

## CHAPTER 29

## HYDRAULICS

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## CHAPTER 29

## HYDRAULICS

29-00 Description**WARNING**

Except as instructed in this manual, service on the hydraulic system is limited to component removal and replacement.

**CAUTION**

Cleanliness of hydraulic fluid is vital to proper system operation. Use only clean fluid from sealed containers and avoid contamination from dirty funnels, tubing, etc. Use LPS PreSolve to clean hydraulic parts. Do not use alcohol.

**NOTE**

Recent hydraulic servos include an absorbent pad. Any combination of servos with or without an absorbent pad is approved.

Hydraulically boosted main rotor flight controls eliminate cyclic and collective feedback forces. The hydraulic system consists of a pump, three servos, a reservoir, and interconnecting lines. Normal operating pressure is 450 to 500 psi. The pump is mounted on and driven by the main rotor gearbox. A servo is connected to each of the three push-pull tubes that support the main rotor swashplate. The reservoir is mounted to the aft end of the main rotor gearbox and includes a filter, pressure relief valve, and pilot-controlled pressure shut-off valve.

A sight glass for pre-flight fluid level checks is incorporated in the reservoir and accessible via a left side cowl door. A vented filler cap is located on top of the reservoir.

The pressure shut-off valve is solenoid-actuated and controlled by the hydraulic switch on the pilot's cyclic. The switch should be left on during helicopter shutdown and start up except during the hydraulic system check.

Electrical power is required to turn off hydraulics. Pulling HYD circuit breaker will NOT turn off hydraulics but will disable hydraulic switch.

