CHAPTER 29 — HYDRAULIC SYSTEM

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FIGURES

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HYDRAULIC SYSTEM

29-1. HYDRAULIC SYSTEM

Two similar but separate hydraulic systems are used to operate flight controls power cylinders (Figure 29-1). Hydraulic systems No. 1 and No. 2 are alike as to their reservoirs and integrated valve and filter modules, which contain system filters, solenoid valves, and relief valves. Although both systems operate three dual servo hydraulic cylinders in main rotor controls, there is no connection between systems because the systems use separate passages and chambers inside each duel cylinder and valve assembly. If one system is disabled, the remaining system can still operate normally. The directional control actuator is operated from hydraulic system No. 1.

In normal operation of each system, hydraulic fluid is supplied from a non-pressurized reservoir by gravity feed and suction to a transmission drive pump. The pump is a variable delivery type with internal pressure compensation, preset to provide 1000 ±25 PSI (6895 ±172.38 kPa) output pressure and 6.0 gallons per minute (22.71 L/min) flow rate at operating RPM, according to system demands. Pump output is delivered to the module and passes through the pressure filter. A relief valve in the module guards the system against excessive pressure, being set to open at 1100 PSI (7585 kPa). The system solenoid valve is normally deenergized and open to the SYS PRESS outlet of the module but can be electrically energized to OFF position by means of the HYDR SYS switch.

Each module has two red indicator buttons for its two filters, and is also electrically connected to a remote warning indicator located in the cabin nose forward of the pilot station. If any of the four filters becomes partially clogged, differential pressure will cause the red button to extend and the remote indicator to change from green to red, remaining so until the clogging filter element is cleaned and both indicators are manually reset. Temperature and pressure gauge indications for each system are provided by a temperature bulb at the reservoir inlet and a pressure transmitter at the module outlet.

On helicopters S/N 30554 and subsequent, temperature switches located on both hydraulic system No. 1 and No. 2 reservoir inlets will illuminate a HYDRAULIC caution segment located on the caution panel when hydraulic fluid temperature reaches 190°F (88°C). Pressure switches located at the module outlets illuminate the same segment light when system pressures drop below 650 PSI (4482 kPa) during normal operation.

On helicopters S/N 30875 and subsequent, a pulsation damper is installed on hydraulic system No. 2 between the hydraulic pump and check valve. The damper will reduce hydraulic system noise in the cabin.

29-2. GENERAL MAINTENANCE PRACTICES

29-3. LEAKAGE LIMITS

The following provides guidelines for allowable external leakage of in-service hydraulic system components, and some methods of measuring such leakage.

1. Scope – Limits described are only for components in-service in helicopter hydraulic systems. Intent is to minimize replacement of hydraulic components that are still serviceable.

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

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

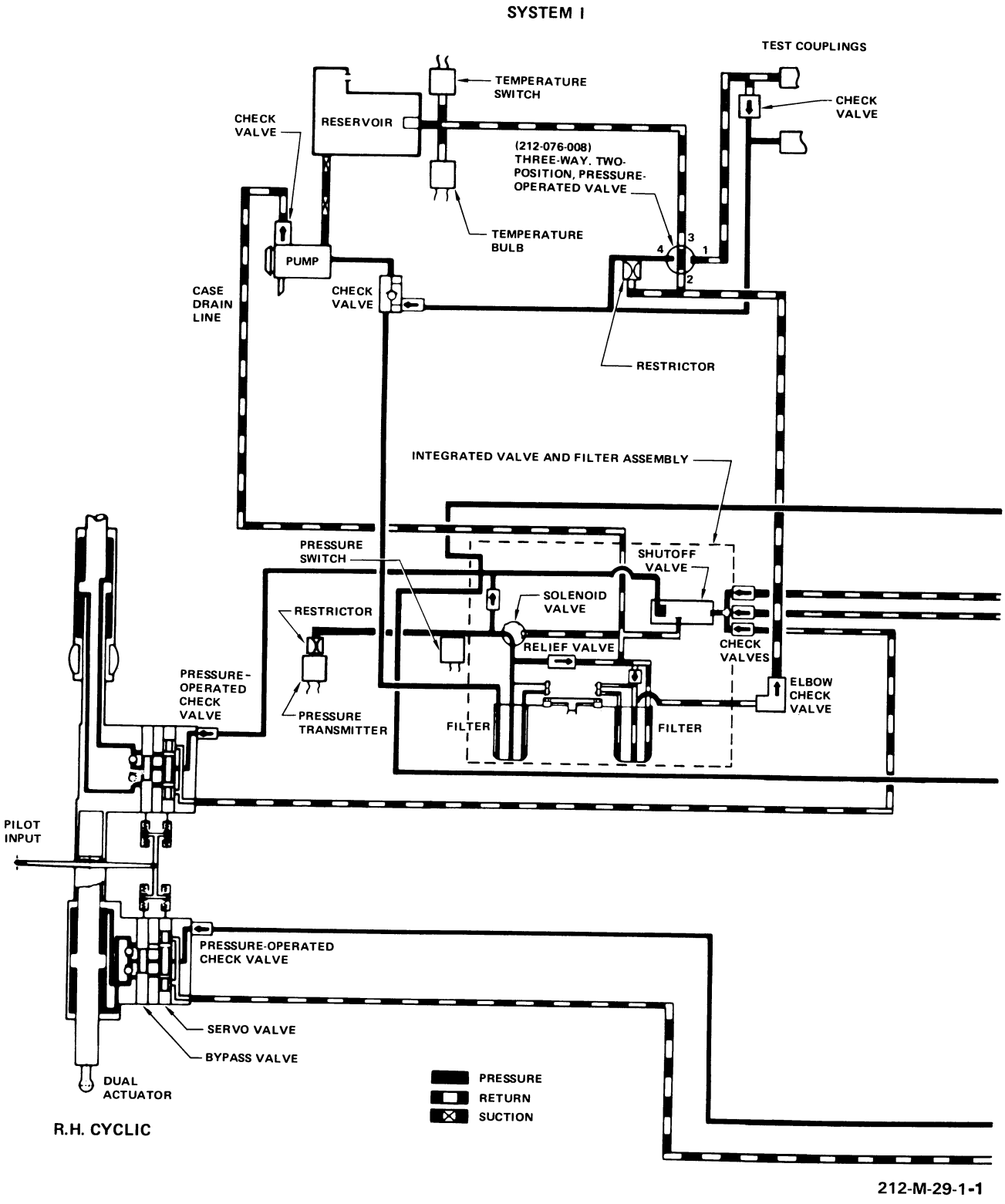

Figure 29-1. Hydraulic schematic (sheet 1 of 4)

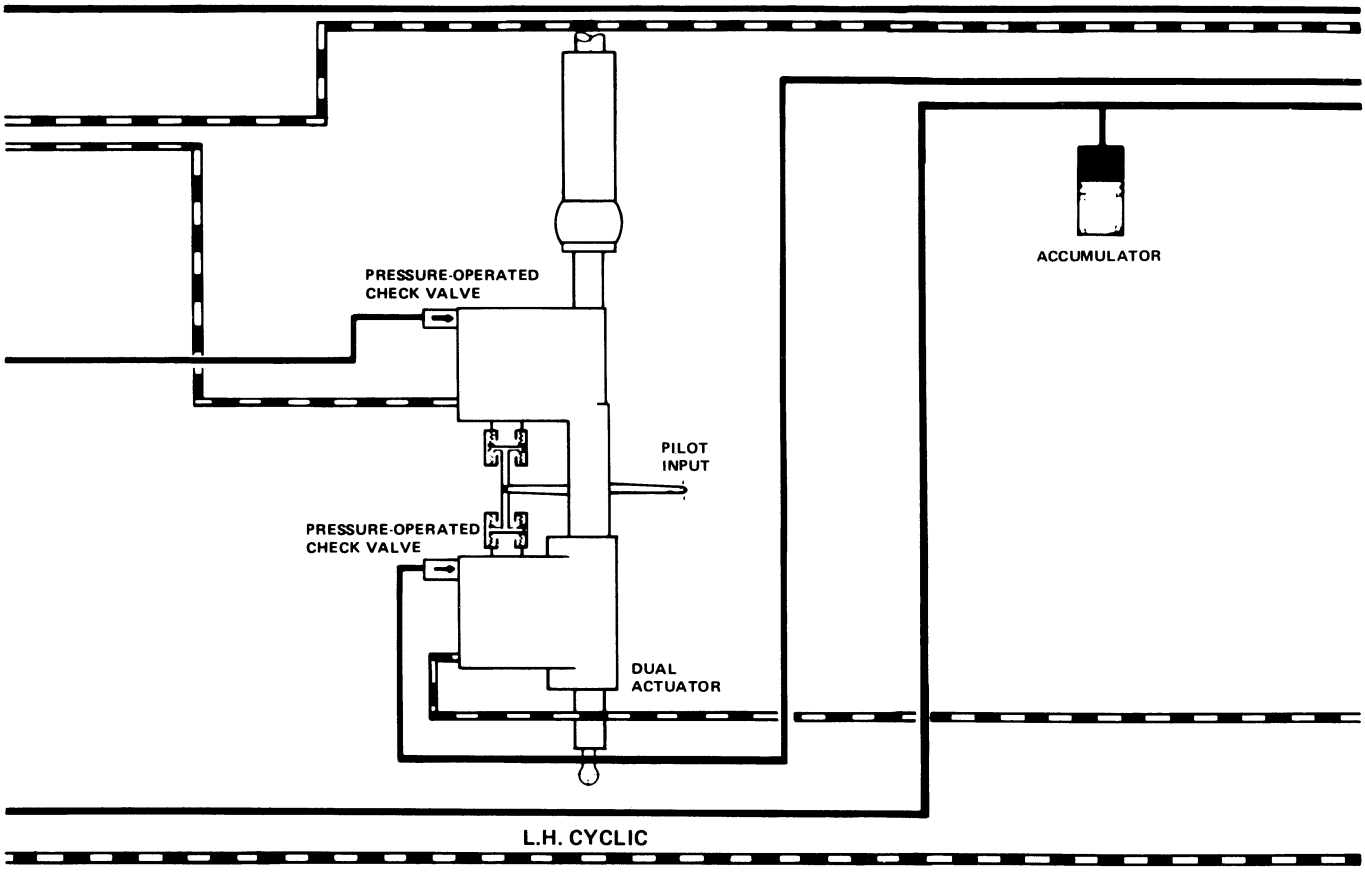

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Figure 29-1. Hydraulic schematic (sheet 2)

SYSTEM II

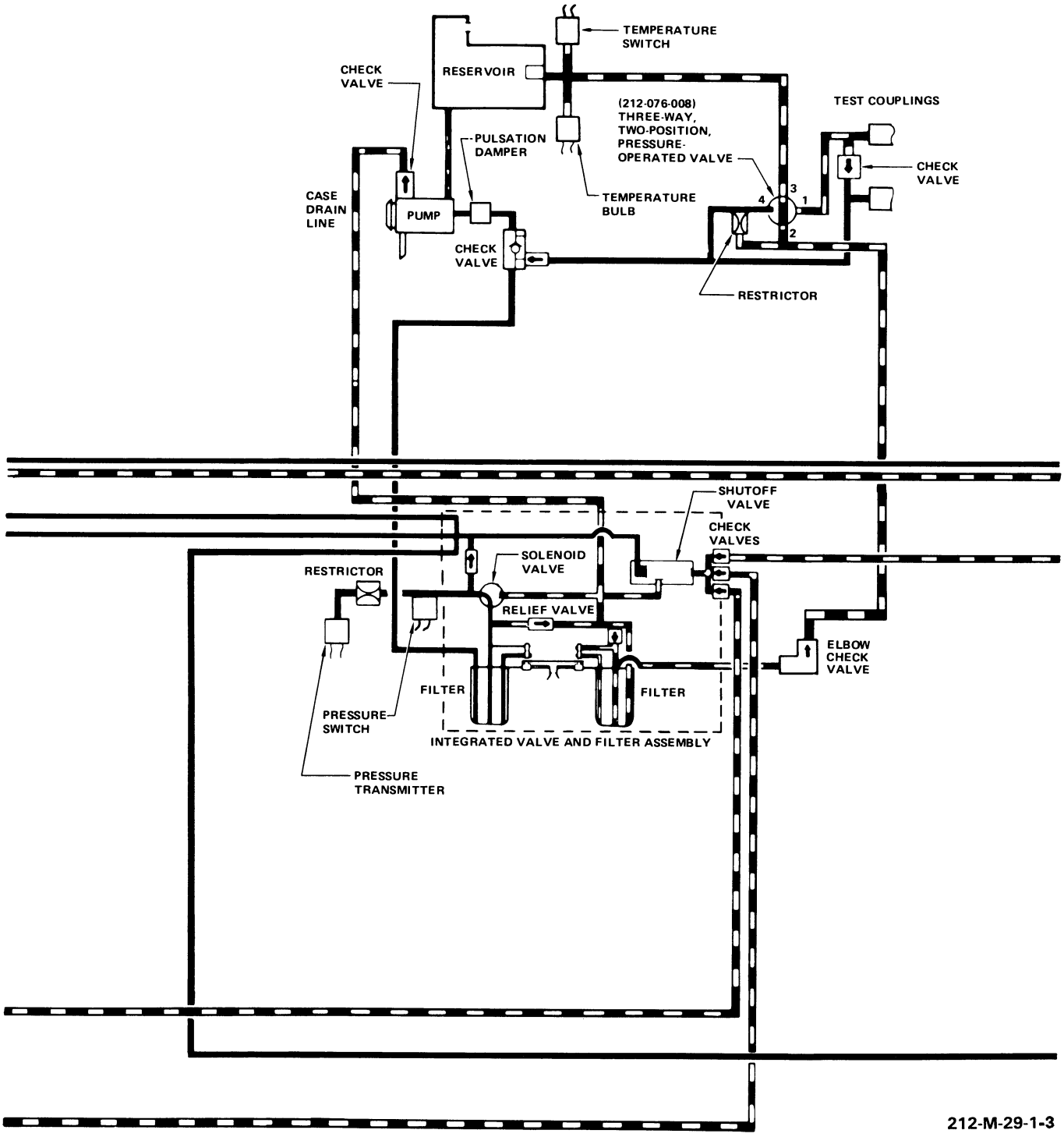


Figure 29-1. Hydraulic schematic (sheet 3)

