SERVICE INSTRUCTIONS

ASSEMBLY & DISASSEMBLY

T30X.X-SR AND T40X.X-SR

SPRING RETURN HYDRAULIC ACTUATORS

INTRODUCTION

This service procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis T30X.X-SR/T40X.X-SR "Scotch-Yoke" type hydraulic actuators.

NOTE: This does not include those high pressure hydraulic actuators (5000 PSI) that use the MILLER CYLINDER MOD as hydraulic cylinder.

BASIC TOOLS

Large Adjustable Wrench, Screwdriver, Pipe Wrench, (1/4") Drift Punch, 1/2" Drive Socket Set, Torque Wrench (up to 3000 in. lb.), 24 oz. Ball Peen Hammer, Allen Wrench Set, Pry Bar, Leather or Rubber Mallet and two (2) Heavy Hex Nuts (7/8-9).

REFERENCE GH-BETTIS MATERIALS

GH-Bettis Assembly Drawing 48099 for T30X.X-SR actuator failing clockwise
GH-Bettis Assembly Drawing 48098 for T30X.X-SR actuator failing counter clockwise
GH-Bettis Assembly Drawing 48096 for T40X.X-SR actuator failing clockwise
GH-Bettis Assembly Drawing 48097 for T40X.X-SR actuator failing counter clockwise
GH-Bettis Operating, Storage & Maintenance Instruction (Op/Maint-002)

GENERAL DISASSEMBLY

NOTE: Numbers in parentheses, indicate the bubble number (reference number) used on the GH-Bettis Assembly Drawing and actuator parts list.

1. Remove all operating pressure from actuator power cylinder (2-10) allowing the spring to stroke. The spring will rotate the yoke to the fail position.

2. Remove all plumbing and accessories from actuator.

3. Spring cartridge "preload". Locate the stop adjust screw (1-60) that is on the opposite side of the center housing from the spring cylinder (4-10). Loosen the jam nut (1-120) and unscrew the stop adjusting screw (1-60) until there isn't any more "preload" on the actuator. NOTE: DO NOT PROCEED TO NEXT STEP UNTIL YOU ARE SURE THERE IS NO SPRING "PRELOAD".

4. Check again for spring 'preload'. Check the position of position indicator (1-170). Facing front side of actuator (stop screws facing you), CW units will have position indicator pointed toward worker. CCW units will have indicator parallel to center line of actuator and facing to the right.

5. Remove four socket cap screws (1-180) from position indicator (1-170)/yoke weather cover (3-130) and remove position indicator/yoke weather cover.

DISASSEMBLY - HYDRAULIC CYLINDER

1. Remove all operating pressure from actuator power cylinder (2-10) and cylinder adapter (2-40).

2. Drain the hydraulic fluid from hydraulic cylinder (2-10) by removing the cylinder drain plugs (2-80). They are located at inboard and outboard ends of cylinder assembly bottom side.

3. Remove socket cap screws (2-140) and lockwashers (2-130) from cylinder assembly 2-10).

4. Apply downward pressure on end of cylinder assembly (2-10). By canting cylinder up and down, assembly should break free from adapter (2-40).

5. Remove hex nut (2-100) and lockwasher (2-110) from piston rod (2-170).

6. Piston seal retainers (2-70) and piston (2-20) will slide off the piston rod (2-170).

7. Remove piston seals (3-90) and piston head seal (3-40) from piston (2-20).

8. Remove oring seal (3-30) and back-up ring (3-120) from cylinder adapter (2-40).

SPRING CARTRIDGE REMOVAL

NOTICE: When the spring cartridge is installed on the actuator the spring is under compression. DO NOT remove the spring cartridge until the actuator has the "preload" removed (refer to step 2 under General Disassembly). WARNING: Under no circumstances should the spring cartridge be cut open as the spring is preloaded and the spring cartridge welded around it.

1. Remove socket head screw (4-60), washer (4-50) and nut retainer (4-40).

2. Alternately loosen the two large hex nuts on the outboard end of the spring cartridge (4-10). These nuts are welded to the tie bars that extend through the spring cartridge and screw into the actuator housing (1-10). Unscrew the tie bars until the spring cartridge is free from the housing. Care should be taken so that the tie bars are not pulled back into the spring cartridge. NOTE: To keep tie bars from inadvertently pulling back into the spring cartridge, use hex nuts (7/8-9) and insert them onto the tie bars. Place the spring cartridge to one side.

