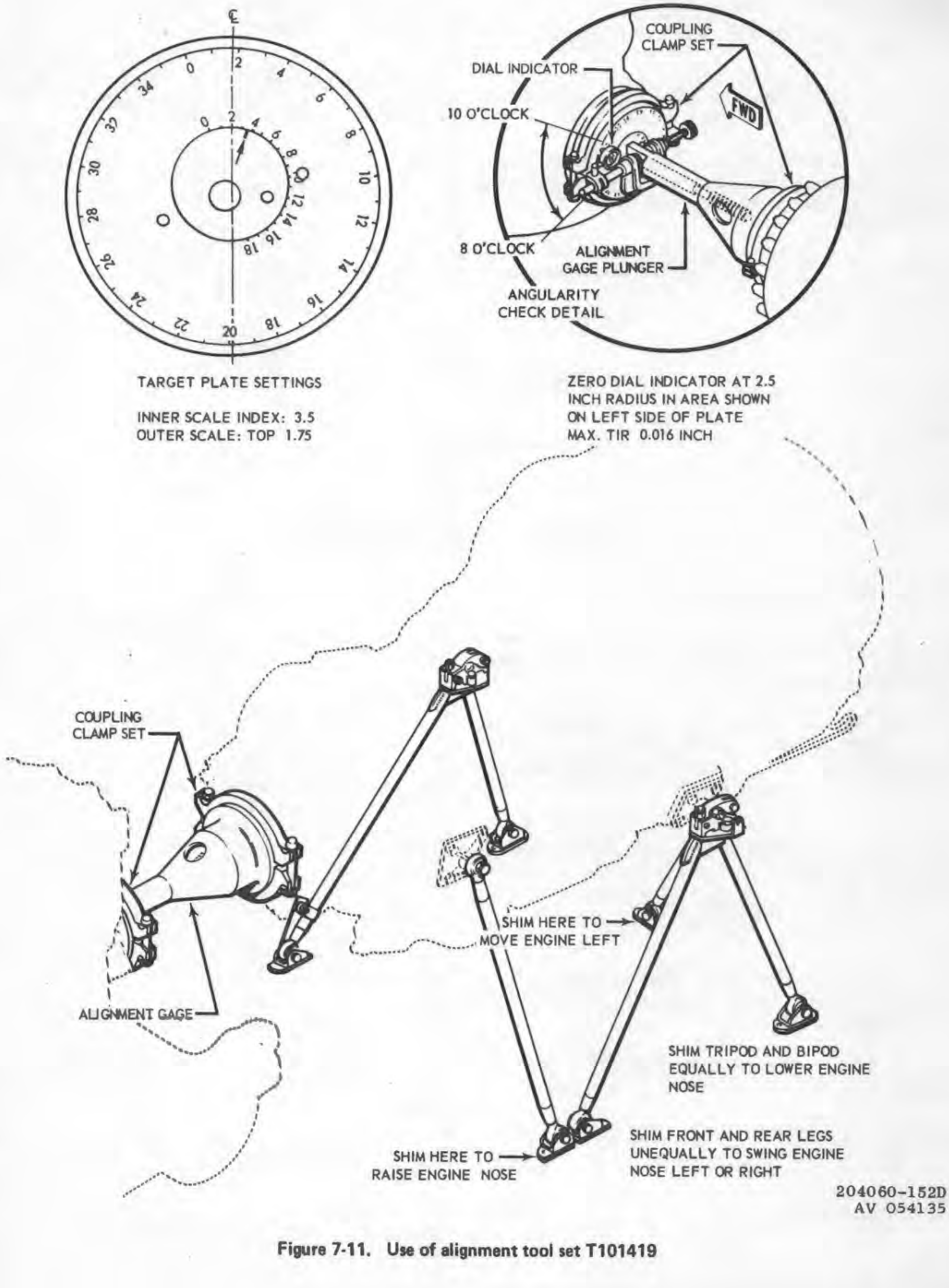


Figure 7-11. Use of alignment tool set T101419

i. Packaging – Main Drive Shaft.

(1) Clean and dry main drive shaft in accordance with MIL-P-116.

(2) Apply corrosion preventive compound (item 309, table 1-2) to unplated steel surfaces.

(3) Wrap assembly in grease-proof barrier material (item 505, table 1-2) and secure with pressure-sensitive tape (item 400, table 1-2). Shape wrapper to contour of assembly.

(4) Place drive shaft into contoured bottom cushion of metal container, Part No. 204-040-000 MUSC, and align to fit contour.

(5) Align top contoured cushion to fit drive shaft and lower into container.

(6) Plate 10 eight-unit bags (total 80 units) of desiccant (item 310, table 1-2) in container.

(7) Place rubber gasket on lower half of container and install container lid.

(8) Install locking ring over lip of container lid and container and secure with bolt and nut. Tighten nut sufficiently to insure a moisture-vapor proof closure.

Section III. CLUTCHES

(Not Applicable)

Section IV. MAIN TRANSMISSION

7-5. Main Transmission.

a. The transmission (see figure 7-12) is located directly ahead of engine and is suspended by pylon-isolating mounts on structural support.

b. The unit is coupled to the engine through a short drive shaft and provides drive angle change and speed reduction, through a train of spiral bevel gears and two-stage planetary gears, to drive the main rotor mast.

c. A freewheel clutch in the input drive quill coupling disengages to allow main rotor and gear train to turn freely when engine is stopped or is idling below rotor driving speed, as in auto-rotational descent.

d. Secondary gear trains drive tail rotor shaft, DC generator, rotor tachometer generator, hydraulic pump, and transmission oil pump.

e. Output reduction ratios, expressed as revolutions of each driven unit per engine revolution, are as follows:

Main Rotor Mast	0.0491
DC Generator	1.0
Tail Rotor Drive Shaft	0.6516
Hydraulic Pump	0.6516
Tachometer Generator	0.6516
Oil Pump	0.6274

NOTE

After further reduction in 90-degree gear box, tail rotor turns at 0.25 engine rpm.

7-6. Transmission Pylon Mounts.

a. A lift link and five pylon isolation mounts are used to attach transmission to the helicopter fuselage. Lift link is of forged steel with self-aligning end bearings, and is connected between forward underside of transmission support case and a fuselage beam directly below.

b. Four main isolation mounts are located on pylon supports under corners of transmission support case. Each consists of a cylindrical molded rubber core bonded between steel inner and outer sleeves, with outer sleeve flange secured on pylon support by four bolts.

c. A large mount bolt extends up through mount inner sleeve to seat in tapered bushing of transmission support case leg, and is secured by a retaining bolt installed from top through a broad special washer and threaded into tapped upper end of mount bolt.

d. Silicone rubber protective boots, with supporting bushings, cover both ends of mount.

e. Both rear main pylon isolation mounts are restrained by friction dampers, which are cylindrical units

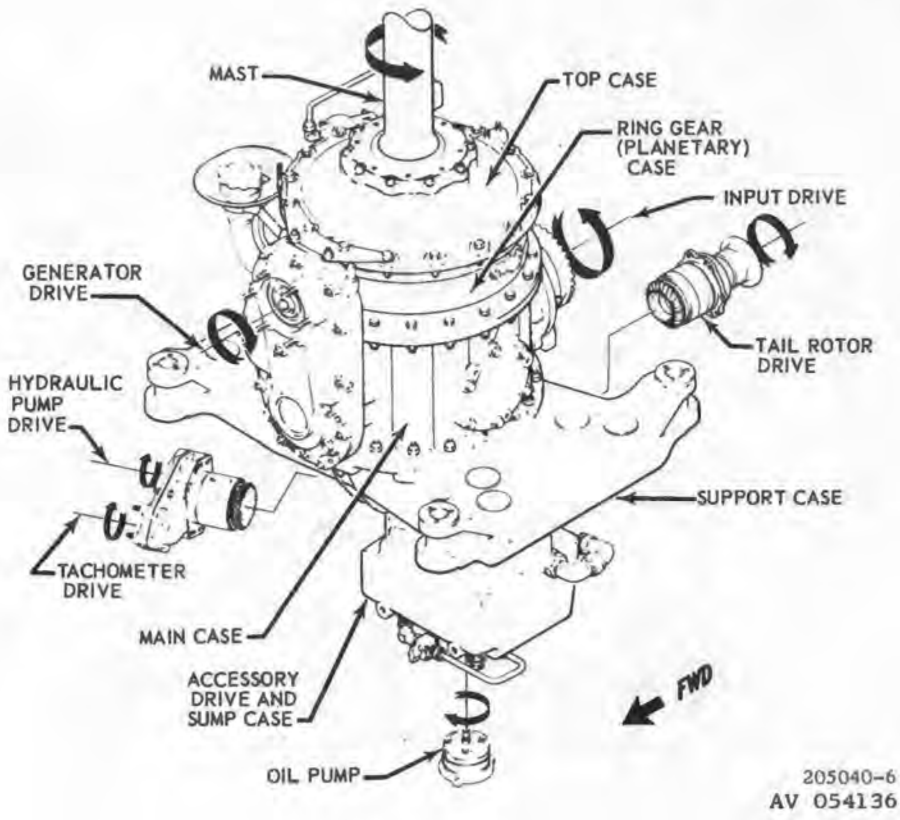


Figure 7-12. Transmission diagram

connected between lower ends of mount bolts and fittings in pylon support structure.

f. A fifth isolation mount, similar to four main mounts, is located at center aft of pylon on a support fitting bridged across rear side of pylon support. Fifth mount bolt has a self-aligning bearing at upper end, which is attached by a bolt to middle of a welded beam extending between aft legs of transmission support case.

g. Inspection – Transmission Mounts.

(1) Inspect mount boots for proper installation and deterioration.

(2) Any boot that has deteriorated, is ripped, or cut should be replaced.

(3) If vibration, roughness or mount bottoming is noted, mount must be replaced.

h. Inspection – Friction Dampers. Inspect dampers for binding, rough movement or actual lack of movement by stationing personnel around pylon mounting points and move pylon fore and aft using mast as a lever to rock pylon. If any of the above conditions exist replace damper.

7-7. Transmission Oil System.

a. The transmission (see figures 7-13 and 7-14) is lubricated by an oil system which is independent of engine oil system, except that oil coolers are mounted side by side and use same blower.

b. Oil supply from transmission sump is circulated under pressure from gear-driven pump through internal passages and a filter to sump outlet from which external lines are routed to an oil cooler with a separate thermal bypass valve (for external filter), then to a manifold on transmission main case.

c. This manifold is equipped with a relief valve to regulate system pressure and distributes oil through jets and internal passages to lubricate bearings and gears inside transmission, where oil drains back to sump.

d. Oil temperature and pressure gage indications are provided by a thermobulb and a pressure transmitter.

e. A thermoswitch and a pressure switch will light caution panels lettered XMSN OIL HOT and XSN OIL PRESS (low pressure) if such conditions occur.

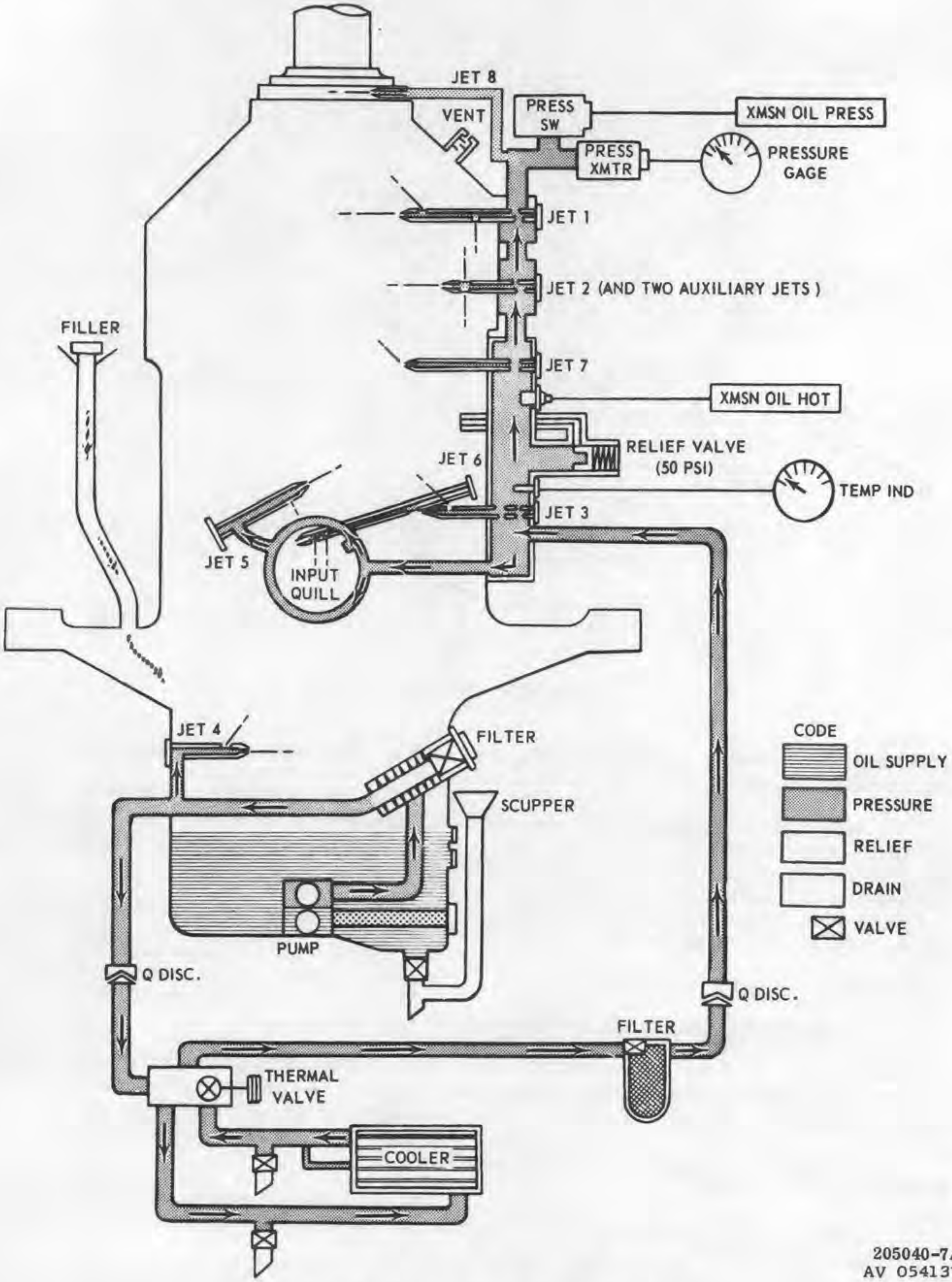


Figure 7-13. Transmission oil system (schematic)

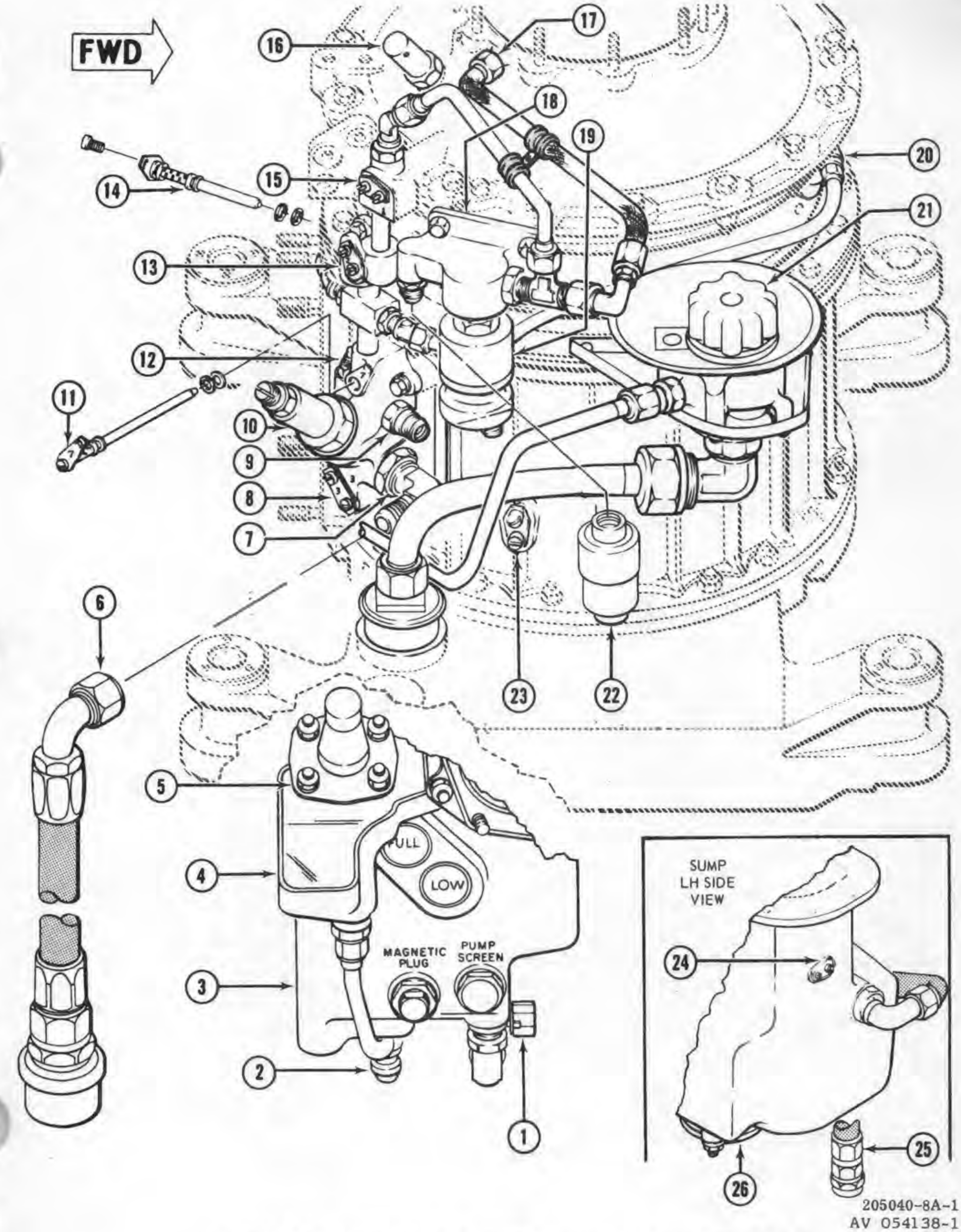
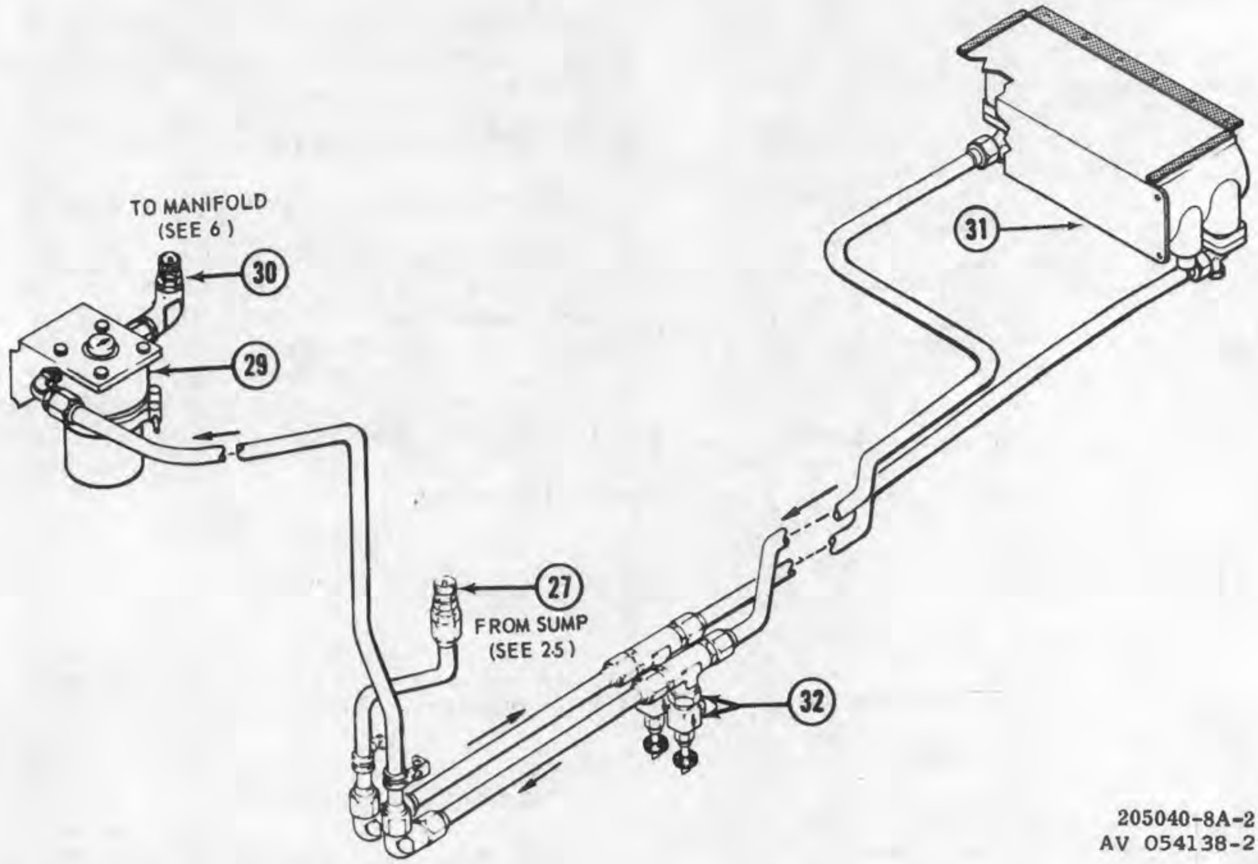


Figure 7-14. Transmission oil system components and piping (Sheet 1 of 2)



1. Drain Valve	12. Thermoswitch	23. Jet No. 6
2. Drain Coupling	13. Jet No. 2	24. Jet No. 4
3. Sump	14. Jet No. 5	25. Sump Outlet Hose (to 27)
4. Scupper	15. Jet No. 1	26. Oil Pump
5. Filter	16. Breather	27. Coupling
6. Manifold Inlet Hose (to 30)	17. Jet No. 8	29. External Filter
7. Manifold Inlet	18. Pressure Tap Manifold	30. Coupling
8. Jet No. 3	19. Pressure Transmitter	31. Oil Cooler
9. Temperature Bulb	20. Auxiliary Jet No. 2	32. Drain Valves
10. Pressure Relief Valve	21. Filler Cap	
11. Jet No. 7	22. Pressure Switch	

Figure 7-14. Transmission oil system components and piping (Sheet 2 of 2)

7-8. Servicing And Drain Provisions.

a. Oil system servicing provisions are mainly accessible from right side of transmission. Filler neck is at top right, under transmission fairing.

b. Oil level sight gages on sump case can be checked through a view port on pylon island in cabin, using light controlled by a pushbutton switch.

c. Sump oil filter, pump screen, and magnetic plug can be reached through access door at same location.

d. A drain valve is located under transmission sump. Two cooler line drain valves are in bottom of fuselage compartment just behind aft cross tube of landing gear.

7-9. Transmission Primary Oil Filter.

Transmission is provided with an oil filter mounted in a pocket in upper right aft corner of sump case, with inlet and outlet through internal passages. Filter assembly consists of a stack of wafer-disc screens assembled with spacers on a perforated tube, attached on a body incorporating a bypass valve for continued oil flow if screens become clogged. A cast scupper on sump case is located below filter mounting pad, and is connected to an overboard drain line to dispose of spilled oil.

a. Removal – Primary Oil Filter.

(1) Obtain access through right-hand side of pylon island in cabin by peeling down soundproofing from top and removing plate marked TRANSMISSION OIL LEVEL ACCESS.

(2) Remove nuts and washers from four mounting studs at corners of filter body.

(3) Pull filter from sump case pocket. Allow excess oil to drain through scupper into suitable container placed under overboard drain outlet at left underside of fuselage.

b. Cleaning – Primary Oil Filter.

(1) Disassemble screens and spacers from tube by removing retaining nut and tab-washer.

(2) Wash parts in dry cleaning solvent, (item 302, table 1-2).

(3) Dry thoroughly with filtered compressed air.

(4) Reassemble screens, spacers, tab-washer, and retaining nut on tube of filter body.

(5) Tighten until screens do not turn on tube, and bend washer tab against side of nut.

c. Installation – Primary Oil Filter.

(1) Install new gasket.

(2) Insert filter into sump case pocket. Secure with thin aluminum alloy washer next to filter body, thin steel washer, and nut on each mounting stud. Torque nuts evenly.

(3) Check oil level sight gages and add oil if required. Reinstall access plate and attach soundproofing blanket in place.

7-10. Transmission External Oil Filter.

a. A second filter is used in transmission oil system.

b. This filter is located in cargo-sling compartment on right-hand wall, and is connected into external oil line between cooler thermal valve outlet and inlet of oil manifold on transmission main case.

c. Unit contains a pleated-paper type filter element, and incorporates a bypass valve set to open at 18 to 22 psig differential pressure to assure oil flow if filter element should become clogged.

NOTE

In event of transmission internal failure, replace external oil filter element.

d. Removal – External Oil Filter.

(1) Obtain access to filter through hole at bottom of cargo-sling well or by opening soundproofing blanket and removing door on front of pylon island in cabin.

(2) Disconnect transmission inlet oil hose from filter outlet coupling on right wall and transmission outlet hose from coupling on bracket on left wall of compartment.

(3) Place a suitable vessel under filter to catch spilled oil.

(4) Remove filter element for inspection or replacement.

(a) Open V-band clamp.

(b) Remove filter body and element downward. Pull element out of body.

(5) When necessary, remove filter head assembly from mounting brackets.

(a) Disconnect oil line tube from filter inlet fitting. Cap open line.

(b) Remove coupling half from outlet elbow.

(c) Remove lockwire and four bolts with washers and spacers to detach filter head from bracket. Remove head assembly downward.

e. *Cleaning – External Oil Filter.* Clean filter body, and head assembly if removed, with dry cleaning solvent (item 302, table 1-2). Dry with filtered compressed air.

CAUTION

Do not attempt to clean filter element for re-use.

f. *Installation – External Oil Filter.*

(1) If removed, reinstall filter head assembly.

(a) Check installation of union with nut and gasket, and elbow pointing up with nut and gasket, in outlet port of filter head. Check installation of elbow, pointing inboard, with nut and gasket in inlet port.

(b) Position head assembly to mounting brackets, with inlet elbow forward and pointing inboard, and with outlet elbow aligned to hole in aft bracket.

(c) Install four bolts through bracket into filter head, using a spacer between filter head and bracket and a thin aluminum alloy washer under head of each bolt. Lockwire bolt heads.

(d) Install quick-disconnect coupling half on outlet elbow at aft bracket.

(e) Connect oil tube from thermal valve to filter inlet elbow.

(2) Install filter element and body.

(a) Install packing on boss in bottom of filter body.

(b) Place filter element in body, seated firmly on boss.

(c) Install packing around upper lip of body, next to flange.

(d) Install packing around center boss in underside of filter head.

(e) Install body assembly into filter head, pressing upward to seat.

(f) Install V-band clamp around mating flanges of filter head and body. Torque nut to a torque of 50 inch-pounds.

(3) Connect transmission inlet hose to filter outlet coupling, and transmission outlet hose to coupling on opposite wall of compartment.

7-11. Transmission Oil Jets.

Jet assemblies (see figure 7-14) are installed from exterior of transmission at various points, passing through walls of internal passages which carry oil under pressure, and extend inside transmission case to deliver aimed sprays of oil on gears and bearings. Each jet is identified to its mounting port by matching stamped numerals. Attaching screw hole indexes the jet nozzle spray direction.

JET	LOCATION AND FUNCTION
No. 1	Right aft on top case. Sprays mast upper bearing, mast driving spline area, and upper stage planetary pinion bearings.
No. 2	On housing at right aft on ring gear case, with two auxiliary jets fed by external tubes and located 120 degrees apart on ring gear case. Sprays spur gear and pinion bearings of both planetary stages.
No. 3	On bottom of oil manifold at right aft on main case. Sprays input bevel gears (leaving mesh) and delivers oil to No. 6 jet inside case.
No. 4	On left side of sump case. Lubricates accessory drive gears and tail rotor drive quill.
No. 5	Left aft main case, beside input drive quill. Lubricates input quill gears (entering mesh).
No. 6	Right side of main case, near oil manifold. Receives oil from No. 3 jet inside case. Sprays inboard bearing of input drive quill, and through end of gear to lubricate bearings of freewheel coupling.
No. 7	Through top of oil manifold at right aft on main case. Lubricates bearings of internal gear quill which is driven by input drive gear quill.
No. 8	Right rear side of upper mast bearing retainer plate. Provides additional lubrication for upper mast bearing assembly and mast driving spline area.

a. Removal – Transmission Oil Jets.

CAUTION

Remove only the screw securing jet mounting plate to jet housing. Do not attempt to remove mount housing bolts.

(1) Remove any jet, except No. 7 or auxiliary jets of No. 2 as follows:

(a) Cut lockwire between two screw heads on jet. Remove only one screw, which secures mounting plate of jet to case.

(b) Pull jet tube, with packings, from case. Cover open port to prevent contamination.

(2) Remove auxiliary jets of No. 2 as follows:

(a) Disconnect oil tube from jet. Cap open end of tube.

(b) Remove lockwire and screw through jet mounting plate.

(c) Pull jet, with packing, from housing. Cover open port.

(3) Remove No. 7 jet as follows:

(a) Remove pressure relief valve from oil manifold. (Refer to paragraph 7-13.)

(b) Remove jet as in step (a) above.

b. Cleaning – Transmission Oil Jets.

(1) Remove screw with packing from outer end of jet (except auxiliary No. 2 jets) to permit thorough cleaning, drainage, and inspection.

(2) Wash in dry cleaning solvent, (item 302, table 1-2). A suitable brush can be used. Drain and dry with filtered compressed air. Be sure all nozzle openings are clear.

(3) Install screw, with seal, in outer end of tube.

c. Installation – Transmission Oil Jets.

(1) Uncover mounting port. Check matching numerals beside port and on jet.

(2) Install packings on jet tube in grooves at each side of inlet slot.

(3) Insert jet, align lug, and secure to case with screw. Lock-wire with head of screw installed in end of jet tube.

(a) For No. 3 jet, use bolt for attachment, with bracket for electrical harness clamp installed under bolt head.

(b) Connect oil tubes to auxiliary No. 2 jets. Lock-wire attaching screw to elbow fitting next to tube connector nut.

7-12. Transmission Oil Manifold And Relief Valve.

An oil manifold assembly (see figure 7-14) on right side of transmission main case is provided with a relief valve to regulate system pressure, a thermobulb for oil temperature indicator, and a thermoswitch for caution panel. An external line for sump delivers oil into manifold and is distributed through various outlets. Pressure relief valve, which is adjustable spring-loaded type, allows some oil to bypass through a port on inner face of manifold into main case interior. A second port on inner face of manifold supplies internal passages leading to input drive quill bearings. No. 3 and No. 7 jets extend through manifold into main case. An outlet at top of manifold delivers oil through an external tube to upper part of system.

7-13. Relief Valve.

Refer to paragraph 7-12 for description.

a. Removal – Relief Valve. Remove lockwire. Use wrench on hexagonal shoulder of valve body to loosen and remove valve assembly with packing.

b. Installation – Relief Valve.

(1) Check that threads of relief valve are clean and undamaged. Lubricate threads and packing with oil (item 2, table 1-2) and place packing on valve.

(2) Install body in manifold. Lockwire separately from valve body to thermobulb and to thermoswitch.

(3) Recheck oil pressure in operation.

c. Adjustment – Relief Valve.

(1) Remove cotter pin passing through holes at top of valve body and slot of valve adjusting screw, or back off jam nut on end of adjusting screw.

(2) Turn adjusting screw in to increase pressure or out to reduce indicated oil pressure. Adjust to mid-range of operating limits as shown on instrument markings.

(3) Align slot screw with nearest set of holes and install cotter pin after adjustment, or tighten jam nut.

7-14. Thermobulb.

Refer to paragraph 7-12 for description.

a. Removal – Thermobulb. Remove lockwire and disconnect electrical connector. Remove lockwire and unscrew thermobulb from oil manifold. Remove gasket.

b. Installation – Thermobulb. Lubricate threads and gasket with transmission oil when installing gasket on thermobulb. Install thermobulb in oil manifold. Lockwire to adjacent bolt head on manifold and to pressure relief valve. Connect and lockwire electrical connector.

7-15. Thermoswitch.

Refer to paragraph 7-12 for description.

a. Removal – Thermoswitch.

(1) Disconnect electrical leads from the thermoswitch terminal.

(2) Remove lockwire and unscrew thermoswitch from oil manifold. Remove gasket.

b. Installation – Thermoswitch.

(1) Lubricate threads and gasket with oil (item 2, table 1-2) and place gasket on lower end of thermoswitch.

(2) Install thermoswitch in top of manifold, using not more than 12 inch-pounds of torque on hexagonal body shoulder of switch body.

(3) Connect electrical leads using not more than six inch-pounds of torque on terminal stud nut.

7-16. Transmission Oil Pump Screen.

Intake screen for transmission oil pump is a wire mesh cylinder attached on a threaded plug, externally accessible at a marked location on lower right on sump case.

a. Removal – Pump Screen.

(1) Peel down soundproofing blanket from top on right-hand side of pylon island in cabin. Remove plate marked OIL LEVEL ACCESS.

(2) Drain oil sump as when removing pump.

(3) Remove lockwire from hexagonal plug head below cast legend, PUMP SCREEN. Remove screen assembly with gasket.

b. Inspection – Pump Screen. Check for metallic particles or other material collected on pump screen, as indication of oil contamination or internal failure of transmission. Inspect screen for holes or other damage.

c. Installation – Pump Screen.

(1) Place new gasket on screen assembly next to plug head.

(2) Insert screen in sump case. Torque plug head to a torque of 300-400 inch-pounds. Secure to adjacent sump plug with lockwire.

(3) Fill transmission sump with oil to normal level on sight gages. Close access openings and cowling.

7-17. Transmission Magnetic Plug.

Transmission has a magnetic plug in right side of generator offset drive quill case. Plug is self-closing to prevent loss of oil when magnetic insert is removed to inspect for metal chips or particles.

a. Removal – Magnetic Plugs.

(1) Open transmission fairing for access to plug on generator drive quill case.

(2) Cut lockwire and remove magnetic insert only, leaving plug itself in place.

b. Inspection – Magnetic Plug. (Refer to paragraph 7-3 and see figure 7-2.)

c. Installation – Magnetic Plug. Replace O-ring gasket on magnetic insert as necessary. Install magnetic insert. Lockwire to plug.

7-18. Chip Detector.

A chip detector is located in the bottom of the transmission sump. The chip detector consists of a single pole of a permanent magnet. When the pole attracts sufficient metal chips to complete the circuit between the pole and the ground the "Chip Detector" segment on the caution panel will illuminate.

a. Removal – Electrical Chip Detector.

(1) Disconnect electrical wires from insert.

(2) Push detector insert in as far as possible and turn counterclockwise to disengage pins from plug and lift insert from plug insert.

b. Inspection – Electrical Chip Detector. Check for accumulated metal particles on pole, as indication of possible excessive wear or parts failure in transmission. If such particles are present further investigation is required to determine need for replacement or corrective action. (Refer to paragraph 7-3 and see figure 7-2.)

c. Installation – Electrical Chip Detector.

(1) Replace O-rings on detector insert.

(2) Engage pins on insert into groove on plug. Push insert in as far as possible on plug and turn insert clockwise to lock in place.

(3) Connect electrical wire to insert.

7-19. Transmission Oil Level Sight Gages.

Visual indication of oil level in transmission is provided by two small transparent plastic plugs set into right side of sump case, backed by indicator discs with FULL and LOW markings.

a. Removal – Sight Gage.

(1) Detach soundproofing blanket and remove TRANSMISSION OIL LEVEL ACCESS plate from right side of pylon island in cabin.

(2) Drain oil below gage level.

(3) Remove spiral retaining ring, sight glass with O-ring and indicator disc.

b. Repair or Replacement – Sight Gage. Careful inspection must be made of oil level sight gages to be sure that they are not oil stained internally and are giving erroneous indications of proper oil level. Upon inspection, faulty stained glasses should be cleaned or, if necessary, replaced.

c. Installation – Sight Gage.

(1) Insert correctly marked indicator disc in port, with indexing tab in notch of inner lip. Install serviceable packing in groove around sight glass. Insert glass with flat side out. Install retaining ring.

(2) Fill sump with oil. Check for leaks. Close access openings.

7-20. Transmission Oil Cooler And Thermal Valve.

Transmission oil system cooler is mounted in bottom of rear fuselage compartment, in same opening as engine oil cooler and served by same turbo blower and air duct. Thermal bypass valve for transmission cooler is located on rear wall, Station 155 bulkhead, of cargo-sling compartment below transmission. Two drains with manual valves are provided in lines between cooler and valve.

a. Removal – Thermal Valve.

(1) Enter cargo-sling compartment through hole at bottom.

(2) Disconnect transmission oil inlet and outlet hoses at quick-disconnect couplings.

(3) Place suitable vessel under thermal valve to catch trapped oil.

(4) Disconnect oil lines from thermal valve fittings. Cap lines.

(5) Remove two screws and washers to detach valve body from mounting bracket.

(6) When necessary for cleaning or replacement, cut lockwire and remove thermal valve from body.

b. Installation – Thermal Valve.

(1) If removed, install valve into body. Lock-wire. Check for proper installation of fittings in four ports of body.

(2) Position valve assembly on mounting bracket located approximately on vertical centerline of rear bulkhead in compartment below transmission. Head of valve should be toward left side.

(3) Install two screws, with washers, through valve body into plate nuts of bracket.

(4) Connect oil cooler lines on two lower fittings of valve body, filter inlet line to upper fitting, and line from coupling on left wall to fitting on right end of valve assembly.

(5) Connect transmission oil outlet hose to quick-disconnect coupling on left wall of compartment, and inlet hose to filter outlet coupling on right wall.

(6) Service transmission to replace any oil lost. At first ground run-up, check for leaks and for indication that valve is operating properly.

c. Inspection – Transmission Oil Cooler and Valve.

(1) Inspect oil cooler support for damage.

(2) Inspect lines and fittings for stripped threads and serviceability.

(3) Inspect oil cooler and valve for damage, clogging and malfunction.

d. Repair or Replacement – Transmission Oil Cooler and Valve.

(1) Replace unserviceable lines, fittings, gaskets, or support as required.

(2) Replace oil cooler or thermal valve as assemblies for damage or malfunction. In event of transmission internal failure, replace cooler and thermal valve and flush out all connecting lines and fittings thoroughly, using solvent (item 302, table 1-2). Dry with filtered compressed air.

e. Removal – Transmission Oil Cooler.

(1) Disconnect transmission inlet and outlet oil hoses at quick-disconnect couplings to reduce oil loss.

(2) Drain transmission cooler lines by opening two drain valves located behind aft landing gear crosstube at left side, using access openings in lower skin.

(3) Open rear compartment door on right side of fuselage.

(4) Remove turbo blower and air duct of engine oil cooler installation.

(5) Disconnect three oil lines from fittings of smaller cooler at left side. Cap lines and fittings.

(6) Support both coolers in position. Remove four bolts and washers which secure lower flange of transmission cooler to structural support. Remove bolts, nuts, and spacer washers at four corners of mating flanges of coolers.

(7) Lift out transmission oil cooler.

NOTE

Be sure engine oil cooler is securely supported in place, if not also removed.

f. Installation – Transmission Oil Cooler.

(1) Align transmission oil cooler, with outlet end forward, to engine oil cooler. At each corner of mating flanges, install bolt and nut with three aluminum alloy washers. Secure lower outboard flange of cooler to structural support with four bolts and washers.

(2) Connect three oil line tubes to fittings on cooler.

(3) Reinstall air duct and turbo blower of engine oil cooler installation. (Refer to Chapter 5.)

(4) Reconnect transmission oil inlet and outlet hoses at quick-disconnect couplings in compartment below pylon.

(5) Service system with oil.

(6) Ground run helicopter until transmission operating temperature is reached. Check for leaks and proper operation of system.

(7) Check transmission oil and add oil as necessary.

7-21. Main Rotor Mast.

Main rotor mast assembly is a tubular steel shaft fitted with two bearings which support it vertically in the transmission. Mast driving splines engage with transmission upper stage planetary gear, providing counterclockwise rotation as viewed from above. Splines on upper portion of mast provide mounting for main rotor and control assemblies. The upper bearing retainer plate has an oil jet fed by an external hose.

a. Inspection – Mast and Static Stop. Exposed surfaces at mast for nicks, scratches, or corrosion not to exceed 0.010 inch after repair. Minor nicks, scratches, or corrosion in static stop are acceptable.

b. Repair or Replacement – Mast and Static Stop. If limits in step *a.* to mast are exceeded, replace mast. If damage to static stop effect operation of stop, replace stop.

7-22. Input Drive Quill.

NOTE

External leakage is not permitted for the transmission quill seals. However, a small amount of seepage assures a satisfactory seal condition. Continuous flow (droplets) is considered excessive and will require seal replacement.

An input drive quill equipped with a freewheel coupling is located on aft side of transmission main case section. Engine torque is transmitted through main drive shaft to this input quill, which drives transmission gear trains. Freewheel clutch in drive quill coupling operates automatically, engaging to allow engine to drive rotor or disengaging the idling engine during autorotational descent.

a. Inspection – Input Drive Quill. Inspect drive quill for security of mounting, evidence of oil leakage, damage and corrosion.

b. Repair or Replacement – Input Drive Quill. Replace quill if inspection requirements are not met.

7-23. Generator Offset Drive Quill.

Drive quill for DC generator is an offset box assembly mounted on front of the transmission, with a generator drive pad above cabin roof level being driven through a gear train from a spiral bevel drive gear mounted in transmission main case. Case of gear quill is equipped with a vent breather and a magnetic plug.

a. Inspection – Generator Offset Drive Quill.

(1) Inspect generator drive quill for security of mounting, external damage, and for evidence of oil leaks.

NOTE

Generator drive quill cannot be removed and installed while transmission is in place in helicopter.

(2) Check magnetic plug for metal particles at prescribed intervals or occasions. (Refer to paragraph 7-3.) Replace gasket on plug.

b. Repair or Replacement – Generator Offset Drive Quill. Replace quill if inspection requirements are not met.

7-24. Hydraulic Pump And Tachometer Drive Quill.

A drive quill (see figure 7-12) located on right side of transmission sump case is driven by an accessory gear train. Gear shaft of this quill directly drives the hydraulic system pump, and also drives the rotor tachometer generator by means of a chain-and-sprocket offset drive.

a. Inspection – Hydraulic Pump and Tachometer Drive Quill. Inspect quill for security of mounting, evidence of oil leakage, damage and corrosion.

b. Repair or Replacement – Hydraulic Pump and Tachometer Drive Quill. Replace quill if inspection requirements are not met.

7-25. Tail Rotor Drive Quill.

Tail rotor drive quill is mounted into aft side of transmission sump case and is driven by an accessory gear train. (See figure 7-12.) A flexible splined coupling on quill provides means of attaching tail rotor drive shaft.

a. Inspection – Tail Rotor Drive Quill. Inspect quill for security of mounting, evidence of oil and grease leakage, damage and corrosion.

b. Lubrication – Tail Rotor Drive Quill. Coupling splines can be lubricated as described below. This procedure can be accomplished with quills in place on transmission, with drive shafts disconnected.

(1) Remove spiral lockring while holding seal plate against spring pressure.

(2) Remove seal plate spring and spacer.

NOTE

Care must be taken to ensure that the retainer plug does not become unseated from inner coupling.

CAUTION

Do not use cleaning solvent inside coupling.

(3) Hold couplings at full outward position. Remove old grease as thoroughly as possible.

(4) Hand pack grease to 0.12 inch depth over top of internal spline teeth. Use lubricant (item 8, table 1-2).

(5) Keep coupling at full outward position. Ensure retainer and locking spring are properly seated. Reinstall spacer, spring, seal plate and spiral lockring.

c. Repair or Replacement – Tail Rotor Drive Quill. Replace quill if inspection requirements are not met.

Section V. TAIL ROTOR DRIVE SHAFT

7-26. Tail Rotor Drive Shaft.

Six drive shaft sections are incorporated in power train aft of transmission tail rotor drive quill; these drive shafts serve as a line between three bearing hanger assemblies, an intermediate gear box on tail boom, and a tail rotor gear box on vertical fin. (See figure 7-1.) Each shaft section is an anodized aluminum alloy tube with a curvic-splined coupling riveted to each end and is statically balanced by metal strips bonded near middle on tube surface, with an identification plate showing part and serial numbers. Forward shaft section extends through a tunnel between engine firewalls, with ends connected by V-band clamps to mating splined couplings on transmission tail rotor drive quill and on forward bearing hanger. Other shaft sections are mounted in similar manner along tail boom and vertical fin between hangers and gear boxes.

a. Removal – Tail Rotor Drive Shafts.

(1) Open hinged access doors along top of tail boom and vertical fin by releasing fasteners on left side. Also remove tailpipe fairing and vented cover over immediate gear box, as necessary.

(2) Remove clamp set from coupling at each end of shaft. Push shaft against flexible coupling to disengage opposite end, and lift out shaft. Remove other shafts aft of forward bearing hanger in same manner.

(3) To remove forward shaft, open access panel at left side of transmission and remove clamp set from tail rotor drive quill coupling. With tailpipe fairing removed and shaft disconnected from forward hanger coupling, disengage and remove shaft carefully rearward and to right through firewall tunnel.

b. Inspection, Repair or Replacement – Tail Rotor Drive Shafts.

(1) Replace shaft for any of the following conditions:

(a) Any crack.

(b) Any sign of rivet failure.

(c) Total indicated run-out, using dial indicator and V-blocks, in excess of 0.050 inch at any area on shaft. No straightening procedures are prescribed.

(d) Loss or partial detachment of balance strips which are bonded on tube near center.

NOTE

Do not mistake empty imprints in bonding material next to balance strip, as an indication of a missing balance strip. This spot results from removal of a test coupon to inspect for bonding voids.

(e) Damaged or excessively worn curvic coupling teeth. There should be no radial play or backlash between mating teeth when fully meshed with V-band clamp removed.

(f) Grooves worn by V-band clamp on shaft coupling to extent that such wear prevents proper clamping.

(g) Surface damage of shaft tube exceeding limits in (2) below.

(2) Classify surface damage on shaft tube as acceptable, repairable, or excessive by following limits. Define "Area A" as central portion of shaft, and "Area B" as portions within 14 inches of ends. (See figure 7-15.)

(a) Any damage to anodized finish requires anti-corrosion treatment in accordance with TM 55-1500-204-25/1.

(b) Nicks or scratches aligned within 15 degrees of spanwise axis are acceptable without repair to maximum depth of 0.002 inch in "Area A" or 0.004 inch in "Area B".

(c) Other nicks or scratches must be polished out with fine abrasive cloth (item 508, table 1-2), provided depth of material removed does not exceed 0.008 inch in "Area A" or 0.012 inch in "Area B".

NOTE

Shaft must be checked for balance if total worked surface area of one side exceeds 8 square inches, when compared with other side.

(d) Sharp dents are permissible to maximum depth of 0.010 inch in "Area A" and 0.015 inch in "Area B".

(e) Nonsharp dents are permissible to maximum depth of 0.020 inch in "Area A" and 0.030 inch in "Area B".

NOTE

All dents should be carefully inspected for cracks, nicks, and scratches. No cracks permitted. Nicks or scratches shall be within limits. Total depth of defect shall not exceed limits for dents.

c. Inspection – Steel Tail Rotor Drive Shaft Clamps.

(1) Inspect clamps for distortion or burrs on clamping surface.

(2) Inspect length of welds. Minimum length should be 0.500 inch.

(3) Inspect clamp bolts for stripped or damaged threads and selflocking nuts for serviceable condition.

(4) Inspect spot welds for evidence of failure.

(5) Steel clamps may be inspected by Magnetic Particle method.

d. Inspection – Aluminum Tail Rotor Drive Shaft Clamps.

(1) Inspect bolt holes for wear, nicks and scratches.

(2) Inspect spot face, lug fillets and internal "V" groove for nicks and scratches in excess of 0.008 inch, and gouges or wear pattern extending into the fillet radius at bottom of internal "V".

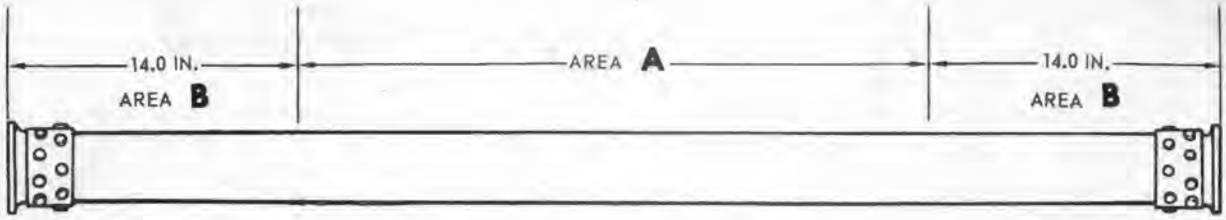


Figure 7-15. Tail rotor drive shaft inspection diagram

(3) Inspect all remaining surfaces for nicks and gouges exceeding 0.010 inch.

(4) Aluminum clamps may be inspected by Fluorescent Penetrant method.

e. Repair or Replacement – Tail Rotor Drive Shaft Clamps. Replace clamp sets which do not meet inspection requirements. (Refer to paragraph 7-26 steps c. and d.)

f. Installation – Tail Rotor Drive Shafts.

(1) Engage shaft couplings with mating fixed and flexible couplings. Install clamp sets at each end, with nuts trailing direction of rotation, and with bolted joints indexed 90 degrees to those of adjacent clamps for balance in operation.

NOTE

Clamp halves are matched by identical vendor and forging lot numbers or by weight. Maximum weight differential for matched halves is one (1) gram. Every effort should be made to retain clamp halves as matched sets. If doubt exists concerning clamp balance, the parts should be forwarded to a higher echelon for matching halves. All nuts on any one clamp set must be identical parts.

NOTE

Determine friction torque of each nut as follows: Thread nut onto bolt until full length of each nut is on attaching bolt and then check torque.

(2) Torque clamp bolts evenly to 30 to 35 inch-pounds above the nut friction torque noted above. Tap lightly around outer surface of seal clamps, and recheck torque. Spacing between clamp halves should be within 0.030 inch.

(3) Reinstall tailpipe fairing or gear box cover as required. Close access doors and cowling.

7-27. Drive Shaft Hangers.

Four hanger assemblies are utilized for the drive shaft. Each assembly consists of couplings on a short splined shaft, mounted through a single-row sealed ball bearing in a ring-shaped hanger, equipped with two mounting lugs for attachment on a support fitting.

a. Removal – Drive Shaft Hangers.

(1) Open hinged access doors along top of tail boom by releasing fasteners on left side.

(2) Remove tail rotor drive shafts from each side of hanger. (Refer to paragraph 7-26.)

(3) Remove bolt, with nut and washers, at each side to detach any hanger assembly from its support fitting.

b. Inspection – Drive Shaft Hangers.

(1) Evidence of excessive bearing roughness or binding.

NOTE

Bearing P/N 204-040-623-1 has more drag than the older type bearing. This bearing may feel slightly rough after 150 to 200 hours of operation. This is due to the special lubricant separating into minute particles. When the bearing is rotated slowly by hand with drive shaft disconnected, the rolling elements contact and spread these minute particles. This type of roughness does not constitute cause for rejection. If when rotated slowly by hand the bearing comes to a definite stop, then jumps and a corresponding increase in roughness is noted, the hanger should be replaced.

(2) Cracks, elongated bolt holes, or other visible damage to hanger ring or attachment lugs.

(3) Inspect hanger support fittings, in place on tail boom, for security of attachment and evidence of cracks or other damage.

CAUTION

Do not attempt to remove or change shims under fittings.

c. *Repair or Replacement – Drive Shaft Hangers.* Replace drive shaft hangers that do not meet inspection requirements.

d. *Lubrication – Drive Shaft Hanger.* Coupling splines can be lubricated as described below. This procedure can be accomplished with drive shafts disconnected and hangers installed on tail boom.

(1) Remove spiral lockring while holding seal plate against spring pressure.

(2) Remove seal plate spring and spacer.

NOTE

Care must be taken to ensure that the retainer plug does not become unseated from inner coupling.

CAUTION

Do not use cleaning solvent inside coupling.

(3) Hold couplings at full outward position. Remove old grease as thoroughly as possible.

(4) Hand pack grease to 0.12 inch depth over top of internal spline teeth. Use lubricant (item 8, table 1-2).

(5) Keep coupling at full outward position. Ensure retainer and locking spring are properly seated. Reinstall spacer, spring, seal plate, and spiral lockring.

e. *Lubrication – Drive Shaft Hanger Bearings.* The drive shaft hanger bearings, except bearing, Part No. 204-040-623-1, may be lubricated in the field without removing the seal from the bearing or bearings from hanger by using the following equipment and procedures.

WARNING

Positively identify bearing before lubricating by the following procedure. Bearing, Part No. 204-040-623-1, CANNOT be lubricated. This bearing utilizes a special lubricant. Any attempt to lubricate the 204-040-623-1 bearing will also result in seal damage which is cause for bearing rejection. Bearing must be replaced.

NOTE

These instructions do not constitute, by definition, bearing repack.

(1) Obtain one hypodermic syringe (item 507, table 1-2).

NOTE

Prior to lubrication of bearing, drive train must be disconnected from each side of hanger assembly. Examine bearing for indications of failure (binding, overheating, etc.).

(2) Using a clean, dry cloth, wipe bearing seal area as clean as possible.

(3) Fill hypodermic syringe with grease (item 7, table 1-2) then carefully insert tapered portion of needle under lip of bearing seal. (Avoid damage to seal.) Inject a small amount of grease at each of three locations (120 degrees apart); two cc's of grease per bearing is considered sufficient. After lubrication is completed, wipe off all excess grease.

NOTE

Any damage to seal is cause for rejection of bearing.

(4) Lubrication of drive shaft hanger bearing should be accomplished as dictated by environmental conditions.

f. *Installation – Drive Shaft Hangers.*

(1) Position hanger assembly, with flexible coupling forward, on support fitting.

(2) Install aluminum hanger assembly by installing bolt on each side with thin steel washer next to bolt head and thin aluminum alloy washer next to hanger. Install thin aluminum alloy washer against under side of support

fitting, with thin steel washer under nut. Torque nuts 50 to 70 inch-pounds.

(3) Install steel or stainless steel hanger assembly by installing bolt on each side with two thin steel washers under bolt heads and one aluminum washer and one steel washer under each nut, with the aluminum washer next to mount. Torque nuts 50 to 70 inch-pounds.

(4) Install drive shafts. (Refer to paragraph 7-26 f..)

Section VI. INTERMEDIATE GEARBOX

7-28. Intermediate Gear Box.

An intermediate gear box is located on tail boom, at base of vertical fin. (See figure 7-1.) This gear box provides a 42 degree change in direction of tail rotor drive shaft, with no speed change. Gear box assembly consists of a case with a gear quill in each end. Case is fitted with an oil filler cap, a vent breather, an oil level sight gage and a drain plug equipped with a magnetic insert. Input and output quills have flexible couplings for attachment of drive shafts. Access is provided by a vented cover with quick-release fasteners.

a. Removal – Intermediate Gear Box.

(1) When replacing any gear box, unless condition prevents operation, accomplish preservation before removal: Drain oil and reservice gear box with corrosion preventive oil (item 9, table 1-2). Ground run at least ten minutes. Do not drain gear box.

(2) Remove gear box cover and open tail rotor drive shaft access doors.

CAUTION

As shafts are disconnected from gear box, support unattached ends to hold shaft alignment on normal operating axis to avoid damage to hanger bearing or coupling.

(3) Remove or disconnect shafts from gear box input and output couplings (refer to paragraph 7-26).

(4) Remove electrical wire from electrical chip detector.

(5) Remove lockwire and four bolts, with washers, which secure gear box on tail boom. Lift off gear box assembly. Do not attempt to remove shims from mounting points.

(6) The maximum allowable wear (elongation) for all 42° gear box attachment holes is 0.005 inch over standard high side dimension (0.287 inch).

b. Inspection – Intermediate Gear Box.

(1) Inspect gear box case for cracks and damage.

(2) Check cap assembly, vent cap, and chip detector for security. Press in on chip detector and rotate until locking tangs are in slots of plug, then remove to determine magnetic particle buildup. Unscrew vent cap and determine if clean throughout.

(3) Ensure that studs and nuts are tight, with no apparent leakage.

(4) Inspect sight gage for damage or discoloration.

c. Cleaning – Intermediate Gear Box.

(1) Clean exterior of gear box case with dry cleaning solvent (item 302, table 1-2).

(2) Clean vent cap as follows:

(a) Wash cap assembly in dry cleaning solvent (item 302, table 1-2).

(b) Flush breather passage with cleaning solvent.

(c) Dry with filtered compressed air.

(3) Clean cap assembly and chip detector with dry cleaning solvent (item 302, table 1-2).

d. Repair or Replacement – Intermediate Gear Box.

(1) Replace unserviceable oil filler cap or packing and vent breather or gasket.

CAUTION

Do not interchange filler caps of 42-degree gear box and 90-degree gear box. The 42 degree gear boxes are marked with a black dot on the case and a corresponding black dot on the filler cap. The 90 degree gear boxes and filler caps have white dot markings.

(a) Secure chain of cap by safety pin through drilled hole in case rib at right of filler neck.

(b) Lock-wire breather to drilled hole in case rib just ahead.

(2) To replace other gear box fittings, drain oil by removing drain plug from right side of gear box.

(a) This plug also has a magnetic insert which can be removed, without loss of oil, to inspect for steel particles as indication of gear or bearing wear. (Refer to paragraph 7-3.)

(b) Replace packing on magnetic insert plug, and gasket on drain plug.

(c) When installed, lock-wire magnetic plug to drain plug.

NOTE

Lock-wire drain plug in accordance with paragraph e. (3).

(3) Remove oil level sight gage retaining ring, glass, packing, and indicator disc to clean, inspect, or replace parts. To reinstall, place indicator disc in port with indexing tab in notch of inner lip. Place packing in groove around glass, install glass with flat side out, and secure with spiral retaining ring.

e. *Installation – Intermediate Gear Box.*

(1) Check condition and security of shims at gear box location on tail boom just ahead of vertical fin.

CAUTION

Do not attempt to remove or change shims installed on tail boom under gear box, as any resulting misalignment could cause excessive stresses, vibration, wear and possibly eventual failure of components in tail rotor drive train.

(2) Position intermediate gear box, with oil service fittings at right side, on tail boom shims.

(3) Install four bolts through corners of gear box base into plate nuts in tail boom. Use thin aluminum alloy washers next to gear case and thin steel washers next to bolt heads. If holes in the 42° gear box mounting flange do not exceed the dimensions given in paragraph 7-28 a. (6), install bolts with steel washers under head and an aluminum washer between steel washer and flange. Torque bolts 50 to 70 inch-pounds. Lock-wire left rear attachment bolt to left forward attachment bolt. Lock-wire right rear attachment bolt through drain plug to right forward attachment bolt.

(4) Connect electrical wire to electrical chip detector.

(5) Install drive shafts. (Refer to paragraph 7-26. f.)

f. *Lubrication – Intermediate Gear Box.*

(1) Fill gearbox to sight gage level with oil prescribed by servicing points diagram. (Refer to Chapter 1.)

(2) Internal splines of couplings on gearbox are packed with grease during assembly. Coupling splines can be lubricated as described below. This procedure can be accomplished with quills in place on gearbox, with drive shafts disconnected.

CAUTION

Do not intermix parts removed from forward quill with parts removed from aft quill.

(a) Remove spiral lock-ring from coupling while holding seal plate against spring pressure.

(b) Remove seal plate and spring.

NOTE

Care must be taken to insure that the retainer plug does not become unseated from inner coupling.

CAUTION

Do not use cleaning solvent inside coupling.

(c) Hold couplings at full outward position. Remove old grease as thoroughly as possible.

(d) Hand pack grease to 0.12 inch depth over top of internal spline teeth. Use lubricant (item 8, table 1-2).

(e) Keep coupling at full outward position, insure retainer and locking spring are properly seated. Reinstall spring, seal plate and spiral lock-ring.

g. *Packaging – Intermediate Gear Box.*

(1) Clean and dry gear box in accordance with MIL-P-116.

(2) Flush gearbox with corrosion preventive (item 9, Table 1-2).

(3) Wrap assembly in greaseproof barrier material (item 505, table 1-2), and secure with pressure-sensitive tape (item 400, table 1-2). Shape wrapper to contour of gear box.

(4) Place gear box in contoured bottom cushion of metal container, Part No. 204-070-MUSC1.

(5) Align top contoured cushion to fit gear box and lower in place in container.

(6) Place 10 eight-unit bags (total of 80 units) of desiccant (item 310, table 1-2) in container.

(7) Install, with rubber gasket in place, on lower half of container.

(8) Place locking ring on tip of container lid and secure with bolt and nut. Tighten nut sufficiently to insure a moisture-vapor proof closure.

Section VII. TAIL ROTOR GEARBOX

7-29. Tail Rotor Gear Box.

A gear box at top of tail boom vertical fin provides 90 degree change in direction of drive and 2.6:1 speed reduction between input drive shaft and its output shaft on which tail rotor is mounted. Gear box consists of mating input and output gear quill assemblies set into a gear case provided with a vented oil filler cap, and oil level sight gage, and a drain plug which has a magnetic insert plug. Input quill has a flexible coupling for attachment of drive shaft.

a. Removal – Tail Rotor Gear Box.

(1) Accomplish preservation before removal: Drain oil and reservice gear box with corrosion preventive oil (item 9, table 1-2). Ground run at least ten minutes. Do not drain gear box.

(2) Remove tail rotor hub and blade assembly. (Refer to Chapter 8.)

(3) Remove pitch control mechanism; or detach cover from fin structure and chain from control cables if replacement of gear box or output gear quill is not required. (Refer to Chapter 9.)

CAUTION

To avoid damage to gearboxes or couplings, either remove clamp set from both ends of drive shaft before removing either end of shaft from its mating curvic coupling, or support unattached end of shaft to hold shaft aligned on normal operating axis while gear box is removed.

(4) Open hinged access door on front of vertical fin and remove or disconnect drive shaft from input coupling of gear box. (Refer to paragraph 7-26.)

(5) Remove electrical wire from electrical chip detector.

(6) Detach gear box from support casting on vertical fin by removing nuts and washers from six mounting studs around input coupling. Lift off gear box assembly.

(7) Reinstall nuts with suitable spacers on two opposite studs to secure input gear quill in case during handling or shipping.

b. Cleaning – Tail Rotor Gear Box.

(1) Clean exterior of gear box assembly, or removed parts, with dry cleaning solvent (item 302, table 1-2).

CAUTION

Do not permit solvent or dirt to be forced into flexible coupling by use of compressed air.

(2) Clean gear box breather filler cap as follows.

(a) Wash cap assembly in dry cleaning solvent (item 302, table 1-2).

(b) Clean aluminum wool in the breather passage by flushing with dry cleaning solvent.

(c) Dry with filtered compressed air.

c. Inspection – Tail Rotor Gear Box.

(1) Inspect gear box cases for cracks and damage.

(2) Inspect quill for evidence of oil and grease leakage.

(3) Check oil filler cap and O-ring packings for serviceability.

(4) Inspect chip detector for excessive accumulation of metal particles.

(5) Inspect gear box breather filler cap as follows.

(a) Inspect to determine that the cap is still tightly filled with aluminum wool by slightly compressing the wool by pressing the retaining washer.

(b) If cap is properly filled with wool; the wool will return the retaining washer against the retaining ring when pressure is released.

(6) Inspect gear box input sleeve flange for protrusion of sealant in jack screw holes. Inspect mating surface of tail boom fin casting for areas of sealant remaining on casting.

(7) Inspect sight gage for damage or stain.

d. Repair or Replacement – Tail Rotor Gear Box.

(1) Replace unserviceable oil filler cap or packing. Secure cap chain by safety pin through drilled hole in filler neck boss of case.

CAUTION

Do not interchange filler caps of intermediate gear box and tail rotor gear box. The 90 degree gear boxes are marked with a white dot on the case and a corresponding white dot on the filler cap. The 42 degree gear boxes and filler caps have black dot markings.

(2) Replace gear box breather filler caps containing an insufficient quantity of aluminum wool.

(3) To replace other gear box fittings, drain oil by removing drain plug.

(a) Drain plug also has a magnetic insert which can be removed, without loss of oil, to inspect for steel particles as indication of gear or bearing wear. (Refer to paragraph 7-3.)

(b) Replace packing on magnetic plug, and gasket on drain plug, as required.

(c) When reinstalled, lock-wire magnetic plug to drain plug, and drain plug to adjacent drilled holes in boss of base.

(4) Remove oil level sight gage retaining ring, glass, packing, and indicator disc to clean, inspect, or replace parts. To reinstall, place indicator disc in port with indexing tab in notch of inner lip. Place packing in groove around sight glass, install glass with flat side out, and secure with spiral retaining ring.

(5) If sealant protrudes above surface of jack screw holes, trim off excess sealant. Remove any uneven areas of sealant remaining on tail boom fin casting. Any cleaned area that penetrates to the bare metal should be protected with zinc chromate primer (item 200, table 1-2).

e. Installation – Tail Rotor Gear Box.

(1) Inspect ninety degree gear box support fitting on tail boom for wear and damage limits. See figures 7-16 and 7-17. Repair damage, if within limits, prior to installation of gear box. Refer to paragraph 7-30. If damage exceeds limits, request assistance of field maintenance.

(2) Remove nuts and shipping spacers from studs at input gear quill flange.

NOTE

When installing new gear box, refer to paragraph 7-29, step c., and paragraph 7-29, step d.

(3) Position gear box with studs engaged through support casting at top of vertical fin. Rotate box counterclockwise until studs contact sides of the holes. If holes in the 90° gear box mounting flange do not exceed the dimensions given in paragraph 7-29. c. install nuts with steel washers under nut and an aluminum washer between steel washer and flange. Torque nuts evenly to a torque of 100 to 140 inch-pounds.

(4) Install drive shaft, connected to output coupling of gear box. (Refer to paragraph 7-26. f.)

(5) Connect electrical wire to electrical chip detector.

(6) Install pitch control mechanism. (Refer to Chapter 9.)

(7) Install and rig tail rotor. (Refer to Chapters 8 and 9.)

(8) Service gear box with oil.

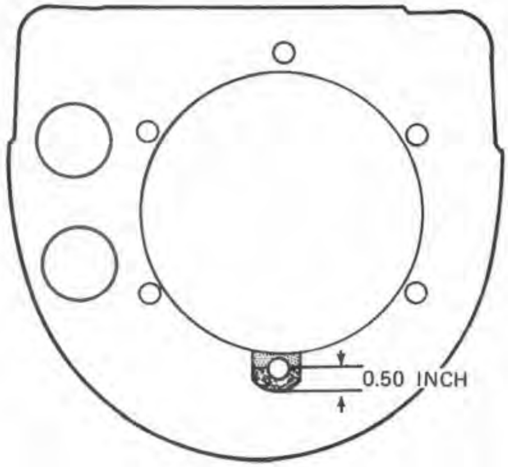
f. Lubrication – Tail Rotor Gearbox.

(1) Fill gearbox to sight gage level with oil prescribed by servicing points diagram. (Refer to Chapter 1.)

(2) Internal splines of couplings on gearbox are packed with grease during assembly. Coupling splines can be lubricated as described below. This procedure can be accomplished with quills in place on gearbox, with drive shafts disconnected.

(a) Remove spiral lock-ring from coupling while holding seal plate against spring pressure.

(b) Remove seal plate spring and spacer.



VIEW LOOKING DOWN ON
TOP OF SUPPORT FITTING

TYPE OF DAMAGE	AREA A	AREA B	AREA C
NICKS, SCRATCHES, SHARP DENTS	0.025 Inch Max. Depth	0.060 Inch Max. Depth	0.100 Inch Max. Depth 0.200 Inch Max. Width

Notes

1. The particular damage limits adjacent to holes is applicable to each of the six gearbox stud holes; however, if the area around two or more holes is damaged up to the limits shown, the part must be replaced.

2. The total reworked surface area on the top surface of the fitting must not exceed thirty percent of the total area.

3. The wear limits (elongation) of stud holes in fitting P/N 204-030-828 is 0.329 inch. Holes may be repaired by installation of bushing at higher level of maintenance.

204030-165A
AV 054315

Figure 7-16. Damage limits – ninety degree gearbox support fitting

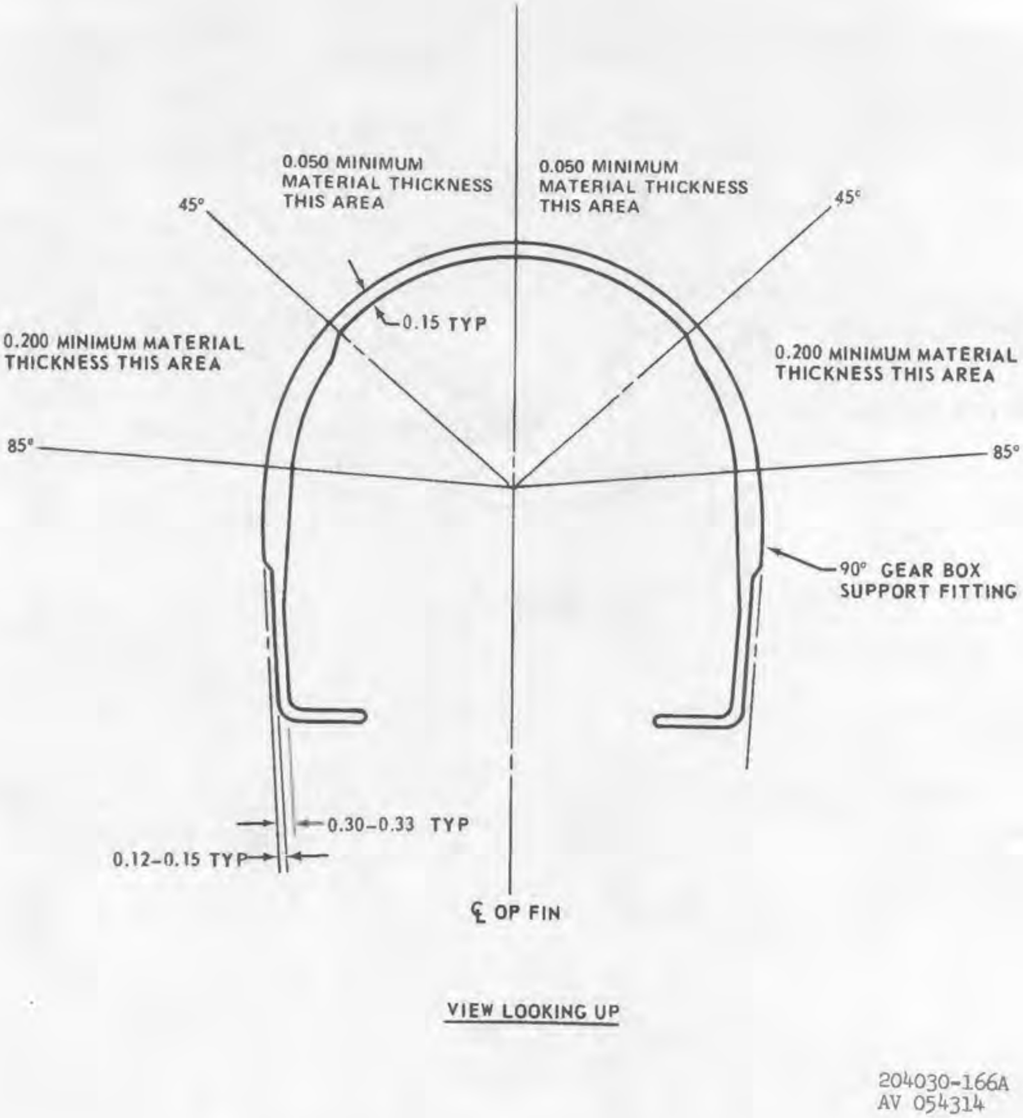


Figure 7-17. Wear limits – ninety degree gearbox fitting

NOTE

Care must be taken to insure that the retainer plug does not become unseated from inner coupling.

CAUTION

Do not use cleaning solvent inside coupling.

(c) Hold couplings at full outward position. Remove old grease as thoroughly as possible.

(d) Hand pack grease to 0.12 inch depth over top of internal spline teeth. Use lubricant (item 8, table 1-2.)