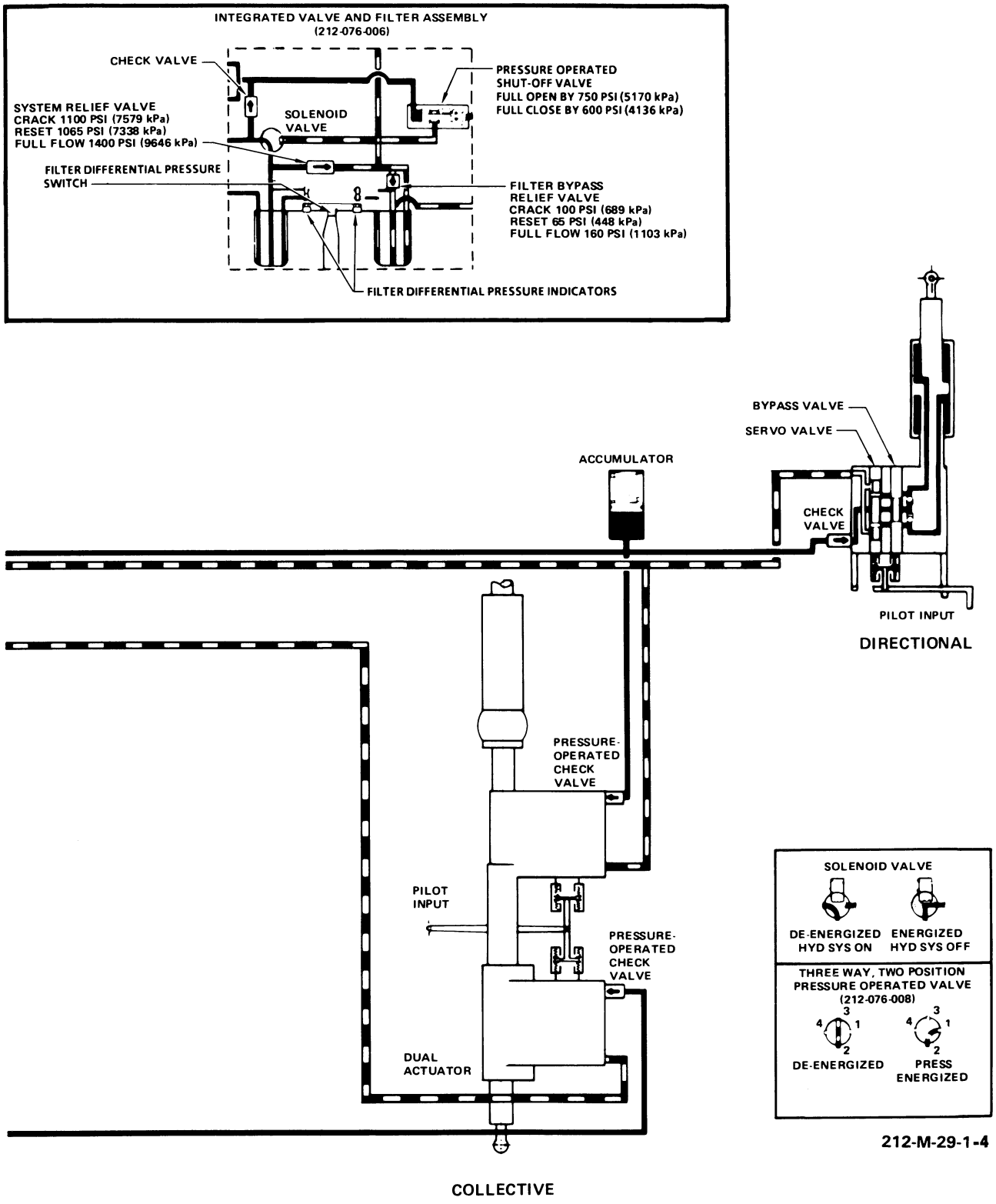


Figure 29-1. Hydraulic schematic (sheet 4)

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

2. Causes of Leakage - Some seepage is normally present, since static or dynamic seals are not functionally perfect, due to such causes as follow:

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

b. Pressure and temperature variations affecting seals.

c. Seals tending to take a permanent set after a period of time.

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

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

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

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

4. Leakage Checks - Measurement of leakage rates, for classification according to table 29-1 , can be performed as follows:

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

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

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

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

Table 29-1. Allowable leakage for in-service hydraulic components

COMPONENT	FUNCTION	LEAK TYPE	LEAKAGE RATE (Max)
FLIGHT	Rod seal	D	1 drop/20 full stroke cycles
CONTROLS	Rod seal	S-D	1 drop/15 minutes
ACTUATORS	End cap	S	2 drops/day
	Valve input	D	1 drop/5 cycles
		S-D	1 drop/5 minutes
	Pressure switch	S-D	1 drop/5 min.
	Valve body (weep holes)	S-D	1 drop/5 min.
PUMPS	Output shaft	D	8 drops/min.
		S-D	1 drop/min.
	Housing (mating surfaces)	S	2 drops/day
VALVES	Body (weep hole)	S	2 drops/day
	Manual stem	D	1 drop/5 cycles
		S-D	1 drop/15 min.
	Dump valve	S	2 drops/day
BY-PASS CHECK VALVE		D	2 drops/25 cycles
		S	None at static pressure of 5 to 1000 psi
FITTINGS	Flared or flareless	S	None
	Compression seals	S	1 drop/30 min. (less if readily accessible)

NOTES:

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

29-4. TROUBLESHOOTING.

The following list of probable causes, isolation procedures, and remedies is intended to aid in hydraulic system troubleshooting. The guide should be used with other sources of information such as hydraulic schematic, electrical diagrams, operational check, and other detailed procedures in this chapter.

Table 29-2. Troubleshooting

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
ONE SYSTEM LACKS POWER AND PRESSURE IS LOW.		
Leaks in system.	Visually check for leaks due to loose connections, line rupture, component rupture, or failed seals.	Repair connections; replace faulty lines, hoses, seals or components. Service system and perform operational check.
Pump malfunction.	Check system can be powered by hydraulic test unit.	Replace pump.
System check valve struck closed in pump pressure line.	If operation on hydraulic test unit is normal, but operation with a known serviceable pump remains faulty, check valve may be defective.	Replace check valve.
Reservoir vent obstructed.	If system pressure is intermittently low when operating on pump, though normal with test unit, check reservoir for obstructed vent causing pump cavitation.	Clear reservoir vent screen or replace reservoir. Operationally check for possible pump damage.
System solenoid valve remaining in off position.	Electrically check that solenoid is not energized. If not circuit fault, valve may be mechanically stuck.	Repair electrical circuit, or replace valve and filter assembly.
ONE SYSTEM LACKS POWER BUT PRESSURE IS NORMAL.		
Pressure operated valve in reservoir return line locked in energized (test coupling) position.	If system normal on test unit but controls not powered by pump operation, valve may be defective.	Replace valve.
Reservoir return port screen clogged.	Visually check reservoir return screen.	Clean screen or replace reservoir.
Pressure operated shutoff valve or internal check valve in integrated valve and filter module malfunctioning.	Disconnect reservoir return line. With system on, move controls and check for steady flow. If not, valve is faulty.	Replace integrated valve and filter module.

Table 29-2. Troubleshooting (Cont)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
PRESSURE FLUCTUATION WITH CONTROLS MOTIONLESS		
Airlock in line between pressure transmitter and restrictor.	Operating on ground test unit, briefly loosen line connection on elbow at P port of pressure transmitter. Tighten connector after bleeding, and recheck pressure indication.	If pressure is steady after bleeding line, no further action. If fluctuation continues, check transmitter and gage. Replace faulty unit(s).
Reservoir return screen ruptured, or vent screen partially obstructed.	Check for foaming in reservoir after rapid control movements, as indication of return screen damage. Inspect reservoir screens.	Clear obstructed vent or replace reservoir.
FILTER INDICATORS TRIPPED.		
Filters clogged.	If indicator in cabin nose is red, check both system filter assemblies for tripped indicators. Manually reset indicators and operate system. Move controls rapidly. If indicators again trip, filters are clogged.	Clean filter elements as required. Reset module indicators and remote indicator.
Module indicators defective.	Module indicators trip with known serviceable filter elements installed, but remote indicators remain green and do not extend.	Replace or repair defective filter modules.
Remote indicators defective.	Remote indicators trip (red), but module indicators do not trip.	Replace remote indicators. (It is acceptable to return helicopter to service provided the module indicators are inspected daily until remote indicators are replaced).
EITHER HYDRAULIC SYSTEM OVERHEATS.		
	NOTE	
System 2 operates at slightly higher temperature than system 1 due to difference in pump rpm.		
Pump defective, allows increasing pressure.	Use a test gage to check system pressure, 1050 psi (7240 kPa) maximum.	Replace pump.
System relief valve held fully open.	Check for loss of control response, and for flow through relief valve.	Replace valve and filter module.

Table 29-2. Troubleshooting (Cont)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
HYDRAULICS AND MASTER CAUTION LIGHTS ON.		
System 1 or 2 overheating.	Check temperature gage for temperature higher than 190°F (88°C).	Refer to EITHER HYDRAULIC SYSTEM OVERHEATS.
System 1 and 2 have low pressure.	Check pressure gage for low pressure below 650 psi (4482 kPa).	Refer to ONE SYSTEM LACKS POWER AND PRESSURE IS LOW.
Temperature switch malfunctioning.	Temperature gage indicates normal.	Replace switch of each system independently and recheck system.
Pressure switch malfunctioning.	Pressure gage indicates normal.	Replace switch of each system independently and recheck system.
CONTROLS DO NOT OPERATE SMOOTHLY.		
Servo or bypass valves sticking.	With hydraulic pressure off, disconnect control tube from servo input lever of dual actuator. Manually check force required to operate lever 0.070 in. (1.78 mm), not to exceed 32 oz. (8.90 N). (Reconnect control tube before hydraulic pressure is turned on.)	1. Check lever pivot for binding. Clean or replace bolts. 2. Flush system thoroughly. Recheck operation. 3. Replace seals on servo or by-pass valves, or replace actuator.
Binding in flight control linkage.	Check linkage components for freedom of motion.	Replace defective parts.
INADEQUATE CONTROL RESPONSE		
Internal leakage past piston in actuator.	Check actuator is only partially powered.	Replace servo actuator.
Check valve stuck closed in pressure port of actuator or in return port of integrated valve and filter assembly.	Substitute valve with one known to be serviceable. Operational check system.	Replace check valve.

Table 29-2. Troubleshooting (Cont)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
One of the internal bypass check valves stuck open in actuator.	Check actuator is powered in one direction only.	Replace actuator.
RESERVOIR OVERFLOWS WHEN USING GROUND TEST UNIT.		
Test unit pressure too low.	Check test unit setting.	Increase test unit pressure above 550 psi (3792 kPa).
Pressure operated valve malfunction.	Check for increased overflow when flight controls are moved.	Replace valve.
Check valve in pump case drain line closed.	Check for overflow with no control motion.	Replace valve.
System check valve in pump pressure line open.	Check for overflow with no control motion.	Replace valve.
HIGH FREQUENCY VIBRATIONS DUE TO TAIL ROTOR CONTROLS.		
Stiffness of binding in action of tail rotor control hydraulic cylinder.	1. Cylinder input lever binding on spacer at bell crank. (Move lever laterally to check.)	1. Polish spacer OD until free in lever bearing.
	2. Cylinder trunnions binding in mounting plates. (Move cylinder laterally 0.003 to 0.050 in. (0.076 to 1.27 mm).	2. Polish trunnion plate bushings ID for free fit.
	3. Cylinder input lever binding at pivot.	3. Repair cylinder assembly per overhaul instructions.
Binding in tail rotor controls.	1. Check pitch control tube for binding in bearing in left side of tail rotor gearbox.	1. Remove pitch change tube. Clean ID of bearing and OD of tube. Install and recheck.

