

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY AND REASSEMBLY**

**FOR THE FOLLOWING MODELS**

**KST3XX-SR AND KST4XX-SR**

**SPRING RETURN SERIES**

**K-MASS COATED**

**PNEUMATIC ACTUATORS**

PART NUMBER: 109734

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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 Bettis KST3XX-SR, KST3XX-SR-M3, KST3XX-SR-M3HW, KST4XX-SR, KST4XX-SR-M3, and KST4XX-SR-M3HW series K-Mass actuators.
- 1.2 The maximum recommended service interval for this series of actuator is five years. Storage time is counted as part of the service interval.
- 1.3 This procedure is written with the understanding that all operating power has been removed from the actuator, allowing the spring to stroke and rotate the yoke to the actuators 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.

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

## 2.0 SUPPORT ITEMS AND TOOLS

- 2.1 Support Items - Service Kit, razor sharp cutting instrument, latex window caulking, commercial leak testing solution, and non-hardening thread sealant, two each 7/8-9 UNC hex nuts.
- 2.2 Tools - All tools are American Standard inch. Two each medium screwdriver, small standard screwdriver with corners rounded, putty knife, strap wrench, Allen wrench set, 3/16" in punch, rubber or leather mallet and torque wrench (up to 5,000 inch pounds). For recommended tool list refer to last page of this procedure.

## 3.0 BETTIS REFERENCE MATERIALS

- 3.1 Assembly Drawing 104619 \* for KST3XX-SR(CW) failing close actuators.
- 3.2 Assembly Drawing 109332 \* for KST3XX-SR(CCW) failing open actuators.
- 3.3 Assembly Drawing 104618 \* for KST4XX-SR(CW) failing close actuators.

\* Drawings do not show the K-Mass coating and its related covers and hardware.

## 4.0 GENERAL

- 4.1 Numbers in parentheses, ( ) indicate the bubble number (reference number) used on the Bettis Assembly Drawing and Actuator Parts Lists.

- 4.2 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.
- 4.3 To help at re-assembly mark or tag all mating surfaces.
- 4.4 When removing seals from seal grooves, use a small screwdriver with sharp corners rounded off or a commercial seal removing tool.

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

- 4.5 Use a non-hardening thread sealant on all pipe threads.
- 4.6 Disassembly of actuator should be done in a clean area on a work bench.
- 4.7 Some components of this actuator are very heavy and will require a means of assistance.
- 4.8 LUBRICATION REQUIREMENTS: Standard and high temperature service (-20° F to 350° F) use Bettis ESL-5 (Kronaplate 100). ESL-5 is contained in the Bettis Service Kit.

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

- 4.9 It is a good practice to operate the actuator with the nominal operating pressure (NOP), as listed on the actuator name tag or the pressure used by the customer to operate the actuator during normal operation, before starting the general disassembly of the actuator. Notate and record any abnormal symptoms such as jerky or erratic operation.

## **5.0 GENERAL DISASSEMBLY**

- 5.1 If an M3 Jackscrew is mounted in the power cylinder (2-10), the M3 (2-210) should not contact the end of the piston rod (2-170).
- 5.2 Remove any hardware attached protection covers from the actuator.
- 5.3 Remove the latex caulking that covers the hardware on the housing cover.
- 5.4 Cut through the latex caulking that seals all joints where the actuator parts are disassembled.
- 5.5 Actuators equipped with M3HW jackscrew with handwheel option, remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10).
- 5.6 Measure the exposed length of right and left stop screws (1-60) and record each before loosening for removal.

## 6.0 SPRING CARTRIDGE REMOVAL

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

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

6.1 When the spring cartridge is installed on the actuator the spring is under compression.

**CAUTION:** DO NOT remove the spring cartridge until the actuator has the stop screw "pre-load" removed.

6.2 Remove spring cartridge stop screw "pre-load" as follows: Apply nominal operating pressure to the pressure inlet port located in the outer end cap (2-30). Locate the stop screw (1-60) that is on the opposite side of the housing from the spring cartridge (4-10). Loosen jam nut (1-120). Unscrew the stop screw (1-60) until it runs into the inner end cap (2-40). Remove the pressure from the pressure inlet port.