(e) Keep coupling at full outward position, insure retainer and locking spring are properly seated. Reinstall spacer, spring, seal plate and spiral lock-ring.

g. Packaging Tail Rotor Gear Box.

(1) Clean and dry gear box in accordance with MIL-P-116.

(2) Flush gearbox with corrosion preventive (item 9, Table 1-2).

(3) Wrap assembly in greaseproof barrier material (item 505, table 1-2) and secure with pressure-sensitive tape (item 400, table 1-2). Shape wrapper to contour of gear box.

(4) Place gear box in bottom contoured cushion of container.

(5) Align top contoured cushion to fit gear box and lower into container.

(6) Place 12 eight-unit bags (total 96 units) of desiccant (item 310, table 1-2) in container.

(7) Install lid, with rubber gasket in place, on lower half of container.

(8) Place locking ring on lip of container lid and secure with bolt and nut. Torque nut sufficiently to insure a moisture-vaporproof closure.

7-30. Gear Box Support Fitting.

a. Maximum Allowable Chaffing Wear Limits on 90° Gear Box Support Fitting P/N 204-030-828. (Refer to figure 7-17.)

(1) In the area 45° either side of the vertical fin center line (viewed from forward side looking up), the minimum material thickness is 0.050 inch.

(2) In the area 45° to 85° either side of the vertical fin center line, the minimum material thickness is 0.200 inch.

b. Repair or Replacement – Tail Rotor Gear Box Support Fitting.

(1) Inspect tail rotor gear box support fitting for damage and wear in excess of limits shown on Figure 7-16 and 7-17. Request assistance of higher level of maintenance if damage or wear exceeds limits. Repair damage or wear that is within limits as outlined in steps (2) through (5).

(2) Blend out damage within limits shown on Figure 7-16 with a smooth file or stone. Form a generous radius into surrounding area. Inspect the fitting after cleanup of damage to ensure that limits have not been exceeded. Touchup repaired area with zinc chromate primer.

(3) Build up chafed area of reparable support fitting in area (45° on either side of the vertical fin center line) to approximately 0.150 inch using adhesive (item 205, table 102) as a filler providing a new seat for the shaft cover.

(4) Build up chafed area of reparable support fitting area (45° to 85° on either side of the vertical fin center line) to approximately 0.200 inch thickness using adhesive (item 205, table 1-2) as a filler providing a new seat for the drive shaft cover.

(5) Install tape (item 405, table 1-2) on forward upper edge of support fitting where tail rotor drive shaft cover contacts fitting.

CHAPTER 8

MAIN AND TAIL ROTOR GROUPS

Section I. INTRODUCTION

8-1. General.

a. The purpose of this chapter is to provide all essential information for maintenance personnel to accomplish organizational maintenance on the complete main and tail rotor groups. This information includes a detailed description and chronological instructions as to methods and procedures.

b. The special tools and equipment required for accomplishment of those maintenance phases as are applicable on the Maintenance Allocation Chart. Special tools required for performance of Organizational Maintenance can be found in TM 55-1520-210-20P.

Section II. MAIN ROTOR HUB AND BLADE

8-2. Main Rotor Group.

Main rotor group (see figures 8-1 and 8-2) includes a two-blade semirigid rotor, a stabilizer bar with dampers, a swashplate and support, a scissors and collective sleeve, and interconnecting linkage. Rotor hub yoke is underslung on its mounting trunnion through two pillow blocks which provide a flapping axis, and the all-metal blades are attached through grips which can turn on yoke spindles to change blade pitch. Hub trunnion is installed on splines at top of mast, supported by a cone set and secured by a retaining nut which also serves as mast cap and lifting eye. In operation, collective pitch control stick movements cause angular changes of both blade grips equally and simultaneously. Tilting of main rotor for directional control is accomplished by independent changes of each blade grip by means of cyclic controls. Stabilizer bar, mounted with its flapping axis crosswise to that of main rotor, is connected into rotor controls to provide greater stability for all flight conditions. Without restraint, bar would tend to stay always in its original plane of rotation and hold the rotor to one plane. Since this would limit controllability too severely, this effect is modified by connecting bar to mast through hydraulic dampers. This induces bar to follow movements of mast, relative to rotor, with a slight time lag. Result is a compromise providing both stability and controllability.

a. Vibrations. Mechanics are primarily interested in vibrations felt during in-flight or ground operations in the co-pilot's seat. Most vibrations are always present in the helicopter at low magnitudes. It is when the magnitude of any vibration increases that it becomes of concern. The main problem is deciding when a vibration level has reached the point of being excessive. The only sources of vibrations of any frequency are the rotating or moving parts on the ship, other parts vibrating only in sympathy with an existing vibration. Extreme low, low frequency, and most medium frequency vibrations are caused by the rotor or dynamic controls. Various malfunctions in stationary components can affect the absorption or damping of the existing vibrations and increase the overall level felt by the pilot. A number of vibrations are present which are considered a normal characteristic of the machine. Two per revolution (2/rev) vibration is the most prominent of these, with 4/rev or 6/rev the next most prominent. There is always a small amount of high frequency present. Flight experience is necessary to learn the normal vibration levels. Even experienced pilots sometimes make the mistake of concentrating on feeling one specific vibration and conclude that the vibration level is higher than normal when actually it isn't. It just seems so because the pilot is concentrating on it. For simplicity and some sort of standardization vibrations are arbitrarily divided in general frequencies as follows:

Extreme low frequency –	Less than 1/rev pylon rock
Low frequency –	1/rev or 2/rev type vibration
Med. frequency –	Generally 4, 5 or 6/rev
High frequency –	Tail rotor or faster

(1) Extreme low frequency vibration. Extreme low frequency vibration is pretty well limited to pylon rock. Pylon rocking two to three cycles per second is inherent with the rotor, mast and transmission system. To keep the vibration from reaching noticeable levels transmission mount dampening is incorporated to absorb the rocking. Malfunctions in the dampening system will allow rocking to start and continue until it can be felt by the pilot. A quick check of the dampening system may be made by the pilot while in a hover. Moving the cyclic fore and aft at about one movement per second will start the pylon rocking. The length of time it takes for the rocking to die out after the motion of the cyclic is stopped is indicative of the quality

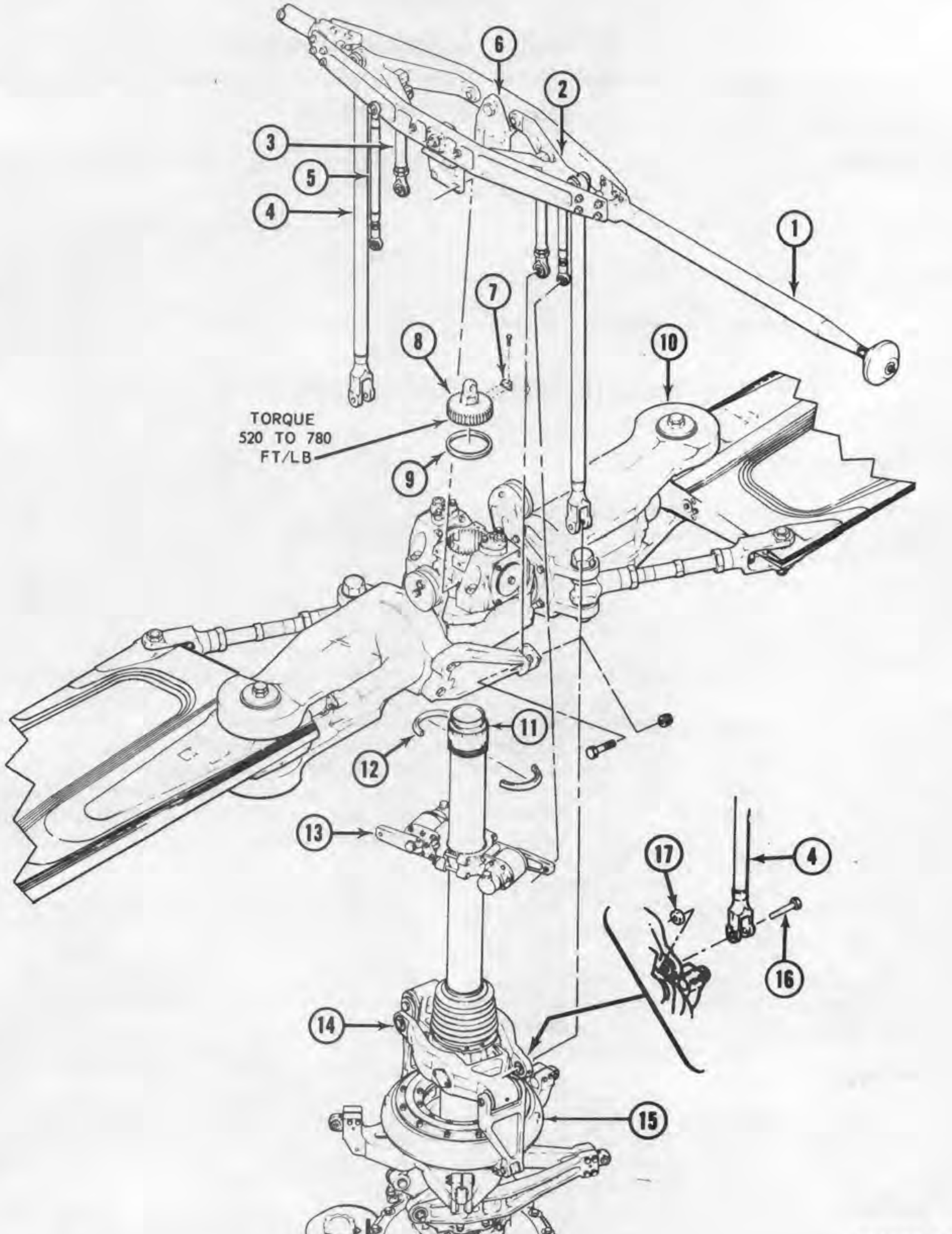


Figure 8-1. Main rotor group (Sheet 1 of 2)

1. Stabilizer Bar Assembly
2. Mixing Lever
3. Pitch Change Link
4. Control Tube
5. Damper Link Tube
6. Stabilizer Support
7. Retaining Nut Lock
8. Retaining Nut
9. Washer
10. Main Rotor
11. Mast
12. Cone Set
13. Stabilizer Dampers
14. Scissors and Sleeve Assembly
15. Swashplate and Support Assembly
16. Bolt
17. Nut

205200-1I

Figure 8-1. Main rotor group (Sheet 2 of 2)

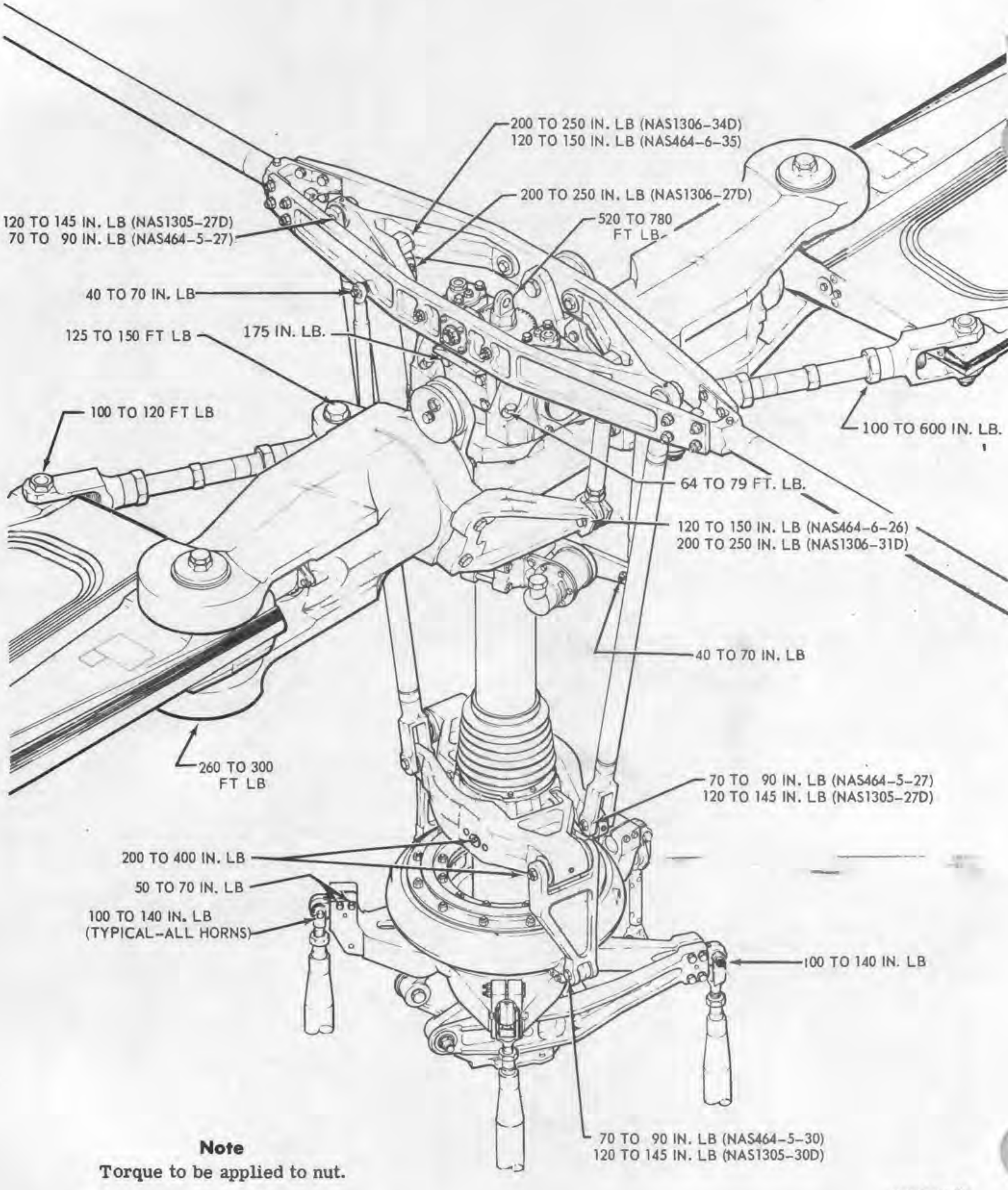
of the dampening. An abnormal continuation of rock during the check or a continued presence of rock during normal flight is an indication that something is wrong with the transmission mounts or dampers. This may be excessive wear, parts loosening up, breakage, incorrect installations, or the wrong type parts installed. Once the pilot determines that an abnormal amount of pylon rock exists, it becomes the responsibility of the mechanic to locate the exact source and take corrective action.

(2) Low frequency vibration. Low frequency vibrations, 1/rev and 2/rev are caused by the rotor itself. 1/rev vibrations are of two basic types, vertical or lateral. A 1/rev is caused simply by one blade developing more lift at a given point than the other blade develops at the same point. A lateral vibration is caused by a spanwise unbalance of the rotor due to a difference of weight between the blades, the alignment of the CG of the blades with respect to the spanwise axis which affects chordwise balance, or unbalance of the hub or stabilizer bar. Rigidly controlled manufacturing processes and techniques, eliminate all but minor differences between blades, resulting in blades which are virtually identical. The minor differences which remain will affect flight but are compensated for by adjustments of trim tabs and pitch settings. Initially the rotor is brought into ground track by normal tracking procedures using the pitch change link (rolling the grip) to make a blade fly higher or lower to bring both blades into the same tip path plane. A track is taken using a higher operating RPM to determine if one blade is climbing (developing more lift) more than the other as its speed increases. This climbing tendency is overcome by using the trim tabs, adjusting them after a flight check is made then re-flying to determine the effect. Because of the physical differences in blades it is sometimes necessary to roll a blade out of track slightly in order to get both blades developing the same amount of lift. Generally, verticals felt predominantly in low power descent at moderate airspeeds (60-70 knots) are because of a basic difference in blade lift and can be corrected by rolling the grip slightly out of track. Verticals felt mostly in forward flight, that get worse as airspeed increases, are usually due to one blade developing more lift with increased speed than the other (a climbing blade). This condition is corrected by adjustment of the trim tabs.

(a) Smoothing of 1/rev verticals is essentially a trial and error process. A basic straight forward procedure is used but the outcome of any adjustment is uncertain and must be flight-tested and the effect analyzed to determine the path of further action. Because of the idiosyncracies of the individual blades, it is occasionally necessary to attempt adjustment procedures not normally utilized; such as lateral procedures for a vertical, using roll when normally tab is used (and vice versa), changing both tabs an equal amount. Once in a while it will be found to be impossible to get two blades flying satisfactorily together and it will be necessary to remove and replace one blade.

(b) Associated with the 1/rev vertical is the intermittent 1/rev vertical. Essentially, this is a vibration initiated by a gust effect causing a momentary increase of lift in one blade giving a 1/rev vibration. The momentary vibration is normal but if picked up by the rotating collective controls and fed back to the rotor causing several cycles of 1/rev then it is undesirable. Sometimes during steep turns one blade will "pop" out of track and cause a hard 1/rev vertical. This condition is usually caused by too much differential tab in the blades and can be corrected by rolling one blade at the grip and removing some of the tab, (as much as can be done without hurting the ride in normal flight).

(c) Should a rotor, or rotor component, be out of balance, a 1/rev vibration called a lateral will be present. This vibration is usually felt as a vertical due to the rolling motion it imparts to the aircraft, causing the pilots' seats to bounce up and down. It can be noted that the seats bounce up and down out of phase; that is the pilot goes up while the co-pilot goes down. An unusually severe lateral can be felt as a definite sideward motion as well as a vertical motion. Laterals existing due to an unbalance in the rotor are of two types; spanwise and chordwise. Spanwise unbalance is caused simply by one blade and hub being heavier than the other (i.e. an unbalance along the rotor span). A chordwise unbalance means there is more weight toward the trailing edge of one blade than the other. Both types of unbalance can be caused by the hub as well as the blades. Another occasional source of a lateral is the stabilizer bar. Improper balancing of the bar prior to installation is the main reason for this problem. Lateral



Note
Torque to be applied to nut.

Figure 8-2. Rotor system torque values

vibrations are usually felt in a hover and in descending moderate airspeed turns and tend to disappear in forward flight. An out-of-ground effect hover is usually the best place to feel a lateral and reducing the RPM to 6000 will often make the lateral more prominent. The correction of 1/rev lateral vibration begins by determining if one blade is heavier than the other. This is done by wrapping one or two turns of a 2 inch masking tape (or equivalent weight of another type) around one blade, a few inches in from the tip so that it won't be so easily torn off by wind. The aircraft is then hovered, either in or out of ground effect, wherever the lateral was most evident, and the effect of the tape noted. A worsening of the vibration means the tape was placed on the wrong blade. Once the correct blade is determined further tape is added, in amounts depending on the severity of the vibration, until a final best balance using 1/2 wraps of tape is obtained. Should the lateral still be excessive or the tape no help on either blade, then a chordwise unbalance exists and it will be necessary to sweep a blade. One blade is arbitrarily picked and swept aft by shortening the drag link. One flat of turn (1/6 of a full turn) is used to start with. The aircraft is then hovered and the effect determined. Once it is ascertained that the correct blade is being swept continued sweep adjustment in amounts based on the severity of the vibration is used until the lateral is eliminated or further sweep fails to help. If still not satisfactory, it will be necessary to return to taping and adjust tape and sweep until the optimum combination is obtained. If it is still not possible to eliminate the lateral, a small amount of grip rolling should be attempted as in the 1/rev vertical procedure, being careful not to adversely affect forward flight. Should the lateral still be present, a small amount of tab may be tried, and if still not corrected, the hub and blades should be checked for grip spacing and if no problem found, then removed from the aircraft and the alignment checked and the stabilizer bar balanced.

(d) Two per rev (2/rev) vibrations are inherent with two bladed rotor systems and a low level of vibration is always present. A marked increase over the normal 2/rev level can be caused by two basic factors: a loss of designed dampening or absorption capability or an actual increase in the 2/rev vibration level of the rotor itself. The loss of dampening can be caused by such factors as deteriorated transmission mounts or lift link bushing, or an airframe component loosening up and vibrating in sympathy with the inherent 2/rev. An increase in the 2/rev level of the rotor itself can be caused by worn or loose parts in the rotor hub or looseness in the rotating controls. The correction of excessive 2/rev vibrations is primarily dependent upon the mechanic. The pilot generally cannot determine the exact cause and hence cannot prescribe specific corrective procedures. Occasionally it has been found that tab settings, and sweep, affect the overall 2/rev level. If no mechanical cause of excessive 2/rev can be found, an attempt to decrease the level by rotor adjustments may be made. Unequalizing the tension-torsion strap adjustments sometimes helps as does tabbing both blades down (most usually) or up (rarely) a few degrees. A recheck of boost off forces should be made. It has been found that both blades may be swept in the same direction small amounts and sometimes decrease 2/rev.

(3) *Medium frequency vibrations.* Medium frequency vibrations at frequencies of 4/rev and 6/rev are another inherent vibration associated with most rotors. An increase in the level of these vibrations is caused by a change in the capability of the fuselage to absorb vibration, or a loose airframe component, such as the skids, vibrating at that frequency. Changes in the fuselage vibration absorption can be caused by such things as fuel level, external stores, structural damage, structural repairs, internal loading, or gross weight. Abnormal vibration levels of this range are nearly always caused by something loose; either a regular part of the aircraft or part of the cargo or external stores. The vibration is felt as a rattling in the aircraft structure. The most common cause is loose skids caused by worn, loose, or improper skid retaining straps. Loose skids can be discovered by shaking the ship with cyclic and feeling if they vibrate or looking out the door at the skids while shaking the aircraft. (Excessive or severe shaking is undesirable and will make even tight skids vibrate.) Many times skids will cause considerable vibration during turns and maneuvers if they are excessively loose. Loose skids is not a serious condition but it can cause annoyance to flight crews and passengers. Other sources of medium frequency vibrations are the elevator, access doors, cargo hook electronic gear, safety belt out the door, and engine/transmission cowling. Sometimes air loads will cause the small fire extinguisher doors and the step doors to vibrate. Occasionally portions of the cabin roof, side panels or doors, will "oil can" rapidly in flight, giving the same sensation as a medium frequency vibration.

(4) *High frequency vibration.* High frequency vibrations can be caused by anything in the ship that rotates or vibrates at a speed equal to or greater than that of the tail rotor. This includes many unusual situations such as hydraulic line buzzing, or starter relay buzzing, to the most common and obvious causes; loose elevator linkage at swashplate horn, loose elevator, or tail rotor balance and track. Pilot experience can help greatly in trouble shooting the cause of a high frequency vibration, as a pilot who has experienced a vibration can often recognize the cause the next time he feels the same vibration. Generally, determining the cause of a high frequency should begin with investigating tail rotor track (ground track using a rubber tipped stick with grease, lipstick or some marking substance on the tip to mark the blades and determine if one is out of track). Should the rotor be properly in track, balance should be checked by removing the tail rotor and hub assembly and checking on a balance stand. Should tail rotor balance check out also, an inspection of the complete drive shaft should be made. Physical damage like loss of balance tabs would be evident. Observing the shaft (cover removed) while the rotor is running may show up a bent shaft, faulty bearing, or some other obvious malfunction. Attempting to locate the source of the vibration by feeling

the fuselage in various places while ground running can sometimes be successful in localizing the cause and at least eliminating some possible causes. It should be recognized that vibrations that are specifically being watched for always appear more severe than when no particular attention is being directed to them. Many points on the airframe, such as the engine mounts, have a surprisingly high level of high frequency vibration and it is easy to decide that the level is higher than normal when actually it isn't. A comparison between the feel of a helicopter without excessive vibration and the aircraft with the vibration is helpful in precluding erroneous conclusions.

b. Troubleshooting – Main Rotor. A chart of possible main rotor troubles, causes, and corrective action, is shown below. Refer also to step c. for additional information and specific testing and mechanical procedures for adjusting the main rotor.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Lateral vibration	Rotor spanwise unbalance	Balance dynamically with weight in blade bolt.
	Rotor chordwise unbalance	Balance dynamically by adjusting drag brace (sweeping blade).
	Stabilizer bar unbalanced	Balance stabilizer bar,
Vertical 1/rev vibration	Rotor blades out of track	Track blades.
	Worn bearings in collective lever assembly and link	*Replace worn bearings.
	Worn pitch change link rod end bearing	*Replace if wear is excessive.
	Excessive wear in collective scissors assembly	*Replace scissors and sleeve assembly.
	Internal wear or damage in main rotor hub assembly	Replace hub or refer to direct support maintenance activity for repair.
Collective stick light or heavy in downstroke	Balance spring on collective cylinder out of adjustment	Adjust spring on servo valve to provide equal force to move collective either direction.
Collective pitch control forces not normal in cruise (Boost off)	Incorrect torsion strap adjustment	Adjust strap torsion
Slow control response	Internal leakage in servo cylinder	Replace cylinder or seals as necessary.
High frequency vibration	Loose elevator linkage at swash-plate horn	Replace worn bushings.
	Loose elevator	Re-shim bearing.
	Tail rotor out of track	Track tail rotor
	Tail rotor out of balance	Balance tail rotor
Pylon rock	Defective fifth mount	Replace mount.
	Defective pylon dampers	Repair or replace pylon dampers.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Mount bolts bottomed or stripped	Replace bolts.
	Fifth mount	Inspect mount and forgings for damage
2/rev vibration, approximately ten per second	Pylon mounts deteriorated	Replace mounts.
Rotor rpm high or low in autorotation	Low pitch blade angle incorrect	Adjust both pitch change tubes equally

*Wear at one bearing or combined wear at these locations significantly contributes to vibration.

c. *Operational Ground Check – Main Rotor.*

NOTE

Run-up of helicopter shall be performed only by personnel authorized according to AR95-13.

(1) Coat the tracking tips of each blade with grease pencil using a different color on each tip. See figures 8-3 and 8-4 for use of tracking flag.

(2) Take a low speed blade track (4700 RPM) by following the steps in the tracking chart. (See figure 8-4.)

(3) Correct a low speed out-of-track condition by rolling up the low blade as follows:

(a) Loosen barrel nuts on pitch change link on the low blade.

(b) Turn pitch link barrel one flat at a time to shorten pitch link.

NOTE

One flat rotation of barrel will result in approximately 3/8 inch in blade track for all RPM.

(c) Tighten jam nuts and lock-wire barrel to nuts.

(d) Re-check track with the flag. Continue adjustments and checks until blades are in track.

(4) Take a high speed track check (6600 RPM).

(5) If blades are out of track at high speed, make no adjustments but make a record of which blade is low. Next, proceed to steps in step d. below.

d. *In-Flight Check and Troubleshooting – Main Rotor.*

(1) Test fly the helicopter. If vertical vibrations are felt, begin making adjustments according to trouble shooting chart. (See figure 8-5.) If no vibrations are felt, no further adjustments will be required.

NOTE

When adjustments must be made, designate one blade "A" and the other "B". Use these designations to keep a running account of adjustments. Tabs may be bent to a maximum angle of 8 degrees in either direction. It can be bent up 8 degrees from original setting of "0" degrees. (See figure 8-6 for tool application.)

(2) Test fly the helicopter after each adjustment. Continue adjustments according to figure 8-5, until all vertical vibration is worked out. Keep an accurate record of all adjustments.

(3) Fly the helicopter through the full airspeed range and check for lateral vibration. (Lateral vibrations are usually more pronounced in hover.) Check that adjustments have not changed autorotation RPM.

(4) If lateral vibration is felt, follow the procedures charted in figure 8-7.

e. *Taping Blades When Troubleshooting Main Rotor.*

NOTE

When lateral vibrations have been corrected by taping blades with two-inch masking tape on the blade tips, (see figure 8-7), the tape is then removed and weight added to the blade bolt.

(1) Remove the tape from blade and count the number of wraps.

(2) Remove the cap from the retaining bolt of the taped blade.

(3) For every complete wrap of two-inch wide masking tape, add 3.4 ounces of lead in the retaining bolt.

Figure 8-3. Tracking main rotor

(4) Reinstall and lock-wire the cap.

f. Sweeping Blade – Main Rotor.

(1) Loosen jam nuts enough to turn barrel one flat AFT as shown by direction of arrows.

(2) After adjustment, tighten jam nuts. Record the adjustment.

(3) Make additional adjustments as required, but do not exceed two full turns of the barrel.

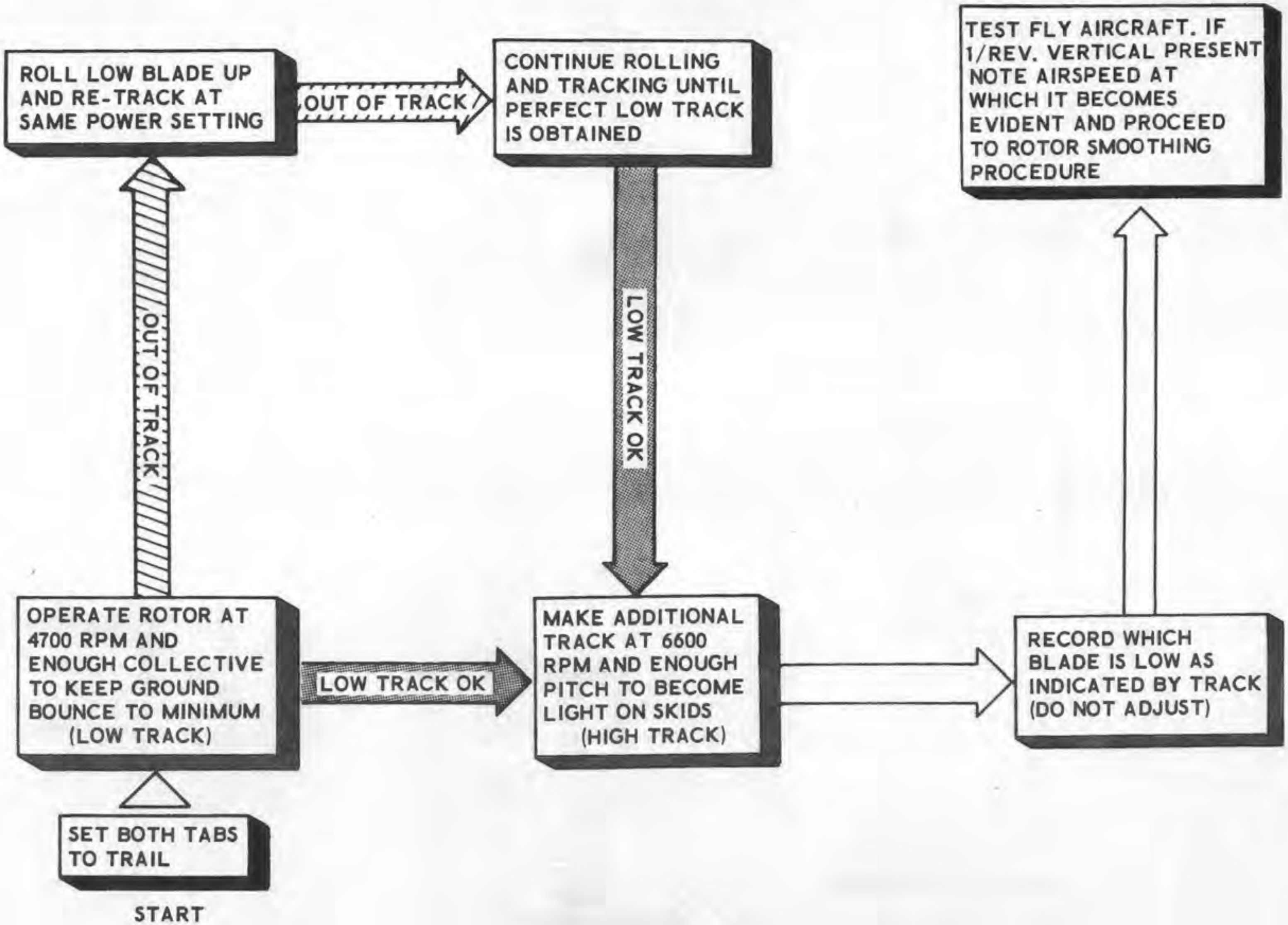
NOTE

If maximum adjustments fail to correct vibrations, the rotor must be removed from the helicopter and aligned on stand with a scope. Refer to higher maintenance level.

g. Autorotation RPM Adjusting – Main Rotor.

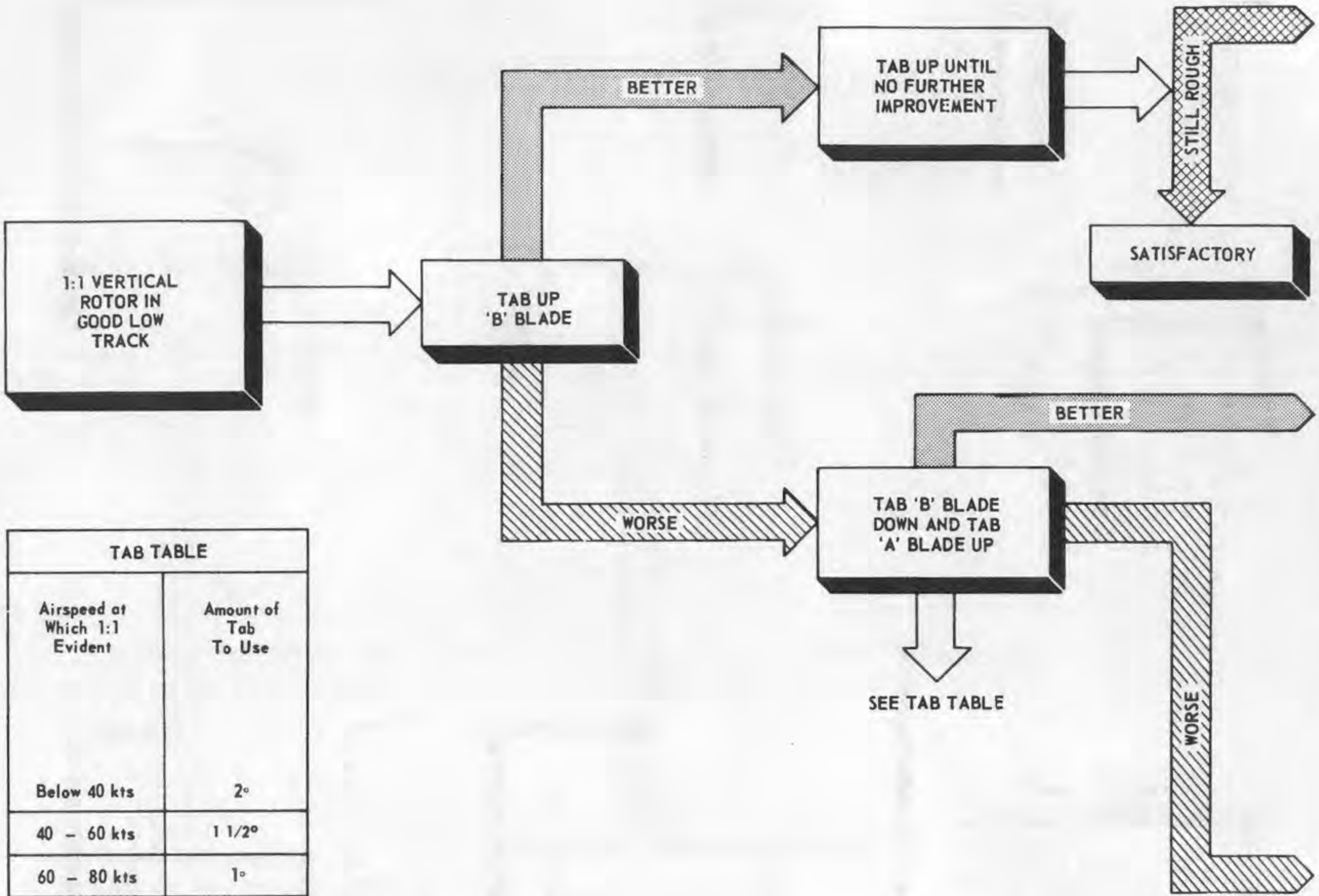
(1) Check rotor RPM in autorotation. Make straight ahead autorotative descent at constant 60 knots indicated airspeed. (Turns and changes of airspeed affect rotor RPM.) Throttle should be at flight idle and collective full down. Do not let RPM exceed limits if rotor is out of adjustment. When in steady autorotative descent note rotor RPM.

(2) If rotor overspeeds, shorten both pitch change links equally. One full rotation of pitch link barrel changes rotor speed approximately 7 to 10 RPM.



209200-5C
AV 054143

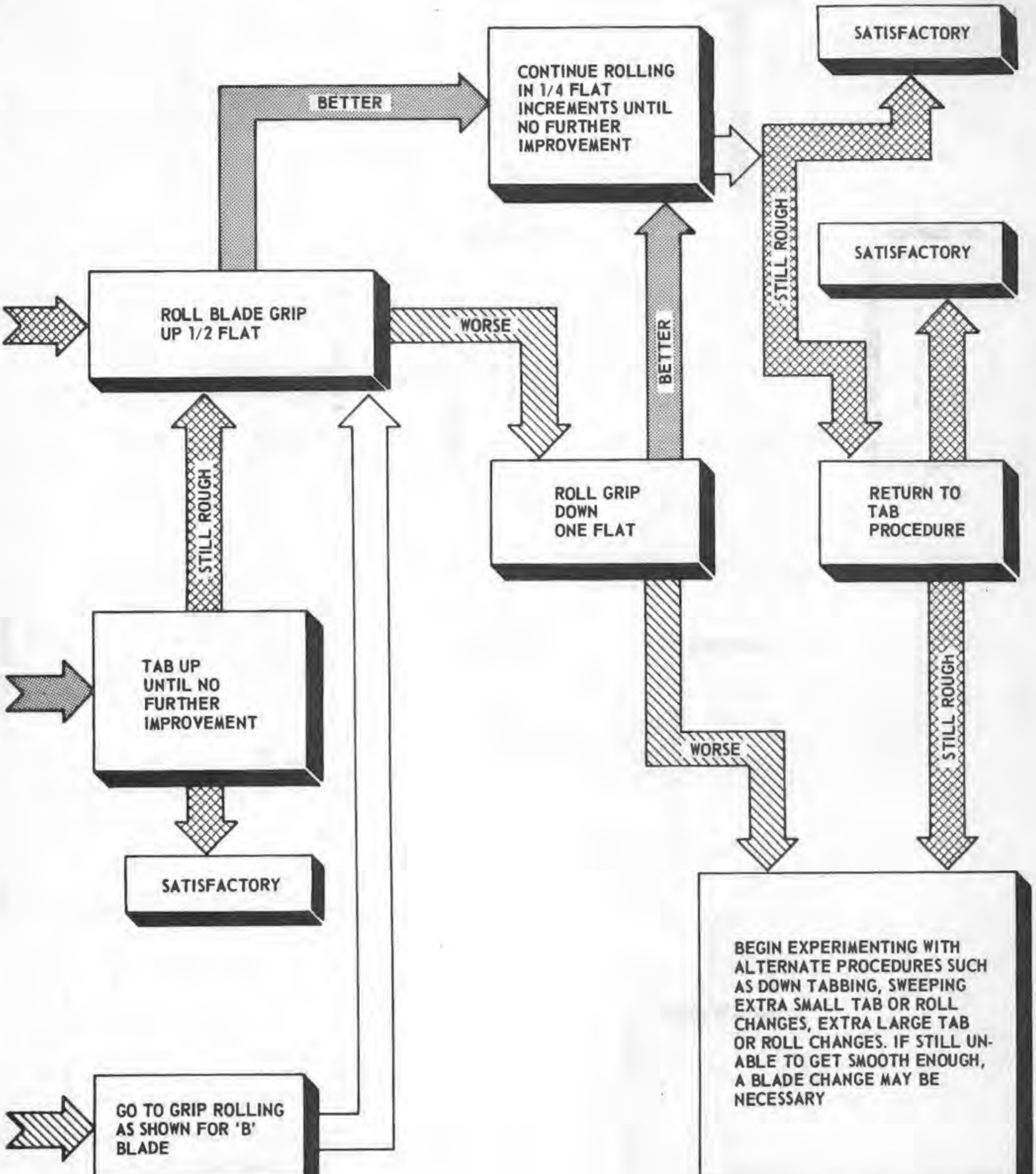
Figure 8-4. Main rotor tracking procedure



TAB TABLE	
Airspeed at Which 1:1 Evident	Amount of Tab To Use
Below 40 kts	2°
40 – 60 kts	1 1/2°
60 – 80 kts	1°
80 – 100 kts	1/2°
100 – 120 kts	1/4°

205200-9-1B
AV 054144-1

Figure 8-5. Rotor smoothing procedure — 1:1 vertical (Sheet 1 of 2)



205200-9-2
AV 054144-2

Figure 8-5. Rotor smoothing procedure — 1:1 vertical (Sheet 2 of 2)

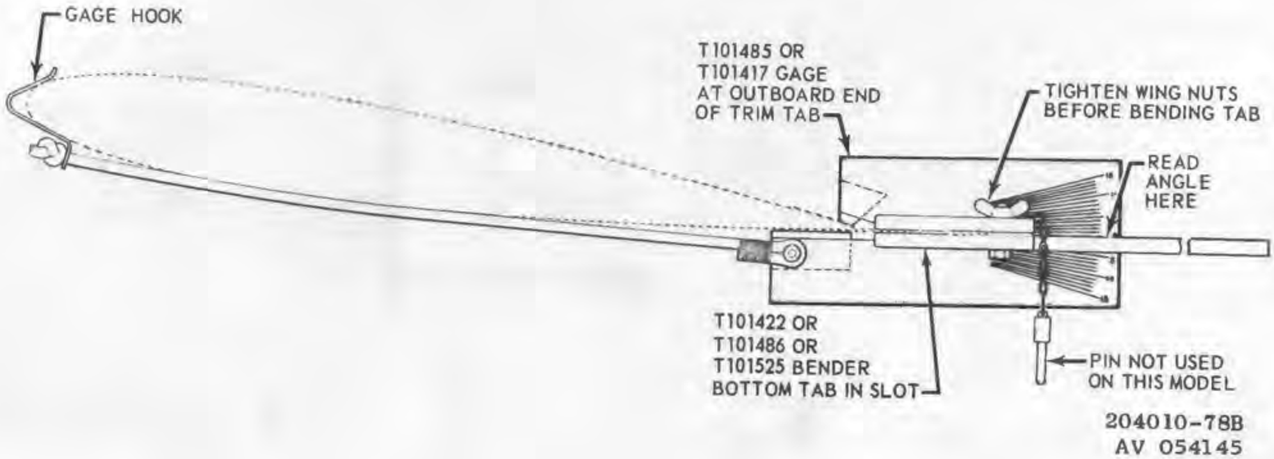


Figure 8-6. Trim tab bender and gage application

(3) If rotor underspeeds, lengthen both pitch change links equally.

(4) Tighten jam nuts and lock-wire.

NOTE

After final pitch link adjustment the exposed thread length of upper and lower bearings shall be equal within 2-1/2 threads for pitch links without thread engagement inspection holes. For pitch links with thread engagement inspection holes, exposed thread lengths shall be equal within 5 threads, provided adequate thread engagement is indicated at inspection hole.

(5) Recheck RPM in flight and repeat adjustment as necessary.

8-3. Main Rotor Hub And Blade Assembly.

Main rotor blades (see figure 8-8) are all metal bonded assemblies, set into hub grips at a preconing angle and secured by a single retaining bolt in each grip. Each blade is formed of four major sections: main spar, honeycomb core, trailing edge extrusion, and nose block extrusion, all bonded to skin by adhesive applied under heat and pressure. Reinforcing doublers, grip plates, and drag plates are attached on blade butt end. Stainless steel strips cover leading edges for resistance to abrasion. A trim tab is provided on trailing edge for tracking adjustments. A fitting on blade tip, which is used in flag-tracking procedure, has a hole for attachment of rotor tie-down. An adjustable drag brace connects trailing edge of blade to hub, providing a means of aligning blades. Blade grips and pillow blocks on hub are lubricated with same oil as that used for engine, transmission, and gear boxes. Oil levels can be checked through transparent covers. On main rotors, torsion on the retention strap within each blade grip counteract aerodynamic forces which tend to change blade pitch. Control linkage connects to a pitch horn on leading side of each blade grip. Special tools required to perform the following maintenance functions on the main rotor hub and blade assembly are listed below in Table 8-1. To ensure correct reassembly and to maintain proper blade balance, a color coding system is used. Red dots identify all parts connected to the red blade; white dots identify all parts connected to the white blade.

Table 8-1. Special Tools

PART NUMBER	NOMENCLATURE
T100220	Lifting Slings
T101358	Wrench Adapter
T101402	Grip Positioning Link
T101452	Maintenance Hoist

a. Removal – Main Rotor Hub and Blade Assembly.

(1) Remove stabilizer bar (1, figure 8-1) with pitch change link (3) and tubes (4 and 5). (Refer to paragraph 8-6a.)

CAUTION

Grip positioning links must be installed to prevent damage to main rotor strap assemblies. (See figure 8-9.)

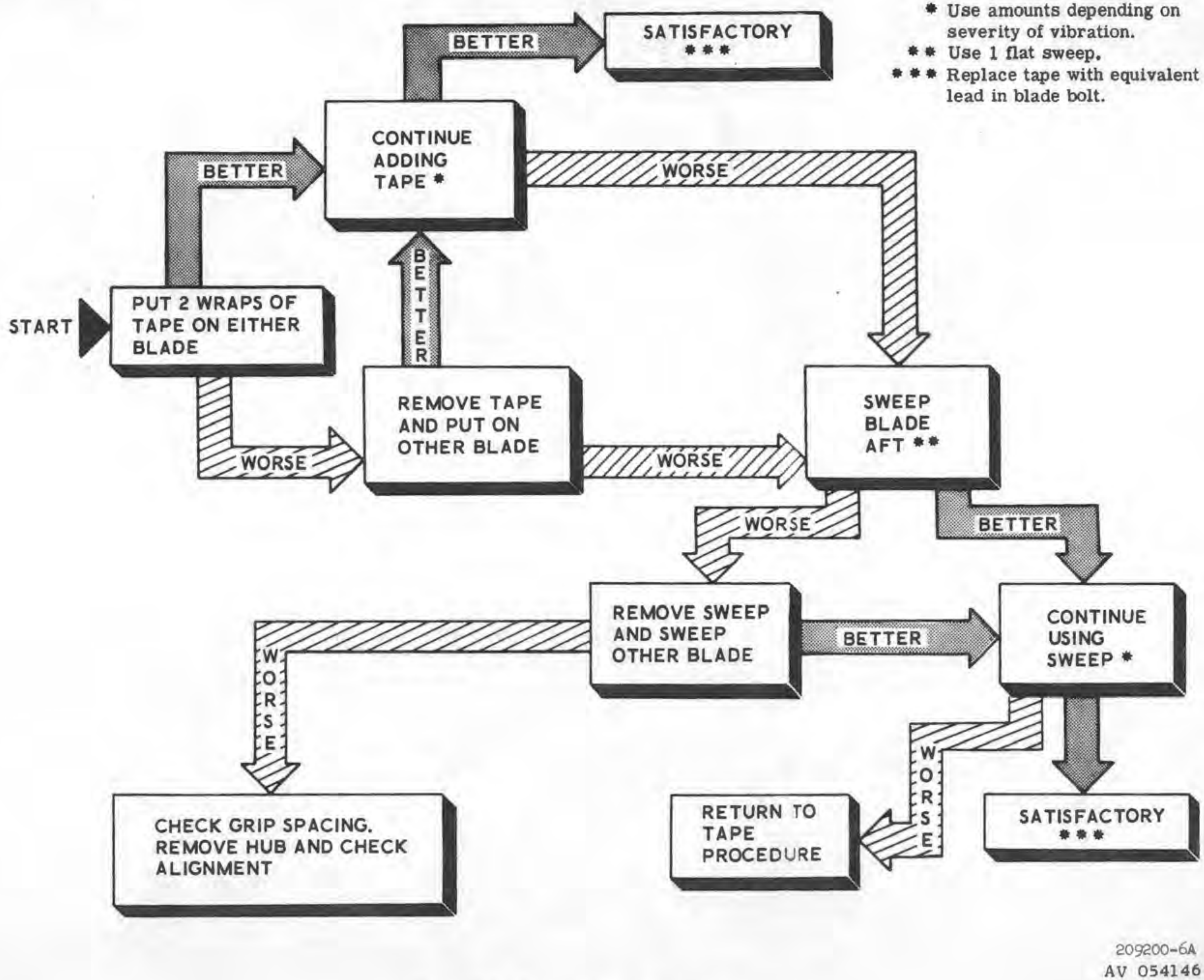
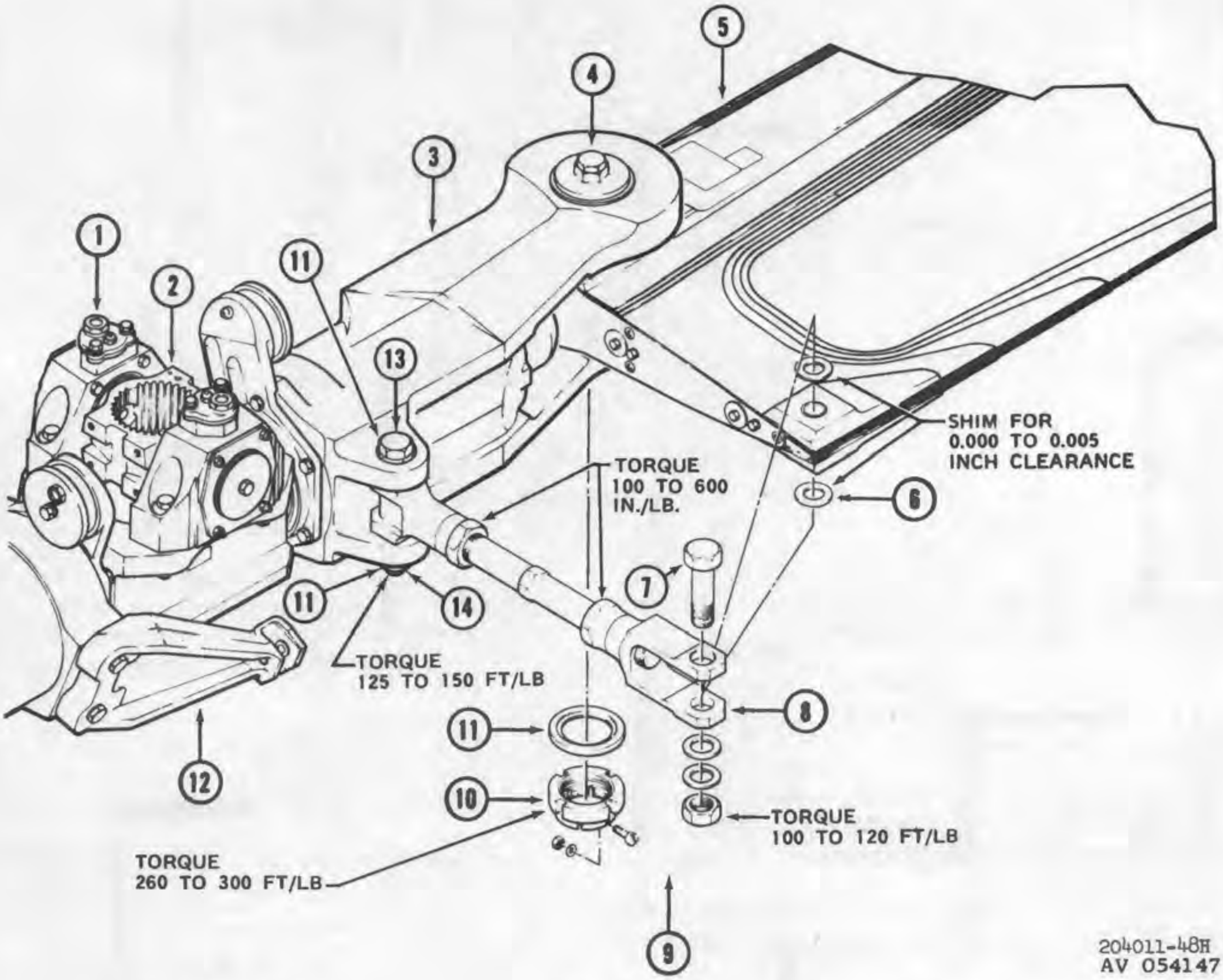


Figure 8-7. Troubleshooting — lateral vibration



1. Pillow Block
2. Hub Trunnion
3. Grip
4. Blade Retaining Bolt
5. Main Rotor Blade
6. Shims
7. Drag Brace Bolt
8. Drag Brace
9. Screw
10. Nut
11. Washer
12. Pitch Horn
13. Drag Brace Bolt
14. Nut

Figure 8-8. Main rotor hub and blade assembly

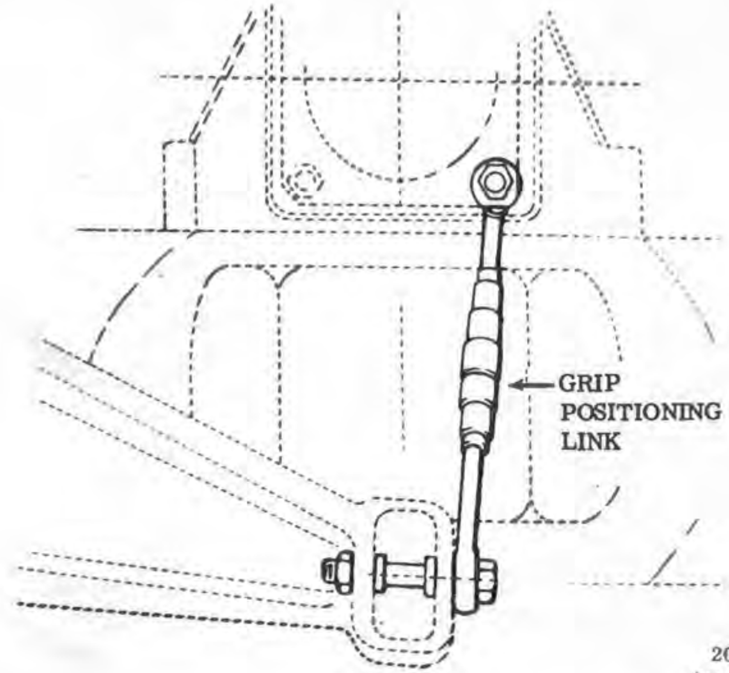


Figure 8-9. T101402 grip position link installed

(2) At same time, install a T101402 grip positioning link between each rotor pitch horn and adjacent stud of pillow block as shown in figure 8-9.

(3) Remove lockwire, bolt, and lock (7, figure 8-1) at side of retaining nut (8), Use T101358 wrench adapter to remove nut with washer (9).

(4) Install T101452 maintenance hoist, or position other suitable hoist above mast. Attach to hub of main rotor (10) with two T100220 lifting slings.

(5) Guide and steady rotor by means of tie-down assembly, while lifting hub clear of mast (11). Remove split cone set (12).

NOTE

Fasten split cones together and retain as a matched set.

b. Installation – Main Rotor Hub and Blade Assembly.

(1) Erect T101452 maintenance hoist, or provide other suitable hoist.

(2) Attach two T100220 hoisting slings and lift main rotor (10, figure 8-1) to position above mast (11). Use rotor tie-down tool to guide and steady rotor during handling.

(3) Coat splines of mast and rotor hub trunnion with light coat of corrosion preventive compound (item 309, table 1-2). Place cone set (12), with bevel side up, in groove of upper mast splines with end gaps equally spaced.

NOTE

Install split cones as matched set only.

(4) Align master splines and lower rotor onto mast, seated on split cone.

CAUTION

Rotor must be aligned directly over mast to avoid damaging mast threads.

(5) Coat mast threads with corrosion preventive compound (item 312, table 1-2). Install washer (9) and retaining nut (8) on mast. Use T101358 wrench adapter to tighten nut to a torque of 520 to 780 foot-pounds. Install lock (7), engaged with nut splines and secured to hub trunnion by a bolt. Lock-wire head to trunnion.

(6) Install stabilizer bar (1) and connect links (3) to pitch horns, control tubes (4) to scissor levers, and tubes (5) to damper levers. (Refer to paragraph 8-6, step d.)

NOTE

When installing connect links (3) to pitch horns, install bolt with heads inside of pitch horn.

(a) Set pitch change links to length of 10.5 inches for main rotor blades, between centers of hole in lower rod-end and upper hole of universal fitting. (Refer to paragraph 8-3, step d.)

(b) Remove grip positioning links while installing pitch change links.

(c) Hold cyclic stick in centered position and the collective control stick in the full down position. Hold main rotor hub approximately level. Check low pitch position of grips for a plus reading of eight degrees, plus or minus one-half degree, by placing a protractor chordwise on the outboard machined surface of the blade grip. Holding blade level, check reading on opposite blade grip. Adjust pitch change links equally until a total reading of sixteen degrees plus or minus one degree is obtained.

NOTE

If rotor overspeeds in autorotation, shorten links equally. If rotor underspeeds, lengthen links equally. Normal rpm range in autorotation is 324 to 339. (Refer to TM 55-1520-210-10.)

(d) Tighten lock-nuts on pitch change links to a torque of 650 to 800 inch-pounds. Lockwire by using one continuous safety from the barrel around to the nut then up to the clevis.

NOTE

Further adjustment of pitch change links may be required in operational checks.

(e) When required, due to parts replacement, check adjustment of tubes (5) to damper levers. (Refer to paragraph 8-7, step e.)

c. *Pitch Change Link Assembly Prcedure.*

(1) Center of rod end bearing to center of universal bearing shall be 10.5 inches after assembly. (See figure 8-10.)

(2) Torque bolt, NAS1306-27D and nut, MS17825-6, 200 to 250 inch-pounds, above the nut friction torque.

(3) Both the clevis and rod end bearing should be installed into barrel approximately the same number of turns, equal within 0.030 inch. See dimensions A and B, figure 8-10.

d. *Adjustment – Collective Pitch Force.*

NOTE

At approximately 324 rotor rpm in cruise flight, with hydraulic boost off, and minimum collective friction, collective stick dynamic force is considered satisfactory under the following conditions:

(1) Up collective - Pilot should be able to pull the collective stick up until an engine torque pressure reading of approximately 33 psi. is obtained. If unable to do so, a negative force exists.

(2) Down collective – Pilot should be able to push the collective stick down until an engine torque pressure reading of 10 to 13 psi. is obtained. If unable to do so, a positive force exists.

(3) If the above conditions are not met, it is necessary to change collective force by adjusting torsion of blade retention strap in each grip. Determine exact nature of condition; positive or negative force prevailing, as noted by pilots during flight.

CAUTION

The following steps should be performed with extreme caution. Loosening bolts too far will require a complete resetting of grip angle.

(a) Cut lockwire and loosen retaining bolts (7, figure 8-11) just enough to permit free turning of static stop worm screw (4).

(b) Turning the grip worm screw (4) clockwise, as viewed from its head, upward wrench motion, will decrease strap twist, this is the corrective action for positive collective. Rotating the grip strap worm screw counterclockwise is the corrective method for a negative force.

WARNING

Never tamper with the large retaining nut, (acorn nut) in outboard end of each grip, in this procedure or any other used in Organizational Maintenance.

(c) Adjustment of the screw (4) should not be made in increments of more than one turn at each adjustment, and not more than four turns total.

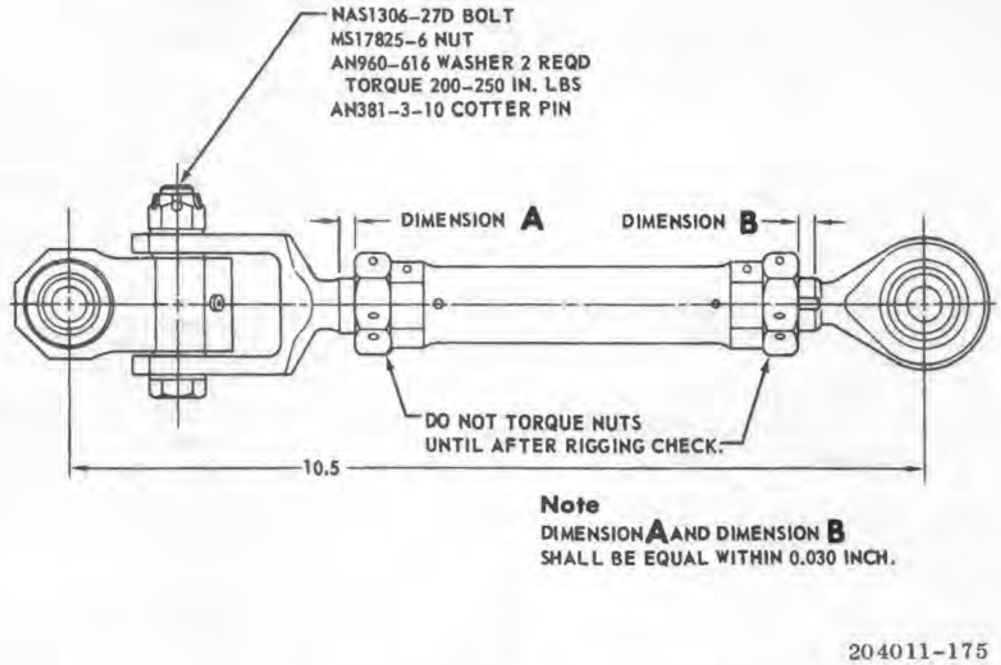


Figure 8-10. Pitch change link assembly

(d) Tighten, torque and lock-wire static stop retaining bolts after each adjustment.

(e) Repeat sub steps (3)(a) through (d) on opposite blade.

(f) Test fly helicopter and check collective forces.

(g) After functional test flight and final pitch adjustment, seal joint of inboard fitting (204-012-102-1) and yoke (204-011-102-17) with sealant (item 207, table 1-2).

e. *Resetting Tension Torsion Straps to Initial Setting.* If retaining bolts (7, figure 8-11) have been loosened too far, allowing worm gear assemblies to become disengaged, the following procedure must be accomplished to position the straps to their initial setting.

CAUTION

If the worm gear assembly becomes disengaged on either blade the following steps must be performed on both blades.

(1) With worm gear assembly disengaged from fitting (3), position fitting so that leading edge tab (8) dimension "D" is 0.200 inch greater than trailing edge tab (2) dimension "D". (See figure 8-11.)

(2) Maintain the dimensions outlined in step (1), engage worm gear assembly, tighten, torque and lock-wire bolts (7).

(3) Test fly helicopter and check collective forces. If adjustment is required perform sub steps (a) through (g) paragraph 8-3 step d(3).

8-4. Main Rotor Blade.

Main rotor blades (see figure 8-8) are all metal bonded assemblies, set in hub grips at a preconing angle and secured by a single retaining bolt in each grip. Each blade is formed of four major sections; main spar, honeycomb core, trailing edge extrusion and nose block extrusion, which are all bonded to skin by adhesive applied under heat and pressure. Reinforcing doublers, grip plates and drag plates are attached to blade butt end. Stainless steel strips cover leading edges for resistance to abrasion. A trim tab is provided on trailing edge for tracking adjustments. A fitting on blade tip, which is used in flag tracking procedure, has a hole for attachment of rotor tie-down. Special tool required to perform the following maintenance functions on the main rotor blades is listed below in Table 8-2.

Table 8-2. Special Tools

PART NUMBER	NOMENCLATURE
T101414	Wrench

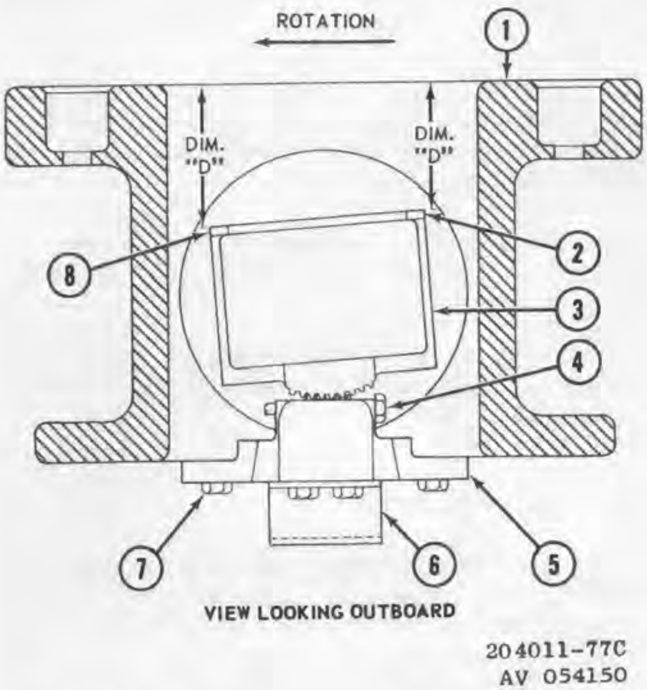
a. Removal – Main Rotor Blades.

(1) Support main rotor hub on stand. Support each blade (5, figure 8-8) so that leading edge is straight.

(2) Remove bolt (7) with shims (6), washers, and nut to detach drag brace (8) from blade. Secure shims to brace or to blade for use in reassembly.

(3) Remove screw (9) with nut and washer to unlock nut (10). Remove nut and washer (11) from lower end of blade retaining bolt (4).

(4) Gently raise tip of blade until blade bolt (4) can be readily removed. Remove blade from grip.



1. Main Rotor Yoke
2. Tab (Trailing Edge)
3. Inboard Strap Fitting
4. Worm Screw
5. Static Stop
6. Aligning Bracket
7. Bolt (2)
8. Tab (Leading Edge)

Figure 8-11. Collective pitch retention strap adjustment

CAUTION

Reason for lifting blades is because they are pre-set to 4 degree cone, and elevation is necessary to free bolts. If difficulty is still encountered in removing bolts use Main Rotor Blade Retention Bolt Extracting Fixture Assembly, which may be locally fabricated as shown on figure 8-12.

NOTE

Do not change adjustment of drag brace. Assure that blade retention bolt is identified for reassembly in same grip from which removed. Assure that blade is identified, only required if blade is to be reassembled to same grip of same hub and blade assembly from which removed.

(5) Remove opposite blade in same manner.

b. Cleaning – Main Rotor Blades. Wash main rotor blades with a solution of mild soap and water. Refer to Chapter 3 for special cleaning requirements.

c. Inspection – Main Rotor Blades.

(1) Main rotor blades receiving damage in the form of nicks, scratches, gouges, tears, holes, etc., in the skin may be repaired. (See figure 8-13.)

NOTE

Loose balance weights retention nuts may be retorqued to: ¼" studs 40 - 50 inch-pounds, 5/16" studs 80 - 100 inch-pounds.

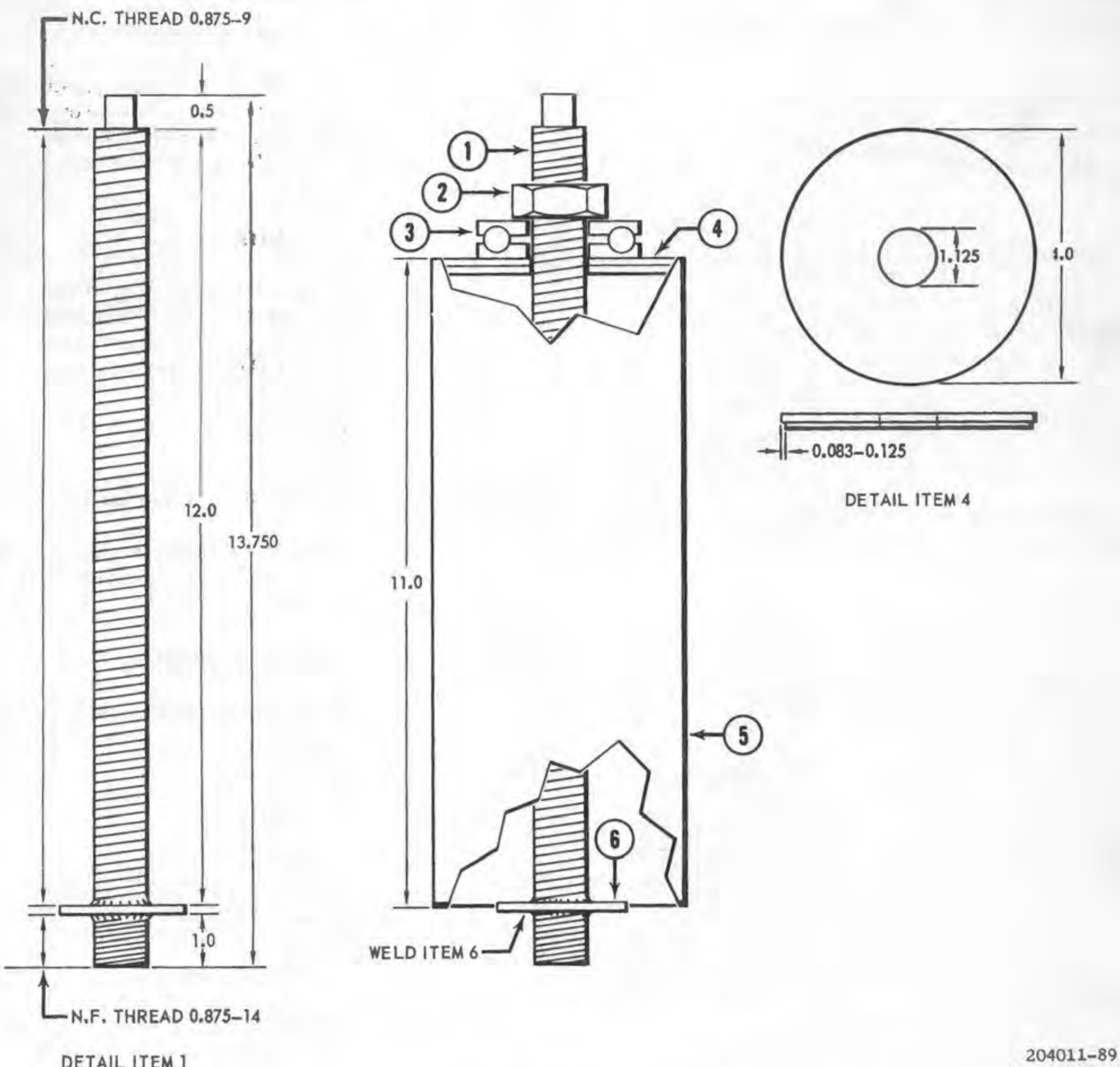
NOTE

If inspection reveals defects as outlined in (a) through (f) below request assistance from higher echelon for repairs. Defects in excess of limitations listed will be cause for removal and will be repaired when possible by higher echelon.

(a) Nicks and scratches anywhere on the surface of the skins or trailing edge strip that are not in excess of 0.008 inch in depth.

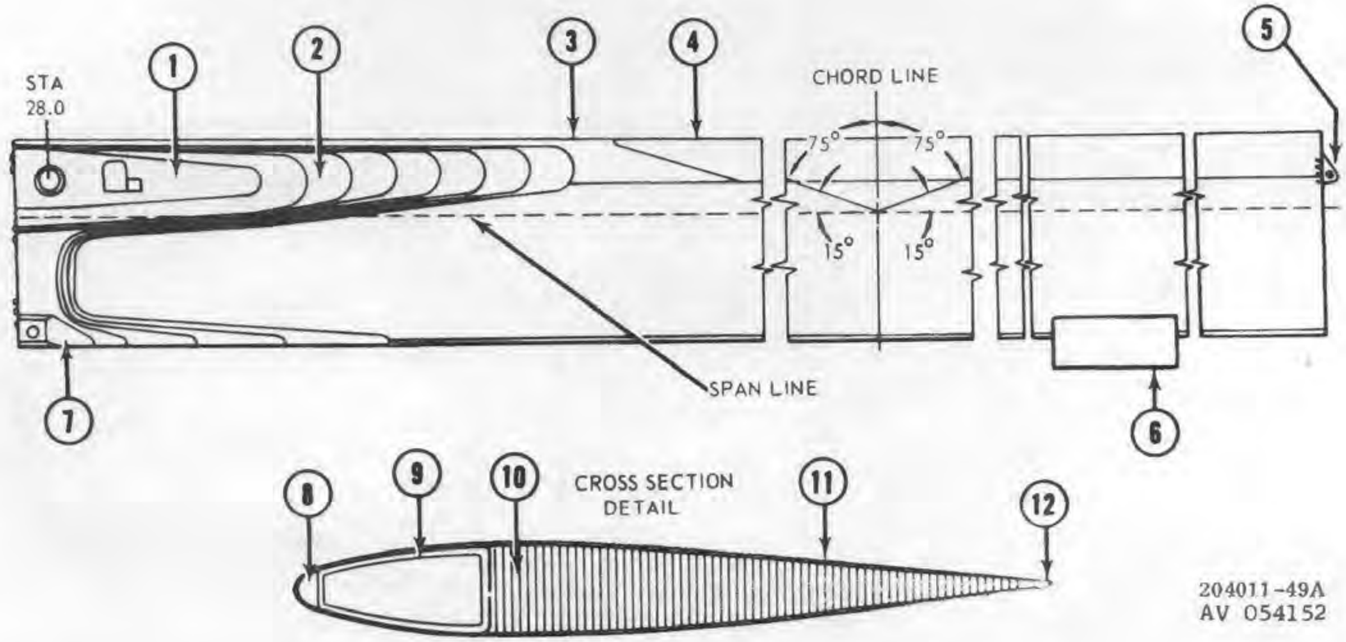
(b) Nicks and notches in the extreme trailing edge of the blade that are 0.120 inch deep or less.