HOUSING GROUP DISASSEMBLY

1. Unscrew push rod (4-20) from yoke pin nut (1-30) and remove from housing.

2. Unscrew piston rod (2-170) from yoke pin nut (1-30) and remove. Flats are provided on the outboard end of the piston rod for wrench placement. DO NOT use a pipe wrench on the piston rod as it will mark the rod and cause seal leakage.

3. Remove cover screws (1-90) and gasket seals (3-100).

4. Remove the housing cover (1-20). NOTE: This piece will have a very tight fit.

5. Remove the top two yoke rollers (1-50) from the top of the yoke pin (1-40). Remove yoke pin (1-40).

6. Remove yoke pin nut (1-30).

7. Remove bottom two yoke rollers (1-50) from the housing.

8. The yoke (1-160) can now be removed by lifting it from the housing.

9. Remove socket cap screws (2-120) and lockwashers (2-130) from inside housing.

   ~~NOTE:~~ T3 units will have a quantity of three screws and T4's will have four.

10. Slide cylinder adapter (2-40) away from housing. Remove rod seal (3-70) from adapter.

11. Remove rod bushing (2-50) from housing.

    ~~NOTE:~~ It is not necessary to remove the stop screws, drain plug or grease fittings to service the actuator.

~~GENERAL RE-ASSEMBLY~~

Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.

Before starting the assembly of an actuator, all parts should be thoroughly cleaned, inspected and de-burred. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.

~~LUBRICATION REQUIREMENTS~~

1. Standard and high temperature service (-20°F to 350°F) use Kronaplate 100. Reference GH-Bettis Engineering Standard ESL-5.

2. Low temperature service (-100°F to 300°F) use Aeroshell 17. Reference GH-Bettis Engineering Standard ESL-4.

~~FLUID REQUIREMENTS~~

1. Standard and high temperature service (35°F to 350°F) use Exxon Dexron II Automatic Transmission Fluid. Identification #D-20106. Reference GH-Bettis Engineering Standard ESF-1.

2. Low temperature service (65°F to 180°F) use Exxon Univis J13 Hydraulic Fluid. Reference GH-Bettis Engineering Standard ESF-2.

CENTER HOUSING GROUP RE-ASSEMBLY

1. If removed install drain plug (1-80) in actuator housing (1-10).

2. If removed install grease fitting (1-70) in the actuator housing (not shown on assembly drawing). This fitting is located on the bottom of the housing next to the lower yoke bearing area. NOTE: Grease fittings optional as of 3/1/83.

3. Take all the yoke rollers (1-50) and check to see if they will run (move) freely thru the tracks in the bottom of the housing and the housing cover.

4. Coat the yoke oring seal (3-50) with grease and install into the housing (1-10).

5. Inside the housing (1-10) apply grease to the tracks and yoke bore and orient the housing with the yoke bore nearest you.

6. Apply grease to the yoke (1-160) lower bearing surface and install into the housing (1-10) as follows: Orient the yoke arm to approximately a 45° position in either direction and lower into the housing. The hub with tapped holes faces up. Rotate the yoke back to approximately the mid-stroke (center) position.

7. Apply grease to the slots in the upper and lower yoke arm.

8. Apply grease to all surfaces of two yoke rollers (1-50). Place one yoke roller (1-50) in the track in the bottom of the housing and position it under the slot in the yoke arms. Place a second yoke roller on top of the first yoke roller in the slot in the lower yoke arm and align the holes in the yoke rollers.

9. Coat the upper and lower surfaces of the yoke pin nut (1-30) with grease and insert into position between the yoke arm, parallel to the track in the housing. Align the yoke pin hole with the yoke rollers.

10. Grease the yoke pin (1-40) and insert through the yoke pin nut (1-30) and the two yoke rollers (1-50).

11. Apply grease to all the surfaces of the two remaining yoke rollers (1-50).

12. Install the third yoke pin roller over the yoke pin in the slot in the upper yoke arm and now install the fourth and last remaining yoke roller on top of the yoke roller you just installed in the upper yoke arm slot.

    ~~NOTE:~~ The top roller will remain above the yoke arm and will engage the cover track when cover is installed.

13. Slide the piston rod (2-170) into the side of body and screw into the yoke pin nut (1-30). (DO NOT TIGHTEN) For spring to close actuators, install the piston rod on the right side of the housing. For spring to open actuators, install the piston rod on the left hand side of the housing. Flats are provided on the outboard end of the piston rod. These flats should be used to put a wrench on to tighten the piston rod. DO NOT use a pipe wrench on the piston rod, as it will cause seal leakage.

