SERVICE INSTRUCTIONS

ASSEMBLY & DISASSEMBLY

T30X.XM SERIES HYDRAULIC ACTUATORS

INTRODUCTION

This service procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis T30X.XM "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, 24 oz. Ball Peen Hammer, Allen Wrench Set, Pry Bar, 1/2" Drive Socket Set and Torque Wrench (up to 3,000 in. lbs.).

RFFERENCE GH-BETTIS MATERIALS

GH-Bettis Assembly Drawing 048104
GH-Bettis Operating, Storage & Maintenance Instruction (Op/Maint-002)
Dimensional (Base 1) Drawing 042390.

GENERAL DISASSEMBLY

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

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

2. Remove all piping and accessories mounted on actuator.

3. Using manual override, place mechanism in approximate mid-stroke position. Disengage override. Manual override will be in "engaged" position when handle shaft/lever knob assembly (1-300 + 1-320) is in vertically "up" position. Turn knob 180 0 and mechanism will be disengaged.

4. 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. Drain the hydraulic fluid from hydraulic cylinder by removing the cylinder drain plugs (2-80). One is located on the outboard end of hydraulic cylinder and the other on the inboard end.

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

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

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

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

6. Remove piston seals (3-90) and piston head seal (3-40) from piston.

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

HOUSING GROUP DISASSEMBLY

1. Unscrew piston rod (2-170) from split nut retainer (1-30) and remove. DO NOT use a pipe wrench on the piston rod as it will mark the rod and cause seal leakage.

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

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

4. Drive roll pin (1-350) out of handwheel (1-360). Remove handwheel.

5. Unbolt and remove socket cap screws (1-210) and seal gaskets (6-40) from the bearing cap assembly.

6. Remove bearing cap assembly (1-200) by sliding cap off lead screw (1-250).

   NOTE: As you remove bearing cap, check for detent spring (1-340) and detent ball (1-330). These parts are small and can easily fall out.

7. Carefully, pry the oil seal (6-30) from the bearing cap assembly.

8. Remove bearing cap gasket (6-10).

9. Draw out lead screw (1-250) and remove first set of race washers (1-260) and thrust bearing (1-270). Slide second set toward housing, off split ring (1-280). Remove split ring (1-280) and second set of race/thrust bearings. Remove lead screw.

10. Draw out cam shaft assembly (1-310).

11. Remove cam (1-220) from split nut (1-240).

12. Remove cam bushings (1-230) from split nut retainer (1-30).

13. Remove the top two yoke rollers (1-50) from the top of the yoke pin (1-40). Remove yoke pin and rotate the yoke to facilitate removal of the bottom two yoke rollers (1-50) from the housing.

14. Remove split nut retainer (1-30) and split nut (1-240).

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

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

16. Remove socket cap screws (2-120) and lockwashers (2-130) from inside housing. NOTE: T3 units will have a quantity of three (3) screws and T4's will have four (4).

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

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

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

NOTE: Stop screw side of actuator will be considered front side.

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, and in cover next to upper 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 must face 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 all four 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 split nut retainer (1-30) with grease and insert into position between the yoke arm, parallel to the track in the housing, and with the threaded hole to the right, align the yoke pin hole with the yoke rollers.

10. Grease the yoke pin (1-40) and insert through the split nut retainer (1-30) and the two bottom 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 right side of body and screw into the split nut retainer (1-30). (DO NOT TIGHTEN). DO NOT use a pipe wrench on the piston rod, as it will cause seal leakage.

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 seat 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 (1-110) on the stop screw (1-60). Install stop screws in the housing. Screw the jam nut down against the actuator housing.

20. Install cam bushings (1-230) into split nut retainer (1-30).

21. Coat oring (6-20) with grease and install on lever hub (1-290).

22. Insert cam shaft/lever hub assembly into housing assembly far enough into housing until cam shaft is inserted into first cam bushing (1-230).

    NOTE: When handle shaft (1-300 + 1-320) is installed, make sure handle is positioned down.

23. Insert split nut (1-240) into split nut retainer (1-30) - open side facing up, threads facing front.

24. Install T3M cam (1-220), lobe section facing toward back of housing, into split nut; this will put split nut in "disengaged" position.