(c) In the outboard four feet of the blade, any dent in the skin that does not tear the skin, produce a void detectable when tapping with a coin, or affect flight characteristics, is acceptable.



1. Puller Rod Assembly 4130 (or better), 1.0 O.D. - 13.750 Long
2. Hex Nut 0.875 NC (9) Thread
3. Bearing (Thrust) Inner Race I.D. 0.080 - 0.093
4. Plate, Steel or Aluminum, 4.0 O.D., 0.375 Thick
5. Tube, Steel or Aluminum, Wall Thickness 0.083 - 0.125
6. Steel Flat Washer, 2.0 O.D. - 0.875 I.D.

Figure 8-12. Main rotor blade retention bolt extracting fixture



1.	Grip Plate	5.	Tip Fitting	9.	Spar
2.	Doublers	6.	Trim Tab	10.	Honeycomb Core
3.	Inboard Abrasion Strip	7.	Drag Plate	11.	Skin
4.	Outboard Abrasion Strip	8.	Nose Block	12.	Trailing Edge Strip

Figure 8-13. Main rotor blade inspection diagram

(d) Dents in the skin inboard of a station four feet from the tip of the blade that are not in excess of 0.060 inch deep are acceptable.

(e) If a nick or scratch exists in a sharp dent in the skin, the total depth of both must not exceed 0.060 inch.

(f) Nicks or scratches in the abrasive strips, doublers, grip plates or drag plates that are not in excess of 0.012 inch in depth.

CAUTION

Repairs inboard of station 240.0 must be inspected daily for cracks.

(2) Voids are acceptable within the following limits.

NOTE

A void shall be defined as an unbonded area that is normally bonded. Many sub-definitions of voids are given such a lack of adhesive, gas pocket, misfit, etc. This manual shall make no distinction among these but shall group them in the one general term "Void". All dimensions are in inches.

(a) Voids in the spar assembly, outboard of Station 100.0:

1. 1.0-inch wide (maximum) void between abrasive strip and nose block at extreme leading edge is acceptable to within 1.0 inch of the top of the blade.

2. Voids not exceeding 30 square inches with a maximum of 10 square inches in any single void are acceptable. If voids come closer than 1.0 inch to each other they are to be considered a single void.

3. No voids within 0.38-inch of edge of abrasive strip are acceptable.

4. Voids between the reinforcement doubler and the spar not larger than 1.0 by 3.0 inches are acceptable. Minimum spacing between centers to be 5 inches. Maximum total area of voids to be 30 square inches.

5. Voids between the nose block and the box beam not larger than 0.50 by 2.0 inches are acceptable providing minimum center to center spacing exceeds 6 inches. Maximum total area of voids to be 18 square inches.

(b) Voids in the spar assembly, inboard of Station 100.0: (See step (c) 5. below.)

1. 1.0-inch wide (maximum) void between abrasive strip and nose block is acceptable.

2. Voids between abrasive strip and reinforcement doubler, not exceeding 10.0 square inches with a maximum of 2.0 square inches in any single void, are acceptable. Minimum spacing between void centers to exceed 3.0-inches.

3. No voids within 0.38-inch of edge of the abrasive strip except at the butt end, per step 1. above, are acceptable.

4. Voids between the reinforcement doubler and the spar, not larger than 0.5 by 1.0 inch are acceptable. If voids come closer than 1.0 inch to each other they are to be considered a single void. Maximum total area of voids to be 10 square inches.

5. Voids between the nose block and box beam not larger than 0.5 by 1.0 inch are considered acceptable providing minimum center to center spacing exceeds 3.0 inches. Maximum total area of voids not to exceed 5 square inches.

(c) Voids at butt end of blade:

1. Void not deeper than 3.0 inches between nose block and box beam is acceptable.

2. Void between trailing edge extrusion and skin not deeper than 1.0-inch nor wider than 1.0-inch is acceptable.

3. Any other void not longer than 1.0-inch or deeper than 0.35-inch is acceptable.

4. No voids are acceptable within 0.5-inch of the front or rear edge of either grip plate, (viewing the section of the butt end).

5. No edge voids allowed between butt cap and blade.

(d) Voids in the retention area, inboard of Station 100.0:

1. Single edge voids of .06 inch maximum depth on leading edge of doublers and .10 inch on trailing edge of doublers are acceptable if sealed with adhesive. Edge voids 0.06-inch maximum depth of any one bond line shall not exceed 10 percent in total length of the bond line. Single edge voids of 0.06-inch maximum depth and 2.0-inches maximum length are acceptable on doublers, grip and drag plates, but must be sealed with adhesive. Edge voids are not acceptable in outboard seven inches of each finger of the doublers. Edge voids in the outer three inches of the grip plate and outer 1.5-inches of the drag plate are not acceptable.

2. Voids between the doublers or innermost doubler and skin 2.0-inches wide maximum (chordwise) by 4.0-inches long maximum (spanwise) are allowable, providing they are not closer than 1.0-inch to the edge of the doubler or to another void. Total allowable area of voids between all doublers shall not exceed 10 square inches. Voids between the doublers, doublers and skin, doubler and grip plate, skin and reinforcement (box beam) doublers are not acceptable, except as allowed in steps (c) 2., (c) 3., and (d) 1. above.

3. Voids between the skin and the core, in a 5.0-inch wide region running adjacent to the trailing edge extrusion, not wider than 1.0-inch nor longer than 10.0-inches, with a minimum width of 1.0-inch of good bond between them, are permissible. In the remaining area, the width of the void may not exceed 0.5-inch. The total area of all voids is not to exceed 30 square inches.

4. Edge voids between the edge of the skin and the trailing edge extrusion, that are less than 0.06-inch wide by any length or less than 0.25-inch wide by 7.0-inches long are acceptable if they are sealed with adhesive.

5. Voids within 1.0-inch of the main retention bolt, in any bond line, are not permissible.

6. Other voids between the skin and the trailing edge extrusion which do not exceed one-half the width of the faying surfaces by 20.0-inches long are acceptable.

7. Voids between the skin and the box beam reinforcement doubler wider than 0.25-inch are not acceptable.

8. Voids between the skin and the spar not wider than 0.50-inch are acceptable.

(e) Voids under skin, outboard of Station 100.0:

1. Voids between the skin and the trailing edge extrusion shall not exceed one-third the width of the mating surfaces.

2. Voids between the skin and the core shall not exceed 1.0-inch in width span or chordwise. Voids within 1.0-inch of each other are to be considered one void.

3. Voids between the skin and the box beam reinforcement doubler not wider (chordwise) than 0.25-inch are acceptable. Voids not larger than 0.38 by 2.0-inches are acceptable providing spacing between centers exceeds 6.0-inches. Edge voids are not acceptable.

4. Edge voids between the edge of the skin and the trailing edge extrusion that are less than 0.06-inch wide by any length or less than 0.25-inch wide by 10.0-inches long are acceptable if they are sealed with adhesive.

NOTE

Where two voids of two different types (Example: Voids between skin and trailing edge extrusion next to a void between the skin and the core) are closer than 1.0 inch apart, shall be considered as one void and the stricter limitations shall apply.

(3) Wear allowance on main retention and drag bolt hole: (If wear allowance is exceeded, bushings must be replaced.)

(a) Main retention bolt hole is oversize when the diameter exceeds 2.505-inches.

(b) Drag plate bolt hole is oversize when the diameter exceeds 0.877-inch.

(c) Any corrosion or pitting of either bushing in excess of replacement dimension after polishing is cause for removal and replacement at an approved overhaul facility. Local polishing in excess of replacement dimension is acceptable, only if burr need be removed. Example would be a burr created by scratch from the top of the bushing I.D. to the bottom.

(4) Non-repairable damage:

NOTE

Main rotor blades having any one or more of the following deficiencies should be condemned, demilitarized and scrapped locally rather than returned to a repair facility.

(a) Trailing edge.

1. Trailing edge extrusion cracked.

2. Any hole through the trailing edge extrusion.

3. Any nick/dent in the trailing edge extrusion deeper than 0.125 inch.

4. Any hole closer than 2.0 inches to the trailing edge on the outboard 7 feet of the blade.

5. Any hole closer than 4.0 inches to the trailing edge on the inboard 15.0 feet of the blade.

6. Any blade that is bent more than 0.50 inch. Position the blade horizontally with the leading edge on the bottom and the trailing edge up. Stretch a string along the trailing edge from root to the tip of the blade and measure the maximum distance between the trailing edge and the string.

NOTE

Bonding separation, loose rivets, or damage to the trim tab is repairable and the blade should be returned to an approved repair facility.

(b) Leading edge.

1. Any hole through the leading edge spar.

2. Any hole through the skin that is closer than 6.50 inches to the leading edge.

3. Erosion of the leading edge that penetrates completely through the skin at the tip.

NOTE

Damage or erosion of the leading edge strip and nose block is repairable and the blade should be returned to an approved repair facility.

(c) Skin and honeycomb core.

1. Skin cracked (chordwise).

2. Water in honeycomb core.

3. Any hole in the skin closer than 1.0 inch to the grip or drag doublers.

4. Any one or combination of dents exceeding ten (10.0) square inches.

5. More than seven (7) holes through the honeycomb and skin. Count each deep dent, exceeding 0.25 inch deep, as a hole.

6. Hole in the honeycomb and skin closer than 2.0 inches to each other.

7. Holes in the honeycomb and skin inboard of a station four (4) feet from the blade tip that lie on the same chordline and on the same surface.

8. Single voids between honeycomb and skin larger than 25 square inches.

9. Any crack that develops from a previously repaired area.

NOTE

Damage existing in the outboard 24 inches of the blade that exceeds the criteria of (a) through (c) above is acceptable for depot rework if the blade has 400 hours or less operating time and is otherwise acceptable.

(d) Doublers.

1. Any hole through the doublers.

2. Edge voids deeper than 0.50 inch at tip end of any doubler, drag plate of grip plate.

3. Edge voids under doublers deeper than 0.060 inch on the leading edge.

4. Edge voids under doublers deeper than 0.10 inch on the trailing edge.

(e) Any blade that has reached the maximum service life.

(f) Any blade that required extensive or time consuming repairs and has less than 200 hours service life remaining.

d. *Installation – Main Rotor Blade.*

NOTE

If drag braces are once properly adjusted, blades are interchangeable without further adjustment. To avoid disturbing rotor balance, reinstall blade retaining bolts in grips from which removed.

(1) Support main rotor hub on a stand. When available, shipping container for hub assembly can be used as a buildup stand in following manner.

(a) Remove top of shipping container.

(b) Remove eight bolts and lift out frame of container base.

(c) Relocate frame 90 degrees on container base and secure with four camlock fasteners.

(d) Position rotor hub 90 degrees to frame, and tighten center nut.

(2) Apply corrosion preventive compound (item 309, table 1-2), to blade-retaining bolt holes in hub grips and blade butts, and to drag brace and drag plate bolt holes.

CAUTION

Foreign material or misalignment of bolt holes will result in damaged parts.

(3) Insert blade (5, figure 8-8) into grip, observing color coding. Apply a thin coat of corrosion preventive compound (item 309, table 1-2), to bolt shank (4) but not to threads. Align bolt holes and insert bolt (4) through grip and blade from top. To find best alignment gently move tip of blade up and down while inserting bolt.

(4) Support end of installed blade. Install washer (11) and nut (10) on blade bolt.

(5) Align clevis of drag brace (8) to blade drag plate hole. Install shims (6) top, bottom or equally, depending on existing gap location between clevis and drag plate. Shim for 0.000 to 0.005 clearance. Install bolt (7) with two washers next to nut.

(6) Be sure that grip positioning link T101402 is installed between pitch horn and stud on pillow block. (See figure 8-9.)

(7) Install opposite blade in same manner.

(8) Tighten nuts on drag brace bolts (7, figure 8-8) to a torque of 100 to 120 foot-pounds.

(9) Tighten nut on each blade retaining bolt to a torque of 260 to 300 foot-pounds, using wrench T101414. Safety each nut by installing a screw (9, figure 8-8) through aligned holes of nut and blade retaining bolt, secure with nut and washer.

NOTE

Install screw (9) with head in direction of rotation or in the direction of the root of the blade.

NOTE

Retorque nut after 25 hours of operation after initial installation. Proper torque is 260 to 300 foot-pounds.

(10) Tighten nuts on inner drag brace bolts (14, figure 8-8) to a torque of 125 to 150 foot-pounds.

e. Preparation for Storage or Shipment – Main Rotor Blades.

(1) Blades shall be inspected and determined to be reparable or non-reparable, based on the information presented in paragraph 8-4, step c.

(2) Prepare reparable blades for shipment as outlined in the following steps:

(a) Blades shall be segregated as scrap or reparable as outlined in paragraph 8-4, step c. Do not ship scrap blades to overhaul facility.

(b) Tape all holes, bullet damage, tree damage, foreign object damage, etc., to protect the interior of the blade.

(c) Clean blade to ensure removal of soil, oil or grease using alkaline soap (item 324, table 1-2).

(d) Apply a light preservative grease (item 309, table 1-2) to main retention bolt hole and drag brace retention bolt hole. If this is not available use any other type grease.

(e) Wrap the blade at areas (5 places) which will be in contact with the rubberized hair pads. Use barrier-material, (item 505, table 1-2) the shiny side of the material goes next to the blade.

(f) Attach directly to the blade DD Form 1577-2 Unserviceable (Reparable) Tag or DD Form 1577-3 Unserviceable (Reparable) Label.

(g) Install blade in shipping container.

(h) Secure blade to shock mounted fixture.

(i) Secure lid.

(j) Initiate DA Form 2410 (Component Removal and Repair/Overhaul Record). Forward the original copy through processing channels. Insert remaining copies in records receptacle.

(k) Obliterate old markings from the container which pertain to the original shipment or to the original item which it contained. If the identification marking coincides with the item to be returned it need not be erased. Stencil new identification marking on the container and apply a shipping tag or label showing origin and destination.

8-5. Main Rotor Hub Assembly.

The main rotor hub assembly (see figure 8-8) consists basically of a yoke with a machined spindle on each end. The blade grips, which are mounted on the ends, permit the grips to turn on the spindle axis. Provisions are made for attachment of linkage to control cyclic and collective pitch. The rotor hub yoke is underslung on its mounting trunnion through two pillow blocks which provide a flapping axis. The splined trunnion mounts at top of mast.

a. Removal – Main Rotor Hub Assembly. (Refer to paragraph 8-3, step a.)

b. Inspection – Main Rotor Hub Assembly.

(1) Inspect grips, pillow blocks, pitch horn, bushings, and drag brace bolts for wear, pitting, corrosion, and scored marks. (See figures 8-8, 8-14, and 8-15.)

NOTE

If loss of dry film lubricant (bare metal exposed) exceeds 30 percent, replace bolt.

(2) Inspect blade retaining bolts for loss of dry film lubricant (bare metal exposed), pitting, and fretting corrosion. If inspection of blade retaining bolts reveals damaged areas, replace bolts.

(3) Dimensions of damaged areas on drag brace bolts, after polishing and cleanup, shall not exceed 1/4 of the bolt circumference. Bolts shall be replaced if the outside diameter (in inches) is less than the values specified below.

(a) Inboard drag brace 0.8730.

(b) Outboard drag brace 0.8721.

(4) Bushings shall be replaced if the inside diameters (in inches) exceed the values specified below.

(a) Blade retaining bushing 2.504.

(b) Drag brace bushing 0.8760.

(5) Dimensions of damaged areas on grip, after polishing and cleanup, shall not exceed values specified in figure 8-14. Grips that fail to meet specified requirements shall be depot overhaul responsibility:

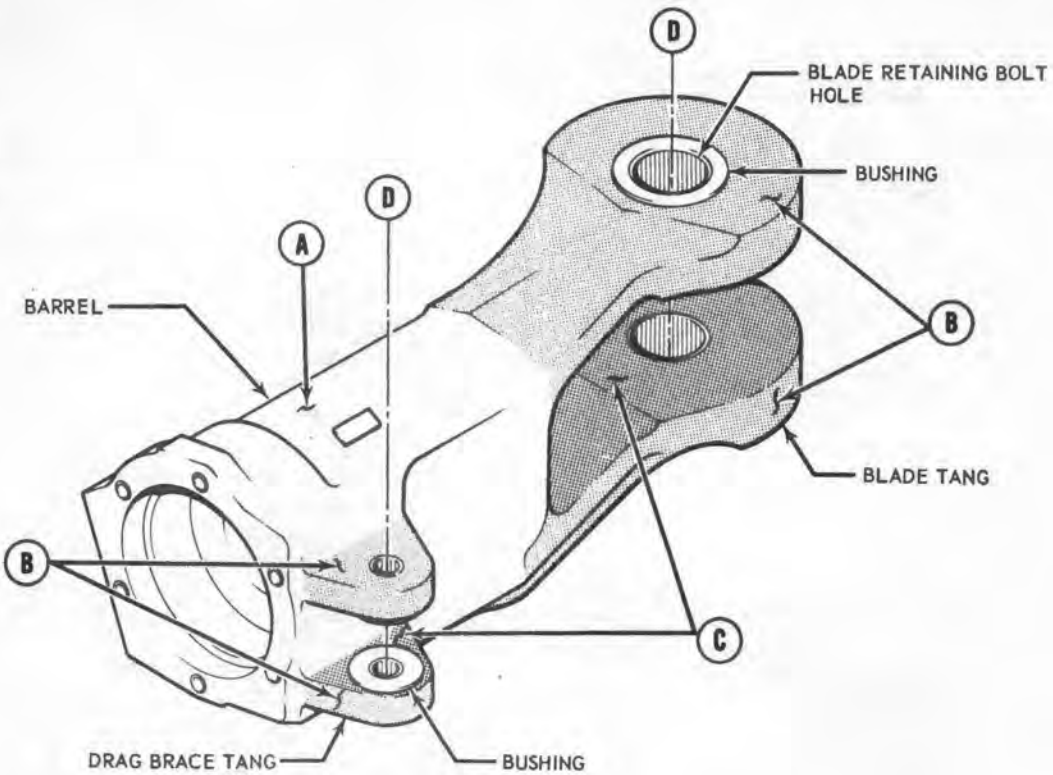
(6) Check that oil seepage from main rotor grips does not exceed normal amount. Replacement of grip seals is required if either of the following conditions occurs:

(a) During a 2 hour flight, grip reservoir becomes empty.

(b) After a 24 hour period when helicopter is not operated, oil level is not visible in grip reservoir.

NOTE

Do not attempt to clean main rotor grip seals.

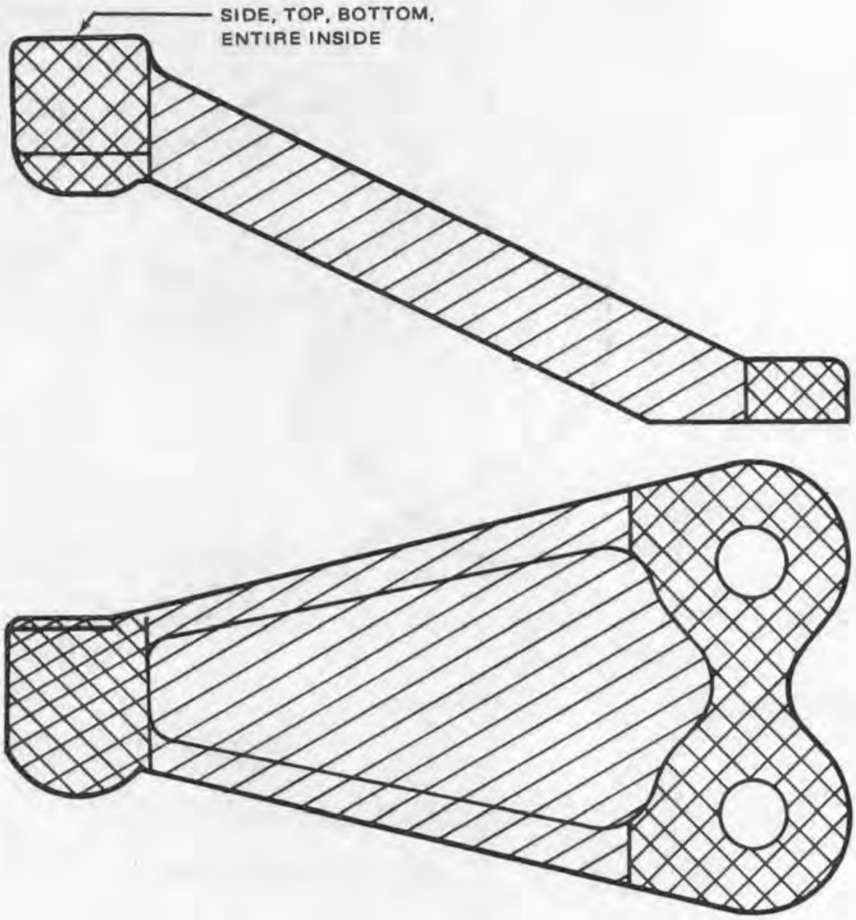


MAXIMUM ALLOWABLE DAMAGE

AREA	DEPTH (INCHES)	LENGTH (INCHES)	
A (Barrel)	0.060	3.5	
		GRIP	DRAG BRACE
B (Outside Surfaces of Blade Tangs and Drag Brace Tangs)			
Inboard of Bolt Hole	0.060	3.4	0.5
Between Bolt Hole and Edge of Tang	0.060	1.2	0.4
Between Inside and Outside Tang Surface	0.060	0.5	0.5
C (Inside Surfaces of Blade Tangs and Drag Brace Tangs			
Inboard of Bolt Hole	0.020	3.4	0.5
Between Bolt Hole and Edge of Tang	0.020	1.2	0.4
D (Inner Surface of Bushings	0.010	1.9	0.6

204011-71A
AV 054153

Figure 8-14. Main rotor grip inspection diagram



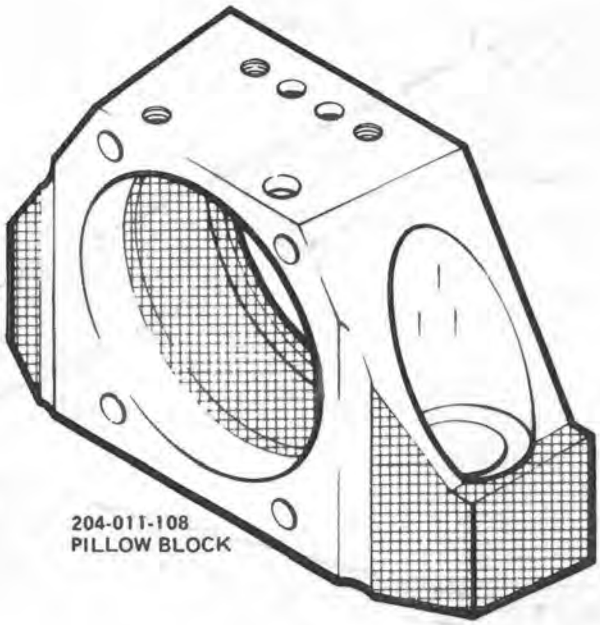
TYPE OF DAMAGE	AREA **A**	AREA **B**
		MAX DEPTH
MECHANICAL	0.010 Including clean-up	0.030 Including clean-up
CORROSION	0.005 / 0.010 Including clean-up	0.015 / 0.030 Including clean-up
MIN. RADIUS OF REPAIR	0.50	0.35
NO. OF REPAIR AREAS	One per end total of two on entire pitch horn	Two

NOTE

1. Repair areas must be coated with brush alodine.
2. After rework of the mating surfaces, it must be possible to reassemble the affected parts without misalignment or cocking.

AV 006323

Figure 8-15. Inspection main rotor hub (Sheet 1 of 2)



DAMAGE AREA REPAIR SYMBOLS

TYPE OF DAMAGE	MAXIMUM DEPTHS AND REPAIR AREAS ALLOWED	
NICKS, SCRATCHES SHARP DENTS	0.020 IN. BEFORE AND AFTER REPAIR	0.040 IN. BEFORE AND AFTER REPAIR
CORROSION	0.010 IN. BEFORE REPAIR 0.020 IN. AFTER REPAIR	0.020 IN. BEFORE REPAIR 0.040 IN. AFTER REPAIR
AREA OF FULL DEPTH REPAIR	0.10 SQ. IN.	0.25 SQ. INCH
NUMBER OF REPAIR AREAS	ONE PER SEGMENT	TWO

Notes:

1. ALL EDGES MAY BE RADIUSED OR CHAMFERED 0.060 INCH TO REMOVE NICKS AND DENTS.
2. REPAIR AREAS SHOULD NOT OVERLAP.

204011-249

Figure 8-15. Inspection main rotor hub (Sheet 2 of 2)

c. Cleaning – Main Rotor Hub Assembly.

(1) Remove pillow block reservoir.

(2) Pump oil (item 2, table 1-2) into oe oil inlet hole of pillow block bearing cup until clean oil emerges from opposite hole. Move main rotor blades so that trunnion rotates in pillow block bearings while pumping oil into bearings.

d. Installation – Main Rotor Hub Assembly. (Refer to paragraphs 8-3, step b. and 8-4, step d.)

e. Preparation for Storage or Shipment – Main Rotor Hub Assembly.

(1) Clean and dry hub assembly in accordance with MIL-P-116.

(2) Apply corrosion preventive compound (item 309, table 1-2) to bushings and exposed unplated steel surfaces.

(3) Place hub in shipping container base, and lower onto frame center block.

(4) Secure frame end brackets over each end of hub, and around hub bolt attached to frame.

(5) Install washer and retaining nut. Tighten nut securely.

(6) Place 12 eight-unit bags and one four-unit bag (total 100 units) of desiccant (item 310, table 1-2) in container.

(7) Lower container top into place and secure with bolts, washers, and nuts, tightened to provide moistureproof closure.

f. Placing in Service – Main Rotor Hub Assembly.

(1) Remove bolts and remove top half of shipping container.

(2) Remove attachments and lift hub out of container.

NOTE

Blade bolts are balanced and should not be interchanged.

(3) Clean and dry hub assembly in accordance with Specification MIL-P-116.

NOTE

The main rotor hub container may be used as a build up stand for attachment of main rotor blades. (Refer to paragraph 8-4, step d.)

8-6. Stabilizer Bar Assembly.

Stabilizer bar assembly is a weighted rotating unit mounted above and across main rotor, suspended in pivot bearings of supports bolted on rotor hub trunnion. Each side of bar frame is connected through a control tube to a damper on mast. Mixing levers on bar are connected into main rotor control linkage, by control tubes from scissors levers and by links to pitch horns on rotor hub. Special tool required to perform the following maintenance functions on the stabilizer bar assembly is listed below in Table 8-3.

Table 8-3. Special Tools

PART NUMBER	NOMENCLATURE
T101402	Grip Positioning Links

a. Removal – Stabilizer Bar Assembly.

(1) Disconnect pitch links (3, figure 8-1) from main rotor pitch horns and install grip positioning links T101402 to hold blades in normal position as shown in figure 8-9.

(2) Disconnect control tubes (4, figure 8-1) from scissor levers, and tubes (5) from damper levers. Secure control tubes to bar with tape.

NOTE

It is not necessary to remove damper link tube (5, figure 8-1) from stabilizer bar assembly. However, if removed, ensure that safety washer (P/N AN960-416) is retained for installation between bolt head and bearing.

(3) Detach each stabilizer support (6) from main rotor trunnion by removing lockwire and four bolts.

(4) Lift off stabilizer bar assembly.

b. Inspection – Stabilizer Bar and Linkage.

(1) Inspect stabilizer bar tubes for nicks, dents, gouges and scratches to a maximum depth of 0.010 inch. Inspect for external corrosion damage to a maximum depth of 0.005 inch.

(2) Inspect the following areas for nicks, dents, gouges and scratches to a maximum depth of 0.010 inch, and corrosion damage to a maximum depth of 0.005 inch:

NOTE

Maximum allowable radial and axial play (in inches) of the lever assembly bearings are as follows:

PART NUMBER	RADIAL	AXIAL
BR5R	0.007	0.010
AN201KP6A (MS20201KP6A)	0.010	0.010

(a) On the center frame, within 4.0 inches of the center of the central pivot bearing hole.

NOTE

Maximum allowable radial and axial play (in inches) of the center frame bearings are as follows:

PART NUMBER	RADIAL	AXIAL
204-011-310-1	0.012	0.005

(b) On the center frame, within 3.5 inches of the outboard ends of the center frame.

(c) On the mixing lever, within 1.38 inches of the center of the pivot holes. (See figure 8-16.)

(d) On the mixing lever, within 1.5 inches of the center of the pitch link attachment holes.

(e) On the mixing lever, within 1.0 inch of the center of the scissors link attachment hole.

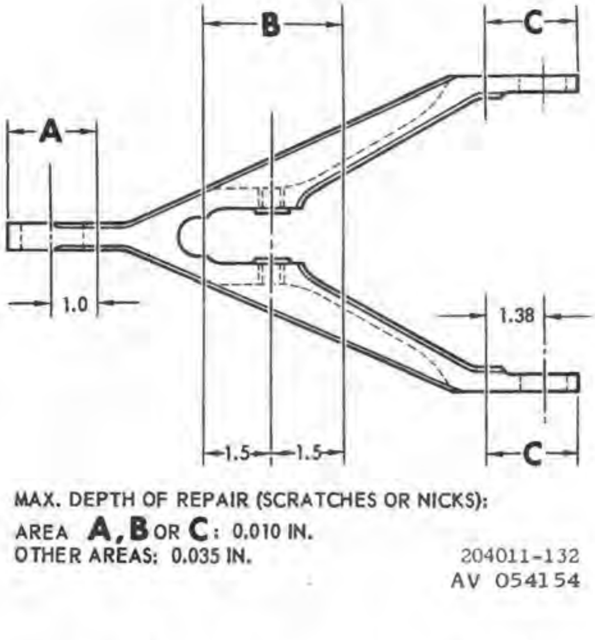


Figure 8-16. Stabilizer bar mixing lever — repair limits

(f) Surfaces surrounding a hole, within a distance of 1.5 times the radius from the edge of the hole.

(g) Allowable clean up 0.005 inch.

(3) Inspect other stabilizer bar areas for nicks, dents, gouges and scratches to a maximum depth of 0.035 inch and corrosion damage to a maximum depth of 0.017 inch. Any one area of such damage shall not exceed 0.250 square inch in area or 0.750 inch in any one dimension.

(4) Inspect outer tube assembly for cracks five inches outward from frame assembly detachment point.

(5) Inspect inside surface of bushings for score marks to a maximum depth of 0.002 inch.

(6) Check bearings of stabilizer bar for freedom of operation and indications of damage.

(7) Check bearings of pitch change links (3, figure 8-1) and damper link tubes (5) for indications of wear exceeding the maximum allowable axial and radial tolerances stated below.

(a) Damper link rod end: (roller bearing) 0.030 inch axial, 0.010 radial. Damper link rod ends: (teflon P/N 47-140-252-5) 0.012 inch axial and 0.012 inch radial.

(b) Pitch change link universals: 0.017-inch axial, 0.0085 inch radial.

(c) Pitch change link rod-ends 0.010 inch axial and radial (can be extended to 0.020 inch axial and radial provided excessive vertical vibration does not occur).

NOTE

To prevent chafing between control tube and mixing lever install a bumper washer between mixing lever and push-pull tube clevis, only on side on which heavy contact is noted, but not to cause vertical binding between tube clevis and mixing lever. Allowable clean up is 0.005 inch to the leading edge of the mixing lever and 0.015 inch to the trailing edge side. The bumper washer may be locally fabricated from approximately 0.031 inch rubber with a 1.5 inch O.D. and 0.625 inch I.D. (See figure 8-1.)

c. *Repair or Replacement — Stabilizer Bar and Linkage.* Replace all parts that do not meet inspection requirements. Stabilizer bar outer tube assembly should be replaced if cracks are noted.

d. *Installation — Stabilizer Bar Assembly.*

(1) Observing color code, position stabilizer bar over main rotor trunnion. Attach each support (6, figure 8-1) with four bolts and washers, assemble washers on bolts with countersink side against bolt head. Lock-wire bolts in vertical pairs.

(2) Connect control tubes (4) to scissor levers (14) with bolts (16).

NOTE

Control tube bolts should be installed with heads in direction of rotation. If this results in interference between cotter pin and opposite scissors lever, bolts may be installed with heads opposite the direction of rotation.

(3) Remove grip positioning links and connect pitch change links (3) to main rotor pitch horns. (Refer to paragraph 8-2, step c. if adjustment is required.)

NOTE

When connecting links to pitch horns install bolt with head inside of pitch horns.

(4) Connect damper link tubes (5) from stabilizer bar to leading sides of damper levers (13). Install bolts from leading side with safety washer installed next to bolt head with cup side of washer facing in direction of rotation. Install one steel washer between bushing in damper arm and link tube bearing and one aluminum alloy washer under nut. Install nut and torque 50 to 70 inch-pounds. Install cotter pin.

NOTE

When assembling damper link tube (5, figure 8-1) ensure safety washer (P/N 206-010-324-1) is inserted between bolt head and bearing.

8-7. Stabilizer Bar Dampers.

Two rotary viscous type dampers (see figure 8-17) are mounted on a pair of adapters, which are attached on mast splines below main rotor. Levers on damper wingshafts are connected by control tubes to each side of stabilizer bar frame. Dampers are non-adjustable, being preset for required stiffness of action. Each has a filler plug for such occasional addition of hydraulic fluid (item 4, table 1-2), as may be necessary due to minor leakage. A window is also provided through which an indicator pin and a cam mark can be viewed for a check of timing.

a. Removal – Stabilizer Bar Dampers.

(1) To remove either damper: Disconnect control tube rod-end from damper lever by removing bolt with cotter pin, nut, and washers. Detach damper from adapter by removing two bolts with nuts and washers. (See figure 8-17.)

(2) To remove lever from damper wingshaft, remove snap ring from outer groove of shaft, loosen nut on clamping bolt, and pull lever off shaft. Remove inner snap ring from shaft.

(3) To remove adapters, remove spiral retaining ring from groove in mast splines above adapter set, remove four adapter clamp bolts, with nuts and washers, and slide adapters from mast. Remove lower retaining ring as necessary.

b. Inspection – Stabilizer Bar Dampers.

NOTE

Large washer in front plate of damper may turn with wingshaft. This is not an abnormal condition and does not affect damper serviceability.

(1) If damper shows signs of fluid leakage or if level can be seen slightly below top of window, remove filler plug, fill damper with hydraulic fluid (item 4, table 1-2) and reinstall plug. Thereafter, check damper frequently for further leakage.

(2) If fluid level falls more than 1/8 to 3/16 inch below top of window, satisfactory filling without trapped air may not be possible and replacement of damper may be necessary.

NOTE

There is no specific oil contamination level established for the damper. Excessive contamination results in slow timing. If damper times properly, do not remove it for contamination.

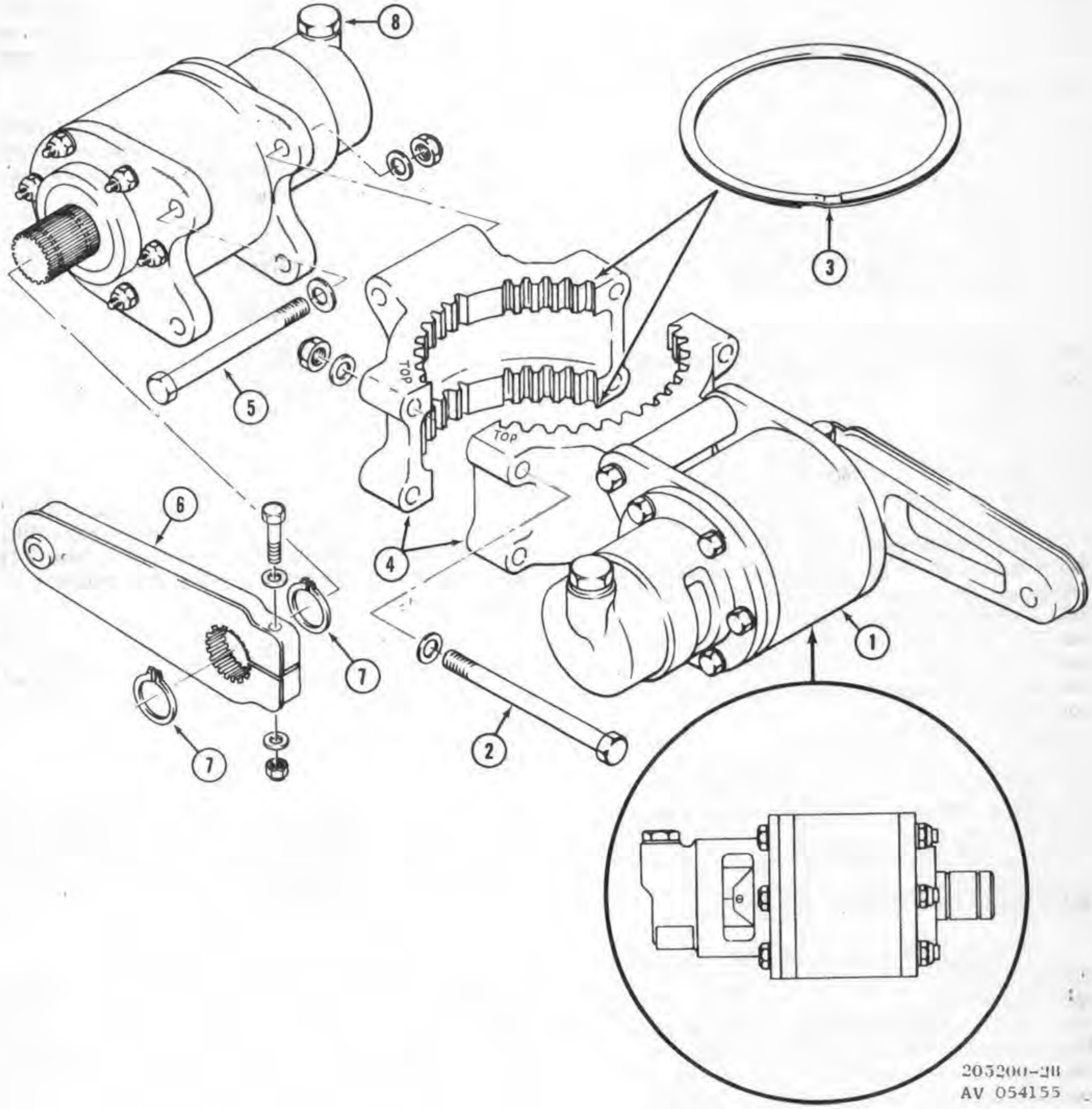
(3) Check damper timing as required to determine serviceability.

(a) Hold stabilizer bar against limit stops while observing pin in damper window.

(b) Rapidly return bar to neutral position, and check time required for pin to return to contact flat surface on cam.

(c) Time required should be five seconds (plus or minus one).

c. Repair or Replacement – Stabilizer Bar Dampers. Replace damper if it fails to meet inspection requirements.



1. Damper Assembly
2. Adapter Bolts
3. Retainer Rings (2)
4. Adapter
5. Damper Mounting Bolts
6. Lever Arm
7. Retainer Ring
8. Filler Plug

Figure 8-17. Stabilizer dampers and adapters

d. Installation – Stabilizer Bar Dampers.

WARNING

Use alternate tightening procedure to draw four nuts down evenly. Torque each nut in increments of 10 inch-pounds, until a torque value of 50 to 70 inch-pounds is obtained.

CAUTION

Do not attempt to pull the supports into the mast splines by means of the attaching bolts which may result in chipping or fracturing the support splines, bolt lugs, and/or the entire support.

NOTE

Clean mast splines and adapter splines (4, figure 8-17) with dry cleaning solvent (item 302, table 1-2). Coat mast splines with corrosion preventative compound (item 309, table 1-2).

(1) Install spiral retaining ring in lower groove of mast splines. Align adapter halves with the etched word "Top" facing upward. Position adapters according to markings and master splines, and slide onto mast. Install four bolts with washers and nuts and torque evenly. Install retainer ring in groove of mast splines above adapter set.

(2) To install damper on adapter, position damper on adapter, with wingshaft toward rotation, and install two bolts, with washer under each head and nut.

(3) Inspect damper wingshaft splines to the following criteria:

(a) Worn or damaged splines, not to exceed a total of 9, are permissible in the area inboard of the snap ring groove.

(b) Longitudinal cracks in the area between the snap-ring grooves are not permissible.

(c) Cracks originating in the inboard snap-ring groove or cracks inboard of this groove are cause for rejection of the damper assembly.

(4) To install damper lever: Clean damper shaft splines and lever splines with solvent (item 302, table 1-2).

NOTE

Incorrect positioning of the damper arm on the wingshaft is improper rigging. This results in damper bottoming internally prior to stabilizer bar center frame contacting support stops and the shaft splines are loaded excessively.

(a) Apply adhesive (item 205, table 1-2) to the damper shaft splines and lever splines.

NOTE

Adhesive (item 205, table 1-2), is supplied in two parts. Use part "A" and "B" in equal proportions.

NOTE

Some dampers do not have inboard snap-ring groove. When installing these dampers, ignore the first sentence of (b) below.

(b) Install snap-ring in the inboard groove on damper wingshaft. Turn shaft to align pin with mark on cam as seen through damper window. Place lever on shaft horizontal to the closest serration.

NOTE

Torque lever arm bolt-nut 45 to 50 inch-pounds. Incorrect torquing of this bolt results in wear, fretting or shearing of shaft splines.

(c) Install snap-ring in outer groove. Allow the adhesive to dry at room temperature for 24 hours or at 150°F for one hour plus additional two hours at room temperature before operation of the damper assembly.

e. Adjustment – Stabilizer Bar Damper.

(1) Pull stabilizer bar (see figure 8-1) down against its stop and swing damper arm down as far as it will go. Adjust link tube (5) to fit and shorten two to two and one half turns.

(2) Install bolt with safety washer under head, from leading edge of damper lever with steel washer between bushing in lever and rod end bearing and aluminum washer between lever and nut.

(3) Repeat procedure for opposite damper.

8-8. Swashplate And Collective Sleeve Assembly.

A swashplate and support assembly and a scissors and sleeve assembly (see figure 8-18) are installed together,

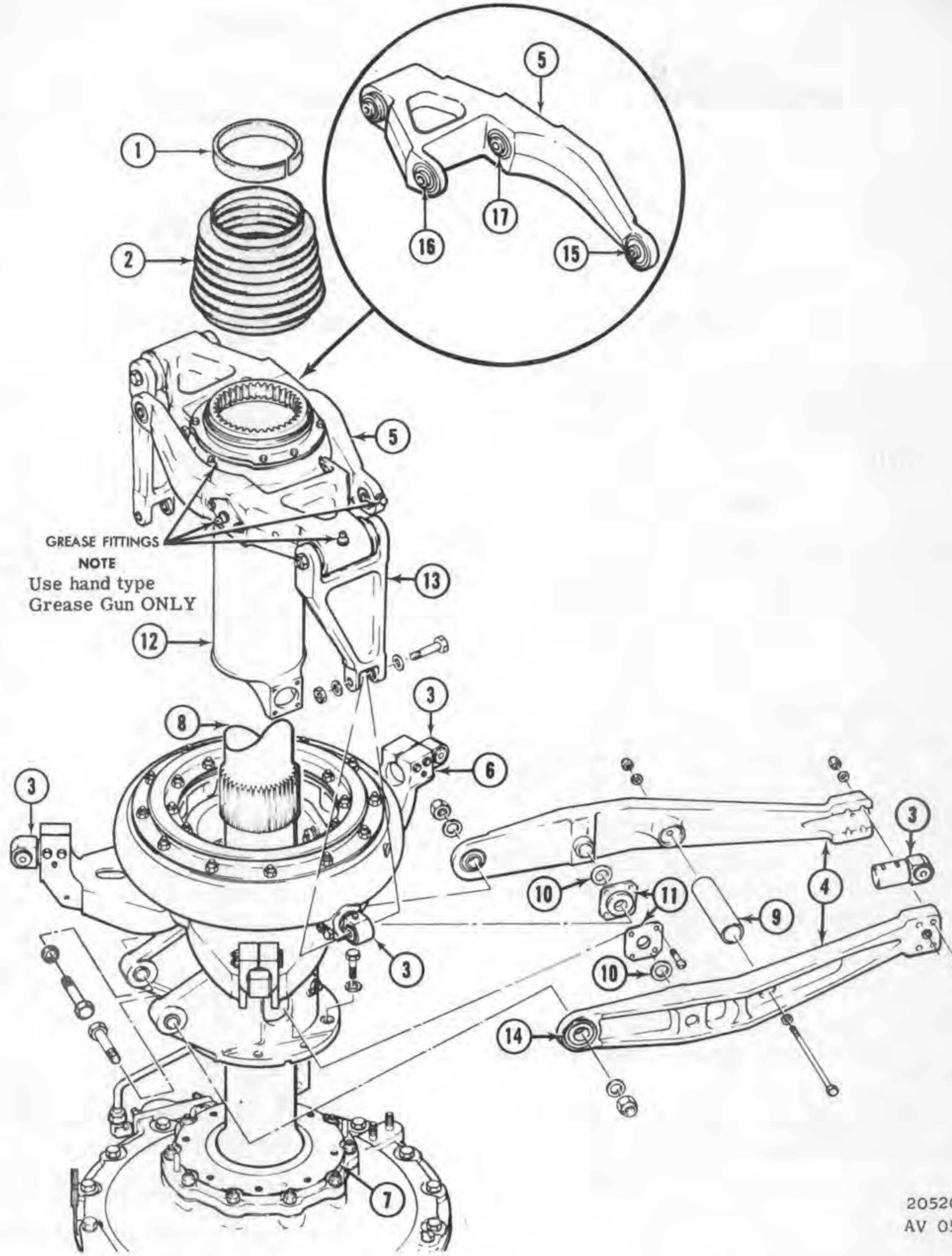


Figure 8-18. Swashplate and collective sleeve assembly (Sheet 1 of 2)

1. Seal
2. Boot
3. Trunnion
4. Collective Lever Halves
5. Scissors and Sleeve Assembly
6. Swashplate and Support Assembly
7. Transmission Cap Plate
8. Mast
9. Spacer
10. Shims
11. Bearing and Liner Assembly
12. Collective Sleeve
13. Links
14. Lever Bearing and Liner
15. Bearing BR-5R
16. Bearing MS20201KP8A
17. Bearing Set 204-011-412-1*

*Install with (>) Vee mark on bearings pointing inboard

205200-3D

Figure 8-18. Swashplate and collective sleeve assembly (Sheet 2 of 2)

mounted around mast at top of transmission. The control unit thus formed transmits movements from cyclic and collective control systems mounted in cabin and fuselage to linkages which rotate with main rotor. Swashplate is mounted on a universal support, for tilt according to position of cyclic control stick. Collective sleeve moves vertically within swashplate support, as actuated by collective control stick. Combined effect on scissor levers and upper linkage determines main rotor tilt and blade pitch.

a. Removal – Swashplate and Collective Sleeve Assembly.

(1) Remove stabilizer bar with attached control tubes. (Refer to paragraph 8-6, step a.)

(2) Remove main rotor. (Refer to paragraph 8-3, step a.)

(3) Remove stabilizer dampers with adapters and retainer rings. (Refer to paragraph 8-7, step a.)

(4) Cut lockwire and remove boot (2, figure 8-18) and seal (1).

(5) Disconnect control tube from trunnion (3) of collective pitch lever (4).

NOTE

If scissors and sleeve assembly (5) is to be removed alone, proceed to paragraph 8-9, step a. Following steps apply for removing complete unit.

(6) Disconnect cyclic and elevator control tubes from trunnions on swashplate (6). Insert a piece of folded paper or cardboard into each of four gimbal support clevises to prevent damage in handling.

(7) Remove eight bolts which secure swashplate support to cap plate (7) on transmission.

(8) Carefully lift assembly from mast (8).

b. Inspection – Swashplate and Support Assembly.

(1) Total axial play across gimbal ring bearings and attaching bolts should not exceed 0.010 inches.

(2) Check all trunnions for axial chuck, not to exceed 0.020 inch.

NOTE

The trunnion bearings are different from other bearings, which normally can be feel checked for roughness and ease of rotation. The trunnion bearings are preloaded into the cylinder portion of the trunnion with a 0.0005-inch tight to 0.0005-inch loose tolerance. The bearings are roller type, with no separated roller cases and angular-faced inner and outer races. The normal feel of this assembly is one of tightness, due mainly to the 0.0005-inch tight tolerance. The feeling of roughness is due to the preloaded and the angular faces of the inner and outer races. When grease (item 7, table 1-2) is applied to the assembly, as required, the normal bearing feel does not exist. The conditions described are inherent in the trunnion bearing assembly. Checking the bearing assembly for tightness should be accomplished by hand movement only of the barrel and the crosshead.

(3) The KSP9001-1 will allow the servo cylinder to be manually rotated. However, no flight loads will be experienced that could cause the servo to rotate when the hoses are correctly routed and properly rigged. The servo cylinders should be cycled and the hoses checked for chafing or interference whenever work is done on the controls rigging.

NOTE

Both types of trunnion bearings are installed and removed in the same manner. The tolerances between bearing and swashplate are the same for both types of trunnion bearings. A swashplate can have both types of trunnion bearings installed at the same time. Axial and radial play of KSP9001-1 bearing is not to exceed 0.020 inches. The KSP9001-1 bearing should never be greased and the bearing will never lock as the 204-011-451-1 bearing did.

c. *Surface Damage Limits – Cyclic and Collective.*

NOTE

The following general and specific limits apply to the swashplate and collective sleeve assembly, and the scissors and sleeve assembly.

(1) *General damage limits.*

(a) Nicks, cuts and scratches not to exceed 0.035 inch in depth before and after repair.

(b) Corrosion damage not to exceed 0.17 inch before repair and 0.035 after repair.

(c) The full depth of repair in any one area will not exceed 0.25 square inch in area or 0.75 inch in any one length. The area in which the repair is blended may lay outside these limits.

(d) Damage to surfaces surrounding a hole, within a distance of 1.5 times the radius of that hole, will not exceed 0.010 inch in depth for nicks, cuts or scratches and 0.005 inch in depth for corrosion damage. Surface repair within this boundary will not exceed 25 percent of the area.

(2) *Specific damage limits.*

(a) In some critical areas, specific damage limits will supersede general damage limits, presented in (1)(a) through (1)(c).

(b) In these specific areas mechanical damage shall not exceed 0.010 inch. Corrosion damage shall not exceed 0.005 inch. See figure 8-19 for specific areas and damage limits.

d. *Repair or Replacement – Swashplate and Support Assembly.* Replace assembly if inspection requirements are not met.

e. *Installation – Swashplate and Collective Assembly.*

NOTE

Swashplate and support assembly and scissors and sleeve assembly can be installed as an assembled unit, or as separate assemblies.

(1) Lubricate splines with grease (item 7, table 1-2).

(2) Carefully lower assembly over mast until swashplate support rests on transmission cap plate. (See figure 8-18.)

(3) Align holes and install eight bolts with aluminum alloy washers under heads, through flange of support into cap. Use two longest bolts between pivots of collective lever. Lockwire bolt heads in pairs.

NOTE

If installing a complete unit, with scissors and sleeve and collective lever already assembled, omit step (4) and proceed to step (5).

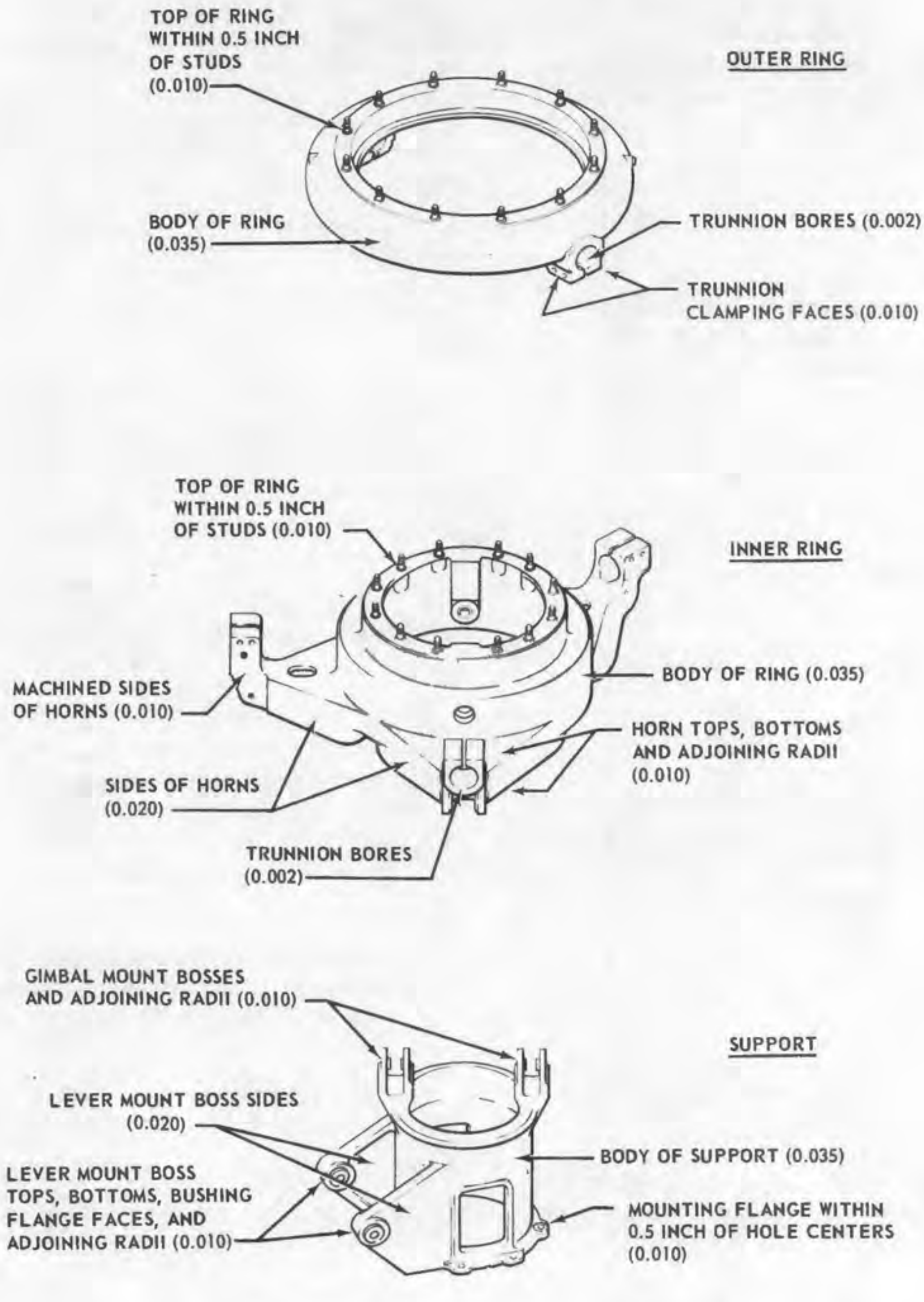
(4) Install scissors and sleeve assembly, with collective lever. (Refer to paragraph 8-9, step d.)

(5) Connect collective pitch control tube to collective lever. Connect cyclic and elevator control tubes to swashplate trunnions.

(6) Slide boot (2, figure 8-18) down over flange at top of sleeve assembly and secure with lockwire. Position seal (1) around mast, under top edge of boot, and secure with lockwire.

NOTE

To prevent possible damage to the dust boot during operation, a distance of 10.25 to 10.75-inches must be maintained between the top of the boot and the lower surface of the damper support frame. Position of the collective stick will be no problem in setting these dimensions.



NOTE: Numerals in parentheses show maximum allowable depth in inches of surface damage after repair.

204011-172
AV 054157

Figure 8-19. Swashplate – specific damage limits

f. Preparation for Storage or Shipment – Swashplate and Support Assembly.

(1) Clean and dry assembly in accordance with MIL-P-116.

(2) Apply corrosion-preventive compound (item 309, table 1-2) to bushings and exposed unplated steel surfaces not in contact with bearings.

(3) Apply grease (item 7, table 1-2), to all bearings and grease fittings.

(4) Wrap assembly in grease-proof barrier material (item 505, table 1-2) and secure with pressure-sensitive tape (item 400, table 1-2). Shape wrapper to contour of assembly.

(5) Place wrapped assembly into contoured bottom cushion in container. Fit top cushion over assembly.

(6) Place 19 eight-unit bags (total 152 units) of desiccant (item 310, table 1-2) in container.

(7) Place gasket and lid on container. Install locking ring over lips of lid and container, and secure by bolt and nut tightened to provide moisture-proof closure.

8-9. Scissors And Sleeve Assembly.

Refer to paragraph 8-8 for description.

a. Removal – Scissors and Sleeve Assembly.

Check collective sleeve drive plate wear prior to removal of scissors and sleeve. Refer to paragraph 8-9, step a., substep (1).

NOTE

Scissors and sleeve assembly can be separated from swashplate and support while on mast or after removing complete unit. If on mast, accomplish paragraph 8-8, step a., substeps (1) through (5), before proceeding.

(1) Remove bolts to detach and remove parts of collective lever (4, figure 8-18). Keep all parts together, including shims (10), for reassembly.

(2) Remove lockwire and four screws to detach each bearing and liner assembly (11) from lower end of collective sleeve (12) at each side.

(3) Disconnect two links (13) from swashplate trunnions by removing bolts.

(4) Remove scissors and sleeve assembly (5) upward.

b. Inspection – Scissors and Sleeve Assembly.

NOTE

Perform step (1) prior to removal of scissors and sleeve from mast.

(1) Clamp dial indicator to mast with plunger resting on the collective boot flange attaching bolt head. Rotate sleeve assembly and measure amount of play present. Maximum radial play allowed between mast and collective sleeve drive plate is 0.040-inch at point of measurement.

NOTE

When scissors (5, figure 8-18) is removed from hub, secure bearings (16) and (17) in place to prevent loss or damage.

(2) Inspect all bearings for damage, freedom of movement, and maximum allowable play as stated in Table 8-4.

c. Repair or Replacement – Scissors and Sleeve Assembly. Replace lever assembly if inspection requirements are not met.

d. Installation – Scissors and Sleeve Assembly.

(1) Lubricate splines and collective sleeve with grease (item 7, table 1-2). Lower scissors and sleeve assembly (5, figure 8-18) carefully over mast and into swashplate support.

CAUTION

Use high tensile, close tolerance bolts with a minimum of two steel washers positioned as shown in figure 8-18. Torque NAS 465-5-30 bolt to 70 to 90 inch-pounds or NAS 1305-30D to 120 to 145 inch-pounds and retorque after first ten hours of operation.

(2) Attach links (13) to trunnion bearings on swashplate outer ring, with bolt heads toward rotation. End play between scissors and drive link should be 0.032 to 0.090 inch.

(3) Attach bearing and liner assemblies (11) to lower end of collective sleeve (12) with screws. Lock-wire screws as vertical pairs.

NOTE

Maximum allowable play of bearing AN201KP10A (11, figure 8-18) is 0.005 inch axial and 0.005 inch radial.

(4) Assemble collective lever (4) on swashplate support, with pins inserted into bearings on sleeve. Install bolts through rear end of lever with trunnion (3) in place. Tighten bolts. With feeler gage, measure clearance between shoulder on pin and bearing inner race at each side. Add the two feeler gage clearances and divide by two, to determine thickness of shims (10) required. Prepare two shims to this dimension, equal to each other within 0.005 inch.

(5) Remove levers, install shims, and reassemble. Check for no end play of pins in bearings, and for freedom of bearing rotation. Installation should be 0.000 to 0.002 inch tight.

e. Preparation for Storage and Shipment – Scissors and Sleeve Assembly.

(1) Clean and dry assembly in accordance with MIL-P-116.

(2) Apply corrosion-preventive compound (item 309, table 1-2) to bushings and exposed unplated steel surfaces not in contact with bearings.

(3) Apply grease (item 7, table 1-2) to all bearings and grease fittings.

(4) Wrap assembly in grease-proof barrier material (item 505, table 1-2) and secure with pressure-sensitive tape, (item 400, table 1-2). Shape wrapper to contour of assembly.

(5) Place wrapped assembly into contoured bottom cushion in container. Fit top cushion over assembly.

(6) Place 12 eight-unit bags and one four-unit bag (total 100 units) of desiccant (item 310, table 1-2) in container.

(7) Place gasket and lid on container. Install locking ring over lips of lid and container and secure by bolt and nut tightened to provide moisture proof closure.

8-10. Control Tubes.

Control tubes consist of all rotating and non-rotating tubes in the control system.

a. Inspection – Control Tubes. Inspect control tubes for minor damage in the form of scratches. Inspect control tubes at connecting link for elongated rivet holes, deformed rivets or looseness of the connection.

b. Repair or Replacement – Control Tubes.

(1) Minor damage to both rotating and non-rotating control tubes in the form of scratches may be polished out.

NOTE

No limitations apply to length or direction of scratches. Scratches should be blended out to extend over a minimum two inch area.

(2) Scratches in all control tubes above the swashplate not in excess of 0.005-inch in depth may be polished out in accordance with step (4).

(3) Scratches, below and aft of the swashplate not in excess of 0.010-inch in depth may be polished out in accordance with step (4).

(4) Remove all scratches that are within limitations with abrasive cloth (item 508, table 1-2) or finer, to obtain a smooth scratch free surface. Apply two coats of zinc chromate primer (item 106, table 1-2) to repaired area.

(5) Allowable wear limits for the damper control tube bearings permit a maximum of 0.010-inch radial play and 0.030-inch axial play. Some of these tube assemblies may be equipped with alternate rod end bearings, 47-140-252-5. Tube assemblies so equipped have 0.012-inch radial and 0.012-inch axial maximum allowable wear limits.

(6) Bearing end of pitch change links (3, figure 8-1) have 0.020-inch radial and 0.020-inch axial maximum allowable wear limits. Universal end of the pitch change links have 0.0085-inch radial and 0.017-inch axial maximum allowable wear limits.

(7) Maximum allowable elongation to a bushing or clevis hole in the control system is 0.003-inch.

(8) Any wear in excess of limits shown in steps (5) through (7), above, is cause for replacement.

NOTE

To prevent chafing between control tube and mixing lever, install a bumper washer between mixing lever and push-pull tube clevis, only on the side on which heavy contact is noted, but not to cause vertical binding between tube clevis and mixing lever. Allowable clean-up is 0.005 inch to the leading edge of the mixing lever and 0.015 inch to the trailing edge side. The bumper washer may be locally fabricated from approximately 0.031 inch rubber with a 1.5 inch O.D. and a 0.625 inch I.D. (See figure 8-1.)

(9) For replacement of control system bolts, refer to Chapter 3, Overhaul and Retirement Schedule.

Table 8-4. (Added) Allowable Wear Limits Scissors Bearings

BEARING	AXIAL LIMITS	RADIAL LIMITS
Item 16, figure 8-18 P/N AN201KP8A, MS20201KP8A	0.010 inch	0.012 inch
Item 15, figure 8-18 P/N BR-5R	0.010 inch	0.007 inch
Item 17, figure 8-18 P/N 204-011-412-1	0.010 inch	None

NOTE

BEARING set (17) is considered to be a floating bearing installation before the scissors is installed on the HUB. The 0.010 inch axial play limit applies to wear in the bearing set (17) and not to the amount of axial movement relative to the scissors.

NOTE

BEARING (16) is considered to be a floating installation before the scissors is installed on the HUB. The 0.010 inch axial play limit applies to wear in the bearing (16) and not to the amount of axial movement relative to the scissors.

Section III. TAIL ROTOR HUB AND BLADE ASSEMBLY

8-11. Tail Rotor Group.

A single two blade controllable pitch tail rotor (see figure 8-20) is located on the left side of the tail rotor gear box. It is composed of two assemblies, the blades and the hub, and is driven through the tail rotor gear box. Blades are all metal construction and attached by bolts in blade grips which are mounted through bearings to spindles of a hub yoke. The tail rotor hub is hinge mounted to provide automatic equalization of thrust on advancing and retreating blades. Control links provide equal and simultaneous pitch change to both blades. The tail rotor counteracts torque of the main rotor and provides directional control.

a. Troubleshooting – Tail Rotor Hub and Blade Assembly. Indications of troubles and their corrections are as follows:

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
High frequency vibration	Tail rotor out of track	Track tail rotor
	Tail rotor out of balance	Remove tail rotor for balance on fixture
	Worn or loose hinge mounting	Replace rotor

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Loose grip bearing	Replace rotor
	Loose retaining nut	Tighten nut
	Bent pitch change links	Replace pitch change links
	Worn or loose pitch change rod duplex bearings	Replace bearings
	Worn or loose pitch change slider	Replace slider
	Loose or improperly torqued bipod and tripod mounts	Torque bipod and tripod mounts
	Loose mount bolts	Torque mount bolts
	Elongated holes 90 degree gear box mount	Replace gear box mount
	Loose rivets from spar to casting under 90 degree gear box	Replace rivets
Inability to make normal right and left turns in flight	Blade angles not set properly	Check pitch settings and rigging

b. Operational Check – Tail Rotor Hub and Blade Assembly.

NOTE

After replacement or installation of tail rotor hub, blades, or pitch change systems, check tail rotor rigging and track tail rotor blades. (See figure 8-25.)

(1) Attach a small piece of sponge rubber 1/8 to 1/4 inch thick on end of a 1/2 x 1/2 inch pine stick or any other flexible device. Cover sponge rubber with prussian blue (item 101, table 1-2) or similar type of coloring thinned with oil.

NOTE

Ground runup shall be performed by authorized personnel only.

(2) Start engine. Run engine at 6600 rpm, with pedals in neutral position. Reset marking device on underside of tail boom assembly. Slowly move marking device into disc of tail rotor just far enough to touch near blade approximately one inch from tip.

(3) When near blade is marked, stop engine and allow rotor to stop. Shorten pitch control link of marked blade and recheck track of blades.

c. Removal – Tail Rotor Hub and Blade Assembly.

(1) Disconnect pitch change link (1, figure 8-20) from each tail rotor blade grip pitch horn by removing nut, bolt and washers. Keep safety washer (3), spacer (2) and other attaching parts with link.

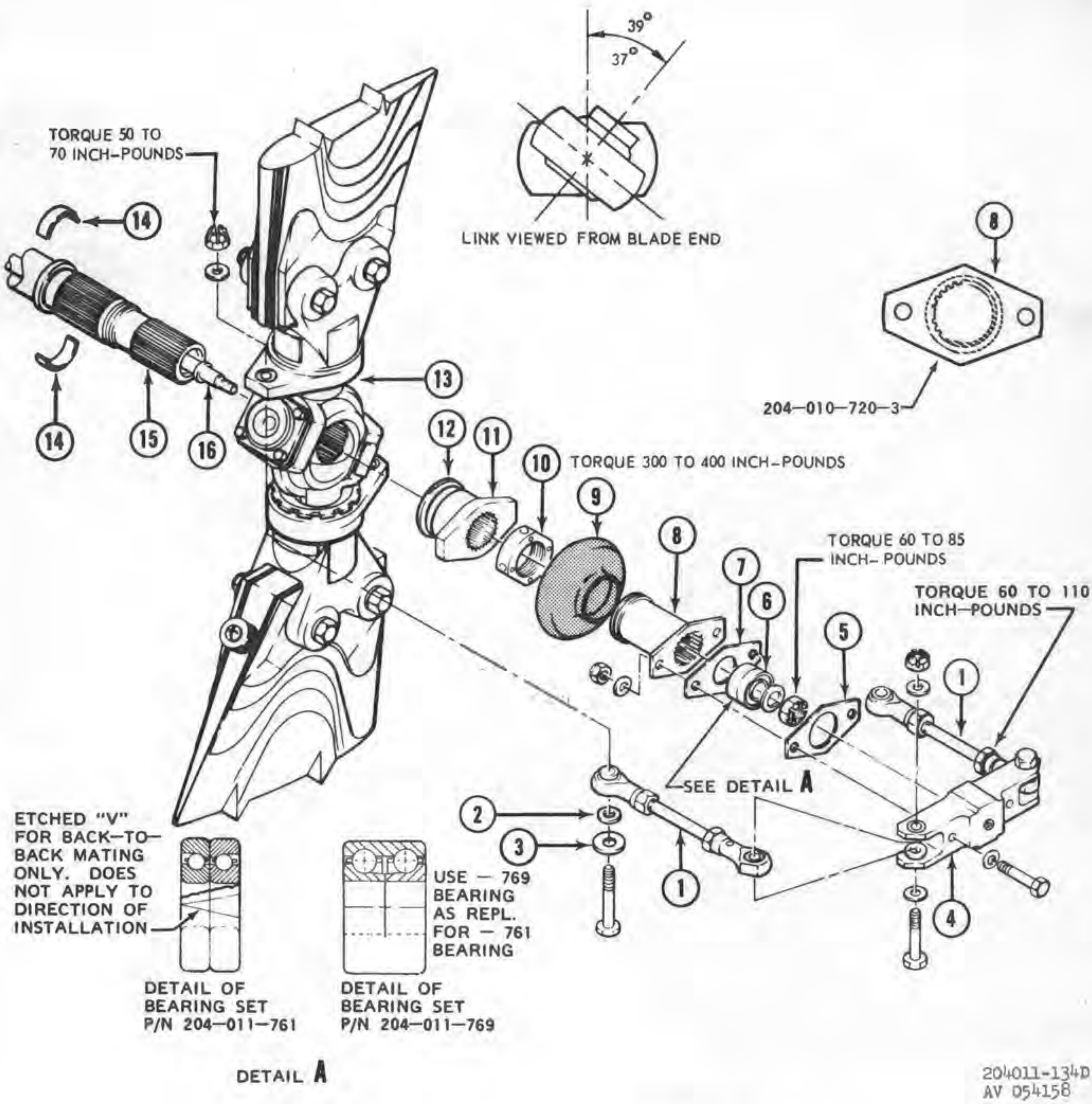
(2) Remove crosshead (4) and shim (5) by removing two attaching bolts with nuts and washers.

(3) Cut lockwire wrapped on each end of boot.

(4) Remove cotter pin, nut, and washer from end of pitch change rod. Remove bearing set (6), retainer plate (7), and pitch change slider (8). Remove boot (9).

(5) Cut lockwire and remove hub retainer nut (10). Remove static stop (11) and shim (12), if existing.

(6) Move tail rotor hub and blade assembly (13) outboard on splines of shaft, and remove split cone set (14) as it is released. Remove tail rotor over end of gear box shaft (15) and pitch change rod (16).



1. Pitch Change Links
2. Spacer NAS43HT-4-8
3. Safety Washer
4. Crosshead
5. Shim
6. Bearing Set
7. Retainer Plate
8. Slider
9. Boot
10. Hub Retaining Nut
11. Static Stop
12. Shim (As Required)
13. Hub and Blade Assembly
14. Split Cone Set
15. Gear Box Shaft
16. Pitch Change Rod

Figure 8-20. Tail rotor installation

NOTE

Fasten split cones together and retain as a matched set.

d. Inspection – Tail Rotor Assembly.

(1) Inspect all tail rotor parts for evidence of damage.

(2) Inspect moving parts and pivot bolts in the pitch change mechanism for looseness, wear, and play. Use a dial indicator to measure axial and radial play in the pitch link bearings. (Refer to Chapter 9.)

(3) Inspect for excessive movement between blade grip and the hub on each blade as follows:

(a) Rigidly support the rotor at the hub yoke to eliminate any possibility of movement. (The blades and grips must be free.)

(b) Free play check. (See figure 8-26.) With fingertips, move leading edge of blade away from center just enough to take out play. Do not use force. Measure total movement. Release, allow blade to return to center. Move trailing edge away from center and measure in the same manner. Maximum movement allowed: 0.25 inch each side. Repeat procedures on opposite blade.

(c) Maximum deflection check. (See figure 8-26.) Pull leading edge of blade away from center with 4 to 5 pounds force. Measure amount of movement. Allow blade to center. Pull the trailing edge of blade away from center with 4 to 5 pounds force and measure amount of movement. Maximum movement allowed: 1.0 inch each side.