    ~~NOTE:~~ For spring to open actuators, install piston rod on the left side of housing. For spring to close actuators, install the piston rod on the right side of housing.

14. Apply grease to the rod bushing (2-50), install it over the piston rod and slide it up into the housing.

15. Coat end cap gasket (3-10) with grease on both sides and install over the piston rod end bushing.

16. Coat the rod seal (3-70) with fluid and install into the recess provided in the cylinder adapter. Be sure that the seal lips are installed first, with heel of seal facing housing.

17. Install cylinder adapter (2-40) over piston rod and slide adapter up against housing. As adapter is installed, be sure to align bolt holes in housing.

18. Fasten cylinder adapter (2-40) to housing (1-10) with socket cap screws (2-120) and lockwashers (2-130) from inside housing.

    ~~NOTE:~~ Yoke (1-160) will have to be orientated to full counter-clockwise position, opposite cylinder adapter.

19. Do this step only if you have removed the housing stop screws (1-60). Place gasket (3-110) and jam nut (1-120) on the stop screw (I -60). Install stop screws in the housing. Screw the jam nut down against the actuator housing.

20. Slide push rod (4-20) into side of body and install into yoke pin nut (1-30).

21. Apply a thin coating of grease to the housing cover gasket (3-20) surface.

22. Place the housing cover gasket (3-20) on the housing (1-10).

23. Coat the yoke oring seal (3-50) with grease and install in cover (1-20).

24. Apply grease to the yoke bore and the track in the housing cover (1-20). Apply a thin coat of grease to the gasket surface.

25. Apply grease to the yoke upper bearing surface.

26. Install the housing cover (1-20), being careful not to damage the gasket (3-20) or yoke oring (3-50).

27. Install the cover screws (1-90) and seal gasket ~~(3-100). LEAVE FINGER TIGHT - DO~~ ~~NOT TIGHTEN~~.

28. Do this step ~~only~~ if you have pulled the cover pins (1-130) or if you are replacing the cover pins. Drive the four pins (1-130) thru the cover (1-20) and into the housing (1-10) until the pin is flush with the cover.

29. Tighten the cover screws (1-90).

30A. For spring to close actuators (clockwise), rotate the yoke to the full clockwise (CW) position (as shown on the clockwise assembly drawings). Position the yoke weather cover (3-130)/position indicator (1-170) on the yoke with the pointer facing the front and perpendicular with the piston rod (2-170). Secure with the socket head cap screws (1-80).

30B. For spring to open actuators (counter-clockwise), rotate the yoke to the full counter clockwise (CCW) position (as shown on the counter clockwise assembly drawings). Position the yoke weather cover (3-130)/position indicator (1-170) on the yoke with the pointer facing the right and parallel with the piston rod (2-170). Secure with the socket head cap screws (1-180).

31. Rotate the yoke to a position that will leave a minimum of the piston rod (2-170) protruding from the actuator housing.

HYDRAULIC CYLINDER RE-ASSEMBLY

1. Coat oring seal (3-30) and back-up ring (3-130) with hydraulic fluid and install in cylinder adapter (2-40). NOTE: Back-up ring will be installed in the groove between the oring and the 'housing-side' of the groove.

2. Coat oring seal (3-40) with hydraulic fluid and install in piston (2-20).

3. Coat piston seals (3-90) with hydraulic fluid and install on piston (2-20). They should simply slide onto the piston.

4. Install piston seal retainer (2-70) over piston rod (2-170).

5. Coat piston rod (2-170) with hydraulic fluid (threaded end) and slide piston (2-20) into place.

6. Install last piston seal retainer (2-70).

7. Install lockwasher (2-110) and heavy hex nut (2-100) onto piston rod. Torque to 200 foot pounds maximum (2400 in. lbs.). Tightening hex nut will also tighten piston rod.

8. If removed, install drain plugs (2-80) into cylinder assembly (2-10).

9. Coat cylinder adapter (2-40) and cylinder assembly cylinder bore (2-10) with hydraulic fluid. Install cylinder assembly over adapter.

10. Fasten cylinder (2-10) with socket cap screws (2-140) and lockwasher-

11. Fill hydraulic cylinder (both inboard and outboard) with fluid until 'full', install bleed valves (2-90), if removed.