6.3 Remove socket screw (4-60), lockwasher (4-50) and nut retainer (4-40) from the end of the spring cartridge (4-10).

6.4 Loosen the two large hex nuts on the outboard end of the spring cartridge (4-10). Unscrew the tie bars until the spring cartridge is free from the housing (1-10). Flats are provided on the outboard end of the tie bars for wrench placement. Care should be taken so that the tie bars are not pulled back into the spring cartridge. Place the spring cartridge to one side. NOTE: To keep from inadvertently pulling the tie bars back into the spring cartridge use 7/8 inch 9 UNC hex nuts and screw them on to the spring cartridge tie bars.

## 7.0 PRESSURE CYLINDER DISASSEMBLY

7.1 Remove breather assembly (610) from inner end cap (2-40).

7.2 OUTER END CAP REMOVAL With M3 use steps 7.3 thru 7.5. Without M3 use steps 7.6 thru 7.8.

7.3 Outer end cap (2-30) with M3 or M3HW jackscrew will be removed as follows: Loosen and thread seal nut (2-130) all the way back to the outboard nut.

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

7.5 Back jackscrew adapter (2-190) out until clear of hex nuts (2-90), now go to step 7.8.

7.6 Outer end cap (2-30) without M3 or M3HW jackscrew will be removed as follows: Unscrew and remove socket cap screw (2-120), lockwasher (2-110), and nut retainer (2-100).

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

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

7.9 Pry inner end cap (2-40) away from the housing (1-10). Break the inner end cap free from the cylinder (2-10).

NOTE: When sliding the cylinder off of the piston, tilt the cylinder to the piston rod, approximately 15° to 30° degrees.

7.10 Remove the cylinder (2-10).

7.11 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 may mark the bars and cause seal leakage.

7.12 Pull the tie bars out from the inner end cap (2-40) far enough to remove the o-ring seals (3-30) from the inboard side of the piston (2-20).

7.13 Remove the tie bars (2-60) from the piston (2-20).

**CAUTION: Keep split ring halves (2-70) in matched sets.**

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

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

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

**CAUTION: Keep split ring halves (2-70) in matched sets.**

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

7.18 Slide the inner end cap (2-40) off over the piston rod (2-170).

## **8.0 JACKSCREW DISASSEMBLY**

8.1 For actuators equipped with M3 or M3HW jackscrew override, use the following procedure for jackscrew disassembly:

8.2 Using a pin punch, drive out and remove pin from jackscrew stud and slotted thrust nut.

8.3 Thread the slotted thrust nut against the Timken bearing until the bearing retainer and the retaining ring are forced off of the end of the M3 stud. Then continue to thread the slotted thrust nut until the bearing and the nut are removed from the M3 stud.

8.4 Remove the M3 (2-210) from the outer end cap (2-30).

**9.0 HOUSING GROUP DISASSEMBLY**

- 9.1 Unscrew push rod (4-20) from yoke pin nut (1-30) and remove from housing (1-10).
- 9.2 Unscrew piston rod (2-170) from yoke pin nut (1-30) and remove, including the rod bushing (2-50). 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 may mark the rod and cause seal leakage.
- 9.3 Remove position indicator pin (1-170).
- 9.4 Unscrew and remove hex cap screws (1-240) with gasket seals (3-100) from position indicator cover (1-210).
- 9.5 Remove position indicator cover (1-210).
- 9.6 Unscrew and remove set screw (1-180) from position indicator drive (1-230). NOTE: Mark the hole that the set screw (1-180) is removed from.
- 9.7 Remove position indicator drive (1-230) from the top of the yoke (1-160).
- 9.8 Remove the housing cover hex cap screws (1-90) and gasket seals (3-100).
- 9.9 Remove the housing cover (1-20). NOTE: The cover will have a very tight fit. It is not necessary to remove cover pins (1-130).
- 9.10 Remove snubber valves (1-190) from the housing cover (1-20) and the housing (1-10).
- 9.11 Remove the top two yoke rollers (1-50) from the top of the yoke pin (1-40).
- 9.12 Remove yoke pin (1-40).
- 9.13 Remove yoke pin nut (1-30).
- 9.14 Remove bottom two yoke rollers (1-50) from the housing (1-10).
- 9.15 Remove the yoke (1-160) by lifting it from the housing (1-10).
- 9.16 Remove the stop screws (1-60), jam nuts (1-120), thread seals (3-110) and countersunk washer (3-120). Be sure to mark or identify as left and right stop screws.