(d) Inspect crosshead for visible damage, surface nicks and scratching. Maximum allowable depth after repair of surface nicks and scratches not to exceed 0.020 inch. Corrosion or pitting shall be cause for rejection.

(4) Use a dial indicator to inspect for maximum allowable play in either the radial or axial direction of 0.020 inch at each end of the pitch change link.

e. Repair or Replacement – Tail Rotor Assembly. If inspection requirements are not met, replace tail rotor assembly.

f. Installation – Tail Rotor Hub and Blade Assembly.

WARNING

Ensure slider, part number 204-010-720-3, is installed (8, figure 8-20).

NOTE

Prior to installation ensure tail rotor hub, crosshead, and pitch links are compatable for installation on UH-1D/H helicopters. (Refer to figure 8-21 or TM 55-1520-210-20P.)

NOTE

For information regarding UH-1D/H tail rotor hub (P/N 204-011-801-5 and -9) components useability, see figure 8-24.

(1) Observe color coding of parts during installation.

(2) Position tail rotor hub and blade assembly (13, figure 8-19) near end of shaft (15) with bearing bosses of the yoke inboard and flat side of yoke outboard. Align master splines and slide hub of shaft until trunnion is just started on second set of splines.

(3) Place split cone set (14), with bevel outboard, in groove between splines and shoulder on shaft with end gaps equally spaced. Slide hub inboard to seat trunnion on cones. Check cone set for equal spacing.

NOTE

Install split cones as matched set only.

(4) Install shim (12) on shaft against trunnion. Install static stop (11) and hub retaining nut (10). Hold rotor by hub and tighten to a torque of 300 to 400 inch-pounds. A maximum of one exposed unengaged thread inside nut (10) is permissable after shimming instructions have been accomplished. (Refer to substep (11) for shimming instructions.) Lockwire nut to static stop and install boot (9) on shaft.

CAUTION

Ensure proper alignment of etched "V" back-to-back mating on bearing set is maintained prior to and during installation. (See figure 8-27.) Nuts MS17826-5 and MS17825-4 are not to be reused (Reference TM 55-1500-204-25/1). The 204-011-769-1 bearing is a one-piece design, has no "V" etch, and may be installed in either direction.

(5) Install slider (8, figure 8-20) on shaft (15) and into boot (9). Safety wire each end of boot. Place retainer plate (7) and bearings (6) on end of pitch change rod (16) and secure by washer and nut. Tighten nut 60 to 85 inch-pounds torque and secure with cotter pin.

Note

Identify crosshead P/N 204-011-711-1 by six inch dimension. The crosshead may have an embossed forging part number; this does not reflect the crosshead part number.

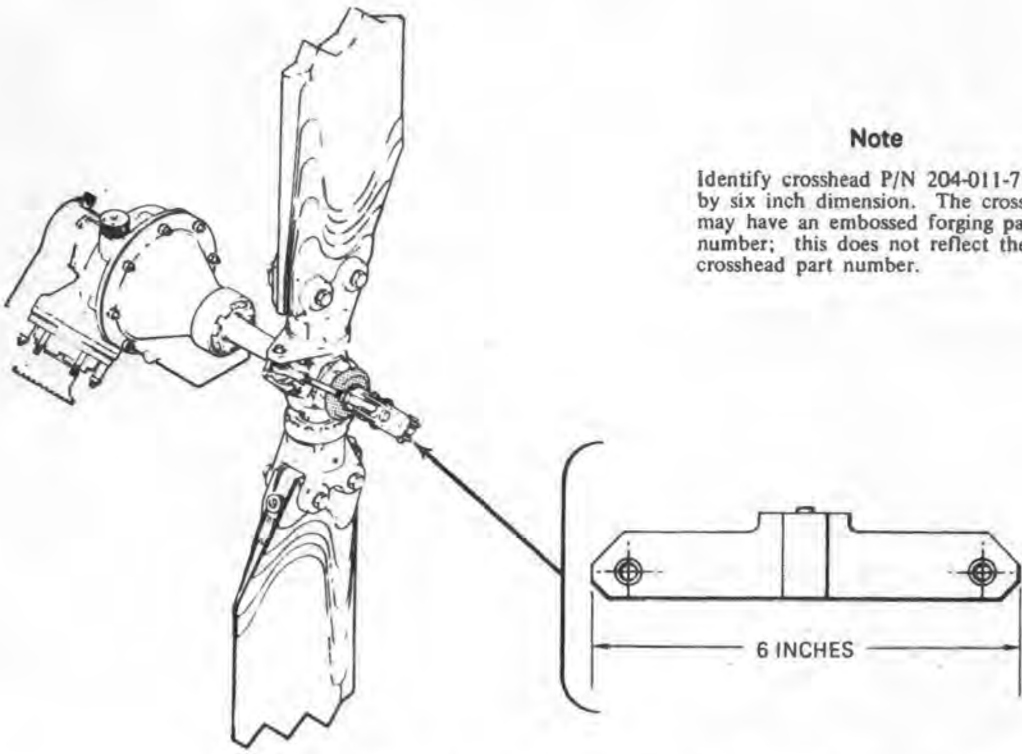


Figure 8-21. Tail rotor hub, crosshead and pitch link compatability

NOTE

The following tail rotor hubs are compatible with crosshead P/N 204-011-711-1 and pitch change links P/N 204-011-762-1 or P/N 204-011-762-7 (KAcarb P/N KSP9003-1)or P/N 204-011-762-11.

Tail rotor Hubs

P/N 204-011-801-5
P/N 204-011-801-9

(6) Determine thickness of shim (5) required for 0.002 to 0.004 inch pinch on pitch change rod bearings as follows:

(a) With shim omitted temporarily assemble crosshead (4) and secure with two bolts, washers and nuts.

CAUTION

Ensure correct P/N crosshead is installed. (See figure 8-21.)

(b) Tighten nuts enough to secure assembly without distortion.

(c) With a feeler gage measure gap between retainer plate and crosshead. Subtract 0.002 to 0.004 inch and peel or replace shim as necessary for this thickness.

(d) Remove bolts and crosshead.

CAUTION

Recheck "V" etched on outer races of bearing set (6) for proper back-to-back mating. "The 204-011-769-1 bearing is a one piece design, has no "V" etch, and may be installed in either direction."

(7) Fill cavity of crosshead with grease, (item 7, table 1-2). Place shim (5, figure 8-20) and crosshead over bearings. Align parts and install bolts, with washers under heads, through crosshead, shim, retainer plate, and flange of slider.

NOTE

Use bolts, P/N NAS1304-21D, nuts, P/N MS17825-4, and cotter keys, P/N MS24665-151, to attach crosshead to slider. Use one steel washer under head of bolts and one steel washer under nuts. One additional thin steel washer may be used under nuts to align for cotter key.

(8) Either full or partially threaded links can be used to assemble pitch change link (1). Do not intermix KSP rod ends with P/N 204-011-762-1 or P/N 204-011-762-11 rod ends. Crosshead and blade grip attaching bolts should be installed with bolt heads toward direction of rotation.

(a) Maximum allowable wear tolerance for rod-ends bearings is 0.020 inch, either axial or radial play.

(b) Set pitch links to initial length of 5.4 inches measured between bolt hole centers. Refer to chapter 9.

(9) Connect each pitch change link (1, figure 8-20) to blade pitch horn as follows:

(a) Inspect pitch change links, and determine part number of links being installed.

(b) Install links on tail rotor grips with attaching parts illustrated in the appropriate view of figure 8-22. Torque nuts to 60 to 110 inch-pounds, and install cotter pins.

NOTE

The pitch change link with the extended rod end bearing must contact the tail rotor grip. (See figure 8-22.)

(10) Install pitch change links in crosshead as follows:

(a) Install bolts with washers as illustrated in figure 8-23. Install bolts with heads in direction of rotation.

(b) Torque nuts to 50 to 70 inch-pounds and install cotter pins. Use one additional thin steel washer under nuts, if necessary for cotter pin alignment.

(11) Check for 3.0 (±0.5) inch clearance between tail boom vertical fin and nearest trailing edge of tail rotor at full right pedal position in rigged condition. If necessary, change thickness of shim (12 figure 8-20) installed between rotor hub trunnion and static stop for proper clearance. Use bonded laminated shims only.

CAUTION

Ensure all safety provisions are followed if adjustment of shim (12) is required.

NOTE

Inspect nut (10, figure 8-20) for proper thread engagement to shaft. A maximum of one exposed unengaged thread inside nut is permissible, after shimming is accomplished.

(12) Check the tail rotor, and controls for free movement, with no interference, through full flapping angle with full right and left anti-torque pedal applied. If installation is not correct, interference between the pitch change links (1, figure 8-20) and the safety washer (3) may occur before the rotor hub contacts the static stop (11).

(13) Lubricate the tail rotor. Refer to Chapter 2.

(14) Track tail rotor. (Refer to paragraph 8-11, step b.)

NOTE

Between five and ten hours of flight, after installation of tail rotor, retorque tail rotor retaining nut (10, figure 8-20). Retorque can be accomplished with slider and crosshead installed using care that wrench does not contact adjacent parts.

(15) Relubricate tail rotor grips after tracking. Centrifugal force may force grease away from inboard bearings. Purge grips until uncontaminated grease is expelled at inboard seal.

8-12. Tail Rotor Blades.

Refer to paragraph 8-11 for description.

a. Cleaning – Tail Rotor Blades. Wash tail rotor blades with a solution of mild soap and water.

b. Inspection – Tail Rotor Blades. (Figure 8-28.)

NOTE

Any repair or replacement of tail rotor blades will be performed by Direct Support maintenance level.

(1) *Nicks and scratches.*

(a) Nicks and scratches on the surface of the blade that are 0.008 inch, or less, deep are repairable.

(b) Nicks and notches in the extreme trailing edge of the blade that are 0.050 inch, or less, deep are repairable.

(2) Dents which are not in excess of 0.060 inch in depth are acceptable. In cases where a scratch or nick is present in a dent, the depth is measured to the bottom of the scratch or nick and must be repaired.

(3) Any crack, in any location, on any blade is cause for blade replacement. Replace tail rotor hub and blade assembly.

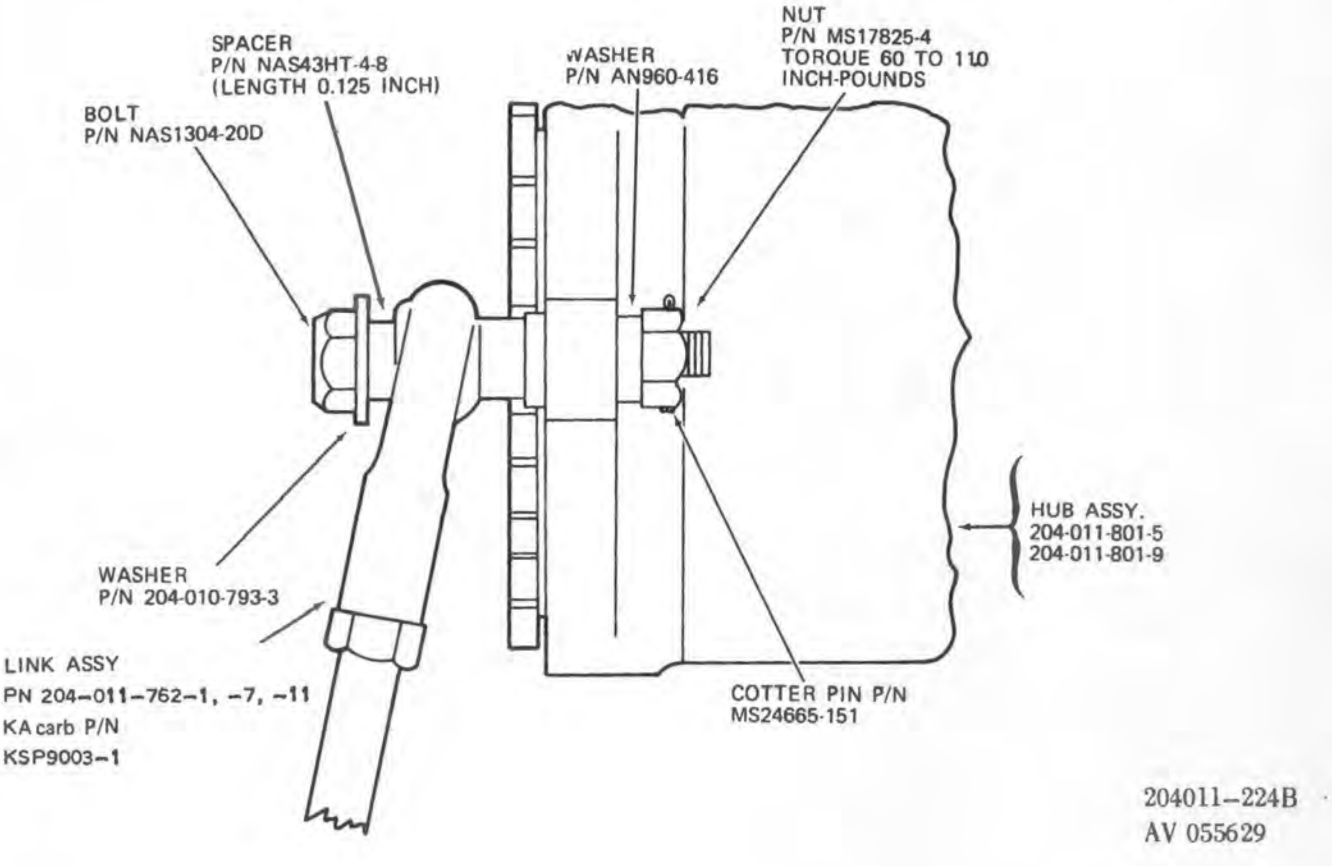


Figure 8-22. Pitch change link to tail rotor grip installation

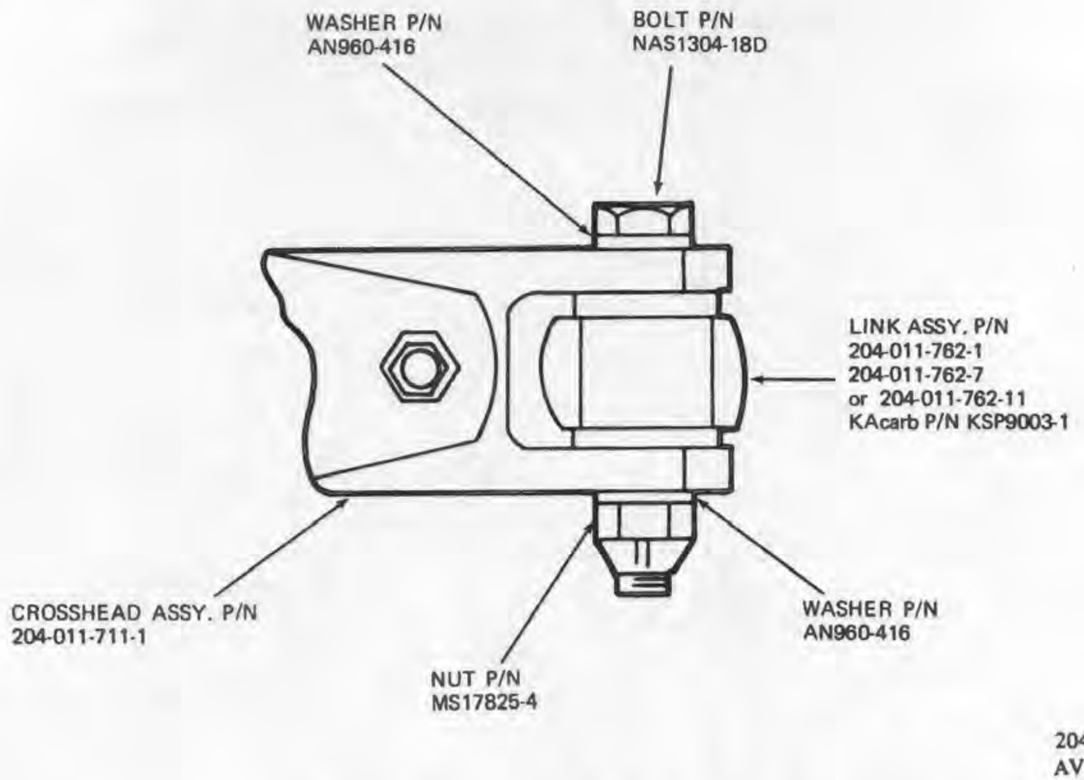


Figure 8-23. Pitch change link to crosshead installation

(4) *Voids.*

(a) Between the abrasive strip and the inner doubler, along blade centerline, a void with a maximum width of 0.250 inch in acceptable.

(b) At butt end, voids between skin and trailing edge, under doubler rear "fingers" are not acceptable.

(c) At butt end, voids between skin and inner doubler, under front "fingers" are not acceptable.

(d) At blade tip, between skins and trailing edge, in the outboard 1.00 inch, voids are not acceptable.

(e) In the blade body between the ends of the blade, between the skin and the core, voids not larger than 0.200 inch wide chordwise, by 0.500 inch long spanwise, are acceptable, providing spacing between centers exceeds 2.00 inches.

(f) In the blade body between the ends of the blade, between the skin and the inner doubler, voids not larger than 0.500 inch wide chordwise, by 1.00 inch long are acceptable, providing spacing between centers exceeds 3.00 inches.

(g) In the blade body between the ends of the blade, between the core and the inner doubler, voids not larger than 0.500 inch chordwise, by 1.500 inch spanwise, are acceptable, providing spacing between centers exceeds 3.00 inches.

NOTE

Any edge void is not acceptable. Replace tail rotor hub and blade assembly.

(5) Inspect the tail rotor blades for corrosion in accordance with the following limits:

(a) Skin corrosion areas inboard of station 25.0 not in excess of 0.010 inch in depth are permissible.

(b) Skin corrosion areas outboard of station 25.0 not in excess of 0.015 inch in depth are permissible.

(c) Corrosion areas in the abrasive strip not in excess of 0.010 inch in depth are permissible.

(d) Corrosion areas in the trailing edge not in excess of 0.015 inch in depth are permissible.

UH-1D/H TAIL ROTOR HUB (PN 204-011-801-5 and -9) COMPONENTS

HUB ASSEMBLY DASH NUMBERS -9	-5	DETAIL PART NUMBER	NOMENCLATURE
	1	204-010-785-1 or 204-000-737-1	Trunnion
1		204-011-737-1	Trunnion
2	2	204-010-786-1	Housing
2	2	204-010-787-1	Thrust Washer
2	2	204-010-788-1	Thrust Cap
2	2	204-010-789-1	Shim
	1	204-011-722-1 or -5	Yoke Assembly
1		204-011-722-5	Yoke Assembly
2		204-011-728-19	Grip
	2	204-011-728-1 or -19	Grip

Note

a. The -5 configuration incorporates uniform static stop points of contact for the tail rotor hub and blade assembly for left side installation only.

b. The -9 configuration incorporates uniform static stop points of contact for the tail rotor hub and blade assembly for either left or right side installation.

Figure 8-24. Tail rotor hub and hub components, usability chart (Hub P/N 204-022-801-5 and -9)

(6) Inspect retention bolts for tightness and security.

(7) Looseness of either retention bolt hole bushing is cause for blade replacement.

(8) If overspeed, sudden stoppage, hard landing or overtorque has occurred, inspect blades. (Refer to Chapter 3.)

(9) Bond separation or cracks anywhere on blade is cause for blade replacement.

(10) Movement of tip or root weights is cause for blade replacement.

(11) Inspect all tail rotor blades, P/N 204-011-702-15, for chordwise cracks in tip cap. Cracks in tip cap are repairable.

(12) If one blade of pair has been damaged badly enough that metal has been torn or any bond lines have separated, both blades must be replaced.

c. *Repair or Replacement – Tail Rotor Blades.*

(1) Request assistance of Direct Support maintenance personnel for repair of repairable items, as shown in paragraph 8-11, step b. If assistance is not immediately available, replace tail rotor hub and blade assembly.

(2) Replace hub and blade assembly if any blade has voids in excess of limits shown in paragraph 8-11, step b, substep (4).

204010-77
AV 054159

Figure 8-25. Tracking tail rotor

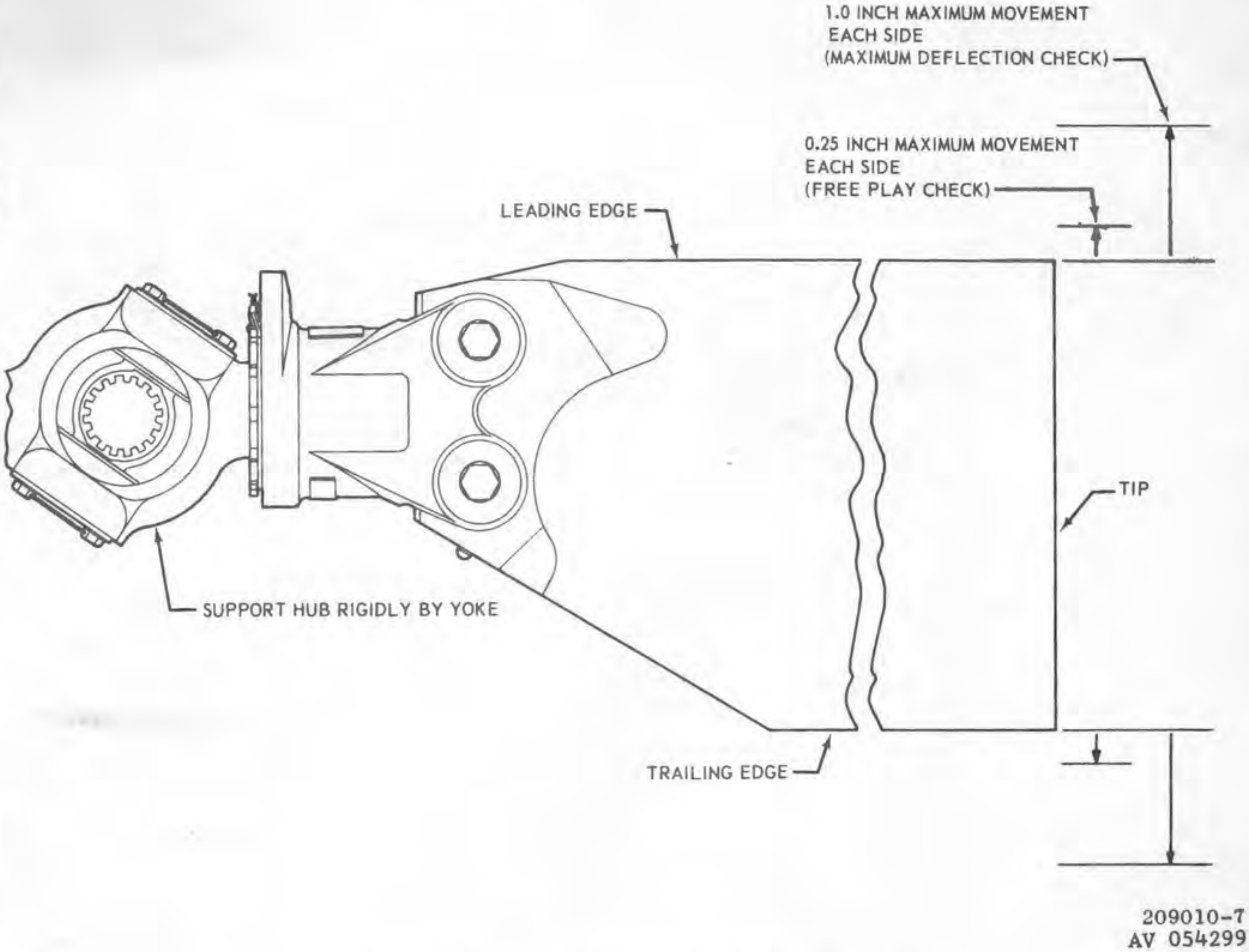


Figure 8-26. Checking looseness of tail rotor blades

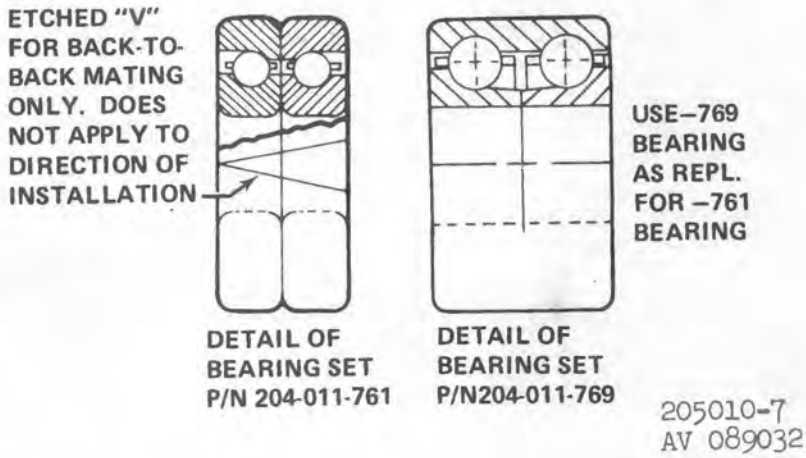


Figure 8-27. Bearing set-pitch change rod

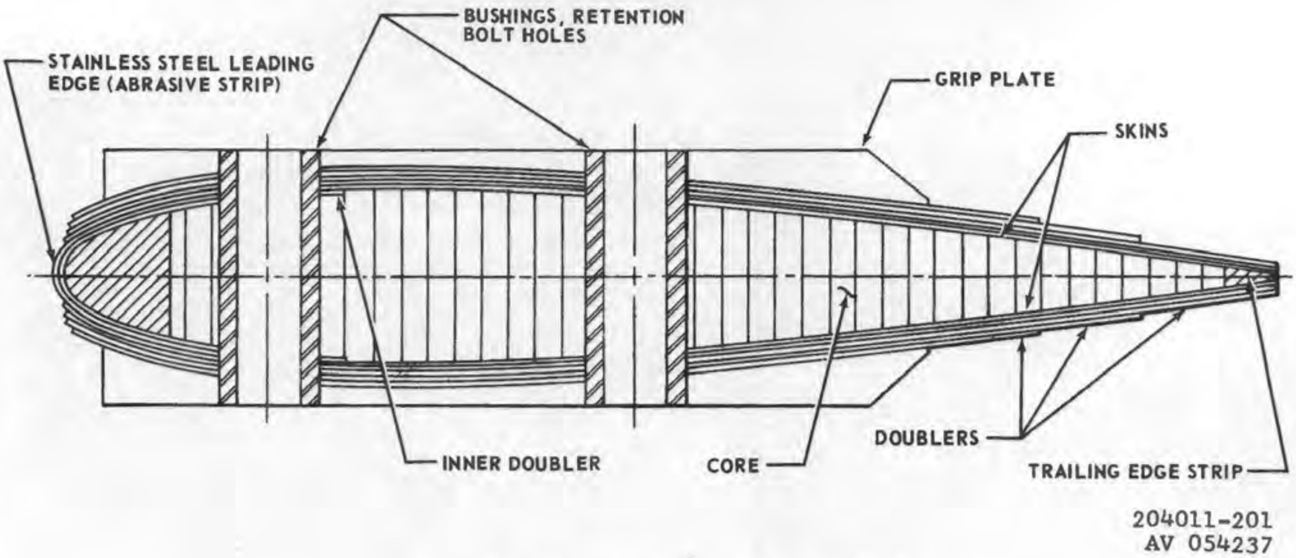


Figure 8-28. Root end view of tail rotor blade

CHAPTER 9

FLIGHT CONTROLS

Section I. INTRODUCTION

9-1. General.

a. The purpose of this chapter is to provide all the essential information for maintenance personnel to accomplish organizational maintenance on the complete flight controls.

b. This information includes a detail description and chronological instructions as to methods and procedures. It also includes special tools and equipment required for accomplishment of the maintenance phases as are applicable in accordance with the Maintenance Allocation Chart.

c. Special tools required for performance of Organizational Maintenance will be found in the TM 55-1520-210-20P.

Section II. CONTROL SURFACES

(Not Applicable)

Section III. FLIGHT CONTROLS

9-2. Movable Flight Controls.

a. Mechanical linkage systems, actuated by conventional helicopter controls, are used to control flight attitude and direction.

b. Systems include a cyclic control stick for fore-aft and lateral control, a collective pitch control stick for vertical control, and tail rotor pedals for directional control.

c. A synchronized stabilizer is linked into fore-aft control system.

d. Electrically operated force trims, connected to cyclic and tail rotor controls, induce artificial control feel and stabilize control stick and pedals to prevent them from moving of their own accord.

e. Special tools required to perform the following maintenance functions on the movable flight controls are listed below in Table 9-1.

Table 9-1. Special Tools

PART NUMBER	NOMENCLATURE
T101330	Rigging Fixture
T27872-11	Taper Reamer
T27872-2	Taper Reamer

9-3. Collective Pitch Control System.

a. Collective pitch control system (see figure 9-1) consists of a jackshaft assembly with dual control sticks, push-pull tubes and bell cranks, and a hydraulic power cylinder connected to a control lever on swashplate support.

b. Movement of either control stick is transmitted through linkage and hydraulic cylinder to main rotor pitch control mechanism, causing helicopter to ascend or descend or to remain at constant altitude.

c. Hydraulic cylinder has an irreversible valve to reduce feedback forces and to provide for use of controls in event of hydraulic boost failure.

9-4. Cyclic Controls System.

a. A system of linkage (see figure 9-2 and 9-3) transmits movement from cyclic control sticks to swashplate which actuates rotating controls to main rotor, controlling direction of helicopter.

b. Fore-aft lateral control are independent linkages from control stick to an intermixing bellcrank. From this point on to swashplate horns, linkage cannot be considered separately as to effect.

c. Two hydraulic power cylinders are incorporated to reduce effort required for control and to reduce feedback forces from main rotor.

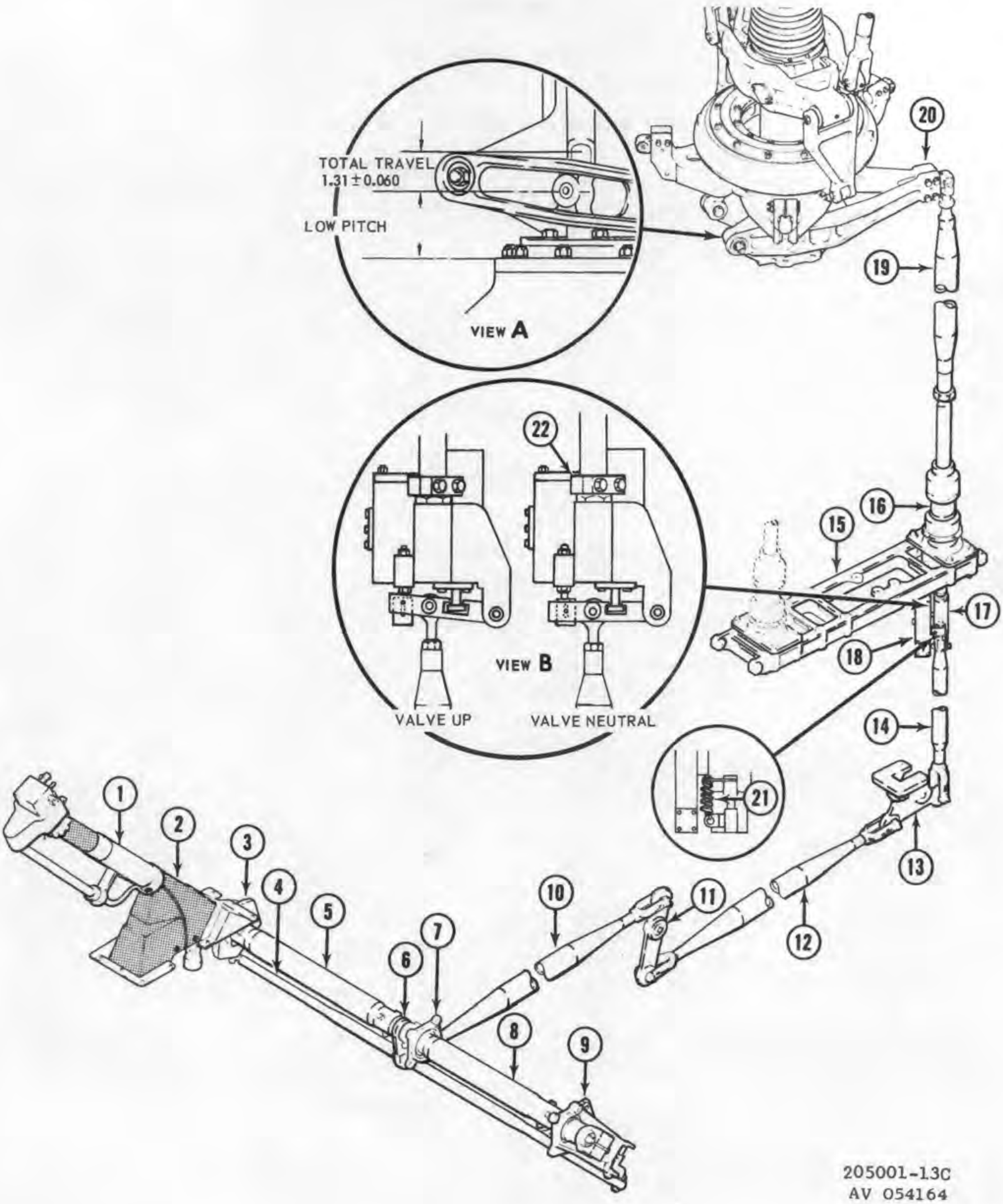
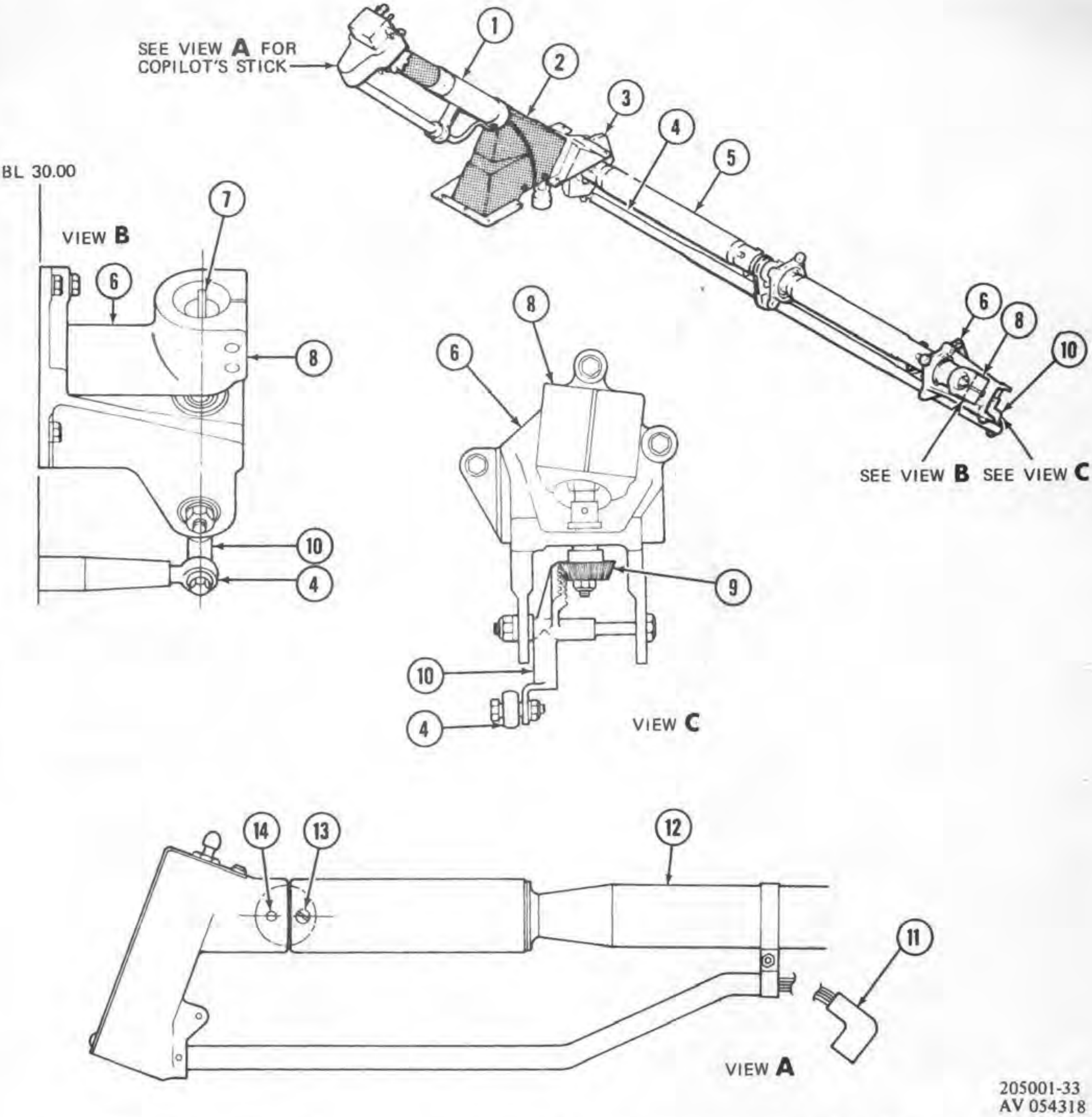


Figure 9-1. Collective pitch control system (Sheet 1 of 3)



1. Pilot's Collective Stick
2. Boot
3. Control Assembly
4. Power Interconnect Tube
5. Jackshaft Tube
6. Control Assembly
7. Tongue on top of Drive Assembly
8. Elbow
9. Drive Assembly
10. Lever Assembly
11. Wiring Assembly
12. Copilot's Collective Stick
13. Screw
14. Pin

Figure 9-1. Collective pitch control system (Sheet 2 of 3)

1. Pilot's Collective Stick
2. Boot
3. Control Assembly
4. Power Control Interconnect Tube
5. Jackshaft Tube
6. Control Arm
7. Bearing and Housing
8. Jackshaft Tube
9. Control Assembly
10. Control Tube
11. Lever
12. Control Tube
13. Bellcrank
14. Control Tube
15. Support
16. Power Cylinder
17. Servo Valve
18. Irreversible Valve
19. Cylinder Tube
20. Collective Sleeve Lever
21. Spring
22. Stop

205001-13C

Figure 9-1. Collective pitch control system (Sheet 3 of 3)

d. Two force gradient units, with magnetic brakes, are incorporated for artificial control feel and stabilization of controls.

9-5. Tail Rotor Controls.

a. Tail rotor control system (see figure 9-4) includes control pedals, pedal adjusters, a force gradient (centering spring) assembly with an electrically operated magnetic brake.

b. A hydraulic power cylinder, a quadrant and cables operating a pitch control mechanism mounted through tail rotor shaft, and connecting linkage.

c. Actuation of pedals causes power-assisted pitch change of tail rotor blades to offset main rotor torque and control directional heading of helicopter.

9-6. Synchronized Elevator Controls.

a. The synchronized elevator is located near the aft end of the tail boom and is connected by control tubes, bellcranks and mechanical linkage to the fore and aft cyclic control system.

b. Fore and aft movement of the cyclic control stick produces a change in the synchronized elevato ; ttitude, thus increasing controllability and lengthening the CG range of the helicopter. (See figure 9-5.)

9-7. Collective Control Sticks And Jackshaft.

a. Pilot's and copilot's collective pitch control sticks extend up and forward through flexible boots in floor at left side of each seat, and are interconnected by a jackshaft mounted laterally under floor.

b. When sticks are up, main rotor blades are high pitch; when sticks are down, blades are in low pitch. A knurled collar allows adjustment of friction drag on stick operation.

c. A spring-loaded down lock is provided on floor below pilot's stick.

d. A twist-grip type power control, with friction adjustment, is incorporated in control stick assembly.

e. Switch boxes on top of pilot's collective stick contain control switches for starter, engine governor, idle stop release, landing light, and searchlight.

f. Copilot's collective stick has only a power control grip, starter switch, and governor control switch.

g. Removal – Copilot's Collective Pitch Stick.

(1) Remove boot from copilot's collective pitch stick.

(2) Disconnect electrical cable plug of stick at connector on bulkhead under floor.

(3) Remove two bolts that secure stick in elbow on control assembly. Remove stick assembly.

NOTE

If helicopter is being converted for operation with single controls, accomplish following steps.

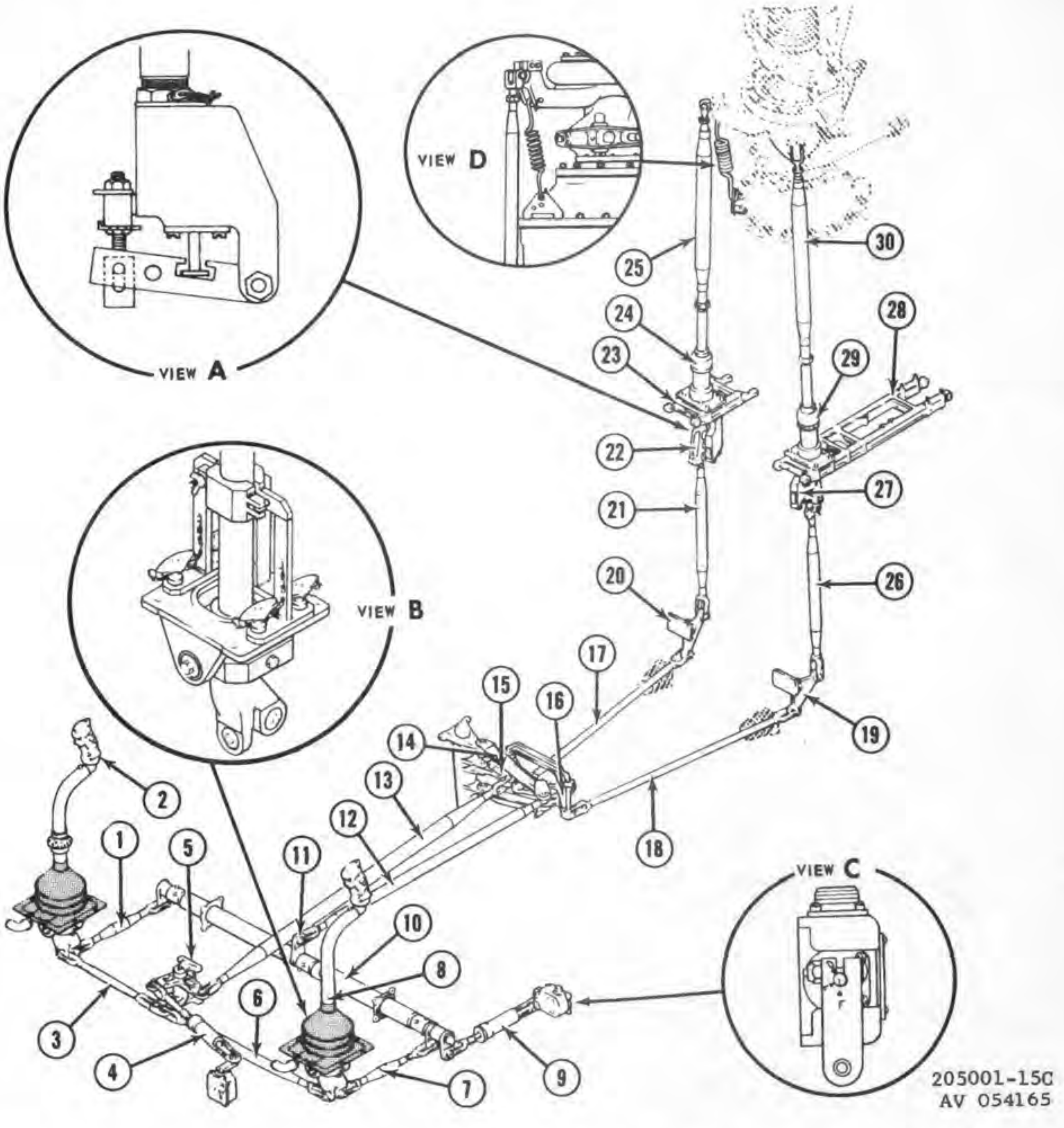
(4) Install shorting plug in electrical receptacle on bulkhead where cable of copilot's collective stick was disconnected.

(5) Install access door with eight screws to cover floor opening where collective stick boot was removed.

h. Installation – Copilot's Collective Pitch Stick.

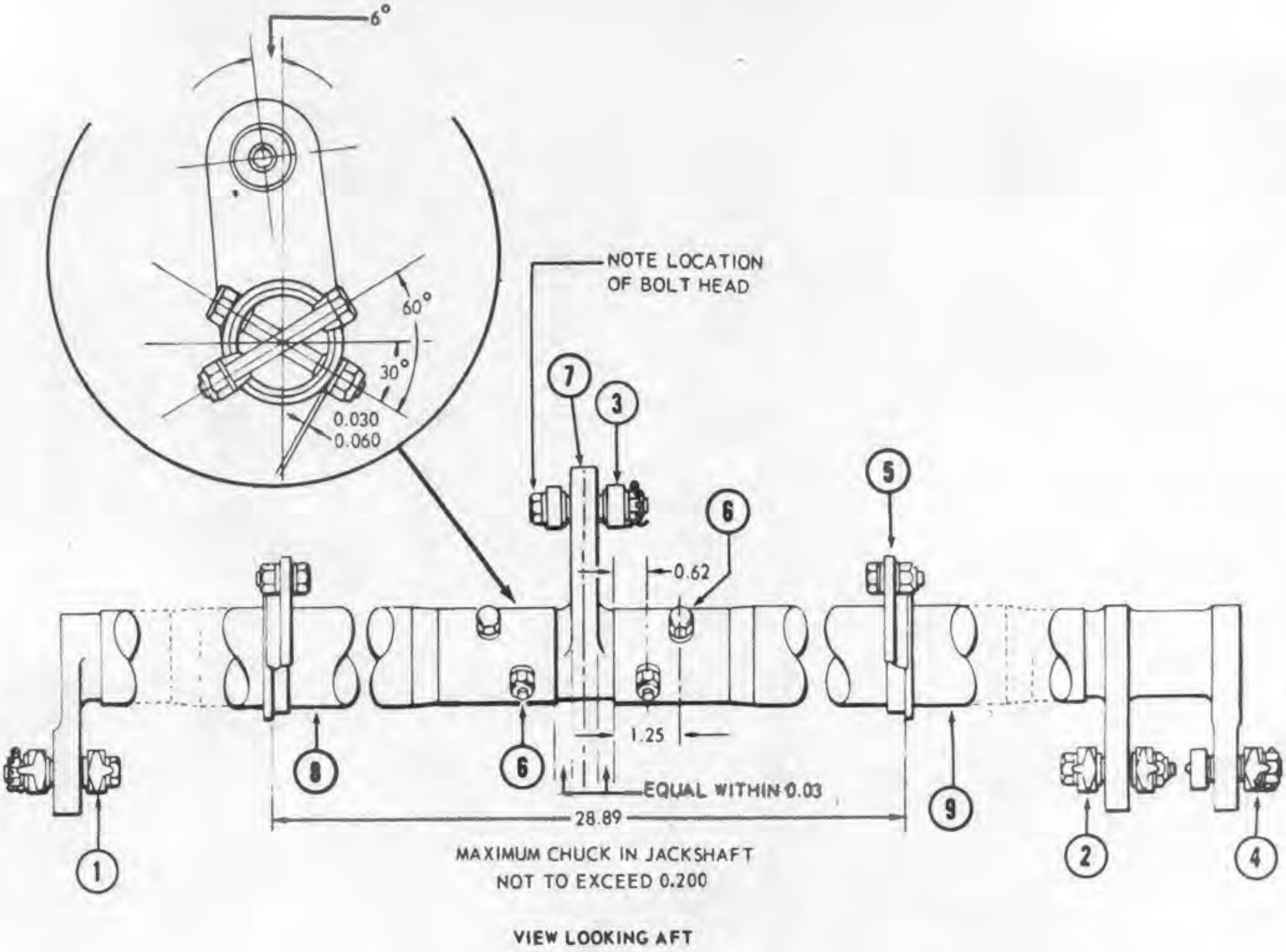
NOTE

Installation procedure for the improved collective pitch stick (P/N 205-001-116) and prior production pitch sticks is similar. However, the pitch stick (P/N 205-001-116) throttle twist grip will not rotate through 180 degrees, and must be synchronized with the pilot's throttle at installation.



1. Control Tube - Fore Aft
2. Cyclic Control Stick
3. Control Tube - Lateral
4. Force Gradient - Lateral
5. Bellcrank
6. Control Tube - Lateral
7. Control Tube - Fore Aft
8. Cyclic Control Stick
9. Force Gradient - Fore Aft
10. Jackshaft
11. Lever
12. Control Tube
13. Control Tube
14. Matched Link Set
15. Bellcrank
16. Bellcrank
17. Control Tube
18. Control Tube
19. Bellcrank
20. Bellcrank
21. Control Tube
22. Servo Valve
23. Support
24. Cylinder Assembly
25. Control Tube
26. Control Tube
27. Irreversible Valve
28. Support
29. Cylinder Assembly
30. Control Tube

Figure 9-2. Cyclic control system



1. Control Tube - Fore and Aft
2. Control Tube - Fore and Aft
3. Control Tube
4. Force Gradient - Fore and Aft
5. Bearing and Housing Assembly
6. Bolt
7. Arm
8. Tube
9. Tube

204001-36M
AV 054166

Figure 9-3. Cyclic control tube and lever assembly

(1) Remove access door, if installed, at floor opening at left of copilot's seat. Remove shorting plug, if installed, at electrical receptacle provided for copilot's collective stick wiring assembly.

(2) If a copilot's collective stick (P/N 205-001-116) is to be installed, accomplish steps (3) through (9). If a collective stick (P/N 204-001-290) is being installed, accomplish steps (5) through (9).

(3) Disconnect tube (4, figure 9-1 (sheet 3) at lever assembly (10) on copilot's side. Align tongue (7) and lever assembly (10) on a butt line. (A butt line is a vertical plane parallel with the longitudinal axis of the helicopter.) If alignment of the tongue and lever on a butt line cannot be accomplished by moving the lever, roll the lever assembly off the pinion of the drive assembly (9) and re-index the sector and pinion on several teeth by trial and error until alignment is accomplished.

(4) Align pin (14) and screw (13) in copilot's collective stick. Maintain this alignment and the alignment accomplished in step (3) while installing collective stick.

(5) Install copilot's collective stick in elbow (8). Align grooves at base of collective stick with holes in elbow (8), and install two bolts.

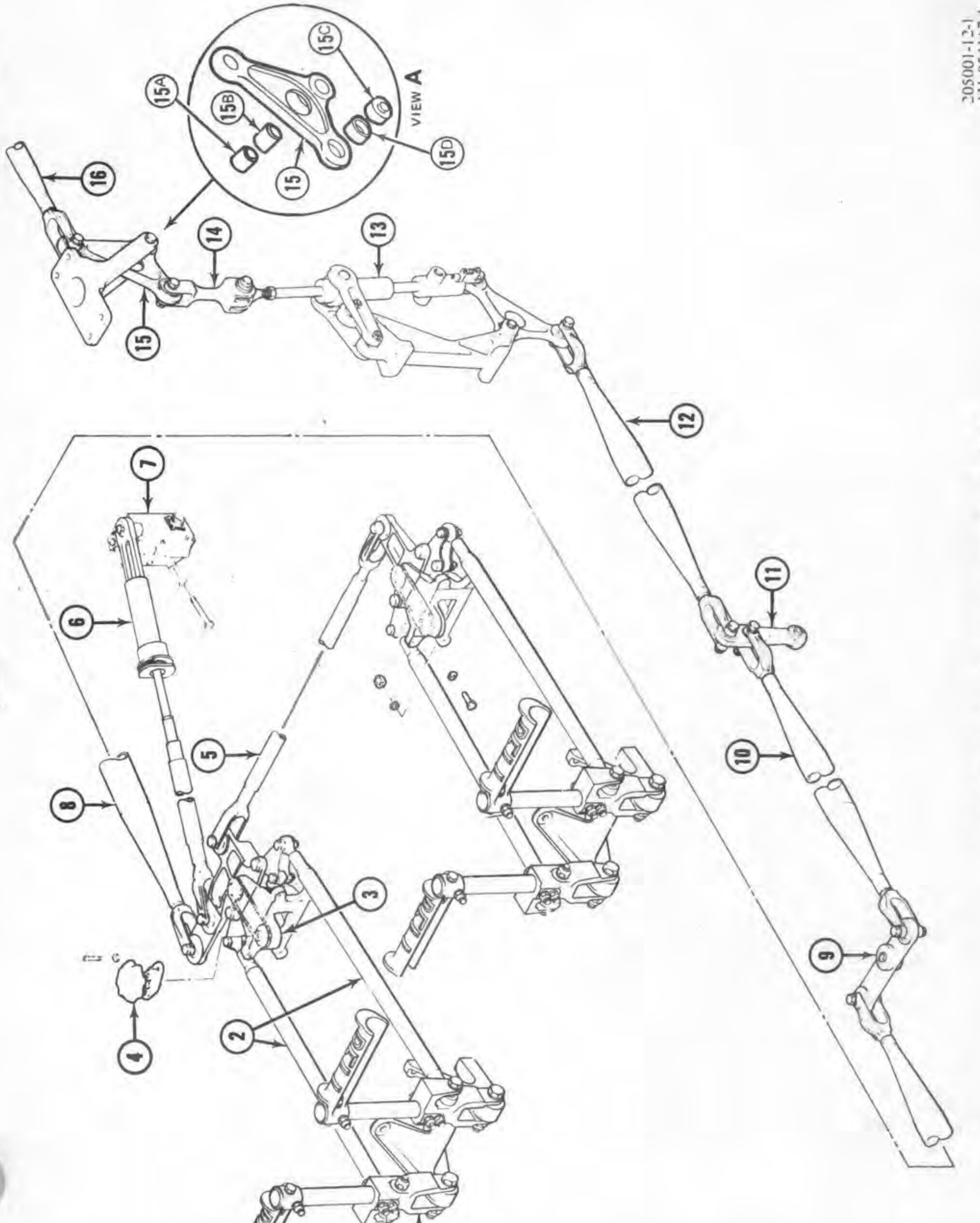
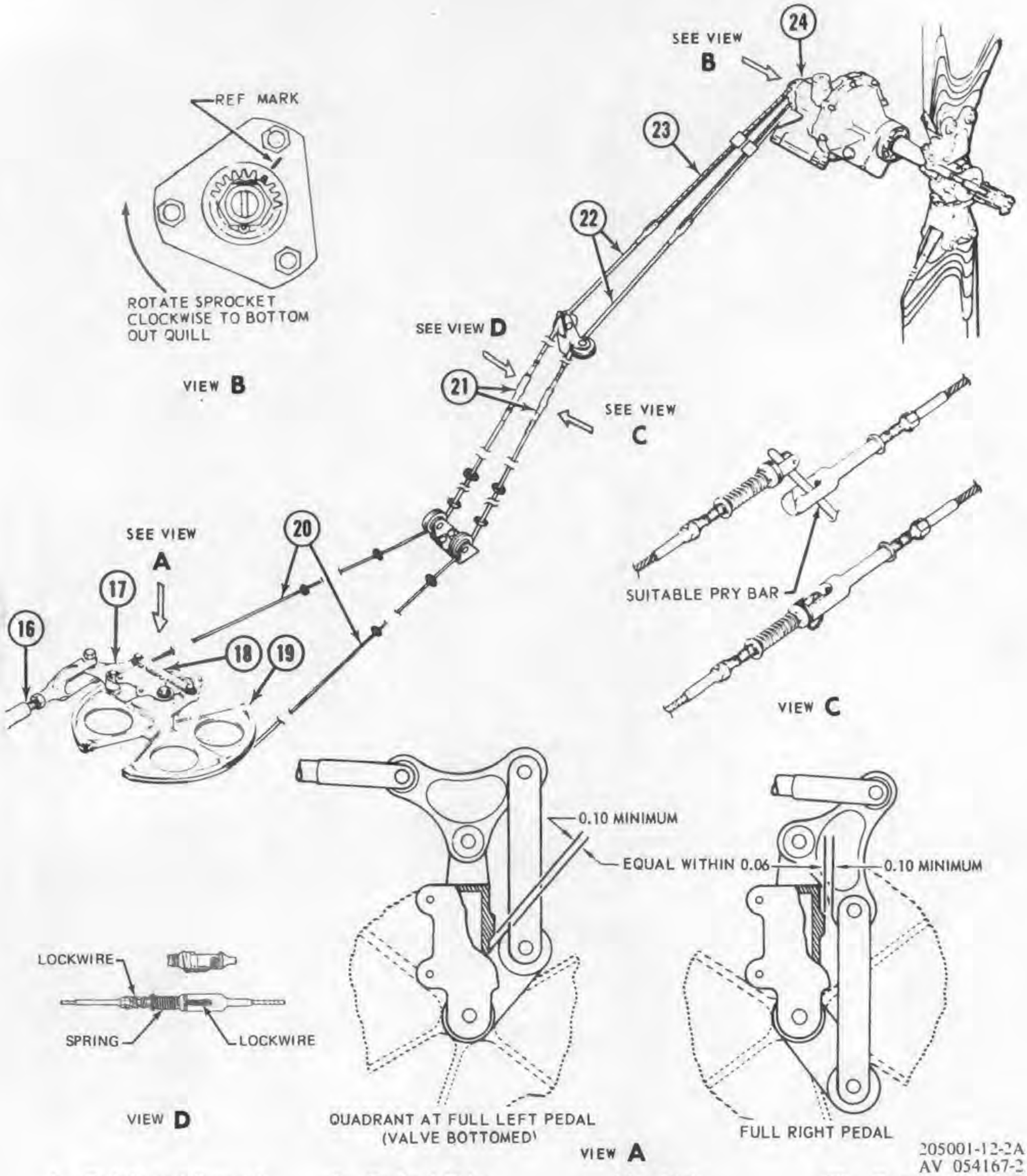


Figure 9-4. Tail rotor control system (Sheet 1 of 2)



1. Pedals and Support	8. Control Tube	14. Link	20. Forward Cables
2. Control Tubes	9. Bellcrank	15. Bellcrank	21. Speed Rig
3. Pedal Adjuster	10. Control Tube	16. Control Tube	22. Aft Cables
4. Adjuster Knob	11. Idler Arm	17. Bellcrank and Support	23. Control Chain
5. Interconnect Tube	12. Control Tube	18. Links	24. Control Quill Sprocket
6. Force Gradient	13. Power Cylinder and Support Assembly	19. Quadrant	
7. Magnetic Brake			

Figure 9-4. Tail rotor control system (Sheet 2 of 2)

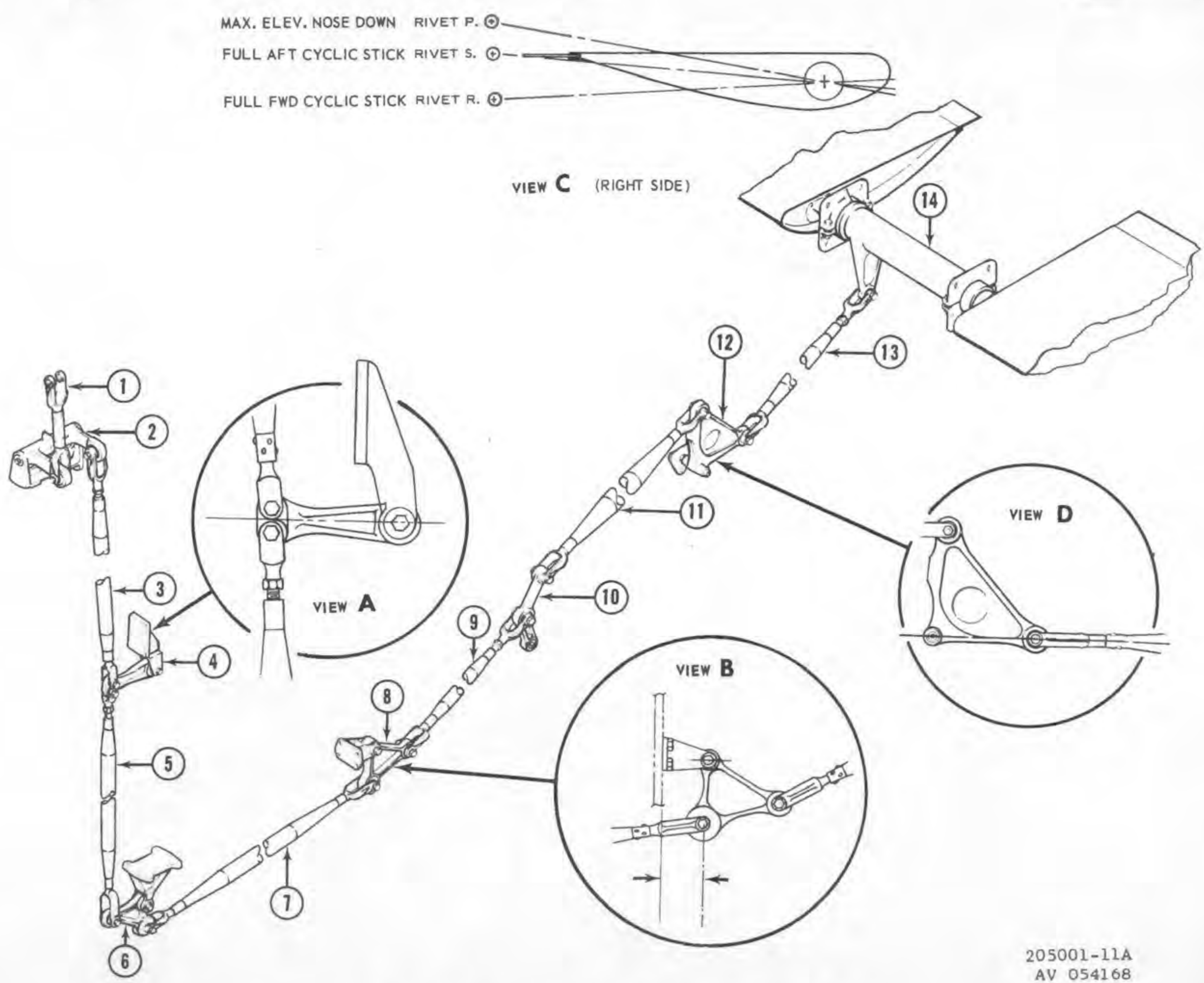


Figure 9-5. Synchronized elevator controls (Sheet 1 of 2)

1. Control Tube
2. Bellcrank (Rotated for clarity)
3. Control Tube
4. Idler Arm
5. Control Tube
6. Bellcrank
7. Control Tube
8. Bellcrank
9. Control Tube
10. Idler Arm
11. Control Tube
12. Bellcrank
13. Control Tube
14. Elevator Shaft

205001-11A

Figure 9-5. Synchronized elevator controls (Sheet 2 of 2)

(6) Attach power interconnect tube (4) to lever assembly (10). (This step is applicable to collective stick (P/N 205-001-116) installation only).

(7) Check pilot and copilot throttle and collective controls for freedom of movement through full throw. Observe sector and pinion gears at base of pilot's and copilot's collective sticks, while moving controls through full throw to ensure sector gears remain fully engaged. It will be necessary to actuate the flight idle release stop to obtain full movement of throttle controls.

(8) Connect and lockwire wiring assembly (11) to receptacle provided. Perform functional check of the electric Switch/Switches on the copilot's collective stick.

(9) Install boot over copilot's collective stick, and secure to the floor with screws.

i. Removal – Collective Stick and Jackshaft Assemblies.

(1) Remove access plates from floor and left side of cabin. Remove boots (2, figure 9-1) from both collective control sticks.

(2) Disconnect electrical cable connectors of control sticks at bulkhead.

(3) Disconnect power control system tube from gear lever on lower end of pilot's collective stick. Disconnect power control interconnect tube (4) from both sticks and remove through access opening in side of cabin.

(4) Disconnect pitch control tube (10) from arm (6) on jackshaft.

(5) Remove two bolts and pull copilot's stick from elbow of control assembly (9).

(6) Remove four bolts attaching copilot's control assembly to intercostal structural member.

(7) Remove two bolts and tapered bushings attaching left tube (8) of jackshaft to stub shaft of arm (6).

(8) Remove four bolts attaching bearing housing (7) to structural beam.

(9) Remove left section of jackshaft, with bearing housing and copilot's control assembly, from structure through access opening in left side of cabin.

(10) Remove two bolts and tapered bushings attaching jackshaft tube (5) to pilot's control assembly (3). Remove jackshaft tube with attached arm through floor opening.

(11) Remove two screws and two bolts attaching pilot's control assembly support (3) to structural intercostal. Remove control stick assembly through floor opening.

j. Inspection – Collective Stick and Jackshaft Assemblies.

(1) Inspect control tubes for nicks and scratches and repair in accordance with instructions contained in Chapter 8.

NOTE

For bearing tolerances, refer to paragraph 9-18.

(2) Inspect the bell crank to servo valve tube assembly (14, figure 9-1) bearing for 0.005 inch radial and 0.030 inch axial maximum allowable wear. Some of these tube assemblies may be equipped with alternate rod end bearings, 47-140-252-3. Tube assemblies so equipped have 0.012 inch radial and 0.012 inch axial maximum allowable wear limits. Any wear in excess of these limits is cause for replacement.

(3) Maximum allowable elongation to a bushing or clevis hole in the control system is 0.003 inch.

(4) Maximum allowable chuck for the collective pitch jackshaft is 0.060 inch.

(5) For replacement of control system bolts refer to Chapter 3.

(6) Check pilot's collective stick friction after installation.

k. Installation – Collective Stick and Jackshaft Assemblies.

(1) Apply a coat of zinc chromate putty (item 200, table 1-2) to mounting faces of pilot's and copilot's control assemblies (3 and 9, figure 9-1).

(2) Lower control assembly of pilot's stick through floor opening, and insert elbow through mounting hole of structural intercostal. Attach support of control assembly to intercostal by installing two screws and two bolts with nuts and washers.

(3) Position right section of jackshaft (5) with attached arm (6) in area between intercostal and left main beam. Place end of jackshaft tube on elbow of pilot's control assembly, with control arm pointing down. Align holes and install two bolts with tapered bushings (use taper reamers, T-27872-2 and -11).

(4) Insert left section of jackshaft (8), with copilot's control assembly (9), through access opening in left side of cabin. Insert jackshaft tube through mounting hole of intercostal.

(5) Place bearing and housing assembly (7) on jackshaft tube. Insert end of tube through mounting hole in left main beam and over stub shaft of control arm. Align holes and install two bolts with tapered bushings (use taper reamers, T-27872-2 and -11).

(6) Attach copilot's control assembly to intercostal by installing four bolts with nuts and washers.

(7) Attach jackshaft bearing housing to beam by installing four bolts with nuts and washers.

(8) Insert copilot's control stick into elbow of control assembly and secure with two bolts.

(9) Mesh pinion and sector gears of power control mechanism, and align control arms on axis of each control stick. Adjust and attach interconnect tube (4) to sector gear arms of both control sticks. Connect power control linkage tube to pilot's stick. Check for freedom of operation.

(10) Connect control tube (10) to jackshaft arm.

(11) Connect and lock-wire electrical cable plugs at receptacles on bulkhead.

(12) Install boots (2) on control sticks. Reinstall all access plates.

(13) Check for proper adjustment of spring (21) by moving collective stick up and down, with hydraulic power on. If spring tension correctly balances weight of stick, equal force will be required to move stick either direction. If greater force is required to move stick up than down, bend up attachment tab at upper end of spring. If opposite condition occurs, bend tab down.

(14) Check pilot's collective stick for correct minimum friction, as follows:

(a) With hydraulic boost power on, place collective stick full down, turn friction adjustment full off. Insure friction control nut assembly is backed off to assure that no friction is being applied by the nut assembly.

(b) Attach a pull scale at the center of the twist grip (plus or minus one half inch). Pull up perpendicular to the collective stick and check for a breakaway force of 8 to 10 pounds.

NOTE

This check can be performed without hydraulic power, by disconnecting control tube (10) from jackshaft arm (6). Under these conditions, check for a constant load of 14 to 16 pounds breakaway force.

(c) On UH-1D/H through Serial No. 63-13002, adjustment of friction load will require partial disassembly at field maintenance level to change shim at lower end of stick.

(d) On UH-1D/H Serial No. 64-13492 and subsequent, friction load can be adjusted by means of set-screws at lower end of collective stick. (See figure 9-6.) Adjust friction nut on grip to obtain required load, then adjust set-screws in connector to touch against washer below connector.

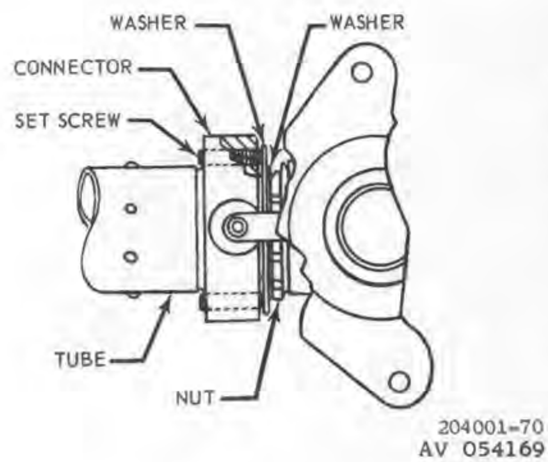


Figure 9-6. Collective control stick friction load adjustment — UH-1D/H serial number 64-13492 and subsequent

CAUTION

Do not over-tighten screws, since this could bend washer and require disassembly for replacement.

9-8. Collective Pitch Control Linkage.

Linkage between collective pitch control jackshaft and collective sleeve lever on swashplate support consists of push-pull tubes, bellcranks, and hydraulic power cylinder assembly.

a. Removal – Collective Pitch Control Linkage.

(1) Remove control tubes (10 and 12, figure 9-1) and lever (11) under cabin floor, or bellcrank (13) and tube (14) in compartment below transmission pylon, only when necessary to inspect and lubricate or replace parts. Use access plates provided on floor and lower skin of cabin.

(2) Remove hydraulic power cylinder assembly as necessary for replacement. (Refer to Chapter 6.)

b. Inspection – Collective Pitch Control Linkage. Inspect linkage parts for wear, elongated bolt holes, cracks, nicks or damage. Inspect bearings for wear or roughness.

NOTE

For bearing tolerances, refer to paragraph 9-16.

c. Repair or Replacement – Collective Pitch Control Linkage. Repair control tubes in accordance with Chapter 8. Replace parts that fail to meet inspection requirements above.

NOTE

Check rigging and proper operation of system after removal and installation of any parts.

d. Installation – Collective Pitch Control Linkage.

(1) Install any parts removed in lower linkage.

(a) Install lever (11, figure 9-1) with long end down in bracket at inboard side of left main structural beam. Attach control tubes (10 and 12) to lever.

(b) Install bellcrank (13) in support located at lower left in cargo-sling compartment. Attach control tubes (12 and 14). Also connect control tube of engine droop compensator linkage.

(2) Install hydraulic power cylinder. (Refer to Chapter 6.)

(3) Service and bleed hydraulic system. (Refer to Chapter 6.)

(4) Complete connection of linkage while rigging flight control system.

e. Adjustment – Collective Pitch Controls.

(1) Rig system with control stick and jackshaft assembly and all nonadjustable control tubes and bellcranks installed and connected.

NOTE

Check that stop (22, figure 9-1) (see view B) is firmly against the nut.

(2) Place collective control stick full UP against stop and secure with friction adjustment.

(3) Adjust control tube (14) to fit attachment point on lever of servo control valve (17), with cylinder bottomed full up and control valve lever at top of travel. (See view B, figure 9-1.) Shorten tube by one-half to five turns of rod-end and attach to valve lever with bolt, nut, washers. Torque nut finger tight and install cotter pin.

(4) Place collective control stick full DOWN against stop. Position collective sleeve lever (20) to obtain dimension of 2.39 to 2.45 inches from center of cam roller to transmission cap plate surface. (See view A, figure 9-1.)

(5) Position cylinder control valve lever in neutral. (See view B, figure 9-1.) Use auxiliary hydraulic power if available. Adjust clevis on tube (19) to fit trunnion on collective sleeve lever and connect.

(6) Check for free travel of collective controls with hydraulic boost pressure off.

(7) Apply hydraulic boost pressure and check for 1.31 inches total travel of collective pitch sleeve. (See view A, figure 9-1.)

(8) Check minimum pitch angle of main rotor. (Refer to Chapter 8.)

(9) Inspect complete collective control system for security of parts.

9-9. Cyclic Control Sticks.

a. Two cyclic control sticks are mounted through floor in front of pilot seats. Grip of pilot's cyclic stick is equipped with a trigger type communications switch, a cargo hook release switch, and a force trim switch.

b. Copilot's stick is linked to pilot's stick and has the same control provisions with the exception of adjustable friction.

c. Removal – Copilot's Cyclic Control Stick.

