

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR MODELS

T8XX-SR

SPRING RETURN SERIES

PNEUMATIC ACTUATORS

PART NUMBER: 074901

REVISION: "A"

RELEASE DATE: September, 1994

REPLACES: Service-021

1.0. **INTRODUCTION**

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis T8XX-SR, T8XXA-SR, T8XXB-SR and current model spring return series pneumatic actuators. 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 **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 a well trained, equipped, prepared and competent technician.

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.

1.3 **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.

1.4 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is operating.

1.5 The maximum recommended service interval for this actuator series is five years. Storage time is counted as part of the service interval.

1.6 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator, allowing the spring to stroke and rotate the actuator to its fail position. 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.

2.0 **SUPPORT ITEMS AND TOOLS**

2.1 Support Items - Service/Seal Kit, razor sharp cutting instrument, seal removal tool, commercial leak testing solution, two each 1-8 UNC hex nuts and non-hardening thread sealant.

- 2.2 Tools - All tools are American Standard inch. Large adjustable wrench, two (2) large screwdrivers, allen wrench set, set of open/box-end wrenches, rubber or leather mallet, torque wrench (up to 5,000 in.lbs.), breaker bar, 1/4" drift punch and a 1/2" drive socket set. For recommended tool list refer to Chart 2 on page 15.

3.0 REFERENCE BETTIS MATERIALS

- 3.1 Assembly Drawing part number 036566 for fail clockwise (CW) actuators.
- 3.2 Assembly Drawing part number 048024 for fail counter clockwise (CCW) actuators.
- 3.3 Exploded Detail Drawing part number 063419 for T8XX-SRX(CW), this drawing is provided in the Bettis Service/Seal Kit.

4.0 GENERAL DETAILS

- 4.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- 4.2 Numbers in parentheses, () indicate the bubble number (reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawing, and Actuator Parts Lists.
- 4.3 This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front of the actuator. The housing cover (1-20) will be the top of the actuator.
- 4.4 Refer to Chart 1 on page 15 of this instruction for approximate actuator weights.
- 4.5 To ensure correct re-assembly; that is, with spring on same end of housing as was, mark or tag right or left and mark mating surfaces.
- 4.6 When removing seals from seal grooves, use a commercial seal removing tool or a small screwdriver with sharp corners rounded off.
- 4.7 Use a non-hardening thread sealant on all pipe threads.

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

- 4.8 Disassembly of actuator should be done in a clean area on a work bench.
- 4.9 LUBRICATION REQUIREMENTS: For use in all areas of the actuator. Lubricants, other than those listed in steps 4.9.1 and 4.9.2, should not be used without prior written approval of Bettis Product Engineering.
- 4.9.1 Standard and high temperature service (-20° to +350°) use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis Service/Seal Kit.
- 4.9.2 Low temperature service (-50° to +150°) use Kronaplate 50 lubricant. This lubricant is not contained in the Low Temperature Service/Seal Kit.

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

- 4.10 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.

5.0 GENERAL DISASSEMBLY

- 5.1 If not already removed, disconnect all operating pressure from actuator power cylinder (2-10), allowing the spring to stroke. The spring will rotate the yoke to the fail position.
- 5.2 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.
- 5.3 Remove breather (4-30) from inner end cap (2-40).
- 5.4 Unscrew and remove snubber valve (1-190) from housing cover (1-20).
- 5.5 Remove socket cap screws (1-180) from position indicator (1-170), yoke weather cover (3-130), and remove position indicator/yoke weather cover.
- 5.6 Mark and record location of the pneumatic inlet ports on cylinder outer end cap (2-30) and inner end cap (2-40).

6.0 SPRING CARTRIDGE REMOVAL

WARNING: Under no circumstances should spring cartridge be cut open as the spring is pre-loaded with end caps and cylinder welded around the loaded spring.

CAUTION: Due to weight and size of spring cartridge, support equipment will be required when removing spring cartridge from actuator housing.