**10.0 GENERAL REASSEMBLY**

- 10.1 Remove and discard all old seals and gaskets.
- 10.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

- 10.3 All parts should be thoroughly inspected. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. Sealing surfaces must be free of deep scratches, pitting, corrosion and blistering or flaking coating.
- 10.4 All K-Mass coated parts should be inspected for damage to the coating. Replace all K-Mass parts that are damaged.
- 10.5 Before installation coat all moving parts with lubricant. Coat all seals with lubricant, before installing them into their seal grooves.
- 10.6 T Seal Set installation - The T-seal is composed of one rubber seal and two split skive-cut back-up rings.
  - 10.6.1 Install the T-seal into the seal groove.
  - 10.6.2 Install a back-up ring on each side of the T-seal.
  - 10.6.3 When installing the back-up rings, do not align the skive-cuts.
  - 10.6.4 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.
- 10.7 Prime and apply master gasket (510) to all surfaces as indicated on the assembly drawing, reference note number 5.

## **11.0 HOUSING REASSEMBLY**

- 11.1 Install one yoke o-ring seal (3-50) into the housing (1-10).
- 11.2 If the yoke bushings (1-200) was removed then install one in the housing yoke bore and one in the housing cover yoke bore.
- 11.3 Inside the housing (1-10) apply lubricant to the tracks and yoke bore and arrange the housing with the yoke bore nearest you.
- 11.4 Apply lubricant to the slots in the upper and lower arms of the yoke (1-160).
- 11.5 Apply lubricant to the yoke (1-160) lower bearing surface and install into the housing (1-10) as follows: Position the yoke arm to approximately at 45° degree position in either direction and lower into the housing. NOTE: The hub with tapped holes faces up. Rotate the yoke back to approximately the mid-stroke (center) position.
- 11.6 Apply lubricant to all surfaces of all four yoke pin rollers (1-50). Place one yoke pin 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 pin roller (1-50) on top of the first yoke pin roller in the slot in the lower yoke arm and align the holes in the yoke pin rollers.
- 11.7 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 pin rollers.

- 11.8 Lubricate yoke pin (1-40) and insert through the yoke pin nut (1-30) and the two yoke pin rollers (1-50).
- 11.9 Install the third yoke pin roller (1-50) over the yoke pin in the slot in the upper yoke arm and now install the fourth and last remaining yoke pin roller (1-50) on top of the yoke roller you just installed in the upper yoke arm slot. The top roller will remain partially above the yoke and will engage the cover track when cover is installed.
- 11.10 Apply lubricant to the rod bushing (2-50), install it up into the right side of the housing for fail close (CW) actuators or into the left side of the housing for fail open (CCW) actuators.
- 11.11 Apply Loctite - 242 to external threads on the piston rod (2-170). NOTE: Loctite cure time is 10 - 30 minutes. Lubricate the piston rod (2-170) and insert it into and thru the rod bushing installed in step 11.10. Screw the piston rod into the yoke pin nut (1-30). Tighten the piston rod (2-170) to a torque of approximately 1800 inch pounds (150 foot pounds). 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 on the piston rod, as it may cause seal leakage.**
- 11.12 Lubricate the push rod (4-20) and slide into the other side of the housing and screw into the yoke pin nut (1-30). Tighten the push rod with a strap wrench or a pipe wrench.
- 11.13 Place thread seals (3-110), countersunk washers (3-120) and jam nuts (1-120) on the stop screws (1-60). Install the stop screws into the housing, making sure the stop screws marked in step 9.16 are installed into the same stop screw holes as they were removed from.
- 11.14 Position the position indicator drive (1-230) onto the top of the yoke (1-160) with the slot positioned over the hole that was marked in step 9.6. Secure with the set screw (1-180).
- 11.15 Install the o-ring seal (3-150) over the position indicator drive shaft and down against the flat cover plate.
- 11.16 Place the housing cover gasket (3-20) onto the master gasket prepared housing (1-10).
- 11.17 Install the remaining yoke o-ring seal (3-50) into cover (1-20).
- 11.18 Apply lubricant to the yoke bore and the track in the housing cover (1-20).
- 11.19 Apply lubricant to the upper bearing surface of the yoke (1-160).
- 11.20 Install the housing cover (1-20), being careful not to damage the gasket (3-20) or yoke o-ring (3-50).
- 11.21 Install the cover screws (1-90) and seal gaskets (3-100). **LEAVE FINGER TIGHT-DO NOT TIGHTEN.**

