

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY & REASSEMBLY**

**FOR MODELS**

**T3XX-M3 AND T4XX-M3**

**DOUBLE ACTING SERIES**

**PNEUMATIC ACTUATORS**

PART NUMBER: 074987

REVISION: "A"

RELEASE DATE: October, 1995

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## SECTION 1.0 - INTRODUCTION

- 1.1 **GENERAL INTRODUCTION** This service procedure is offered as a guide to enable general maintenance to be performed on Bettis T3XX-M3, T3XX-M3HW, T4XX-M3, and T4XX-M3HW Series Double Acting Pneumatic Actuators (includes actuator models that have a -10 or -11 suffix at the end of the model number). When the actuator model number has "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.
- 1.2 **DEFINITIONS:**
- WARNING:** If not observed, user incurs a high risk of severe damage to actuator and/or fatal injury to personnel.
- CAUTION:** If not observed, user may incur damage to actuator and/or injury to personnel.
- NOTE:** Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.
- 1.3 **SAFETY STATEMENT:** Products supplied by Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by well trained, equipped, prepared and competent personnel.
- WARNING:** For the protection of personnel working on Bettis actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be noted to the WARNINGS, CAUTIONS and NOTES contained in this procedure.
- WARNING:** This procedure should not supersede or replace any customers plant safety or work procedures. If a conflict arises between this procedure and the customers procedures the differences should be resolved in writing between an authorized customers representative and a authorized Bettis representative.
- 1.4 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment will require the actuator to be dismantled from the valve or device it is operating.
- 1.4.1 The maximum recommended service interval for this actuator series is five years. Storage time is counted as part of the service interval.
- 1.4.2 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator. Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.
- 1.4.3 Support Items - Service/Seal Kit, razor sharp cutting instrument, commercial leak testing solution, and non-hardening thread sealant.

## 1.5 BETTIS REFERENCE MATERIALS

1.5.1 Actuator model T3XX-M3 Series Assembly Drawing part number 063718.

1.5.2 Actuator model T4XX-M3 Series Assembly Drawing part number 040864.

## 1.6 GENERAL INFORMATION

1.6.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.

1.6.2 Numbers in parenthesis, ( ), indicate the bubble number (reference number) used on the Bettis Assembly Drawing and Actuator Parts List.

1.6.3 This procedure is written using the stop screw side of housing (1-10) as a reference and this side will be considered the front side of the actuator. Housing cover (1-20) will be considered the top of the actuator.

1.6.4 Mating parts should be marked for ease of reassembly, i.e. left and right stop screws and cylinder to housing.

1.6.5 When removing seals from seal groove, use a commercial seal removing tool or use a small standard screwdriver with the sharp edges rounded off.

1.6.6 Use a non-hardening thread sealant on all pipe threads.

**CAUTION: Apply thread sealant per the manufacture's instructions.**

1.6.7 Disassembly should be done in a clean area on a work bench.

**CAUTION: Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator name tag.**

1.6.8 Before starting the general disassembly of the actuator, it is a good practice to operate the actuator with the pressure used by the customer to operate the actuator during normal operation. Notate and record any abnormal symptoms such as jerky or erratic operation.

## 1.7 LUBRICATION REQUIREMENTS

1.7.1 The actuator should be re-lubricated at the beginning of each service interval using the following recommended lubricants. Lubricants, other than those listed in steps 1.7.2, 1.7.3, and 1.7.4, should not be used without prior written approval of Bettis Product Engineering.

1.7.3 Standard Temperature Service (-20°F to +200°F) use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis Standard Temperature. Service/Seal Kit.

1.7.4 High Temperature Service (0°F to +350°F) use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis High Temperature Service/Seal Kit.

1.7.5 Low temperature service (-40°F to +150°F) use Kronaplate 50 lubricant. Kronaplate 50 is not contained in the Bettis Low Temperature Service/Seal Kit.

## SECTION 2.0 - ACTUATOR DISASSEMBLY

### 2.1 GENERAL DISASSEMBLY

2.1.1 If not already removed, disconnect all operating pressure from actuator power cylinder (2-10).

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

NOTE: Stop screws will be removed later in this procedure.

