

GH-BETTIS

OPERATING & MAINTENANCE INSTRUCTIONS

DISASSEMBLY & ASSEMBLY

FOR THE FOLLOWING MODEL

T3XX-M3HW-S AND T4XX-M3HW-S

DOUBLE ACTING SERIES

SUBMERGED PNEUMATIC ACTUATORS

- "S" INDICATES SUBMERGED WITH SPECIAL
POSITION INDICATOR AND YOKE COVER

PART NUMBER: 074474

REVISION: "A"

REPLACES: NEW RELEASE

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1.0 INTRODUCTION

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis T3XX-M3HW-S and T4XX-M3HW-S double acting "Scotch Yoke" submerged pneumatic 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.

**COMPLETE ACTUATOR REFURBISHMENT
REQUIRES THAT THE ACTUATOR BE
DISMOUNTED FROM THE VALVE**

2.0 BASIC TOOLS

All tools are American Standard inch. Large adjustable Wrench, two each medium screwdriver, small standard screwdriver with edges removed, strap wrench, pipe wrench, 1/4" and 3/16" pin punch, 24 oz. ball peen hammer, allen wrench set, pry bar, 1/2" drive socket set, 1-7/16" deepwell socket, 1-1/4" crowfoot, 1-5/16" box end wrench, torque wrench (up to 5000 inch pounds), putty knife, razor sharp cutting instrument and non-corrosive leak testing solution.

3.0 REFERENCE GH-BETTIS MATERIALS

- 3.1 Assembly Drawing 074511 for T3XX-M3HW-S actuators.
- 3.2 Assembly Drawing 074512 for T4XX-M3HW-S actuators.
- 3.3 General Operating & Maintenance Instruction 074650.

4.0 GENERAL

- 4.1 Numbers in parentheses, () indicate the bubble number (reference number) used on the GH-Bettis Assembly 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. cylinder to housing, and left/right stop screws.
- 4.4 When removing seals from seal grooves, use a small screwdriver with the sharp edges rounded off or use a commercial seal removing tool.
- 4.5 Use sealant (3-10) on all surfaces as indicated in note 1 of the assembly drawing.
- 4.6 Disassembly of actuator should be done in a clean area on a work bench.

4.7 **LUBRICATION REQUIREMENTS**

4.7.1 Standard and high temperature service (-20°F to +350°F) use Kronaplate 100.

4.7.2 Low temperature service (-100°F to +300°F) use Kronaplate 50.

4.7.3 For distributors of Kronaplate lubricant in your area, call 800-428-7802.

5.0 **GENERAL DISASSEMBLY**

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

5.2 Remove all plumbing and accessories from actuator.

5.3 Mark the stop screws (1-60) left and right. The setting of the stop screws (1-60) should be checked and setting recorded before stop screws are loosened or removed.

5.4 For actuators equipped with M3HW jackscrew override with handwheel option, remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10).

5.5 Remove actuator from valve and valve mounting bracket.

6.0 **PRESSURE CYLINDER DISASSEMBLY**

6.1 Loosen and thread nut seal (2-130) all the way back to the welded nut.

6.2 Loosen and remove socket cap screws (2-200) from jackscrew adapter (2-190).

6.3 Back jackscrew adapter (2-190) out until clear of hex nuts (2-90).

6.4 Remove hex nuts (2-90) from tie bars (2-60).

6.5 Remove outer end cap (2-30). The fit between the cylinder (2-10) and the outer end cap is very tight. Break the outer end cap free by tapping with a breaker bar on the lip provided on the end cap.

6.6 Pry inner end cap (2-40) away from the housing (1-10). Break the inner end cap free from the cylinder (2-10) by tapping with a breaker bar on the lip provided on the end cap.

6.7 Remove the cylinder (2-10). **Note:** When sliding the cylinder off of the piston, cant the cylinder at an angle to the piston rod, approximately 15° to 30° degrees.

6.8 Remove the ring retainer (2-80) and split ring (2-70) from the outboard side of the piston (2-20).

6.9 Remove the piston (2-20) from the piston rod (2-170). The piston will slide off of the piston rod.

6.10 Remove the rod T-seal sets (3-80) from piston (2-20).

6.11 Remove the remaining ring retainer (2-80) and the split ring (2-70) from the inboard side of the piston.

- 6.12 Remove the inner end cap (2-40) off over the tie bars (2-60) and piston rod (2-170).
- 6.13 Unscrew the tie bars (2-60) from the housing (1-10). Flats are provided on the outboard end of the tie bars for wrench placement. DO NOT use a pipe wrench on the tie bars as it will mark the bar and cause seal leakage. This step is optional as the tie bars can be left in the housing.
- 6.14 Using a 1/4 inch pin punch, drive out and remove pin from bearing on end of jackscrew assembly (2-210).
- 6.15 Remove bearing assembly from jackscrew assembly (2-210).
- 6.16 Remove jackscrew assembly (2-210) by pulling it out of outer end cap (2-30).
- 6.17 Thread jackscrew adapter (2-190) off of jackscrew assembly (2-210).
- 6.18 Thread nut seal (2-130) off of jackscrew assembly (2-210).