WARNING: When spring cartridge is installed on the actuator the spring is under compression. Do not remove spring cartridge until actuator has "pre-load" removed.

- 6.1 Remove spring cartridge "pre-load" as follows: Apply sufficient operating pressure to the cylinder pressure inlet port, located in outer end cap (2-30), to move the actuator yoke (1-160) off of stop screw (1-60).
- 6.2 Locate stop screw (1-60) that is on the opposite side of the housing from spring cartridge (4-10). Loosen jam nut (1-120).
- 6.3 Unscrew stop screw (1-60) until it runs into inner end cap (2-40).
- 6.4 Remove pressure from pressure inlet port and allow spring to return actuator to the spring extended position (fail position).
- 6.5 Remove hex nuts (10-200) from back side of spring brace (10-240). The remaining hex nuts (10-200) may be left on brace rods (4-80). Brace rods (4-80) will not be removed from spring cartridge (4-10).

NOTE: If the actuator being disassembled is a early model T8XX-SR and does not have brace rods (4-80) refer to section 15 step 15.3 for further information.

- 6.6 Remove socket cap screw (4-60), lockwasher (4-50), and nut retainer (4-40) from between large hex nuts on outboard end of spring cartridge (4-10).

WARNING: Do not proceed to next step until spring cartridge "PRE-LOAD" has been removed.

- 6.7 Alternately loosen two large hex nuts on outboard end of spring cartridge (4-10). NOTE: The spring cartridge tie bar nuts are welded to the tie bars that extend through spring cartridge and screw into spacer (10-250).

- 6.8 Unscrew tie bars until spring cartridge is free from spacer (10-250). Care should be taken so that tie bars are not pulled back into the spring cartridge. Place spring cartridge (4-10) to one side.

NOTE: To keep from inadvertently pulling tie bars back into spring cartridge use two each one inch -8 UNC hex nuts and screw them onto the spring cartridge tie bars.

- 6.9 The removal of ferry cap screws (10-220) and spacer plate (10-250) is not required to service actuator.

7.0 PRESSURE CYLINDER DISASSEMBLY

- 7.1 Remove socket cap screw (2-120), washer (2-110) and nut retainer (2-100) from outer end cap (2-30).

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

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

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

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

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

- 7.5 Remove cylinder (2-10). NOTE: When sliding cylinder off of piston, tilt cylinder 15° to 30° degrees to the piston rod.

- 7.6 Unscrew tie bars (2-60) from spacer (10-250). NOTE: Flats are provided on the outboard end of the tie bars for wrench placement. Remove tie bars (2-60) by pulling them out through housing (1-10), inner end cap (2-40) and piston (2-20).

- 7.7 Remove split ring retainer (2-80) and split rings (2-70) from outboard side of piston (2-20). NOTE: Disregard this step and step 7.10 if the actuator has the piston retained in place with a hex nut and refer to section 15 step 15.1 for actuators not equipped with split rings and split ring retainers.

CAUTION: Keep the split rings in matched sets.

- 7.8 Remove piston (2-20) from piston rod (2-170). Refer to step 7.12 for disassembling tie bar bushings (2-180) from fabricated pistons with outer diameters of 24" inches and larger.
- 7.9 Remove o-ring seal (3-40) from piston rod (2-170).
- 7.10 Remove split ring retainer (2-80) and split rings (2-70) from inboard side of the piston.

CAUTION: Keep the split rings in matched sets.

- 7.11 Remove inner end cap (2-40) off piston rod (2-170).
- 7.12 Disassembly of pistons with outer diameters of 24" inches and larger. Refer to assembly drawing detail "A".
 - 7.12.1 Remove retaining rings (2-190) from the piston.
 - 7.12.2 Remove piston tie bar bushings (2-180) from the piston.

8.0 HOUSING GROUP DISASSEMBLY

- 8.1 Unscrew push rod (4-20) from yoke pin nut (1-30) and remove from housing.
- 8.2 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. NOTE: Removal of piston rod may require extra amount of torque for break out due to the use of Loctite - 242 during assembly. A new rod bushing is provided in the standard Bettis Service/Seal Kit.