2.1.3 Mark and record location of the pneumatic inlet ports on cylinder outer end cap (2-30) and inner end cap (2-40).

2.1.4 For actuator equipped with M3HW jackscrew with handwheel option, remove hex nut, lock washer, and handwheel.

2.1.5 Remove snubber valve (1-190) from cover (1-20).

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

### 2.2 PRESSURE CYLINDER DISASSEMBLY

2.2.1 Loosen and rotate seal nut (2-130) all the way back to the jackscrew outboard nut.

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

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

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

2.2.5 Remove outer end cap (2-30). The fit between cylinder (2-10) and the outer end cap is very tight.

NOTE: Break outer end cap (2-30) free by tapping with a breaker bar on the lip provided on the outer diameter of the end cap.

**CAUTION: When separating cylinder (2-10) from outer end cap (2-30) do not damage o-ring groove.**

2.2.6 Pry inner end cap (2-40) away from housing (1-10).

NOTE: Break inner end cap (2-40) free from cylinder (2-10) by tapping with a breaker bar on the lip provided on the outer diameter of the end cap.

**CAUTION: When separating cylinder (2-10) from inner end cap (2-40) do not damage o-ring groove.**

2.2.7 Remove cylinder (2-10).

NOTE: When removing cylinder (2-10) off of piston (2-20), tilt cylinder to piston rod, approximately 15° to 30° degrees.

2.2.8 Flats are provided on the outboard end of the tie bars for wrench placement. Unscrew tie bars (2-60) from housing (1-10).

**CAUTION: Do not use a pipe wrench on the tie bars as it may mark the bars and cause seal leakage.**

2.2.9 Pull tie bars (2-60) out of inner end cap (2-40) far enough to expose o-rings (3-30). Remove o-rings (3-30) from inboard end of tie bars.

2.2.10 Remove tie bars (2-60) by pulling them out of piston (2-20).

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

NOTE: Keep split rings (2-70) in matched sets.

2.2.12 Remove piston (2-20) from piston rod (2-170).

2.2.13 Remove o-ring seal (3-40) from piston rod (2-170).

2.2.14 Remove inboard split ring retainer (2-80) and split ring (2-70) from piston rod (2-170).

NOTE: Keep split rings (2-70) in matched sets.

2.2.15 Remove inner end cap (2-40) from piston rod (2-170).

### 2.3 BLIND END CAP REMOVAL

2.3.1 Loosen and rotate seal nut (6-60) all the way back to jackscrew assembly outboard hex nut.

2.3.2 Remove two socket cap screws (6-20) with seal gaskets (6-30).

2.3.3 Remove blind end cap (6-10), with jackscrew assembly (6-40), from housing (1-10).

### 2.4 HOUSING DISASSEMBLY

2.4.1 Unscrew piston rod (2-170) from yoke pin nut (1-30) and remove, including rod bushing (2-50).

NOTE: Removal of piston rod may require extra amount of torque for break out due to the use of Loctite - 242 during assembly.

**CAUTION: Do not use a pipe wrench on the piston rod as it may mark the rod and cause seal leakage. Flats are provided on the outboard end of the piston rod for wrench placement.**

2.4.2 Remove rod bushing (2-50) from piston rod (2-170).

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

2.4.4 Remove cover (1-20).

NOTE: The cover will have a very tight fit. It is not necessary to remove cover pins (1-130) from cover (1-20).

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

2.4.6 Remove yoke pin (1-40) from the yoke and yoke pin nut.

2.4.7 Remove yoke pin nut (1-30).

2.4.8 Remove lower two yoke rollers (1-50) from housing (1-10).

2.4.9 Remove yoke (1-160) from housing (1-10).

**CAUTION:** The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of torque output. This can only be accomplished by removing the yoke from the housing which requires removing the actuator from the valve.

2.4.10 Remove stop screws (1-60), jam nuts (1-120), and seal gaskets (3-110).

2.4.11 It is not necessary to remove pipe plug (1-80) or yoke nut screw (6-50) to service the actuator.

## 2.5 M3 JACKSCREW DISASSEMBLY

2.5.1 Jackscrew assembly (2-210) disassembly.

2.5.1.1 Using a pin punch, drive out and remove pin from the jackscrew assembly and slotted thrust nut.

2.5.1.2 Rotate the slotted thrust nut against the Timken bearing until the bearing retainer and the retaining ring are forced off of the end of jackscrew assembly (2-210). Then continue to rotate the slotted thrust nut until the bearing and the nut are removed from jackscrew assembly (2-210).