Table 29-2. Troubleshooting (Cont)

INDICATION OF TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
	2. Check lever on left side of tailrotor gearbox for stiffness of lower end bearing in alignment motion. If stiffness occurs, twist attached link to turn nut end of bolt upward. Pull nut downward with a spring scale. If force to move bearing exceeds 10 lbs. (44.48 N), lever is unserviceable.	2. Replace unserviceable lever.
MOTORING SERVO ACTUATOR IN TAIL ROTOR CONTROLS.		
Hoses restraining or causing action of actuator valve on tail rotor hydraulic cylinder.	Inspect hoses for position through full operating range.	Position hoses for least restraint.
COLLECTIVE STICK LIGHT OR HEAVY IN DOWNSTROKE.		
Collective minimum friction incorrect.	Check friction preload on collective stick.	Adjust minimum friction (Chapter 67).
Balance spring on collective cylinder defective.	Check condition of balance spring on input lever of collective hydraulic cylinder.	Replace defective spring.
INABILITY TO MAKE NORMAL RIGHT AND LEFT TURNS IN FLIGHT.		
Tail rotor controls rigging incorrect.	Check tail rotor rigging.	Rig tail rotor controls.
BINDING IN TAIL ROTOR MOVEMENT.		
Pitch change tube binding in bearing at left side of tail rotor gearbox.	Manually check tube for free movement through bearing.	Clean surfaces of tube and bearing.
Binding bearing in lower end of lever on left side of tail rotor gearbox.	Manually check bearing.	Replace lever.

29-5. FLUSHING.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-405	Lockwire

SPECIAL TOOLS REQUIRED

NUMBER	NOMENCLATURE
—	Hydraulic test stand

1. The entire system shall be thoroughly flushed to ensure removal of all foreign matter from lines and components.

NOTE

If system 1 is contaminated, remove system 1 hydraulic pump, cyclic, collective and antitorque actuators. If system 2 is contaminated, remove system 2 hydraulic pump, cyclic and collective actuators. Attach statement to each component stating reason for removal and send to overhaul facility for evaluation.

a. Fill helicopter reservoir to capacity with hydraulic fluid (C-002) and keep filled during system flushing.

b. Disconnect hoses from cyclic, collective, and antitorque actuators.

c. Connect hose ends together using MS21916D6-4 reducers.

d. Cap open actuator ports to prevent contamination of systems.

e. Remove filter element and discard. Reinstall filter bowl.

f. Connect test unit to system 1 through ground test provisions located on left side of helicopter just aft of F.S. 144 and below W.L. 22.

g. Accomplish a complete visual inspection of hydraulic system to ensure all components and lines are securely attached and appear capable of satisfactory operation.

CAUTION

THROUGHOUT FUNCTIONAL TESTS, DO NOT OPERATE BELOW 550 PSIG (3792 kPa). HOWEVER, IF IT BECOMES NECESSARY TO REDUCE SYSTEM PRESSURE TO ZERO, DE-ENERGIZE TEST UNIT FLOW TO HELICOPTER AND REDUCE SYSTEM PRESSURE. FAILURE TO DO THIS WILL RESULT IN OVER-FILLING OF THE SYSTEM RESERVOIR. TESTS REQUIRING DEACTIVATION OF A SYSTEM SHALL BE ACCOMPLISHED BY DISCONNECTING TEST UNIT FROM THAT SYSTEM.

h. Set test unit pressure relief valve for a cracking pressure of 2100 psig (14480 kPa) and set test unit to a pressure sufficient to maintain a 6.0 gpm (22.71 lpm) minimum flow through the system.

NOTE

Test unit reservoir shall be used in this flushing procedure.

i. Maintain this pressure setting for at least five minutes while observing all portions of system for external leakage. Take appropriate action to correct any leakage.

j. Decrease system pressure to 9 psig (62.05 kPa).

2. Disconnect test unit from system 1 and connect system 2.

3. Repeat step 1.a. through 1.j.

NOTE

The systems may be under pressure caused by the lock-out valve and accumulator. A small container should be available to catch a small amount of oil when disconnecting hoses.

4. After flushing procedure is completed, remove dust caps from actuators. Reconnect hoses to cyclic, collective and antitorque actuators. Remove filter bowl, drain fluid and clean bowl, replace element and bowl, and torque bolt 100 to 140 in.lbs. (11.30 to 15.82 Nm) and secure with lockwire (C-405).

29-6. OPERATIONAL CHECK.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-405	Lockwire
C-304	Solvent

SPECIAL TOOLS REQUIRED

NUMBER	NOMENCLATURE
—	Hydraulic test stand

WARNING

UNLESS OTHERWISE SPECIFIED, CLEANING OF HYDRAULIC COMPONENTS SHALL BE ACCOMPLISHED WITH SOLVENT (C-304) ONLY. DO NOT USE ALCHOHOL.

This procedure is for ground operational check of hydraulic systems to aid in troubleshooting, or to test for proper functioning after maintenance.

1. Provide a portable hydraulic test stand conforming to the following requirements:

a. Thoroughly cleaned and serviced with hydraulic fluid (C-002).

b. Equipped with a 10-micron absolute maximum particle size metal filter through which all fluid passes before leaving unit and a 10-micron filter on return line to test unit before fluid returns to test stand.

c. Capable of producing pressure to 1400 psig, and a minimum flow rate of 6.0 gallons per minute.

d. Equipped with a calibrated pressure gage with minimum 1500 psig (10343 kPa) capacity.

2. Visually inspect entire hydraulic system of helicopter to ensure all lines and components are secure and appear capable of operation. Obtain access by opening transmission cowling, doors on front and sides of pylon structure in cabin, and door to fuselage compartment in which tail rotor control actuator is located.

3. Prepare portable hydraulic test stand for operation: Relief valve set for 1300 psig (8964 kPa) pressure; pump set for at least 6 gallons per minute flow.

4. Remove test coupling access doors below left cargo door opening, at approximately F.S. 150 for system 1 and F.S. 134 for system 2.

CAUTION

THROUGHOUT FUNCTIONAL TESTS, DO NOT OPERATE BELOW 550 PSIG (3792 kPa) PRESSURE. IF NECESSARY TO REDUCE SYSTEM PRESSURE TO ZERO, DE-ENERGIZE TEST UNIT FLOW TO HELICOPTER BEFORE REDUCING SYSTEM PRESSURE. FAILURE TO DO THIS MAY RESULT IN OVER-FILLING SYSTEM RESERVOIR. TESTS REQUIRING DEACTIVATION OF A

SYSTEM SHALL BE ACCOMPLISHED BY DISCONNECTING HYDRAULIC TEST STAND FROM THAT SYSTEM.

5. Connect hydraulic test stand to both systems. (if test unit does not have dual hoses, perform test on each system separately.) Apply 1000 PSIG (6895 kPa) for at least 15 minutes, while performing the following.

a. Observe all parts of system for evidence of leakage, taking corrective action as necessary.

b. Slowly cycle all controls through full motions. Check all moving parts have clearance so there is no fouling or binding. Give particular attention to flexible connections to ensure hoses are not pinched or twisted and vibration does not tend to loosen fittings.

c. Work out any air from system by actuating each of flight controls through at least ten full strokes, cyclic and collective sticks on either system, and tail rotor pedals on hydraulic system No. 1.

6. Check system pressure gauges as follows:

a. Close HYD SYS 1 and HYD SYS 2 circuit breakers. Place BATTERY BUS 1 and BATTERY BUS 2 switches ON. Energize inverters with INV 1 and INV 2 switches (BHT-212-FM).

b. Slowly decrease and increase test unit pressure in range between 550 and 1000 PSIG (3792 to 6895 kPa), observing both hydraulic pressure gauges for smooth operation throughout range.

7. On helicopters S/N 30554 and subsequent, check system pressure caution lights as follows:

a. Slowly decrease hydraulic test stand pressure for each system independently, and check NO.1 HYDRAULIC and NO.2 HYDRAULIC and MASTER CAUTION segments illuminate when hydraulic test stand pressure drops below 650 PSI (4482 kPa).

b. Slowly increase hydraulic test stand pressure for each system independently, and check NO.1 HYDRAULIC and NO.2 HYDRAULIC and MASTER CAUTION segments extinguish when hydraulic test stand pressure rises above 750 PSI (5171 kPa).

8. Check single system operation, if not already accomplished in performing step 5, as follows:

a. With hydraulic test stand connected to hydraulic system No. 2 only, apply 1000 PSIG (6895 kPa) pressure from hydraulic test stand. Observe hydraulic system No. 2 pressure gauge indicates 1000 PSIG (6895 kPa) while hydraulic system No. 1 gauge indicates zero. Move flight controls, checking cyclic and collective controls are smooth, positive, and fully powered but directional (tail rotor) controls are not powered.

b. With hydraulic test stand connected to hydraulic system No. 1 only, apply 1000 PSIG (6895 kPa) hydraulic test stand pressure and observe hydraulic system No. 1 pressure gauge indicates 1000 PSIG (6895 kPa) while hydraulic system No. 2 gauge indicates zero. Move flight controls, checking cyclic, collective, and directional controls are smooth, positive, and fully powered.

c. Shut off hydraulic test stand flow and reduce pressure to zero.

NOTE

If operational check-out is satisfactory, proceed to step 10. When further checks for proper operation of pressure operated shutoff valves and system relief valves are required, perform step 9.

9. With hydraulic test stand connected to one system only, monitor pressure gauge of test unit while performing following checks:

a. Apply 550 PSIG (3792 kPa) test unit pressure. Station a person to check action of flight controls. Slowly increase hydraulic test stand pressure. Controls should become fully powered (directional controls will not be powered if hydraulic system No. 2 is being checked) before pressure exceeds 900 PSIG (6205 kPa) for

212-076-006-3 valve assemblies, or 900 psig (6205 kPa) for 212-076-006-7 valve assemblies, indicating pressure operated shut-off valve in system module has opened.

b. Stop all movement of flight controls. Continue increasing pressure. Listen, or feel, valve module for evidence of system relief valve opening between 1100 and 1300 psig (7585 and 8964 kPa), and being fully open by 1400 psig (9653 kPa).

CAUTION

DO NOT INCREASE PRESSURE ABOVE 1400 PSIG (9653 kPa).

c. Slowly reduce pressure. Observe for evidence of system relief valve closing at not less then 1065 psig (7343 kPa).

d. Continue reducing pressure while checking action of flight controls. Controls should lose hydraulic power between 600 and 750 psig (4137 to 5171 kPa), indicating pressure-operated shut-off valve has closed.

e. Shut off hydraulic test stand flow and reduce pressure to zero. Remove filter bowls and drain all fluid. Replace filter elements and replace filter bowls. Tighten filter bowls 100 to 140 in.lbs. (11.30 to 15.82 Nm) and secure to housing using lockwire (C-405).

f. Apply 1000 psig (6895 kPa) hydraulic test stand pressure and bleed air from system by cycling all controls through full travel a minimum of 10 cycles.

g. Shut off test unit flow and reduce pressure to zero. Disconnect test unit from system. If required, connect unit to untested system and repeat checks.

10. On helicopter S/N 30554 and sub., perform steps a. through e. in step 9., noting in step d. NO.1 HYDRAULIC and NO.2 HYDRAULIC and MASTER CAUTION segments should illuminate at 650 psi (4481 kPa).

11. When checks are completed, place BATTERY BUS 1, BATTERY BUS 2 and INV 1 and INV 2 switches OFF. Install access doors.

29-7. OPERATIONAL CHECK (HELICOPTER POWER).

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid

CAUTION

ENGINE START AND RUNUP SHALL BE ACCOMPLISHED BY AUTHORIZED PERSONNEL ONLY.

1. Start either power section (BHT-212-FM). When main rotor had turned ten revolutions, shut down power section.

2. Replenish reservoir with hydraulic fluid (C-002) (Chapter 12).

3. Start engine. Operate at idle (BHT-212-FM).

4. Slowly move pilot cyclic, collective, and directional controls to allowable limits for ground operation. Repeat at least ten times to bleed air from system.

5. Shut down engine and replenish reservoir (Chapter 12).

HYDRAULIC SYSTEM COMPONENTS

29-8. HYDRAULIC SYSTEM COMPONENTS.

29-9. RESERVOIR ASSEMBLIES.

The reservoirs for system 1 and system 2 are identical, nonpressurized, magnesium alloy units with an approximate capacity per unit of 5.25 (2.48L) pints at overflow, 2.75 (1.30L) pints at refill level (Chapter 12). Each unit features a fluid level sight gage, filler cap and screen, screened vent, scupper with overboard drain line, and connections for supply to pump and return from system. System 1 and 2 reservoirs are located on the right and left side respectively of cabin roof under forward pylon fairing.

