

GH BETTIS  
 OPERATING & MAINTENANCE INSTRUCTIONS  
 DISASSEMBLY & ASSEMBLY  
 T20X.X-M SERIES DOUBLE ACTING ACTUATOR WITH  
 INTERNAL MANUAL OPERATOR

PART NUMBER: 74643

REVISION: "A"

REPLACES: SERVICE 031 DATED 1/84

ECN	DATE	REV LTR		By *	Date
74643	11/21/88	A	Compiled	BSC	11-21-88
			Checked		
			Approved		
			Approved	RTU	11-21-88

## 1.0 INTRODUCTION

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on GH Bettis T20X.X-M "Scotch-Yoke" type hydraulic actuators.
- 1.2 The maximum recommended service interval for this actuator series is five years. Storage time is counted as part of the service interval.

## 2.0 BASIC TOOLS

Large adjustable Wrench, Screwdriver, 1/2" Drive Socket Set, Torque Wrench (0-2,000 in. lbs.), Pipe Wrench, (1/2") Drift Punch, 24 oz. Ball Peen Hammer, Allen Wrench Set and Pry Bar.

## 3.0 REFERENCE GH BETTIS MATERIALS

- 3.1 Assembly Drawing Part Number 60000 for T201.5-M.
- 3.2 Assembly Drawing Part Number 60001 for T202.0-M.
- 3.3 Exploded Detail Drawing Part Number 68278 for T201.5-M.
- 3.4 Exploded Detail Drawing Part Number 68306 for T202.0-M.

## 4.0 GENERAL

- 4.1 Numbers in parentheses, () indicate the bubble number (reference number) used on the GH Bettis Assembly Drawing, Exploded Detail Drawing, and actuator Parts Lists.
- 4.2 This procedure is written using the stop screw side of the housing (1-10) as the front side of the actuator and the housing cover (1-20) as the top of the actuator.
- 4.3 Mating parts should be marked for ease of reassembly, i.e. housing to cylinder adapter.
- 4.4 When removing seals from seal grooves, use a small standard screwdriver with the sharp edges rounded off or use a commercial seal removing tool.
- 4.5 Disassembly should be done in a clean area on a work bench.
- 4.6 Lubrication Requirements:
  - 4.6.1 Standard and high temperature service (-20°F to 300°F) use Kronaplate 100 lubricant. This lubricant is furnished in the GH Bettis Service/Seal Kit.
  - 4.6.2 Low temperature service (-50°F to +150°F) use Kronaplate 50.

#### 4.7 Fluid Requirements:

4.7.1 Standard and high temperature service (-20°F to +350°F) use Dexron II Automatic Transmission Fluid.

4.7.2 Low temperature service (-50°F to +150°F) use Exxon Univis J13 Hydraulic Fluid.

#### 5.0 GENERAL DISASSEMBLY

5.1 Remove all operating pressure from actuator power cylinder (2-10).

5.2 Remove all plumbing and accessories mounted on actuators.

5.3 Using manual override, place mechanism in approximate mid-stroke position. Disengage override. Manual override will be in 'engaged' position when cam shaft assembly (1-220) is in vertical 'up' position. Turn knob 180° and mechanism will be disengaged (vertically 'down' position).

5.4 Remove four round head cap screws (1-380) from position indicator (1-370)/yoke weather cover (3-130) and remove position indicator/ yoke weather cover.

5.5 Drain the hydraulic fluid from hydraulic cylinder by removing o-ring plugs (2-80) - located on the bottom side at inboard and outboard ends of the cylinder assembly.

#### 6.0 DISASSEMBLY - HYDRAULIC CYLINDER

6.1 Remove socket cap screws (2-120) and lockwashers (2-130) from cylinder assembly (2-10).

6.2 Apply downward pressure on end of cylinder assembly (2-10). By slightly canting cylinder up or down, assembly should break free from adapter (2-40). Remove the cylinder.

