



**Filling and Pressurizing the System**

Use Hynautic steering oil or light viscosity hydraulic oil that meets the aircraft hydraulic fluid spec Mil-H-5606, such as Texaco #15, Exxon Univil J-13, Castrol AWH-15, Castrol Aero-585-B, or Shell Tellus 15. Heavier oils, such as automatic transmission oil Type A or Dextron II, may be used but will cause harder steering.

1. Locate the two screws with pinned 1/2" hex nuts on the top of the relief valve. Loosen and back off by hand, turning counterclockwise until they stop.
2. Remove the hex plug from top of the reservoir and fill with oil to within 1/2" of the top and replace the hex plug.
3. The reservoir is equipped with a tire type air valve. Any tire air pump or compressed air supply can be used to pressurize the system. Slowly pressurize the reservoir to 40-45 psi. As pressure is applied, oil will flow into the system. When the oil level drops to within 2" of the bottom of the reservoir, stop pressurizing. Exhaust the air pressure through the air valve, remove the hex fill plug, refill, and replace the fill plug. Repressurize until the reservoir oil level stabilizes and gage pressure reads between 40-45 psi. Check all connections for leakage.
4. Go to the highest helm and bleed the air out of the (P) port and (S) starboard lines by cracking open the fitting connections. Allow the air to escape until oil appears, and then retighten.
5. Disconnect the clevis or rod end of the cylinder from its engine or rudder mounting if at all possible, making certain it is free to stroke without interference. This will assist in purging the air from the cylinder.
6. Bleed both ends of the cylinder by backing off the socket head cap screw bleeders one turn. If the cylinder is not equipped with bleeders, crack open the fitting connections. Hold the cylinder so bleeding will be performed on the highest end of the cylinder. Allow the air to escape until oil appears and then close.
7. Verify that the reservoir is at least 3/4 full and the gage reads between 40 and 45 psi. If oil level is below 1/2 full, exhaust the air pressure through the air valve, remove the fill plug, refill, and replace the fill plug. Repressurize to 40-45 psi.

**Purging the System of Air**

The following procedure is a process by which the helm(s) and autopilot are sequentially operated to pump oil into the (P) port and (S) starboard hydraulic lines, displacing the air-infiltrated oil out through the relief valve and into the reservoir where the air separates from the oil. Solid oil from the bottom of the reservoir is then fed back to the helm and autopilot through the (R) line as needed.

The number of wheel turns specified in Table 1 have been established for average tubing lengths of 20 feet between components. If tubing lengths exceed 20 feet, increase the number of turns by 2 for every extra foot of tubing length.

1. Go to the highest helm and turn slowly (2 to 3 sec/rev.) 60 times in one direction.
2. Repeat Step 1 at each successively lower helm and autopilot.

*NOTE: Purging air from a hydraulic autopilot is accomplished by setting a course on the autopilot to the same direction you are steering the helm(s). If you are steering the helm(s) to the starboard (clockwise) direction, set a starboard course heading on the autopilot and allow it to run for 1 to 2 minutes.*

3. Once more, crack the bleeders at the cylinder. If bleeders are not available, crack the fittings at the appropriate ends and allow the air to bleed out. Retighten when solid oil appears.
4. Check the reservoir pressure and oil level. If oil level is below the half full mark, exhaust the air pressure through the air valve, remove the oil fill plug, refill, and replace fill plug. Repressurize to 40-45 psi.
5. Go to the highest helm and turn the wheel slowly 60 turns in the OPPOSITE direction. Repeat at each successively lower helm and autopilot.
6. Close the two relief valve screws with pinned hex nuts by turning clockwise, and snug with a wrench.

**WARNING LOSS OF STEERING WILL OCCUR IF THE RELIEF VALVE SCREWS ARE NOT CLOSED. WHEN SECURING THESE SCREWS WITH A WRENCH, DO NOT APPLY HEAVY FORCE OR DAMAGE TO THE SCREW AND RELIEF VALVE WILL RESULT.**

7. Go to a helm station and turn in one direction until a hardover is felt.
8. Go to the cylinder and open the bleeder or crack the fitting at the end of the cylinder that the rod is extended from, closing when solid oil appears.
9. Again go to a helm station and turn now in the opposite direction until a hardover is felt.
10. Go to the cylinder and bleed until solid oil appears at the opposite end of the cylinder previously bled and the reclose.
11. Verification of a complete purge is accomplished by rotating the helm and achieving, within 1/2 turn, the corresponding number of turns hardover to hardover shown on Table 1. An excessive number of turns indicates air in the system and Steps 1-10 must be repeated.
12. To verify relief operation and system integrity, go to a helm and turn past hardover, forcing oil over the relief valve for a turn or two at each hardover position. A squeak may be heard as the relief valve unloads.
13. Secure the cylinder to the mounting structure and to the engine or tiller arm. Check the reservoir for fluid level and pressure. Leave the reservoir 1/2 to 2/3 full and at 20-30 psi.