29-10. Removal.

1. Open forward pylon fairing.

2. Drain fluid from reservoir into a container by disconnecting hose from suction outlet fitting (figures 29-2 and 29-3).

3. Disconnect return and scupper drain lines.

4. Cap open fittings and lines.

5. Detach reservoir from roof structure by removing four bolts from mounting lugs.

6. If replacing reservoir, remove fittings from suction and scupper drain ports for use in new reservoir.

7. Cover open ports.

NOTE

Tee in return port is a special fitting with a baffle screen, and is supplied with reservoir.

29-11. Inspection.

1. Visually inspect filler cap adapter and strainer screen for cleanliness, damage, and corrosion.

2. Inspect fluid level sight plug for scratches, cracks, checks, internal staining, and other defects of transparency which could prevent proper observation of fluid level.

3. Inspect vent screen for cleanliness, damage, and corrosion. Damage to screen resulting in enlarged holes is not acceptable.

4. Inspect screen on inner end of RETURN port fitting for cleanliness and damage. Damage to screen resulting in enlarged holes is not acceptable.

5. Inspect bosses for damaged threads and seal contact surfaces.

29-12. Repair.

MATERIALS REQUIRED

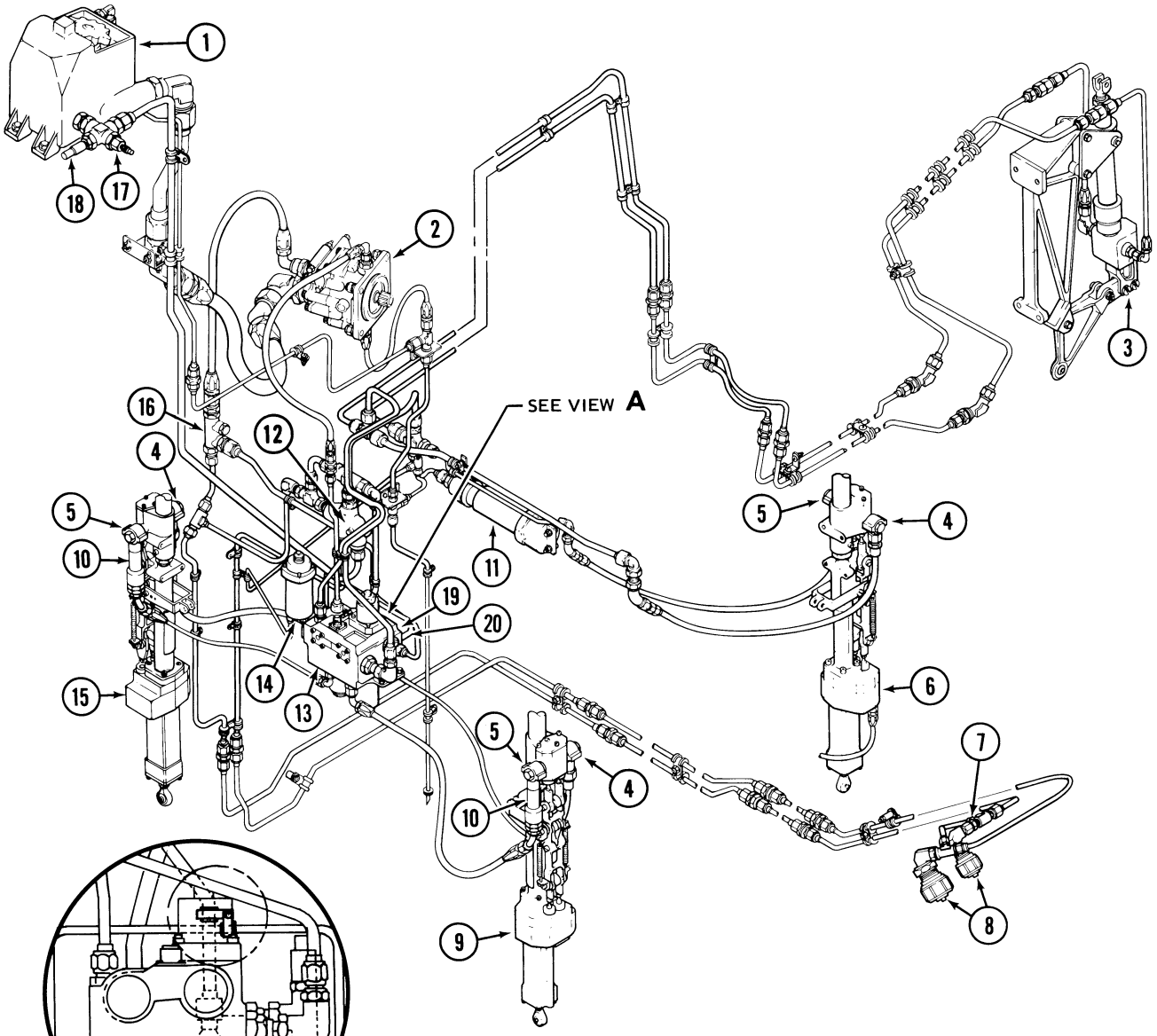
NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-201	Primer
C-304	Solvent
C-405	Lockwire

1. Replace filler cap strainer if corroded or damaged as follows:

a. Unscrew adapter from filler opening and lift out strainer.

b. Clean threads of adapter and opening with solvent (C-304).

c. Place strainer into reservoir.



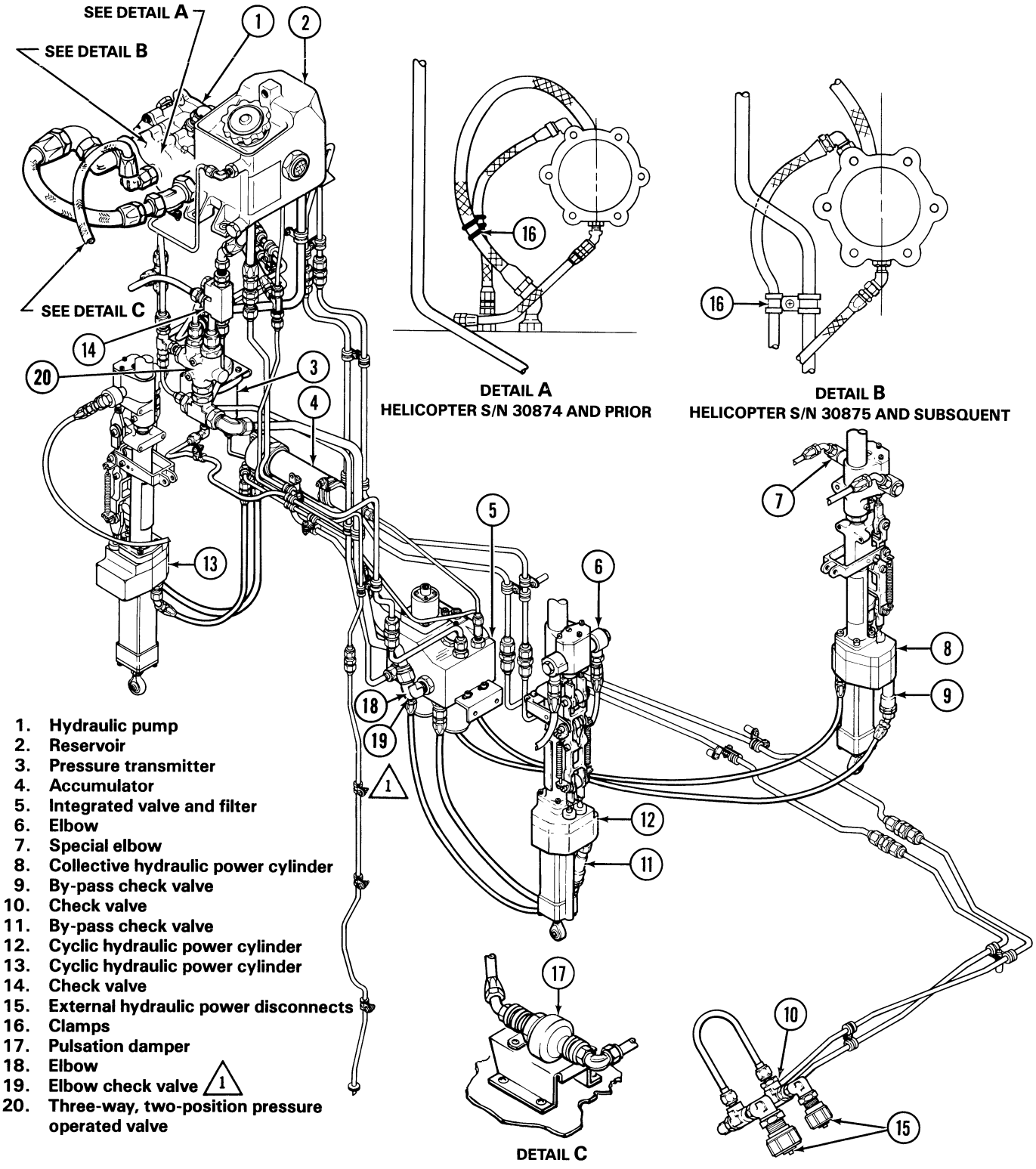
1. Reservoir
2. Hydraulic pump
3. Tail rotor hydraulic power cylinder
4. Elbow
5. Special elbow
6. Collective hydraulic power cylinder
7. Check valve
8. External hydraulic power disconnects
9. Cyclic hydraulic power cylinder
10. By-pass check valve
11. Accumulator
12. Three-way, two-position pressure operated valve
13. Integrated valve and filter assembly
14. Pressure transmitter
15. Cyclic hydraulic power cylinder
16. Check valve
17. Temp bulb
18. Temp switch
19. Elbow
20. Elbow check valve (1)

NOTE

(1) Helicopters modified in accordance with TB212-80-43, and helicopter S/N 31109 and subsequent have a check valve elbow.

212-M-29-2
212-076-002T

Figure 29-2. Hydraulic system no. 1



1. Hydraulic pump
2. Reservoir
3. Pressure transmitter
4. Accumulator
5. Integrated valve and filter
6. Elbow
7. Special elbow
8. Collective hydraulic power cylinder
9. By-pass check valve
10. Check valve
11. By-pass check valve
12. Cyclic hydraulic power cylinder
13. Cyclic hydraulic power cylinder
14. Check valve
15. External hydraulic power disconnects
16. Clamps
17. Pulsation damper
18. Elbow
19. Elbow check valve (1)
20. Three-way, two-position pressure operated valve

NOTE

(1) Helicopters modified in accordance with TB212-80-43 , and helicopter S/N 31109 and subsequent have elbow check valve.

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Figure 29-3. Hydraulic system no. 2

d. Coat adapter threads with primer (C-201) and screw adapter into reservoir.

CAUTION

EXERCISE CARE TO PREVENT FOREIGN MATERIAL FROM ENTERING RESERVOIR WHILE SCREEN IS REMOVED.

2. If vent screeen is unserviceable due to damage or clogging, replace as follows:.

a. Carefully drill out area where screen is staked in position.

b. Position new vent in reservoir and stake in three places to secure screen.

3. Replace sight plug as follows:

a. Remove lockwire, plug, and packing. Discard packing.

b. Lubricate new packing with hydraulic fluid (C-002) and position packing on serviceable plug.

c. Install new plug and packing into boss, tighten, and lockwire (C-405) to fitting in adjacent RETURN boss.

4. Replace any damaged fitting. Replace reservoir if cracked or otherwise unserviceable.

29-13. Installation.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-405	Lockwire

1. If reservoir is being replaced, install elbow fittings in suction and scupper drain ports. Verify plug is installed in drain port, and tee fitting in return port.

2. Position reservoir to mounting points on cabin roof.

3. Align holes and install bolts through four mounting lugs, with thin aluminum alloy washers under boltheads.

4. Install nuts and aluminum alloy washers on lower ends of two aft bolts. Secure drain plug to drilled head of aft outboard bolt with. lockwire (C-405).

5. Connect system return line, pump supply hose, and scupper drain.

6. Service hydraulic system (Chapter 12).

7. Perform operational run. Check hydraulic system for leaks and normal operation.

8. Close pylon fairing.

29-14. INTEGRATED VALVE AND FILTER ASSEMBLIES.

The integrated valve and filter assemblies are two independent modules. Each module contains system relief valve, solenoid valve, and system pressure and return filters. The filter assemblies are equipped with visual differential pressure indicators that warn of a clogging condition. To facilitate inspection of both module filters, an additional indicator is mounted on right side nose frame. With electrical and hydraulic systems operating, the indicator (viewed through right nose window looking inboard) indicates normal filtering if a green dot is present or a red dot will be present indicating a clogged condition. Connections are provided on each module for cylinder pressure and return lines, pump pressure line, system return line and pressure transmitter line. The valve and filter assemblies are located inside the pylon support and are accessible through a door on front of the support. System 1 module is on front of the lift beamand system 2 module is on left inside pylon support below and aft of the lift beam. The low pressure switch warns of low system pressure by illuminating the NO.1 HYDRAULIC and NO.2 HYDRAULIC segments located in the caution panel.