2.5.1.3 Remove jackscrew assembly (2-210) from outer end cap (2-30).

NOTE: Steps 2.5.1.4 and 2.5.1.5 does not need to be done unless jackscrew assembly (2-210), M3 adapter (2-190) or seal nut (2-130) is being replaced.

2.5.1.4 Rotate M3 adapter (2-190) off of jackscrew assembly (2-210).

2.5.1.5 Rotate nut seal (2-130) off of jackscrew assembly (2-210).

## 2.5.2 Jackscrew assembly (6-40) disassembly.

NOTE: Steps 2.5.2.1 through 2.5.2.4 does not need to be done unless jackscrew assembly (6-40) or seal nut (6-60) are being replaced.

2.5.2.1 Using a pin punch, drive out and remove pin from jackscrew assembly (6-40) and the slotted thrust nut.

2.5.2.2 Rotate slotted nut until it is removed from jackscrew assembly (6-40).

2.5.2.3 Rotate nut seal (6-60) off of jackscrew assembly (6-40).

2.5.2.4 Hold blind end cap (6-10) in place, rotate jackscrew assembly (6-40) until it is removed from blind end cap (6-10).

## SECTION 3.0 - ACTUATOR REASSEMBLY

### 3.1 GENERAL REASSEMBLY

**CAUTION:** Only new seals, that are still within the seals expectant shelf life, should be install back into actuator being refurbished.

3.1.1 Remove and discard all old seals and gaskets.

3.1.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

3.1.3 All parts should be thoroughly inspected for excessive wear, stress cracking, galling and pitting. Attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding or rotating motion. Sealing surfaces of the cylinder, tie bars and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

**CAUTION:** Actuator parts that reflect any of the above listed characteristics must be replaced with new parts.

3.1.4 **INSTALLATION LUBRICATION INSTRUCTIONS:** Use the correct lubrication as defined in section 1.7.

3.1.4.1 Before installation coat all moving parts with lubricant.

3.1.4.2 Coat all seals with lubricant, before installing into grooves, also both sides of gaskets.

3.1.5 T-seal set installation - The T-seal is composed of one rubber seal and two split skive-cut back-up rings.

3.1.5.1 Install the T-seal into the seal grooves.

3.1.5.2 Install a back-up ring on each side of the T-seal.

3.1.5.3 When installing the back-up rings, do not align the skive-cuts.

3.1.5.4 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.

### **3.2 M3 JACKSCREWS PRE-ASSEMBLY**

3.2.1 Jackscrew assembly (2-210) pre-assembly.

3.2.1.1 Apply a light coating of lubricant to the threads of jackscrew assembly (2-210).

3.2.1.2 If removed, screw nut seal (2-130) onto jackscrew assembly (2-210).

3.2.1.3 Lubricate the o-ring groove area on jackscrew adapter (2-190).

3.2.1.4 Lubricate o-ring seal (100) and install into o-ring groove on jackscrew adapter (2-190).

3.2.1.5 Screw jackscrew adapter (2-190) onto jackscrew assembly (2-210).

3.2.1.6 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.

3.2.1.7 Install slotted thrust nut on to turned-down end of jackscrew stud with slotted face toward the outer end cap (2-30). Rotate the nut past the pin hole in the jackscrew stud.

3.2.1.8 Assemble the bearing onto the bearing retainer with the inner race facing the retainer flange. Insert the wire "C" ring into the bearing side of the retainer assembly until the "C" ring opens up into its groove.

3.2.1.9 Press the retainer assembly onto the turned-down end of the stud, using a wood block and a hammer. NOTE: The wire "C" ring needs to be forced onto the neck of the jackscrew stud end.

3.2.1.10 Begin to unscrew the thrust nut. Continue till the nut mates with face of bearing. Then back off until nut slot lines up with pin hole. Insert spiral pin through the jackscrew stud retaining the slotted nut in its position.

3.2.1.11 While holding outer end cap (2-30) in position rotate jackscrew assembly (2-210) counter clockwise until bearing is up against outer end cap (2-30).

3.2.2 Jackscrew assembly (6-40) pre-assembly.

NOTE: Steps 3.2.2.1 through 3.2.2.4 does not need to be done if jackscrew assembly (6-40) was not removed from blind end cap (6-10).