6.3 Remove hex nut (2-100) from piston rod (2-170).

6.4 Slide piston (2-20) off the piston rod (2-170). On T201.5 units, piston split ring (2-60) will be removed at this step as well.

#### 7.0 HOUSING GROUP DISASSEMBLY

7.1 Remove hex cap screws (1-90) and gasket seals (3-100) from housing cover (1-20).

- 7.2 Remove housing cover (1-20). The cover will have a very tight fit. It is not necessary to remove the cover pins (1-120).
- 7.3 Drive roll pin (1-250) out of handwheel (1-240) and remove the handwheel.
- 7.4 Unbolt and remove hex cap screws (1-170/1-160) and seal gaskets (6-40) from the bearing retainer.
- 7.5 Remove bearing retainer (1-190).
- 7.6 Carefully, pry the shaft seal (6-20) from the bearing retainer (1-190).
- 7.7 Draw out lead screw (1-230) and remove first set of thrust race (1-280) and thrust washer (1-290). Remove ring retainer (1-150) and split ring (1-140) then remove second set of thrust race, two thrust washers and another thrust race.
- 7.8 Engage the manual override by rotating the cam shaft assembly 180° (vertically 'up' position) and draw out cam shaft assembly (1-220). As you remove the cam shaft assembly, check for detent spring (1-360) and detent ball (1-270). These parts are small and will easily fall out.
- 7.9 Remove socket cap screw (1-180), manual bearing cap (1-200) and bearing cap gasket (3-120).
- 7.10 Remove yoke pin (1-40) and top two rollers (1-50).
- 7.11 Slide the split nut retainer/piston rod assembly (4) through the right side of housing (1-10).
- 7.12 Unscrew piston rod (2-170) from split nut retainer (4) and remove. On T202.0 units - the top two rollers (1-50), yoke pin (1-40) and nut pin (2-180) must be removed before piston rod will disengage from split nut retainer (4).
- 7.13 Remove guide link (1-320) from split nut retainer (4) by removing four screws (1-330).
- 7.14 Remove cam (1-210) from split nut (1-350).
- 7.15 Remove split nut (1-350) from split nut retainer (4). As you remove split nut, check for springs (1-310). These parts are small and will easily fall out.
- 7.16 Rotate the yoke to facilitate removal of the bottom two yoke rollers (1-50) from the housing.
- 7.17 The yoke (1-360) can now be removed by lifting it from the housing.

- 7.18 Remove cylinder adapter (2-40) by unscrewing socket head cap screw (2-140) and lockwasher (2-130).
- 7.19 Remove rod bushing (2-50) from cylinder adapter.
- 7.20 It is not necessary to remove the stop screws or drain plug to service the actuator.

#### 8.0 GENERAL RE-ASSEMBLY

- 8.1 Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 8.2 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.
- 8.3 After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.

#### 9.0 RE-ASSEMBLY - HOUSING GROUP

- 9.1 Apply fluid to rod seal (3-70) and install inside cylinder adapter (2-40). Lips or energizer ring of rod seal must face away from housing.
- 9.2 Apply fluid to rod bushing (2-50) and install into cylinder adapter (2-40).
- 9.3 Bolt cylinder adapter (2-40) to housing from inside, using socket head screws (2-140) and lockwashers (2-130). Insert end cap gasket (3-140) between housing and cylinder adapter.
- 9.4 If removed, install drain plug (1-80) in actuator housing (1-10).
- 9.5 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.
- 9.6 Coat the yoke o-ring seal (3-50) with lubricant and install into the housing (1-10).
- 9.7 Inside the housing (1-10) apply lubricant to the tracks and yoke bore and arrange the housing with the yoke bore nearest you.
- 9.8 Apply lubricant to the yokes lower bearing surface and install into the housing (1-10) as follows: rotate 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.