29-15. Integrated Valve and Filter Assemblies — Removal

MATERIALS REQUIRED

Refer to BHT-ALL-SPM for specifications.

NUMBER	NOMENCLATURE
C-428	Caps and/or Plugs

NOTE

Valve and filter modules will normally be left in place, since filters, valves, and other components can be replaced without removing valve and filter assembly.

1. Remove access door from front of pylon support in cabin.

2. Disconnect electrical connectors.

3. Disconnect tubes and hoses from valve and filter assembly (13, Figure 29-2 or 5, Figure 29-3).

4. Remove four bolts and washers securing valve and filter assembly.

5. Remove valve and filter assembly.

6. Cover open lines with caps and/or plugs (C-428) to prevent contamination.

29-16. Integrated Valve and Filter Assemblies — Inspection

1. Inspect housing for cracks or other visible damage for unserviceability.

2. Inspect for excessive leaks.

3. Inspect pressure switch for damage.

4. Inspect fittings for damaged threads.

29-17. Integrated Valve and Filter Assemblies — Repair

1. Replace any defective fittings.

2. Replace packings at reassembly.

3. Clean filter elements (paragraph 29-19). Reset clogged filter indicator.

29-18. Integrated Valve and Filter Assemblies — Installation

1. Position valve and filter assembly (13, Figure 29-2 or 5, Figure 29-3).

2. Secure in place using four bolts and washers.

3. Remove caps and/or plugs.

4. Connect tubes and hoses to valve and filter assembly.

5. Connect electrical connectors.

29-19. HYDRAULIC FILTER ASSEMBLIES

The pressure and return filter assemblies are located on the bottom of the integrated valve and filter assembly valve body. Each filter assembly contains: a filter bowl, a filter element, two packings, and a retainer. The hydraulic filter element removes the particles from the hydraulic fluid. These particles come from usual, and sometimes unusual, wear of hydraulic components. Examine, clean, or replace filter element when the impending bypass indicator button extends (pops), or at recommended inspection intervals (Chapter 5).

29-19A. Hydraulic Filter Assemblies (P/N 212-076-006-007) — Removal

1. Remove the forward pylon fairing (Chapter 52).

2. Remove lockwire from filter bowl (6, Figure 29-3A) and valve body (1).

3. Remove filter bowl (6).

NOTE

If filter element is to be used again, put it in a new, clean plastic bag to prevent contamination.

4. Remove retainer (3) and filter element (5).

5. Remove and discard packings (2 and 4).

29-19B. Hydraulic Filter Assemblies (P/N 212-076-006-105) — Removal

1. Remove the forward pylon fairing (Chapter 52).

2. Press on ratchet lever (10, Figure 29-3A) and remove filter bowl (11).

NOTE

If filter element is to be used again, put it in a new, clean plastic bag to prevent contamination.

3. Remove retainer (14) and filter element (12).

4. Remove and discard packings (13 and 15).

29-19C. Hydraulic Filter Assemblies (P/N 212-076-006-007) — Inspection

1. Examine the hydraulic fluid in filter bowl (6, Figure 29-3A) for condition and for particles.

2. If the hydraulic fluid is dirty, discolored, or contains bubbles, flush the system (paragraph 29-5).

3. Examine valve body (1), retainer (3), and filter bowl (6) for scratches, nicks, dents, thread damage, and damage to the lockwire holes.

4. If the lockwire holes in the valve body (1) are damaged, replace the valve body.

5. Examine impending bypass indicator button (7) to make sure it is not in the extended position.

6. Examine the filter element (5) for general condition. Pay particular attention to damage to the filtering surfaces, and bonding of the end caps to the filtering core.

7. Replace filter element (5) if any abnormality is found.

8. Inspect the filter element (5) core for metal, brass, and aluminum contamination.

9. Replace the non-cleanable filter element (5) P/N 205-076-034-003 if contamination is found and flush the hydraulic system.

29-19D. Hydraulic Filter Assemblies (P/N 212-076-006-105) — Inspection

1. Examine the hydraulic fluid in filter bowl (11, Figure 29-3A) for condition and for particles.

2. If the hydraulic fluid is dirty, discolored, or contains bubbles, flush the system (paragraph 29-5).

3. Examine valve body (8), retainer (14), and filter bowl (11) for scratches, nicks, dents, and thread damage.

4. Examine ratchet lever (10) for wear and security of installation.

5. Examine ratchet teeth on filter bowl (11) for wear.

6. Examine impending bypass indicator button (9) to make sure it is not in the extended position.

7. Examine the filter element (12) for general condition. Pay particular attention to damage to the filtering surfaces, and bonding of the end caps to the filtering core.

8. Replace filter element (12) if any abnormality is found.

9. Inspect the filter element (12) for metal, brass, and aluminum contamination.

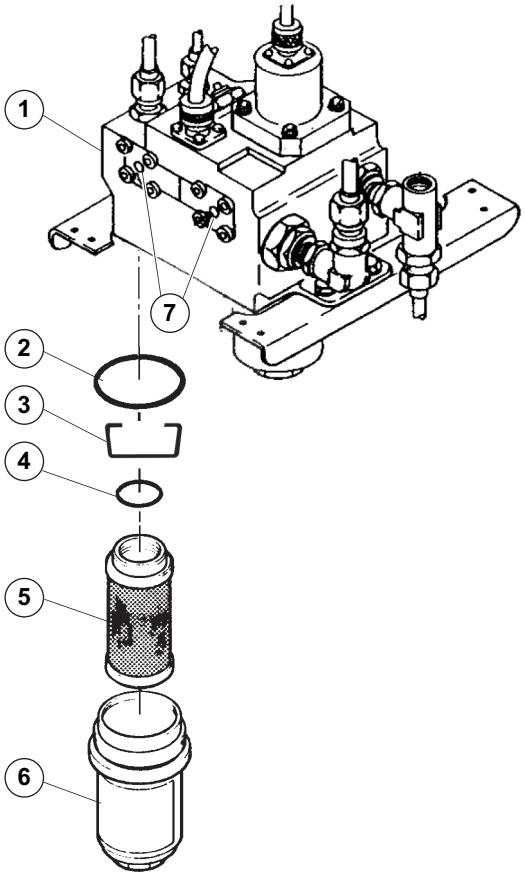
10. Replace the non-cleanable filter element (12) P/N 205-076-034-003 if contamination is found and flush the hydraulic system.

29-19E. Hydraulic Filter Assemblies — Cleaning

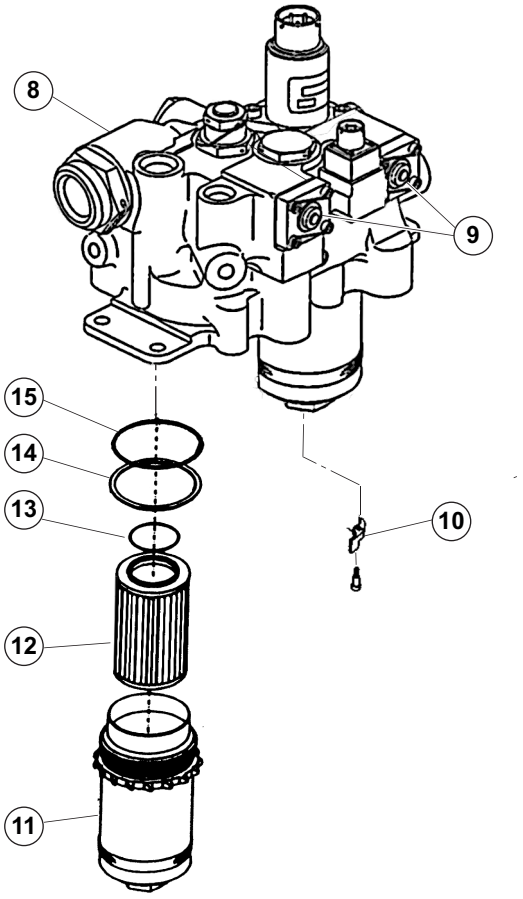
MATERIALS REQUIRED

Refer to BHT-ALL-SPM for specifications.

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-003	Turbine Fuel
C-304	Drycleaning Solvent
C-355	Detergent



INTEGRATED VALVE AND FILTER ASSEMBLY
(P/N 212-076-006-007)



INTEGRATED VALVE AND FILTER ASSEMBLY
(P/N 212-076-006-105)

1. Valve body
2. Packing
3. Retainer
4. Packing
5. Filter element
6. Filter bowl
7. Indicator button
8. Valve body
9. Indicator button
10. Ratchet lever
11. Filter bowl
12. Filter element
13. Packing
14. Retainer
15. Packing

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Figure 29-3A. Hydraulic Filter Assemblies

CAUTION

CLEAN HYDRAULIC COMPONENTS WITH DRYCLEANING SOLVENT (C-304) ONLY. DO NOT USE ALCOHOL.

NOTE

Discard contaminated non-cleanable P/N 205-076-034-003 filter elements.

Examine filter for 'X's inscribed on the filter. If there are three 'X's inscribed on filter element P/N 205-076-034-007, discard filter.

1. Use a suitable clean container large enough to hold cleanable filter element (5, Figure 29-3A) P/N 205-076-034-007.

2. Pour enough of one of the following fluids to cover filter element (5): hydraulic fluid (C-002), drycleaning solvent (C-304), 0.5% of detergent (C-355) dissolved in clean warm water, or turbine fuel (C-003).

3. Cap or plug both ends of the filter element (5) to prevent contamination migration into the filter element.

NOTE

Discard cleanable filter element P/N 205-076-034-007 after three cleaning events.

4. Insert cleanable filter element (5) only into container and vigorously agitate the filter in the cleaning fluid.

5. Attach an air hose with a nozzle and rubber grommet to the filter element (5) to prevent air from escaping.

CAUTION

USE NO MORE THAN 10 TO 15 PSI (68.95 TO 103.42 kPa) AIR PRESSURE SO AS NOT TO DAMAGE THE FILTER ELEMENT.

6. Using no more than 10 to 15 PSI (68.95 to 103.42 kPa) air pressure, slowly backflush the cleaning fluid through the filter element (5) a maximum of three times until there is no indication of contamination.

NOTE

Discard cleanable filter element P/N 205-076-034-007 after three cleaning events.

7. Make an 'X' on bottom of filter element (5) for each cleaning event.

8. Rinse the filter element (5) with clean hydraulic fluid (C-002) to remove traces of the cleaning fluid.

9. Dry filter element (5) using filtered, compressed air. If element is not going to be installed immediately, put it in a new plastic bag to prevent contamination.

10. Rinse filter bowl (5) with clean hydraulic fluid (C-002).

29-19F. Hydraulic Filter Assemblies (P/N 212-076-006-007) — Installation

MATERIALS REQUIRED

Refer to BHT-ALL-SPM for specifications.

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-405	Lockwire

NOTE

Lubricate all packings, retainers, and threads with hydraulic fluid (C-002) before installation.

CAUTION

DO NOT USE NON-CLEANABLE P/N 205-076-034-003 AND CLEANABLE P/N 205-076-034-007 FILTER ELEMENTS IN THE SAME SYSTEM. DO NOT MIX.

1. Lubricate packing (2, Figure 29-3A) with hydraulic fluid (C-002).

2. Install packing (2) and retainer (3) in valve body (1).

3. Lubricate packing (4) with clean hydraulic fluid (C-002).

4. Install packing (4) in filter element (5).

5. Install filter element (5) into filter bowl (6).

6. Fill filter bowl (6) half full with clean hydraulic fluid (C-002).

7. Lubricate threads of filter bowl (6) with clean hydraulic fluid (C-002).

8. Install filter bowl (6) in valve body (1).

CAUTION

DO NOT EXCESSIVELY TIGHTEN THE LOCKWIRE ON FILTER BODY AND FILTER BOWL. DAMAGE TO THE LOCKWIRE HOLES CAN OCCUR.

9. Carefully secure filter bowl (6) to valve body (1) with lockwire (C-405).

10. Install the forward pylon fairing (Chapter 52).

11. During initial run-up, check for leaks.

29-19G. Hydraulic Filter Assemblies (P/N 212-076-006-105) — Installation

MATERIALS REQUIRED

Refer to BHT-ALL-SPM for specifications.

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid

CAUTION

DO NOT USE NON-CLEANABLE P/N 205-076-034-003 AND CLEANABLE P/N 205-076-034-007 FILTER ELEMENTS IN THE SAME SYSTEM. DO NOT MIX.