3.2.2.1 Apply a light coating of lubricant to threads of jackscrew assembly (6-40).

3.2.2.2 Screw blind end cap (6-10) onto jackscrew assembly (6-40).

3.2.2.3 If removed, screw nut seal (6-60) onto jackscrew assembly (6-40).

3.2.2.4 Install slotted thrust nut on to outboard end of jackscrew assembly (6-40) with slotted face toward inboard end of jackscrew stud. Rotate the nut past the pin hole in the jack screw stud. Then back off until nut slot lines up with pin hole.

3.2.2.5 Insert spiral pin through the jackscrew stud retaining the slotted nut in its position.

### **3.3 HOUSING REASSEMBLY**

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

3.3.2 If removed, install grease fitting (1-70) in actuator housing (1-10) and cover (1-20). The fitting in the housing is located on the bottom of the housing, next to the lower yoke bearing area. The fitting in the cover is located on top of the cover in the upper yoke bearing area.

NOTE: Grease fittings are optional as of March, 1983.

3.3.3 Inside housing (1-10) apply lubricant to the tracks and yoke bore.

3.3.4 Coat one o-ring seal (3-50) with lubricant and install into seal groove located in bottom area of housing (1-10).

3.3.5 Apply lubricant to the slots in the upper/lower yoke arms and the lower bearing surface.

3.3.6 Install yoke (1-160) into housing (1-10) as follows: Rotate yoke arms to approximately a 45° degree position in either direction and lower into the housing. Rotate the yoke arms back to approximately mid-stroke (center) position.

NOTE: The yoke hub with tapped holes faces up.

3.3.7 Apply lubricant to the surfaces of all four yoke rollers (1-50).

3.3.8 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.

3.3.9 Place a second yoke roller (1-50) on top of the first yoke roller in the slot in the lower yoke arm and align the holes in the yoke rollers.

3.3.10 Coat the upper and lower surfaces of 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.

3.3.11 Lubricate yoke pin (1-40) and insert through yoke pin nut (1-30) and two yoke rollers (1-50).

3.3.12 Install third yoke roller (1-50) over yoke pin (1-40) in the slot in the upper yoke arm and now install the fourth and last remaining yoke roller (1-50) on top of the yoke roller just installed in the upper yoke arm slot.

NOTE: The top yoke roller (1-50) will remain partially above the upper yoke arm and will engage the track, located in cover (1-20) , when cover (1-20) is installed.

3.3.13 If removed, install yoke nut screw (6-50) into yoke pin nut (1-30).

**CAUTION:** If cycle speed of the actuator is two seconds or faster, apply Loctite 242 to external threads of piston rod (2-170). NOTE: Loctite cure time is 10 - 30 minutes.

3.3.14 Apply lubricant to piston rod (2-170) and rod bushing (2-50). Install rod bushing over the piston rod.

NOTE: A new rod bushing (2-50) is provided in the standard Bettis Service/Seal Kit.

3.3.15 Install piston rod (2-170) with rod bushing (2-50) into right side of housing. Slide rod bushing along the piston rod and into housing counter bore. Screw piston rod into yoke pin nut (1-30).

NOTE: Do not torque tighten piston rod until the housing cover is installed later in this procedure.

3.3.16 Place jam nuts (1-120) and new gaskets (3-110) on stop screws (1-60).

3.3.17 Install the pre-assembled stop screws (1-60) into housing (1-10).

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

3.3.19 Coat remaining o-ring seal (3-50) with lubricant and install into cover (1-20).

3.3.20 Apply lubricant to the yoke bore and track in housing cover (1-20).

3.3.21 Apply lubricant to upper bearing surface of yoke (1-160).

3.3.22 Install new seal gaskets (3-100) onto hex cap screws (1-90).

3.3.23 Install cover (1-20), being careful not to damage gasket (3-20) or o-ring seal (3-50).

3.3.24 Install hex cap screws (1-90) with new seal gaskets (3-100).

NOTE: Leave hex cap screws (1-90) loose, do not tighten.

3.3.25 Do this step only if you have pulled cover pins (1-130) or if you are replacing the cover pins.

NOTE: The cover pins (1-130) are grooved at one end, tapering to a smooth diameter at the other end.

3.3.25.1 Install four cover pins smooth end first into housing cover (1-20).

3.3.25.2 Drive four cover pins (1-130) through cover (1-20) and into housing (1-10) until each pin is flush with the cover.