CAUTION: Do not use a pipe wrench on the piston rod as it may mark the rod and cause seal leakage.

- 8.3 Remove rod bushing (2-50) from the housing or the piston rod.
- 8.4 Remove four cover/spring brace hex cap screws (10-210) with gasket seals (3-100).
- 8.5 Remove hex cap screws (1-90) with gasket seals (3-100).
- 8.6 Remove housing cover (1-20). Spring brace (10-240), cover (1-20), and cover pins (10-230) will come off together as one assembly. NOTE: The cover will have a very tight fit due to cover pins (10-230) and (1-130). It is not necessary to remove cover pins (10-230), (1-130) or separate cover (1-20) from spring brace (10-240).

NOTE: If the actuator being disassembled is a early model T8XX-SR and does not have brace rods (4-80) refer to section 15 step 15.3 for further information.

- 8.7 Remove top two yoke rollers (1-50) and two roller spacer (1-110) from top of yoke pin (1-40).

NOTE: Early model actuators did not use the roller spacer. When replacing rollers refer to section 15 step 15.2 and it's **CAUTION**.

- 8.8 Remove yoke pin (1-40).
- 8.9 Remove yoke pin nut (1-30).

- 8.10 Remove lower two yoke rollers (1-50) and two roller spacers (1-110) from the bottom of yoke and housing.

CAUTION: The yoke/housing bearing 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.

NOTE: Step 8.11 is done if housing cover is equipped with a upper yoke bushing (1-140). The addition of upper yoke bushing (1-140) was implemented during the year 1989. All replacement housing covers will be machined to accept a upper yoke bushing (1-140) and will automatically come fitted with a upper yoke bushing (1-140).

- 8.11 Remove yoke bushing (1-140) from the top of yoke (1-160).

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

NOTE: Step 8.13 is done if housing is equipped with a lower yoke bushing (1-140). The addition of lower yoke bushing (1-140) was implemented during the year 1989. All replacement housings will be machined to accept a lower yoke bushing (1-140) and will automatically come fitted with a lower yoke bushing (1-140).

- 8.13 Remove yoke bushing (1-140) from the lower housing area.

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

- 8.15 It is not necessary to remove pipe plug (1-80), grease fittings (1-70), ferry cap screws (10-220), or spacer plate (10-250), to service the actuator. NOTE: Grease fittings are optional as of March, 1983.

9.0 GENERAL RE-ASSEMBLY

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

- 9.1 Remove and discard all seals and gaskets.

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

- 9.3 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.

- 9.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of 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 If removed install drain plug (1-80) in actuator housing (1-10).
- 10.2 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.
- 10.3 Inside housing (1-10) apply lubricant to the track and yoke bore.
- 10.4 Coat one of the o-ring seal (3-50) with lubricant and install into housing (1-10).

NOTE: Step 10.5 is done if housing is equipped with a lower yoke bushing (1-140). The addition of lower yoke bushing (1-140) was implemented during the year 1989. All replacement housings will be machined to accept a lower yoke bushing (1-140) and will automatically come fitted with a lower yoke bushing (1-140).

- 10.5 Coat lower yoke bushing (1-140) with lubricant and install into lower area of housing (1-10)
- 10.6 Apply lubricant to the slots in the upper/lower yoke arms and the lower bearing surface.
- 10.7 Install yoke (1-160) into housing (1-10) as follows: Arrange the yoke arms to approximately a 45° degree position in either direction and lower into the housing. NOTE: The yoke hub with tapped holes faces up. Rotate the yoke back to approximately mid-stroke (center) position.
- 10.8 Apply lubricant to all surfaces of two yoke rollers (1-50) and two roller spacers (1-110).
- 10.9 Place one yoke roller in the track in bottom of housing and position it under the slot in the yoke arms.
- 10.10 Place a roller spacer (1-110) on top of lower yoke roller (1-50).
- 10.11 Place a second yoke roller on top of the roller spacer in the slot in the lower yoke arm.
- 10.12 Place a second roller spacer (1-110) on to of the second yoke roller (1-50) and align the holes in the roller spacer and the yoke rollers.