NOTE

Apply following procedure when converting to a single set of controls. (See figure 9-2.)

(1) Remove eight screws to detach boot from floor. Unsnap and remove boot assembly from copilot's cyclic control stick. Remove access plate from lower skin under control stick.

(2) Disconnect control stick electrical cable plug from receptacle on structure. Install shorting plug in receptacle. Detach cable support clamp from structure.

(3) Remove nut, washers, and bolt through lever and end of control stick just below support gimbal. Pull stick from support and lever assembly.

(4) Install door over floor opening with eight screws. Install access plate on lower skin.

d. Removal – Cyclic Control Stick Assembly.

NOTE

Use this procedure to remove a complete stick assembly, including support and lever.

(1) Remove eight screws and washers to detach boot from floor. Remove boot assembly. Remove access plate on lower skin.

(2) Disconnect control stick cable plug from receptacle on structure.

(3) Disconnect fore-aft and lateral control tubes from lever, below stick support, by removing bolts.

(4) Remove four bolts and washers from support. Remove stick and support assembly.

e. Installation – Copilot's Cyclic Control Stick.

NOTE

Apply following procedure when converting from single to dual controls.

(1) Remove door with eight screws from floor ahead of pilot's seat location. Remove access plate from lower skin. Remove shorting plug from electrical receptacle on structure below floor.

(2) Insert end of copilot's control stick into socket of support and lever assembly. Below support gimbal, align holes and install bolt, with washer under head, through lever and end of stick. Secure bolt with washer, nut, and cotter pin.

(3) Connect and lock-wire control stick cable plug to receptacle on structure. Secure cable support clamps with bolt and nut, allowing enough cable slack for full stick travel only.

(4) Install boot, secured to floor with eight screws and washers. Install access plates on lower skin.

f. Installation – Cyclic Control Stick Assembly.

NOTE

Use this procedure to install a stick assembly complete with support and lever.

(1) Position stick in place. Secure support to structure with four bolts and washers.

(2) Attach fore-aft and lateral control tubes to control stick lever with bolts, washers, nuts, and cotter pins.

(3) Connect and lock-wire control stick electrical cable plug to receptacle on structure below floor. Check that cable support clamp allows enough slack in cable for full stick travel only.

(4) Install boot assembly, secured to floor with eight screws and washers. Install access plate on lower skin.

g. Inspection – Cyclic Stick Assemblies.

(1) Inspect for binding, full travel and synchronization of pilot's and copilot's cyclic stick assemblies.

(2) Inspect friction lock for restriction of cyclic stick movement and proper release.

(3) Check boot for cuts, tears, deterioration and missing, loose or improperly installed hardware.

9-10. Cyclic Control Linkage.

Linkage between cyclic control sticks and swashplate control horns includes push-pull tubes, bellcranks, a jackshaft, two force gradients with magnetic brakes, and two hydraulic power cylinder assemblies.

a. Removal – Cyclic Controls Linkage.

NOTE

Parts of control system can be removed separately as need occurs, or completely in practical sequence. Take precautions against damage by accidental movement of linkage while disconnected.

(1) Remove access covers on cabin floor, front of pylon island, and lower skin of fuselage.

(2) Disconnect control tubes from cyclic control sticks (2 and 8, figure 9-2), bellcrank (5) and jackshaft (10).

(3) Disconnect and remove lateral force gradient (4) from bellcrank and magnetic brake arm. Remove brake by disconnecting electrical wiring connector and removing four bolts to detach from bulkhead.

(4) Disconnect fore-aft force gradient (9) from jackshaft and from arm of magnetic brake. Remove brake by disconnecting electrical wiring connector and removing four bolts to detach from bulkhead.

(5) When removal of jackshaft is required, remove bolts and tapered bushings to separate jackshaft tubes from each side of control lever (11). Remove each section of jackshaft by removing four bolts attaching bearing housing to beam, withdrawing assembly through access opening in side of cabin lower skin.

(6) To remove control rod (13), first remove bolts from front bellcrank and rear mixing lever assembly. Remove bolts from end of connecting link, then move rod to the right. Remove control rod through hole of connecting link, through eyebeam and tilt down 45°.

(7) Disconnect control tubes from mixing lever assembly bellcranks (15 and 16) and bellcranks (19 and 20).

(8) Remove bellcranks from or with supports as required.

(9) Remove either hydraulic cylinder assembly (24 or 29). (Refer to Chapter 6.)

b. Inspection – Cyclic Control Linkage.

NOTE

For bearing tolerances, refer to paragraph 9-16.

(1) Inspect the jackshaft to mixing lever tube assembly (12, figure 9-2) bearing for 0.012 inch radial and 0.030 inch axial maximum allowable wear.

(2) Inspect the bellcrank to servo valve tube assemblies (21 and 26) bearings for 0.012 inch radial and 0.030 axial maximum allowable wear.

(3) Maximum allowable elongation of a bushing or clevis hole in the control system is 0.003 inch.

(4) The maximum allowable lateral chuck on the jackshaft is 0.200 (see figure 9-3).

(5) The maximum allowable wear of bearing (5, figure 9-3) is 0.010 inch radial.

(6) Check balance spring (see view D, figure 9-2) for security, distortion and excessive length. Spring should be approximately 7.85 inches long, with a spring rate of 15.5 pounds, plus or minus 1.5 pounds, per inch.

(7) Inspect all cyclic control tubes for nicks, scratches and corrosion to the following criteria:

(a) At angles less than 45 degrees from the longitudinal, scratches and score marks shall not exceed 0.010 inch in depth.

(b) For angles greater than 45 degrees from the longitudinal scratches and score marks shall not exceed 0.005 inch in depth.

(c) Mechanical repair shall not exceed the original damage depth.

(d) Corrosion damage may be 0.005 inch in depth before repair and 0.010 inch in depth after repair.

(e) The width of repair areas at any section shall not exceed one third of the tube circumference.

(f) No damage to threads will be allowed before or after repair.

(g) Elongation of bolts and bushing holes shall not exceed 0.001 inch on the diameter. Score marks on the inside surface of the holes and bushings may be polished out for one fourth of the circumference of the hole, if the depth of the score is 0.002 inch or less.

(h) The area of repair to damage within a distance of one diameter from the edge of a hole shall not exceed 25 percent of the total area.

(i) The mechanical damage limits for exposed surfaces of clevis and rod end bearings is 0.010 inch in depth before and after repair. Corrosion damage limit is 0.005 inch before repair and 0.010 inch after repair.

c. Repair or Replacement – Cyclic Control Tubes.

NOTE

Check rigging and proper operation of system after removal and installation of any parts.

(1) Replace worn or rough bearings and damaged or unserviceable parts.

(2) Replace all parts that do not meet inspection requirements.

(3) Refer to Lubrication Chart, Chapter 2, before assembly.

d. Installation – Cyclic Control Linkage.

(1) Install bellcranks (5, 19, and 20, figure 9-2) if removed. Assemble and install mixing lever assembly. (See figure 9-7.)

(2) Install jackshaft (10, figure 9-2) if removed. Insert right and left tube assemblies, with bearing and supports in place, through access openings at sides of cabin lower skin. Slip ends of tubes on stub shafts of control arm (11). Align bolt holes with center arm pointing up and end arms down, and install bolts and tapered bushings (use taper reamers T-27872-2 and -11). Secure right and left bearing supports to each beam by installing four bolts with nuts and washers. Check for free operation.

(3) Install and attach all fixed-length control tubes. If adjustable control tubes are not correct length to be attached, leave one end free until controls are rigged.

(4) Install power cylinders. (Refer to Chapter 6.)

(5) Complete connection of linkage while rigging control system.

e. Adjustment – Cyclic Control System.

(1) Rig system with control sticks, jackshaft, bellcranks, and all nonadjustable tubes installed and connected.

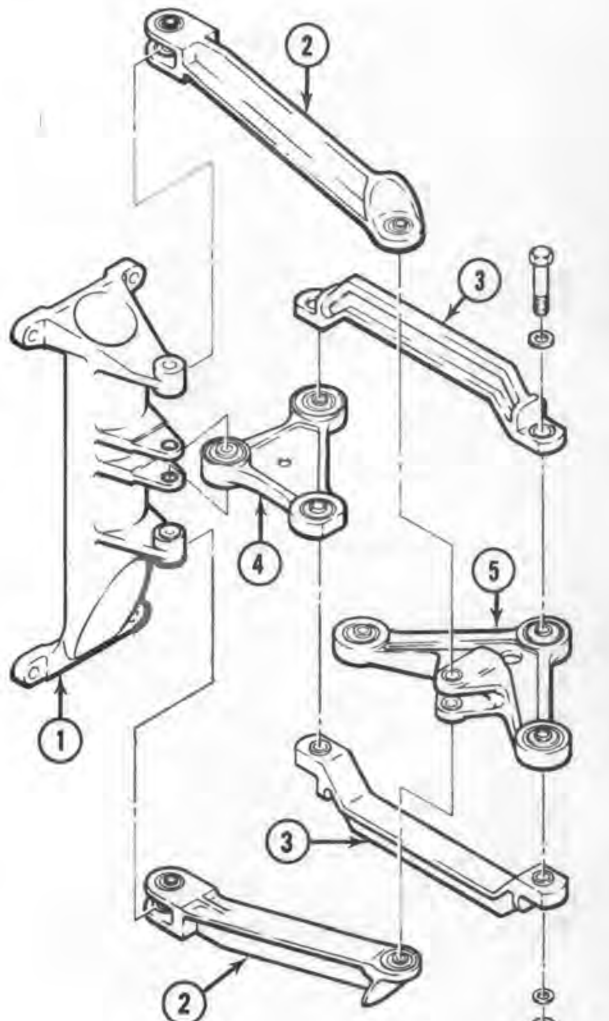
(2) Place and hold both cyclic control sticks in either extreme right or left lateral position against stops. Adjust tube (6, figure 9-2) to fit and connect.

(3) Place and hold both cyclic control sticks in extreme forward or extreme aft position against stops. Adjust tube (7) to fit and connect.

(4) Place and hold pilot's cyclic stick in extreme aft-left corner position, so that upper arm of bellcrank (20) is in its uppermost position. Bottom out piston up-travel at top of cylinder (24) and set lever of servo valve in up position. (See view A, figure 9-2.) Adjust tube (21) to fit, then shorten three full turns and attach to valve lever with bolt, nut, and washers. Install washer next to bolt head and also next to nut. Torque nut to 25 inch pounds maximum (bolt must turn freely). Install cotter pin.

(5) Place and hold pilot's cyclic stick in extreme aft-right corner position, and adjust tube (26) in same manner. Attach tube to valve lever and torque as outlined in step (4).

(6) Install T101330 cyclic stick fixture on copilot's control stick. (See view B, figure 9-2.)

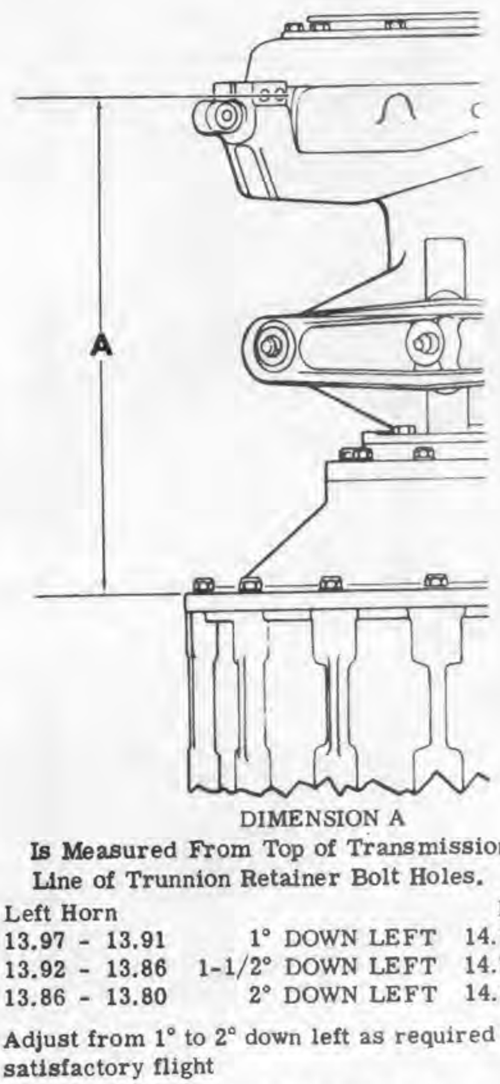


1. Support
2. Matched Links
3. Matched Links
4. Bellcrank
5. Bellcrank

Figure 9-7. Mixing lever assembly – cyclic controls

(7) Position swashplate according to dimensions within limits shown. (See figure 9-8.) With servo valve levers neutral, adjust control tubes (25 and 30, figure 9-2) to fit and connect. Use hydraulic power if available.

(8) Check arm of fore-aft magnetic brake for alignment of letter "F" opposite scribe mark on shaft and lateral magnetic brake arm for letter "L" opposite mark on shaft. (Refer to paragraph 9-11.)



DIMENSION A

Is Measured From Top of Transmission to Center Line of Trunnion Retainer Bolt Holes.

Left Horn		Right Horn
13.97 - 13.91	1° DOWN LEFT	14.19 - 14.13
13.92 - 13.86	1-1/2° DOWN LEFT	14.23 - 14.18
13.86 - 13.80	2° DOWN LEFT	14.30 - 14.24

Adjust from 1° to 2° down left as required for satisfactory flight

Personnel Hoist Rescue Missions Only

Left Horn		Right Horn
13.86 - 13.80	2° DOWN LEFT	14.30 - 14.24
13.80 - 13.74	2.5° DOWN LEFT	14.36 - 14.30

204001-33J
AV 054172

Figure 9-8. Swashplate setting dimensions

(9) Place arm of lateral magnetic brake at center of travel. With cyclic stick in neutral, adjust link on lateral force gradient (4) to fit and connect.

(10) Remove T101330 rigging fixture from control stick.

(11) Place and hold cyclic stick against forward stop. Place arm of fore-aft magnetic brake against aft stop. Adjust fore-aft force gradient (9) to fit. Extend clevis fitting 3-1/2 turns and connect.

(12) Check controls for full free travel before applying hydraulic pressure. Check controls for full free travel with hydraulic pressure applied.

(13) Check that balance spring (view D, figure 9-2) is hooked over NAS43D4-31 spacer on AN4-24A bolt installed through swashplate control horn. Hook lower end of spring in proper hole of bracket so that spring does not go slack when swashplate horn is at lowest position. Make final adjustment as required by flight test.

(14) Inspect complete cyclic controls system for security of safetying of parts.

9-11. Force Gradient Assembly.

Force gradient assemblies in fore-aft, lateral and directional linkages are alike except for attached clevis or link. Check that attaching linkage is correct for each location.

a. Removal – Force Gradient Assembly. (See figure 9-2.) Refer to paragraph 9-9, a. (3) and (4).

b. Adjustment – Force Gradient Assembly.

(1) Spring assembly (1, figure 9-9) will be compressed with 2.5 to 3.0 pounds force and secured by two nuts tightened to lock together.

(2) With spring assembly in housing (2), screw in cap (3) until all noticeable end play is eliminated. Lock-wire cap against turning either direction.

(3) Adjustment of clevis on shaft of fore-aft force gradient (9, figure 9-2) and link on lateral force gradient (4) will be completed during rigging of system.

c. Installation – Force Gradient Assembly. (See figure 9-2.) Refer to paragraph 9-11, step e. (3) and (4).

d. Inspection – Force Gradient.

(1) Inspect for preloading, and freedom of operation.

(2) Inspect for loose, missing . or improperly installed hardware.

(3) Inspect for bottoming at all control positions.

(4) Inspect shaft lock nuts for security and cap for correct safetying.

9-12. Magnetic Brake.

a. A magnetic brake used in conjunction with a force gradient assembly is mounted in each control element; the fore and aft cyclic, the lateral cyclic and the tail rotor pitch control.

b. All three assemblies are identical except for the position of the arm on the brake.

c. By positioning one of the letters "D", "L" or "F" relative to the brake shaft the brake may be used in either the D–irectional, L–ateral, or F–ore and aft control assembly.

d. Removal – Magnetic Brake.

(1) Disconnect electrical plug from brake body.

(2) Remove attachment bolt through force gradient and brake arm.

(3) Remove four bolts attaching brake body to structure.

e. Installation – Magnetic Brake.

(1) Mount brake arm on brake in appropriate position. Secure arm with retaining bolt. Position brake in place on structure and install mounting bolts.

(2) Rig the fore and aft cyclic, lateral cyclic, and tail rotor pitch control magnetic brakes as follows:

(a) Place arm of lateral magnetic brake at center of travel. With cyclic stick in neutral, adjust link on lateral force gradient (4, figure 9-2) to fit and connect.

(b) Place and hold cyclic stick against forward stop. Place arm of fore-aft magnetic brake against aft stop. Adjust fore-aft force gradient (9, figure 9-2) to fit. Extend clevis fitting 3-1/2 turns and connect.

(c) Place directional control arm at center of travel and with control pedals held in neutral, adjust force gradient tube to fit and connect.

(3) Attach force gradient assembly to brake arm with bolt, nut and washers. Install cotter pin in bolt. Attach and lock-wire electrical plug to brake body.

(4) Check flight controls for unobstructed full travel.

f. Inspection – Magnetic Brake.

(1) Check flight controls for unobstructed full travel.

(2) Check assembly for corrosion, unobstructed travel, cannon plug safetying.

(3) Check for loose, missing or improperly installed hardware.

9-13. Tail Rotor Control Pedals And Adjusters.

a. Two sets of control pedals, supported on a forward bulkhead, are connected under cabin floor to adjuster assemblies.

b. Adjusters are bellcrank assemblies, each having a knob above floor for manual adjustment of pedal position according to pilot's need.

c. Pedal sets are interconnected by a tube between adjuster bellcranks.

d. Force gradient and control linkage to power cylinder are connected to a bellcrank on pilot's adjuster. (See figure 9-4.)

e. Removal – Tail Rotor Control Pedals and Adjusters.

(1) Disconnect control tubes from pedal levers by removing bolts.

(2) Remove lower skin plate for access to inner side of bulkhead, and remove four bolts to detach pedal support from bulkhead. Lift out pedal and support assembly.

(3) Remove two bolts to detach and remove adjuster knob.

(4) Remove access plate from floor under seat.

(5) Disconnect pedal control tubes and interconnect tube from adjuster. For removal of right-hand adjuster, also disconnect control tube and force trim tube.

(6) Detach support of pedal adjuster from bulkhead by removing nuts and washers from four bolts. Lift adjuster out through floor access opening.

f. Inspection – Tail Rotor Control Pedals and Adjusters.

NOTE

For bearing tolerances, refer to paragraph 9-16.

(1) Inspect bearings for wear and roughness.

(2) Inspect parts for wear, elongated bolt holes, cracks, nicks and surface damage.

(3) Inspect sprocket and chain for excessive wear, rust and corrosion.

(4) Inspect clevis and bushing holes for excessive wear.

(5) Inspect rod ends for binding and excessive wear.

(6) Inspect for loose, missing or improperly installed hardware.

g. Repair or Replacement – Tail Rotor Control Pedals and Adjusters. Replace bearings and parts that fail to meet inspection requirements.

h. Installation – Tail Rotor Control Pedals and Adjusters.

(1) Apply a coat of zinc chromate putty (item 200, table 1-2) to mounting face of pedal support (1, figure 9-4). Observe TOP marking to position support on bulkhead. Secure support on four bolts installed from inner side of bulkhead, with aluminum alloy washers under heads and nuts.

(2) In similar manner, install adjuster assembly with support secured on aft side of Station 37 bulkhead.

(3) Connect control tubes to adjuster bellcranks and to pedal levers with bolts, washers, nuts and cotter pins. Tighten bolts at adjuster finger-tight plus one castellation.

(4) Install adjuster knob attached to floor by two bolts with washers. Before fully tightening bolts, check that knob is aligned to engage and release from adjuster shaft without binding.

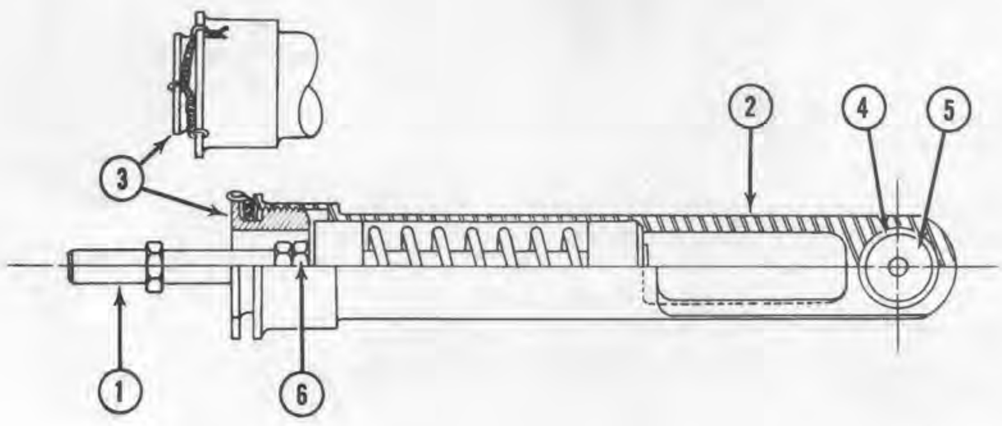
(5) Install opposite pedal and adjuster assemblies in same manner.

(6) Install interconnect tube connected to aft bellcrank arm of each adjuster by a bolt with washers, nut, and cotter pin.

(7) On pilot's adjuster, connect control tube on outer end of bellcrank arm extending to right side, and force trim tube at inboard hole on same arm, with bolts, washers, nuts, and cotter pins.

9-14. Tail Rotor Control Quadrant.

The tail rotor control quadrant (19, figure 9-4) is located in the upper forward section of the tail boom. The quadrant is utilized to interconnect the push-pull tubes and the tail rotor control cables.



1. Spring Assembly
2. Housing
3. Cap
4. Sleeve
5. Bearing
6. Nuts

Figure 9-9. Force gradient assembly

a. Removal – Tail Rotor Control Quadrant.

NOTE

With cables disconnected, quadrant and support with attached bellcrank can be removed for inspection or replacement.

(1) Disconnect links from arm of quadrant.

(2) Remove bolt attaching quadrant in supports. Remove quadrant.

(3) Disconnect control tube from bellcrank.

(4) Remove four bolts attaching upper support to structure.

(5) Remove upper support with attached bellcrank and links. Disassemble as required.

b. Inspection – Tail Rotor Control Quadrant.

NOTE

For bearing tolerances, refer to paragraph 9-16.

(1) Inspect bearings for wear and roughness.

(2) Inspect parts for wear, elongated bolt holes, cracks, nicks, surface damage, and corrosion.

c. Repair or Replacement – Tail Rotor Control Quadrant.

(1) Replace bearings and parts that fail to meet inspection requirements.

(2) Corrosion damage of parts must not exceed 25% of cross section and must affect less than 10% of the thickness or 0.040 inch depth. It must clear fillets and fastener holes or counterbores by 0.50 inch minimum. Corrosion exceeding above limits requires replacement of part.

(3) Repair corrosion by removing corrosion with a stiff bristle brush. Apply chrome-pickle solution for one minute. Rinse with fresh water.

d. Installation – Tail Rotor Control Quadrant.

(1) Position widest bearing of bellcrank in upper support and install bolt from top. Attach links to bellcrank arm in same manner.

(2) Position upper support under structural bracket and secure with four bolts.

(3) Position quadrant between upper and lower support and insert bolt from top. Check for 0.010 inch minimum clearance between quadrant and lower support. If necessary, change shim under lower support to obtain clearance within limit. Secure bolt with washer, nut and cotter pin.

(4) Align links on quadrant arm and install bolt.

(5) Connect control tube to bellcrank.

9-15. Tail Rotor Pitch Control Quill And Rod.

a. Tail rotor blade pitch control is accomplished by means of a control quill assembly mounted in right side of 90 degree gear box, with a control rod extending through hollow rotor drive shaft to a pitch control crosshead and links connected to tail rotor.

b. Control quill has a sprocket, actuated by a chain attached to control cables, with a worm thread engagement to control rod.

c. Rotation of sprocket is transmitted through rod as linear motion to crosshead and pitch change links.

d. Chain and sprocket are enclosed by a metal housing pan with a removable cover for access. (See figure 9-10.)

e. Removal – Tail Rotor Pitch Control Quill and Rod.

(1) Remove tail rotor pitch control crosshead assembly. (Refer to Chapter 8.) Be sure bearings and retaining nut are removed from pitch control rod.

(2) Cut lockwire and remove two bolts and cover (1, figure 9-10) from housing pan (4). Remove screw from bracket of pan.

(3) Remove three nuts, washers, and guard (2) from gear case studs.

(4) Open speed rigs to allow slack in control cables. Lift chain from sprocket. If chain is to be removed, detach ends from cables by removing bolts.

(5) Remove pan.

(6) Pull control quill (5) with packing (6) and control rod (7) out of gear case (8). Cover open port. Detach rod from quill by turning sprocket to disengage thread.

f. Inspection – Tail Rotor Pitch Control Quill and Rod.

(1) Inspect guard, cover and pan for cracks and damage.

(2) Inspect control rod for improper operation, binding, cracks, damaged threads or splines.

(3) Inspect chain for faulty operation or wear.

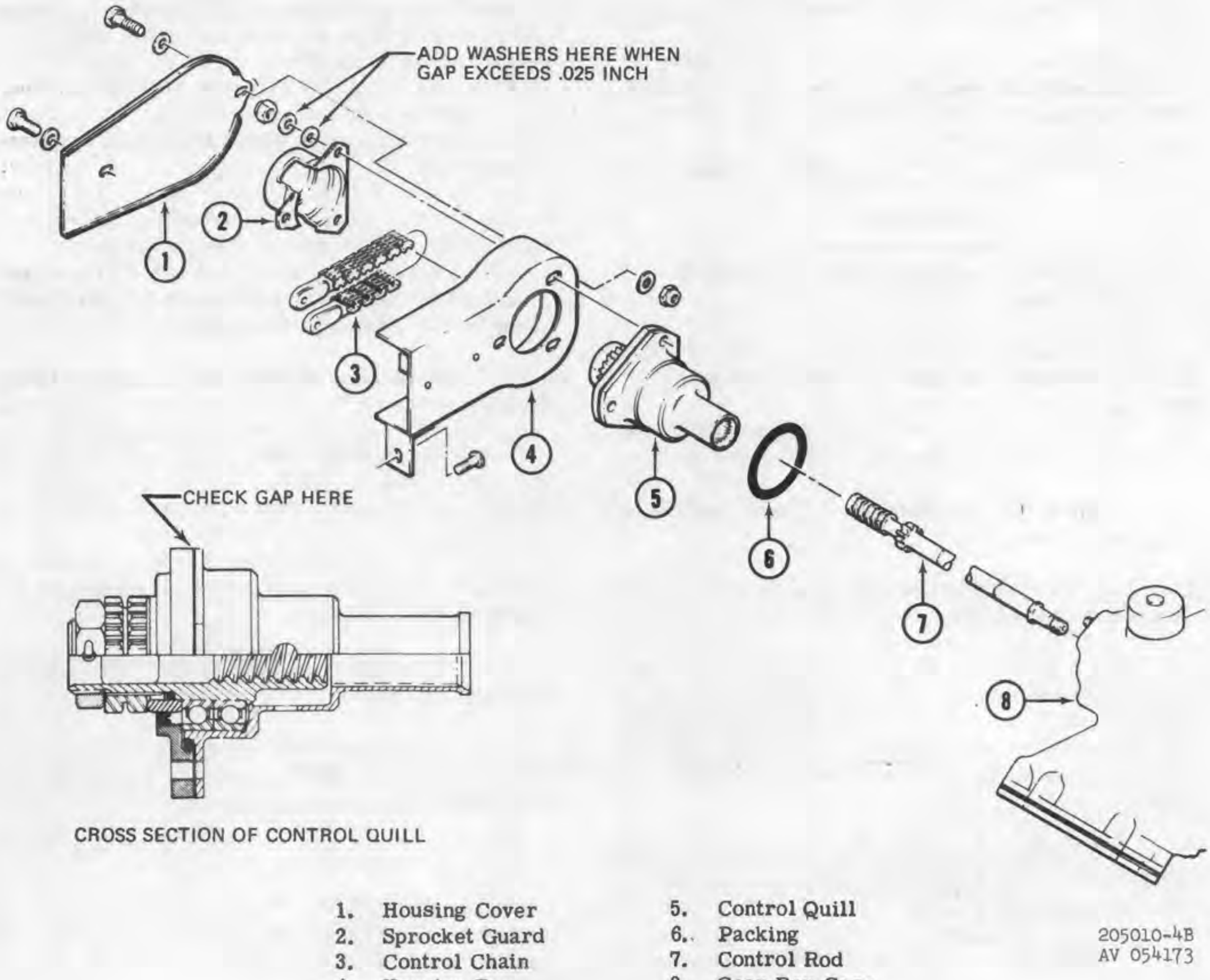
NOTE

Joint wear of control chain (3, figure 9-10) may be checked by placing chain under tension and measuring length of any 32 pitches. Maximum allowable length is 6-3/16 inches. If chain has been removed from helicopter, tension may be applied by suspending chain from one end and attaching 10 pound weight to opposite end.

(4) Inspect control quill for roughness, binding and unserviceable seals.

NOTE

Inspection of the tail rotor sprocket can be performed without removing sprocket from the helicopter. Gain access to sprocket by removing sprocket guard (2, figure 9-10).



1. Housing Cover
2. Sprocket Guard
3. Control Chain
4. Housing Pan
5. Control Quill
6. Packing
7. Control Rod
8. Gear Box Case

Figure 9-10. Tail rotor control and rod

(5) Lay a straight edge across top of sprocket teeth and determine if any space exists between the teeth and straight edge. During this inspection it may be noted that slight depressions are visible on the sprocket. This is caused by the chain links and should not be misconstrued as criteria for sprocket replacement. (Refer to figure 9-11.)

g. Repair or Replacement – Tail Rotor Pitch Control Quill and Rod.

(1) Replace guard, cover, or pan when cracked or damaged.

(2) Replace control rod for faulty operation or visible defects such as cracks, bending, and damaged threads or splines.

(3) Replace control chain when faulty operation or visible indications of excessive wear occur. When chain is replaced, replace sprocket on control quill as outlined in step (4).

CAUTION

Do not apply any lubricant on control chain.

(4) Replace sprocket if any space exists between sprocket teeth and straight edge. (See step f. (5).) To replace sprocket on control quill, proceed as follows:

NOTE

Tail rotor chain and sprocket shall be changed as a matched set.

(a) Remove cotter pin and retaining nut while holding sprocket carefully in padded jaws of suitable tool or vise.

(b) Remove and replace sprocket without separating other parts.

(c) Reinstall retaining nut on end of control nut. Tighten 100 to 300 inch-pounds and align cotter pin holes.

(d) Install cotter pin with spread ends parallel to face of sprocket and bent flat against hex face of retaining nut.

(5) Replace control quill when rough or binding in operation, or for oil leaks past internal seals. Replace packing on quill housing at installation.

h. Installation – Tail Rotor Control Quill and Rod.

(1) Insert control rod (7, figure 9-10) through inner end of control quill (5) with splines meshed. Turn sprocket to engage quill control nut on threads of rod. Place O-ring (6) on quill.

(2) Uncover port on right side of 90 degree gear box (8). Insert control rod carefully through rotor shaft and seat quill flanges over mounting studs.

(3) Place cover pan (4) on studs and secure temporarily with nuts and washers, and with screw through bracket on lower corner into matching plate nut of vertical fin.

(4) Install pitch change control head assembly as when installing tail rotor. (Refer to Chapter 8.)

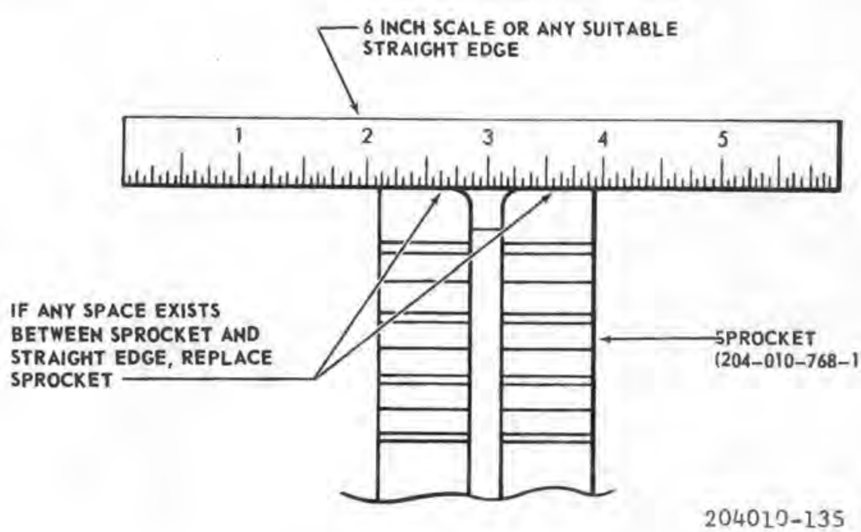


Figure 9-11. Sprocket inspection criteria

(5) Install and connect control chain (3) while rigging system. (Refer to paragraph 9-15, step i.)

(6) After rigging, install sprocket guard (2) on mounting studs, secured by nuts and washers. Check gap between flanges of quill housing and retainer. If gap is more than 0.025 but less than 0.040 inch, add one thin aluminum alloy washer between housing and retainer on each stud. If gap is more than 0.040 inch, add two thin aluminum alloy washers in the same manner. After installing, apply sealant (item 212, table 1-2) externally around joints at inner and outer sides of quill housing. (Refer to figure 9-10.)

(7) Install cover (1) secured by two bolts and lock-wire.

i. Inspection – Tail Rotor Control Head.

NOTE

Apply following procedure to determine amount of looseness between internal spline of tail rotor control head slider and rotor shaft spline and looseness in pitch change rod bearings and in pitch change threads.

(1) Mount a dial indicator on tail rotor shaft with indicator against crosshead as illustrated in figure 9-12.

(2) With left control pedal held full forward, manually test crosshead for radial play not to exceed 0.030 inch.

(3) With full right pedal, repeat check for radial play not to exceed 0.045 inch.

(4) With pedals held neutral, manually test for axial play (along shaft center line without radial motion) not to exceed 0.018 inch. Excessive axial play would indicate worn or loose pitch change rod bearings or worn pitch change threads.

9-16. Tail Rotor Control Cable Installation.

a. Tail rotor control cables are connected between a quadrant, mounted in front end of tail boom, and ends of a chain which actuates the tail rotor control quill and pitch change rod.

b. Left and right cables are each in two sections, connected by turnbuckles with speed rig type barrels which can be disconnected and reconnected without disturbing cable tension adjustment.

c. On YUH-1D, cable connectors are in tail boom near quadrant.

d. On UH-1D/H, cable connectors are on front of tail boom vertical fin under drive shaft access door.

e. Removal – Tail Rotor Control Cables.

(1) Cut lockwire and disconnect cables at speed rigs.

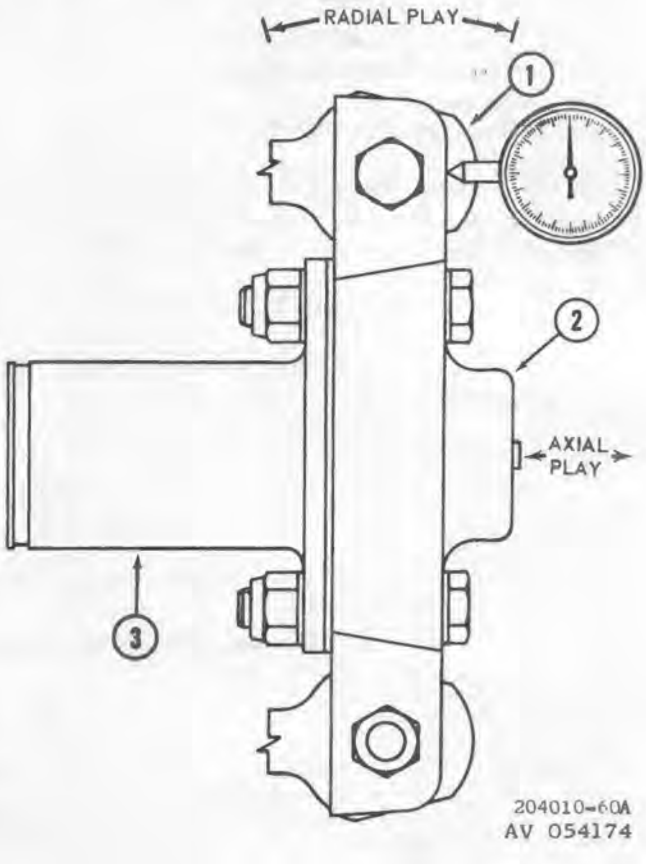
(2) Disconnect aft cables from pitch control chain by removing bolts.

(3) Disconnect forward cables from quadrant by removing clevis pins.

(4) Detach cables from pulleys by removing clevis pins or pulleys as necessary.

(5) Remove fairlead grommets from brackets to detach cables.

f. Inspection – Tail Rotor Cable Installation.



1. Pitch Change Link
2. Crosshead
3. Slider

Figure 9-12. Checking tail rotor pitch control for looseness

(1) Inspect cables for worn areas, broken wires and proper tension.

(2) Inspect pulleys for flat spots, damage, and tight or worn bearings.

(3) Inspect grommets for wear and signs of misalignment.

(4) Inspect supports for condition and security.

g. Repair or Replacement – Tail Rotor Cable Installation.

(1) Replace unserviceable cables, pulleys and grommets.

(2) Adjust cable tension in accordance with step i. (7).

h. Installation – Tail Rotor Control Cables.

(1) Install forward cables on quadrant with ball terminals seated in washers at forward ends of quadrant grooves. Install two clevis pins, secured by cotter pins, to retain cable ends. Install a clevis pin in bracket at each side of quadrant to act as cable guards.

(2) Thread cables through pulley supports and fairlead supports. Install grommets in supports. Install cable retaining clevis pins and pulleys in supports where necessary.

NOTE

If clevis pin is a loose fit in the pulley bracket, pro-seal (item 212, table 1-2) may be used on installation to provide a close fit and to prevent looseness.

(3) Install aft cables in same manner, with aft ends secured temporarily with safety wire.

(4) If supports have been disturbed, check alignment for cables through grommets and realign if necessary.

(5) Attach ends of aft cables to control chain with clevis bolts.

(6) Install pitch control chain on sprocket and adjust cable tension during rigging. (Refer to step i.) Secure speed rigs with lock-wire as follows:

(a) Run one end of wire through hole in aft portion of speed rig around pin and back out. (Refer to figure 9-4, view D.)

(b) Twist wires as shown in view D, until slot around shoulder of speed rig is reached.

(c) Separate wires and run in opposite directions around shoulder in slot.

(d) Twist wires together again on opposite side; clip wires, and push twisted ends against speed rig.

NOTE

Tail rotor chain and sprocket will be changed as a matched set.

i. Adjustment – Tail Rotor Controls.

NOTE

Accomplish rigging with hydraulic boost off.

(1) Adjust tail rotor pitch links to initial length, between bearing centers, to 5.4 inches with crosshead 204-011-711 (See figure 9-13.) Install all fixed tubes and links in tail rotor controls. (See figure 9-4.)

CAUTION

Ensure that correct P/N crosshead, pitch change links, and attaching hardware are used and that they are installed as illustrated in figure 9-13. If incorrect combinations of these parts are installed, interference and/or binding may occur.

NOTE

Length specified for pitch change links is an initial setting, and may be changed after operational checks for blade track or to obtain normal pedal positioning in autorotative landing and right sideward flight.

NOTE

Replace nuts on housing pan prior to applying full pedal.

(2) Apply and hold full left pedal on both pilot's and copilot's controls. Adjust interconnect tube to fit and connect.

(3) Install control tube ahead of quadrant, adjusted to provide minimum clearance at cable quadrant as illustrated for full left and full right pedal positions. (See view A, figure 9-4.)

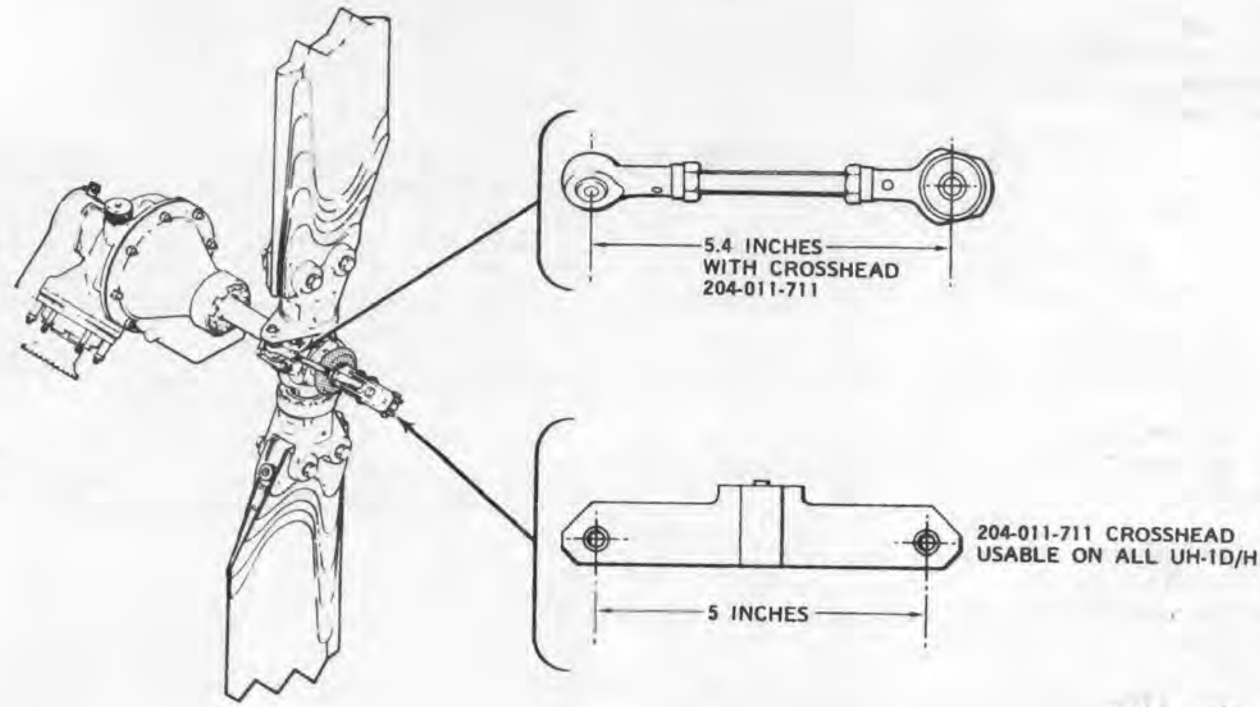


Figure 9-13. Tail rotor control crosshead and link usage

(4) At control assembly on right side of 90-degree gear box, remove housing cover, sprocket guard, upper cable speed rig, and chain from sprocket. Check that sprocket guard nuts and washers are reinstalled. Bottom out control quill by turning sprocket clockwise to end of travel.

(5) Mark any convenient tooth of sprocket with grease pencil, and place a reference mark on cover pan next to marked tooth. (See view B, figure 9-4.)

(6) With sprocket bottomed clockwise, and left pedal held against stop, apply sufficient tension on lower cable to take out servo cylinder control valve motion. Install chain over sprocket and connect upper speed rig.

(7) Adjust cable tension at 40 to 50 pounds, maintaining sprocket position.

(8) Actuate control pedals through full travel and recheck sprocket tooth position to be 2-1/2 to 3-1/2 teeth off of bottom with full left pedal applied.

(9) Place and hold right pedal full forward. Mark sprocket tooth opposite reference mark.

(10) Pull lower chain to rotate sprocket four or five teeth counterclockwise. At this position, check that splines of pitch change slider and tail rotor shaft are securely engaged.

(11) At full left pedal, without hydraulic power, check that sprocket is 2-1/2 to 3-1/2 teeth from bottom position as shown by reference mark.

NOTE

If hydraulic power is available, check full left pedal sprocket position with "boost on" to be 1/2 to 1-1/2 teeth from bottom by observing relation of sprocket and index mark.

(12) Install guard and cover over control quill. (Refer to paragraph 9-15., step i.) Secure cable speed rigs with lockwire.

(13) Be sure magnetic brake has arm located properly, with "D" mark (for directional) on arm aligned to scribe mark on shaft. With arm at center of travel and with control pedals held in neutral, adjust force gradient tube to fit and connect.

9-17. Synchronized Elevator Controls.

A synchronized elevator, mounted near aft end of tail boom, is connected to cyclic control system at aft side of swashplate by a linkage of push-pull tubes and bellcranks. (See figure 9-5.)

a. Adjustment – Synchronized Elevator.

(1) Accomplish rigging after installing all bellcranks and nonadjustable control tubes (1, 7, and 11, figure 9-5).

(2) Install T101330 rigging fixture on copilot's cyclic control stick (View B, figure 9-2).

(3) With cylinder control valves centered, and idler arm (4, figure 9-5, view A) parallel to longitudinal axis, adjust tube (3) to fit and connect.

(4) Maintain position of idler arm. Position bellcrank (8) so that center of bolt head is 2.6 inches from bulkhead as illustrated. (See view B, figure 9-5.) Adjust tube (5) to fit and connect.

(5) Check that tube (9) is disconnected from idler arm (10).

(6) Set right elevator so that chord line passes through rigging rivet "P" for maximum elevator nosedown position. (See view C.) Adjust tube (13) to minimum length that will reach bellcrank (12) and connect. Tube will be in line with output arm and pivot of bellcrank. (See view D.)

(7) Remove T101330 fixture from copilot's cyclic stick. Place and hold pilot's cyclic stick full forward.

(8) Set right elevator chord line 0.50 to 0.75 inch below rivet "R" for full forward cyclic stick position. (See view C.) Aft arm of bellcrank (12) must be above horizontal. With valves centered in both cyclic cylinders, adjust tube (9) to fit and connect.

(9) Place and hold pilot's cyclic stick full aft. Check right elevator chord line for alignment to rigging rivet "S" within ±0.400 inch. (See view C.)

(10) Check system for freedom of operation and full travel.

(11) With hydraulic power on, place pilot's stick full forward. Check alignment of right elevator chord line of rigging rivet "R". If necessary, readjust tube (9) only.

b. Inspection – Synchronized Elevator Controls.

(1) Remove tail boom access doors on underside of tail boom to gain access to synchronized elevator controls.

(2) Visually inspect bellcrank assembly (1, figure 9-14) located forward of elevator. Correct installation is with longest leg up when controls are connected.

NOTE

For bearing tolerances in the elevator, refer to paragraph 9-18.

(3) With one man holding elevator (2), disconnect tube assembly (3) at elevator pitch horn (4) and bellcrank (1). Allow elevator to move to trailing edge down position.

(4) Disconnect tube assembly (5) at swashplate synchronized elevator trunnion (6).

(5) Inspect for freedom of movement, binding, scraping or chattering of the synchronized elevator control linkage by lifting and lowering tube assembly (5).

(6) If binding, chattering or noticeable looseness of linkage is detected, isolate the source. This can be accomplished by placing finger tips adjacent to a suspected area, or by audible squeaks or chatters being omitted while moving the synchronized elevator control linkage.

(7) Inspect tube assembly (3) for nicks, mars or elongated rivet holes in the area of rivets and for bonding separation between insert and tube.

NOTE

Inserts are attached to tube with rivets and adhesive (item 205, table 1-2).

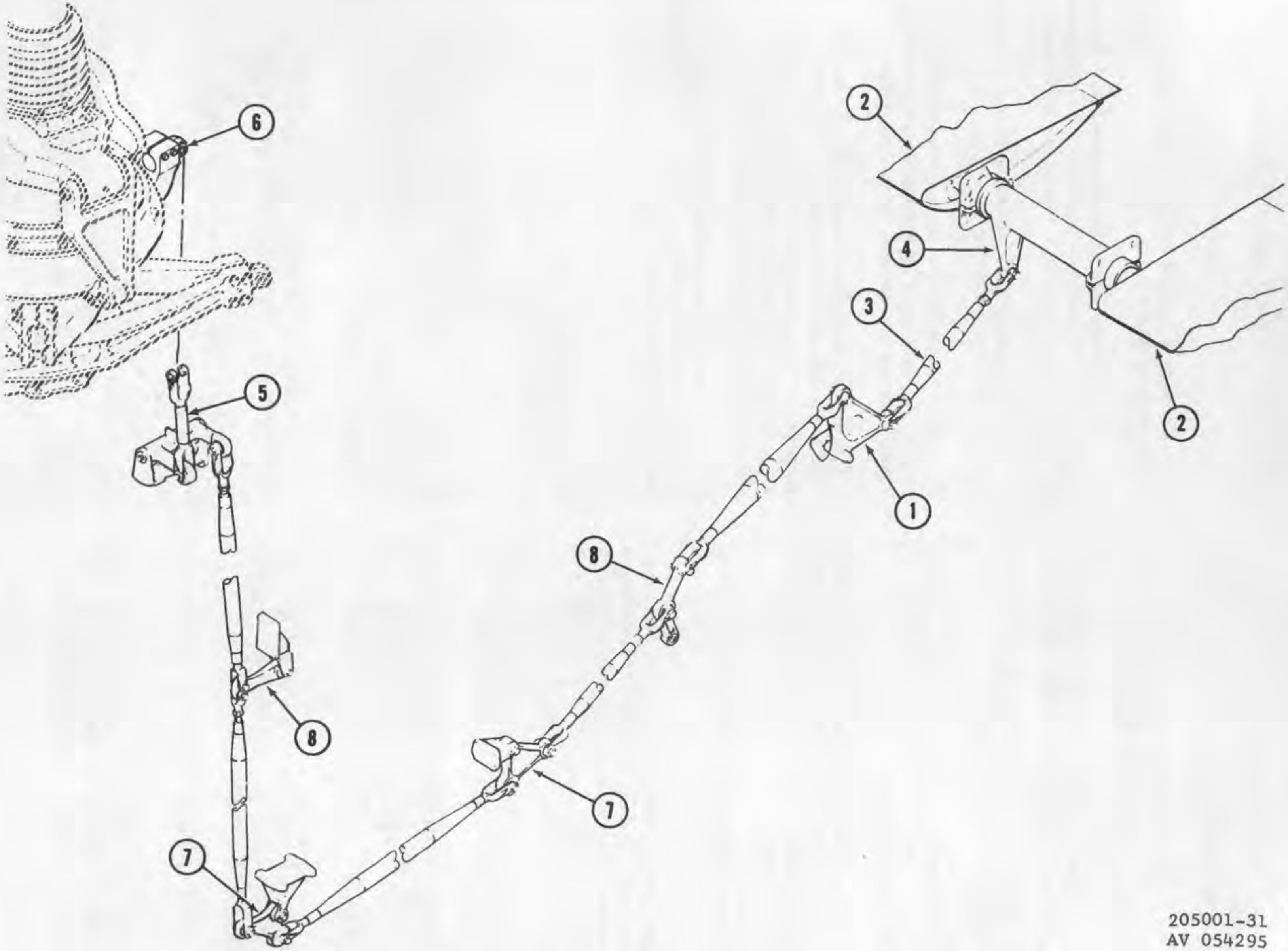
(8) Tube assemblies having rivet holes elongated and obvious bonding separation, as evidenced by looseness, will be replaced. Inspect tubes for nicks, cracks, distortion, corrosion, binding and loose, missing or improperly installed hardware. Tubes must not be bent or marred beyond limits specified in Chapter 8.

(9) Inspect bellcranks (1 and 7) and idlers (8) for damage, corrosion and smooth operation of bearings.

(10) Inspect clevis and bushing holes for excessive wear.

(11) At adjustable clevis end of tube assembly (3) inspect insert for cracks at 0.125 inch radius undercut between threads on insert and tube attached point with dye penetrant. Remove clevis from tube and inspect threads with dye penetrant.

(12) If evidence of cracks is found as a result of the inspection outlined in step (11) above, replace complete tube assembly (3).



205001-31
AV 054295

1. Bellcrank Assembly
2. Elevator
3. Tube Assembly
4. Elevator Horn
5. Tube Assembly
6. Swashplate Elevator Trunnion
7. Bellcranks
8. Idlers

Figure 9-14. Synchronized elevator control inspection diagram

(13) Connect tube assembly (5) to swashplate synchronized elevator trunnion (6) with bolt, washers, nut and cotter pin.

NOTE

Bellcrank assembly (1) and tube assembly (3) are color coded to facilitate proper installation.

(14) Move synchronized elevator (2) to normal position and connect adjustable end of tube assembly (3) to elevator pitch horn (4) with bolt, washers, nut and cotter pin.

(15) Rig synchronized elevator controls. (Refer to paragraph 9-17., step a.)

9-18. Bearing Replacement.

The following instructions contain bearing replacement information on the bellcranks, levers, and supports of the flight control system. (See figure 9-15.) Replacement is limited to bearings that are retained by a ring staked sleeve and bearings that do not require staking. Figure 9-15 illustrates each assembly in numerical (part number) sequence and provides sleeve diameter requirements. Each detail is coded to footnotes located on the last page of the illustration. The footnotes provide specific information on each assembly and must be used in conjunction with the following instructions.

a. Bearing removal.

(1) Place bearing on a suitable support having clearance for bearing.

(2) Apply pressure to OD of bearing and remove bearing from housing.

(3) Remove sleeve from housing.

b. Inspect housing by method specified in note 1, figure 9-15.

c. Clean aged primer from housing bore. Clean bore with naphtha (item 304, table 1-2).

d. Inspect chamfered edge of bearing bore hole each side to depth and degree specified in figure 9-15.

e. Remove any visible burrs on replacement sleeve with 320 grit or finer sandpaper. Chamfer sleeve both ends, 0.005 inch x 45 degrees maximum.

f. If required, ream sleeve to dimension shown on figure 9-15, with a surface finish of 63 RMS. Clean sleeve thoroughly with naphtha (item 304, table 1-2).

CAUTION

Refer to step g. for applications requiring zinc chromate primer and to step h. and i. for sealant application. Do not allow primer or sealant to contaminate bearings.

g. Apply wet zinc chromate primer (item 109, table 1-2) to sleeve OD and housing bore as required by figure 9-15. Press sleeve into housing with equal projection on each side. Apply wet primer to sleeve ID and bearing OD and install bearing, centered equally from each end.

h. Clean housing bore, sleeve and bearing OD with naphtha (item 304, table 1-2). Apply Locquic primer (item 110, table 1-2) to sleeve OD and housing bore. Allow three to five minutes drying and apply Loctite sealant (grade as specified by figure 9-15) sparingly to sleeve and bore. Install sleeve and check for equal projection each side. Sealant cure time is 10 to 40 minutes.

CAUTION

Do not allow sealant to contaminate bearing.

i. Apply Locquic primer (item 110, table 1-2) to ID of sleeve and OD of bearing. Allow three to five minutes drying and apply Loctite sealant (grade as specified by figure 9-15) to bearing OD and sleeve ID. Install bearing, centered equally from each end. After bearing is centered, apply additional drops of sealant to parting line between bearing and sleeve.

CAUTION

Staking operation should be performed within 30 minutes after sealant application. Do not allow sealant to cure before staking.

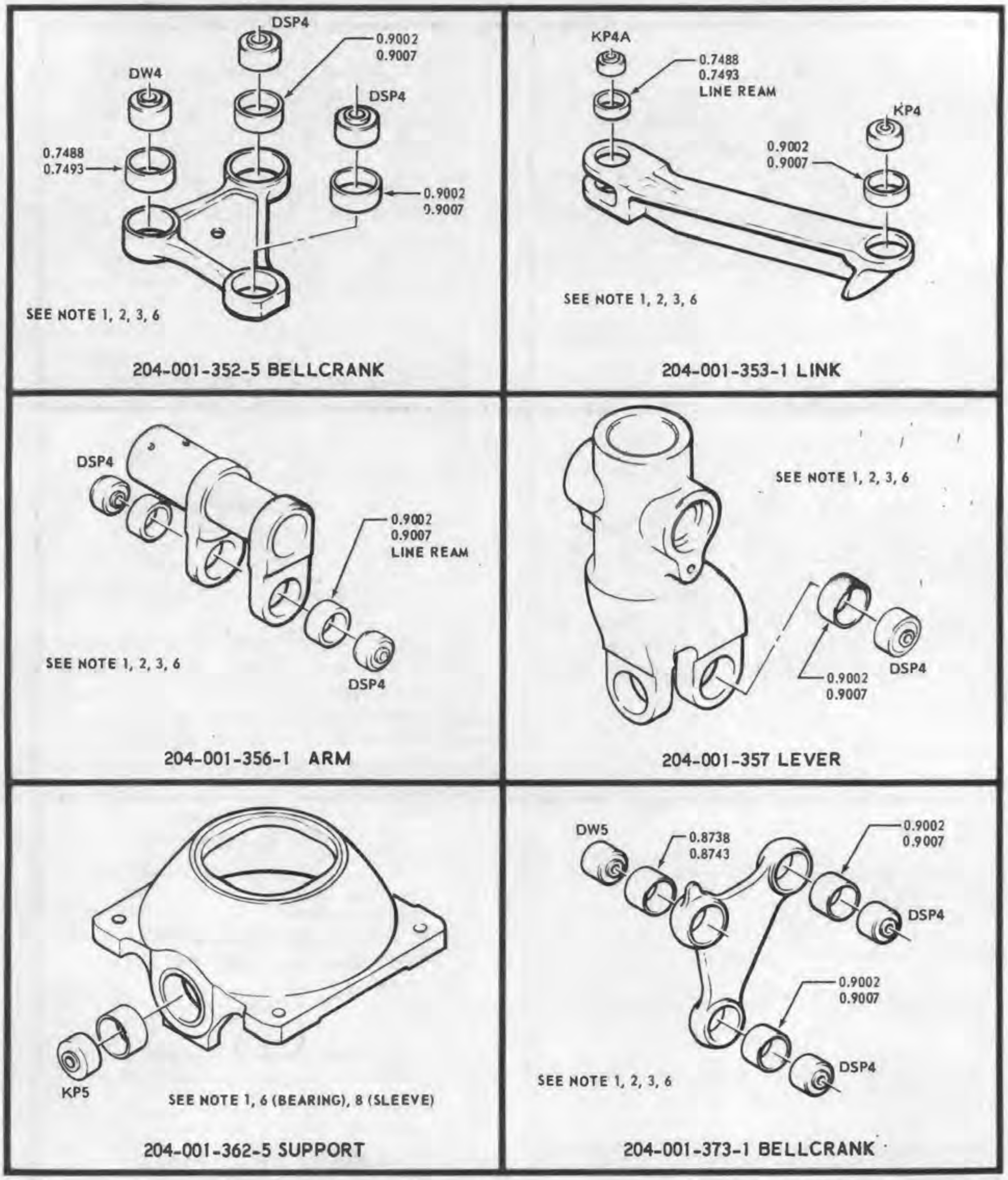
NOTE

Select a staking tool to accomplish a ring stake as shown in figure 9-15. The tool shall be so designed to have a 90 degree ring stake, using a ring radius equal to the retaining hole plus 1/2 the thickness of the sleeve, within plus or minus 0.0025 inch tolerance.

j. Ring stake sleeve both sides in accordance with figure 9-15.

k. Check bearing for freedom of movement after curing of sealant. Check that bearing is true to surface.

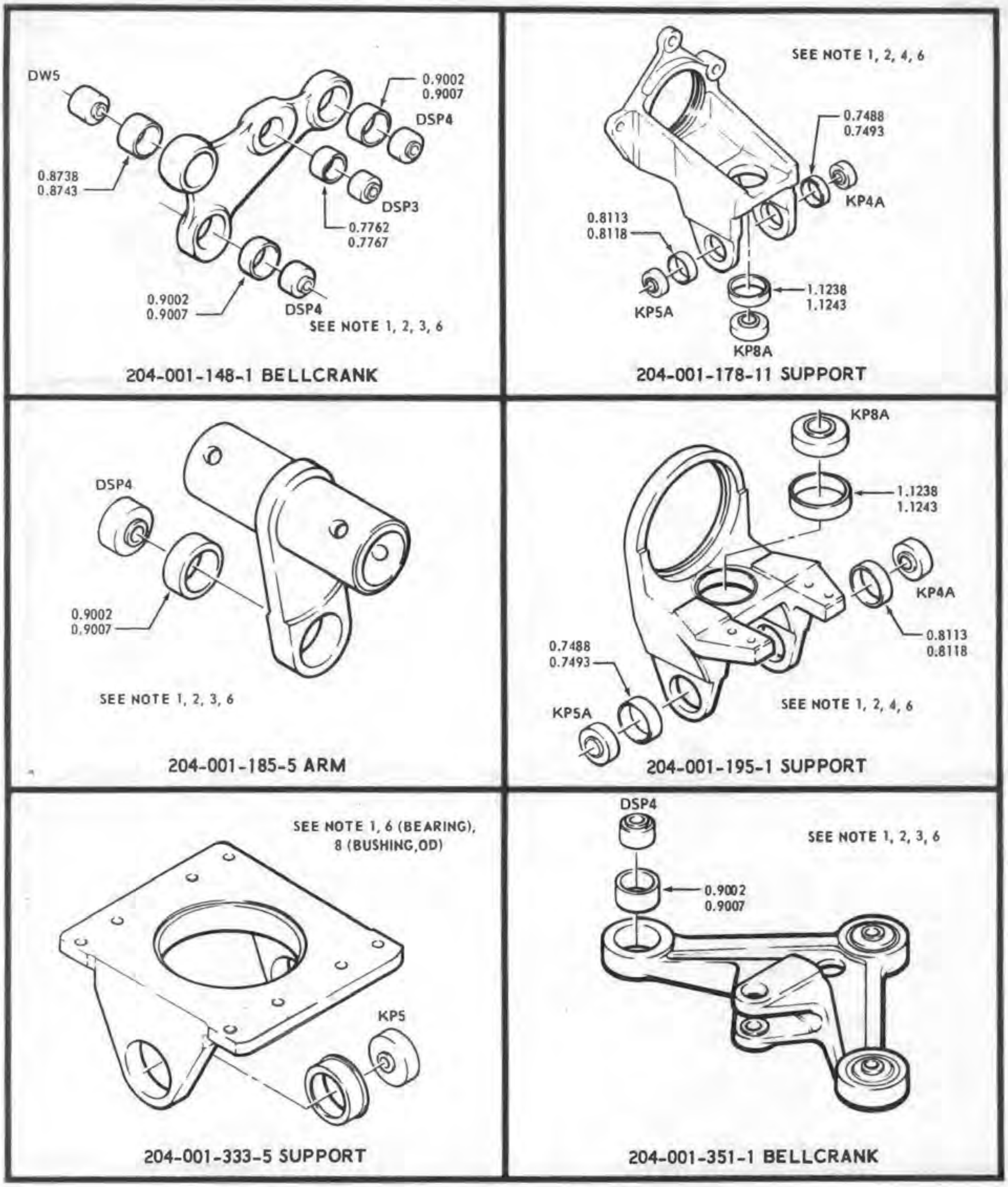
l. Inspect housing by fluorescent penetrant per MIL-I-6866.