3.3.26 Torque tighten cover screws (1-90) as follows:

3.3.26.1 Torque tighten T3 hex cap screws (1-90) to a torque of 12  $\pm$ 5% foot pounds lubricated.

3.3.26.2 Torque tighten T4 hex cap screws (1-90) to a torque of 18  $\pm$ 5% foot pounds lubricated.

3.3.27 Torque tighten piston rod (2-170) to a torque of 150  $\pm$ 7 foot pounds lubricated.

NOTE: Flats are provided on the outer end for wrenching purposes.

**CAUTION: Do not use a pipe wrench or similar tool to tighten piston rod.**

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

#### **3.4 BLIND END CAP REASSEMBLY**

NOTE: If required pre-assemble jackscrew into blind end cap per 3.2.2, then proceed with steps 3.4.1 through 3.4.5.

3.4.1 Apply a light coating of lubricant to left end of housing (1-10).

3.4.2 Install new seal gaskets (6-30) onto hex cap screws (6-20).

3.4.3 Coat one end cap gasket (3-10) with lubricant on both sides and install onto lubricated housing end.

3.4.4 Install blind end cap (6-10), with jackscrew assembly (6-40), onto left end of housing and retain using hex cap screws (6-20) with seal gaskets (6-30).

3.4.5 Torque tighten hex cap screws (6-20) to 126 foot pounds lubricated.

#### **3.5 PRESSURE CYLINDER RE-ASSEMBLY**

3.5.1 Apply lubricant to rod seal (3-70) and install, lip first, into the recess provided in inner end cap (2-40).

**CAUTION: Install rod seal (3-70) with the energizer ring facing outboard side (away from housing).**

3.5.2 Apply lubricant to end cap gasket (3-10) and install over piston rod (2-170) and rod bushing (2-50).

3.5.3 Install inner end cap (2-40) over piston rod (2-170) and rod bushing (2-50).

NOTE: Install inner end cap with large raised boss toward the housing (flat side outward). End cap pressure inlet port should be toward the top of actuator.

3.5.4 Apply lubricant to o-ring seal (3-60) and install into outer diameter seal groove on inner end cap (2-40).

- 3.5.5 Apply lubricant to two sets of piston tie bar T-seal components (3-80) and install into piston internal seal groove. Refer to step 3.1.5 for proper T-seal installation instructions.
- 3.5.6 Apply lubricant to outboard end of piston rod (2-170).
- 3.5.7 Install matched set of split rings (2-70) into inner most groove on piston rod and retain with retaining ring (2-80).
- 3.5.8 Apply lubricant to o-ring seal (3-40) and place onto piston rod (2-170).
- 3.5.9 Install piston (2-20) onto piston rod (2-170) and up against split rings (2-70).
- 3.5.10 Install matched set of split rings (2-70) onto piston rod and retain with retaining ring (2-80).
- 3.5.11 Apply lubricant to threads and end of tie bars (2-60), end without wrench flat.
- 3.5.12 Install two tie bars (2-60) by carefully inserting through piston (2-20).
- NOTE: Install tie bars far enough through piston to expose inboard o-ring seal groove.
- 3.5.13 Apply lubricant to two o-ring seals (3-30) and install into exposed seal groove on inboard end of tie bars.
- 3.5.14 Insert tie bars through inner end cap (2-40) and screw into housing (1-10).
- CAUTION: Tighten tie bars (2-60) until the threads bottom out, then back out each tie bar one-half (1/2) turn.**
- 3.5.15 Apply a light coat of lubricant to the bore of the cylinder (2-10).
- 3.5.16 Apply lubricant to piston T-seal components (3-90) and install into piston internal seal groove. Refer to step 3.1.5 for proper T-seal installation instructions.
- CAUTION: If needed when installing cylinder (2-10), hammer on end of cylinder only with a non metallic object.**
- CAUTION: Make certain back-up rings, components of piston T-seal (3-90), are seated into piston external seal groove. Should back-up rings or seal member be pinched between the piston and cylinder, the component could be damaged, becoming a potential source of leakage.**
- 3.5.17 Install end of cylinder (2-10) over piston (2-20) and onto inner end cap (2-40).
- NOTE: When installing cylinder over piston seal (3-90), tilt cylinder 15° to 30° degrees to piston rod (2-170).
- 3.5.18 Apply lubricant to two o-ring seals (3-30) and install into seal groove on outboard end of tie bars (2-60).
- 3.5.19 If not already done, pre-assemble jackscrew into outer end cap per 3.2.1, then proceed with steps 3.5.20 through 3.5.28.