29-10 Hydraulic Pump**A. Removal**

1. Remove tailcone cowling per § 53-23.

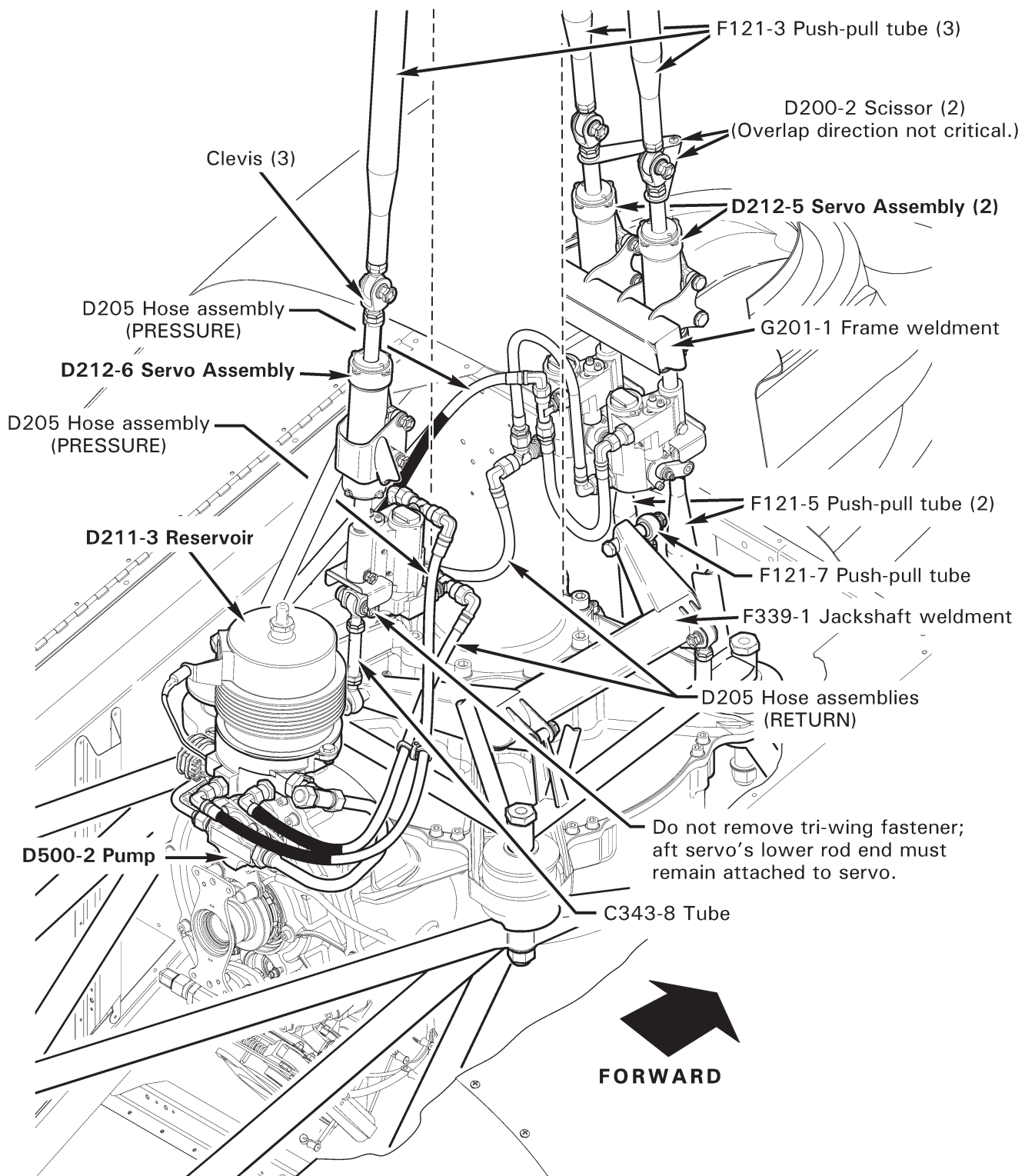


FIGURE 29-1 HYDRAULIC FLIGHT CONTROL SYSTEM

29-10 Hydraulic Pump (continued)**A. Removal (continued)**

2. For helicopters with air conditioning:
  - a. Loosen hardware securing G777-1 compressor assembly to G781-1 arm weldment.

**CAUTION**

Do not use refrigerant hose assemblies or fittings to rotate compressor. Do not rotate compressor further than necessary, to avoid damaging system wiring and refrigerant hoses or fittings.

- b. Rotate compressor down and inboard as required to disengage B173-5 v-belt from pulleys.
  - c. Remove hardware securing G779-1 pulley to F908-1 yoke assembly and slide pulley aft (do not scuff paint on tail rotor drive fan shaft).
3. Remove hydraulic reservoir filler-vent and temporarily install an air-tight plug.
4. Refer to Figure 12-4. Remove F902 suction line assembly and protect exposed line and fitting openings.
5. Remove F902 pressure line assembly and protect exposed line and fitting openings.
6. Remove aft jam nut from both MR rpm senders and remove both senders from bracket attached to hydraulic pump. Temporarily secure senders away from drive train to prevent damage.
7. Remove four self-locking nuts and washers securing pump to gearbox and remove pump and o-ring. Discard o-ring. Protect pump opening on gearbox.

**B. Installation**

1. Prelubricate new o-ring with gearbox oil and install on pump mounting flange. With pump bracket pointing down, install pump on gearbox and secure. Special torque nuts per § 20-33.
2. Install both MR rpm senders in pump bracket. Adjust clearance between both senders and both yoke magnets to 0.040/0.020 inch and hand-tighten sender jam nuts.
3. Refer to Figure 12-4. Install F902 pressure line assembly & special torque per § 20-33.
4. Install F902 suction line assembly and special torque per § 20-33.
5. Remove temporary air-tight plug from reservoir and adjust fluid level as required. Install filler-vent and special torque per § 20-33.
6. Torque stripe jam nuts and B-nuts.
7. Bleed hydraulic system per § 12-34.
8. Install a 110-4 Telatemp on aft surface of pump.