25. Insert cam shaft assembly (1-130), with lever facing down, thru cam (1-220) and second cam bushing (1-230). Install far enough until lever knob rests snuggly in cavity inside of housing.

26. If removed, install lead screw pin (1-400) into lead screw (1-250).

27. Insert race (1-260), thrust bearing (2-270) and another race onto lead screw (unthreaded end). Install set far enough onto lead screw until it has slipped past relief. Install split rings (1-280) into relief. Slide back race, bearing, race set over split ring. Install second set of race, thrust bearing and race onto lead screw and over split ring.

28. Insert lead screw (1-250) into housing far enough until lead screw is through split nut retainer and lead screw pin (1-400) is installed into hole on far side of housing.

29. Coat bearing cap gasket (6-10) with grease and install to housing (1-10).

30. Move cam shaft handle to mid-stroke position. (Handle facing away).

31. Insert detent spring (1-340) and detent ball (1-330) into bearing cap assembly (1-200).

    NOTE: Bearing cap assembly may be first installed onto lead screw but not far enough to prevent inserting detent ball and spring.

32. Assemble bearing cap assembly to actuator. Slide bearing cap toward housing, be sure detent ball and spring are still firmly held in place until up against lever hub (1-300).

33. Install bearing cap assembly to housing with socket cap screws (1-210) and seal gaskets (6-40).

34. Install oil seal (6-30) into bearing cap assembly (1-200).

35. Install handle (1-360) to lead screw with roll pin (1-350).

36. Moving cam shaft handle (1-300) assembly to vertical position (up); split nut should be fully engaged into lead screw.

37. Rotate actuator, using handle (1-360) to full clockwise position.

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

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

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

41. 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.

42. Apply grease to the yoke upper bearing surface.

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

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

45. Do this step ~~only~~ if you have pulled the cover pins (1-120) or if you are replacing the cover pins. Drive the four pins (1-120) thru the cover (1-20) and into the housing (1-10) until the pin is flush with the cover.

    ~~NOTE:~~ The pins are deeply grooved at one end, tapering to a smooth diameter at the other end. The pin should be installed smooth end first.

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

47. With 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 toward the front and perpendicular to the piston rod (2-170). Secure with the socket head cap screws (1-80).

48. Using the manual override, 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). NOTF-: 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.).

   ~~NOTE:~~ Tightening hex nut will tighten piston rod as well. Remove any burrs from piston rod wrench flats.

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

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

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

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

~~TESTING T3M ACTUATORS~~

1. Be sure that all operating pressure is off.

2. Move handle (1-300) shaft to desired position for operating manual mechanism.
   Shaft vertical (up) – engaged.
   Shaft vertical (down) - disengaged

   ~~NOTE:~~ Listen for 'click' in each position, detent ball is springing into recess inside lever hub. This secures handle from shifting freely.

3. Disengage manual (down) and turn handle (1-360). It should move freely with no binding.

   ~~NOTE:~~ Observe position indicator, there should be no actuator movement.

4. Engage manual. Rotate actuator clockwise and counter-clockwise two times. Again, note any binding of actuator.

5. Disengage manual before pressure testing actuator.

TESTING HYDRAULIC ACTUATORS

A. Leakage Test

NOTE: All sources of leakage to atmosphere and across the piston are to be checked using hydraulic pressure.

Procedure:

1. Cycle the actuator five times at 100% of the normal operating pressure (NOP), as marked on 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 minutes. If any leakage occurs, the unit must be disassembled and the cause of leakage must be determined and corrected.

5. If an 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. Cycle the actuator at 10% of the maximum operating pressure. Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, must be corrected.

2. 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. 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.

2. 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.

FINAL QUALITY TESTING OF ACTUATORS

MODEL	NOMINAL OPERATING PRESSURE (NOP)	MAXIMUM OPERAING PRESSURE (MOP)	MAXIMUM ALLOWABLE WORKING PRESSURE (MAWP)
T302.7M	Customer spec or N.A.	2775	2775
T303.5M	"	1615	1750