3. Starting at the upper helm, turn 40 turns in one direction, repeating at successively lower helms. Again in the same manner, turn the helm(s) in the opposite direction.
4. Close the relief valve screws and snug with a wrench.
5. Verify that the proper number of turns hardover to hardover has been obtained. Recheck the oil level (1/2 to 2/3 full) and reservoir pressure (20-30 psi).

**NOTE:** If a line must be disconnected, exhaust the air pressure from within the reservoir and remove the filler plug. Then open the relief valve screws to relieve all pressure in the lines. After work is completed, reconnect lines and repurge the system of air.

### System Check and Final Purging

It is recommended that you check the system and perform a short, final purge after approx. 24 hours. After this time, any leaks will be detected; and any remaining small bubbles will have formed larger bubbles which are easily removed.

1. Observe system for oil leaks and reservoir gage for possible pressure loss.

**NOTE:** It is common to observe a 5 psi pressure fluctuation on systems that are subject to a temperature change of 20°F or more.

2. Open the relief valve screws.

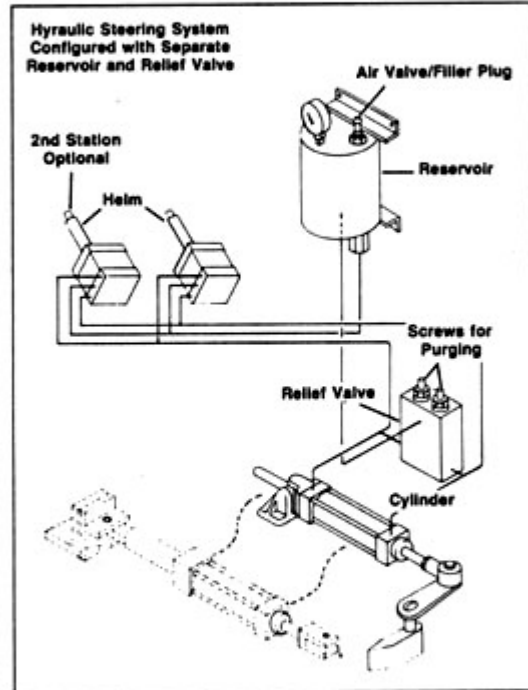


Table 1. Helm Turns - Hardover to Hardover

Helm Number	Cylinder Number							
	K-1	K-2	K-3	K-22 K-27	K-28 K-29	K-31	K-33	K-5 (1) Pair
H-21, H-25, H-29	4.4	6.5	8.4	5.0	6.0	10.0	8.4	10.0
H-42	3.0	4.5	5.8	3.5	4.0	6.5	5.8	6.5
H-41	2.2	3.3	4.2	2.5	3.0	5.0	4.2	5.0





**IMPORTANT NOTE**

USE HYNAUTIC STEERING OIL OR LIGHT VISCOSITY HYDRAULIC OIL THAT MEETS THE AIRCRAFT HYDRAULIC FLUID SPECIFICATION MIL-H-5606 SUCH AS TEXACO #15, EXXON UNIVIS J-13 , CASTROL AWH-15, CASTROL AERO-585-B, OR SHELL TELLUS 15. HEAVIER OILS, SUCH AS AUTOMATIC TRANSMISSION OIL TYPE A DEXTRON II, MAY BE USED BUT WILL CAUSE HARDER STEERING.

**FILLING AND PRESSURIZING THE SYSTEM**

1. Remove the hex plug from top of the reservoir (Reservale) and fill with oil to within 1/2" of the top. Replace the hex plug.
2. Locate the two screws, with pinned 1/2" hex nuts, on the front of the relief valve located at the base of the reservoir. Loosen and back off by hand, turning counterclockwise until they stop.

**CAUTION**

**Do not back nuts all the way off with a wrench or diasassembly of internal relief valve parts may occur.**

3. The top of the Reservale is equipped with a tire-type air valve. Any tire air pump can be used for pressurizing the system. As the oil-filled Reservale is pressurized, oil will flow into the system. Pressurize until flow stops and pressure stabilizes between 35 and 45 PSI. Check all connections for leakage.
4. Disconnect the rod end of the cylinder from its engine or rudder mounting. Make certain it is free to stroke without interference. This will assist in purging the air from the cylinder.