12. Install breather (4-30), if removed, into hydraulic cylinder adapter.

SPRING CYLINDER RE-ASSEMBLY

NOTE: Make sure that the stop screws (1-60) have not been screwed into the point that 'Preload' will be created on the spring cartridge.

1. Coat end cap gasket (3-10) with grease.

2. Install end cap gasket (3-10) onto spring cartridge.

3. By pushing on the exposed spring return push rod (4-20) or tapping it with a soft mallet, stroke the unit until the yoke touches the body at the end adjacent to the installed pressure cylinder.

4. Remove the safety nuts from the spring return cartridge.

5. Engage the spring return cartridge onto the spring return push rod and engage the tie bars by threading them into the body.

6. Tighten the tie bars to 125 ft. lbs. (1500 in. lbs.). Install the nut retainer (4-40), securing in place with the retainer screw (4-60) and lockwasher (4-50). It is necessary that the flats on the hex nuts be aligned and parallel before the nut retainer can be installed.

TESTING HYDRAULIC ACTUATORS

A. Leakage Test

NOTE: All areas, where leakage to atmosphere may occur, are to be checked using a soapy solution.

Procedure:

1. Cycle the actuator five times at 100% of the nominal operating pressure (NOP), as per actuator name tag. This allows the seals to seek their proper working attitude.

2. Apply 100% of the maximum operating pressure (MOP), as marked on actuator name tag and allow the unit to stabilize.

3. If there is any notable leakage, the actuator must be disassembled and the cause of leakage must be determined and corrected.

4. Shell tests the actuator by applying 1.5 times the maximum test pressure, as marked on actuator name tag, to both sides of the piston simultaneously for a period of two (2) minutes. If any leakage occurs, the unit must be disassembled and the cause of leakage must be determined and corrected.

5. If actuator was disassembled and repaired, the above leakage test must be performed again.

B. Operational (Functional) Test

NOTE: This test is used to verify proper function of the actuator and its' related system (accessories).

Procedure:

1. Adjust the pressure regulator to the pressure rating indicated in column 'B' of Chart 1, on the following page, for the model actuator being tested.

2. Cycle the actuator five times at the above pressure. This will allow the seals to seek their proper working attitude.

NOTE: Check the spring cartridge to insure that the vent is not plugged and is venting properly to the atmosphere.

3. Apply the above pressure to the actuator and allow the unit to stabilize. The actuator should stroke a full 90° degrees travel with the stops properly set.

4. Decrease the cylinder pressure slowly until the actuator strokes approximately 5° degrees off the opposite stop. The pressure reading attained must be greater than or equal to that listed in Column 'A' of Chart I for the model actuator being tested.

5. All accessories, including solenoid valves, positioners, pressure switches, etc., must be hooked up and tested for proper operations and replaced if found defective.

RETURN TO SERVICE

1 . Install snubber valve assembly (1-190) into cover.

2. Pneumatic rotary valve actuators - refer to "Operating, Storage & Maintenance Instructions for GH-Bettis Pneumatic Rotary Valve Actuators" (OP/MAINT-001) for actuator start-up procedures.

3. Hydraulic rotary valve actuators - refer to "Operating, Storage and Maintenance Instructions for GH-Bettis Hydraulic Rotary Valve Actuators" (OP/MAINT-002) for actuator start-up procedures.

CHART I

PRESSURE REQUIREMENTS AND LIMITATIONS

FOR

T30X.X-SR & T40X.X-SR HYDRAULIC ACTUATORS

MODEL NUMBER	COLUMN A	COLUMN B	MODEL NUMBER	COLUMN A	COLUMN B
T402.7-SR2	941	2130	T302.2-SR2	1145	1940
T402.7-SR3	704	1370	T302.2-SR3	770	1600
T402.7-SR4	441	1160	T302.2-SR4	548	1255
T402.7-SR5	264	945	T302.2-SR5	317	965
T403.5-SR1	817	1610	T302.7-SR1	1060	1995
T403.5-SR2	582	1315	T302.7-SR2	765	1300
T403.5-SR3	435	848	T302.7-SR3	517	1070
T403.5-SR4	273	720	T302.7-SR4	368	839
T403.5-SR5	163	585	T302.7-SR5	212	646
T404.0-SR1	626	1234	T303.5-SR1	655	1230
T404.0-SR2	446	1008	T303.5-SR2	473	803
T404.0-SR3	334	650	T303.5-SR3	319	663
T404.0-SR4	209	552	T303.5-SR4	226	520
T404.0-SR5	125	450	T303.5-SR5	131	400