1. Lubricate packing (15, Figure 29-3A) with hydraulic fluid (C-002).

2. Install packing (15) and retainer (14) in valve body (8).

3. Lubricate packing (13) with clean hydraulic fluid (C-002).

4. Install packing (13) in filter element (12).

5. Install filter element (12) into filter bowl (11).

6. Fill filter bowl (11) half full with clean hydraulic fluid (C-002).

7. Lubricate threads of filter bowl (11) with clean hydraulic fluid (C-002).

8. Install filter bowl (11) in valve body (8).

9. Make sure the ratchet lever (10) is well engaged in the ratchet teeth of filter bowl (11).

10. Install the forward pylon fairing (Chapter 52).

11. During initial run-up, check for leaks.

29-20. HYDRAULIC SYSTEM ACCUMULATORS

Hydraulic systems No. 1 and No. 2 each contain one accumulator connected in pressure line of upper or lower cylinders, depending on system. Each unit consists of a spring-loaded piston enclosed in a cylindrical body. The accumulators maintain pressure on fluid for irreversible operation and to make up any leakage past seals. The units are horizontally mounted to aft side of lift beam. Hydraulic system No. 1 accumulator is located above hydraulic system No. 2 accumulator.

29-21. Hydraulic System Accumulators — Removal

MATERIALS REQUIRED

Refer to BHT-ALL-SPM for specifications.

NUMBER	NOMENCLATURE
C-428	Caps and/or Plugs

1. Place suitable container to catch a small amount of fluid.

2. To release pressure with minimum spraying of fluid, slowly open pressure line connections from tee fitting at lower end of accumulator.

3. Cover open lines with caps and/or plugs (C-428).

4. Remove screw from clamp at lower end, and two bolts from upper end to detach accumulator from support brackets. Remove clamp.

29-22. Hydraulic System Accumulators — Installation

1. Place clamp on accumulator. Install fittings using new packings.

2. Position accumulator to support brackets. Install two bolts at upper end, and clamp attaching screw at lower end.

3. Connect tubes to tee fitting.

4. Perform operational check, observe for leaks.

29-23. HYDRAULIC PUMP (SYSTEM 1).

System 1 hydraulic pump is installed on transmission sump case (Chapter 63). The pump is an axial type rated at 6.0 gal. per minute at 1000 ±25 psi (6890 ±172 kPa) at operating speed.

29-24. Removal.

1. Remove forward pylon fairing and access panel on right side of pylon support structure inside cabin area.

2. Loosen connection of hoses on pump to break torque but not to point of leaking.

3. Disconnect hoses at ends opposite hydraulic pump.

4. Remove nuts and washers from four studs at pump flange. Pull pump and gasket outward off studs. Place pump, with hoses attached, in container large enough to hold fluid contents of reservoir and hoses.

5. Disconnect hoses from pump, draining fluid from reservoir and hoses.

6. Cap open lines and fittings. Cover open port in transmission case.

7. If replacing pump, remove fittings and check valve for use on new assembly. Discard gasket.

29-25. Inspection.

1. Inspect pump for damage and leakage.

2. Inspect fittings for damaged threads.

3. Inspect check valve for damage and proper operation.

4. Inspect splines and mounting stud for damage.

29-26. Repair.

1. Replace damaged studs and fittings as necessary.

2. Replace check valve if there is evidence of malfunction.

3. Replaced damaged or malfunctioning pump.

29-27. Installation.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-007	Bearing Grease

CAUTION

DO NOT LUBRICATE SPLINES FOR PUMPS P/N 731634 (PV3-044-8A) OR 212-076-010-101 WITH NON-METALLIC COUPLING INSTALLED.

1. If replacing pump, install elbow fittings in suction port, and unions in pressure, case drain, and seal drain ports. Use new packings.

2. Place gasket over drive quill studs.

NOTE

If pump shaft splines are made of nonmetallic (plastic) material, lubrication is not required.

3. For pump with metallic splines, lubricate splines with a thin even coating of bearing grease (C-007).

CAUTION

ENSURE PUMP CASE IS FULL OF FLUID PRIOR TO INSTALLATION.

4. Fill pump with hydraulic fluid (C-002) through case drain port.

5. Position pump with seal drain down. Engage shaft in splines of drive quill shaft and mounting flange over studs. Install a nut and two aluminum washers on each stud. Tighten nuts evenly.

6. Connect hoses to fittings at suction, pressure, case drain, and seal drain ports.

7. Service hydraulic system with hydraulic fluid (C-002).

8. Perform operational check (paragraph 29-6 or 29-7).

9. Check for leaks. Install access door and close cowling.

29-28. HYDRAULIC PUMP (SYSTEM 2).

System 2 pump is identical to system 1 pump. System 2 pump is installed on front of transmission main case.

29-29. Removal.

1. Open transmission cowling to gain access to pump which is located between and below both hydraulic reservoirs at helicopter center line. Place uitable containers below pump to catch spilled fluid.

2. Remove fluid from system 2 reservoir using a suction gun.

3. Disconnect hoses from fittings on pump. Cap fittings and ends of hoses.

4. Remove nuts and washers from six studs at pump flange. Pull pump and gasket outward off studs. Discard gasket.

5. If replacing pump, remove fittings for use on new assembly. Cover open ports.

29-30. Inspection.

Refer to paragraph 29-25 .

29-31. Repair.

Refer to paragraph 29-26 .

29-32. Installation.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-002	Hydraulic Fluid
C-007	Bearing Grease

1. If replacing pump, install 90° elbow fittings in suction port, and unions in pressure, case drain, and seal drain ports. Use new packings.

2. Place gasket over drive quill studs.

CAUTION

DO NOT LUBRICATE SPLINES FOR PUMPS P/N 731634 (PV3-044-8A) OR 212-076-010-101 WITH NON-METALLIC COUPLING INSTALLED.

3. For pump with metallic splines, lubricate splines with a thin even coating of bearing grease (C-007).

CAUTION

ENSURE PUMP CASE IS FULL OF FLUID PRIOR TO INSTALLATION.

4. Fill pump with hydraulic fluid (C-002) through case drain port.

5. Position pump with seal drain down. Engage shaft in splines of drive quill shaft and mounting flange over studs. Install a nut and two aluminum alloy washers on each stud. Tighten nuts evenly.

6. Connect hoses to fittings at suction pressure, case drain, and seal drain ports (figure 29-4).

7. Service hydraulic system with hydraulic fluid (C-002).

8. Perform operational check (paragraph 29-5 or 29-6).

9. Check for leaks. Close transmission cowling.

29-33. COLLECTIVE HYDRAULIC CYLINDER.

A dual hydraulic cylinder, located in left aft pylon area is used to assist collective control of main rotor and reduce feed back forces. The hydraulic cylinder lower valve assembly receives pressure from two, and system one supplies pressure to upper valve assembly.

NOTE

When overhaul of hydraulic servo cylinder assemblies is required, contact HR Textron, Inc., Valencia, California 91355, for nearest approved service facility.

29-34. Removal.

1. Remove access panel on left side of pylon island.

2. Disconnect hydraulic pressure and return hoses by removing banjo fittings. Cap or plug openings. Label hoses for reference at installation.

3. Detach lower end of spring (14, figure 29-5) and disconnect control tube (16) from input lever (15). If cylinder is to be replaced, retain spring (14) for use in reinstallation.

4. Remove bolt to disconnect lower end of cylinder from support (20).

5. Remove four nuts and washers to detach bearing housing (9) from support (10).

NOTE

If transmission is installed, cylinder assembly will have to be removed by rotating bearing housing (9) so it will pass down through support (10). If transmission is not installed, cylinder assembly can be removed up through support (10).

6. Disconnect control tube (5) from collective lever (1) and remove cylinder assembly.

7. Remove boot (6) and detach clevis (8) from universal (7). Remove clevis with jamnut and lock.

29-35. Repair.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-405	Lockwire

1. For replacement of seals in servo and bypass valves, refer to Flight Control Cylinder Overhaul Manual, H.R. Textron, Inc., Valencia, California 91355.

2. Replace rod end bearings as follows:

NOTE

Rod end bearing wear tolerance is 0.006 in. (0.152 mm) radial and 0.012 in. (0.3048 mm) axial. Replace bearing if limits are exceeded.

a. Remove cotter pin, nut, washer and bolt from rod end bearing (19, figure 29-5).

b. Remove lockwire, loosen jamnut (18) sufficiently to allow rod end to turn. Count

number of turns to remove rod end bearing (19).

c. Install new KBNE-6W or NHHE6-21W rod end bearing with same number of turns.

NOTE

Center line of input lever (15) to center line of rod end bearing (19) is 16.75 in. (425.45 mm).

d. With valve body pushed full up and lower piston pulled full down, adjust lower rod end bearing (19) to align in support (20).

e. Install bolt temporarily through support and rod end. Torque jamnut (18) on rod end 200 to 250 in.lbs. (22.60 to 28.25 Nm) and secure with lockwire (C-405).

f. Remove bolt attaching lower or end bearing (19) to support (20) and ensure no side loads have been induced into lower piston rod. If necessary, loosen and retighten bearing and jamnuts (11 and 12) to assure proper cylinder alignment in airframe.

29-36. Installation.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-101	Corrosion Preventive Compound
C-104	Corrosion Preventive Compound
C-308	Adhesive
C-405	Lockwire

1. Coat threads of clevis (8, figure 29-5) with corrosion preventive compound (C-101).

2. Assemble jamnut and lock on clevis and install in end of cylinder (13) to 1.75 in. (44.45 mm) between end of cylinder rod and center of hole in clevis. Torque jamnut 660 to 780 in.lbs. (74.57 to 88.12 Nm).

3. Secure jamnut with lockwire (C-405). Apply adhesive (C-308) around nut, lock, and threads on clevis.

4. Attach clevis (8) to universal (7) with bolt, using washers under bolt head and nut. Torque nut 60 to 85 in.lbs. (6.78 to 9.60 Nm). Install cotter pin.

5. Place boot (6) over end of control tube (5). Fill cavity of housing (9) with corrosion preventive compound (C-104). Secure lower end of boot to housing (9, figure 29-6).

6. Adjust bearing nut (11, figure 29-5) and jamnut (12) to allow easy movement of cylinder in bearing housing (9) during installation.

7. Install cylinder assembly as follows:

NOTE

Cylinder can be installed from the top or bottom.

a. Insert cylinder (13) through support (10).

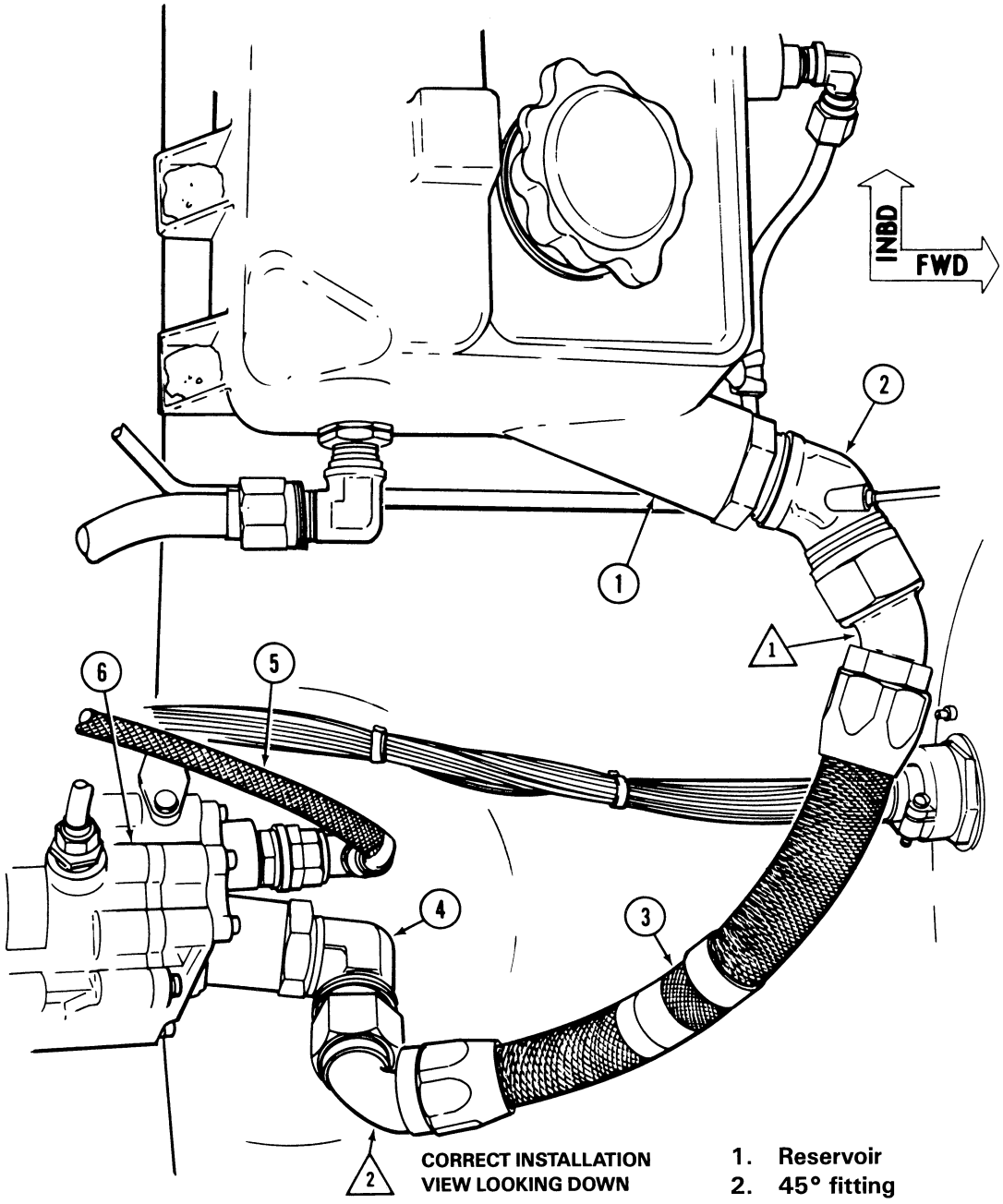
b. Align bearing housing (9) over studs of support, and install nuts and washers. Torque three smaller nuts 50 to 70 in.lbs. (5.65 to 7.91 Nm), and largest nut 100 to 140 in.lbs. (11.30 to 15.82 Nm).