KP 4	Bearing	Radial 0.006 Axial 0.030
KP 5	Bearing	Radial 0.006 Axial 0.030
KP4A	Bearing	Radial 0.006 Axial 0.030
DW 4	Bearing	Radial 0.006 Axial 0.030
DW 5	Bearing	Radial 0.006 Axial 0.030
DSP 4	Bearing	Radial 0.006 Axial 0.030

204001-88-2

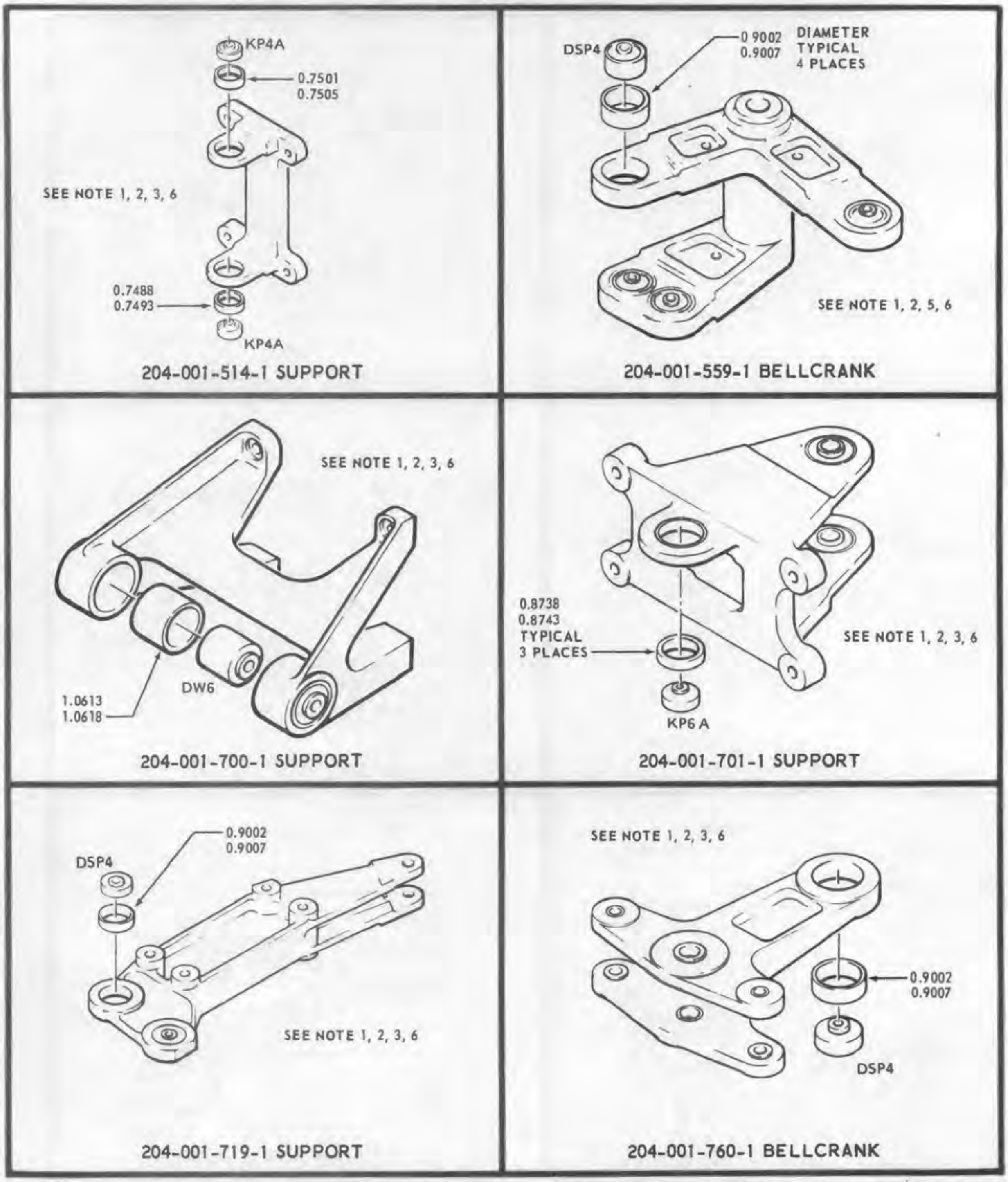
Figure 9-15. Bearing replacement (Sheet 1 of 7)



DW 5	Bearing	Radial 0.006 Axial 0.030
DSP 3	Bearing	Radial 0.006 Axial 0.030
DSP 4	Bearing	Radial 0.006 Axial 0.030
KP 5	Bearing	Radial 0.006 Axial 0.030
KP4A	Bearing	Radial 0.006 Axial 0.030
KP5A	Bearing	Radial 0.006 Axial 0.030
KP8A	Bearing	Radial 0.007 Axial 0.030

204001-88-1

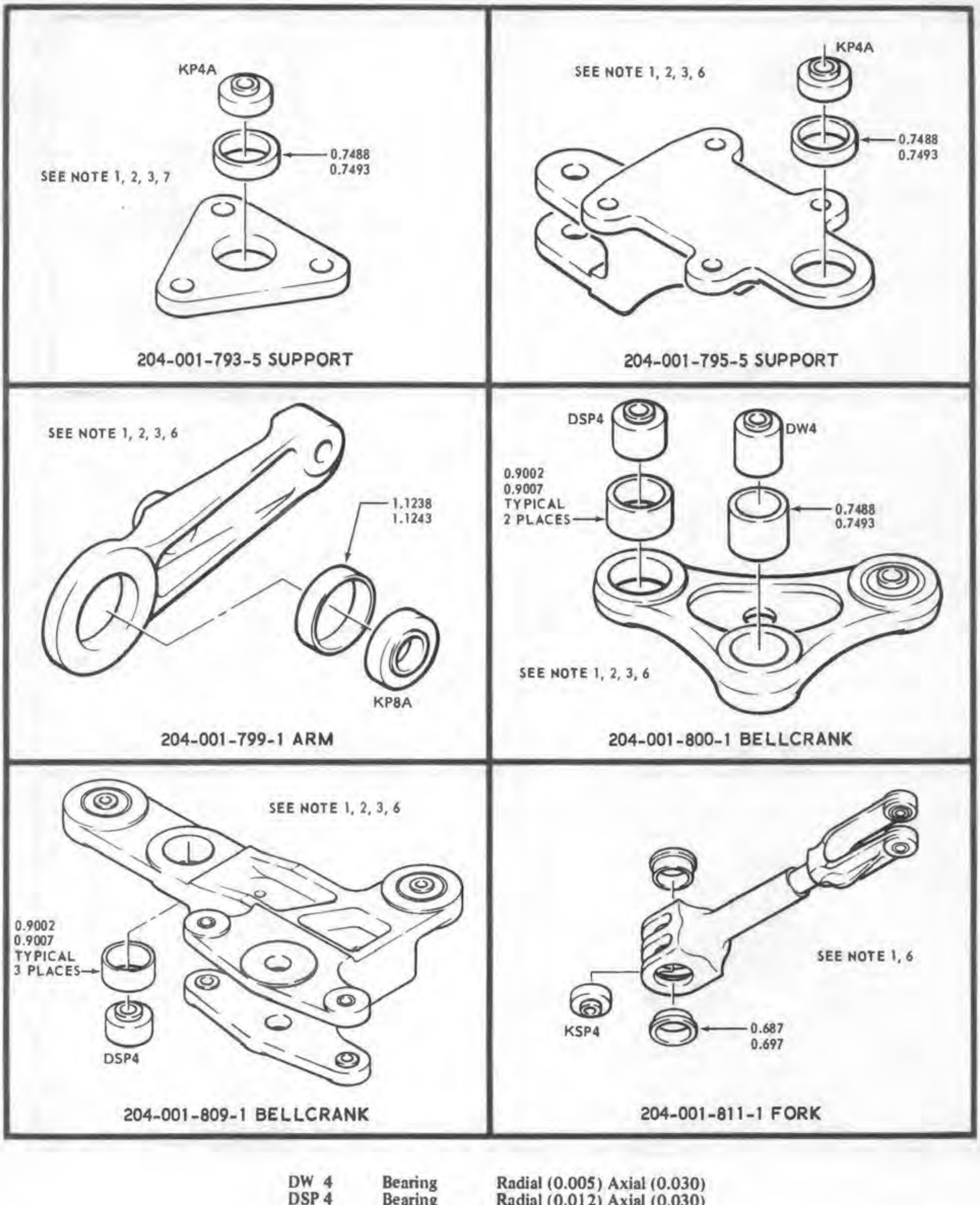
Figure 9-15. Bearing replacement (Sheet 2 of 7)



DSP 4	Bearing	Radial (0.012) Axial (0.030)
KP4A	Bearing	Radial (0.005) Axial (0.030)
DW 6	Bearing	Radial (0.005) Axial (0.030)
KP6A	Bearing	Radial (0.005) Axial (0.030)

204001-88-3

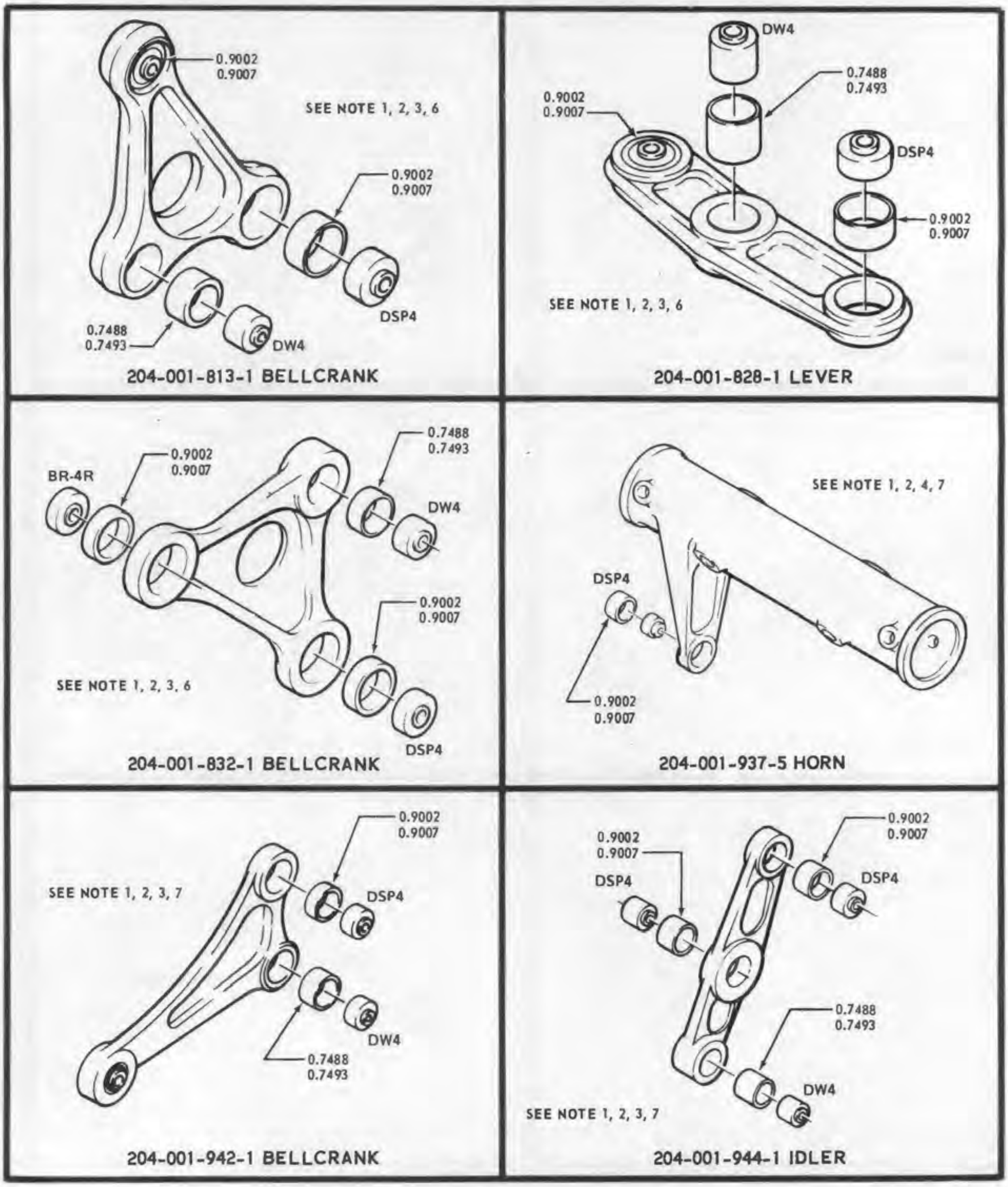
Figure 9-15. Bearing replacement (Sheet 3 of 7)



DW 4	Bearing	Radial (0.005) Axial (0.030)
DSP 4	Bearing	Radial (0.012) Axial (0.030)
KP4A	Bearing	Radial (0.005) Axial (0.030)
KSP 4	Bearing	Radial (0.012) Axial (0.045)
KP8A	Bearing	Radial (0.005) Axial (0.030)

204001-88-4

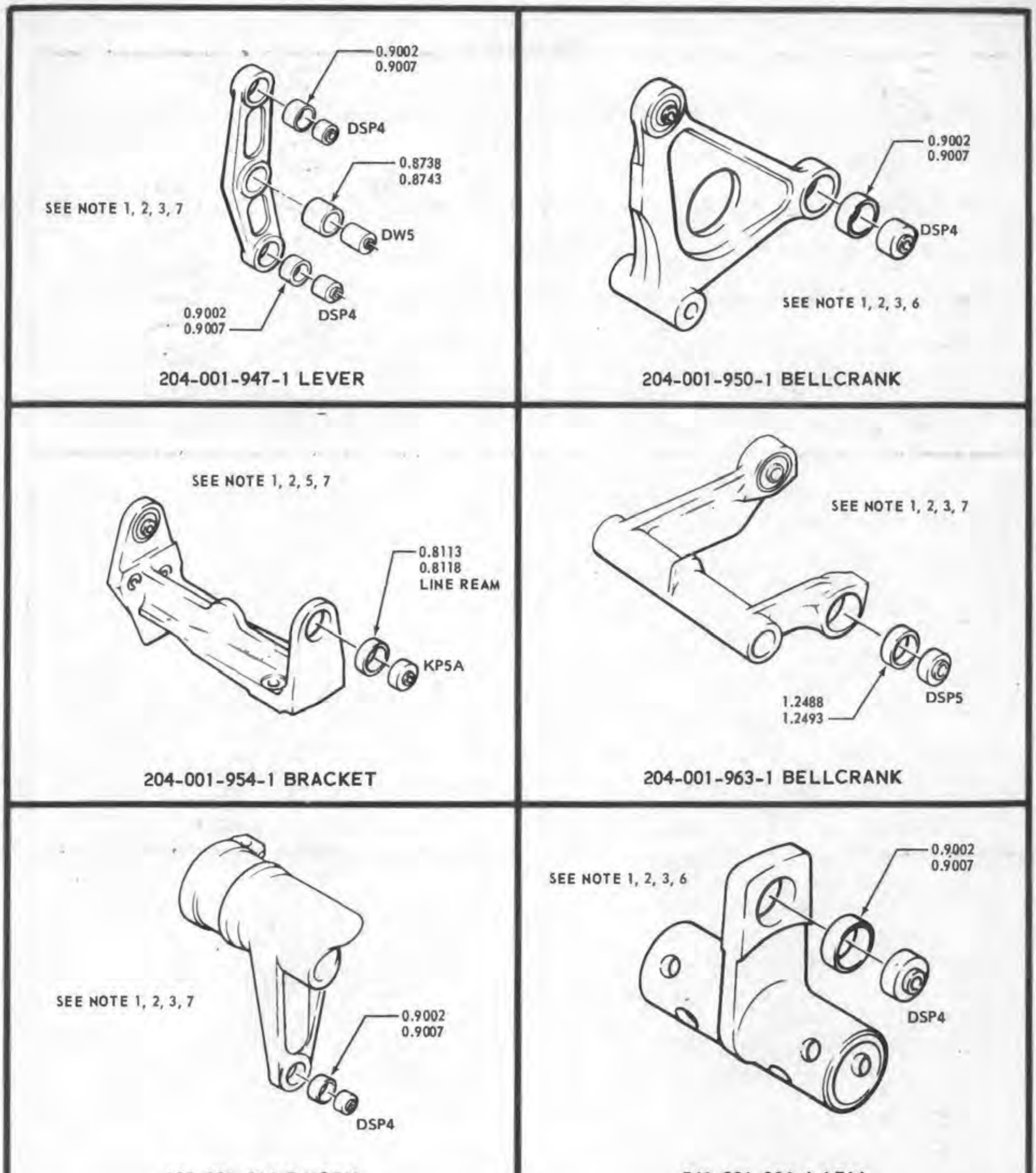
Figure 9-15. Bearing replacement (Sheet 4 of 7)



DW 4	Bearing	Radial (0.005) Axial (0.030)
DSP 4	Bearing	Radial (0.012) Axial (0.030)
BR-4R	Bearing	Radial (0.012) Axial (0.030)

204001-88-5

Figure 9-15. Bearing replacement (Sheet 5 of 7)



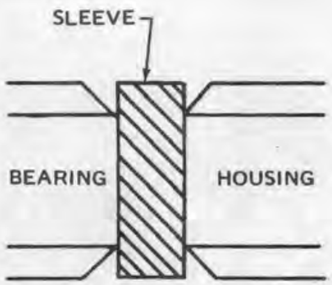
DSP 4	Bearing	Radial (0.012) Axial (0.030)
DW 5	Bearing	Radial (0.005) Axial (0.030)
DSP 5	Bearing	Radial (0.012) Axial (0.030)
KP5A	Bearing	Radial (0.005) Axial (0.030)

204001-88-6

Figure 9-15. Bearing replacement (Sheet 6 of 7)

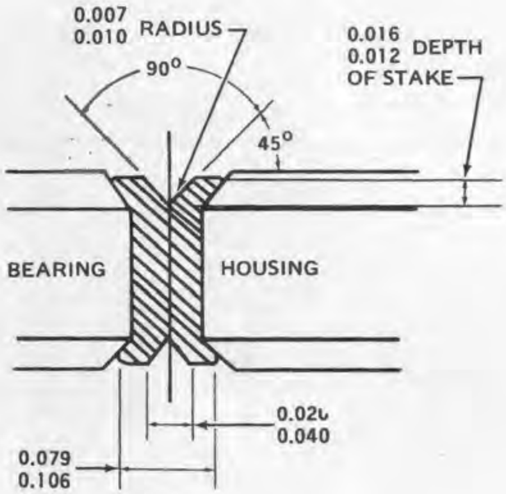
Notes

1. Fluorescent penetrant inspect housing per MIL-I-6866 after bearing removal and installation.
2. Ring stake sleeve both sides.
3. Chamfer 0.030 inch depth x 45 degrees each side of hole in housing.
4. Chamfer 0.032 inch depth x 45 degrees each side of hole in housing.
5. Chamfer 0.025 inch depth x 45 degrees each side of hole in housing.
6. Coat sleeve ID and OD, bearing OD, and housing bore with wet zinc chromate primer (item 109, table 1-2) during assembly.
7. Retain sleeve and bearing with sealant, grade CV (item 201, table 1-2) and locquic primer, grade T (item 217, table 1-2).
8. Retain sleeve and bearing with sealant, grade AA (item 216, table 1-2) and locquic primer, grade T (item 217, table 1-2).



BEFORE STAKING

TYPICAL RING STAKE
UTILIZING SLEEVE.
CROSS SECTIONAL VIEW



AFTER STAKING OF
ALUMINUM SLEEVE

CROSS SECTIONAL VIEW.
ALL DIMENSIONS TYPICAL

204001-88-7A

Figure 9-15. Bearing replacement (Sheet 7 of 7)

CHAPTER 10

INSTRUMENTS

Section I. INTRODUCTION

10-1. General.

10-2. This chapter provides the instructions and information required by organizational maintenance personnel to perform maintenance on UH-1D/H helicopter instruments. All flight, navigation, engine and miscellaneous instruments are mounted in a panel attached to the top forward side of pedestal.

NOTE

Additional illustrations, pertaining to the information found in the following sections, are contained in TM 55-1520-210-10.

NOTE

For compartment location see figure 12-1. For equipment location see figure 12-2. See figures 13-10 through 13-39 for systems diagrams, Tables 13-1 through 13-4 for equipment listing. Table 13-5 for connector replacement chart, and figures 13-40 through 13-49 for wiring diagrams of ships prior to 65-9565.

10-3. Instrument Panel.

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, washer, 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. Inspect for cracks and loose, missing or improperly installed hardware. Inspect compass correction cards, placards, and decals for legibility. Inspect shock mounts and vibration dampers for sagging, deterioration, cracks and permanent set. Inspect rheostats and switches for missing and loose knobs.

10-4. Instruments.

a. Removal. Remove any instrument from panel, by the following general procedure:

(1) Be sure all electrical power is OFF.

(2) 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.

(3) Protect ends of electrical leads, and cap open piping and openings on instrument.

NOTE

On UH-1D/H Helicopters, serial No. 66-746 and subsequent; the MS28042 clamp will be used to mount certain round instruments. 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.

(4) Remove mounting screws or loosen mounting clamp screw. Remove instrument.

b. Cleaning. Clean panel and instrument cover glasses with a suitable soft, lint-free cloth.

c. Inspection.

(1) Inspect for loose, missing or improperly installed hardware. Inspect gage lens for cleanliness, looseness, cracked glass or slippage.

(2) Inspect for legibility of range markings.

(3) Inspect for faulty decals.

(4) Inspect instrument lights for defective bulbs.

d. Repair or Replacement. Replace any missing or damaged limits or index markings on cover glasses of instruments. Also replace any required decals which are not clearly legible. Replace any instrument if cover glass is loose or broken, or when found to be unserviceable.

e. Installation. Install any instrument in panel by the following general procedure:

(1) Check instrument for correct markings on cover glass.

NOTE

On UH-1D/H Helicopters, serial No. 66-746 and subsequent; the MS28042 clamp will be used to mount certain round instruments. The installation technique required to insure 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.

(2) Position instrument in panel. Install mounting screws or tighten screw of mounting clamp.

(3) Remove protective caps or covers as necessary. Connect electrical leads and instrument piping.

(4) Check operation of instrument.

f. Operational Check. Wiring diagrams and schematics shall be utilized in accomplishing the functional tests of electrical circuits and components. Tests shall be conducted after installation, repair or replacement of equipment.

Section II. FLIGHT INSTRUMENTS

10-5. Description.

The flight instruments include altimeter airspeed indicator, pitot system, turn and slip indicator, attitude indicators (pilot and co-pilot), vertical velocity indicator, and clock.

10-6. Altimeter.

The altimeter is vented through piping to static pressure ports of pitot-atmospheric pressure. An external adjustment knob is provided to make compensation for variations of prevailing barometric pressure. See figure 10-1.

a. Troubleshooting. Perform necessary checks to isolate trouble.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Incorrect reading	Leak in static pressure line	Correct leak
	Clogged static vent port or piping	Clean vent port or piping
	Instrument defective	Replace instrument

b. Maintenance. (Refer to paragraph 10-4.)

10-7. Airspeed Indicator.

The airspeed indicator is a standard pitot-static instrument. The single-scale indicator provides airspeed indication in knots by measuring differences between impact air pressure from pitot tube and pressure from static vents. The pitot tube, which has a heating element for icing conditions, is located on forward left side of cabin nose, or top right hand side of cabin roof. Static air pressure vents are located just forward of each crew door, with piping to altimeters, vertical velocity indicators, and airspeed indicators. Helicopters having pitot tube installed in roof have static port incorporated into pitot head. See figure 10-1.

NOTE

Pitot tube mounted on cabin roof effective on UH-1D/H helicopters Serial No. 66-746 through 66-1210, 66-16000 through 66-17144 and 66-8574 through 66-8577, 67-17145 through 67-17312.

a. Troubleshooting. Perform checks as necessary to isolate trouble.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Pointer fails to respond	Pressure line not connected	Connect line
	Lines clogged by water or dirt	Disconnect and blow lines clear
Pointer indicates incorrectly	Defective or leaking indicator	Replace indicator
	Leak in line	Repair or replace line

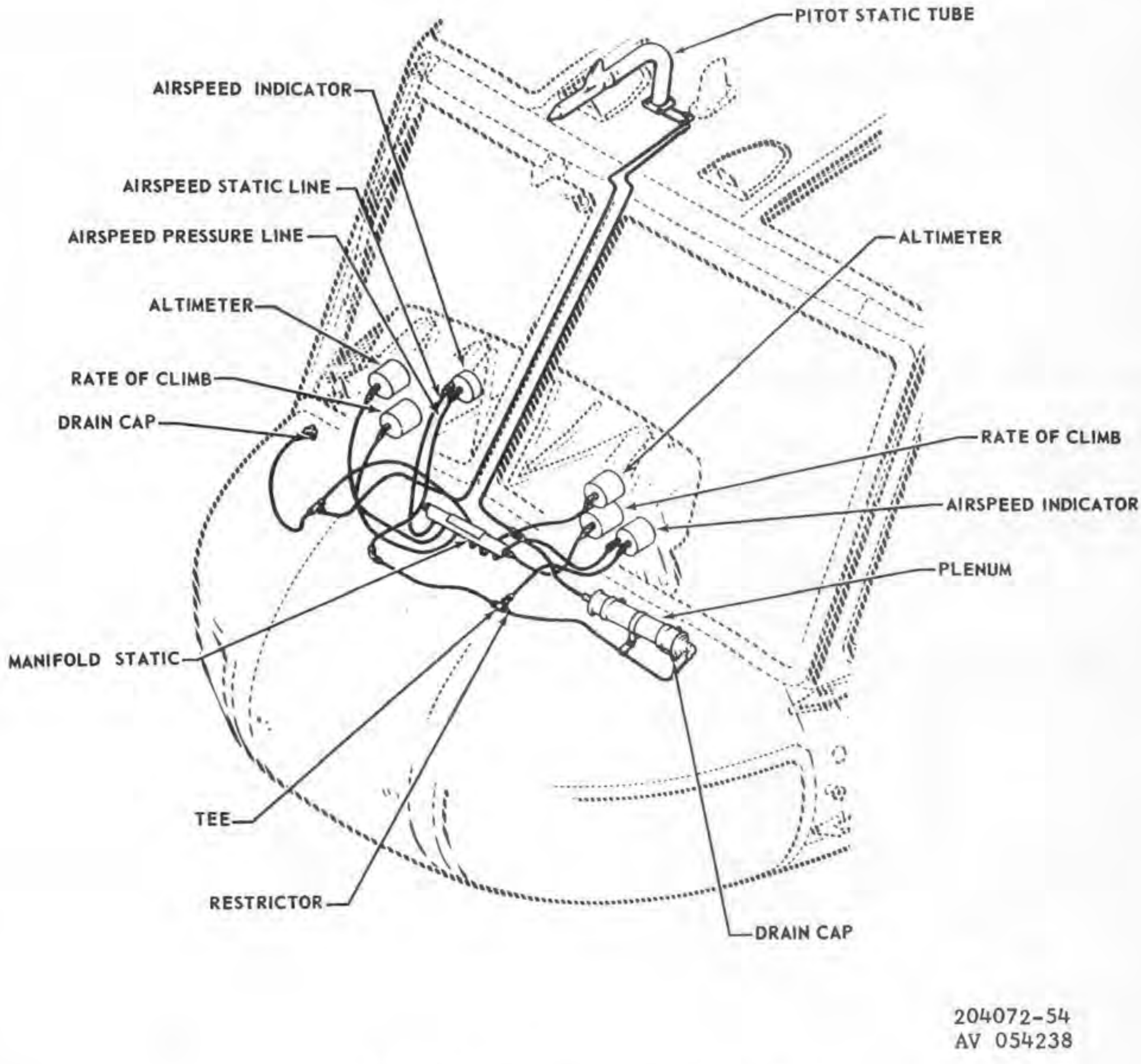


Figure 10-1. Instrument piping (typical)

b. Maintenance. (Refer to paragraph 10-4.)

10-8. Pitot System.

The pitot system consists of the electrically heated pitot tube, two static air pressure vents, and necessary piping to connect these units to altimeters, vertical velocity indicators, and airspeed indicators. The pitot tube is located on the forward left-hand side of the cabin nose, or on top right-hand side of cabin roof. Static air pressure vents are located just forward of each crew door. Helicopters having pitot tube installed in roof have static port incorporated into pitot head. (See figure 10-1.)

a. Cleaning.

(1) Disconnect pitot tube pressure lines from airspeed indicators. Cap openings in indicators to prevent entrance of foreign material.

(2) Disconnect static vent lines from altimeters and vertical velocity indicators. Cap openings in altimeters and indicators to prevent entrance of foreign material.

(3) Blow all lines clean with filtered, compressed air.

(4) Uncap openings in instruments and reconnect lines.

b. Inspection.

(1) Inspect pitot tube for clogged drain hole on bottom of tube.

(2) Inspect pitot tube and static vents for corrosion, dents, or other visible damage.

(3) Inspect pitot tube electrical receptacle, pins and sockets for damage.

(4) Inspect for loose, missing or improperly installed hardware. Inspect pitot and static lines for leaks, anchoring and chaffing. Check lines from manifold to instruments for interference with shock mount movement.

c. Operational Check.

(1) Close PITOT TUBE HEATER circuit breaker.

(2) Position pitot heater switch S9 to ON and check that pitot tube heating element is energized. Return switch S9 to OFF. (See figure 13-10.)

10-9. Turn And Slip Indicator.

This instrument has a needle (turn indicator), controlled by an electrically activated gyro, and a ball (slip indicator). Although 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 helicopter is in directional balance, either in a turn or in straight and level flight. If helicopter is yawing or slipping, ball will be off center. The needle indicates in which direction and at what rate helicopter is turning.

NOTE

Mark "DC ELECT" on instrument face or directly below Turn and Slip Indicator on flight instrument panel.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-11.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Pointer remains centered, either constantly or intermittently	Sticky gyro	Replace indicator
	No electrical power to indicator	Check circuit connections; replace wiring
Ball too sensitive	Dampening fluid leaked out	Replace indicator

b. Operational Check.

(1) Open all circuit breakers. Close TURN SLIP IND circuit breaker.

(2) Check that indicator gyro is running.

c. Maintenance. (Refer to paragraph 10-4.)

10-10. Attitude Indicator System.

This system displays flight attitude of the helicopter relative to the earth. The complete system includes a roll and pitch gyro, rate switching gyro, pilot's and copilot's indicator, and an amplifier located in the nose compartment. Power for these units is supplied by the 115 volt ac bus. On model UH-1D/H Serial No. 65-9565 and subsequent, the pilot's attitude indicator is a one-piece unit containing both the indicator and the amplifier.

a. Troubleshooting – Attitude Indicator (Pilot). Perform checks as necessary to isolate trouble. See figure 13-12.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator does not operate but roll and pitch gyro has indications of operating	Plug loose at indicator	Check for proper plug installation
Indicator does not operate	One unit of system defective	Replace defective unit
System functions properly but power failure flag does not lift.	Defective indicator	Replace indicator

b. Operational Check – Attitude Indicator – Pilot (Type IND-A5-UH1). Open both pilot attitude indicator circuit breakers on the pedestal panel. Energize the main inverter and perform the following steps:

(1) Close both pilot attitude indicator circuit breakers. Check that display erects to within ± 1 degree in pitch and roll and the power warning flag disappears within one minute.

(2) Rotate the roll trim knob to the extreme clockwise position and check that bank index is at 8 to 20 degrees left bank.

(3) Rotate the roll trim knob to extreme counterclockwise position and check that bank index is at 8 to 20 degrees right bank.

(4) Rotate the pitch trim knob fully clockwise and check that deflection of the horizon line is a minimum of 16 degrees downward.

(5) Rotate pitch trim knob fully counterclockwise and check that horizon line deflects upward a minimum of 8 degrees.

(6) Turn off the main inverter and, after a few seconds delay, turn on the spare inverter. Check that pitch and bank axis remain level within ± 1 degree.

c. Maintenance Attitude Indicator. (Refer to paragraph 10-4.)

d. Troubleshooting – Attitude Indicator (Copilot). Perform checks as necessary to isolate trouble. See figure 13-12.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator does not operate	Power failure	Check wiring and plugs
	Defective indicator	Replace indicator

e. Operational Check – Attitude Indicator – Copilot (Type J-8).

(1) Open both copilot attitude indicator circuit breakers. Energize the main inverter.

(2) Close both copilot attitude indicator circuit breakers. After fifteen seconds, pull out and then release the PULL TO CAGE knob. The gyro should cage and release. Within three minutes the indicator should settle to its zero position within ± 1 degree in bank and pitch.

(3) Maintenance – Attitude Indicator. (Refer to paragraph 10-4.)

CAUTION

Remove power before disconnecting any component of the attitude indicator system. Power must remain off until all components are reconnected. Both circuit breakers should be opened or closed at the same time.

NOTE

One and two-piece attitude indicators are interchangeable for all helicopters prior to Serial No. 65-9565; however, when installing one-piece attitude indicators in helicopters prior to Serial No. 65-9565, cannon plugs of amplifier must be stowed when amplifier is removed. Connect remaining cannon plug to receptacle on one-piece attitude indicator.

10-11. Vertical Velocity Indicator.

The vertical velocity indicator is vented to the static air system to sense the rate of atmospheric pressure change. The indicator registers ascent or descent in feet. See figure 10-1.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 10-1.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Pointer off zero	Mechanism shifted	Return pointer to zero by turning adjustment knob; tap face of indicator lightly while adjusting
Inaccurate readings	Defective indicator	Replace indicator
	Loose connections in static line	Tighten connections
	Indicator case leaks	Replace indicator
Excessive pointer oscillation	Leak in static line	Tighten connections; replace leaky lines
	Defective indicator	Replace indicator

b. Maintenance – Vertical Velocity Indicator. (Refer to paragraph 10-4.)

10-12. Clock.

Clock has a sweep-second pointer and a minute totalizer hand to indicate elapsed time. A control knob on case stops both pointers when pressed and returns pointers when pressed again.

10-13. Maintenance – Clock.

(Refer to paragraph 10-4.)

Section III. NAVIGATION INSTRUMENTS

10-14. Description.

Navigation instrument includes Course Indicator, Bearing Heading Indicator, Radio Compass, AN/ASN-43 Gyro Magnetic Compass, and standby Compass.

10-15. Course Indicator.

The ID-453/ARN course indicator functions to furnish the pilot visual bearing from or to the station being received. A knob is provided on the instrument for selection or adjustment of the bearing indicator needle to set up a desired omni course or to change course 180 degrees on the indicator, thereby reversing the TO-FROM meter. Operating in conjunction with the course selector is the cross pointer meter. The pilot, by means of the omni system, can set up any bearing to or from a station when he knows his general geographical location and he can determine that location by obtaining a position fix on two omni stations. The cross pointer will deflect right or left depending upon the relative bearing of the helicopter to the station.

NOTE

Refer to paragraph 10-4 for maintenance of course indicator.

10-16. Bearing — Heading Indicator.

The ID-998 ( )/ASN (C-6H) and ID-250 ( )/ARN indicators are dual pointer, moving type instruments. The ID-998 ( )/ASN provides additional isolated heading output by means of an external servo amplifier. The ID-250 ( )/ARN is a repeater type instrument. The dial on each instrument displays heading from the J-2 compass system. Pointer number one of each indicator displays magnetic bearing received by the ARN-59 Direction Finder Set. Pointer number two of each indicator displays omni bearing received by the ARN-30( ) Radio Receiving Set. (Refer to TM 11-1520-210-20 for description, installation, and maintenance of the System Components.)

10-17. Maintenance — Bearing Heading Indicator.

(Refer to paragraph 10-4.)

10-18. Radio Compass.

Pilot and copilot are both provided with a radio compass which is a part of the J-2 radio compass system. (Refer to TM 11-1520-210-20.)

The UH-1D/H helicopter Serial No. 66-8574 through 66-8577 and 66-16307 through 66-17144 are equipped with the AN/ASN-43 Gyro Magnetic Compass system. This system replaces the J-2 radio compass system. (Refer to TM 11-1520-210-20 for description, installation, and maintenance of the system components.)

10-19. Standby Compass.

One standby compass, of standard magnetic type, is provided for navigational use. This unit is to be used in conjunction with the compass correction card, which is located adjacent to the compass.

a. Troubleshooting. Perform checks as necessary to isolate trouble.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive card error	Improper compensation	Compensate compass
Excessive card oscillation	External magnetic interference	Locate magnetic interference and eliminate if possible
Card element not level	Insufficient liquid in bowl	Replace compass
Card sluggish	Leaking float chamber	Replace compass
	Card magnets detached	Replace compass
	Dirty jewels on pivots restricting rotation	Replace compass

b. Maintenance. (Refer to paragraph 10-4.)

c. Calibration.

(1) Check condition of compass before positioning helicopter on compass rose. (Refer to paragraph 10-4, c.)

(2) Position helicopter on compass rose. Observe the following precautions prior to start of swinging procedure:

(a) Make sure that all magnetic material and equipment in helicopter is secured in normal flight position.

(b) Check that all controls and levers are set in normal position. (Refer to TM 55-1520-210-10.)

(c) Check all observers or personnel near or in the helicopters to insure they have no metals on their person that have magnetic properties that could cause compass deviation.

(d) Check that all magentic objects, such as trucks, automobiles or other aircraft, are removed from the compass rose swing area to a distance at which they will have no magnetic effect on the compass.

(e) Calibrate compass utilizing procedures outlined in TM 55-403.

Section IV. ENGINE INSTRUMENTS

10-20. Description.

Engine instruments include Dual Tachometer (rotor and Turbine), Gas Producer Tachometer, Engine oil pressure, Torque Pressure, Fuel Pressure, Engine Oil Temperature, Exhaust Temperature, and Fuel Quantity Indicators.

10-21. Dual Tachometer System.

Dual tachometer indicates both main rotor rpm and engine output shaft rpm. Each tachometer has a synchronous motor connected electrically to a separate tachometer generator. The system operates independently of helicopter electrical power systems. Rotor rpm pointer indicates on inner scale of instrument, by connection to a generator mounted on right side of transmission sump case. Engine rpm pointer indicates on outer scale, by connection to a generator on upper left side of engine inlet housing. Pointers will be aligned when engine and rotor speeds are synchronized in normal operation.

a. Troubleshooting. Perform checks as necessary to isolate trouble. See figure 13-13.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Excessive scale error	Weak magnet in tachometer generator	Replace tachometer generator
Pointer moves backward	Leads reversed at generator	Change leads in generator plug
Indication only half actual speed	Leads connected to wrong terminal in indicator	Refer to wiring diagram and install wires in indicator plug correctly.
No reading on instrument, either constant or intermittent	Break or short circuit in leads	Repair or replace leads
	Poor connections at indicator or generator plugs	Clean or tighten connections
	Break in unit circuit	Replace defective unit (generator) or (indicator)
	Poor connection at indicator or generator	Clean and tighten connections
Low reading or indicator, either constant or intermittent	Indicator resistance out of adjustment	Replace indicator
High reading on indicator, either constant or intermittent	Indicator resistance out of adjustment	Replace indicator

b. Maintenance. (Refer to paragraph 10-4.)

10-22. Rotor Tachometer Generator.

The rotor tachometer generator is located on the lower right hand side of the transmission. It is mounted on the hydraulic pump and tachometer drive quill assembly. It is connected to the dual tachometer indicator on the instrument panel.

a. Removal. Remove cowling from right-hand side of transmission. Disconnect electrical receptacle, remove mounting nuts and washers and lift tachometer generator from helicopter.

b. Inspection. Inspect generator case for cracks, excessive wear, or any visible damage. Check connector for damaged or bent pins and cracked inserts. Check that rotor turns freely and there is no visible indication of excessive wear to bearings.

c. Repair or Replacement. Replace item if inspection requirements at not met.

d. Installation. Position generator on mounting studs and install mounting washers and nuts. Connect electrical receptacle and install cowling.

10-23. Power Turbine Tachometer Generator.

The engine tachometer generator is mounted on the governor and tachometer drive gear box on the left upper side of the engine and is connected to the dual tachometer indicator on the instrument panel.

a. Removal.

(1) Remove cowling from left-hand side of engine.

(2) Disconnect electrical receptacle, remove mounting nuts and washers and lift tachometer from engine.

b. Inspection. (Refer to paragraph 10-22, b; procedure is the same.)

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation. Position generator and gasket on studs and install nuts. Connect electrical receptacle and install cowling.

10-24. Gas Producer Tachometer System.

Gas producer tachometer indicator provides indication in percentage rpm of engine gas producer (first-stage on N1 turbine and compressor) by connection to a synchronous generator mounted on engine accessory drive section. Indicator and generator circuit is independent of helicopter electrical power system.

a. Troubleshooting. (Refer to paragraph 10-21, a; procedure is the same.)

b. Maintenance. (Refer to paragraph 10-4.)

10-25. Gas Producer Tachometer Generator.

The gas producer tachometer generator, located on the right hand side of the engine on the accessory gear box, registers the rpm of the gas producer turbine. This instrument is used in conjunction with the gas producer tachometer indicator on the instrument panel.

a. Removal. (Refer to paragraph 10-23, a; procedure is the same.)

b. Inspection. (Refer to paragraph 10-22, b; procedure is the same.)

c. Repair or Replacement. Replace item if inspection requirements are not met. (Refer to paragraph 10-23, b.; procedure is the same.)

d. Installation. (Refer to paragraph 10-23, d; procedure is the same.)

10-26. Engine Oil Pressure Indicator System.

The engine oil pressure indicator provides continuous readings of engine oil pump pressure in psi, by means of an electrical transmitter mounted on top of engine inlet section. The transmitter is connected to 28-volt ac electrical power, and by a hose to a pressure tap on engine oil filter housing.

a. Troubleshooting. Perform checks as necessary to isolate trouble. See figure 13-14.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Low reading on oil pressure indicator	Kinked or obstructed oil pressure line	Replace or clean line

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Inaccurate or sticking pressure indicator	Defective indicator	Replace indicator
Sluggish oil pressure reading or fluctuating oil pressure	Sludge in oil pressure line	Bleed line
No reading on indicator	Defective transmitter	Replace transmitter
	Open circuit between transmitter and indicator	Make continuity check and replace or repair leads
Fluctuating oil pressure indicator	Loose electrical connection	Check connections

b. Maintenance. (Refer to paragraph 10-4.)

10-27. Operational Check – AC Pressure Instruments.

To perform functional test of the torque transmitter, transmission oil pressure transmitter, engine oil pressure transmitter or fuel pressure transmitter, proceed as follows:

a. Energize main inverter.

b. Close TORQUE PRESS circuit breaker.

c. Disconnect the pressure line from the torque transmitter and apply pressure while monitoring the torque indicator. For helicopters using T53-L-11 indicated pressure shall be 50 psi when applied pressure in 50±7 psi, and for helicopters using T53-L-13 indicated pressure shall be 100 psi when applied pressure is 100±10 psi.

d. Open TORQUE PRESS circuit breaker and reconnect pressure line.

e. Close XMSN OIL PRESS circuit breaker and repeat steps c. and d. for transmission oil pressure transmitter and indicator, except indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi.

f. Close ENG OIL PRESS circuit breaker and repeat steps c. and d. for engine oil pressure transmitter and indicator, except indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi.

g. Close FUEL PRESS circuit breaker and repeat steps c. and d. for the fuel pressure transmitter and indicator, except that the indicated pressure shall be 50 psi when applied pressure is 50 ±7 psi.

NOTE

Pressure caution lights test may also be performed at this time. (Refer to paragraph 12-41.)

10-28. Engine Oil Pressure Transmitter.

The engine oil pressure transmitter is mounted on a bracket on top of the engine and is connected to the engine oil pressure indicator on the instrument panel.

a. Removal.

(1) Remove cowling from engine.

(2) Disconnect electrical connector. Disconnect oil line. Place cover over connector and oil line.

(3) Remove lockwire and mounting screws and lift transmitter from mounting bracket.

b. Inspection. (Refer to paragraph 10-31, b.; procedure is the same.)

c. Repair or Replacement. Repair connectors, tighten pressure fitting and replace item if inspection requirements are not met.

d. Installation.

(1) Position transmitter on bracket and install mounting screws. Install lockwire.

(2) Remove cover and connect electrical receptacle and oil line. Install cowling.

10-29. Torque Pressure Indicator System.

The torquemeter indicator is a pressure indicator type instrument for continuous readings of engine output shaft torque, supplied by an electrical transmitter mounted at top of engine inlet section. The transmitter is connected by hoses to a specialized oil pressure tap on right side of engine inlet housing, and to a vent connection on front of accessory drive gear box. The electrical circuit is operated by 28-volt ac power.

10-30. Maintenance — Torquemeter Indicator.

(Refer to paragraph 10-4.)

10-31. Torque Pressure Transmitter.

The torque pressure transmitter is mounted on a bracket on top of the engine and is connected to the torquemeter on the instrument panel.

a. Removal.

(1) Remove cowling from engine.

(2) Disconnect electrical connector and oil line and connector.

(3) Cover openings of oil line and protect electrical connector.

(4) Cut lockwire, remove mounting screws and washers and lift transmitter from helicopter.

b. Inspection.

(1) Visually inspect case for damage or cracks. check for proper security of unit on mounting bracket and tightness of all pressure fittings.

(2) Check connectors for security, bent or damaged pins, broken or cracked inserts and check operation of unit.

c. Repair or Replacement. Repair connectors, tighten pressure fitting and replace item if other inspection requirements are not met.

d. Installation.

(1) Position transmitter on bracket and install mounting screws.

(2) Remove cover from openings and connect oil line and electrical connector to transmitter. Instal cowling.

10-32. Fuel Pressure Indicator.

A fuel pressure indicator provides reading in psi of pressure in main fuel supply line from boost pumps in tanks, by means of an electrical transmitter mounted at engine deck level just ahead of forward firewall at right side. Electrical circuit is operated by 28-volt ac power.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-14.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator sticks or hand does not return to zero	Defective indicator	Replace indicator
No reading, either constant or intermittent	Defective indicator	Replace indicator
	Break or grounded circuit in leads	Repair or replace leads
	Poor connection at indicator	Clean and tighten electrical connection
	Defective transmitter	Replace transmitter
Low reading on fuel pressure indicator	Kinked or obstructed transmitter pressure line	Clean or replace pressure line

b. Maintenance. (Refer to paragraph 10-4.)

10-33. Engine Oil Temperature Indicator.

The engine oil temperature indicator is electrically connected to 28-volt dc essential bus. The electrical resistance type thermobulb installed in engine oil pump housing measures temperature of the oil entering that unit.

a. Troubleshooting. Perform checks as necessary to isolate trouble. See figure 13-11.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Oil temperature reading off scale at low end, or low reading either constant or intermittent	Defective indicator	Replace indicator
	Short circuit in leads from resistance bulb to indicator	Make continuity check and repair or replace leads
	Short circuit in bulb	Replace bulb
Oil temperature reading off scale at high temperature end, either constant or intermittent	Resistance bulb circuit open	Check continuity and repair wiring or replace defective bulb
	Defective indicator	Replace indicator
No reading on indicator	Defective circuit breaker	Replace circuit breaker
	Defective indicator	Replace indicator
	Break in leads	Repair wiring

b. Maintenance. (Refer to paragraph 10-4.)

10-34. Operational Check — Temperature Indicators.

a. Open all circuit breakers and close TEMP IND ENG & XMSN circuit breakers.

b. Check that engine oil temperature and transmission oil temperature instruments read approximately ambient temperature.

10-35. Exhaust Gas Temperature Indicator.

Exhaust gas temperature indicator operates on electrical potential from an engine thermocouple harness with probes mounted in aft section of engine exhaust diffuser. Indicator circuit is entirely independent of any other electrical power source, and includes a coil resistor which provides a means of instrument calibration. (See figure 13-15.)

a. Troubleshooting. In event of malfunction, check and tighten circuit connections. Any further repair will require use of a testing unit to check and calibrate instrument circuit.

b. Operational Check.

(1) Connect and operate the "Jetcal" analyzer in accordance with the instructions for "Functional Check of Aircraft E.G.T. (Exhaust Gas Temperature) Circuit" which is attached to the analyzer cover.

(2) Set the heater probes to an outlet temperature of 500°C by adjustment of the TEMP REGULATOR. The helicopter's exhaust temperature indicator (Type MJ-2) should read 500 ±10°C.

c. Maintenance. (Refer to paragraph 10-4.)

10-36. Thermocouple Lead Spool Resistor.

The thermocouple lead spool resistor is located inside the cabin roof at approximately station 104.20 and buttock line 30.0. Sections of alumel and chromel are used to connect the thermocouple with an indicator by way of the spool resistor. The resistor acts as a matching device between indicator and thermocouple.

10-37. Inspection — Thermocouple Lead Spool Resistor.

Inspect resistor for loose connections, corrosion, broken wires, broken terminals and damage to cover or cover fasteners.

10-38. Fuel Quantity Indicator.

a. Fuel quantity indicator provides readings of fuel supply in tank system. The indicator is connected to capacitor-type probes mounted in upper and lower fuel cells and requires a 115-volt ac power source.

b. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-16.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator reads low.	System out of adjustment.	Perform adjustment procedure. Change tank unit.
Indicator reads high.	Tank unit has low capacitance.	Change tank unit.
Indicator remains at one point on scale.	Compensator capacitance too high.	Perform adjustment procedure. Change tank unit.
	System out of adjustment.	Check wiring terminals for security.
	Tank unit has high capacitance.	Change tank unit.
	Open lead on compensator circuit. Compensator section of tank unit open.	
	No power.	Check 115 volts, 400 hertz power supply.
	Defective indicator.	Replace indicator.
	Coaxial lead grounded.	Check wiring and/or replace indicator assembly.
	400 hertz lead grounded.	
	Prolonged existence of this condition will burn out fire hazard resistor in indicator.	
Indicator remains at zero or below.	Open wiring.	Check wiring.
Indicator operation sluggish.	Low insulation resistance of the circuit.	Check wiring and tank unit.

c. Operational Test. The fuel quantity system shall be functionally tested and calibrated at higher maintenance level.

d. Maintenance. (Refer to paragraph 10-4.)

Section V. MISCELLANEOUS INSTRUMENTS

10-39. Description.

Miscellaneous Instruments include transmission oil pressure indicator, transmission oil temperature indicator, alternating current voltmeter, direct current voltmeter, direct current loadmeter, and free air temperature gage.

10-40. Transmission Oil Pressure Indicator.

Transmission oil pressure indicator provides continuous readings in psi by means of an electrical transmitter mounted directly into an oil manifold at right aft on transmission top case. Electrical circuit is operated by 28-volt ac power.

a. Troubleshooting. (Refer to paragraph 10-26, a.; procedure is the same.)

b. Maintenance. (Refer to paragraph 10-4.)

10-41. Transmission Oil Pressure Transmitter.

The transmission oil pressure transmitter is located on the right hand side of the transmission. It is connected to the transmission oil pressure indicator on the instrument panel.

a. Removal.

(1) Disconnect electrical connector.

(2) Remove lockwire and unscrew transmitter from manifold.

b. Inspection. (Refer to paragraph 10-31, b.)

c. Repair or Replacement. (Refer to paragraph 10-31, c.; procedure is the same.)

d. Installation.

(1) Screw transmitter into manifold.

(2) Connect electrical connector and install lockwire.

10-42. Transmission Oil Temperature Indicator.

The transmission oil temperature indicator is electrically connected to the 28-volt dc essential bus. The electrical resistance type thermobulb installed in the transmission oil manifold measures temperature of the oil entering that unit.

a. Troubleshooting. (Refer to paragraph 10-32, a.; procedure is the same.)

b. Operational Check. (Refer to paragraph 10-34.)

c. Maintenance. (Refer to paragraph 10-4.)

10-43. AC Voltmeter.

The AC voltmeter will indicate 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.

Maintenance – AC Voltmeter. (Refer to paragraph 10-4.)

10-44. DC Voltmeter.

A DC voltmeter is provided to indicate the voltage of the main generator, standby generator, essential bus, non-essential bus, or battery. These sources are selected by the VM selector on the DC power panel in the overhead console.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-17.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No reading or erratic reading	Open or short circuit in instrument	Replace instrument
	Dirty or worn mechanism in instrument	Replace instrument

b. Maintenance. (Refer to paragraph 10-4.)

10-45. Loadmeter.

Two DC loadmeters are provided for main and standby DC generators to indicate output or load of each generator as percent of total capacity.

10-46. Maintenance — Loadmeter.

(Refer to paragraph 10-4.)

10-47. Free Air Temperature Gage.

The free air temperature gage is installed through the upper left corner of the pilot's windshield and measure the outside air temperature.

a. Removal.

(1) Screw retainer off probe outside of the windshield.

(2) Remove seal from probe and pull assembly out of windshield.

b. Inspection.

(1) Inspect assembly for corrosion.

(2) Inspect for discoloration.

(3) Inspect for leaking seal.

(4) Check for proper temperature indication.

c. Repair or Replacement.

(1) Replace assembly if unserviceable or damaged.

(2) Replace seal if leaking or damage.

(3) Replace assembly if it fails to register proper temperature indication.

d. Installation.

(1) Insert probe through windshield.

(2) Position seal around probe against windshield.

(3) Secure assembly to windshield by screwing retainer on probe.

CHAPTER 11

UTILITY SYSTEMS

Section I. INTRODUCTION

11-1. General.

The purpose of this chapter is to provide information for maintenance personnel to accomplish organizational maintenance on the utility systems.

Section II. HEATING AND VENTILATING SYSTEMS

11-2. Cabin Heating – Defrosting Systems.

Basic helicopter has a defroster-heater system (see figure 11-1) using engine compressor bleed air, blended with outside air and routed through ducts under left side of cabin floor to registers under pilot seats and to nozzles at windshields and lower nose windows. Another duct system, extending under right side of cabin floor and connected through valves to defrost nozzles as well as to additional heat outlets, is not operational without installation of a combustion type heater kit but can be used for heating while on ground by connection of external heater duct at capped inlet provided on right side aft of cargo door. In this configuration all mechanical and electrical controls are complete for bleed air heat system. Electrical circuits for combustion heater are installed but stowed, ready for final connection during kit installation. Aft heat outlet ducts and heater fuel line are installed and capped.

11-3. Winterization Equipment.

For operation in cold weather conditions, an auxiliary combustion-type heater (see figure 11-2) may be installed in fuselage compartment at right side of fuselage, operating on fuel pumped from supply tanks through a fuel train assembly installed under left side of cabin floor.

11-4. Bleed Air Heat System.

Bleed air heat-defrost system includes a five-position control valve, an air mixing valve, two noise suppressors, a four-position distribution valve, ducts, underseat registers, defrost nozzles, a heat selector valve with manual control, and electrical circuits with two rotary selector switches on BLEED AIR section of CABIN HEAT overhead control panel. (See figure 11-1.) Heat source is engine compressor bleed air, taken off from centrifugal compressor housing on T53-L-9 engine or from diffuser housing on T53-L-9A, -11, -11B, and -13 engine.

a. Inspection – Bleed Air Heat System.

(1) Check heater ducts for cracks, fraying and wear.

(2) Check clamps for security and condition.

(3) Check defrost nozzles and underseat registers for cleanliness and freedom from obstructions.

(4) Check manual control levers on pedestal for operation and freedom of movement.

(5) Check electrical connections on all switches and circuit breakers for security. Check continuity of circuits. (Refer to Chapter 13.)

(6) Check bleed air control valve for operation and security of attachment.

(7) Check bleed air hose for security of attachment to bleed air control valve.

(8) Check bleed air mixing valve for operation and security of attachment.

(9) Check heat distribution valve for operation and security of attachment.

b. Troubleshooting – Bleed Air Heat System.

NOTE

Troubleshoot bleed air heat system in accordance with the following chart.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No heated air from nozzles or registers	Manual HEAT SELECTOR control at wrong position	Place control at BLEED AIR ON (or CLOSE ON YUH-1D)
	Faulty limit switch at manual control	Replace switch
	Open or faulty BLEED AIR circuit breaker	Reset or replace circuit breaker
	Faulty AIR control switch CABIN HEATING panel	Replace switch
	Faulty connection on bleed air valve	Repair electrical circuit to valve
Restricted warm air supply at nozzles and registers	Wrong reducer fitting at bleed air valve outlet (with T53-L-9 engine)	Install correct fitting for engine model
	Faulty bleed air valve operation	Repair control circuit or replace valve.
	Faulty air mixing valve	Replace valve
	Faulty BLEED AIR DEFROST circuit or distribution valve operation	Repair control circuit, or replace valve or actuator
	Leaks or obstruction in ducts.	Repair or replace ducts
	Air leaking through valve to right-hand (auxiliary heater) duct system	Repair or replace selector valve in pedestal
Excessive hot air	Wrong reducer fitting at bleed air valve outlet (with T53-L-9A, -11 series, and -13 engines)	Install correct fitting for engine model
	Faulty air mixing valve	Replace valve

BLEED AIR HEAT SYSTEM:

1. Engine Bleed Air Hose
2. Bleed Air Control Valve
3. Air Mixing Valve
4. Noise Suppressors
5. Bleed Air Heat Distribution Valve
6. Under-Seat Registers
7. Windshield Nozzles
8. Heat Selector Valve
9. Lower Window Nozzle
10. Heat Selector Control

AUXILIARY HEATING PROVISIONS:

11. Lower Right Outlet Control
12. Lower Left Outlet Control
13. Iris Valves
14. Auxiliary Heat Duct
15. Thermostat Dial
16. Door Post Outlets
17. Distribution Valve
18. Capped Fuel Line
19. Capped Aft Outlets
20. Spot Heating Connection

205070-34

Figure 11-1. Heat-defrost air system without auxiliary heater (Sheet 1 of 2)

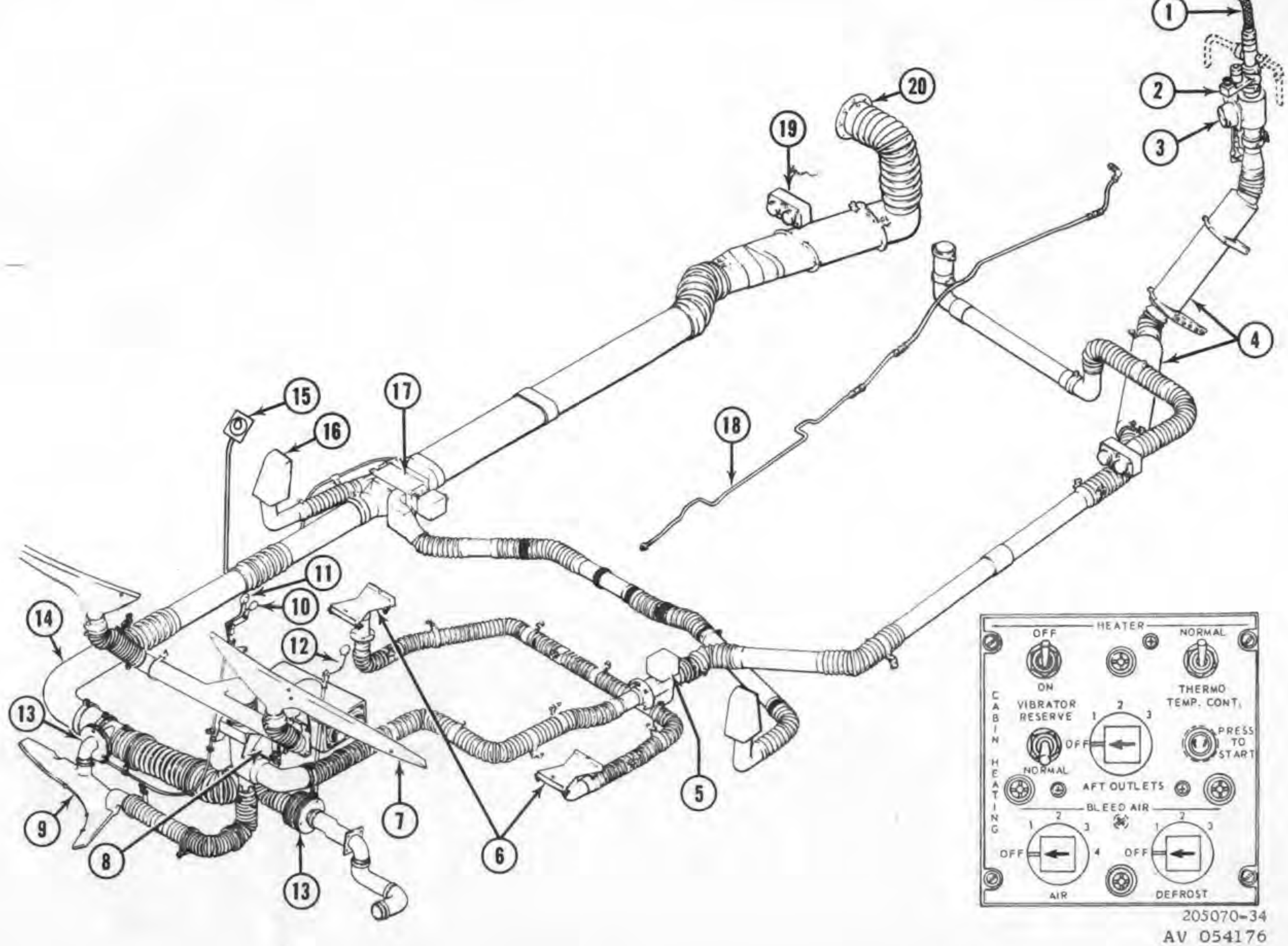


Figure 11-1. Heat-defrost air system without auxiliary heater (Sheet 2 of 2)

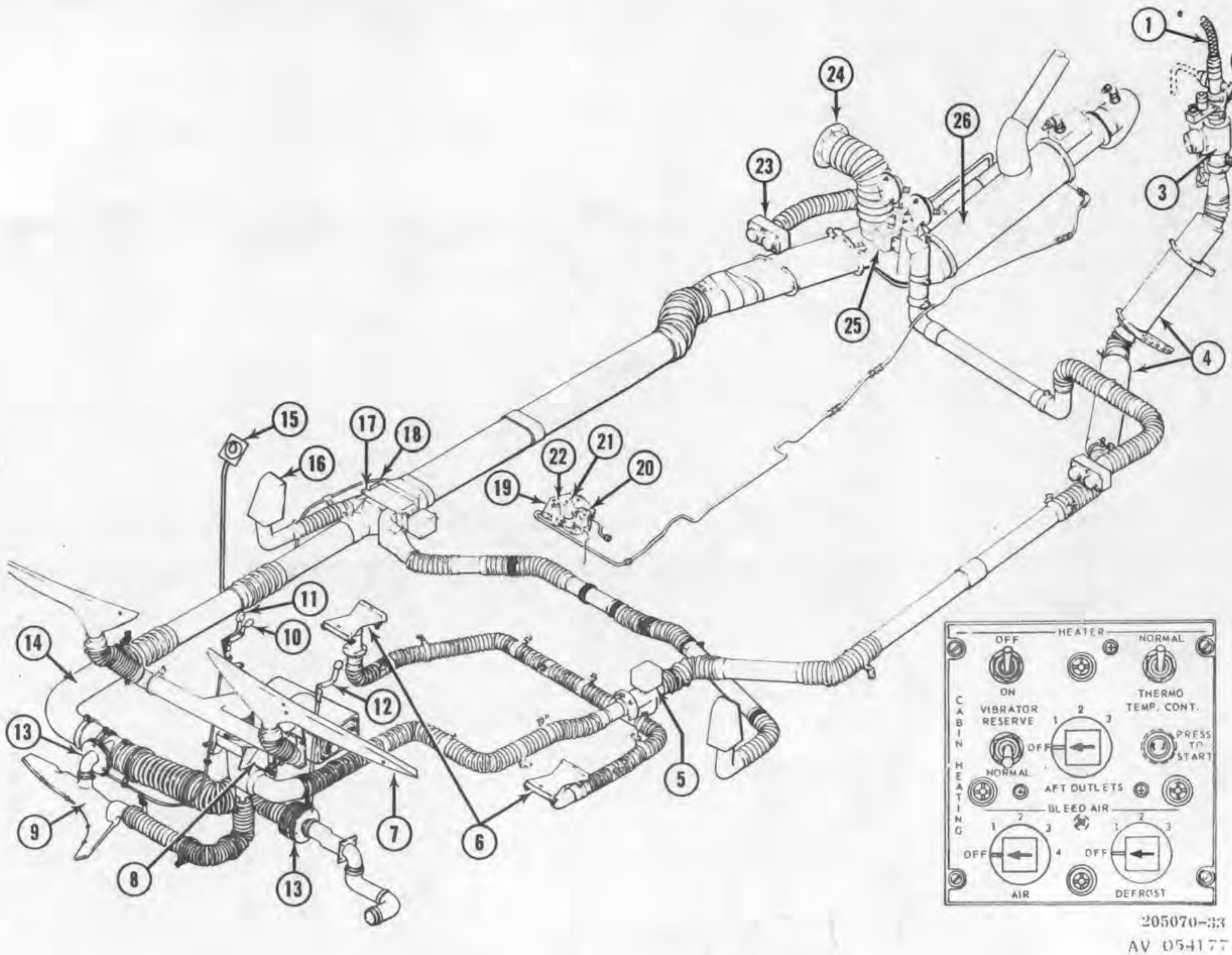


Figure 11-2. Heat-defrost air system with auxiliary heater (Sheet 1 of 2)

BLEED AIR HEAT SYSTEM:

1. Engine Bleed Air Hose
2. Bleed Air Control Valve
3. Air Mixing Valve
4. Noise Suppressors
5. Bleed Air Heat Distribution Valve
6. Under-Seat Registers
7. Windshield Nozzles
8. Heat Selector Valve
9. Lower Window Nozzle
10. Heat Selector Control

AUXILIARY HEATING SYSTEM:

11. Lower Right Outlet Control
12. Lower Left Outlet Control
13. Iris Valves
14. Auxiliary Heat Duct
15. Thermostat Dial
16. Door Post Outlets
17. Distribution Valve
18. Thermostat
19. Heater Fuel Train Assembly
20. Fuel Filter
21. Fuel Pump
22. Fuel Solenoid Valve
23. Aft Heat Outlets
24. Spot Heating Connection
25. Aft Outlets Valve
26. Auxiliary Combustion Heater

205070-33

Figure 11-2. Heat-defrost air system with auxiliary heater (Sheet 2 of 2)

c. Bleed Air Control Valve. Bleed air for heating is shut off or admitted in controlled amounts by a five-position electrically actuated butterfly valve, located on left side of engine compartment deck aft of the forward firewall. Inlet fitting above valve has a coupling for engine bleed air hose, and two noncontrolled connections for air lines to oil cooling blower and left fuel boost pump. Valve outlet is connected by fitting to air mixing valve. Valve automatically returns to OFF (closed) position if not electrically energized, as in event of circuit failure or if upper microswitch on right side of cabin pedestal is not held closed by manual HEAT SELECTOR lever.

d. Inspection – Bleed Air Control Valve. Refer to paragraph 11-4a.

e. Air Mixing Valve. A temperature-operated hot air mixing valve is incorporated in bleed air heating system to regulate temperature of air used for cabin heating. Valve is located under left side of engine deck and is connected to bleed air control valve outlet. Operation of valve is automatic, admitting outside air through its butterfly, as required, to maintain an outlet air mixture within a predetermined temperature range.

f. Inspection – Air Mixing Valve. Refer to paragraph 11-4a.

g. Bleed Air Heat Distribution Valve. Bleed air heat is distributed to defrost nozzles or to under-seat registers by a butterfly type valve assembly, located under left side of cabin floor, inboard and aft of door post. Valve is operated by an electrical solenoid which is controlled by DEFROST switch on overheat panel.

h. Inspection – Bleed Air Heat Distribution Valve. Refer to paragraph 11-4a.

11-5. Auxiliary Combustion Heat System.

Cabin heat-defrost auxiliary system for cold weather operation (see figures 11-2 and 11-3) includes a combustion type heater, with intake blowers for combustion air and for ventilation air, a fuel train to deliver fuel from supply tanks, an outlet plenum assembly, ducts, a distributor valve, heat outlets at aft wall of cabin and at door posts, manually controlled iris valves to lower nose window nozzle and outlet, rear part of HEAT SELECTOR valve in pedestal, and electrical power and control circuits. Electrical controls include switches on HEATER portion of CABIN HEATING overhead panel, circuit breakers for HEATER CONT. and HEATER POWER, a thermostat which senses heat in distributor valve and has a control dial on right door post, actuators on two distribution valves, three thermal switches in heater plenum, two air pressure switches connected to blowers, and two relays on inner wall of heater compartment. Operating instructions will be found in TM 55-1520-210-10.

a. Troubleshooting – Combustion Heater.

NOTE

A general method and specific procedures are outlined below for isolating troubles which may occur in operation of the auxiliary combustion heater installation.

(1) Check heater operation by starting in accordance with operating instructions. (Refer to TM 55-1520-210-10.)

(a) External power connected or BATTERY switch ON.

(b) HEATER POWER and HEATER CONTROL circuit breakers closed.

(c) HEATER switch ON.

(d) VIBRATOR switch NORMAL.

(e) PRESS TO START switch, hold 3 to 4 seconds, then release.

(2) If heater starts, quickly check air distribution controls by use of manual levers and AFT OUTLETS rotary selector switch. During shutdown, check for proper operation of purging switch. (Refer to paragraph 11-5b.)

(3) If heater fails to start, determine whether trouble is in air, fuel, or ignition system of heater.

(a) Air system: Check whether both blowers on heater are operating. If not, proceed to paragraph 11-5b.

(b) Fuel System: Check whether fuel is reaching inlet fitting of heater, by loosening fuel line connection enough to determine that there is flow. If not, proceed to paragraph 11-5c.

CAUTION

Take precautions to avoid fire hazards.

(c) Ignition System: Verify ignition power to ignitor plug. If there is not ignition with VIBRATOR switch at NORMAL, place switch at RESERVE to try for proper operation through the alternate vibrator circuit provided in the heater ignition unit. If not, proceed to paragraph 11-5d.

CAUTION

Heater ignition used 30,000 volts.

(4) When checking functional systems of heater, follow indicated steps in order listed.

(5) Check electrical circuits as required, using standard test voltmeters and continuity test equipment. (Refer to Chapter 13, for schematic and detailed wiring diagrams.) If a no-voltage condition is found at any point in a circuit, verify continuity of wiring back to last voltage point before replacing a component.

b. Troubleshooting – Heater Air System. Components involved in air system of combustion heater are:

Combustion Air Blower

Vent Air Blower

Purging Switch

HEATER POWER Circuit Breaker

HEATER ON/OFF Switch

Purging Relay

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No voltage at purging relay terminal X1	Broken wire	Repair or replace wire
	Faulty HEATER POWER circuit breaker	Replace breaker
No voltage at purging relay terminal A2	Faulty relay	Replace relay
	Broken wire between terminal X2 and HEATER ON/OFF switch	Repair or replace wire
	Faulty ON/OFF switch	Replace switch
Combustion blower not running	Faulty blower motor	Replace blower
Vent air blower not running	Faulty blower motor	Replace blower
Blowers do not continue running to cool heater plenum when HEATER switch is turned OFF after operation	Faulty purging switch	Replace purging switch

c. *Troubleshooting – Heater Fuel System.* If combustion heater is still inoperative after check of air system, check for trouble in heater fuel system. All of the following units must function for heater to have fuel:

1. HEATER CONTROL Circuit Breaker
2. HEATER ON/OFF switch
3. Heater Blowers (Combustion and Vent Air)
4. Air Pressure Switches (Both)
5. Heater Lockout Relay
6. Overheat Switch
7. Heater START Switch
8. Heater Fuel Filter
9. Heater Fuel Pump
10. Heater Cycling Switch
11. TEMP. CONT. Switch
12. Cabin Thermostat
13. Heater Fuel Solenoid Valve

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No voltage at lockout relay terminal B1	Faulty HEATER CONTROL circuit breaker	Replace breaker
	Faulty HEATER ON/OFF switch	Replace switch
No voltage at lockout relay terminal A2	Faulty combustion or vent air pressure switch	Replace faulty pressure switch
No voltage at lockout relay terminals A1, B2, and X1	Relay not energized	
(1) No voltage on X1 with START switch pressed	Faulty START switch	Replace switch
(2) No voltage on B2 with START switch pressed	Faulty relay Faulty overheat switch	Replace relay Replace switch

Note

Trouble shooting to this stage also applies to heater ignition, which depends on proper functioning of all components, items 1 through 7, above.

Heater fuel pump motor not running	Broken wire to pump connector Pin A	Repair or replace wire
	Faulty pump motor	Replace pump
No fuel to pump inlet connection	Clogged fuel filter	Clean or replace filter
No voltage at TEMP. CONT. switch center terminal	Faulty cycling switch	Replace cycling switch
No voltage at heater fuel solenoid connector Pin B		
(1) With TEMP. CONT. switch at NORMAL (manual)	Faulty TEMP. CONT. switch	Replace switch

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
(2) With TEMP. CONT. switch at THERMO (auto)	Faulty TEMP. CONT. switch	Replace switch
	Cabin thermostat set above ambient temperature	Adjust thermostat
	Faulty thermostat	Replace thermostat
No fuel to inlet connection on heater	Faulty fuel solenoid valve	Replace valve

d. Troubleshooting – Heater Ignition System. If a combustion heater fails to operate after it has been determined that its air and fuel systems will function properly, look for cause of trouble in ignition. In addition to units in electrical circuits which are listed in fuel system troubleshooting procedure, ignition system components include ground electrode, ignitor plugs, high tension lead and ignition unit on heater, and a VIBRATOR selector switch with connecting wires.

CAUTION

Ignition unit output is 30,000 volts.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No voltage at ignition unit input connector Pin A	Broken wire	Repair or replace wire
No voltage at ignition unit input connector Pin B with VIBRATOR switch on RESERVE	Faulty VIBRATOR switch	Replace switch
No voltage at ignition unit output connector (lead disconnected)	Faulty ignition unit	Replace ignition unit
No voltage at end of high tension lead disconnected from plug	Faulty lead	Replace lead
Fuel does not ignite	Faulty ignitor plug	Replace plug

e. *Inspection – Combustion Heater Assembly.*

(1) Inspect all parts for damage.

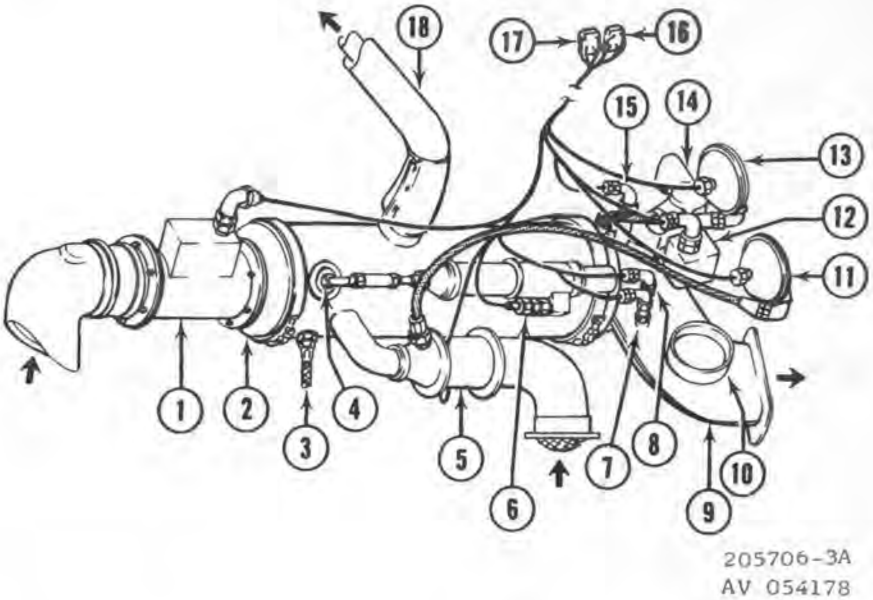
NOTE

Slight scaling and discoloration of radiator and jacket assembly is a normal condition for heaters that have been in service. The scale will be mottled, and a blue-gray powder is sometimes present. This condition is not cause for rejection of the unit, unless severe overheating has produced soft spots in metal.

(2) Damage to radiator and jacket assembly can be classified as follows:

(a) Soft and spongy metal as a result of overheating can be detected by tapping lightly with a hammer. Soft spots will produce a dull sound in contrast to the solid ringing obtained when tapping on live metal. Soft spots will usually occur opposite the crossover passages.

(b) Deformation as a result of overheating can be detected by distortion of radiator wall near crossover passages and by presence of extreme oxidation.



1. Vent Air Blower
2. Combustion Heater
3. Fuel Inlet Hose
4. Ignitor Plug
5. Combustion Air Blower
6. Ignition Unit
7. Cycling Switch
8. Overheat Switch
9. Plenum
10. Spot Heating Duct Connection
11. Combustion Air Pressure Switch
12. Aft Outlets Selector
13. Vent Air Pressure Switch
14. Aft Outlets Valve
15. Purge Switch
16. Purging Relay
17. Heater Lockout Relay
18. Heater Exhaust

Figure 11-3. Auxiliary combustion heater

(c) Deformation as a result of backfiring. Backfiring usually pushes inner wall of the radiator in toward the combustion chamber. This condition may be present in a relatively new heater and is not considered serious unless it causes an increase of more than 10 per cent in the ventilating air pressure drop across the heater.

11-6. Heater Combustion Blower.

An electrically driven blower (5, figure 11-3) is connected to an inlet on right side of heater assembly.

a. Inspection – Combustion Air Blower.

(1) Inspect brushes for damage and wear.

(2) Inspect commutator for nicks, scratches, burned bars, visible grooving or visible wear in the brush track. If any bar or bars are visibly raised above the adjacent surface of the commutator, the armature should be discarded.

(3) Inspect bearings for wear and rough spots.

(4) Check commutator diameter for minimum diameter of 0.6719 inch.

b. Ventilating Air Blower. The ventilating air blower (see figure 11-3) is an electrically driven, axial flow type blower with a multi-vane impeller. A radio noise filter is included as part of the component.

c. Inspection – Ventilating Air Blower.

(1) Check commutator diameter for a minimum diameter of 0.9687.

(2) Check bearings for wear and rough spots.

(3) Inspect brushes for damage and wear.

(4) Inspect leads for damage.

11-7. Heater Air Pressure Switches.

Two air pressure actuated switches (11 and 13, figure 11-3) are mounted in brackets on front wall of heater compartment and connected by air hoses to combustion air blower and to heater plenum. Electrical circuits to heater lockout relay are such that power to heater ignition and fuel train will be shut off if either blower fails.

a. Inspection – Heater Air Pressure Switches.

(1) Check switches for operation and security of mounting.

(2) Check security of electrical connections and security and condition of air hoses.

b. Removal – Air Pressure Switch.

(1) Open heater compartment doors.

(2) Be sure electrical power is off. Disconnect electrical connector from pressure switch being removed.

(3) Disconnect air hose from fitting at bottom of switch assembly.

(4) Remove mounting nuts to detach switch from bracket.

c. Installation – Air Pressure Switch.

(1) Assembly fittings from removed switch on replacement switch assembly, using new gasket.

(2) Install switch assembly, with ports down for self draining, on mounting bracket.

(3) Connect air hose to switch fitting.

(4) Connect and lock-wire electrical connector.

(5) Close compartment after operational check.

11-8. Heater Thermal Switches.

Three temperature-actuated switches are mounted in heater outlet plenum and connected into electrical circuits. (See figure 11-3.) Cycling switch maintains a constant temperature range in duct, and is normally-closed type which closes on falling temperature, being set at 200°F (250°F on YUH-1D). Overheat switch is a safety feature to prevent excessive temperature in duct, and is normally-closed type which closes on falling temperature, being set at 300°F (350°F on YUH-1D). Purge switch keeps blowers running after heater shutoff until plenum has cooled down, and is a normally-open type closing on rising temperature, being set at 115°F. Temperature settings on all switches have a tolerance of plus or minus six degrees.

a. Removal – Thermal Switch.

(1) Open heater compartment door at right side of fuselage.

(2) Be sure electrical power is off. Disconnect electrical wiring connector from thermal switch to be replaced.

(3) Remove thermal switch, with gasket, from plenum.

b. Inspection – Heater Thermal Switches.

(1) Check switches for operation and security of mounting.

(2) Check electrical connections for security.

c. Installation – Thermal Switch.

(1) Install replacement switch, with gasket.

(2) Connect and lock-wire electrical connector to thermal switch.

(3) Close heater compartment door after operational check.

11-9. Heater Ignition.

Ignition to heater combustion chamber is provided by means of an ignition unit mounted on heater, a high voltage lead, an ignitor plug, and a ground electrode. (See figure 11-3.) Ignition unit is a vibrator type, energized by 28-volt DC to produce a high voltage oscillating current output for a continuous spark at gap between plug and electrode in combustion head. A spare set of vibrator points in ignition unit can be actuated by VIBRATOR switch on control panel when required.

a. Removal – Ignitor Plug.

(1) Open heater compartment doors.

(2) Be sure electrical power is off. Disconnect electrical input connector from ignition unit.

(3) Disconnect high voltage lead from ignitor plug. Remove plug.

(4) Before cleaning, examine ignitor plug for evidence of cracked porcelain, arcing or carbon tracks in well of plug.

(a) If cracks are found, discard plug.

(b) Arcing or carbon tracks may be caused by shorting of plug or by dirt on spring connector that seats in well of plug. Faults must be corrected before reinstalling or replacing plug.

(5) Wipe out grease or carbon deposits in well of plug with a clean cloth dampened with carbon tetrachloride.

b. Cleaning – Ignitor Plug. Clean ignitor plug by sand-blasting. Close well of plug with stopper to keep out dirt during cleaning.

c. Inspection – Heater Ignition.

(1) Check ignition system for operation.

(2) Check ignitor plug for condition and security.

(3) Check vibrator unit for condition and security of mounting.

(4) Check electrical lead for condition and security of connections.

d. Installation – Ignitor Plug.

(1) Install ignitor plug and gasket, with 28 foot-pounds torque.