- 9.9 Apply lubricant to the slots in the upper and lower yoke arm.
- 9.10 Apply lubricant 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.
- 9.11 Piston rod (2-170) installation.
  - 9.11.1 For T202.0 Actuators - Slide piston rod (2-170), into split nut retainer (4) and line up the two thru holes. Drive nut pin (2-180) into small thru hole until end is flush with top of split nut retainer.
  - 9.11.2 For T201.5 Actuators - Screw piston rod (2-170) into threaded hole in split nut retainer (4) until hand tight.
- 9.12 Place three springs (1-310) in three holes provided in split nut (1-350) and lightly coat split nut with lubricant.
- 9.13 Arrange the split nut retainer (4) so the four small threaded holes are facing up with the piston rod to the left.
- 9.14 Install split nut (1-350) in split nut retainer (4) so the three springs (1-310) catch under the narrow cross bar. Place cam (1-210) into split nut with cam lobe facing threads.
- 9.15 Place guide link (1-320) on top of split nut retainer assembly (4) so that the indentation clears the yoke pin hole and the chamfers on the four holes are facing up.
- 9.16 Attach guide link (1-320) to split nut retainer (4) with four flat head screws (1-330). Use "Loctite 24" on flat head screws (1-330).
- 9.17 Slide the piston rod/split nut assembly through the left side of the housing (1-10) and align the yoke pin hole with the hole in the lower rollers (1-50).
- 9.18 Lubricate the yoke pin (1-40) and insert through the split nut retainer (4) and the two bottom yoke rollers (1-50).
- 9.19 Apply lubricant to all the surfaces of the two remaining yoke rollers (1-50) and install on yoke pin (1-40).

- 9.20 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. Tighten the jam nut down against the actuator housing.
- 9.21 Install gasket (3-120) and bearing cap (1-200) with socket cap screws (1-180).
- 9.22 Coat the o-ring seal (6-30) with lubricant and install on lever hub of cam shaft assembly (1-220).
- 9.23 Insert cam shaft/lever hub assembly (1-220) into housing (right side) with the handle in the up position. Slide cam shaft assembly far enough into housing until the lever assembly slides through the cam, located in the split nut retainer (4). Care must be taken at this point to not damage the cam.
- 9.24 Inset spring (1-260) and ball (1-270) into bearing cap and install cam shaft/lever assembly far enough until knob rests snugly in cavity inside bearing cap. Cam shaft/lever assembly must slip inside hole at far left side of housing.
- 9.25 Insert race (1-280), two thrust washers (1-290) and another race onto lead screw (unthreaded end). Install set far enough onto lead screw until it has slipped past the relief area. Install split rings (1-140) into relief and retain with retainer ring (1-150). Install second set of race washers, one thrust washer and another race washer onto lead screw.
- 9.26 Rotate the lever assembly to the disengage position (down position) and insert lead screw (1-230) into housing far enough until lead screw is through split nut retainer and is installed into hole on far left side of housing.
- 9.27 Install bearing retainer gasket (6-120) over lead screw shaft (1-230) and up against housing.
- 9.28 Install shaft seal (6-20) into bearing retainer
- 9.29 Install bearing retainer assembly to housing with hex cap screws (1-160) & (1-170) and seal gaskets (6-40).
- 9.30 Install handwheel (1-240) to lead screw with roll pin (1-250).
- 9.31 Moving cam shaft handle assembly (1-220) to the engage position (up); split nut should be fully engaged into lead screw.
- 9.32 Rotate the handwheel clockwise, until the actuator is in the full clockwise position.

- 9.33 Place the housing cover gasket (3-10) on the housing (1-10).
- 9.34 Coat the yoke o-ring seal (3-50) with lubricant and install in cover (1-20).
- 9.35 Apply lubricant to the yoke bore and track in the housing cover.
- 9.36 Apply lubricant to the yoke upper bearing surface and install the housing cover (1-20), being careful not to damage the gasket (3-120) or yoke o-ring seal (3-50).
- 9.37 Install the cover screws (1-90) and seal gaskets (3-100). LEAVE FINGER TIGHT - DO NO TIGHTEN.
- 9.38 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. 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.
- 9.39 Tighten the cover screws (1-90) to a torque of approximately 100 in. lbs. or 8.3 ft. lbs.
- 9.40 With yoke to the full clockwise (cw) position (as shown on the assembly drawings), position the yoke weather cover (3-130)/position indicator (1-370) on the yoke with the pointer facing toward the front and perpendicular to the piston rod (2-170) - secure with the four round head cap screws (1-380).