c. Connect control tube (5) to collective lever (1) using bolt, washer, and nut. If bolt bottoms out, additional washers may be used. Torque 60 to 85 in.lbs. (6.78 to 9.60 Nm). Install cotter pin.

d. With valve body pushed full up and lower piston pulled full down, adjust lower rod end bearing (19) to align in support (20). Install bolt temporarily through support and rod end 200 to 250 in.lbs. (22.60 to 28.25 Nm). Secure with lockwire (C-405).

e. Tighten bearing nut (11) 900 to 1100 in.lbs. (101.68 to 124.28 Nm).

f. Remove bolt attaching lower rod end bearing (19) to support (20). Ensure no side loads have been induced into lower piston



1. Reservoir
2. 45° fitting
3. Hose assembly
4. 90° fitting
5. Hose assembly
6. Hydraulic pump

NOTES

1. Fitting in reservoir mates with 45° fitting on hose assembly.
2. Fitting in pump mates with 90° fitting on hose assembly.

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Figure 29-4. Hydraulic pump and reservoir hose and fittings

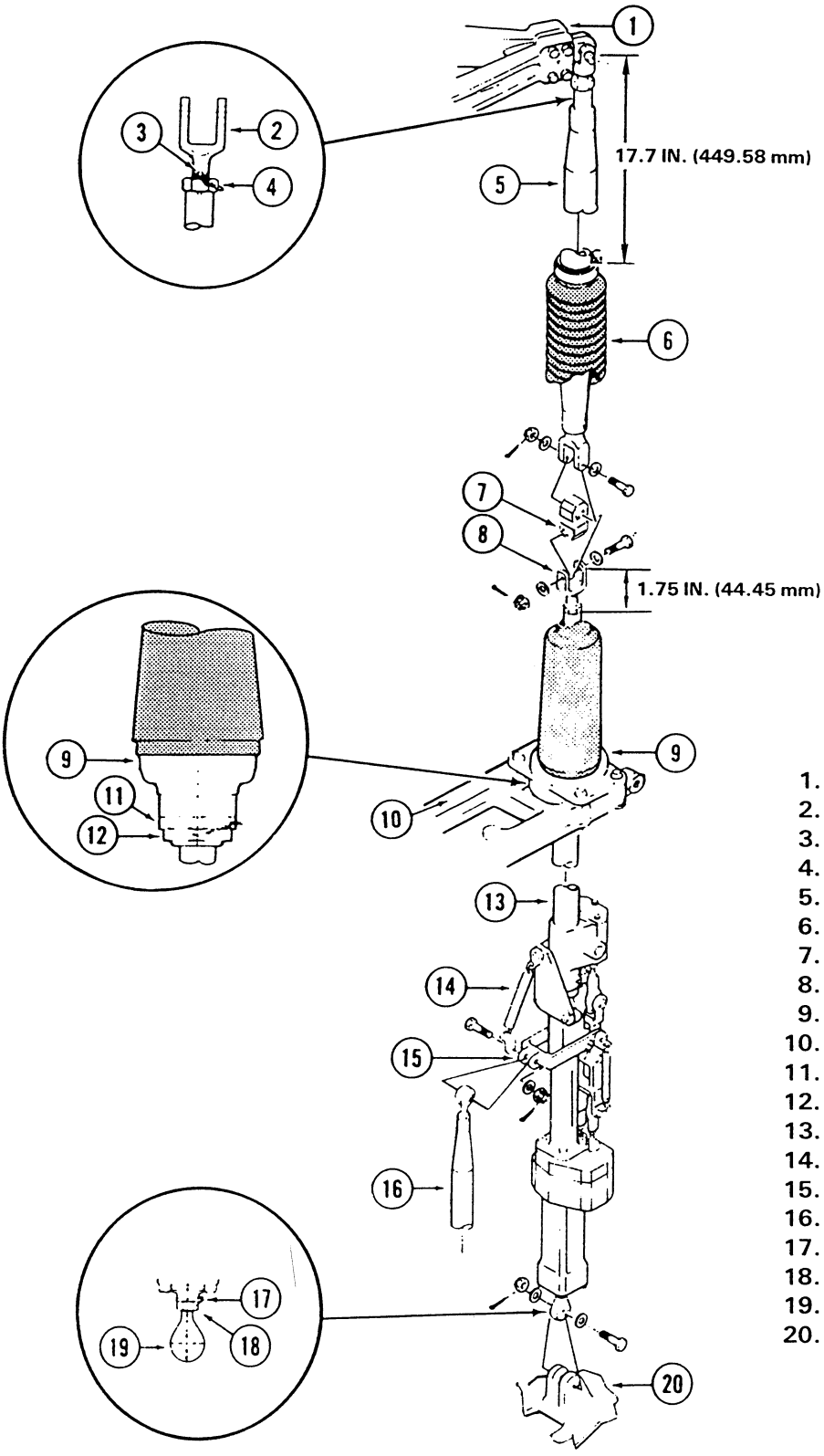


Figure 29-5. Collective hydraulic cylinder

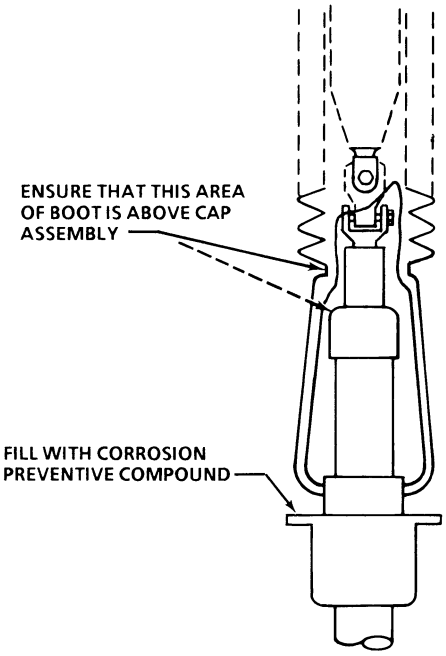


Figure 29-6. Hydraulic Cylinder Boot

rod. If necessary, loosen and retighten bearing nut (11) and jamnut (12) to assure proper cylinder alignment in airframe.

g. When alignment is satisfactory, torque jamnut (12) 900 to 1100 inch-pounds (101.68 to 124.28 Nm) and secure with lockwire (C-405). Install washer and nut on bolt through support (20) and rod end bearing (19). Torque nut 95 to 110 inch-pounds (10.73 to 12.43 Nm). Secure with cotter pin.

NOTE

If collective flight control cylinder (13) still cannot be installed without preload, it is permissible to add one AN960C416L washer (maximum) on two aft studs of support (10) between bearing housing (9) and support (10). Or, it is permissible to add one AN960C416L washer (maximum) and one AN960-516L washer (maximum) on each of the two forward studs between bearing housing (9) and support (10).

8. Observe labels on hydraulic hoses and connect to cylinder pressure and return ports, using new packings.

9. Connect control tube (16, Figure 29-5) and spring (14) during rigging procedures (Chapter 67).

10. Check and service hydraulic system reservoirs. Pressurize system and operate cylinder through full travel. Check for leaks and ensure there is no interference or binding in linkage or hydraulic hoses.

11. Check installation for security and install pylon panels.

29-37. CYCLIC HYDRAULIC CYLINDER

Two dual hydraulic cylinders are mounted vertically in forward end of pylon support and are incorporated in the cyclic controls linkage to reduce effort required for control and to reduce feedback of forces from main rotor. Movement of either cyclic stick is transmitted through linkage to input levers on cylinders, opening control valves to allow hydraulic

pressure to enter cylinders to assist in moving swashplate.

29-38. Removal.

NOTE

Removal procedure for right and left cyclic cylinders is similar.

1. Open forward transmission cowling. Remove panel on front and side of pylon island.

2. Disconnect hydraulic hoses from cylinder at check valves and remove banjo fittings. Cap or plug open lines and ports.

NOTE

Label hydraulic hoses for reference at installation

3. Remove nut, washer and bolt to disconnect control tube (12, figure 29-7) from input lever (11).

4. Remove nut, washer, and bolt to disconnect lower end of cylinder (10) from support (13).

5. Remove four nuts and washers to detach bearing support (6) from cylinder support (7).

6. Remove nut, washer and bolt to disconnect control tube (3) from swashplate and remove cylinder.

NOTE

If transmission is installed, rotate cylinder assembly bearing support (6) so as to pass down through cylinder support (7). If transmission is not installed, cylinder assembly can be removed up through cylinder support (7).

7. Remove clamp and boot (4). Remove nut, washers, and bolt to separate cylinder (10) from universal (5).

8. Loosen jamnut and remove clevis from cylinder.

29-39. Installation.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-101	Corrosion Preventive Compound
C-308	Adhesive
C-405	Lockwire

1. Coat threads of clevis with corrosion preventive compound (C-101).

2. Install clevis with jamnut and rod end lock in end of hydraulic cylinder (10, figure 29-7) to dimension of 1.75 in. (44.45 mm) for left cylinder and 1.90 in. (48.26 mm) for right cylinder between end of cylinder rod and center of holes in clevis.

3. Torque jamnut 660 to 780 in.lbs. (67.79 to 88.12 Nm) and Secure with lockwire (C-405).

4. Cover nut, lock, and threads on clevis with adhesive (C-308).

5. Attach cylinder (10) to universal (5) with bolt, washers, and nut. Use one washer under head and nut. Install cotter pin.

6. Slip boot (4) over end of control tube (3) and secure lower end of boot above cylinder bearing support. Establish 22.2 in. (563.88 mm) dimension as shown in figure 29-7 with cylinder fully retracted and install clamp.

7. Adjust bearing nuts (8 and 9) to allow easy movement of cylinder in bearing housing during installation.

8. Install cylinder assembly as follows:

NOTE

Cylinder assembly can be installed from the top if transmission is

removed. If transmission is installed, install cylinder assembly from the bottom.

a. Insert cylinder (10) through support (7).

NOTE

When transmission is installed insert lower end of cylinder assembly down through cargo compartment until top surface clears access hole in forward island, raise cylinder assembly through cylinder support (7) until bearing support (6) is past attachment studs.

b. Align bearing support (6) over studs of support, and install nuts and washers. Torque three smaller nuts 50 to 70 in.lbs. (5.65 to 7.91 Nm) and largest nut 100 to 140 in.lbs. (11.30 to 15.82 Nm).

c. With valve body pushed full up and lower piston pulled full down, adjust lower rod end to align in support (13). Install bolt temporarily through support and rod end. Torque jamnut on rod end 200 to 250 in.lbs. (22.60 to 28.25 Nm) and lockwire.

d. Tighten bearing nut (8) 900 to 1100 in.lbs. (101.68 to 124.28 Nm).

e. Remove bolt attaching lower rod end to support (13) and ensure no side loads have been induced into lower piston rod. If necessary, loosen and retighten bearing nut (8) to assure proper cylinder alignment in airframe.

f. When alignment is satisfactory, torque bearing nut (9) 900 to 1100 in.lbs. (101.68 to 124.28 Nm) and secure with lockwire (C-405). Install washer and nut on bolt through support (13) and rod end. Torque nut 95 to 110 in.lbs. (10.73 to 12.43 Nm). Secure with cotter pin.

9. Observe labels on hydraulic hoses and connect to cylinder pressure and return ports, using new packings.

10. Connect control tubes (3) and spring (2) to swashplate horns, and tubes (12) to input levers (11) during rigging procedure.

11. Check and service hydraulic system reservoirs (Chapter 12). Pressurize system and operate cylinder through full travel. Check for leaks and ensure there is no interference or binding in linkage or hydraulic hoses.

12. Install pylon panels and close transmission cowling.

29-40. Universal bearing replacement (205-076-381 and 412-076-620).

NOTE

Refer to BHT- ALL- SPM manual for bearing replacement.

29-41. TAIL ROTOR HYDRAULIC CYLINDER.