(2) Connect high voltage lead to plug, and electrical wiring connector to input receptacles of ignition unit.

(3) Close compartment door after operational check.

e. Adjusting – Ignitor Plug. If plug is replaced, be sure new plug is correct type with same length to maintain proper spark gap with ground electrode. If gap is believed incorrect, partial disassembly of heater and check of spark gap will be required, to be accomplished by qualified personnel in accordance with TM 1-15H1-2-10-3.

f. Removal – Heater Ignition Unit.

(1) Be sure electrical power is off. Disconnect input and output leads from ignition unit on heater.

(2) Remove nuts from clamps and lift off ignition unit.

g. Installation – Heater Ignition Unit.

(1) Position replacement ignition unit on heater and secure clamps.

(2) Connect high voltage lead. Connect and lock-wire input wiring connector to ignition unit.

(3) Check for proper operation.

11-10. Heater Fuel Train.

Fuel train assembly for combustion heater consists of a filter, an electric pump, and a solenoid type fuel valve connected in series and mounted on a panel. (See figure 11-2.) Assembly is installed under cabin floor at right side, on front of bulkhead at fuselage station 102. In operation, pump draws fuel through filter from crossfeed line at front of right forward fuel cell and delivers it through valve to heater inlet line.

a. Removal – Heater Fuel Train.

(1) Remove floor plates as necessary for access to fuel train assembly.

(2) Be sure electrical power is off. Disconnect electrical connectors from solenoid valve and pump.

(3) Place suitable vessel to catch spilled fuel. Disconnect fuel lines from filter inlet and valve outlet, and disconnect drain line from pump. Cap open fittings and lines.

(4) Detach panel from bulkhead by removing three mounting screws with spacers, washers, and nuts. Remove fuel train assembly.

b. Inspection – Heater Fuel Train.

(1) Check heater fuel system for leaks.

(2) Check filter for contamination.

(3) Check fuel pump, fuel valve and filter for security of mounting.

(4) Check electrical leads for condition and security of connections.

c. Repair or Replacement – Heater Fuel Train.

(1) Repair any fuel leaks in connections between units by replacing unserviceable gaskets, fittings, or lines.

(2) Replace valve, pump, or filter in event of malfunction.

(3) Replace filter element if clogged by fuel contamination. In normal service, element will be changed at heater overhaul.

d. Installation – Heater Fuel Train.

(1) Insert three mounting screws through fuel train panel from front. Place a spacer on each screw at back of panel.

(2) Position assembly to mounting holes at front of station 102 bulkhead, with pump 27.5 inches to right of cabin center line. Secure to bulkhead with washers and nuts.

(3) Connect pump seal drain line. Connect heater fuel supply line to outlet fitting on solenoid valve. Connect fuel line from tank crossfeed tee fitting to filter inlet fitting.

(4) Connect and lock-wire electrical connectors to pump and valve solenoid.

(5) After operational check for leaks and proper function, reinstall floor plates over access opening.

11-11. Cabin Thermostat.

A thermostat which controls output of combustion heater when TEMP. CONT. switch is at THERMO position, is mounted on outboard side of distribution valve below cabin floor near right door post. A control dial on door post changes setting of thermostat by means of a flexible cable.

a. Removal – Cabin Thermostat.

(1) Remove floor panel at right side of cabin behind door post for access to distribution valve and thermostat.

(2) Be sure electrical power is off. Disconnect electrical connector from thermostat.

(3) Disconnect flexible control cable from thermostat.

(4) Remove mounting screws to detach thermostat from mounting pad on valve assembly.

b. Inspection – Cabin Thermostat.

(1) Check thermostat for operation.

(2) Check thermostat and thermostat dial for security of mounting.

(3) Check electrical leads on thermostat for security.

c. Installation – Cabin Thermostat.

(1) Position replacement thermostat on side of valve and secure with mounting screws.

(2) Connect control cable and electrical connector to thermostat.

(3) Make operational check before reinstalling floor plate.

11-12. Ventilation System.

Volume and directional flow of air into cabin is controlled by one valve in each of two forward scoops and two valves in each of two aft scoops. The air scoops are located in cabin roof. Each scoop pan is vented by a tube to an opening in roof skin to prevent excessive moisture in the scoop.

NOTE

With the combustion (auxiliary) heater installed, cabin air may be changed by turning on the blowers without lighting the heater.

a. Removal – Air Scoop Assemblies.

(1) Remove screws from scoop assemblies on top of cabin roof and remove scoop.

(2) Use a sharp non-metallic instrument for separating pan of either forward assembly from top cabin skin.

NOTE

Pan sections of air scoop assemblies are riveted to roof section and are not removable.

(3) Pull drain tube assembly from pan assembly nipple inside cabin roof.

(4) Remove the screws attaching air control valve to the pan and remove the valve from the assembly.

NOTE

The air control valve may be removed as a unit from inside the cabin without removing either the pan or air scoop.

b. Inspection – Ventilation System.

(1) Check air scoops and valves for security of mounting and condition.

(2) Check air valves for freedom of operation.

(3) Inspect ventilation system and drain tubes for obstructions.

c. Installation – Air Scoop Assembly.

(1) Position control fitting on pan assembly, align holes and install attaching screws.

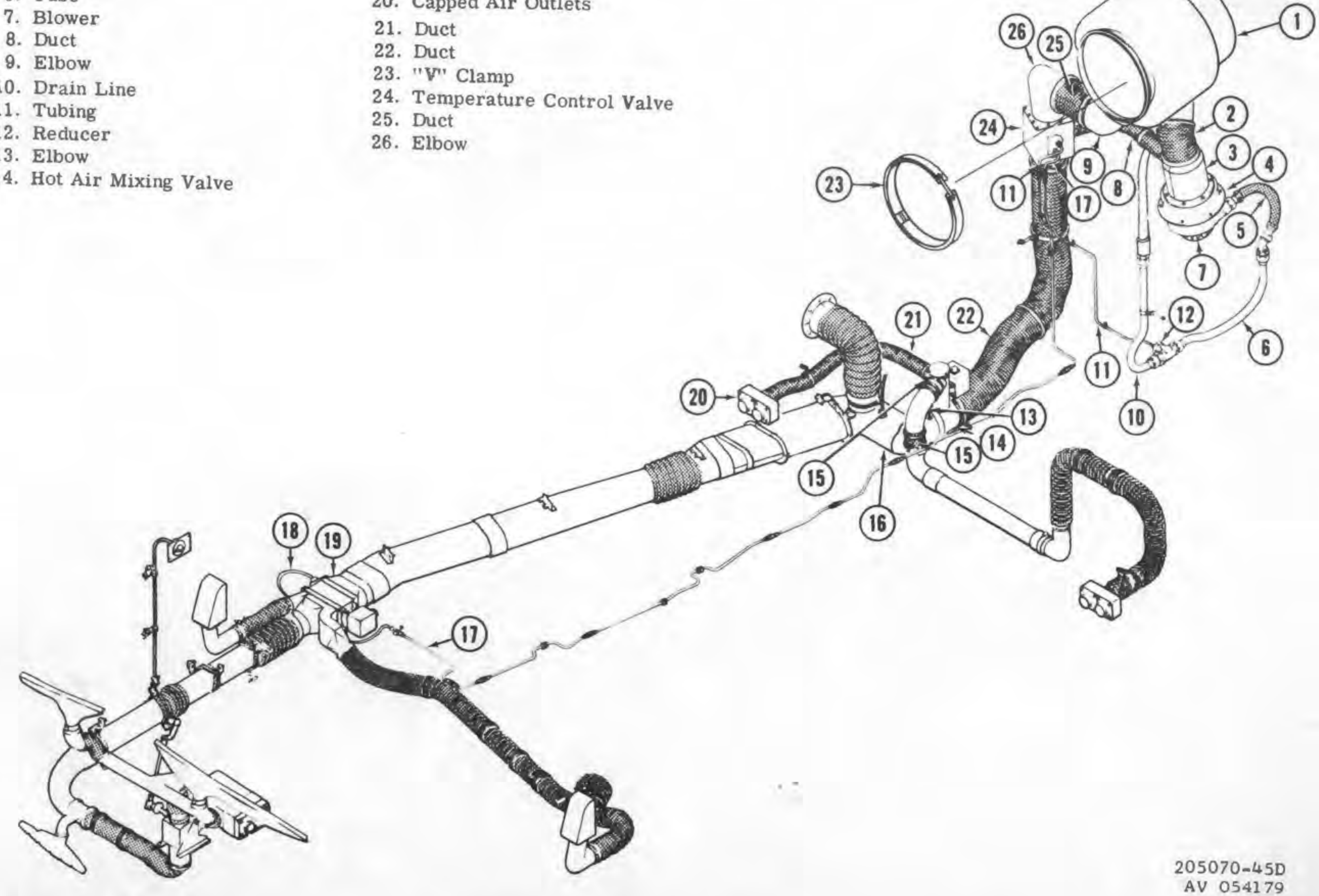
(2) Place a bead of zinc chromate putty (item 200, table 1-2) on mating sections of roof skin (forward scoops only), position pan and align screw holes.

(3) Position scoop assembly on pan assembly, align holes and install screws.

11-13. Auxiliary Exhaust Heater.

The auxiliary exhaust heater system (see figure 11-4) consists of a heat exchanger on the exhaust tailpipe, a blower for circulating air through the heat exchanger, a

1. Heater Exchange
2. Duct
3. Tee
4. Fan
5. Hot Air Bleed Line
6. Tube
7. Blower
8. Duct
9. Elbow
10. Drain Line
11. Tubing
12. Reducer
13. Elbow
14. Hot Air Mixing Valve
15. Flexible Coupling
16. Plenum
17. Tube
18. Tube
19. Distribution Valve
20. Capped Air Outlets
21. Duct
22. Duct
23. "V" Clamp
24. Temperature Control Valve
25. Duct
26. Elbow



205070-45D
AV 054179

Figure 11-4. Exhaust heater installation

mixing valve to conyrol the air to maintain the desired temperature, a plenum assembly which controls the aft cabin outlet ducts, and connect ducts.

a. Inspection – Auxiliary Exhaust Heater.

(1) Check heater ducts for cracks, fraying and wear.

(2) Check clamps for security and condition.

(3) Check hot air mixing valve for security of mounting.

(4) Check temperature control valve for security of mounting.

(5) Check plenum for damage and security of mounting.

b. Heat Exchanger – UH-1D/H (Serial No. 60-6028 Through 65-12895). The heat exchanger (1, figure 11-4) is mounted on the tail pipe of the engine and serves to heat the air as it is distributed through the heat-defrost system. Air is circulated through heat exchanger by the blower fan (4).

c. Blower. An air-driven blower (7, figure 11-4) is connected to the inlet port of the heat exchanger (1).

d. Inspection – Air Blower.

(1) Check blower for damage.

(2) Check blower for security of mounting and security of attachment of bleed air hose and ducts.

e. Hot Air Mixing Valve Assembly. The hot air mixing valve (14, figure 11-4) controls the air to maintain the desired temperature of air routed to the cabin. The valve assumes its position as a result of increasing or decreasing pressures, as dictated by the remote sensor, using bleed air through the actuator to drive the butterfly to the correct position.

f. Inspection – Hot Air Mixing Valve Assembly. Refer to paragraph 11-13a.

g. Temperature Control Valve. The temperature control valve (24, figure 11-4) senses the air temperature in the distribution ducts and controls the hot air mixing valve by increasing or decreasing bleed air pressure by positioning the flapper valve to maintain the selected temperature.

h. Removal – Temperature Control Valve. (See 24, figure 11-4.)

(1) Disconnect tube (18, figure 11-4) from distribution valve (19) and tube (17).

(2) Remove brackets that attach tubing (11) to lower end of bulkhead fitting. Disconnect tubing (11) from reducing adapter (12) in bleed air line and remove.

(3) Disconnect tubing (11) from temperature control valve (24).

(4) Remove tubing (17) from bulkhead fitting and disconnect from temperature control valve (24).

(5) Remove clamp that secures duct (25) to elbow (26).

(6) Remove elbow (26) and gasket from temperature control valve (24).

(7) Remove clamp that secures duct (8) to temperature control valve (24).

(8) Remove clamp that secures duct (22) to temperature control valve (24).

(9) Remove bolts that secure temperature control valve (24) to cabin deck and remove temperature control valve.

i. Inspection – Temperature Control Valve. Refer to paragraph 11-13a.

j. Installation – Temperature Control Valve.

(1) Remove cover on right side of deck.

(2) Position temperature control valve (24, figure 11-4) through hole in cabin deck and secure with bolts.

(3) Position duct (8) on aft port of temperature control valve (24) and secure duct to temperature control valve with clamp, screw, washer, and nut.

(4) Position gasket on top flange of temperature control valve (24). Position elbow (26) on temperature control valve (24) and secure with screws.

(5) Position duct (25) on elbow (26) and secure with clamp, screw, washer, and nut.

(6) Position temperature control valve (24) on duct (22) and secure with clamp.

(7) Remove cap from existing bulkhead fitting at right hand forward side of deck. Install tubing (17) from bulkhead fitting to inboard connection of temperature control valve (24).

(8) Remove plug from deck and install bulkhead fitting and jam nut.

(9) Install tubing (11) from bulkhead fitting to fitting on temperature control valve (24).

(10) Attach tubing (11) to lower end of bulkhead fitting, previously installed and route and attach to reducing adapter (12) in hot air bleed line (5) on left side of fuselage. Secure tubing to bulkhead with brackets, screws, washers, and nuts.

(11) Remove cap from tube (17) and attach flexible tube (18). Route tube (18) beneath distribution valve (19) and connect to sensor switch.

(12) Unstow electrical plug near hot air mixing valve (14) and attach sensor on aft side of hot air mixing valve.

k. Plenum Assembly. The plenum assembly controls the flow of air to the aft cabin.

l. Removal – Plenum Assembly.

(1) Remove clamps and ducts from valve assembly.

(2) Remove cable assembly from plenum.

(3) Disconnect electrical wiring.

(4) Remove mounting screws and washers, and lift assembly from helicopter.

m. Inspection – Plenum Assembly. Refer to paragraph 11-13a.

n. Installation – Plenum Assembly.

(1) Position plenum assembly in place and install mounting screws and washers.

(2) Install ducts and clamps.

(3) Connect cable assembly and electrical wiring.

o. Ducts, Nozzles, Registers, Gaskets and Miscellaneous Valves.

p. Maintain heater miscellaneous components (see figures 11-1, 11-2 and 11-4) in accordance with the following paragraphs.

q. Removal – Ducts, Nozzles, Registers, Gaskets and Miscellaneous Valves. Remove attaching hardware and/or clamps and remove component.

r. Inspection – Ducts, Nozzles, Registers, Gaskets and Miscellaneous Valves.

(1) Inspect hoses for cracks, corrosion, wear and deterioration.

(2) Inspect nozzles, registers and valves for damage and serviceability.

(3) Inspect gaskets for damage.

(4) Inspect duct screens for obstructions, cuts and cleanliness.

(5) Inspect flexible air ducts as follows:

(a) Silicone damage not in excess of 3.00 inches in length and 1.50 inches wide.

(b) Maximum of two repairs per foot of duct.

(c) No more than 3% of surface area may be repaired.

s. Repair or Replacement – Ducts, Nozzles, Registers, Gaskets and Miscellaneous Valves.

(1) Replace damaged or unserviceable hoses.

(2) Replace nozzles, registers, valves and gaskets which do not meet inspection requirements.

(3) If necessary, clean and remove obstructions from duct screens. Replace screens if cut or damaged.

(4) Repair flexible air ducts as follows:

(a) Clean damaged area with Xylene (item 321, table 1-2) or Toluene (item 322, table 1-2). Allow cleaned area to air dry a minimum of 30 minutes.

(b) Apply a brush coat of adhesive (item 214, table 1-2) on damaged area with a 0.500 inch overlap from edge of damaged area.

(c) Smooth and cure by air drying a minimum of two hours at room temperature or until it is dry to the touch.

NOTE

For repair of damage to the fiber glass cloth, the limitation is no more than 10% of surface area after completion of repair.

(d) Clean the complete circumference of the air duct in the vicinity of damaged area with Xylene (item 321, table 1-2) or Toluene (item 322, table 1-2). Allow cleaned area to air dry a minimum of 30 minutes.

(e) Use brush to apply a thin coat of adhesive (item 214, Table 1-2) to the complete circumference of the duct in the damaged area and smooth out adhesive.

(f) Cut a piece of fiber glass cloth (item 511, table 1-2) of sufficient size to cover the complete

circumference of the duct, with a one inch overlap of the damaged area.

(g) Wrap fiber glass cloth around duct and smooth out.

(h) Allow to air dry a minimum of two hours or until dry to touch before handling.

t. Installation – Ducts, Nozzles, Registers, Gaskets and Miscellaneous Valves. Install component and secure with attaching hardware and/or clamps.

Section III. ANTI-ICING AND DEICING SYSTEM

(Not Applicable)

Section IV. OXYGEN SYSTEM

(Not Applicable)

Section V. FIRE DETECTOR SYSTEM

11-14. Fire Detection System – Engine.

The engine fire detection system (see figure 11-5) consists of a fire detector unit, FIRE WARNING caution light, and FIRE DETECTOR TEST pushbutton switch. The fire detector unit consists of two heat sensitive wires (2) one on inside of each engine cowl in the engine compartment. The wires are mounted in spring support brackets (3). The caution light and test switch are located on the instrument panel.

a. Troubleshooting – Fire Detector. The following is a list of indications of trouble, probable causes and corrective action.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Indicator light inoperative	Burnt out bulb	Replace bulb
	Defective test switch	Replace switch
	Loose electrical connections	Tighten connections
	Broken or disconnected detector wire	Replace or connect detector wire

b. Testing – Fire Detector.

(1) Disconnect electrical plug located in work deck directly under power plant on left-hand side of helicopter at station 184.41.

(2) Short receptacle pins "C" and "F" together, depress the "Push-to-Test" switch. Fire warning light should come on.

NOTE

This test assures that the test and control circuit is operable.

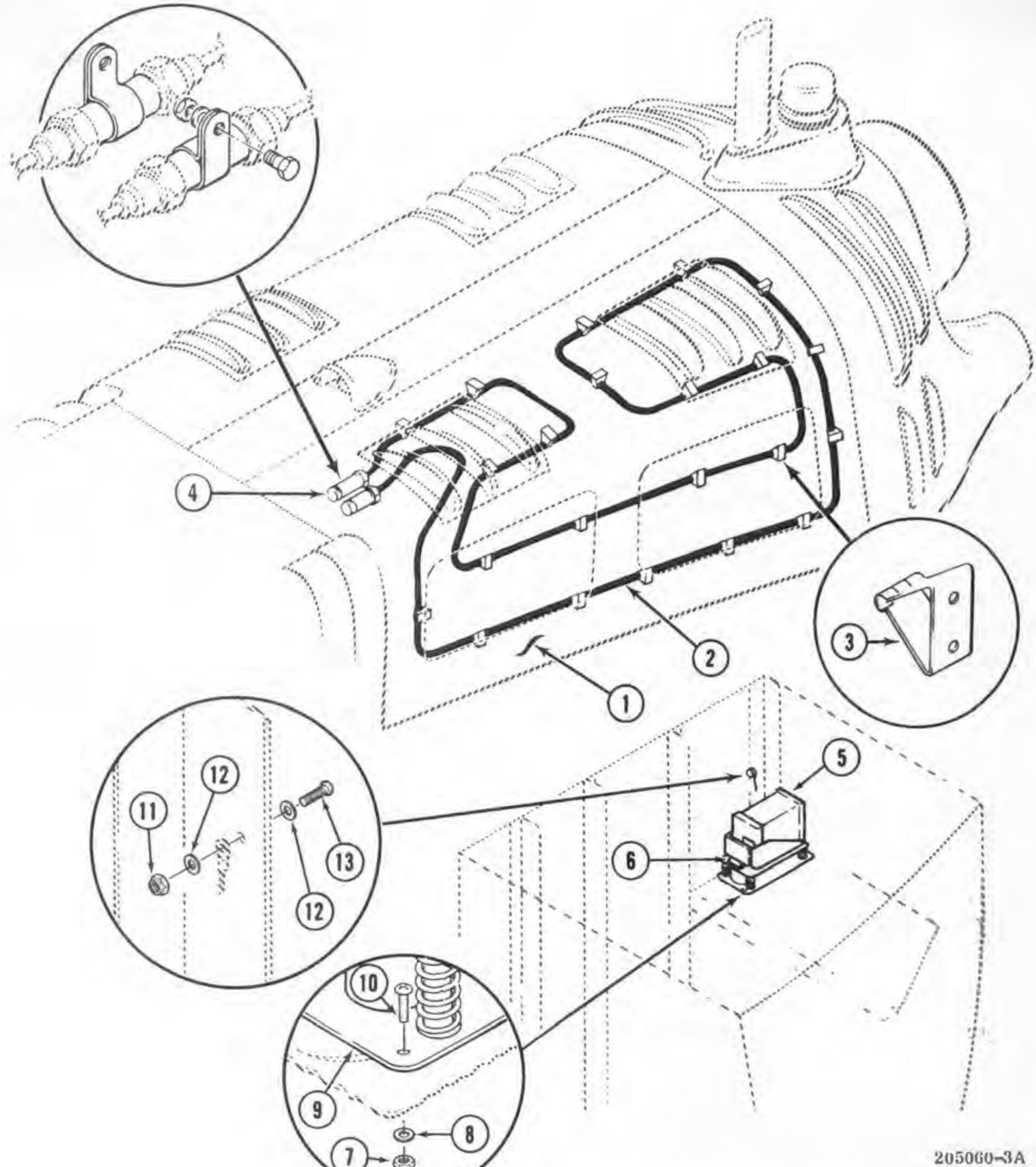
(3) Remove the jumper wire from pins "C" and "F" and use it to short either receptacle pin "C" or "F" to ground.

(4) Fire warning light should come on.

NOTE

This test assures that the alarm circuit is operable.

(5) Use an ohmmeter to check conductivity between pins "C" and "F" at plug side of harness.



1. Engine Cowl (LH)
2. Fire Detector Wire
3. Support Bracket
4. Receptacle
5. Fire Detector Control Box
6. Resistor
7. Nut
8. Washer
9. Mount
10. Screw
11. Nut
12. Washer
13. Screw

Figure 11-5. Engine fire detector

NOTE

Maximum resistance should not exceed 20 ohms. If higher value registers, check all connectors for tightness.

(6) Use an ohmmeter to check either pin "C" or "F" to ground at plug side of harness.

NOTE

Value register should always be a minimum of 200,000 ohms at an ambient temperature of 72°F. As the ambient temperature rises, the resistance value of pin "C" or "F" to ground will decrease. At 100°F this resistance should be a minimum of 100,000 ohms.

(7) If the above values are not obtained, it will be necessary to check each cable for resistance from center pin of cable to ground. At 72°F, the minimum value of each cable is one megohm. Resistance below this value will indicate a faulty cable which should be replaced.

(8) Re-connect main firewall cannon plug.

(9) Depress "Push-to-Test" switch to assure that system is properly assembled.

(10) Install a Jet-Cal Tester Unit to area of cable that assures a good fit for the temperature probe.

NOTE

Make sure that temperature probe is contacting nothing but the cable. It is easy to "heat-sink" the probe if contact is made with helicopter structure.

(11) When alarm light comes on, check indicator on Jet-Cal Tester Unit. Value should be 429°F plus or minus 111°F.

NOTE

The Jet-Cal Tester Unit is only a check system under heated condition. The temperature warning light comes on is not a good indication of system operation temperature.

(12) Remove test equipment and safety wire all electrical connectors and cannon plugs.

c. *Removal – Fire Detector.*

(1) Make sure battery switch is in "OFF" position.

(2) Disconnect electrical wiring from detector wire receptacles and cover wire ends with insulating tape.

(3) Remove bolts, washers, and nuts attaching detector wire receptacles to engine cowl.

(4) Apply pressure on each side of detector wire retaining clips and remove detector wire from cowl.

(5) Remove safety wire from retaining nuts on each end of detector wire receptacles. Remove top nut on each receptacle and remove detector wire ends.

(6) Remove fire detector control unit located in electrical and radio compartment, station 178.00 on left hand side of helicopter, as follows: (See figure 11-5).

(a) Make sure that battery switch is in "OFF" position.

(b) Disconnect cable connector from the fire detector control box (5).

(c) Remove screw (13), two washers (12), and nut (11) securing ground cable to bulkhead.

(d) Remove four screws (10), four washers (8), and four nuts (7), securing fire detector control box (5) to shelf of electrical and radio compartment.

(e) Remove fire detector control box (5).

d. *Inspection – Fire Detector.*

(1) Inspect wires for damage and wear.

(2) Inspect wire retention clips for cracks and serviceability.

(3) Inspect fire detector control box for security of mounting.

e. *Repair or Replacement – Fire Detector.*

(1) Replace wires if damaged or worn.

(2) Replace clips if broken, cracked, or unserviceable.

(3) Replace fire detector control box if unserviceable.

f. *Installation – Fire Detector.*

(1) Insert detector wire ends into receptacle and tighten retaining nuts. Safety wire top and bottom retaining nuts together, on each receptacle.

(2) Position detector wire receptacles on engine cowl and install attaching units, washers, and bolts.

(3) Position and route detector wire through spring retention clips.

(4) Remove insulating tape from wire ends and connect electrical wiring to detector wire receptacles.

(5) Install fire detector control box in electrical and radio compartment, station 178.00 on left hand side of helicopter as follows: (See figure 11-5).

NOTE

Before installation, check resistor (6) for continuity and security on face of fire detector control box.

(a) Secure fire detector control box (5) to shelf of electrical and radio compartment using four screws (10), four washers (8), and four nuts (7).

(b) Attach ground cable to bulkhead with screw (13), two washers (12), and nut (11).

(c) Reconnect battery.

Section VI. FIRE EXTINGUISHER SYSTEM

(Not Applicable)

Section VII. DEFROSTER SYSTEM

(Refer to Section II)

Section VIII. WINDSHIELD WIPER SYSTEM

11-15. Windshield Wiper.

Model UH-1D/H helicopters are equipped with a windshield wiper for both pilot and copilot. Circuit breakers in the overhead console panel protect these installations in case of malfunction. A five position rotary switch on the miscellaneous panel of the overhead console permits operation of the wipers at low, medium or high speed. A selector switch permits operation of pilot and copilot windshield wipers separately or simultaneously. Special tools required to perform the following maintenance functions on the windshield wiper system are listed below in Table 11-1.

Table 11-1. Special Tools

PART NUMBER	NOMENCLATURE
XW 20509	Wrench

a. Removal – Windshield Wiper and Motor-Converter.

(1) Turn battery to OFF position.

CAUTION

Install 3/32 cotter key in stand-off holes prior to removal of windshield wipers.

(2) Remove windshield wiper blade and universal arm from motor shaft. Disconnect electrical receptacle.

(3) Remove bolts which attach head guard bracket and windshield wiper support to cabin. Lift brackets, and motor-converter from cabin.

(4) Remove four nuts, washers, and bolts which attach motor-converter to bracket support.

b. Inspection – Windshield Wiper Blade. Inspect blade for deterioration and serviceability. Check continuity of electrical circuits. (Refer to Chapter 13.)

c. Repair or Replacement – Windshield Wiper Blade. Replace unserviceable blade.

d. Installation – Windshield Wiper and Motor-Converter.

(1) Position motor-converter in support and install mounting bolts, washers, and nuts.

(2) Place converter shaft through hole in cabin and position head guard assembly over motor-converter. Align holes in head assembly and windshield wiper support with holes in cabin, and install mounting screws and connect electrical receptacle.

(3) Operate the motor-converter so that wiper shaft is stopped in the PARK position.

(4) Install wiper arm and blade assembly on serrated shaft so that blade will be parallel to and 5.0 to 5.5 inches below the windshield wiper stop, with a slight upward pressure being applied to arm.

(5) Tighten Allen head screw clamping wiper arm to shaft, install washer and mounting bolt. Safety the Allen screw to mounting bolt.

(6) Using wrench No. XW20509, adjust pressure of blade on windshield to 4.5 to 5 pounds measured at intersection of wiper blade and wiper arm.

CAUTION

Do not operate wiper on dry windshields. Install 3/32 inch cotter key in standoff holes before operating.

(7) With battery switch ON and wiper circuit breaker IN, using wiper control switch, operate the wiper through all speeds, and return to the PARK position.

CAUTION

Testing of the windshield wiper with blade raised clear of windshield should be done in small increments. Do not allow blade to operate fast enough to cause whipping, this can bend wiper arm.

(8) Remove 3/32 inch cotter key from standoff holes and carefully lower blade onto windshield.

Section IX. AUXILIARY POWER UNIT

(Not Applicable)

Section X. VACUUM SYSTEM

(Not Applicable)

Section XI. AUXILIARY FUEL SYSTEM

11-16. 300 Gallon Fuel System — Auxiliary.

Two 150 U.S. gallon capacity auxiliary fuel cells (see figure 11-6) may be installed in the passenger-cargo compartment of the YUH-1D and UH-1D/H helicopters for extended distance and ferry missions. The cells are located at the intersection of the aft cabin bulkhead and the transmission support structure, one on each side of cabin. Each cell is equipped with an electrically operated fuel transfer pump, a fuel low-level switch for controlling CAUTION panel indicator AUX FUEL LOW circuit, fittings and flexible hoses with quick-disconnect couplings. The fuel cell hoses connect to lines under the cabin floor which are a permanent part of the main fuel system. The auxiliary transfer pump circuit relay is controlled by float switches in the main fuel cells. (Refer to TM 55-1520-210-10 for operating instructions and general information.)

a. Removal — Auxiliary Fuel Cells.

NOTE

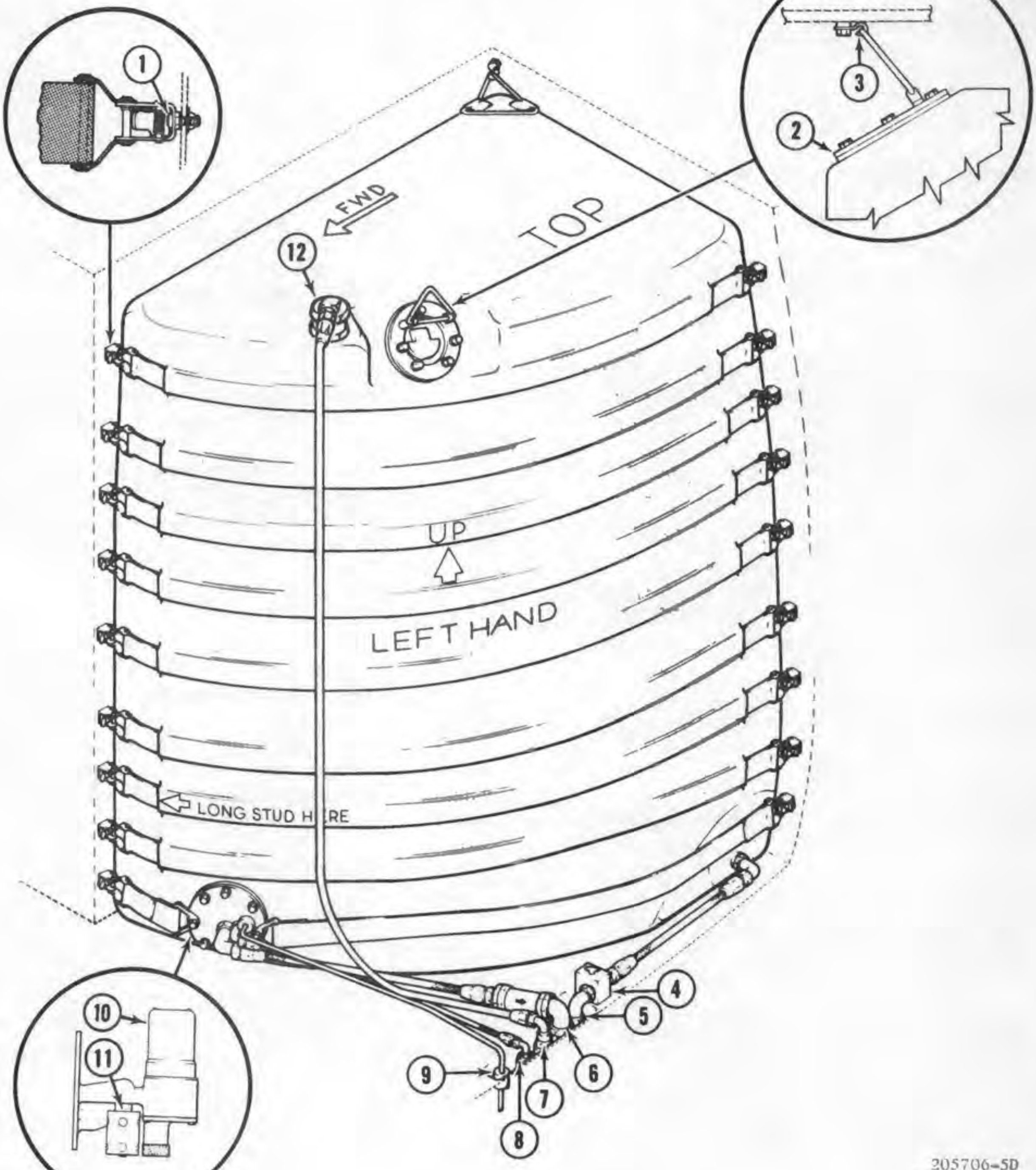
Procedure is the same for both tanks.

NOTE

Drain fuel from auxiliary cells before removing the helicopter.

(1) Disconnect four fuel lines (fuel discharge, cell vent, seal drain, and cell drain) and electrical connector at cabin floor.

(2) Install protective devices, over ends of all lines and plugs, under deck and on cell.



1. Stud
2. Fuel Tank Cap and Adapter Assembly
3. Hook
4. Valve
5. Tank Drain Line
6. Fuel Discharge Line
7. Tank Vent Line
8. Pump Seal Drain Line
9. Electrical Connector
10. Pump Assembly
11. Float Switch
12. Vent Valve

Figure 11-6. Auxiliary fuel cell installation – typical

(3) Install cover plate over fuel line access hole on cabin floor.

(4) Disconnect auxiliary cell holding straps from studs (18 points) at aft cabin bulkhead and transmission support structure.

(5) Unhook two nylon cord loops on top of cell.

(6) Carefully remove cell from helicopter.

NOTE

For repair, handling, and storage instructions of fuel cell, refer to 55-1500-204-25/1.

(7) If auxiliary cell is to remain out of the helicopter, remove all fuel cell equipment kit items from aft cabin bulkhead and transmission support structure and place in storage compartment in door post. Re-install all troop seats and litter fittings along sides of aft cabin bulkhead and transmission support structure.

b. Fuel Pump – Auxiliary Fuel Cell. The electrically operated fuel pump is capable of pumping approximately 600 pounds of fuel per hour at sea level. The auxiliary fuel cell incorporates a float switch to give CAUTION panel (AUX FUEL LOW) indication to the pilot when fuel level is low.

c. Removal – Fuel Pump – Auxiliary Fuel Cell.

NOTE

Turn battery switch to OFF. Drain all fuel from cell.

(1) Disconnect electrical connector and two fuel lines (fuel discharge and seal drain) at access port in cabin floor.

(2) Remove seven bolts and washers holding fuel pump and holding-strap fittings to fuel cell.

(3) Carefully withdraw pump and O-ring from fuel cell by pulling outward and upward on fuel pump base. Upward movement is required in order to clear pump body through opening in cell.

d. Installation – Fuel Pump – Auxiliary Fuel Cell.

(1) Install fuel pump and O-ring into cell with flat section of mounting flange down, using reverse procedure to that noted in step (3), above.

(2) Install seven bolts and washers, two passing through the fittings of cell holding strap.

(3) Tighten bolts to a torque of 50 to 70 inch-pounds.

(4) Connect electrical connector and two fuel lines in access port in cabin floor.

(5) Check installation for leaks.

NOTE

Fuel cell installation to be pressure tested with fuel discharge lines, sump drain lines, vent lines, and seal drain lines capped. Pressurize cells to 2.5 psig and shut off air source. Cells shall retain 2.5 psig pressure for 15 minutes.

e. Installation – Auxiliary Fuel Cells.

(1) Remove troop seats and litter fittings from aft cabin bulkhead and sides of transmission support structure.

(2) Remove auxiliary fuel cell equipment kit items from stowage in doorpost. Install 18 studs and washers into cap plate nuts on aft cabin bulkhead and transmission support structure. Tighten studs to a torque of 50 to 70 inch-pounds.

NOTE

The long stud is used in third plate nut from bottom of transmission support structure.

(3) Install spacer, hook, washer, and bolt into plate nut at top of transmission support structure. Install like items in plate nut at top of aft cabin bulkhead. Tighten bolts to a torque of 50 to 70 inch-pounds.

(4) Carefully lift cell into helicopter.

(5) Thread 0.187 inch nylon cord through two aft cell hangers and through hook on upper transmission support structure. Tighten and tie cord in such a manner as to retain fuel cell to support structure. Repeat process to secure forward end of fuel cell to aft cabin bulkhead, using cord through delta ring hanger and hook on cabin bulkhead.

(6) Snap cell-holding straps to studs on aft cabin bulkhead and transmission support structure. (See figure 11-6.)

(7) Remove cover over fuel lines access on top of cabin floor; remove caps from all lines and plugs.

(8) Connect electrical connector and four lines from cell.

(9) It will be necessary to check transmission oil level by use of mirror when auxiliary fuel cell is installed.

CHAPTER 12

ELECTRICAL SYSTEMS

Section I. INTRODUCTION

12-1. Purpose.

This chapter provides the instructions and information required by organizational maintenance personnel to perform maintenance on the UH-1D/H electrical system.

12-2. General.

All DC electrical power in the helicopter during flight is supplied by a 24 volt battery or by either of two 28 volt dc generators. The main DC generator is mounted on and driven by the main rotor transmission. The stand-by generator is a combination starter-generator which is mounted on and driven directly by the helicopter engine. Control panels for the AC and DC electrical systems are located on the overhead console between the pilot and copilot. Control relays, power relays, voltage regulators, and other equipment required to control and regulate, and to effect power transfer and malfunction monitoring are located in the upper (aft) electrical compartment on left side of fuselage. On YUH-1D and UH-1D/H through 62-12376 a lower (aft) electrical compartment is utilized. On UH-1D/H 63-8739 and subsequent, the inverters and associated equipment, formerly located in the aft electrical compartment are relocated to the nose compartment just forward of the pedestal. For compartment location, see figure 12-1. For equipment location, see figure 12-2. See tables 13-1 through 13-4 for equipment listing; table 13-5 for connector replacement chart. See figures 13-3 through 13-9 for load analysis charts. See figures 13-10 through 13-39 for systems wiring diagrams. See figures 13-40 and 13-41 for armament wiring diagrams, and figures 13-42 through 13-49 for wiring diagrams of helicopters prior to 65-9565.

NOTE

1. Illustrations pertaining to circuit breakers, control panel arrangement and face identification are contained in TM 55-1520-210-10.

2. Throughout this chapter when performing operational checks external power should be utilized whenever possible. Perform operational checks to make certain that circuits are free of possible potential malfunction when equipment is replaced or airframe wiring is repaired or replaced.

3. Words "cycles" or "hertz" are used to designate frequency; either word has the same meaning. The abbreviation "cps" carries the same meaning as "Hz".

12-3. Operational Checks — Electrical.

Systems diagrams, wiring diagrams and schematics shall be utilized in accomplishing functional tests of electrical circuits and components. Tests shall be conducted after installation, repair or replacement of equipment.

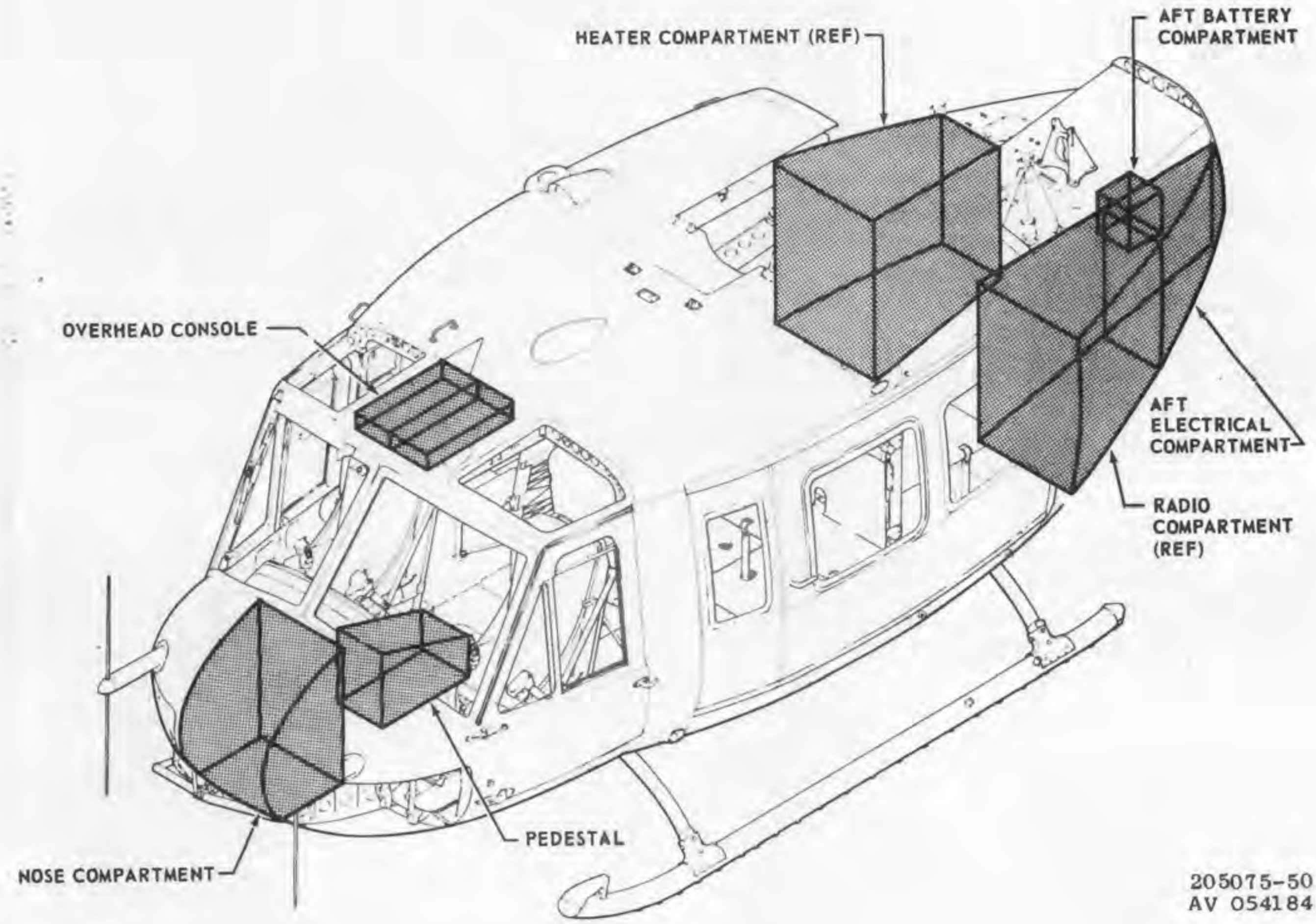


Figure 12-1. Compartment location — electrical

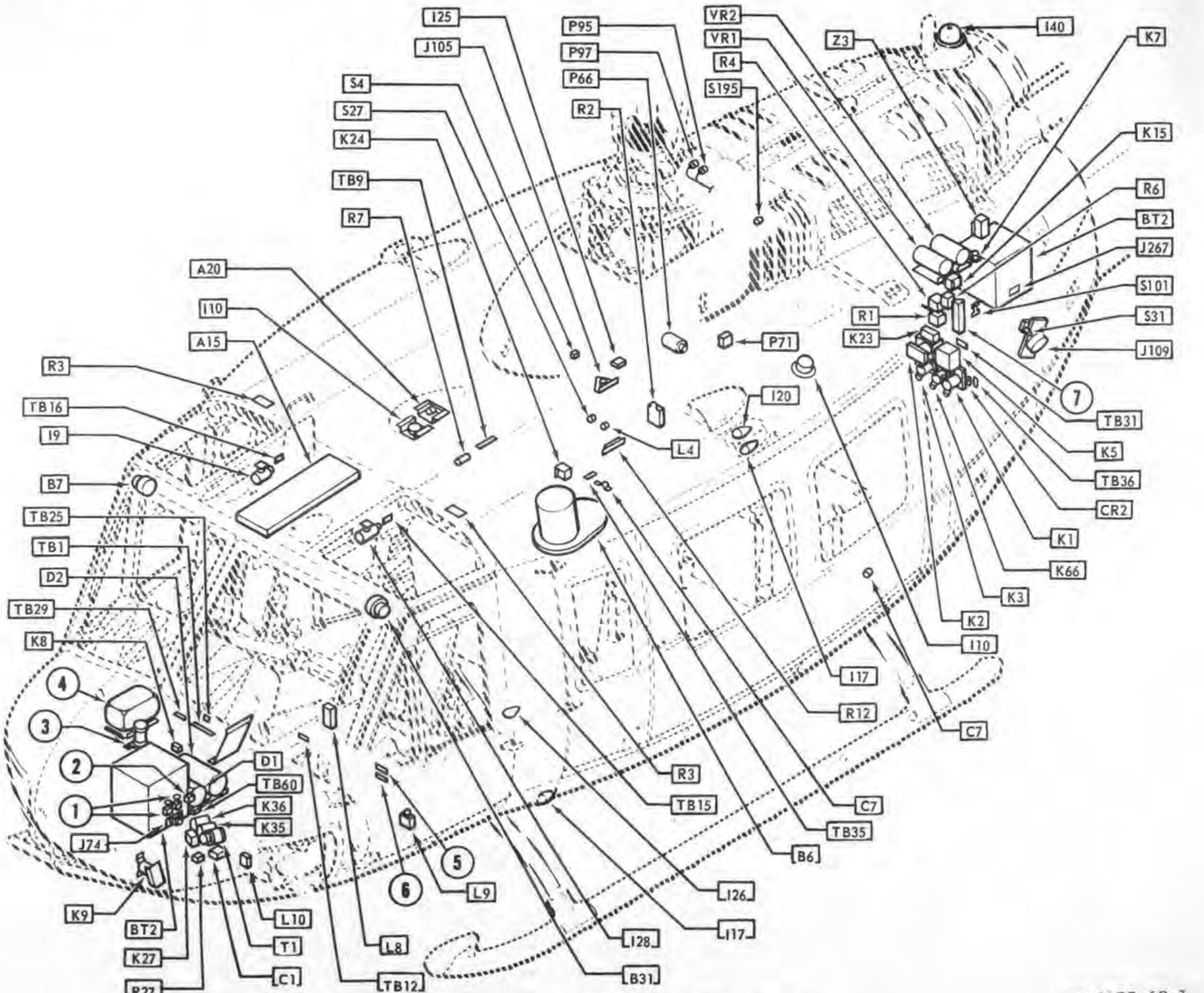
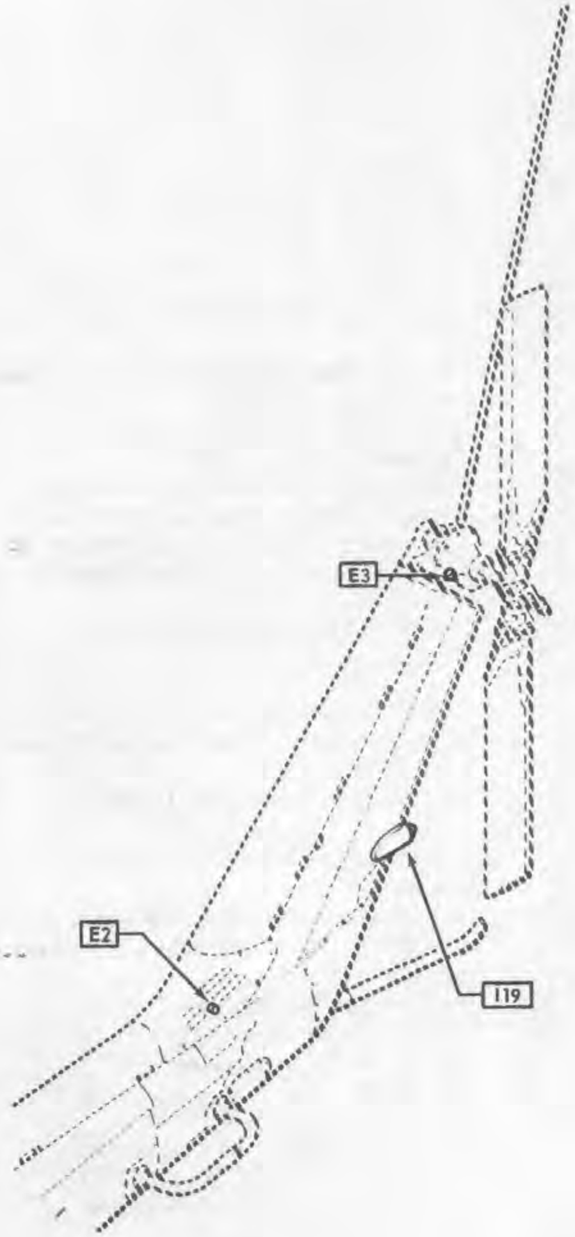


Figure 12-2. Electrical equipment location (Sheet 1 of 3)



CODE ITEM	DESCRIPTION
A15	Overhead Console Panel
A20	Aft Dome Lights Panel
B6	Fuel Boost Pump Motor
B7	Windshield Wiper Motor - Pilot
B31	Windshield Wiper Motor - Copilot
BT2	Battery
C1	Capacitor, Power Factor Correction
C7	Capacitor, Noise Filter
CR2	Diode, External Power Relay
D1	Inverter - Main
D2	Inverter - Spare
E2	Magnetic Chip Detector - 42° Gearbox
E3	Magnetic Chip Detector - 90° Gearbox
I9	Utility Light - Pilot
I10	Dome Light
I17	Navigation Light - Left
I19	Tail Light
I20	Fuselage Light - Top
I25	Transmission Sump Inspection Light
I26	Fuselage Light - Bottom
I28	Utility Light - Copilot
I20	Anti-Collision Light
J74	Receptacle, Battery Disconnect - Forward
J105	Receptacle, Heated Blanket - Left-hand
J109	Receptacle, External Power
J267	Receptacle, Battery Disconnect - Aft
K1	Relay, External Power
K2	Relay, Non-Essential Bus
K3	Relay, Starter
K4	Relay, Bus Control - Generator Fail
K5	Relay, Reverse Current - Main Generator
K7	Relay, Generator Field
K8	Relay, A.C. Failure
K9	Relay, Battery - Forward
K10	Relay, Fuel Transfer
K15	Relay, Standby Generator Field
K23	Relay, Standby Generator Reverse Current
K24	Relay, Cargo Hook Release
K27	Relay, Inverter
K35	Relay, Main Inverter Power
K36	Relay, Spare Inverter Power
K66	Relay, Battery Feeder

205075-60-2

Figure 12-2. Electrical equipment location (Sheet 2 of 3)

CODE ITEM	DESCRIPTION
L4	Solenoid, Hydraulic Bypass
L8	Magnetic Brake, Anti-Torque Force Trim
L9	Magnetic Brake, Fore & Aft Force Trim
L10	Magnetic Brake, Lateral Force Trim
P66	Plug, Fuel Pressure Mixture
P71	Plug, Fuel Valve Shut-Off
P95	Plug, Fire Detector Element - Left-hand
P97	Plug, Fire Detector Element - Left-hand
R1	Shunt-Ammeter - Standby Generator
R2	Shunt-Ammeter - Main Generator
R3	Resistor, Windshield Wiper
R7	Resistor, Navigation Lights - Dim
R12	Resistor, Spool Thermocouple
R27	Resistor, A.C. Load Balancing
S4	Switch, Transmission Sump Inspection Light
S27	Switch, Hydraulic Pressure
S31	Switch, Limit-External Power Door
S101	Switch, Differential Pressure
T1	Transformer, 115/28 Volt
TB1	Terminal Board, Forward Instrument Panel
TB9	Terminal Board, Top & Dome Lights
TB12	Terminal Board, Pedestal Panel Edge Lights
TB15	Terminal Board, Cockpit Lights - Left-hand
TB16	Terminal Board, Cockpit Lights - Right-hand
TB25	Terminal Board, Thermocouple - Indicator
TB29	Terminal Board, Instrument Ground
TB35	Terminal Board, Right-hand Fuel Cell
TB36	Terminal Board, External Power Diode
TB39	Terminal Board, Electrical Compartment - Aft
TB60	Terminal Board, Battery Voltage - Forward
VR 1	Voltage Regulator - Main Generator
VR2	Voltage Regulator - Standby Generator
Z3	Flasher Unit, Navigation Lights
1.	Power Factor Correction Circuit Breakers
2.	Battery Voltmeter Circuit Breaker
3.	AM-3209( )/ASN Amplifier, Electronics Control
4.	Vertical Gyro - Type MD-1
5.	Junction Box - Upper, BJ-4-F
6.	Junction Box - Lower, BJ-4-A
7.	Circuit Breakers a. Main Generator Voltmeter b. Standby Generator Loadmeter Voltmeter c. Standby Generator Loadmeter d. Main Generator Field

205075-60-3
AV 054241

Figure 12-2. Electrical equipment location (Sheet 3 of 3)

Section II. DIRECT CURRENT POWER DISTRIBUTION SYSTEM

12-4. Description.

The Direct Current Power System provides all basic power for operation of electrical components installed in the UH-1D/H Helicopter.

12-5. Miscellaneous Electrical Components.

Included in this category are relays, rheostats, switches, circuit breakers, plugs, leads, connectors, wiring, conduits, receptacles, shunts and shock mounts.

a. Removal. Remove attaching hardware, clamps and/or connectors and remove component.

NOTE

Before attempting to remove or adjust any electrical component, disconnect battery.

b. Inspection.

(1) Inspect rheostats for security, corrosion, burned element, damaged wiper, cracks and correct resistance.

(2) Inspect switches for weak detents, security, corrosion, continuity in ON and OFF position.

(3) Inspect circuit breakers for security, corrosion, actuation for circuit power on and power off and reset retentions.

(4) Inspect plugs, connectors and receptacles for security, contact corrosion, damaged contacts, broken wires, faulty contacts, insert cracks and faulty insulation.

(5) Inspect leads and wiring for loose terminals, chaffing, corrosion or deteriorated conditions, faulty or damaged insulation, excessive mechanical stress, broken strands, damaged shielding, shorted shielding, routing and mounting conditions. (Refer to TM 55-1500-204-25/1 for inspection of electrical wiring.)

(6) Inspect conduits for security, surface damage, cracks, corrosion and deterioration.

(7) Inspect shunts for corrosion, security, deep scratches, physical damage and discoloration (indicating excessive overloading).

(8) Inspect shockmounts for retention, security, cracks, distortion, corrosion and bonding.

(9) 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.)

c. Repair or Replacement.

(1) Tighten loose terminal connectors, mounting and attachments of electrical components.

(2) Replace miscellaneous electrical components that fail to meet inspection requirements.

d. Installation.

(1) Install component and secure with attaching hardware or clamps.

(2) Attach terminals and/or connectors.

12-6. 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.

a. Removal. Remove control panels as follows:

NOTE

The removal procedure for all panels is relatively the same. A single removal procedure may be used for any panel.

(1) Be sure all electrical power if OFF.

(2) Disengage fasteners holding panel to pedestal or overhead console. Carefully lift panel from mount and disconnect electrical connector.

b. Inspection. Visually inspect for scratches, chipped, or broken edge lit panels, loose wiring connections, damaged or faulty switches, damaged connectors and broken or missing mounting fasteners.

c. Repair or Replacement. Replace items that fail to meet inspection requirements.

d. Installation. Connect electrical connector. Position panel in mount being careful not to damage wiring. Engage fasteners.

12-7. DC Circuit Breakers.

The DC circuit breakers are mounted on the overhead console. DC circuits can be opened and closed by operating these trip-free, push-pull circuit breakers.

a. Removal.

(1) Be sure all electrical power is OFF.

(2) Disengage fasteners and open appropriate panel assembly of overhead console.

(3) Disconnect wiring to appropriate breaker and cover wire ends.

(4) Remove mounting screws and lift breaker from panel assembly.

b. Inspection. (Refer to paragraph 12-5.)

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation.

(1) Position breaker in panel assembly and install mounting screws.

(2) Remove cover from wire ends and connect to breaker.

(3) Close panel assembly and engage fasteners.

12-8. External Power System.

For ground checks of the aircraft's electrical systems, power may be supplied from an external power supply. This is accomplished by use of an external power receptacle on the side of the aircraft. Applying external power to the receptacle results in an external power relay automatically connecting power to all DC buses if the polarity of the external power supply is correct; if polarity is reversed the external relay will not close due to a diode in its coil circuit. All circuits in the helicopter function the same on external power as on power from the main generator system. Circuit breakers in the individual systems will protect the aircraft circuit from too much current should overvoltage be applied to the aircraft from the external power supply.

a. Troubleshooting. Perform checks as necessary to isolate trouble. See figure 13-18.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Lack of power when external power plug is inserted.	Reverse polarity in plug.	Rework plug to correct polarity.
	Relay points corroded or pitted.	Replace points or relay.
	Power supply from external source too low.	Increase output of external power.

b. Operational Check. Place battery switch in OFF position and non-essential bus switch in the manual position. Connect 28 volt external power supply to the external power receptacle. Move voltmeter selector switch (S2) to all positions and observe voltmeter indications. Voltmeter should indicate 28 volts in the essential bus and non-essential bus positions. Zero volts should be the indication in all other positions.

(1) Place non-essential switch (S62) in the manual position. Voltmeter indications should be the same as above.

(2) Place the battery switch in the "ON" position with battery connected. Voltmeter should indicate 28 volts in the BATT, non-essential bus, and Essential bus position and zero voltage in all other positions.

(3) Insure that battery switch is OFF and battery is disconnected. Jumper from the 28 volt external power sources negative (−) terminal to the small short pin of the external power receptacle. Jumper the large pin furtherest from the small short pin in the external power receptacle to the external power positive (+) terminal. Check to insure that external power relay is not closing when reverse polarity power is applied from the external power source.

12-9. External Power Receptacle.

The external power receptacle is mounted just below the aft electrical compartment access door. The receptacle is covered by an access door. (See figures 12-1 and 12-2.)

NOTE

External power is not required but is recommended for starting the aircraft.

a. Removal.

(1) Be sure all electrical power is OFF.

(2) Remove nuts and washers from terminal posts of receptacle and remove wires to receptacle. Cover wire ends.

(3) Remove mounting screws and lift receptacle from bracket.

b. Inspection. (Refer to paragraph 12-5.)

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation.

(1) Position receptacle on bracket and install mounting screws.

(2) Remove cover on wire ends and install on terminal posts of receptacle.

12-10. External Power Relay.

The external power relay is located in the aft electrical compartment. This relay connects an external source of power, through the external power receptacle, to the electrical system of the helicopter.

a. Inspection. (Refer to paragraph 12-5.)

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-11. Generator And Bus System.

The self-excited main generator 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 source (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's reverse current relay automatically closes and opens the circuit between the generator and the main bus. The voltage regulator provides for proper generator voltage output during normal operating speeds and average draw. A field control relay operating in conjunction with the overvoltage relay protects the DC powered components on the aircraft from over-voltage from the main generator. A generator switch is provided on the overhead panel to provide manual control of the reverse current relay. A warning light is provided on the caution panel to indicate when the main generator's reverse current relay is not closed. The warning light is provided with DC power from the battery or stand by generator through the contacts of the bus control relay. 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 develops voltage whenever it is being driven by the engine. The voltage regulator in the standby system is adjusted so the voltage output of the standby generator is approximately one volt below that of the main generators normal output. A reverse current relay is also provided for the standby system. Control of the reverse current relay is provided for by the standby position of the standby generator switch and the bus control relay. 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 standby 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 non-essential bus switch to the non-essential bus relay, energizing the non-essential 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 non-essential bus relay, (3) de-energizing the non-essential bus, (4) close the circuit between the standby position of the standby 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 is provided for measuring the system amperage load on the standby generator.

a. Troubleshooting. In the following troubleshooting table, tripped circuit breakers and burned-out indicator lamps are omitted from indications of trouble. Such trouble is usually easily detected and corrected. (See figure 13-17.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
DC GENERATOR light on caution panel not illuminated prior to engine start-up	Bus control relay defective	Connect jumper between terminals B2 and B3 on relay. If light comes on, replace relay.
	Caution panel circuit defective	Disconnect plug P24 from caution panel and check for DC voltage between W (+) and Z(–). If voltage is present, replace caution panel.
DC GENERATOR light on caution panel does not go out after engine start-up	Bus control relay defective	(1) Move DC VOLTMETER switch alternately to MAIN GEN, STBY GEN, and ESS BUS positions (2) If rated voltage is indicated in all position and if main generator voltage is on essential bus, replace bus control relay. (3) If rated voltage is indicated in all positions and standby generator voltage is on essential bus, check main generator reverse current relay.
	Main generator reverse current relay defective	After (3) above, check for DC voltage at SW terminal of reverse current relay. If voltage is present, replace relay.
	Main generator voltage regulator defective or not properly adjusted	After (1) above, if main generator voltage is less than 1 volt above standby generator voltage, adjust or replace main generator voltage regulator.
No output from main generator (standby generator operates normally).	Main generator defective	(1) Place MAIN GEN switch in OFF and DC VOLTMETER switch in MAIN GEN position. (2) Remove plug P60 from main generator field relay, and jumper-connect pins H and N. (3) Place MAIN GEN switch in ON position and observe DC VOLTMETER. If voltage does not build up, replace generator.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION

Caution

If voltage begins to build up, return MAIN GEN switch quickly to OFF to prevent excessive voltage build-up.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Overvoltage relay defective or improperly adjusted.	Check main generator field relay. If relay is tripped, place DC VOLTMETER switch in MAIN GEN position; then, while observing voltmeter, momentarily place MAIN GEN switch in RESET position. If voltage builds up and generator cuts out at less than 31 volts on each reset attempt, replace overvoltage relay.
	Defective main generator field relay	(1) Remove plug P60 from relay. Check for continuity between relay sockets N and P. If no continuity exists or if resistance is more than one ohm, replace relay.
		(2) If relay will not reset, check for voltage between pin B and aircraft structure when MAIN GEN switch is moved to RESET position. If voltage is present, replace relay.
No output from standby generator (main generator operates normally)	Standby generator defective	(1) Place DC VOLTMETER switch in STBY GEN position.

Caution

If voltage begins to build up, remove jumper from across pins H and N of Plug P60.

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
		(2) Momentarily place a 16 gauge jumper wire across main voltage regulator terminal B and standby voltage regulator terminal A. If standby generator voltage, as indicated by DC VOLTMETER, does not build up, replace standby generator
	Standby generator voltage regulator defective	If voltage builds up in (2) above, replace voltage regulator

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Standby generator output normal but does not switch onto main bus when main generator is cut out	Bus control relay defective	Check for DC voltage at terminal D2 on relay. If voltage is present (no voltage may indicate STARTER-GEN switch is defective), jumper-connect terminals D2 and D3. If standby generator switches onto main bus, replace relay.
	Standby generator reverse current relay defective	In step above, if standby generator does not switch onto main bus, replace reverse current relay

b. Operational Check — Main Generator Circuitry. 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 a 28 volt dc power source, observing the proper polarity. Energize power source, reset generator field relay K7 with the main generator switch and accomplish following steps:

(1) Close GEN & BUS RESET, MAIN GEN VM and CAUTION LIGHTS circuit breakers. There should be no voltage on the main bus in the electrical compartment. Check that DC voltmeter indicates voltage in the MAIN GEN position.

(2) Close MAIN GEN FIELD circuit breaker. Position generator switch S8 to ON. Reverse current relay K5 should close and both essential and non-essential buses should be energized. Check that DC GENERATOR caution light is off.

(3) Momentarily turn on a load, such as the main inverter, and check that main generator loadmeter reads upscale.

(4) Slowly increase voltage of 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.

(5) 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.

(6) Return generator switch to OFF, open GEN & BUS RESET circuit breaker, and reconnect wires.

c. Operational Check — Starter Generator Circuitry. Before performing starter generator circuitry test, disconnect wire P37A1 from positive Terminal B and disconnect wires K5A4 and K5C4 from negative Terminal E on the starter generator. Connect these wires to a 28 volt dc power source, observing the proper polarity.

(1) Close both standby generator loadmeter circuit breakers in the electrical compartment. Position starter-generator 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 indicates power source voltage in the STBY GEN position.

(2) Close STBY GEN FIELD circuit breaker. Position starter generator switch S70 to STBY GEN and check that essential bus is energized.

(3) Close GEN & BUS RESET circuit breaker. Position non-essential bus switch S62 to MANUAL ON. Both essential and non-essential buses should be energized. Check that DC voltmeter indicates voltage of the power source in the STBY GEN, ESS BUS and NON ESS BUS Positions.

(4) Momentarily engage a load, such as the main inverter, and check that the standby generator loadmeter reads upscale. Return all switches and breakers to the open position and reconnect wires to their proper terminals.

12-12. Main Generator.

The main DC generator is mounted on an accessory pad on the forward 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. (See figure 12-2.)

a. Removal.

(1) Open forward transmission fairing.

(2) Remove electrical connections from generator.

(3) Loosen attaching nuts and position each washer out of recess, turn generator housing counterclockwise, and pull generator free of transmission drive.

b. Inspection. Visually inspect generator for damage. Check terminals for damage and terminal board to insure that it is not warped or cracked. Check brush cover for dents and loose or bent pins. Check brushes for proper length and for freedom of movement in brush holders. Check brush springs for proper tension on brushes. Check all leads for indication of overheating and condition of insulation. Brush contact surface should be checked to determine that proper amount of area is making contact with commutater. Commutater should be checked to insure that it is not coated with oil or grease. Rock armature back and forth to determine that drive splines are not worn excessively.

c. Repair or Replacement. Replace items that do not meet inspection requirements.

d. Installation.

(1) Apply light coat of grease (item 6, table 1-2) on generator shaft. Align generator with transmission drive, and slide generator into drive spline.

(2) Position generator on studs with terminals one bolt left of helicopter centerline and tighten retaining nuts to attach generator to drive pad.

(3) Connect cables to generator terminals.

(4) Position rubber boot to cover generator connections and secure with lacing cord.

12-13. Bus Control Relay.

Operation of the bus control relay is controlled through the IND terminal of the main generator reverse current relay. Closing of the reverse current relay supplies power from the main generator to the coil of the bus control relay. With this coil energized the following events happen: (1) One set of contacts B2 and B3 terminals open to remove power from the DC generator segment on the caution panel to turn light off, (2) The contacts between A2 and A1 terminals close to allow main generator voltage to energize non-essential bus relay, (3) The contacts between D2 and D3 terminals open to disconnect standby generator power from the "SW" terminal of the standby generator's reverse current relay. When the main generator's reverse current relay opens, the bus control relay's coil is not energized; it moves to it's spring loaded position which results in: (1) Power supply to DC generator light on caution panel and (2) Removal of power to the non-essential bus relay coil resulting in non-essential bus disconnecting from the main bus. Power from the external power supply closes the non-essential relay through the disengaged bus control relay.

a. Inspection. (Refer to paragraph 12-16; procedure is the same.)

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-14. Reverse Current Relay.

Two reverse current relays 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 connection of the generator to the DC bus is accomplished only when the following conditions of the generator voltage are satisfied:

(1) Polarity is correct.

(2) Minimum of (22 to 24) volts.

(3) 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.

Automatic operation of the reverse current relay is possible only when generator voltage is applied to the "SW" terminal of the unit.

a. Inspection. Inspect for loose connections, damaged case or broken terminal studs.

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-15. Overvoltage Relay.

The overvoltage relay is located in the aft electrical compartment. Voltage from the main generator is applied to the coil of the overvoltage relay only when main generator switch is ON. The overvoltage relay's 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.

a. Inspection. (Refer to paragraph 12-16; procedure is the same.)

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-16. Generator Field Control Relay.

UH-1D aircraft prior to serial #66-746 have a field control relay for only the main generator system located in aft electrical compartment. The above and subsequent serial numbered aircraft 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 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.

NOTE

For wiring of standby generator field control relay. Refer to figure 13-17.

a. Inspection. Inspect relay for loose connections, damaged or broken contact pins or terminals, physical damage to case or insulation between contact pins, and discoloration that would indicate internal shorting or excessive overload.

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-17. Non-Essential Bus Relay.

The non-essential bus relay is mounted in the aft electrical compartment. The non-essential bus relay is an electrically operated switch between the main bus bar and the non-essential bus. It is operated by power from external power receptacle when external power is supplied. Power from the main generator will also operate the non-essential bus relay through the bus control relay when main generator reverse current relay closes. Placing the non-essential bus switch in the manual position will also allow standby generator or battery power to close the relay.

a. Inspection. (Refer to paragraph 12-5.)

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-18. Voltage Regulator.

Two voltage regulators are located in the aft electrical compartment (one for the main generator and one for the standby generator) on the left side of the helicopter. The voltage regulator controls the voltage output of the generator by controlling the magnetic field strength within the generator. Variation of the resistance through the carbon pile which is in series with the generator's shunt field coils 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.

a. Adjustment. Adjust voltage regulator by turning adjustment screw on base of regulator clockwise to increase voltage and counterclockwise to decrease voltage. Adjust main generator voltage regulator to the following values dependent upon the average ambient temperature conditions.

27 volts	90° F (and above)
27.5 volts	32° F to 90° F
28.5 volts	32° F (and below)

NOTE

Always adjust the standby generator voltage regulator 1.0 volt below the main generator voltage regulator.

b. Removal.

(1) Be sure all electrical power is OFF.

(2) Unlock snap clamps and remove regulator from mounting base.

c. Inspection. Visually inspect regulator case for physical damage that could impair normal operation of the unit (cracked case, damaged contact pins, loose terminals, etc.) Check for secure mounting of regulator into regulator base. If contact pins are corroded, clean with pencil eraser. Do not use crocus or emery cloth as excessive plating may be removed. Inspect spring tabs for security of attachment and condition. Remove excessive corrosion by use of pencil eraser. Bent spring tabs may be repositioned by bending them in the direction opposite from which contact pins on regulator applies pressure. DO NOT BEND AN EXCESSIVE AMOUNT.

d. Repair or Replacement. Replace item if inspection requirements are not met.

e. Installation. Position regulator on mounting base and lock snap clamps.

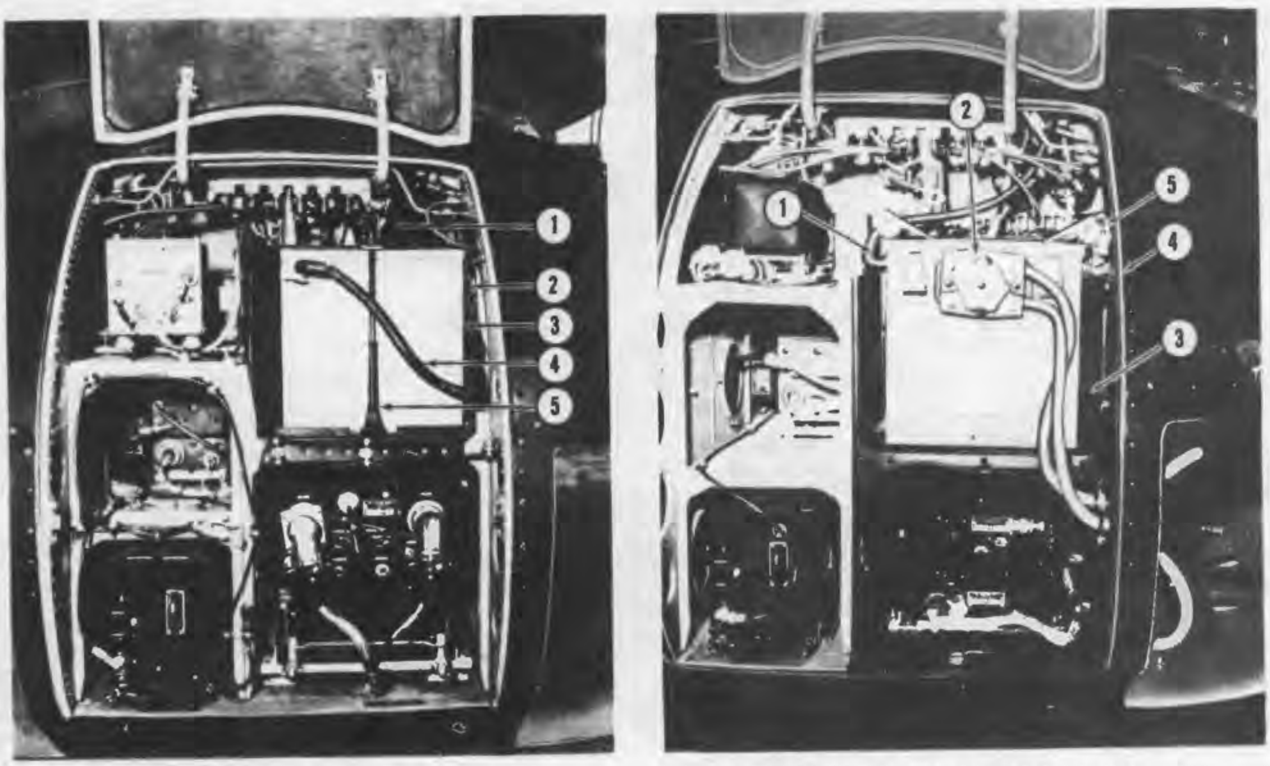
12-19. Battery System.