- 11.22 NOTE: 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.
- 11.23 Tighten the cover screws (1-90).
- 11.24 Tighten the push rod (4-20) securely with a strap wrench.
- 11.25 Install the o-ring seal (3-140) into the bottom seal groove inside the position indicator cover (1-210).
- 11.26 Install the wiper ring (3-160) into the top groove inside the position indicator cover (1-210).
- 11.27 Install the o-ring seal (3-170) into the bottom seal groove on the bottom of the position indicator cover (1-210).
- 11.28 Install the position indicator cover (1-210), being careful not to damage the o-ring seals (3-140), (3-170) and wiper ring (3-160).
- 11.29 Install new gasket seals (3-100) on to hex cap screws (1-240).
- 11.30 Install and tighten the position indicator cover hex screws (1-240).
- 11.31 Install the position indicator pointer (1-170) into the taped hole in the position indicator drive assembly (1-230).
- 11.32 Rotate the yoke to a position that will leave a minimum of the piston rod (2-170) protruding from the actuator housing.

## **12.0 M3 JACKSCREW OUTER END CAP PRE-ASSEMBLY**

- 12.1 Apply a light coating of lubricant to the threads of jackscrew assembly (2-210).
- 12.2 If removed, thread on the nut seal (2-130) onto jackscrew assembly (2-210).
- 12.3 Lubricate the o-ring groove area on the jackscrew adapter (2-190).
- 12.4 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 cap screws (2-200). Leave socket cap screws (2-200) finger tight.
- 12.7 Install slotted thrust nut on to turned-down end of M3 stud with slotted face toward the outer end cap. Thread the nut past the pin hole in the M3 stud.

- 12.8 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.
- 12.9 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 stud end.
- 12.10 Begin to un-screw 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 thru the M3 stud retaining the slotted nut in its position.
- 12.11 Rotate jackscrew assembly (2-210) counterclockwise until the slotted thrust nut is up against the outer end cap (2-30).

### **13.0 PRESSURE CYLINDER REASSEMBLY**

- 13.1 Coat the rod seal (3-70) with lubricant and install, lip first, into the recess provided in the inner end cap ((2-40).
- 13.2 Install end cap o-ring seal (3-10) into the 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 inlet port should be toward the top of the actuator.
- 13.4 Install the o-ring seal (3-60) onto the inner end cap (2-40).
- 13.5 Install two sets of piston tie bar T-seal components (3-80) into the piston internal seal groove. Refer to steps 10.6 for proper T-seal installation instructions.
- 13.6 Coat the ends of the piston rod (2-170) with lubricant.
- 13.7 Install the piston o-ring seal (3-40) onto the piston rod (2-170).
- 13.8 Install a matched set of split rings (2-70) into the inner most groove in the piston rod and retain with one of the retaining rings (2-80).
- 13.9 Slide the piston (2-20) onto the piston rod against the split ring (2-70). Ribbed section of piston should face away from housing.
- 13.10 Install a matched set of split rings (2-70) onto the piston rod and retain with the retaining ring (2-80).
- 13.11 Apply lubricant to the threads and end of the tie bars (2-60), end without wrench flat, and install by carefully pushing tie bars through the piston (2-20).
- 13.12 Install two tie bar o-ring seals (3-30) onto the inboard end of the tie bars (2-60) into the o-ring grooves provided.
- 13.13 Insert the tie bars through the inner end cap (2-40) and screw into the housing (1-10). Tighten until threads bottom out, then back out a half-turn.