NOTE: T8XX-SR actuators manufactured before 1978 did not use roller spacers (1-110) with yoke rollers (1-50), refer to section 15 step 15.2 when replacing rollers or roller spacers.

- 10.13 Coat 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 yoke rollers (1-50) and roller spacers (1-110).
- 10.14 Lubricate yoke pin (1-40) and insert through yoke pin nut (1-30), two yoke rollers (1-50) and two roller spacers (1-110).
- 10.15 Apply lubricant to all surfaces of the two remaining yoke rollers (1-50) and two remaining roller spacers (1-110).
- 10.16 Place one roller spacer over yoke pin (1-40) and on top of yoke pin nut (1-30).
- 10.17 Install third yoke roller (1-50) over yoke pin (1-40) and on top of roller spacer (1-110).
- 10.18 Place the last roller spacer over yoke pin (1-40) and on top of third yoke roller (1-50).
- 10.19 Place the fourth and final yoke roller over the yoke pin (1-40) and on top of roller spacer (1-110).
- NOTE: The top roller will remain above the yoke arm and will engage the cover track when the cover is installed.
- 10.20 Apply lubricant to piston rod (2-170) and rod bushing (2-50). Install rod bushing over the piston rod.
- NOTE: Rod bushing (2-50) should be replaced each time actuator is refurbished (refer to section 1 for recommend service interval). The Bettis Service/Seal Kit should contain a new rod bushing (2-50).
- CAUTION: If the cycle speed of the actuator is two seconds or faster, apply Loctite 242 to the external threads of the piston rod (2-170). NOTE: loctite cure time is 10 - 30 minutes.**
- 10.21 Install lubricated piston rod (2-170) with rod bushing (2-50) into the right side of the housing for fail clockwise (CW) actuators or into the left side of the housing for fail counter clockwise (CCW) actuators. Slide rod bushing along the piston rod and into the housing counter bore. Screw the piston rod into yoke pin nut (1-30). NOTE: Do not tighten piston rod until the housing cover is installed later in this procedure.
- 10.22 Lubricate push rod (4-20) and slide into the other side of the housing and screw into yoke pin nut (1-30).
- 10.23 Place seal gaskets (3-110) and jam nuts (1-120) on stop screws (1-60). Install both assemblies into the housing.
- 10.24 Place housing cover gasket (3-20) on housing (1-10).
- 10.25 Coat o-ring seal (3-50) with lubricant and install into housing cover (1-20).
- 10.26 Apply lubricant to yoke bore and the track in housing cover (1-20).
- 10.27 Apply lubricant to the yoke upper bearing surface.

NOTE: Step 10.28 is done if housing cover is equipped with a upper yoke bushing (1-140). The addition of upper yoke bushing (1-140) was implemented during the year 1989. All replacement housing covers will be machined to accept a upper yoke bushing (1-140) and will automatically come fitted with a upper yoke bushing (1-140).

10.28 Coat upper yoke bushing (1-140) with lubricant and install onto yoke (1-160).

10.29 Install housing cover (1-20) and spring brace (10-240) being careful not to damage gasket (3-20) or o-ring seal (3-50).

10.30 Install seal gaskets (3-100) on to cover screw (3-90) and 10-90.

10.31 Install cover screws (1-90) and (10-210) with seal gasket (3-100).

NOTE: Leave cover screws finger tight - do not tighten.

10.32 Do this step only if you have pulled cover pins (1-130) or if you are replacing the cover pins. Drive the two pins (1-130) through cover (1-20) and into housing (1-10) until the pins are flush with the cover. NOTE: Cover pins are deeply grooved at one end, tapering to a smooth diameter at other end. The cover pin should be installed smooth end first.