The hydraulic boost cylinder (4, figure 29-8) in the antitorque control linkage is mounted in the fuselage under engine deck immediately forward of the tailboom. The cylinder reduces effort required for control and reduces feedback forces from tail rotor. The boost cylinder receives pressure from system 1 only.

29-42. Removal.

1. Open door on aft right side of fuselage.

2. Disconnect hydraulic pressure and return hoses (5, figure 29-8) from hydraulic cylinder (4). Cap or plug open hoses and fittings.

NOTE

Label hoses for reference at installation.

3. Disconnect control tube (1) from clevis (2) at upper end of cylinder.

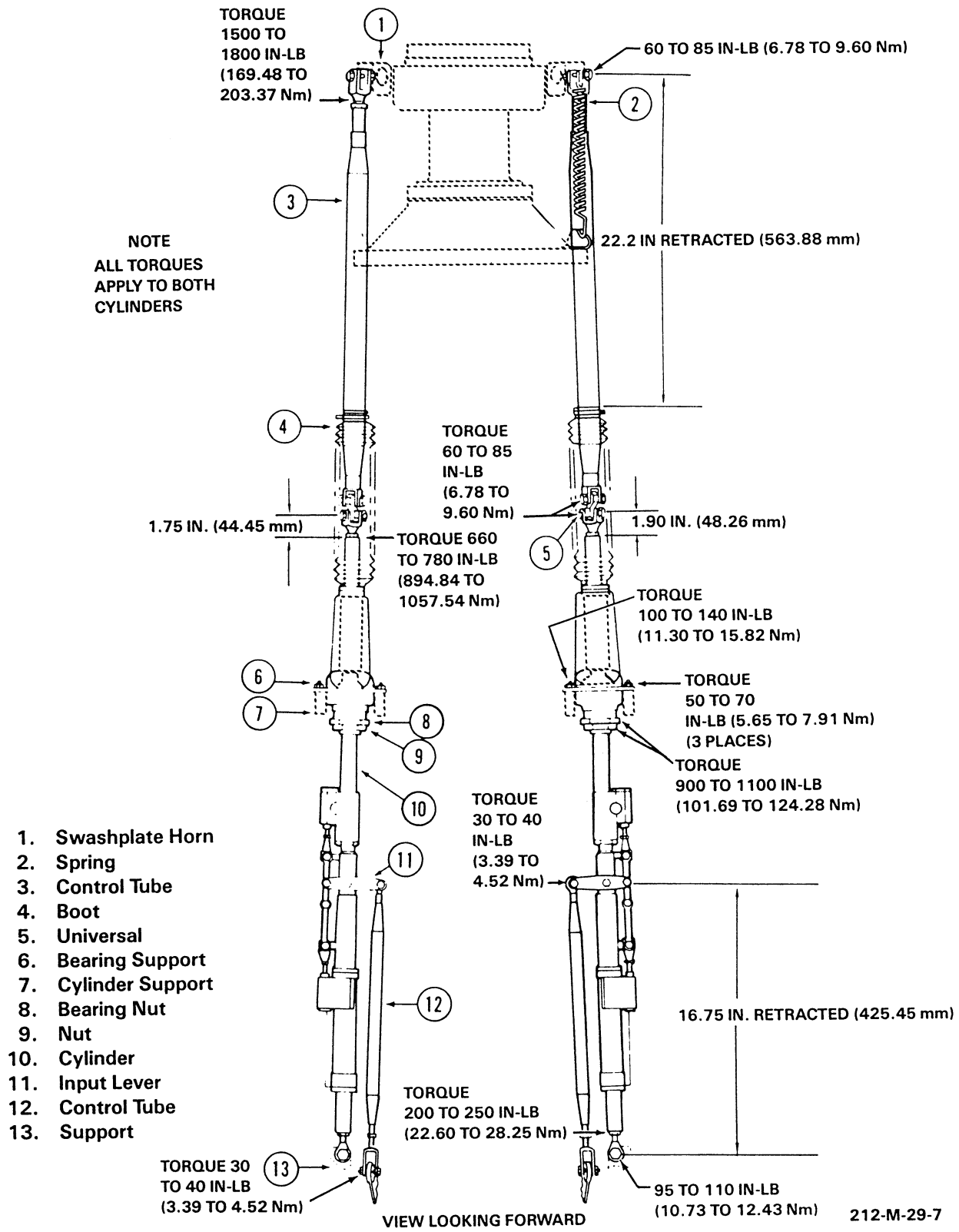
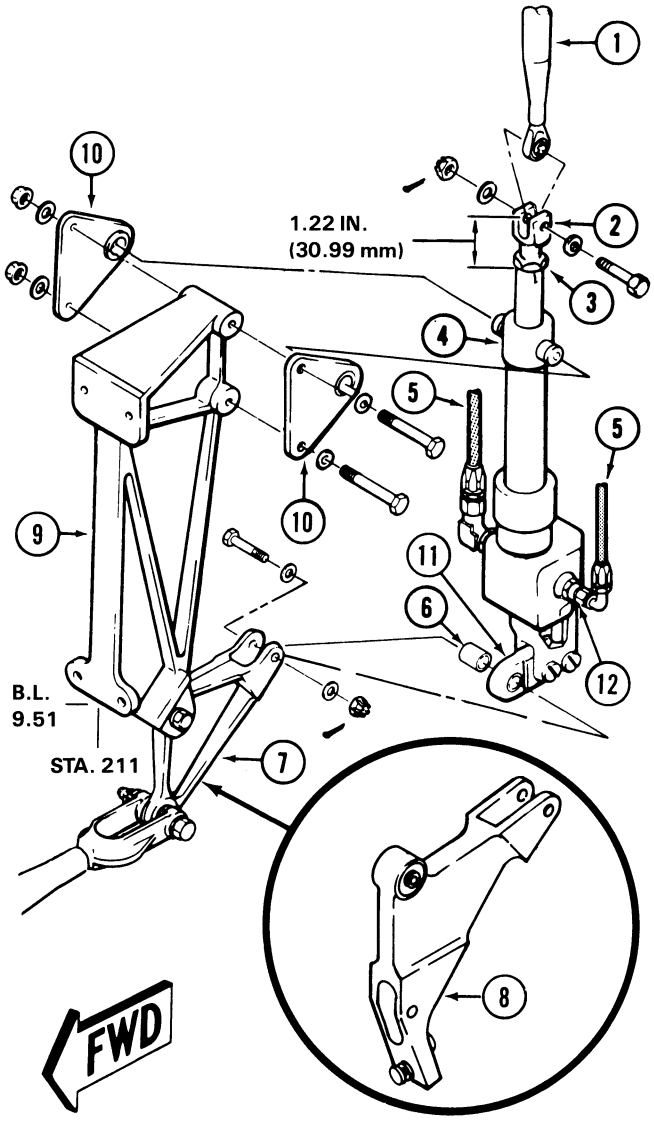


Figure 29-7. Cyclic hydraulic cylinder



1. Control tube
2. Clevis
3. Nut
4. Cylinder
5. Hoses
6. Spacer
7. Bellcrank (P/N 212-001-711-1)
8. Bellcrank (P/N 212-001-188)
9. Support
10. Trunnion plates
11. Cylinder lever
12. Check valve

212-M-29-8

Figure 29-8. Tail rotor hydraulic cylinder

4. Remove nut, washers, spacer (6), and bolt from bellcrank (7 or 8) at lower end of support (9).

5. Support cylinder and remove two bolts through trunnion plates (10). Remove plates and cylinder.

6. If cylinder is being replaced, remove clevis and hydraulic fittings for use on new cylinder.

29-43. Inspection and repair.

MATERIALS REQUIRED

NUMBER	NOMENCLATURE
C-407	Abrasive Pad

1. Grasp cylinder (4, figure 29-8) just below trunnion plates (10) and move the cylinder laterally. Lateral movement of cylinder should be from 0.003 to 0.050 in. (0.076 to 1.27 mm). There should not be any evidence of binding.

2. Should tightness or binding be found during inspection, remove cylinder (4) and clean inside diameter of trunnion plate (10) bushings using fine grade abrasive pad (C-407).

3. Inspect bearing in cylinder lever (11) for tightness. Breakaway torque required to rotate bearing shall not exceed 4.0 in.oz. (0.0282 Nm). This inspection may be accomplished as follows:

a. Disconnect bellcrank (7 or 8) from cylinder lever (11).

b. Place attachment bolt previously removed in cylinder lever bearing.

c. Attach a spring scale to attachment bolt and check force required to rotate bearing (figure 29-9).

d. Should torque required to rotate cylinder lever (11, figure 29-8) bearing exceed limit, use an air drill motor and attaching hardware previously removed to spin bearing until 4.0 in.oz. (0.0282 Nm) or less with no radial play is achieved (figure 29-9).

e. If bearing does not meet torque requirement, replace in accordance with HR Textron Component Manual.

29-44. Installation.

1. Position hydraulic cylinder (4, figure 29-8) and two trunnion plates (10) on support (9).

2. Install two bolts through trunnion plates from left side, using aluminum washers under bolt heads and nuts.

3. Align cylinder lever to bellcrank (7 or 8). Install spacer (6) between bearing of cylinder lever (9) and right (inboard) tang of bellcrank (7 or 8). Install bolt head inboard with aluminum washer under bolt head and nut. Install cotter pin.

4. Assemble clevis (2) and nut (3) to upper end of cylinder. Dimension from center of clevis holes to end of cylinder is 1.22 in. (30.99 mm). Tighten clevis jamnut.

NOTE

Check security of check valve (12) before hoses (5) are connected.

5. Attach control tube (1) to clevis with bolt, two steel washers and nut. Install bolt with head inboard. If raised pad on outside of clevis (2) prevents washer under bolt head or nut from seating properly, refer to Technical Bulletin 212-79-21 . Secure with cotter pin. Observe labels and connect hydraulic pressure and return fittings and hoses (5).

6. If bellcrank (7 or 8) was removed, install with bolt heads inboard. Use washers under head and nuts. Install cotter pins.

CAUTION

DO NOT ATTEMPT ANY ADJUSTMENT OF SERVO VALVE

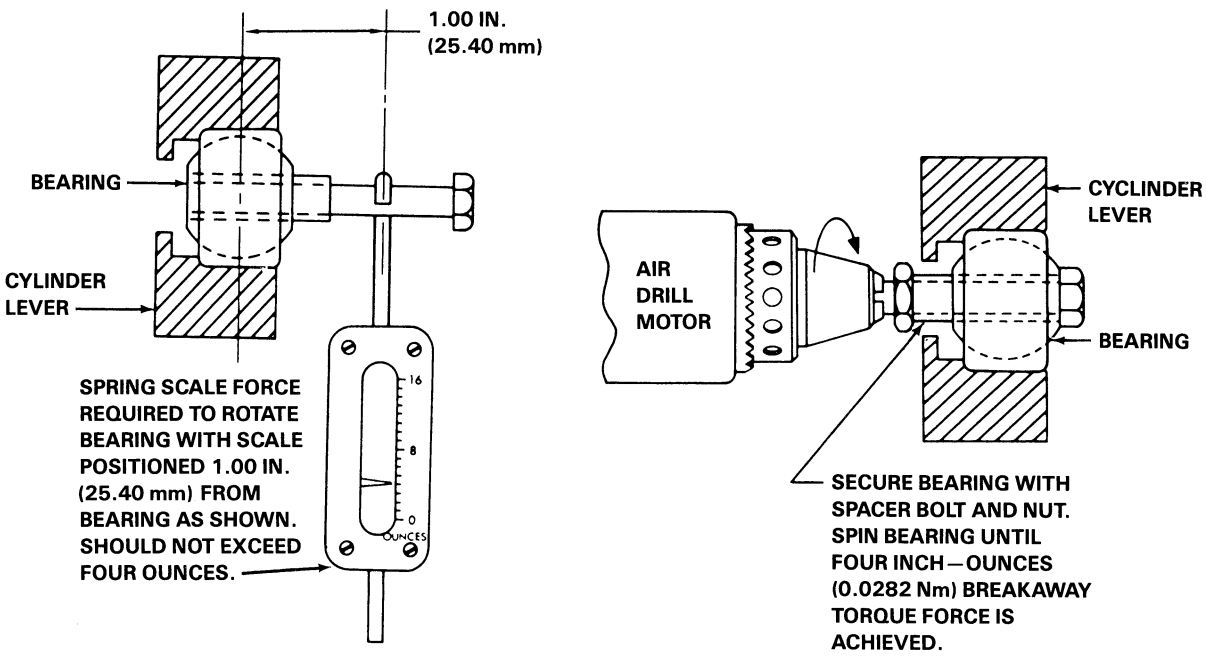


Figure 29-9. Tail rotor hydraulic cylinder lever bearing

OR BYPASS VALVE OF HYDRAULIC CYLINDER. IF MALFUNCTION OCCURS, REPLACE CYLINDER ASSEMBLY.

7. Check antitorque controls for free movement through full range of travel and for interference or binding of hydraulic hoses. Apply hydraulic pressure and check for leaks.

8. Close access door.