- 13.14 Apply lubricant to the entire bore of the cylinder (2-10).
- 13.15 Install the piston T-seal components (3-90) into the piston external seal groove. Refer to step 10.6 for proper "T" seal installation.
- 13.16 Slide the lubricated cylinder (2-10) over the piston (2-20) and onto the inner end cap (2-40). NOTE: When sliding the cylinder over the piston seal, tilt cylinder 15° to 30° to the piston rod.

**CAUTION: Hammer on the end of the cylinder only with a non metallic object.**

**CAUTION: 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 component could be damaged, becoming a potential source of leakage.**

- 13.17 Install two end cap tie bar o-ring seals (3-30) onto the outboard end of the tie bars (2-60) into the o-ring groove provided.
- 13.18 Install the outer end cap cylinder o-ring seal (3-60) onto the outer end cap (2-30).
- 13.19 OUTER END CAP INSTALLATION: Outer end cap installation with M3 use steps 13.20 thru 13.26. Outer end cap without M3 use steps 13.27 thru 13.29.
- 13.20 Install the outer end cap (2-30) onto the tie bars (2-60) and into the end of the cylinder (2-10).
- 13.21 Remove socket cap screws (2-200) from jackscrew adapter and pull out jackscrew assembly until enough clearance is available to install tie bar nuts (2-90).
- 13.22 Install the two tie bar nuts (2-90) onto the tie bars (2-60), using them to draw all of the cylinder components into position. **CAUTION: While the nuts are being tightened, do not allow the tie bars to turn.** Torque alternately until a final torque of 65 foot pounds plus or minus 7 foot pounds has been achieved. It is necessary that the flats on the hex nuts (2-90) be aligned and parallel before the jackscrew adapter can be installed.
- 13.23 Rotate the jackscrew assembly counterclockwise until end of CCW travel.
- 13.24 Insert jackscrew adapter (2-190) and jackscrew assembly (2-210) back into the outer end cap.
- 13.25 Retain jackscrew adapter (2-190) with socket cap screws (2-200).
- 13.26 Tighten seal nut (2-130).
- 13.27 OUTER END CAP INSTALLATION WITHOUT M3: Install the outer end cap (2-30) onto the tie bars (2-60) and into the end of the cylinder (2-10).

- 13.28 Install the two tie bar nuts (2-90) onto the tie bars (2-60), using them to draw all of the cylinder components into position. NOTE: While the nuts are being tightened, do not allow the tie bars to turn. Torque alternately until a final torque of 65 foot pounds plus or minus 7 foot pounds has been achieved.
- 13.29 Install the nut retainer (2-100), securing in place with the retainer screw (2-120) and lockwasher (2-110). It is necessary that the flats on the hex nuts (2-90) be aligned and parallel before the nut retainer can be installed.

#### **14.0 SPRING CARTRIDGE INSTALLATION**

- 14.1 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 (4-10).
- 14.2 Install the end cap o-ring seal (3-10) into the housing end of the spring cartridge (4-10).
- 14.3 Install the SR cartridge (4-10) onto the push rod (4-20). Do not allow the tie bars to be pushed back into the SR cartridge. Insert the tie bars into the mating holes in the housing (1-10).
- 14.4 Screw the tie bars into the housing (1-10). Tighten the tie bars until the threads bottom out, then back the tie bars back out one half turn. Flats are provided on the outboard end of the SR tie bars. These flats should be used to put a wrench on to tighten the piston rod.
- 14.5 Unscrew and remove the spring cartridge tie bar nuts, countersunk washers (3-120) and thread seals (3-110).
- 14.6 Install new thread seals (3-110) and countersunk washers (3-120) on to the spring cartridge tie bars. Reinstall the tie bars nuts and alternately tighten them in 50 foot pounds increments until the spring cartridge is firmly against the spring cartridge adapter plate and then tighten to 65 plus or minus 7 foot pounds.
- 14.7 Install nut retainer (4-40), lockwasher (4-50), and socket cap screw (4-60). It is necessary that the flats on the hex nuts be aligned and parallel before the nut retainer can be installed.