5. Bleed both ends of the cylinder by backing off the socket-head cap screw bleeders one turn. If the cylinder is not equipped with bleeders, crack open the fitting connections. Hold the cylinder so bleeding will be performed on the highest end of the cylinder. Allow air to escape until oil appears, then reclose.

**PURGING THE SYSTEM OF AIR**

The following procedure is a process by which helm(s) and autopilot are sequentially operated to pump oil into the (P) port and (S) starboard hydraulic lines, displacing the air-infiltrated oil out through the relief valve and into the reservoir where the air separates from the oil. Solid oil from the bottom of the reservoir is then fed back to the helm and autopilot through the (R) line as needed.

1. Go to the highest helm and turn slowly (2 to 3 sec/rev.) 40 times in one direction.
2. Repeat Step 1 at each successively lower helm and autopilot.
3. Once more, crack the bleeders at the cylinder. If bleeders are not available, crack the fittings at the appropriate ends and allow the air to bleed out. Retighten when solid oil appears.
4. Check the Reservale pressure and oil level. If oil level is below the half-full mark, exhaust the air pressure through the air valve, remove the oil fill plug, and refill. Repressurize to 35-45 PSI.
5. Go to the highest helm and turn the wheel slowly 40 turns in the **opposite** direction. Repeat at each successively lower helm and autopilot.
6. Once more, crack the bleeders at the cylinder, closing when solid oil appears.

7. Close the two relief valve screws with pinned hex nuts by turning clockwise, and tighten to 106 In-Lb with a wrench.

**WARNING**

**LOSS OF STEERING WILL OCCUR IF THE RELIEF VALVE SCREWS ARE NOT CLOSED. WHEN SECURING THESE SCREWS WITH A WRENCH, DO NOT APPLY HEAVY FORCE OR OVERTIGHTEN AS DAMAGE TO THE SCREW AND RELIEF VALVE WILL RESULT.**

8. Verification of a complete purge is accomplished by rotating the helm and achieving the corresponding number of turns hardover to hardover, within 1/2 turn, shown on the chart below. An excessive number of turns indicates air in the system and Steps 1 thru 7 must be repeated.
9. To verify relief operation and system integrity, go to a helm and turn past hardover, forcing oil over the relief valve for a turn or two at each hardover position. A squeak will be heard as the relief valve unloads.
10. Secure the cylinder to the mounting structure and to the tiller arm. Check the Reservevalve for fluid level and pressure. Leave the Reservevalve 1/3 to 2/3 full and at 20-30 PSI.

**SYSTEM CHECK AND FINAL PURGING**

It is recommended that you check the system and perform a short, final purge after approximately 24 hours. After this time, any leaks will be detected and any remaining small bubbles will have formed larger bubbles which are easily removed.

1. Observe system for oil leaks and Reservevalve gauge for possible pressure loss.

**NOTE**

**FLUCTUATION IN OIL LEVEL AND PRESSURE WILL OCCUR WHEN SYSTEM TEMPERATURE CHANGES AND WHEN THE ROD OF AN UNBALANCED CYLINDER (K-11, K-12, K-13, K-14) IS EXTENDED AND RETRACTED.**

2. Open the relief valve screws.
3. Starting at the upper helm, turn 40 turns in one direction, repeating at successively lower helms. Now, turn 40 turns in the opposite direction at the upper helm, repeating at lower helm(s).
4. Close the relief valve screws and tighten to 106 In-Lb with a wrench.
5. Verify that the proper number of turns hardover to hardover has been obtained. Recheck the oil level (1/2 to 2/3 full) and reservoir pressure (20-30 PSI).

**NOTE**

**IF A LINE MUST BE DISCONNECTED, EXHAUST THE AIR PRESSURE FROM WITHIN THE RESERVEVALVE AND REMOVE THE FILLER PLUG. THEN OPEN THE RELIEF VALVE SCREWS TO RELIEVE ALL PRESSURE IN THE LINES. AFTER WORK IS COMPLETED, RECONNECT LINES AND REPURGE THE SYSTEM OF AIR.**

HELM TURNS HARDOVER TO HARDOVER						*Turns to retract rod of unbalanced cylinder.						
HELM NUMBER	CYLINDER NUMBER											
	K-10	K-11		K-12		K-13		K-14		K-18	K-19	K-20
H-21, H-25, H-51	3.0	3.3*	4.0	2.5*	3.2	3.3*	4.0	2.5*	3.2	2.5	3.3	2.9
H-26, H-50	4.0	4.5*	5.5	3.5*	4.3	4.5*	5.5	3.5*	4.3	3.5	4.5	4.0
H-52	4.5	5.0*	6.1	4.0*	4.8	5.0*	6.1	4.0*	4.8	4.0	5.0	4.8