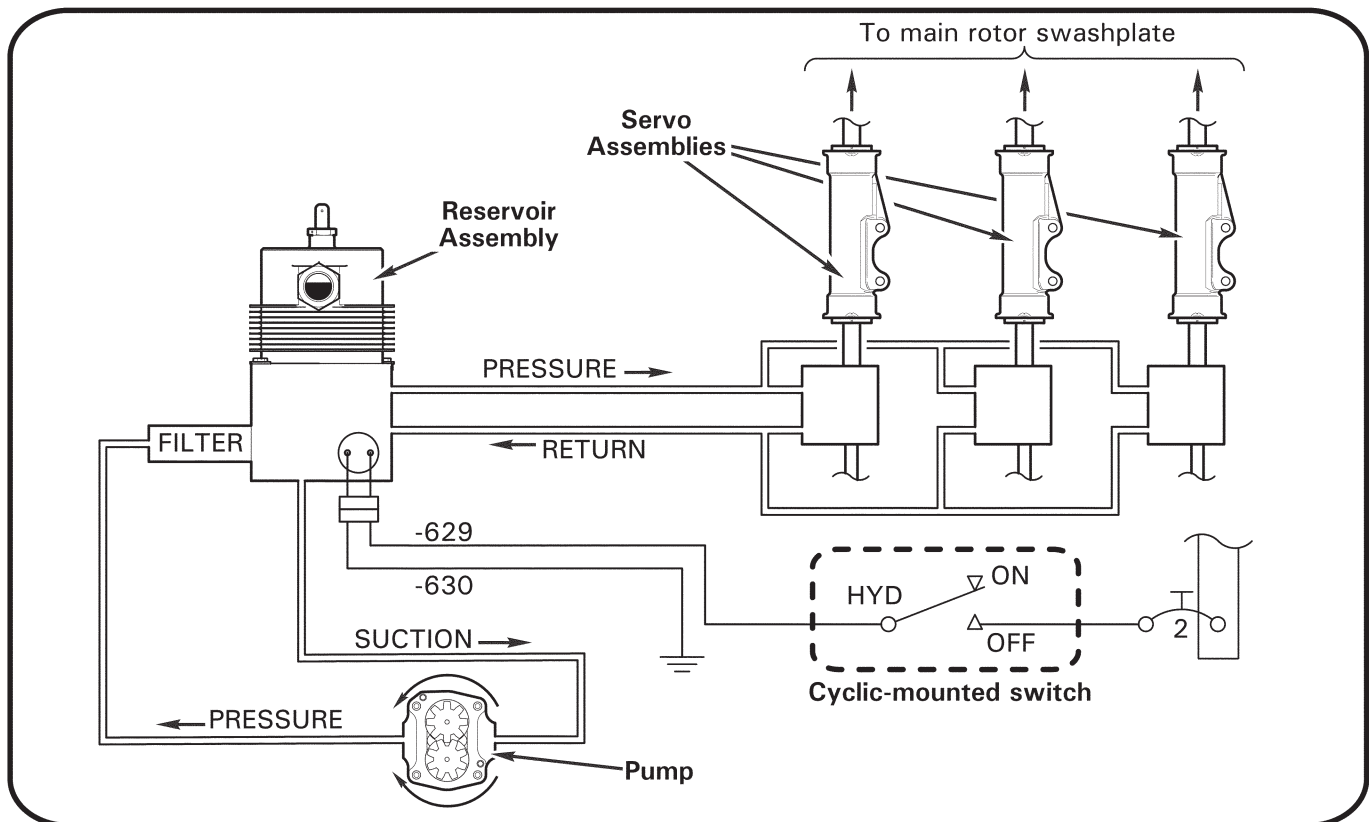


FIGURE 29-2 HYDRAULIC SYSTEM SCHEMATIC

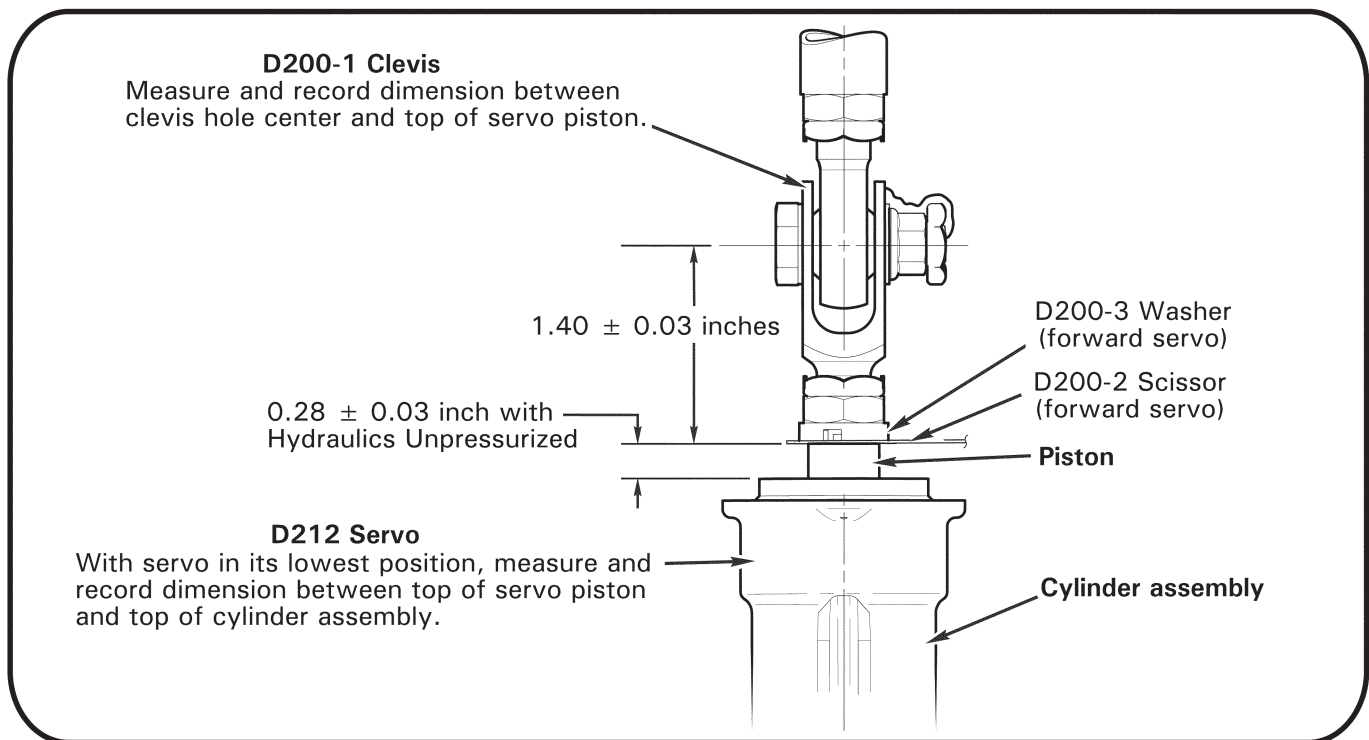


FIGURE 29-3 HYDRAULIC SERVO RIGGING

29-10 Hydraulic Pump (continued)**B. Installation (continued)**

9. For helicopters with air conditioning:
  - a. Position G779-1 pulley on F908-1 yoke assembly. Install hardware, standard torque nuts per § 20-32, and torque stripe per Figure 5-1.
  - b. Route B173-5 v-belt onto pulleys. Rotate compressor up and outboard to tension belt, then tighten hardware securing compressor to weldment. Adjust belt until 4.5-5.5 lb of force applied mid-span deflect belt 0.16-inch. Standard torque bolts per § 20-32 and torque stripe per Figure 5-1.
10. Install tailcone cowling per § 53-23.

29-20 Hydraulic Reservoir**A. Removal**

1. Temporarily install a "DO NOT MOVE FLIGHT CONTROLS" sign in cockpit.
2. Remove tailcone cowling per § 53-23.
3. Place a one-liter container beneath suction tee fitting on reservoir. Remove cap from tee fitting and allow reservoir fluid to drain into container. Reinstall cap and special torque per § 20-33.
4. Remove suction and pressure lines, and disconnect and cap servo supply and return hoses, from reservoir. Protect line and fitting openings.
5. Disconnect pump bypass solenoid and sight gage LED electrical connectors.
6. Remove three screws securing reservoir to gearbox and remove reservoir.
7. Note alignment of tee fittings and sight gage LED. Transfer LED and line and hose fittings from removed reservoir to replacement reservoir.