#### **15.0 ACTUATOR TESTING**

- 15.1 **Leak Test - General** - All areas, where leakage to atmosphere may occur, are to be checked using a leak testing solution.
- 15.2 All leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag.
- 15.3 Before testing for leaks, alternately apply and release NOP pressure to the pressure side of the pistons to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their proper working attitude.
- 15.4 **Leakage Test - Procedure** - Apply NOP pressure to the pressure port in the outer end cap (2-30).

- 15.5 Apply a leak testing solution to the following areas:
  - 15.5.1 Joint between the outer end cap (2-30) and the cylinder (2-10). Checks cylinder to end cap o-ring seals.
  - 15.5.2 Around the tie bar nuts on the cylinder end cap (2-30). Checks tie bars to end cap o-ring seals.
  - 15.5.3 The breather port hole in the inner end cap (2-40). Checks piston to cylinder, piston to tie bar, and piston to piston rod seals.
- 15.6 Remove pressure from pressure inlet port in the outer end cap.
- 15.7 If excessive leakage across the piston 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.
- 15.8 If an actuator was disassembled and repaired, the above leakage test must be performed again.

## **16.0 RETURN TO SERVICE**

- 16.1 Install breather assembly (610) in the inner end cap of the cylinder (2-10).
- 16.2 Replace the software components of the snubber valves (1-190) and then install them into the housing cover (1-20) and the housing (1-10).
- 16.3 Adjust both stop screws (1-60) back to settings recorded in step 5.6 under General Disassembly.
- 16.4 Tighten both jam nuts (1-120) securely, while holding stop screws (1-60).
- 16.5 For actuators equipped with a M3 jackscrew override and require an optional handwheel, M3HW, install the handwheel using the following procedure:
  - 16.6 Place the handwheel (8-10) onto the M3 stud and over the nut (the handwheel hub has a cast hexagon hole that fits over the nut).
  - 16.7 Place lockwasher (8-20) onto M3 up against handwheel hub.
  - 16.8 Place hex nut (8-30) onto M3 and thread up against lockwasher.
- 16.9 Using a tube of latex window caulk seal all joints that were cut through or removed during disassembly.
- 16.10 Reinstall any hardware attached protection covers that were removed in step 5.2.
- 16.11 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up and tested for proper operations and replaced if found defective.

**KST3XX-SR & KST4XX-SR RECOMMENDED****TOOL STYLE AND WRENCH SIZES**

ITEM NO.	WRENCH SIZE	LOCATION	RECOMMENDED WRENCH STYLE
1-60	1/2"	Stop Screw	Open End or Adjustable
1-90	1/2"	KST3 Cover Screws	Socket
1-90	9/16"	KST4 Cover Screws	Socket
1-120	1-5/16"	Stop Screw Nut	Box End <b>(1)</b>
1-180	3/16"	Weather Cover Screws	Allen
1-190	7/8"	Snubber Valve	Deep Socket
2-90	1-5/16"	Power Cylinder Tie Bar Nuts	Deep Socket
2-120	3/16"	Power Cylinder Nut Retainer	Allen
2.130	1-11/16"	M3 Jam Nut	Open End or Adjustable
2-170	1-1/4"	Piston Rod Flats	Crows Foot <b>(1)</b>
2-200	3/8"	M3 Adapter Screw	Allen <b>(1)</b>
4-20	<b>(2)</b>	SR Push Rod	Strap Wrench
4-60	3/16"	SR Nut Retainer	Allen
None	1-5/16"	SR Tie Bar Nuts	Deep Socket
8	1-11/16"	M3 Handwheel	Box End

**(1)** No alternate style tool recommended

**(2)** Wrench placement not provided

ECN	DATE	REV	BY *	DATE	
Released	September, 1992	A	COMPILED	BC	14 September 1992
			CHECKED	BC	14 September 1992
			APPROVED	RMM	14 September 1992

\* Signatures on file Waller, Texas