10.33 Do this step only if you have pulled spring brace/cover pins (10-230) and separated the cover and spring brace. Place spring brace (10-240) into position and drive two cover pins (10-230) through the brace and cover, into housing (1-10).

10.34 Tighten cover screws (1-90) and (10-210), torque to 16 ±1 foot pounds lubricated.

10.35 Tighten piston rod (2-170) to a torque of approximately 150 ±7 foot pounds. NOTE: 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.

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

10.36 Tighten push rod (4-20) securely with a strap wrench.

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

11.0 PRESSURE CYLINDER RE-ASSEMBLY

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

CAUTION: Install rod seal with energizer ring facing outboard side (away from housing).

11.2 Install end cap gasket (3-10) over piston rod (2-170) and rod bushing (2-50).

11.3 Coat two o-ring seals (3-30) with lubricant and install into inner end cap (2-40).

NOTE: Some tie bar o-rings are held in place by "staked" washers. Check end cap to ensure washers are secured. If needed re-stake washers.

- 11.4 Install inner end cap (2-40) over piston rod (2-170) and rod bushing (2-50). Install with the large raised boss toward the housing (flat side outward). NOTE: The pressure inlet port should be toward the top of the actuator.

CAUTION: Exercise extreme care during end cap installation, in order to prevent damage to rod seal (3-70).

- 11.5 Apply lubricant to o-ring seal (3-60) and install onto inner end cap (2-40).

NOTE: Step 11.6 is done only if actuator has a fabricated piston with greater than 20" inch diameter, i.e. 24", 28" 32" ect. If 20" inch diameter or smaller disregard step 11.6 and proceed to step 11.7.

- 11.6 Fabricated piston, 24" and larger, reassembly (refer to assembly drawing detail "A").

CAUTION: Tie bar bushings (2-180) should be replaced each time actuator is refurbished (refer to section 1 for recommend service interval).

NOTE: The Bettis Service/Seal Kit should contain a new tie bar bushings.

- 11.6.1 Install o-ring seals (3-140) into outer diameter seal groove on tie bar bushings (2-180).

- 11.6.2 Apply lubricant to two sets of Tseal components (3-80) and install into inner diameter seal groove in tie bar bushings (2-180).

- 11.6.3 Install tie bar bushings (2-180) into fabricated piston (2-20).

- 11.6.4 Install retaining rings (2-190) into fabricated piston (2-20).

- 11.7 Apply lubricant to two sets of piston tie bar T-seal components (3-80) and install into piston internal seal groove. NOTE: refer to step 9.5 for proper installation instructions.

- 11.8 Coat outer end of piston rod (2-170) with lubricant.

- 11.9 Apply lubricant to o-ring (3-40) and place onto piston rod (2-170).

- 11.10 Install a matched set of split rings (2-70) into the inner most groove in the piston rod and retain with one split ring retainer (2-80), retaining ring groove away from piston. NOTE: Disregard this step and step 11.12 if the actuator has the piston retained in place with a hex nut and refer to section 15 step 15.1 for actuators not equipped with split rings and split ring retainers.

- 11.11 Install piston (2-20) onto the piston rod against split rings (2-70). NOTE: When installing cast pistons install with ribbed section of piston facing away from housing.

CAUTION: When installing 24" inch diameter, or larger, pistons make certain that smaller diameter plate faces outer end cap (2-30).

- 11.12 Install a matched set of split rings (2-70) into the inner most groove in the piston rod and retain with one of the split ring retainers (2-80), retaining ring groove away from piston.

- 11.13 Apply lubricant to the threads and end of tie bars (2-60), end without wrench flat.
- 11.14 Install by carefully inserting the tie bars through piston (2-20), inner end cap (2-40), housing (1-10) and screwing into spacer plate (10-250).

CAUTION: Tighten the tie bars until the threads bottom out, then back out each tie bar one half-turn.