**B. Installation**

1. Note alignment of tee fittings and sight gage LED on removed reservoir. Transfer LED and line and hose fittings from removed reservoir to replacement reservoir. Special torque fittings per § 20-33.
2. Install reservoir on gearbox and secure with three screws.
3. Install pressure and suction lines, repositioning tee fittings as required, and special torque per § 20-33.
4. Connect servo supply and return hoses to reservoir. Position hose elbows to minimize preload and special torque per § 20-33.
5. Connect pump bypass solenoid and sight gage LED electrical connectors and ty-rap wires as required.
6. Fill reservoir with A257-15 hydraulic fluid and special torque filler vent per § 20-33.
7. Bleed hydraulic system per § 12-34.
8. Install tailcone cowling per § 53-23.

29-30 Hydraulic Servos**A. Servo Removal****CAUTION**

Do not pressurize hydraulic system while any hydraulic system component is disconnected or removed.

1. Remove mast fairing per § 53-22. Remove tailcone cowling per § 53-23.
2. Refer to Figures 29-1 and 29-3. Perform the following measurements on all D212 hydraulic servo assemblies to be removed:
  - a. Measure and record dimension between D200-1 clevis hole center & top of servo piston.
  - b. Apply cyclic and collective frictions. With collective full down and hydraulics unpressurized, position cyclic stick so piston in servo to be removed is in its lowest position. Measure and record dimension between top of servo piston and top of cylinder assembly.
3. Remove hardware securing servo clevis to F121-3 push-pull tube's lower rod end.
4.
  - a. Forward Servo: Remove hardware securing servo to F121-5 push-pull tube's upper rod end. Remove hardware joining D200-2 scissors.
  - b. Aft Servo: Remove hardware securing C343-8 tube's lower rod end to F339-1 jackshaft weldment.
5. Disconnect D205 hose assemblies from servo unions and tees. Cap and plug fittings.
6. Remove hardware securing servo to G201-1 frame weldment and remove servo.
7. Aft Servo: Measure and record center-to-center dimension between aft servo's lower rod end and C343-8 tube's lower rod end. Loosen palnut and nut securing C343-8 tube to aft servo's lower rod end and remove tube.

**CAUTION**

Do not remove tri-wing fastener; aft servo's lower rod end must remain attached to servo.

**CAUTION**

Dimension between clevis hole center and top of servo piston must be  $1.40 \pm 0.03$  inches; dimension between top of servo piston and top of cylinder assembly must be  $0.28 \pm 0.03$  inch; dimension between C343-8 tube's rod ends must be  $4.00 \pm 0.03$  inches. If dimension(s) are not within required range, perform main rotor rigging per § 18-40 after servo installation.

8. Remove clevis, scissor, D200-3 washer, unions, and tee fittings from servo, as applicable.
9. Actuate servo piston by hand and drain as much hydraulic fluid from servo as possible. Plug servo ports.



29-30 Hydraulic Servos (continued)**B. Servo Installation****CAUTION**

Do not pressurize hydraulic system while any hydraulic system component is disconnected or removed.

**CAUTION**

Refer to Part A. Dimension between clevis hole center and top of servo piston must be  $1.40 \pm 0.03$  inches; dimension between top of servo piston and top of cylinder assembly must be  $0.28 \pm 0.03$  inch; dimension between C343-8 tube's rod ends must be  $4.00 \pm 0.03$  inches. If dimension(s) recorded during servo removal were not within required range, or if dimension(s) are unknown, adjust to correct dimensions in Part B steps 1 and 2, proceed with servo installation thru step 10, then perform main rotor rigging per § 18-40.