#### 10.0 HYDRAULIC CYLINDER RE-ASSEMBLY

- 10.1 Coat o-ring seal (3-20) and back-up ring (3-30) with hydraulic fluid and install in cylinder adapter (2-40). Back-up ring will be installed in the groove between the o-ring and the 'housing side' of the groove.
- 10.2 Coat o-ring seal (3-40) with hydraulic fluid and install on piston rod (2-170).
- 10.3 Coat piston seals (3-90) with hydraulic fluid and install on piston (2-20). Piston seal will have to be installed over piston. Back-up/wear rings will fold over piston seal.
- 10.4 Coat end of piston rod (2-170) with hydraulic fluid and slide piston (2-20) into place. On T201.5, install piston split ring (2-60) on piston rod first, then slide piston over ring onto piston rod.

- 10.5 Install hex lock nut (2-100) onto piston rod and torque to 1,000 in. lbs. or 83.3 ft. lbs. maximum.
- 10.6 If removed, install o-ring plugs (2-80) into cylinder assembly (2-10).
- 10.7 Coat cylinder adapter (2-40) and cylinder assembly cylinder bore (2-10) with hydraulic fluid. Install cylinder assembly over adapter. Install the cylinder (2-10) so the bleed ports will be facing up when the actuator is mounted on the valve.
- 10.8 Fasten cylinder assembly (2-10) with socket capscrews (2-120) and lockwasher (2-130).
- 10.9 Install lower drain plugs (2-80), if removed, in bottom of cylinder (2-10).
- 10.10 Install bleed valves (2-90), if removed.

#### 11.0 TESTING MANUAL OPERATION

- 11.1 Be sure that all operating pressure is off.
- 11.2 Move cam shaft (1-220) to desired position for operating manual mechanism  
Shaft vertical (up) - engaged  
Shaft vertical (down) - disengaged
- 11.3 Listen for 'click' in each position, detent ball is springing in top recess inside lever hub. This secures handle from shifting freely.
- 11.4 Disengage manual override (lever in down position) and turn handwheel (1-240). It should move freely with no binding.
- 11.5 Observe position indicator (1-370), there should be no actuator movement.
- 11.6 Engage manual override (lever in up position). Cycle the actuator clockwise and counter-clockwise two (2) times using the manual override. Again, note any binding of actuator. Adjust stop screws at this point, if not properly set.
- 11.7 Disengage manual override (lever in down position) before pressure testing actuator.

#### 12.0 TESTING

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

- 12.2 Cycle the actuator five (5) time at 100% of the normal operating pressure (NOP), as marked on actuator name tag. This allows the seals to seek their proper working attitude.
- 12.3 Apply 100% of the maximum operating pressure (MOP), as marked on actuator name tag, and allow the unit to stabilize.
- 12.4 If there is any notable leakage, the actuator must be disassembled and the cause of leakage must be determined and corrected. If no leakage is noted, repeat step 12.3 for the opposite side of the piston.
- 12.5 If an actuator was disassembled and repaired, the above leakage test must be performed again.

PRESSURE REQUIREMENTS & LIMITATIONS  
FOR  
T20X.X-M HYD. ACTUATORS

MODEL	NOMINAL OPERATING PRESSURE (NOP)	MAXIMUM OPERATING PRESSURE (MOP)	ALLOWABLE WORKING PRESSURE (MAWP)	MAXIMUM
T201.5-M	Customer Spec	3150		3500
T202.0-M	or N.A.	1550		2000

13.0 RETURN TO SERVICE

- 13.1 If removed, re-install any piping and accessories that were removed.
- 13.2 Replace software components of snubber (1-390).

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