7.0 BLIND END CAP REMOVAL

- 7.1 Remove the socket cap screws (6-20) and the lockwashers (6-30).
- 7.2 Remove the blind end cap (6-10).
- 7.3 Remove the spiral pin (6-230) and flat washer (6-240) from the jackscrew assembly.

8.0 HOUSING DISASSEMBLY

- 8.1 Remove the rod bushing (2-50). The bushing will slide off of the end of the piston rod.
- 8.2 Unscrew and remove piston rod (2-170) from yoke pin nut (1-30). 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 mar the rod and cause seal leakage.
- 8.3 Remove snubber (1-190) from seapot fittings located on the housing cover.
- 8.4 Remove the dowel pin (1-220) from the yoke position indicator.
- 8.5 Remove the socket cap screws (1-210) and the gasket seals (3-160).
- 8.6 Remove the yoke cover (1-200).
- 8.7 Remove the socket cap screws (1-180) from the position indicator.
- 8.8 Remove the yoke position indicator (1-170) from the yoke.
- 8.9 Remove cover screws (1-90) and gasket seals (3-100).
- 8.10 Remove the housing cover (1-20). The cover will have a very tight fit. It is not necessary to remove the cover pins (1-130) from the cover.

- 8.11 Remove the top two yoke rollers (1-50) from the top of the yoke pin (1-40).
- 8.12 Remove yoke pin (1-40).
- 8.13 Remove yoke pin nut (1-30).
- 8.14 Remove bottom two yoke rollers (1-50) from the housing.
- 8.15 The yoke (1-160) can now be removed by lifting it from the housing.
- 8.16 Remove the stop screws (1-60), jam nut (1-120), thread seal (3-110) and seal washer (3-120).
- 8.17 It is not necessary to remove the drain pipe plug (1-80) to service the actuator.

9.0 GENERAL REASSEMBLY

- 9.1 Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 9.2 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.
- 9.3 After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.
- 9.4 Coat all seals with lubricant, before installing into seal grooves.
- 9.5 T-seal set installation - The T-seal is composed of one rubber seal and two split skive-cut back-up rings.
 - 9.5.1 Install the T-seal into the seal groove.
 - 9.5.2 Install a back-up ring on each side of the T-seal.
 - 9.5.3 When installing the back-up rings, do not align the skive-cuts.
 - 9.5.4 If the back-up rings are too long and the rings overlap beyond the skive-cuts, then the rings must be trimmed with a razor sharp instrument.

10.0 CENTER HOUSING GROUP RE-ASSEMBLY

- 10.1 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.
- 10.2 Inside the housing (1-10) apply lubricant to the tracks and yoke bore and arrange the housing with the yoke bore nearest you.
- 10.3 Coat yoke o-ring seal (3-50) with lubricant and install into the housing (1-10).

- 10.4 Apply lubricant to the yoke (1-160) 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 faces up. Rotate the yoke back to approximately the mid-stroke (center) position.
- 10.5 Apply lubricant to the slots in the upper and lower yoke arms.
- 10.6 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.
- 10.7 Coat the upper and lower surfaces of the yoke pin nut (1-30) with lubricant and insert into position between the yoke arms, parallel to the track in the housing. Align the yoke pin hole with the yoke rollers.
- 10.8 Lubricate the yoke pin (1-40) and insert through the yoke pin nut (1-30) and the two yoke rollers (1-50).
- 10.9 Apply lubricant to all the surfaces of the two remaining yoke rollers (1-50).
- 10.10 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. The top roller will remain above the yoke arm and will engage the cover track when cover is installed.
- 10.11 Place thread seals (3-110), seal washers (3-120), and jam nuts (1-120) on the stop screws (1-60). Install stop screws in the housing.
- 10.12 Apply lubricant to the yoke bore and the track in the housing cover (1-20).
- 10.13 Apply lubricant to the yoke upper bearing surfaces.
- 10.14 Prime and apply the sealant (3-10) to all surfaces marked with a flag number 1 on the actuator assembly drawing.
- 10.15 Slide piston rod (2-170) into the right hand side of body and screw into the yoke pin nut (1-30). (DO NOT TIGHTEN). 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.
- 10.16 Install the housing cover (1-20).
- 10.17 Install the cover screws (1-90) and seal gaskets (3-100). LEAVE FINGER TIGHT - DO NOT TIGHTEN.
- 10.18 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. 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.
- 10.19 Tighten the cover screws (1-90). Torque to 12 foot pounds.