1. Refer to Figures 29-1 and 29-3. Lightly coat D200-1 clevis threads with B270-21 protectant. Assemble clevis, palnut, nut, D200-3 washer (forward servo), and D200-2 scissor (forward servo), and install assembly in D212 hydraulic servo assembly piston. Adjust dimension between clevis hole center & top of servo piston to dimension recorded during servo removal, then tighten jam nut and palnut finger tight.
2. Aft Servo: Lightly coat servo's lower rod end threads with B270-21 protectant and install C343-8 tube. Adjust tube on servo's rod end, and tube's rod end, to the center-to-center dimension (between rod ends) recorded during servo removal, and with rod ends  $90^\circ$  to each other. Tighten jam nuts and palnuts finger tight.

**CAUTION**

Do not remove tri-wing fastener; aft servo's lower rod end must remain attached to servo.

3. Install hardware securing servo to G201-1 frame weldment. Standard torque fasteners per § 20-32 and torque stripe per Figure 5-1.
4. Forward Servos: Install hardware joining scissors (scissor overlap direction not critical); special torque nut to 25 in.-lb, special torque palnut to 5–10 in.-lb, and torque stripe per Figure 5-1.
5. Using backup wrench, align clevis parallel with helicopter's longitudinal axis, standard torque jam nut and palnut per § 20-32, and torque stripe per Figure 5-1.
6. Install hardware securing servo clevis to F121-3 push-pull tube's lower rod end. Standard torque fastener per § 20-32 and torque stripe per Figure 5-1.

29-30 Hydraulic Servos (continued)**B. Servo Installation (continued)**

7. a. Forward Servo: Install hardware securing servo to F121-5 push-pull tube's upper rod end. Standard torque fastener per § 20-32 and torque stripe per Figure 5-1.  
b. Aft Servo: Install hardware securing C343-8 tube's lower rod end to F339-1 jackshaft weldment. Standard torque fastener per § 20-32 and torque stripe per Figure 5-1. Using backup wrench, standard torque jam nuts and palnuts, and torque stripe per Figure 5-1.
8. Refer to Figure 5-2. Verify proper rod end centering on all push-pull tubes attached to servos.
9. Remove caps and plugs. Lubricate new packings using A257-15 hydraulic fluid and install packings on servo unions and tees. Install fittings with associated hardware in servo ports and connect D205 hose assemblies to fittings. Align fittings to minimize hose preload and ensure hose clearance with surrounding structure; special torque fittings per § 20-33 and torque stripe per Figure 5-1. Special torque hose B-nuts per § 20-33 and torque stripe per Figure 5-1.
10. Bleed hydraulic system per § 12-34.
11. Perform the following measurements on all servos just installed:
  - a. Measure and record dimension between clevis hole center & top of servo piston.
  - b. Apply cyclic and collective frictions. With collective full down and hydraulics unpressurized, position cyclic stick so piston in servo just installed is in its lowest position. Measure and record dimension between top of servo piston and top of cylinder assembly.

**CAUTION**

Dimension between clevis hole center and top of servo piston must be  $1.40 \pm 0.03$  inches; dimension between top of servo piston and top of cylinder assembly must be  $0.28 \pm 0.03$  inch; dimension between C343-8 tube's rod ends must be  $4.00 \pm 0.03$  inches. If dimension(s) recorded are not within required range, adjust to correct dimensions in Part B steps 1 and 2, proceed with servo installation thru step 10, then perform main rotor rigging per § 18-40.

12. Install tailcone cowling per § 53-23. Install mast fairing per § 53-22.

29-30 Hydraulic Servos (continued)**C. Inspection**

1. Disconnect servo from upper push-pull tube per § 29-30 Part A steps 1 thru 3.
2. Remove clevis, scissor, and D200-3 washer from servo, as applicable.
3. Visually inspect threaded bore in piston with borescope. Replace servo if corrosion is detected.
4. Assemble servo and connect to upper push-pull tube per § 29-30 Part B steps 1, 4, 5, 6, 8, 11, and 12.

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