The helicopter is equipped with a 24 volt, 34 ampere-hour, nickel-cadmium type battery, located in the nose compartment on helicopters not using armored seats. (See figure 12-3.) An alternate battery location is provided in the aft fuselage compartment, accessible by a door on right-hand side. Utilization of a specific battery location depends on loading of mission equipment for proper weight and balance of the aircraft. Each battery location is equipped with vent tubes, eyebolts for attaching tie-down rods, a battery cable and relay and a voltmeter circuit protected by a diode and a circuit breaker. See figures 12-1 and 12-2.

CAUTION

Rigid connecting link (205-030-249-3) must be installed in aft battery compartment before flight or ground run.

a. Purpose. 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. A fully 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 fully charged.



YUH-1D and UH-1D through 62-12376

205075-11

UH-1D 63-8739 and Subsequent

205075-13

1. Vent Tube
2. Cable Connector
3. Battery
4. Drain Tube
5. Tie-down Rod

Figure 12-3. Battery installation (typical)

NOTE

Nickel-cadmium batteries shall not be serviced while installed in the helicopter. The battery shall be removed and serviced every 100 hours by authorized battery shop personnel only.

CAUTION

Remove battery to heated area if helicopter is to remain at outside tiedown for a prolonged period at -18° C (0° F) or below.

b. *Troubleshooting.* (See Figure 13-19.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Battery (BT2) will not hold charge	Demand too great	Use external power source whenever possible
	Charging rate too low	Adjust voltage regulator
	Broken cell partitions	Replace battery
	Shorted or grounded wire	Repair wiring
	Unbalanced cells	Discharge and recharge battery.
Short battery life	Level of electrolyte below top of plate	Refill and recharge battery
Excessive loss of electrolyte	Charging rate too high, if loss is in individual cells only, cell is faulty	Reduce charging rate
	Cracked battery case	Check battery case for leaks; replace battery
Battery terminals corroded	Excessive charging or discharging rate	Adjust charging rate or load and clean terminals
Polarity reversed	Battery connections reversed	Check wiring to battery plug; reverse wiring if necessary
Actuation of battery toggle switch fails to turn on power	Battery relay points corroded or burned	Replace relay
	Faulty wiring between relay and battery switch	Check and repair wiring.

c. *Operational Check.* Before connecting the battery, check for correct polarity and tightness of the battery leads and terminations. Open all circuit breakers and place all switches in the open position. Insure that battery switch is OFF. Close standby loadmeter circuit breaker, main generator voltmeter circuit breaker, battery relay circuit breaker, non-essential bus voltmeter circuit breaker, and the GEN and BUS reset circuit breaker, (these circuit breakers are located in electrical compartment and on the overhead console.)

NOTE

Unless otherwise specified, the voltmeter circuit breakers are to remain closed throughout the test.

(1) Position DC voltmeter selector switch S2 to BAT and check that voltmeter indicated battery voltage.

(2) Position DC voltmeter selector switch to each remaining position. Voltmeter should indicate zero voltage.

(3) Position switch S2 to ESS BUS. Position battery switch S40 to ON. Check that voltmeter indicates battery voltage. Other positions, except BAT, should indicate zero.

(4) Position non-essential 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 selector switch. Return all switches to normal.

(5) Repeat steps (2), (3), and (4) with the battery or 24 volt external power source connected to the power cables at the quick-disconnect in the aft battery location.

NOTE

Except where otherwise specified, all subsequent tests shall utilize external power. All circuit breakers shall be opened before external power is connected to the helicopter.

d. Removal.

(1) Check that BAT switch is OFF, and external power is not applied. Open compartment door.

(2) Disconnect battery cable connector by turning knob counterclockwise.

(3) Disconnect two vent tubes from battery case.

(4) Open tie-down clamps and disengage rods from battery cover. Lift battery from compartment.

(5) If battery is to be relocated, detach each tie-down rod from eyebolt at lower end by removing attaching bolt with nut and washers.

(6) Stow battery cable connector in dummy receptacle. Close compartment door.

e. Cleaning. Adjust electrolyte level, clean corrosion from all terminals and connectors, and insure that top of battery cells are dry. Only distilled water should be used to adjust the electrolyte level. A brush with non-electrical conducting bristles should be used to brush corrosion from terminals and connectors. Water should be used to rinse the battery terminals and connectors after brushing. The top of the cells should be thoroughly dried after rinsing. Check compartment for cleanliness and any indication of corrosion from alkaline deposits. Remove corrosion with fiber brush and neutralize with diluted boric acid solution. Rinse with clear water and dry thoroughly. Retouch compartment with alkali resistant varnish as necessary. (item 121, table 1-2.)

WARNING

Electrolyte is a strong alkaline solution, and is harmful to hands or clothing. Use a 3 percent solution of boric acid to neutralize spilled electrolyte. Flush thoroughly with water.

CAUTION

Do not use sodium bicarbonate to neutralize the electrolyte spilled in battery compartment from a nickel cadmium battery.

CAUTION

Adjust level of the electrolyte only after battery is fully charged. Remove battery to heated area if helicopter is to remain at outside tiedown for a prolonged period in temperatures −18°C (0°F) or below.

NOTE

Servicing of batteries shall be accomplished in a battery shop area by qualified personnel.

f. Inspection. Inspect battery for the following conditions.

(1) Loose connections at disconnect or between cells.

(2) Electrolyte for proper level.

(3) Clogged vent plugs or vent tubes.

(4) Damage to individual cell cases (distortion due to overcharge, cracks, or leaks).

NOTE

Electrolyte will not be visible in partially charged battery. Electrolyte level should be adjusted by battery shop personnel.

g. Repair or Replacement. Replace item if inspection requirements are not met. Repair of battery should be accomplished in an authorized battery repair station.

h. Installation.

(1) Open compartment door. If battery is being relocated, install tie-down rods on eyebolts provided on

shelf, using bolts, nuts, and washers removed from old location. Detach battery cable connector from dummy receptacle.

(2) Place battery on shelf, aligned for connections. Engage tie-down rods to strap on cover, and close cam-type clamps.

(3) Connect two vent tubes to battery case and tighten clamps.

(4) Insert cable connector in battery receptacle and secure by turning knob clockwise.

(5) Check that battery voltmeter circuit breaker, near left side of battery, is closed and that voltmeter will show indication when BAT switch is ON. Return switch to OFF after test. Close compartment door.

12-20. Battery Relay.

The battery relay is mounted in the left hand side of the nose compartment. Helicopter serial number 65-9565 and subsequent have a battery relay for each battery location. The relay is an electrically operated switch between the battery and the main bus bar. It is controlled by a switch which opens or closes the circuit to the actuating coil of the relay.

a. Inspection. Inspect relay terminal for evidence of corrosion, pits or discoloration (indicating arcing due to loose connections), damaged case and/or broken terminals or electrical overload.

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-21. DC Starter System.

The starter generator is located on the underside of the engine. This unit is used to start the engine and supply standby power for operation of DC equipment. The starter is energized by the starter relay.

a. Troubleshooting. (See figure 13-20.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Starter (G6) fails to operate when START switch (S70) is depressed	Defective starter circuit breaker (CB11)	Replace circuit breaker
	Switch contacts corroded or burned	Replace switch
	Faulty wiring or loose connections	Replace wiring; tighten connections
	Defective starter relay (K3)	Replace relay
	Brushes excessively worn	Replace as required
	Armature burned out	Replace starter-generator
Starter fails to produce sufficient RPM during start cycle	Excessive wear to armature bearings	Replace starter
	Battery in low state of charge	Charge battery

b. Operational Check.

(1) Disconnect wires K4B4 and K4D4 from terminal C of the starter-generator. Position starter-generator switch S70 to START. Close STARTER RELAY circuit breaker. Actuate starter switch S6 to pilot's collective stick and check that starter relay closes and that voltage is present at the ends of the disconnected wires.

(2) Position switch S70 to STBY GEN. Actuate starter switch S6 and check that the starter relay does not close.

(3) Position switch S70 to START and actuate starter switch S77 on copilot's collective stick. Check that starter relay closes and that voltage is present at the ends of disconnected wires K4B4 and K4D4.

NOTE

UH-1D/H serial No.'s 68-15214 through 70-15932 do not employ S77 on copilot's collective stick.

(4) Position switch S70 to STBY GEN. Acuate starter switch S77. Check that starter relay does not close. Open STARTER RELAY circuit breaker.

12-22. Starter Relay.

The starter relay 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 the starter switch on the pilot's or copilot's stick is depressed.

a. Inspection. (Refer to paragraph 12-5.)

b. Repair or Replacement. Replace item if inspection requirements are not met.

12-23. RPM Limit Warning System.

The rpm limit warning system includes a 5 ampere circuit breaker, CB1, located in DC circuit breaker panel A10, a detector unit, DS13, in left forward side of pilot's section, a warning light, DS7, on pilot's instrument panel, an audio rpm switch, S7, in pilot's engine control panel A2, an audio oscillator device, electrical wiring and connectors. Two terminal boards are included in the RPM Warning System; gunner's headset TB22 located in pilot's section, left forward, and pilot's headset TB23 located in pilot's section, right aft. The rpm warning system detector is adjusted before installation. 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. The rpm limit detector, operating on DC power from essential bus, 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, an audio signal is produced in pilot's and copilot's headsets, and warning light is illuminated. For starting and ground operation, audio tone can be turned off by audio switch. (See figure 13-21.)

a. Testing – RPM Limit Warning System. Test rpm limit warning system upon replacement of the limit warning detector, rotor tachometer or N2 tachometer by conducting the following steps with helicopter's engine running.

(1) Position the LOW RPM AUDIO switch S7 on the pilot's engine control panel to AUDIO.

(2) Adjust for an engine speed for approximately 6300 rpm (corresponds to 310 rotor rpm), and ascertain 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's or gunner's 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's and gunner's headsets. This point should be at an engine speed of 6100 ± 100 rpm (corresponds to 300 ± 5 rotor rpm).

(4) Position the LOW RPM audio switch S7 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's and gunner's headsets.

(6) Increase the engine speed and verify that the RPM LIMIT warning light extinguishes within the limits of 6100 ±100 engine rpm (corresponds to 300 ±5 rotor rpm). The LOW RPM audio switch should automatically return to the AUDIO position.

b. Alignment of Low RPM Warning. If the rpm limit warning system does not meet the requirements of paragraph 12-23, a, align system in accordance with paragraph 12-23, c or 12-23, d, whichever is applicable. If Saturn Model 2390-2 appears on the detector's nameplate (see figure 12-4) align system in accordance with paragraph 23, c. All others are BHC designed (see figure 12-5); align in accordance with paragraph 12-23, d.

NOTE

To increase the rpm at which the warning light will illuminate, turn either R1, R2, or R3 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 and are to be performed only by higher level maintenance facility.

CAUTION

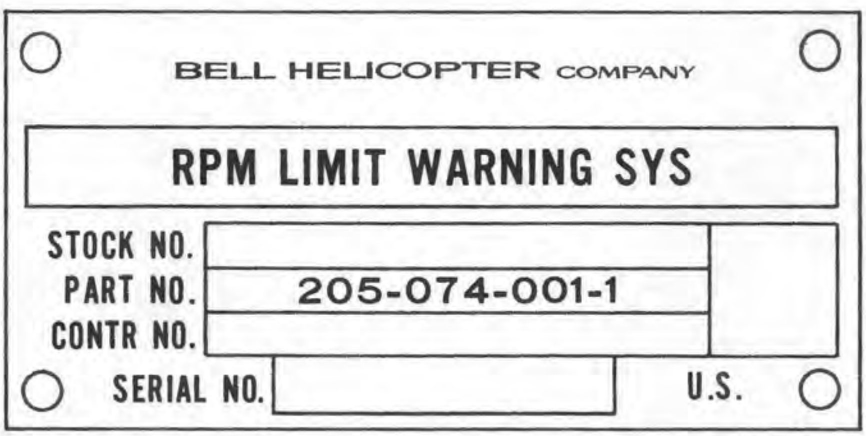
Use caution in making adjustments as excessive turning of adjustment screw can damage box.

c. Alignment of Saturn Designed Detectors.

(1) Loosen screws and slide cover strips aft to expose potentiometer shaft.

205074-18
AV 054185

Figure 12-4. RPM limit warning detector nameplate (Saturn)



205074-17
AV 054186

Figure 12-5. RPM limit warning detector nameplate (Bell)

(2) Install jumper lead between TP6 and TP8 (see figure 12-6) to deactivate the rotor low rpm signal.

(3) Start helicopter engine and increase engine speed to approximately 6300 rpm (corresponds to 310 rotor rpm).

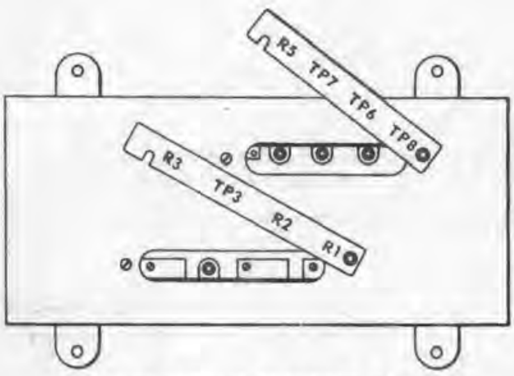
(4) Slowly decrease engine speed to 6100 rpm (corresponds to 300 rotor rpm).

(5) If, following step (4), the warning light is illuminated, turn R3 slowly counterclockwise until the warning light just extinguishes, and then very slowly turn clockwise until the light again illuminates. If, following step 4, the warning light is extinguished, turn R3 slowly clockwise until the light just illuminates.

(6) Vary he 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 (4), (5) and (6).

(7) Remove jumper between TP6 and TP8, and install jumper between TP7 and TP8 (see figure 12-6) to deactivate the engine low rpm signal.

(8) Adjust for a rotor speed of 300 rpm (corresponds to 6100 engine rpm).



RPM LIMIT WARNING DETECTOR (SATURN)

"JUMPER" – 6 INCH 22 GA WIRE
(2) 490–102 TIP PLUGS
HERMAN H SMITH OR EQUV

205074-10
AV 054187

Figure 12-6. Alignment of rpm limit detector (Saturn)

(9) If, following step (8), 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 (8), the warning light is extinguished, turn R1 very slowly clockwise until the light just illuminates.

(10) Vary rotor speed above and below 300 rpm while observing the warning light. Verify that warning occurs at 300 ±5 rotor rpm (corresponds to 6100 ±100 engine rpm). If light does not illuminate, repeat steps (8), (9) and (10).

(11) Remove jumper.

d. Alignment BHC Designed Detectors.

(1) Disengage the RPM WARN SYSTEM circuit breaker and disconnect the ship's harness from the rpm limit warning detector.

NOTE

If desired, the detector may be detached from the frame of the helicopter and moved to a more accessible location during the alignment procedure.

(2) Remove the cover of the detector and connect an Alignment Test Set (BHC No. 546-091-001) or equivalent to the ship's harness and rpm limit warning detector as shown in figure 12-7 making certain that the correct lead is attached to TP1 and TP2 of the detector.

NOTE

A test light, which functions simultaneously with the helicopter's RPM LIMIT warning light during calibration, is provided on the test harness so as to be readily visible to the electronic mechanic making adjustment.

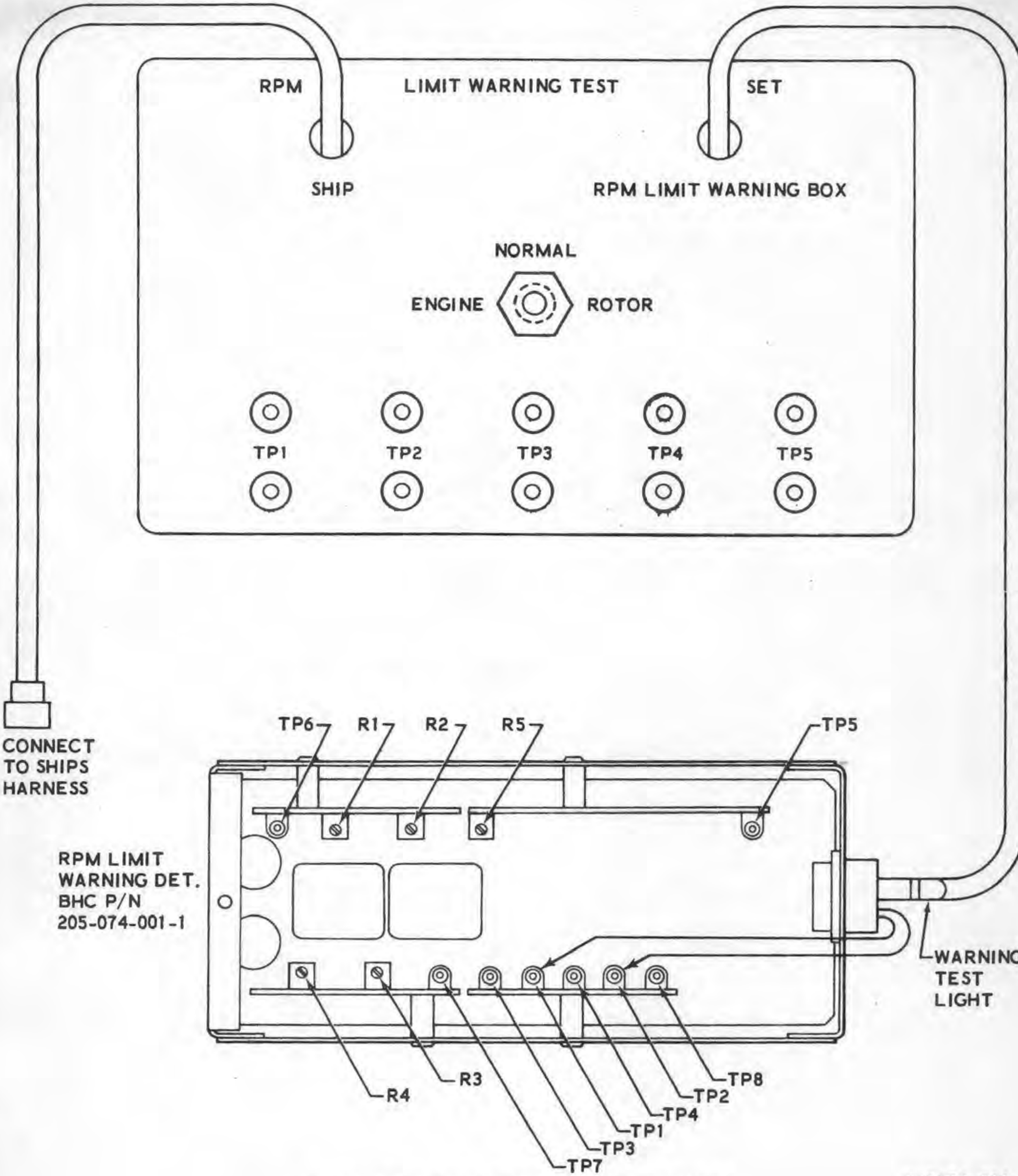
(3) Engage the RPM WARN SYSTEM circuit breaker and position the LOW RPM AUDIO switch to the AUDIO positin. An audio warning should be present in both the pilot's and gunner's headsets.

(4) 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.

(5) Position the ENGINE-NORMAL-ROTOR switch on the test set to the ENGINE position.

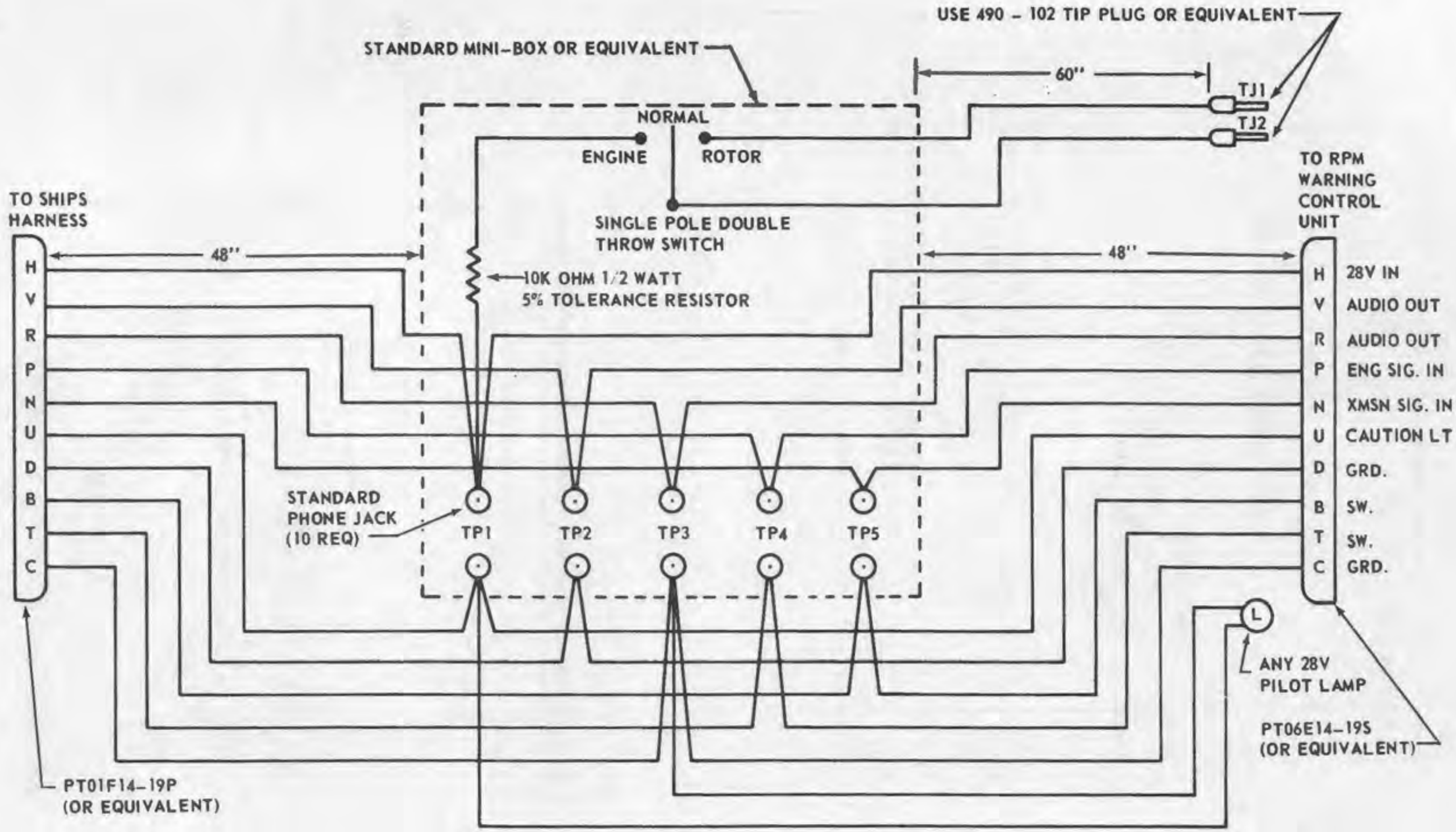
(6) Decrease the engine speed to 6100 rpm (corresponds to 300 rotor rpm).

(7) If, following step (6), the warning light is illuminated, turn R3 slowly counterclockwise until the



ALIGNMENT OF BHC DESIGNED DETECTORS

Figure 12-7. Alignment of rpm limit detector (Bell) (Sheet 1 of 2)



Note

Wire - 22 gage stranded.

Test points (TP) are provided for signal monitoring or continuity checking as necessary.

Note

With Engine - NORMAL ROTOR SELECTOR switch set to rotor position, TJ1 and TJ2 may be used as jumper when testing Saturn RPM warning system.

LIMIT WARNING TEST SET - SCHEMATIC

209075-42B
AV 054188-2

Figure 12-7. Alignment of rpm limit detector (Bell) (Sheet 2 of 2)

warning light just extinguishes and then very slowly clockwise until the light again illuminates. If, following step (6), the warning light is extinguished, turn R3 very slowly clockwise until the light just illuminates.

(8) 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 (6), (7) and (8).

(9) Place the ENGINE-NORMAL-ROTOR switch on the test set in the ROTOR position.

(10) Adjust for a rotor speed of 300 rpm (corresponds to 6100 engine rpm).

(11) If, following step (10), 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 (10), the warning light is extinguished, turn R1 very slowly clockwise until the light just illuminates.

(12) Vary the rotor speed above and below 300 rpm (corresponds to 6100 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 (10), (11) and (12).

(13) Position the ENGINE-NORMAL-ROTOR switch on the test set to the NORMAL position.

NOTE

Alignment Test Set, BHC No. 546-091-001, shall remain connected for the high rpm warning test.

e. *High Rotor RPM Warning Test.*

(1) Position the LOW RPM AUDIO switch to the AUDIO position.

(2) With the rotor in flat pitch and the governor switch set to EMERGENCY, slowly increase throttle until the RPM LIMIT 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's and gunner's headsets.

f. Alignment of High Rotor RPM Warning. If the rpm limit warning system does not meet the requirements of paragraph 12-23, d, align system in accordance with the procedure of paragraph 12-23, g or 12-23, h, whichever is applicable. If Saturn Model 2390-2 (see figure 12-4) appears on the detector's nameplate, the system shall be aligned in accordance with paragraph 12-23, g. All others are BHC designed (see figure 12-5) and shall be aligned in accordance with paragraph 12-23, h.

g. Alignment of High Rotor RPM Warning – Saturn Designed Detectors. (See figure 12-6.)

NOTE

When setting the high rotor RPM warning using the T53-L-13/13A engine, do not exceed 6750RPM.

(1) With the rotor in flat pitch and the governor set to EMERGENCY, slowly increase throttle to an engine speed of 6750 maximum.

(2) If, following step (1), 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 (1), the warning light is extinguished, turn R2 very slowly counterclockwise until the warning light just illuminates.

(3) 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 (1), (2) and (3).

(4) Repeat the low and high rpm warning tests.

(5) Close detector cover strips and tighten screws.

h. Alignment of High Rotor RPM Warning – BHC Designed Detectors. (See figure 12-7.)

NOTE

The high engine potentiometer, R-4, is factory adjusted full clockwise and is not to be adjusted.

(1) Position the ENGINE-NORMAL-ROTOR switch on the test set to the ROTOR position.

(2) With the rotor in flat pitch and the governor set to EMERGENCY, slowly increase throttle to an engine speed of 6800 ±100 rpm.

(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) Disconnect and remove the test set and reinstall the rpm limit warning detector.

(7) Engage the RPM WARN SYSTEM circuit breaker and repeat the low and high rpm warning tests.

12-24. Hydraulic Control System.

The hydraulic system is composed of a hydraulic solenoid valve mounted on the bulkhead on the right side of the transmission. The valve is controlled by the HYD CONT switch on the hydraulic control panel and protected by a 5 ampere hydraulic control 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.

a. Troubleshooting. (See figure 13-22.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Hydraulic solenoid fails to actuate when hydraulic control switch is placed to OFF position	Defective circuit breaker	Replace circuit breaker
	Faulty wiring or loose connections	Repair wiring and/or secure connections
	Defective hydraulic control switch	Replace switch
	Defective hydraulic solenoid	Replace solenoid

b. Operational Check.

(1) 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.

(2) 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.

NOTE

This test is also a requirement of the hydraulic system functional test.

12-25. Hydraulic Solenoid Valve.

a. Removal.

(1) Remove cowling from right hand side of transmission.

(2) Slide a small drain pan under solenoid valve and disconnect hydraulic lines from valve. Cap all openings.

(3) Disconnect electrical connector. Remove mounting nuts, washers, and bolts and remove valve.

b. Inspection. Check valve for security, pressure leaks and proper actuation of solenoid.

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation.

(1) Position valve and install mounting bolts, washers, and nuts. Connect hydraulic lines and electrical connector.

(2) Fill reservoir and bleed system. Install cowling.

12-26. Force Trim System.

The force trim system consists of an antitorque force trim magnetic brake, a fore and aft force trim magnetic brake, a lateral force trim magnetic brake, pilot and copilot force trim switches, and a master force trim switch 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 a 5 ampere 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. Pilots and copilot force trim switches may be triggered to de-energize brakes and eliminate centering force. See figures 12-1 and 12-2.

a. *Troubleshooting.* (See figure 13-22.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
All magnetic brakes fail to energize with FORCE TRIM switch in ON position	Faulty wiring or loose connections	Repair wiring and tighten connections
	Defective switch	Replace defective switch
Any magnetic brake fails to energize with FORCE TRIM switch in ON position	Defective magnetic brake	Replace defective brake
Magnetic brakes fail to de-energize when pilot or co-pilot FORCE TRIM switch is depressed.	Defective switch or shorted wiring	Replace switch or repair wiring

b. *Operational Check.*

(1) Close FORCE TRIM circuit breaker. Position force trim switch S68 to ON. Check the cyclic stick and pedals for centering force.

(2) Depress force trim switch S18 on the pilot's cyclic stick. Check that the three magnetic brakes de-energize and that there is no centering force in the cyclic stick and pedals.

(3) Repeat step (2) using switch S10 on the copilot's cyclic stick.

NOTE

For maintenance of magnetic brakes, refer to Chapter 9.

12-27. Igniter System.

Ignition to the power plant is provided by the igniter pack, furnished with and attached to the engine. This unit provides a continuous ignition arc during engine start cycle. The igniter solenoid valve located on the engine also operates during this cycle to direct fuel to the starting fuel nozzle during engine start. The circuits are energized when the FUEL SW located on the ENGINE CONTROL PANEL is placed to ON and the starter switch is depressed.

a. *Troubleshooting.* (See figure 13-23.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Igniter or igniter solenoid valve fails to operate when starter switch is depressed.	Ignition circuit breaker open or defective	Check and replace faulty breaker
	Starter switch contacts corroded or burned	Replace switch
	Loose connections or defective wiring	Repair wiring and tighten connections
	Defective fuel switch	Replace switch
	Defective starting fuel switch (effective helicopters prior to 66-16034 only)	Replace switch

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	Defective igniter	Replace igniter
	Defective igniter solenoid valve	Replace valve

b. Operation Check. Conduct ignition system and igniter solenoid valve test in accordance with following steps.

(1) Prior to helicopter Serial No. 66-16034, accomplish the following.

(a) Close IGNITION SYSTEM IGNITER SOL circuit breaker. Position fuel switch S38 and starting fuel switch S88 to ON. Actuate pilot's starter switch S6 and check that ignition unit and igniter solenoid valve both operate.

(b) Actuate copilot's starter switch S77. Check that ignition unit and igniter solenoid valve are both operating.

(c) Position starting fuel switch S88 to OFF. Actuate pilot's starter switch S6 and check that ignition unit operates.

(d) Repeat step (c) using copilot's starter switch S77.

(e) Position starting fuel switch S88 to ON. Place fuel switch S38 to OFF. Actuate pilot's starter switch S6 and check that neither the ignition nor the solenoid valve operates.

(f) Repeat step (e) using copilot's starter switch S77. Reconnect starter wires.

(2) For helicopter Serial No. 66-16034 and subsequent, accomplish the following.

(a) Close IGNITION SYSTEM IGNITER SOL circuit breaker. Position fuel switch S38 to ON. Actuate pilot's starter switch S6 and check that ignition unit and igniter solenoid valve both operate.

(b) Actuate copilot's starter switch S77. Check that ignition unit and igniter solenoid valve are both operating.

(c) Position fuel switch S38 to OFF. Actuate pilot's starter switch S6 and check that neither the ignition nor the solenoid valve operates.

(d) Repeat step (c) using copilot's starter switch S77. Reconnect starter wires.

NOTE

UH-1D/H Serial No.'s 68-15214 through 70-15932 do not employ S77 on copilot's collective stick.

NOTE

For additional maintenance information refer to Chapter 5.

12-28. Fuel Boost And Fuel Valve System — Electrical.

The electrical portion of the fuel control system consists of fuel shutoff valve, fuel switch, left and right-hand fuel cell boost pumps, left and right auxiliary fuel pumps, fuel control relay, RH fuel transfer pump switch, LH fuel transfer pump switch, fuel transfer relay, 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, the FUEL VALVE (5 ampere), FUEL TANK SUMP PUMP - RIGHT-HAND (7.5 ampere), FUEL TANK SUMP PUMP - LEFT-HAND (5 ampere) and FUEL TRANS PUMPS (10 ampere) circuit breakers. The entire fuel boost and valve system serves to supply, regulate and control fuel for operation of the helicopter.

a. Troubleshooting. Use system wiring diagram figure 13-24, and standard troubleshooting techniques to isolate and correct malfunctions.

b. Operational Check — Fuel Valve.

(1) Close FUEL VALVE circuit breaker. Position fuel switch S38 to ON and ensure that fuel valve is open. Repeat procedure with FUEL TANK SUMP PUMP-LEFT-HAND circuit breaker.

(2) Position switch S38 to OFF and check that fuel valve closes.

c. Operational Check — Fuel Pumps.

(1) Close FUEL BOOST RIGHT circuit breaker. Position fuel switch S38 to ON. Check that the fuel pump is running and open circuit breaker.

(2) Close FUEL TRANSFER PUMP circuit breaker. Position the right hand fuel transfer switch S46 to ON. Check that auxiliary fuel pump is running. When internal auxiliary tank is not installed, check for voltage at pin D on the tank receptacle J148 and pin A of external fuel control panel plug P57.

(3) Connect a jumper wire between terminals 2 and 3 of TB4 on the access door of the center aft fuel cell (or ground terminal B1 of the fuel control relay K10 in the electrical compartment). Check for voltage at pin D of J148 and pin A of P57.

(4) Connect another jumper wire between terminals 1 and 3 of TB4 (or ground terminal X1 of relay K10). Check that relay K10 shuts off the pump and voltage is not present at pin D of J148 and pin A of P57.

(5) Remove jumper from terminals 1 and 3 of TB4 (or remove ground from X1 of relay K10). Check that relay K10 remains energized and voltage is not present at pin D of J148 and pin A of P57.

(6) Remove jumper from terminals 2 and 3 of TB4 (or remove ground from B1 of relay K10). Check that relay de-energizes and that voltage is present at pin D of J148 and pin A of P57. Return switch S46 to OFF.

(7) Repeat steps (1) through (6) using left hand fuel transfer switch S45 and left hand internal auxiliary fuel tank receptacle J147.

NOTE

For additional maintenance information refer to Chapter 5.

12-29. Governor Control System.

The governor control system consists of an engine control solenoid valve located on engine, and a motor driven RPM actuator also located on engine. Power is supplied by the 28 volt ESS BUS and protected by a 5 ampere GOV CONT circuit breaker located in overhead console. The governor control actuator is energized either by GOV-RPM switch (pilot's) or by GOV-RPM switch (copilot's). With the switch placed to increased 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 governor AUTO EMER switch located on the engine control panel. (See figure 12-2.)

a. Troubleshooting. (See figure 13-25.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Governor actuator (B12) fails to respond when either RPM switch (S37) or (S51) is placed to INCR or DECR position	Faulty wiring or loose connections	Repair wiring and tighten connections
	Switch contacts corroded or burned	Replace switch
	Defective governor actuator	Replace actuator
Actuator (B12) operates in reverse	Switch (S37 or S51) or actuator wiring reversed	Check circuit diagram and correct wiring
Fuel control solenoid valve (L-2) fails to operate when Gov. SW(S33) is actuated	Faulty wiring or loose connections	Repair wiring and tighten connections
	Switch contacts corroded or burned	Replace switch
	Defective fuel control solenoid valve	Replace valve
Solenoid valve operates in reverse	Switch or solenoid wiring reversed	Check circuit diagram and correct wiring

b. Operational Check.

(1) Close GOV CONT circuit breaker. Position governor 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).

(2) 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.

(3) Return switch S33 to AUTO and check that GOV EMER indicator is extinguished.

(4) Position governor rpm switch S37, on pilot's collective stick, to INCR and check that governor rpm actuator on the engine retracts.

(5) Position switch S37 to DECR and check that actuator extends.

(6) Repeat steps (4) and (5) using switch S51 on copilot's collective stick.

12-30. Governor RPM Actuator And Fuel Control Solenoid.

For description, removal, inspection, repair or replacement refer to Chapter 5.

12-31. Idle Stop System.

The idle stop system consists of an idle stop release solenoid, an idle stop release switch located on pilot's collective stick and a 7.5 ampere IDLE STOP RELEASE circuit breaker which protects the system against overload.

a. Troubleshooting. Refer to figure 13-25, and use standard troubleshooting practice to isolate and correct malfunctions.

b. Operational Check.

(1) Close IDLE STOP REL circuit breaker.

(2) Actuate the idle stop release switch S50 on the pilot's collective stick and check that solenoid retracts when power is applied.

12-32. Idle Stop Release Solenoid.

For description and maintenance information, refer to Chapter 5.

Section III. AUXILIARY POWER

(Not Applicable)

Section IV. ALTERNATING CURRENT POWER DISTRIBUTION SYSTEM

12-33. AC Circuit Breakers.

The AC circuit breakers are mounted on the right hand, forward side of the pedestal. AC circuits can be opened and closed by operating these trip-free, push-pull type circuit breakers.

a. Removal.

(1) Be sure all electrical power is OFF.

(2) Remove mounting screws of panel installation and carefully lift panel away from mount.

(3) Disconnect wiring from breakers and cover wire ends. Remove mounting screws and lift breaker from panel.

b. Inspection. (Refer to paragraph 12-5.)

c. Repair or Relacement. Replace item if inspection requirements are not met. (Refer to paragraph 12-5.)

d. Installation.

(1) Position breaker in panel and install mounting screws.

(2) Remove cover from wire end and install on breaker.

(3) Position panel in place being careful not to damage wiring. Install mounting screws.

12-34. Transformer.

The transformer is mounted in the left hand nose electrical compartment. It reduces 115 volts ac to 28 volts ac for engine, transmission, and torquemeter indicator instruments and their transmitters.

a. Removal.

(1) Be sure all electrical power is OFF.

(2) Disconnect wiring from transformer and cover wire ends.

(3) Remove mounting screws and lift transformer from compartment.

b. Inspection. (Refer to paragraph 12-16, a.)

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation.

(1) Position transformer in compartment and install mounting screws.

(2) Remove cover from wire ends and connect to proper terminals of transformer.

12-35. Inverters.

The AC power system consists of a main and a spare 115 volt, 400 Hz, 3 phase inverter. These units are located in the aft electrical compartment on helicopters through serial number 62-12366. On helicopters serial number 63-8739 and subsequent the inverters are located in the nose 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 capacitors correction are mounted in the compartment with the inverters to maintain a power factor of .97 (lag) under normal load. (See figures 12-1 and 12-6.)

CAUTION

Do not press lever adjacent to unused receptacle of inverters on some aircraft. Damage to inverter may result by non-compliance.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-26.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Main inverter fails to operate	Open circuit breaker	Reset circuit breaker
	Faulty wiring or connections in switch or power circuits	Check continuity of wiring. Repair wiring and tighten connections.
	Poor bonding to ground	Clean and tighten ground connections
	Faulty inverter control	Check for 28 volts dc on both main and spare swtich terminals; replace faulty control
	Defective inverter	Replace inverter
Spare inverter fails to operate	Open circuit breaker	Reset circuit breaker
	Faulty wiring or connections in switch or power circuits	Check continuity of wiring. Repair wiring and tighten connections
	Poor bonding to ground	Clean and tighten connections
	Faulty inverter changeover control	Replace faulty control
	Defective inverter	Replace inverter

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Inverter runs but no voltage to instrument	Faulty wiring	Check continuity of wiring; repair wiring
	Defective inverter changeover relay	Check continuity of relay contacts; replace faulty relay
	Faulty inverter	Check for 115 volts ac output from inverter; replace faulty relay
Improper inverter output voltage or frequency	Low input voltage	Check for proper input voltage to inverter; correct low primary voltage condition
	Faulty inverter voltage regulator	Check inverter output voltage and frequency with voltmeter and frequency meters; replace faulty inverter

b. Operational Check. Open all circuit breakers and perform the following steps:

(1) Close the MAIN INVTR PWR, SPARE INVTR PWR, INVTR CONT, CAUTION LIGHTS, *J-2 CMPS IND, POWER FACTOR CORRECTION, and all AC circuit breakers in the pedestal breaker panel. Energize external power source. Check that INST INVERTER caution light illuminates.

NOTE

The J-2 CMPS IND is applicable only on helicopters prior to S/N 66-16307.

(2) Position inverter switch S39 to MAIN ON. Check that main inverter and all AC instruments are on and INST INVERTER light is extinguished.

(3) Select each phase on the AC voltmeter and check that voltmeter indicates 115 ±4.0 volts on each phase when DC bus voltage is 28 volts.

(4) Position switch S39 to OFF and check that INST INVERTER light illuminates.

NOTE

When inverter 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.

(5) Position switch S39 to SPARE ON and check that AC voltmeter indicates 115 volts for each phase.

NOTE

When inverter 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.

c. Removal.

(1) Be sure all electrical power is OFF.

(2) Remove mounting hardware from inverter terminal box cover. Disconnect wiring from terminals and cover wire ends.

(3) Remove mounting bolts and lift inverter from compartment.

d. Inspection. Inspect inverters for cracked or damaged cases, proper bonding and security of mounting broken connector pins or cracked connector inserts and proper operation.

e. Repair or Replacement. Repair connectors, replace brush caps or brushes as necessary and replace unit if other inspection requirements are not met.

f. Installation.

(1) Position inverter in compartment and install mounting bolts.

(2) Remove cover from terminal box on inverter. Remove cover on wire ends and connect to proper terminals of inverter. Replace terminal box cover.

Section V. LIGHTING PROVISIONS

12-36. Description.

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. (See figure 12-2.)

NOTE

In addition to the inspection steps listed in the following paragraphs, all lighting provisions should be inspected for missing or burned out bulbs and cracked or missing lens.

12-37. Interior Lights.

Interior light circuits include the instrument lights, instrument secondary lights located on the glare shield, console and pedestal panel lights, dome lights, and cockpit lights.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-27 and 13-28.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Switch fails to operate lights	Defective switch or rheostat	Replace switch or rheostat
Circuit breaker breaking circuit	Short in switch or wires	Replace necessary parts
One light dim or intermittent	Poor ground	Remove light and clean ground
One light out	Burned out bulb	Replace bulb
	Corroded lamp socket	Clean terminals or replace light
	Broken wire	Replace wire

b. Operational Check – Cockpit Lights. Close COCKPIT LIGHTS 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.)

c. Operational Check – Dome Lights.

(1) Close DOME LIGHTS circuit breaker. Position switch S1 to RED. Rotate rheostat R21 clockwise from OFF. Check that the three aft dome lights are full bright with R21 in the full clockwise position.

(2) Repeat step (1) with switch S1 positioned to WHITE.

NOTE

Step 3. is not applicable to Serial No. 66-16034 and subsequent.

(3) Check that forward dome light is operational for both RED and WHITE positions of switch S35.

d. Operational Check – Instrument Panel Lights.

(1) Close INST PANEL LIGHTS circuit breaker. Rotate pilot's instrument lights rheostat R4 clockwise from OFF. Check that all instrument lights on the pilot's side of the panel, including the standby compass and collective stick light, come on and increase in brightness with clockwise rotation of the rheostat.

(2) 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.

(3) Rotate the copilot's instrument lights rheostat R10 clockwise from OFF. Check that all instrument lights on the copilot's panel come on and increase in brightness with clockwise rotation of the rheostat.

e. *Operational Check – Console and Pedestal Lights.*

(1) Close CONSOLE PED LIGHTS circuit breaker. Rotate pedestal 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.

(2) 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.

f. *Operational Check – Instrument Secondary Lights.*

(1) Close INST SEC LIGHTS circuit breaker.

(2) Rotate instrument secondary lights rheostat R5 clockwise from OFF. Check that instrument secondary lights come on and increase in brightness with clockwise rotation of the rheostat.

g. *Removal.*

(1) Disengage appropriate circuit breaker.

(2) Remove mounting hardware, lift out light assembly, and disconnect light wire.

h. *Inspection.* 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.

i. *Repair or Replacement.* Light assembly may be repaired by replacing damaged or defective component parts. If light case is damaged beyond repair, complete unit must be replaced.

j. *Installation.*

(1) Connect light wire and install light assembly with mounting hardware.

(2) Engage appropriate circuit breaker and check light for proper operation.

12-38. Caution Light System.

The caution light system includes a caution panel located in the pedestal and a master control warning light, 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 systems. The panel is energized from 28V dc Essential Bus and protected by a 5 ampere circuit breaker located in the DC circuit breaker panel in overhead console. See figure 12-2.

12-39. Troubleshooting – Caution Lights 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. See figure 13-29.

12-40. Operational Check – Caution Lights.

The following paragraphs cover operational checks of all caution lights. All circuit breakers shall be open before making tests.

a. *Master Caution Panel.* During checks in the following steps 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.

(1) Close CAUTION LIGHTS and GOV CONT circuit breakers. Check that MASTER CAUTION light illuminates and that each caution light segment operates in accordance with Table 12-1.

Table 12-1. Caution Panel Indication – Lights

Caution Light	On/OFF Condition
ENGINE OIL PRESS	ON
*ENGINE ICING	OFF
*ENGINE ICE DETECTOR	ON
LEFT FUEL BOOST	ON
RIGHT FUEL BOOST	ON
**ENG FUEL PUMP	ON
20 MINUTE FUEL	ON
AUX FUEL LOW	OFF

Table 12-1. Caution Panel Indication — Lights (Cont)

Caution Light	On/OFF Condition
XMSN OIL PRESS	ON
XMSN OIL HOT	OFF
HYD PRESSURE	ON
INST INVERTER	ON
DC GENERATOR	ON
EXTERNAL POWER	ON
FUEL FILTER	OFF
GOV EMER	ON
CHIP DET	OFF
ENGINE CHIP DET	OFF
ENGINE INLET AIR	OFF
IFF	OFF

NOTE

*These caution lights not applicable on Helicopter S/N 66-16868 and subsequent.

NOTE

**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.

(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's 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 PRESSURE indicator extinguishes with increasing pressure at 27 ±1 psi.

(2) Relieve pressure on engine oil pressure switch. Check that ENGINE OIL PRESSURE indicator illuminates before 25 psi decreasing pressure. (Refer to paragraph 10-95.)

c. Engine Icing and Engine Ice Detector Lights (Prior to S/N 66-16868).

(1) Connect test box, wired similar to that shown in figure 12-8, into the engine harness at the hot air valve and ice detector. (See figure 13-30 for system diagram.)

(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 hot air valve 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.

NOTE

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 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.

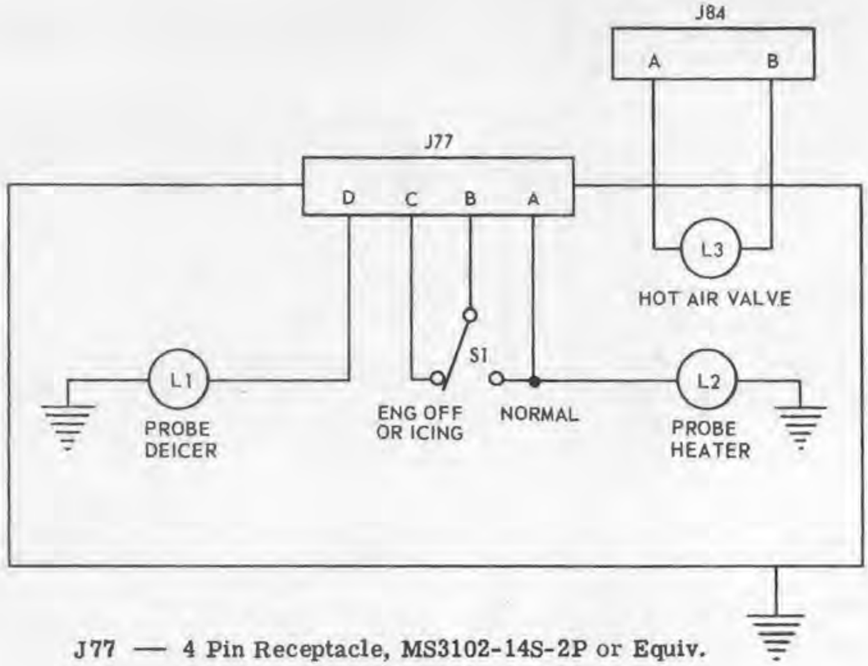
d. Left and Right Fuel Boost Lights.

(1) Disconnect wire Q42A20 from TB38 terminal No. 2 at left hand fuel cell and check that LEFT FUEL BOOST indicator extinguishes.

(2) Disconnect wire Q40A20 from TB35 terminal No. 2 at right hand fuel cell and check that RIGHT FUEL BOOST indicator extinguishes.

(3) Reconnect wires to correct terminals.

e. Engine Fuel Pump Light. At the fuel differential pressure switch on the engine, disconnect both pressure



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

205475-60
AV 054191

Figure 12-8. Wiring diagram — icing system test box

ports. Determine the manufacturer and the manufacturer's part number of the fuel differential pressure switch, then accomplish following steps (1) and (2) as applicable.

NOTE

Cook Electric P/N 575-684, Hydraulic Research P/N 96025, and Gorn Electric P/N GP2B-3001-1 pressure switches are differential types which are activated only when a pressure imbalance exists between the fuel pumps. Equal pressures, whether low or high, have no effect on the caution indicator.

NOTE

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 pressures. Low pressure from either or both fuel pumps will deactivate the switch and cause the caution light to illuminate.

(1) 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.

(2) 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 atmospheric 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 that 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 1 of TB38 under the left fuel cell and check that 20 MINUTE FUEL indicator extinguishes.

(2) When 20 MINUTE FUEL indicator is extinguished (fuel in tanks) connect wire E12A20 to ground and check that 20 MINUTE FUEL indicator illuminates.

(3) Reconnect wire E12A20 to terminal 1 of TB38.

g. Auxiliary Fuel Low Light. Close the FUEL TRANSFER PUMP circuit breaker and test auxiliary fuel low light in accordance with following steps (1), (2) or (3), as applicable. (See figures 13-24 and 13-31.)

(1) *Internal auxiliary fuel tank provisions.*

(a) Connect a jumper wire from pin E of the internal auxiliary fuel tank receptacle J148 to ground.

(b) Position right hand fuel transfer pump switch S46 to ON and check that the AUX FUEL LOW indicator illuminates.

(c) Connect another jumper wire from pin A of J148 to ground. Check that AUX FUEL LOW indicator extinguishes. Remove both jumper wires and position switch S46 to OFF.

(d) Connect a jumper wire from pin E of the internal auxiliary fuel tank receptacle J147 to ground. Position left hand fuel transfer pump switch S45 to ON. Check that AUX FUEL LOW indicator illuminates.

(e) Connect another jumper wire from pin A of J147 to ground. Check that AUX FUEL LOW indicator extinguishes. Remove both jumper wires and position switch S45 to OFF.

(2) *Internal auxiliary fuel tank installed.*

(a) Position the right hand fuel pump transfer switch S46 to ON. Check that AUX FUEL LOW indicator illuminates.

(b) Return switch S46 to OFF and position left hand fuel transfer pump switch S45 to ON. Check that AUX FUEL LOW indicator illuminates.

(3) *External auxiliary fuel tank provisions.*

(a) Connect a jumper wire between pins A and B 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 A and B 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 and check that XMSN OIL PRESS indicator extinguishes at 33 to 37 psi increasing pressure.

(2) Relieve pressure on transmission oil pressure switch 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 pressure switch (located on transmission) to ground and check that XMSN OIL HOT indicator illuminates.

(2) Remove ground from transmission oil pressure switch and check that XMSN OIL HOT indicator extinguishes.

j. Hydraulic Pressure Lights.

(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. (Refer to paragraph 12-35, b.)

l. DC Generator Light. The DC generator light is checked as a part of the main generator system. (Refer to paragraph 12-11, b.)

m. External Power Light. Before performing external power light test, disconnect external power from the helicopter. Perform the following steps:

(1) Turn battery switch 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. Connect external power to the helicopter and perform following steps:

(1) Disconnect plug P195 from fuel filter bypass switch. 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 indiator extinguishes. Reconnect plug P195.

o. Transmission Oil Level Light.

(1) Close both BATTERY VM circuit breakers.

(2) Actuate push button switch S4 on cabin bulkhead at station 123 and check operation of the indicator through the sight glass in the cabin bulkhead adjacent to the switch.

p. Governor Emergency Caution Light. (S/N 66-16868 and subsequent).

(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 Gear Box Chip Detector Light.

(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° gear box) 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 XMSN positions only. Remove short.

(4) Short tail rotor chip detector (in 90° gear box) 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. Engine Chip Detector Light.

(1) Check that ENGINE CHIP DET light is extinguished.

(2) Short engine magnetic chip detector output wire to ground. Check that ENGINE CHIP DET light illuminates.

(3) Remove short and observe that ENGINE CHIP DET light extinguishes.

s. Engine Air Filter Control (Helicopters Prior to 66-16868 only).

(1) Open all circuit breakers and position all switches to OFF. Connect test apparatus to pressure switch as shown in figure 12-9.

(2) Close ENG AIR FILTER CONT circuit breaker. Press ENGINE INLET FILTER CLOGGED indicator I72 (press-to-test type) and observe that the indicator illuminates.

(3) Gradually apply pressure to pressure switch 42D128 with pressure bulb until ENGINE INLET FILTER CLOGGED indicator I72 illuminates (See CAUTION below). The indicator should illuminate at 8.0 ±0.75 inches of water.

CAUTION

Do not exceed an applied pressure of 15 inches of water.

(4) Relieve applied pressure and observe that ENGINE INLET FILTER CLOGGED indicator I72 extinguishes. Disconnect test apparatus.

t. Engine Inlet Air Detector Light (S/N 66-16868 and Subsequent).

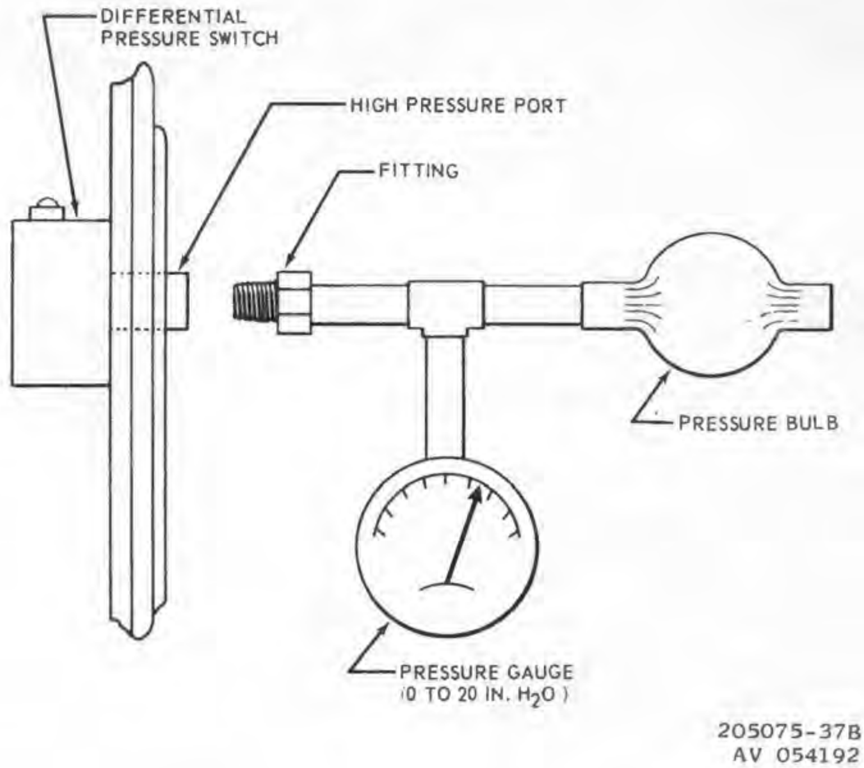


Figure 12-9. Engine air filter pressure tool

(1) Open all circuit breakers and position all switches to OFF. Connect test apparatus to pressure switch as shown in Figure 12-9.

(2) Close CAUTION LIGHTS circuit breaker. Gradually apply pressure to pressure switch with pressure bulb until ENGINE INLET AIR caution indicator illuminates (see Caution below). The indicator should illuminate at 8.0 ±0.75 inches of water.

CAUTION

Do not exceed an applied pressure of 15 inches of water.

(3) Relieve applied pressure and observe that ENGINE INLET AIR caution indicator extinguishes. Disconnect test apparatus.

u. 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. (See figure 13-32.)

12-41. Exterior Lights.

12-42. Landing Light And Searchlight.

One landing light and one searchlight are located on the underside of the cabin. Each has an 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 pilot's collective stick. They consist of four switches, two that control power to the lamps, and two that control the positions of the lights.

CAUTION

Do not operate landing or searchlight in areas of combustible material, such as tall grass, etc.

a. Troubleshooting. Perform checks as necessary to isolate trouble. (See figure 13-33.)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
Light inoperative	Defective switch	Replace switch
Circuit breaker 'pops'	Short in switch or wire	Replace necessary parts
One light dim, constant or intermittently	Poor ground	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 and clean as necessary.
	Loose power lead or corroded terminal	Tighten or clean connection in power circuit.
	Relay contacts badly burned.	Replace relay.
One light out	Burned out bulb Corroded socket Broken wires	Replace bulb Clean terminals Repair wires

b. Operational Check – Landing Light.

(1) Close LDG LT PWR and LDG & SEARCH LIGHT CONT circuit breakers. Position lamp control switch S76 on the pilot's collective stick to ON and check that landing light illuminates. Return switch S76 to OFF.

(2) Position 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 light retracts and is stopped in the stowed position by the retract limit switch.

c. Operational Check – Controllable Landing Light (Searchlight).

(1) Close SEARCHLIGHT PWR and LDG & SEARCHLIGHT CONT circuit breakers. Position lamp 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 limit switch at approximately 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.

d. Removal.

(1) Be sure all electrical power is OFF.

(2) Remove mounting screws forward of light lens.

(3) Remove clamp from wires and pull light assembly through hole.

(4) Remove terminal cover and disconnect wires.

e. Inspection.

(1) Check light for defective or broken seal.

(2) Check for loose connections, and damaged or defective component parts (terminal strips, limit switches, drive motors, relays, etc.).

f. Repair or Replacement.

(1) Accomplish replacement of sealed beam lamp unit 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.

(2) Replace complete unit if inspection items in paragraph 12-42, step e (2), are not met.

(3) Replace landing light motor as follows:

(a) Remove cover plate and remove screws in clamp.

(b) Remove gear and motor together.

(c) Remove gear from motor.

(d) Install gear on new motor and replace in helicopter.

g. Installation.

(1) Connect wires and install terminal cover and clamp.

(2) Insert light through hole, align mounting holes and install screws.

(3) Check light for proper operation.

12-43. Anti-Collision Light.

Anti-collision light circuit consists of a circuit breaker, a switch, and anti-collision light assembly. Anti-collision light is installed on tailpipe fairing. Circuit breaker and switch are on overhead console. (See figure 13-34.)

a. Operational Check.

(1) Close ANTI COLL LIGHT circuit breaker.

(2) Position anti-collision light switch S59 to ON and check that lamp(s) illuminate and that the light rotates at approximately 45 RPM giving 90 flashes per minute.

b. Removal.

(1) Be sure that all electrical power is OFF.

(2) Remove mounting screws around base of light, lift light up, and disconnect electrical connector.

c. Inspection.

(1) Inspect light for broken cover, lens or burned out lamp bulb element.

(2) Inspect light for damaged case, broken connector, pins, and damaged rotation motor or drive unit.

d. Repair or Replacement.

(1) Loosen screw securing lens cover retaining ring, lift lens from light base. Install and secure new lens cover in reverse order of removal procedure.

(2) Replace item if inspection requirements in paragraph 12-43, c, are not met.

e. Installation.

(1) Connect electrical connector to light and secure with lockwire.

(2) Place light in recess and install mounting screws.

(3) Check light for proper operation.

12-44. Navigation Lights.

The navigation lights circuit 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 each above the 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 UH-1D/H serial number 65-9565 and subsequent the white lights are protected by a separate circuit breaker. (See figure 13-34.)

a. Operational Check.

(1) Close FUS LIGHTS circuit breaker. Place navigation lights switch S13 to STEADY. Position dim-bright switch S14 to BRT. Check that the two upper and one lower fuselage lights are on bright.

(2) Position switch S14 to DIM and check that the fuselage lights specified in step (1) are on dim.

(3) Close NAV LIGHTS circuit breaker. Check that the two red (left side) and the two green (right side) navigation lights and the tail light are illuminated and are on dim.

(4) Position switch S14 to BRT. Check that all lights specified in steps (1) and (3) are on bright.

(5) Position switch S13 to FLASH. Check that the two red and two green navigation lights and the tail light flash at a rate of approximately 85 ±15 cycles.

b. Removal.

(1) Check that all electrical power is OFF.

(2) Remove cover retaining screw. Remove two screws attaching light assembly to bracket, pull assembly from helicopter, and disconnect electrical connector. Lift light assembly from helicopter. Cover loose wire with tape.

c. Inspection. (Refer to paragraph 12-37, h; procedure is the same.)

d. Repair or Replacement. Replace faulty or damaged component parts (lens, lamp bulbs, etc.). If light case is damaged beyond repair complete unit must be replaced.

e. Installation.

(1) Remove tape from wire and connect wire to light. Secure light to adapter bracket with two screws. Install cover with screw.

(2) Check operation of light.

12-45. Navigation Lights Flasher.

The navigation lights flasher is mounted in the aft electrical compartment. On UH-1D/H helicopters through serial number 64-13901 the flasher will cause the white and colored navigation lights to flash alternately. On UH-1D/H serial number 65-9565 and subsequent the flasher will cause only the colored navigation lights to flash.

a. Removal.

(1) Be sure all electrical power is OFF.

(2) Disconnect electrical connector. Remove mounting bolts and lift from compartment.

b. Inspection. 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.

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation.

(1) Position flasher in compartment and install mounting bolts.

(2) Connect electrical connector. Check for proper operation.

12-46. Rheostat.

The rheostats are mounted on the INST LTG panel in the overhead console. The rheostats are a means of turning on and dimming instrument, instrument secondary, console, and pedestal lights.

a. Removal.

(1) Be sure all electrical power is OFF. Disengage fasteners to allow access to right hand side of overhead console.

(2) Remove pointer knob and mounting hardware of rheostat. Disconnect wires from terminals of rheostat and cover wire ends.

b. Inspection. (Refer to paragraph 12-5, b.)

c. Repair or Replacement. Replace item if inspection requirements are not met.

d. Installation.

(1) Position rheostat in panel and install mounting hardware and pointer knob.

(2) Remove cover from wire ends and connect to proper terminals of rheostat.

(3) Carefully close panel assembly of overhead console, noting that wires stow without binding or interference. Engage panel fasteners.

Section VI. MISCELLANEOUS EQUIPMENT

12-47. Description.

The following equipment is described and maintained in other chapters of this manual. Refer to alphabetical index for applicable chapters covering the the respective systems. This section presents only electrical operational checks to make certain that circuits are free of possible potential malfunction when equipment is replaced or airframe wiring is repaired or replaced.

12-48. Electrical Operational Checks — Miscellaneous Equipment.

a. Bleed Air Heating. Perform bleed air heating in accordance with following procedures. (See figure 13-35.)

(1) Prior to helicopter Serial No. 66-16868, accomplish the following:

(a) 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.

(b) 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.

(c) 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.

(d) Move manual defrost lever slightly toward the OFF position. Check that the door post outlet valve switch returns to position 3.

(e) Place switch S83 in any position (1, 2, 3, or 4) except OFF. Obtain access to relay K-46 behind heater panel in overhead console. Find wire H110A20 attached to a terminal of relay K-46. Temporarily jump this relay terminal to ground, thus simulating an overheat condition. Check that the bleed air valve returns to the off or closed position.

(f) Remove the temporary jumper. Check that the bleed air valve returns to its preset position.

(2) For helicopter Serial No. 66-16868 and subsequent, accomplish the following:

(a) Close CABIN HEATER AIR VALVE and CABIN HEATER OUTLET VALVE circuit breakers.

(b) Actuate bleed air switch S83 to the ON position and then to OFF. Check that variable mixture solenoid valve (L21) makes an audible click when switch S83 is switched to both ON and OFF positions.

(c) Actuate aft outlet switch S85 from OFF to positions 1, 2, and 3. Check that the door post outlet valve opens to a maximum at position 3.

(d) With switch S85 in position 3, move the aft outlet limit lever to the full ON position. Check that the door post outlet valve returns to its closed position.

(e) Move the aft outlet limit lever slightly toward the OFF position. Check that the door post outlet valve switch returns to position 3.

(f) Position bleed air switch S83 to ON. Obtain access to relay K-46 behind heater panel in overhead console. Find wire H110A20 attached to a terminal of relay K-46. Temporarily jump this relay terminal to ground, thus simulating an overheat condition. Check that the variable mixture solenoid L21 makes an audible click, thus signifying the off or closed position.

(g) Remove the temporary jumper. Check that the variable mixture solenoid valve makes an audible click, thus signifying its return to the on or open position.

b. Muff Heater (If Installed). Perform muff heater test in accordance with the following procedure.

(1) For helicopters prior to Serial No. 66-16868, accomplish the following.

(a) Check that wire H86A20 is connected to terminal 16 (position 3) instead of terminal 13 of switch S85. Close CABIN HEATER CONT circuit breaker.

(b) Move switch S85 to OFF and then in turn to positions 1, 2, and 3. Check that the door post outlet valve and the aft outlet valve are closed when switch S85 is in the OFF position and full-on when switch S85 is in position 3.

(c) With switch S85 in position 1 or 2, move the manual defrost lever to the full-on position. This actuates switch S87. Check that the door post outlet valve is at the full-on or open position and the aft outlet valve is at the off or closed position.

(d) Move manual defrost lever slightly toward the OFF position so that switch S87 is de-activated. Check that the door post outlet valve and the aft outlet valve return to their preset positions.

(e) Place switch S83 in any position (1, 2, 3, or 4) except OFF. Obtain access to relay K-46 behind heater panel in overhead console. Find wire H110A20 attached to a terminal of K-46 relay. Temporarily jump this relay terminal to ground, thus simulating an overheat condition. Check that bleed air valve returns to the off or closed position.

(f) Remove the temporary jumper. Check that the bleed air valve returns to its preset position.

(g) Move switch S83 to OFF and then in turn to positions 1, 2, 3, and 4. Check that the bleed air valve is closed when switch S83 is in the OFF position and full-on when switch S83 is in position 4.

(2) For helicopter Serial No. 66-16868 and subsequent, accomplish the following:

(a) Check that wire H86A20 is connected to terminal 16 (position 3) instead of terminal 13 of switch S85. Close CABIN HEATER AIR VALVE circuit breaker.

(b) Move switch S85 to OFF and then in turn to positions 1, 2, and 3. Check that the door post outlet valve and the aft outlet valve are closed when switch S85 is in the OFF position and full-on when switch S85 is in position 3.

(c) With switch S85 in position 1 or 2, move the aft outlet lever to the full-on position. This actuates switch S87. Check that the door post outlet valve and the aft outlet valve are closed when switch S85 is in the OFF position.

(d) Move aft outlet limit lever slightly toward the OFF position so that the door post outlet valve and the aft outlet valve return to their preset positions.

(e) Position switch S83 to ON. Obtain access to relay K-46 behind heater panel in overhead console. Find wire H110A20 attached to a terminal of K-46 relay. Temporarily jump this relay terminal to ground, thus simulating an overheat condition. Check that the variable mixture solenoid valve, L21, makes an audible click, this signifying the off or closed position. Check that the bleed air valve motor, B34, is functioning.

(f) Remove the temporary jumper. Check that the variable mixture solenoid valve, L21, makes an audible click, thus signifying its return to the on or open position.

(g) Position switch S83 to ON and then OFF, while listening to determine that the bleed air valve motor and the solenoid valve, L21, is functioning.

c. *Heated Blanket Receptacles – Utility Outlets.*

(1) Close both HEATED BLANKET circuit breakers.

(2) Check for 28v dc at each receptacle mounted in the cabin roof. (Six receptacles on all aircraft prior to Serial No. 66-16034 and two receptacles on Serial No. 66-16034 and subsequent.) (See figure 13-36.)

d. *Pilot and Copilot Windshield Wipers.*

(1) Suitably protect windshield against scratching by wiper blades. (See figure 13-37.)

(2) 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's and copilot's wipers operate at low speed.

(3) Position switch S23 to MED position. Check that both wipers operate at medium speed.

(4) Position S23 to HIGH. Check that both wipers operate at high speed.

(5) Position switch S23 to PARK. Check that both wipers move at high speed to their park positions and stop.

(6) Open WINDSHIELD WIPER COPILOT circuit breaker. Position selector switch S124 to PILOT. Check that pilot's wiper operates with wiper switch S23 in the LOW, MED, HIGH, and PARK positions.

(7) Open WINDSHIELD WIPER PILOT circuit breaker. Close WINDSHIELD WIPER COPILOT circuit breaker. Position selector switch S124 to COPILOT. Check that copilot's 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.

e. *Cargo Hook.*

(1) Close both CARGO HOOK REL circuit breakers. Close and latch the hook. Position the cargo release switch to ARM. Check that cargo release armed light on the instrument panel is illuminated. (See figure 13-38.)

(2) Depress cargo release switch S32 on the pilot's cyclic stick. Check that solenoid in the hook actuates and causes the hook to fall open.

(3) Repeat step b. for switch S78 on the copilot's cyclic stick.

f. *Rescue Hoist (Provisions).* These checks shall be conducted on each helicopter having complete provisions for the rescue hoist. (See figure 13-39.)

(1) Check that wire M20A20 is connected to HOIST PWR circuit breaker (1 ampere).

(2) Check that wires M21A20 and M22A20 are connected to HOIST CONT circuit breaker (10 ampere).

(3) Check that wire M25A20 is connected to HOIST CUT circuit breaker (5 ampere).

NOTE

The following checks are basically voltage (28 v dc) checks between the designated pin of connector J119 and ground (pin X of J119).

(4) Close HOIST CONT circuit breaker and measure for 28 v dc on pin G of J119.

(5) Open HOIST CONT circuit breaker and measure for zero v dc on pin G of J119.

(6) Close HOIST CONT circuit breaker. Position HOIST switch S112 (located on pilot's cyclic stick) to DN. Measure for 28 v dc on pin C of J119.

(7) Release HOIST switch S112 and measure for zero v dc on pin C of J119.

(8) Position HOIST switch S112 to RH/OUT, and measure for 28 v dc on pin D of J119.

(9) Release HOIST switch S112 and measure for zero v dc on pin D of J119.

(10) Position HOIST switch S112 to UP, and measure for 28 v dc on pin E of J119.

(11) Release HOIST switch S112 and measure for zero v dc on pin E of J119.

(12) Position HOIST switch S112 to LH/IN and measure for 28 v dc on pin F of J119.

(13) Release HOIST switch S112 and measure for zero v dc on pin F of J119.

(14) Close HOIST CUT circuit breaker. Close CABLE CUT switch S96 (located on pedestal). Measure for 28 v dc on pin H of J119.

(15) Open CABLE CUT switch S96 and measure for zero v dc on pin H of J119.

(16) Close NON ESS BUS switch S62. Close HOIST PWR circuit breaker and measure for 28 v dc on pin W of J119.

(17) Open HOIST PWR circuit breaker and measure for zero v dc on pin W of J119.

(18) Position all circuit breakers and switches to OFF.

(19) 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.

(20) Position crew HOT MIC switch S66 to ON and measure resistance between pins J and K of J119. The resistance should be zero ohms.

(21) Hold crew HOT MIC switch in MOM position and measure resistance between pins J and K of J119. The resistance should be zero ohms.

(22) Position crew HOT MIC switch S66 to OFF. Disconnect ohmmeter.