- 10.20 Apply lubricant to the rod Bushing (2-50), install it over the piston rod and slide it up into the housing.
- 10.21 Tighten the piston rod (2-170) to a torque of approximately 150 foot pounds. Flats are provided on the outer end for wrenching purposes. DO NOT USE A PIPE WRENCH OR SIMILAR TOOL TO TIGHTEN PISTON ROD.
- 10.22 Rotate the yoke to the full clockwise (cw) position (as shown on the assembly drawings) position the yoke position indicator (1-170) on the yoke so when the pointer (1-220) is installed the pointer will be facing the front and perpendicular to the piston rod (2-170). Secure with the socket cap screws (1-180).
- 10.23 Install the position indicator seal (3-130) and the o-ring seal (3-140) into the yoke cover (1-200).
- 10.24 Using the socket cap screws (1-210) and the gasket seals (3-160) install the yoke cover (1-200) over the yoke position indicator (1-170) and onto the yoke (1-160).
- 10.25 Install a new dowel pin (1-220) into the yoke position indicator (1-170).
- 10.26 Rotate the yoke to a position that will leave a minimum of the piston rod (2-170) protruding from the actuator housing.

11.0 BLIND END CAP RE-ASSEMBLY

- 11.1 Install flat washer (6-240) and spiral pin (6-230) into the end of the jackscrew assembly (6-40).
- 11.2 Coat the o-ring seal (3-170) with lubricant and install into the blind end cap (6-10).
- 11.3 Install the blind end cap (6-10) onto the left end of the housing and retain using the socket cap screws (6-20) and lockwashers(6-30).

12.0 JACKSCREW OUTER END CAP PRE-ASSEMBLY

- 12.1 Apply a light coating of lubricant to the threads of the jackscrew assembly (2-210).
- 12.2 If removed thread on nut seal (2-130) onto jackscrew assembly (2-210).
- 12.3 Lightly lubricate the o-ring groove area on the jackscrew adapter (2-190).
- 12.4 Lightly lubricate the o-ring seal (3-180) and install into o-ring groove on jackscrew adapter (2-190).
- 12.5 Thread jackscrew adapter (2-190) onto jackscrew assembly (2-210).
- 12.6 Insert jackscrew assembly (2-210) through outer end cap (2-30) and retain with socket-head cap screws (2-200). Leave socket head cap screws (2-200) finger tight.

12.7 M3/M3HW THRUST BEARING JACKSCREW ASSEMBLY

- 12.7.1 Slide bearing assembly onto the end of jackscrew assembly (2-210) and line up hole in bearing with hole in jackscrew assembly.
- 12.7.2 Using a 1/4 inch pin punch, drive in the pin through the bearing and jackscrew assembly.
- 12.7.3 Rotate jackscrew assembly (2-210) counterclockwise until bearing is up against the outer end cap.

13.0 PRESSURE CYLINDER RE-ASSEMBLY

- 13.1 Coat the rod seal (3-70) with lubricant and install, lip first, onto the recess provided in the inner end cap (2-40).
- 13.2 Install o-ring seal (3-170) into inner end cap (2-40).
- 13.3 Slide the inner end cap (2-40) over the piston rod (2-170) and the rod bushing (2-50), protruding from the housing. Install with the large raised boss toward the housing (flat side outward). The pressure inlet port should be toward the top of the actuator.
- 13.4 Apply lubricant to one of the o-ring seals (3-60) and install on the inner end cap (2-40).
- 13.5 Apply lubricant to two sets of piston tie bar T-seal components (3-80). Refer to steps 9.4 and 9.5 for proper T-seal installation instructions.
 - 13.5.1 Install T-seals (3-80) into the piston seal groove.
 - 13.5.2 Install back-up ring on each side of T-seal.
- 13.6 Apply lubricant to the piston rod o-ring seal (3-40) and place onto the piston rod (2-170).
- 13.7 Coat the ends of the piston rod (2-170) with lubricant.
- 13.8 Install the two halves of the split ring (2-70) into the inner most groove in the piston rod and retain with one of the spiral retaining rings (2-80).
- 13.9 Slide the piston (2-20) onto the piston rod against the split ring (2-70).
- 13.10 Install the two halves of the remaining split ring (2-70) onto the piston rod and retain with the spiral retaining ring (2-80).
- 13.11 Coat the piston T-seal components (3-90) with lubricant. Refer to steps 9.4 and 9.5 for proper T-seal installation instructions.
 - 13.11.1 Install T-seal (3-90) into the piston seal groove.
 - 13.11.2 Install back-up ring on each side of T-seal.