- 11.15 Lubricate all exposed surfaces of piston rod (2-170) and tie bars (2-60).
- 11.16 Apply a light coat of lubricant to bore of cylinder (2-10).
- 11.17 Coat piston T seal components (3-90) with lubricant and install into the piston external seal groove. Refer to section 9 for proper "T" seal installation.
- 11.18 Install lubricated cylinder (2-10) over piston (2-20) and onto inner end cap (2-40). When sliding cylinder over the piston seal tilt cylinder 15° to 30° degrees to piston rod.

CAUTION: If needed when installing cylinder (2-10), hammer on the 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 the back-up rings or seal member be pinched between the piston and cylinder, the component could be damaged, becoming a potential source of leakage.

- 11.19 Apply lubricant to two o-ring seals (3-30) and install into outer end cap (2-30).
- NOTE: Some tie bar o-rings are held in place by "staked" washers. Check end cap to ensure washers are secured. If needed re-stake washers.
- 11.20 Apply lubricant to o-ring seal (3-60) and install onto outer end cap (2-30).
- 11.21 Install outer end cap (2-30) onto tie bars and into open end of cylinder (2-10). NOTE: The pressure inlet port should be toward the top of the actuator.
- 11.22 Install two hex nuts (2-90) on tie bars (2-60), using them to draw all of the cylinder components into position. Torque alternately, in 50 ft.lb. increments until a final torque of 110 ±11 foot pounds has been achieved.

CAUTION: While the tie bar nuts are being tightened, do not allow the tie bars to turn.

- 11.23 Install nut retainer (2-100), securing in place with retainer screw (2-120) and lockwasher (2-110). It is necessary that the flats on hex nuts (2-90) be aligned and parallel before nut retainer (2-100) can be installed.

- 11.24 Apply sufficient pneumatic pressure to the breather port in inner end cap (2-40) and stroke the actuator. Remove the pneumatic pressure from the breather port. If pneumatic pressure is not available then by pushing on the exposed push rod (4-20) or tapping it with a soft mallet, stroke the actuator until the yoke touches the housing at the end of its stroke.

12.0 SPRING CARTRIDGE INSTALLATION

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

- 12.1 Install end cap gasket (3-10), spacer (10-250), ferry cap screws (10-220) and tighten screws.
- 12.2 Remove the nuts, installed at step 6.8, from the spring cartridge tie bars.
- 12.3 Install gasket (4-70) onto spring cartridge (4-10).
- 12.4 Place spring cartridge (4-10) on to push rod (4-20) and align the spring cartridge tie bars with the holes in the spacer (10-250). Also align brace rods (4-80) with holes in spring brace (10-240).
- 12.5 Screw the tie bars into spacer (10-250). Alternately tighten tie bar nuts in 50 foot pounds increments until the spring cartridge is firmly against the spacer and torque to 100 ±11 foot pounds.
- 12.6 Install nut retainer (4-40), lockwasher (4-50), and socket cap screw (4-60). NOTE: It is necessary that the flats on the hex nuts be aligned and parallel before the nut retainer can be installed.
- 12.7 Install hex nuts (10-200) onto brace rods (4-80) and tighten.
- 12.8 POSITION INDICATOR INSTALLATION - Spring to close actuators (clockwise) use steps 12.8.1 through 12.8.3. Spring to open actuators (counter clockwise) use steps 12.8.4 through 12.8.6.
- 12.8.1 For spring to close actuators (clockwise) rotate yoke to the full clockwise (CW) position (as shown on the clockwise assembly drawings).
- 12.8.2 Install weather cover (3-130) and position indicator (1-170) on yoke (1-160). Arrange the position indicator's pointer perpendicular with the piston rod (2-170) and facing front of the actuator (stop screw side of the housing).
- 12.8.3 Secure weather cover (3-130) and position indicator (1-170) to yoke (1-160) with four socket cap screws (1-180).
- 12.8.4 For spring to open actuators (counter clockwise) rotate yoke to the full counterclockwise (CCW) position (as shown on the counter clockwise assembly drawing).
- 12.8.5 Install weather cover (3-130) and position indicator (1-170) on yoke (1-160). Arrange the position indicator's pointer facing the right and parallel with piston rod (2-170).