- 3.5.20 Apply lubricant to o-ring seal (3-60) and install into outer diameter seal groove on outer end cap (2-30).
- 3.5.21 Install outer end cap (2-30) onto tie bars (2-60) and into open end of cylinder (2-10).
- 3.5.22 Remove socket head cap screws (2-200) from jackscrew adapter and pull out jackscrew assembly (2-210) until enough clearance is available to install hex nuts (2-90).
- 3.5.23 Install two hex nuts (2-90) onto tie bars (2-60), using them to draw all of the cylinder components into position.
- 3.5.24 Torque tighten hex nuts (2-90) alternately until a final torque of  $65 \pm 7$  foot pounds lubricated has been achieved. It is necessary that the flats on hex nuts (2-90) be aligned and parallel before jackscrew adapter (2-190) can be installed.

**CAUTION:** While the hex nuts are being tightened, do not allow tie bars to rotate.

- 3.5.25 Rotate jackscrew assembly counter clockwise until end of CCW travel.
- 3.5.26 Install jackscrew adapter (2-190) with jackscrew assembly (2-210) back into position on outer end cap (2-30).
- 3.5.27 Retain jackscrew adapter (2-190) with socket head cap screws (2-200).
- 3.5.28 Tighten seal nut (2-130).
- 3.5.29 Position Indicator Installation:
  - 3.5.29.1 Rotate the yoke to full clockwise (CW) position.
  - 3.5.29.2 Position yoke weather cover (3-130) /position indicator (1-170) on the yoke with pointer facing the front and perpendicular to piston rod (2-170).
  - 3.5.29.3 Install socket cap screws (1-180) into position indicator (1-170).
  - 3.5.29.4 Tighten socket cap screws (1-180).

### 3.6 ACTUATOR TESTING

- 3.6.1 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. These areas will have zero leakage unless other instructions are given with the area being tested.

**WARNING:** Pressure is not to exceed the maximum operating pressure rating listed on the name tag.

- 3.6.2 All leak testing will use 65 psig pressure.

**CAUTION:** Test the actuator using a properly adjusted self relieving regulator, with gauge, to apply pressure to the actuator.

- 3.6.3 Before testing for leaks, alternately apply and release 65 psi pressure to each side of the piston to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 3.6.4 Apply 65 psig pressure to the pressure port in the outer end cap (2-30).
- 3.6.5 Apply a leak testing solution to the following areas:
  - 3.6.5.1 Joint between outer end cap (2-30) and cylinder (2-10). Checks cylinder to end cap o-ring seal.
  - 3.6.5.2 Around tie bar nuts (2-90) on the cylinder outer end cap (2-30). Checks tie bars to outer end cap o-ring seals.
  - 3.6.5.3 Around jackscrew adapter (2-190) and seal nut (2-130) on the cylinder outer end cap (2-30). Checks jackscrew adapter to outer end cap o-ring seal.
  - 3.6.5.4 Form a leak testing solution bubble over the pressure inlet port in inner end cap (2-40). If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected. Checks piston to cylinder, piston to tie bar, and piston to piston rod seals.
  - 3.6.5.5 Remove pressure from pressure inlet port in outer end cap (2-30).
- 3.6.6 Apply 65 psig pressure to the pressure port in inner end cap (2-40).
- 3.6.7 Apply a leak testing solution to the following areas:
  - 3.6.7.1 Joint between inner end cap (2-40) and cylinder (2-10). Checks cylinder to inner end cap o-ring seal.
  - 3.6.7.2 Around the joint of inner end cap (2-40) and housing (1-10). Checks tie bars to inner end cap o-ring seals and the inner end cap to housing gasket seal (3-10).
  - 3.6.7.3 Form a leak testing solution bubble over the snubber valve port hole in cover (1-20). If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected. Checks the rod seal and tie bars to end cap o-ring seals.
  - 3.6.7.4 Form a leak testing solution bubble over the pressure inlet port in outer end cap (2-30). If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected. Checks piston to cylinder, piston to tie bar, and piston to piston rod seals.
  - 3.6.7.5 Remove pressure from pressure inlet port in inner end cap (2-40).

### **3.7 RETURN TO SERVICE**

- 3.7.1 Replace software components of snubber valve (1-190).
- 3.7.2 Install snubber valve (1-190) into port in cover (1-20).