- 13.12 Apply lubricant to the threads and end of the tie bars (2-60), end without wrench flat, and install by carefully threading tie bars through the piston (2-20). If tie bars were not removed, disregard this step and step 13.13.
- 13.13 Coat two tie bar o-ring seals (3-30) with lubricant and install onto the inboard end of the tie bars (2-60) in the o-ring grooves provided.
- 13.14 Insert the tie bars (2-60) through the inner end cap (2-40) and screw into the housing (1-10). If tie bars were not removed, then disregard this step.
- 13.15 Apply a light coat of lubricant to the bore of the cylinder (2-10).
- 13.16 Slide the end of the cylinder (2-10) over the piston (2-20) and onto the inner end cap (2-40). When sliding the cylinder over the piston seal cant cylinder 15° to 30° degrees to piston rod, make certain the back-up rings, components of the piston seal, are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and cylinder, the components could be damaged, becoming a potential source of leakage. DO NOT hammer on ends of cylinder.
- 13.17 Apply lubricant to the two remaining end cap tie bar o-ring seals (3-30) and install onto the outboard end of the tie bars (2-60) in the o-ring grooves provided.
- 13.18 Apply lubricant to the outer end cap cylinder o-ring seal (3-60) and install onto the outer end cap (2-30).
- 13.19 Install the outer end cap (2-30) onto the tie bars and into the end of the cylinder (2-10).
- 13.20 Remove socket head cap screws (2-200) from jackscrew adapter and pull out jackscrew assembly until enough clearance is available to install tie bar nuts (2-90).
- 13.21 Install the two tie bar nuts (2-90) on the tie bars (2-60), using them to draw all of the cylinder components into position. Torque alternately, in 50 ft. lbs. increments, until a final torque of 125 ft. lbs. has been achieved. It is necessary that the flats on the hex nuts (2-40) be aligned and parallel before the jackscrew adapter can be installed. It is permissible to exceed the final torque of 125 ft. lbs. to align the nut flats.
- 13.22 Rotate the jackscrew assembly counterclockwise until end of CCW travel.
- 13.23 Insert jackscrew adapter (2-190) and jackscrew assembly (2-210) back into the outer end cap.
- 13.24 Retain jackscrew adapter with socket head cap screws (2-200).
- 13.25 Tighten jam nut (2-130).

14.0 ACTUATOR TESTING

- 14.1 Leakage Test. All areas, where leakage to atmosphere may occur, are to be checked using a leak testing solution.

14.2 Procedure:

14.2.1 Cycle the actuator five (5) time at 65 psig air pressure. This will allow the seals to seek their proper working attitude.

14.2.2 Apply 65 psig air pressure to the inlet port on the outer end cap (2-30).

14.2.3 Apply a leak testing solution to the following areas:

14.2.3.1 Joint between the outer end cap (2-30) and the cylinder (2-10). Checks cylinder to end cap seal.

14.2.3.2 Around the tie bar nuts on the cylinder end. Checks tie bar to end cap seals.

14.2.3.3 Pressure inlet port in the inner end cap (2-40). Checks piston to cylinder, piston to tie bar, and piston to push rod seals.

14.3 If excessive leakage across the piston is noted, generally a bubble which breaks three seconds or less after starting to form, the unit must be disassembled and the cause of leakage must be determined and corrected.

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

14.5 OPERATIONAL (FUNCTIONAL) TEST

14.5.1 This test is used to verify proper function of the actuator and is to be done off of the valve or when the valve stem is not coupled to the actuator yoke.

14.5.2 Cycle the actuator at ten percent of the maximum operating pressure as per Chart No. 1 (see last page of this procedure). The actuator should stroke a full 90° degree travel with the stop screws properly set.

15.0 RETURN TO SERVICE

15.1 If supplied in seal/service kit, replace the software component of the snubber (1-190) and then install the snubber back into the seapot fittings in the housing cover.

15.2 Re-install actuator to valve mounting bracket and valve.

15.3 Adjust both stop screws (1-60) back to settings recorded in step 5.3 under General Disassembly.

15.4 Tighten both jam nuts (1-120) securely, while holding stop screws (1-60).

15.5 Re-install any piping and accessories that were removed.

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

CHART 1**PRESSURE REQUIREMENTS & LIMITATIONS FOR****T3XX-M3HW-S AND T4XX-M3HW-S DOUBLE ACTING SERIES ACTUATORS**

<u>ACTUATOR MODEL</u>	<u>NOMINAL OPERATING PRESSURE (NOP)</u>	<u>MAXIMUM OPERATING PRESSURE (MOP)</u>	<u>MAXIMUM ALLOWABLE HYDROSTATIC TEST PRESSURE</u>
T310	(1)	160	200
T312	(1)	115	150
T316	(1)	70	85
T320	(1)	45	50
T410	(1)	215	300
T412	(1)	150	200
T416	(1)	95	125
T420	(1)	60	80

NOTE: (1) Per customers specification or not applicable.

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