12.8.6 Secure weather cover (3-130) and position indicator (1-170) to yoke (1-160) with four socket cap screws (1-180).

13.0 ACTUATOR TESTING

13.1 General Leak Testing: A small amount of leakage may be tolerated. Generally, a small bubble which breaks about three seconds after starting to form is considered acceptable.

13.2 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution.

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

13.3 Unless otherwise listed all leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag or the pressure used by the customer to operate actuator during normal operation. NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.

13.4 Before testing for leaks, alternately apply and release pressure, as defined in step 13.3, to the pressure 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.

13.5 Apply pressure, as defined in step 13.3, to pressure inlet port in outer end cap (2-30).

13.6 Apply a leak testing solution to the following areas:

13.6.1 Joint between outer end cap (2-30) and cylinder (2-10). Checks cylinder to end cap o-ring seals.

13.6.2 Around tie bar nuts (2-90) on outer end cap (2-30). Checks tie bars to end cap o-ring seals.

13.6.3 Form a bubble over the breather port hole in inner end cap (2-40). Checks piston to cylinder, piston to tie bar, and piston to piston rod seals.

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

13.8 Operation test the actuator to verify proper function of the actuator. This test is to be done off of the valve.

13.8.1 Adjust the pressure regulator to the pressure as defined in step 13.3.

13.8.2 Apply the above pressure to the actuator power cylinder pressure inlet port and allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.

13.9 Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, should be corrected and the above test performed again.

13.10 Remove pressure from pressure inlet port in the outer end cap.

14.0 RETURN TO SERVICE

- 14.1 Install breather (4-30) in inner end cap (2-40).
- 14.2 Replace software components of snubber (1-90) and then install snubber in housing cover port.
- 14.3 Adjust both stop screws (1-60) back to settings recorded in section 5 under General Disassembly.
- 14.4 Tighten both stop nuts (1-120) securely, while holding stop screw (1-60).
- 14.5 After the actuator is installed on the valve all accessories should be hooked up and tested for proper operations and replaced, if found defective.

15.0 INFORMATION NOTES

- 15.1 Actuators manufactured before 1973 will have a hex lock nut retaining the piston on the piston rod. This hex lock nut is used in place of the split rings and split ring retainers. Actuators of this age will use a Service/Seal Kit that has the term "Pre A" in the description after the actuator model number, i.e. SERV K.T816/SR*PRE A*.
- 15.2 Actuators manufactured before 1978 did not use roller spacers (1-110) with yoke rollers (1-50).

CAUTION: When replacing the rollers on pre 1978 actuators order a complete set of both rollers and roller spacers. **NOTE: A complete set consists of: four rollers (1-50) and four roller spacers (1-110). The original rollers are the same part number as model T8XX-SR actuators shipped after 1978, but the new rollers are shorter than pre 1978 rollers. Due to the difference in size the top or bottom yoke roller may not engage the actuator track sufficiently, unless roller spacers are used, and may cause actuator failure.**

- 15.3 Pre "A" model T8XX-SR series actuators did not use the spring brace package made of the following: one spring brace (10-240), two brace rods (10-80), eight hex nuts (10-200), four hex cap screws (10-210), and two cover pins (10-230). These items can be added to pre "A" model T8XX-SR actuators if a new style spring cartridge replaces the original spring cartridge. For pre "A" style spring cartridge brace information consult Bettis or local Bettis factory representative.