- 3.7.3 Adjust both stop screws (1-60) back to settings recorded in section 2.1 under General Disassembly.
- 3.7.4 Tighten both jam nuts (1-120) securely, while holding stop screws (1-60).
- 3.7.5 For actuators equipped with a jackscrew and require an optional handwheel, M3HW, install the handwheel using the following procedure:
  - 3.7.5.1 Place handwheel onto jackscrew assembly and over the nut (the handwheel hub has a cast hexagon hole that fits over the nut).
  - 3.7.5.2 Place lock washer onto jackscrew up against handwheel hub.
  - 3.7.5.3 Place hex nut onto jackscrew and screw up against lock washer, tighten hex nut while holding jackscrew in place.
- 3.7.6 After the actuator is installed on the valve all accessories should be hooked up, leak tested, and then tested for proper operation. Replace any accessory that is defective.

## SECTION 4.0 - ACTUATOR SUPPORT INFORMATION

### 4.1 TOOL STYLE AND WRENCH SIZES

4.1.1 Tools - All tools are American Standard inch. Two each medium standard screwdrivers, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and a torque wrench (up to 5,000 inch pounds). For recommended tool list refer to following table.

| ITEM NO.                                       | QTY | WRENCH SIZE | DESCRIPTION       | RECOMMEND WRENCH STYLE |
|--|-----|-------------|-------------------|------------------------|
| 1-60   | 2   | 1/2"        | Hex Cap Screw     | Open End or Adjustable |
| 1-80   | 1   | 9/16"       | Pipe Plug         | Open End or Adjustable |
| 1-90   | 8   | 1/2"        | T3 Hex Cap Screws | Socket                 |
| 1-90   | 8   | 9/16"       | T4 Hex Cap Screws | Socket                 |
| 1-120  | 2   | 1-5/16"     | Hex Jam Nut       | Box End Wrench         |
| 1-180  | 4   | 3/16"       | Socket Cap Screws | Allen                  |
| 1-190  | 1   | 7/8"        | Snubber Valve     | Deep Socket            |
| 2-60   | 2   | 1/2"        | Tie Bar Flats     | Open End or Adjustable |
| 2-90   | 2   | 1-7/16"     | Heavy Hex Nuts    | Deep Socket            |
| 2-130  | 1   | 1-11/16"    | M3 Seal Nut       | Open End or Adjustable |
| 2-170  | 1   | 1-1/4"      | Piston Rod Flat   | Crows Foot (1)         |
| 2-200  | 2   | 3/8"        | Socket Cap Screw  | Allen                  |
| 2-210  | 1   | 1-13/16"    | Slotted Nut       | Open End or Adjustable |
| 6-20   | 2   | 3/4"        | Socket Cap Screw  | Socket                 |
| 6-40   | 1   | 1-13/16"    | Slotted Nut       | Open End or Adjustable |
| 6-50   | 1   | 1-1/2"      | Yoke Nut Screw    | Socket or Open End     |
| 6-60   | 1   | 1-11/16"    | M3 Seal Nut       | Open End or Adjustable |
| <b>(1)</b> No alternate style tool recommended |     |             |                   |                        |

#### 4.2 ACTUATOR WEIGHTS

| ACTUATOR MODEL (1)   | APPROXIMATE WEIGHT (POUNDS) (2) | ACTUATOR MODEL (1) | APPROXIMATE WEIGHT (POUNDS) (2) |
|--|---------------------------------|--------------------|---------------------------------|
| T310-M3  | 197                             | T412-M3            | 282                             |
| T312-M3  | 231                             | T416-M3            | 327                             |
| T316-M3  | 276                             | T420-M3            | 393                             |
| T310-M3HW  | 211                             | T410-M3HW          | 261                             |
| T312-M3HW  | 245                             | T412-M3HW          | 296                             |
| T316-M3HW  | 290                             | T416-M3HW          | 341                             |
| T410-M3  | 247                             | T420-M3HW          | 407                             |
| (1) Includes actuator models that have a -10 or -11 suffix at the end of the model number.                       |                                 |                    |                                 |
| (2) Weights listed for each model are for a bare actuator without valve mounting bracket or mounted accessories. |                                 |                    |                                 |

| ECN      | DATE          | REV | BY *                    | DATE            |
|----------|---------------|-----|-------------------------|-----------------|
| Released | October, 1995 | A   | COMPILED Bill Cornelius | 10 October 1995 |
|          |               |     | CHECKED Bill Cornelius  | 10 October 1995 |
|          |               |     | APPROVED Robert McEver  | 10 October 1995 |

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