CHART 1 - ACTUATOR WEIGHTS

| ACTUATOR MODEL | APPROXIMATE WEIGHT (POUNDS) (1) | | | |
|-------------------|---------------------------------|------|------|------|
| | SR2 | SR3 | SR4 | SR5 |
| T816-SRX | 1506 | 1274 | 1299 | 1133 |
| T820-SRX | 1626 | 1393 | 1419 | 1233 |
| T824-SRX | 1961 | 1728 | 1754 | 1568 |

NOTES: (1) Weights listed for each actuator model are for bare actuators without accessories or valve mounting brackets

CHART 2 - TOOL STYLE AND WRENCH SIZES

| ITEM NO. | WRENCH SIZE | QTY | LOCATION | RECOMMENDED WRENCH STYLE |
|-------------|----------------|-----|------------------------|-----------------------------|
| 1-60 | 15/16" | 2 | Stop Screw | Open end or adjustable |
| 1-90 | 9/16" | 10 | Cover Screws | Socket |
| 1-120 | 1-7/8" | 2 | Stop Screw nut | Box end (1) |
| 1-180 | 3/16" | 4 | Weather cover screws | Allen |
| 1-190 | 7/8" | 1 | Snubber | Deep socket |
| 2-60 | 5/8" | 2 | Tie bars flats | Open end or adjustable |
| 2-90 | 1-5/8" | 2 | Tie bar nuts | Crows foot (1) |
| None | 1-5/8" | 2 | SR Tie bar nut | Deep socket |
| 2-120 | 3/16" | 1 | Nut retainer screw | Allen |
| 2-170 | 1-3/8" | 1 | Piston rod flat | Crows foot (1) |
| 4-20 | (1) | 1 | Push rod | Strap wrench |
| 4-30 | 11/16" | 1 | Breather | Open end |
| 4-60 | 3/16" | 1 | Nut retainer screw | Allen |
| 10-200 | 1-5/8" | 8 | Nuts for SR brace rods | Open end |
| 10-210 | 9/16" | 4 | Cover/Brace screws | Socket |

(1) No alternate style recommended or wrench placement not provided.

| ECN | DATE | REV | BY * | DATE |
|----------|------------|-----|----------|-------------------|
| Released | Sept, 1994 | A | COMPILED | 30 September 1994 |
| | | | CHECKED | 30 September 1994 |
| | | | APPROVED | 30 September 1994 |

World Area Configuration Centers (WACC) offer sales support, service, inventory and commissioning to our global customers. Choose the WACC or sales office nearest you:

NORTH & SOUTH AMERICA

19200 Northwest Freeway
Houston, TX 77065
USA
T +1 281 477 4100
F +1 281 477 2809

Av. Hollingsworth,
325, Iporanga Sorocaba
SP 18087-105
Brazil
T +55 15 3238 3788
F +55 15 3228 3300

ASIA PACIFIC

No. 9 Gul Road
#01-02 Singapore 629361
T +65 6501 4600
F +65 6268 0028

No.1 Lai Yuan Road
Wuqing Development Area
Tianjin 301700
P.R.China
T +86 22 8212 3300
F +86 22 8212 3308

MIDDLE EAST & AFRICA

P. O. Box 17033
Dubai
United Arab Emirates
T +971 4 811 8100
F +971 4 886 5465

P. O. Box 10305
Jubail 31961
Saudi Arabia
T +966 3 340 8650
F +966 3 340 8790

24 Angus Crescent
Longmeadow Business Estate
East P.O. Box 6908; Greenstone
1616 Modderfontein, Extension 5
South Africa
T +27 11 451 3700
F +27 11 451 3800

EUROPE

Berenyi u. 72- 100
Videoton Industry Park,
Building #230
Székesfehérvár 8000
Hungary
T +36 22 530 950
F +36 22 543 700

For complete list of sales and manufacturing sites, please visit
www.emersonprocess.com/valveautomationlocations
Or contact us at info.valveautomation@emerson.com

www.emersonprocess.com/bettis

©2016 Emerson Process Management. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. Bettis is a mark of one of the Emerson Process Management family of companies. All other marks are property of their respective owners.

The contents of this publication are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

BETTIS™



EMERSON™
Process Management