

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR MODELS

T4XX-SRX(CW)-S & T4XX-SRX(CW)-10-S

SEISMIC SERIES PNEUMATIC ACTUATORS

WITH SPRING CARTRIDGE

ADJUSTABLE STOP

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SECTION 1.0 - INTRODUCTION

1.1 GENERAL INFORMATION

1.1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis T4XX-SRX(CW)-S and T4XX-SRX(CW)-10-S Seismic Series Actuators with Spring Cartridge Adjustable Stop.

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.

1.1.2 BASIC SERVICE INFORMATION:

1.1.2.1 Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is mounted on.

WARNING: **The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of actuator torque output. This can only be accomplished by removing yoke (1-160) from housing (1-10) which requires removing the actuator from the valve.**

1.1.2.2 This procedure is applicable with the understanding that the following items have been completed by the customer prior to implementing this procedure.

1.1.2.2.1 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.

1.1.2.2.2 The actuator has been removed from the valve or device it is mounted on.

1.1.2.2.3 All piping and accessories that are mounted on the actuator have been removed.

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

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

1.1.2.5 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 side of the actuator. Cover (1-20) will be considered top of the actuator.

1.1.2.6 To ensure correct reassembly; that is, with spring on same end of housing as was, mark or tag right (or left) and mark mating surfaces.

1.1.2.7 When removing seals from seal grooves, use a commercial seal removing tool or a small screwdriver with sharp corners rounded off.

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

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

1.1.2.9 Disassembly of actuator, when possible, should be done in a clean area on a work bench.

1.1.2.10 Actuator weight is 733 pounds, actuator without accessories and valve mounting brackets.

CAUTION: Due to weight and size of the assembled actuator lifting equipment will be required when removing the actuator from the valve or device it is mounted on.

1.2 QUALIFICATION INFORMATION

1.2.1 In order to assure and maintain the present level of Bettis Actuator qualification and auditabile to the Bettis Qualification Report part number 037274, the following is required:

1.2.1.1 All maintenance or service work must be performed by a certified technician.

1.2.1.2 Maintain a maximum service interval of five years (complete actuator refurbishment). Storage time is counted as part of the service interval.

1.3 SAFETY

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.

1.4 BETTIS RECOMMENDED SUPPORT ITEMS

1.4.1 Service/Seal Kit.

- 1.4.2 Razor sharp cutting instrument.
- 1.4.3 Commercial leak testing solution.
- 1.4.4 Non-hardening thread sealant.
- 1.4.5 Two each 7/8-9 UNC hex nuts.

1.5 BETTIS REFERENCE MATERIALS

- 1.5.1 Assembly Drawing part number 119825.

1.6 ACTUATOR LUBRICATION REQUIREMENTS

- 1.6.1 Bettis ESL-5, Kronaplate 100 lubricant.

CAUTION: Lubricants other than Bettis ESL-5 cannot be used without prior written approval of Bettis Product Engineering.

- 1.6.2 Tubes of Bettis ESL-5 lubricant, in sufficient quantity to refurbish one complete T3 or T4 actuator, is contained in Bettis Service Kit.

SECTION 2.0 - DISASSEMBLY

2.1 GENERAL DISASSEMBLY

- 2.1.1 If not already removed, disconnect all operating pressure from pneumatic cylinder (2-10), allowing the spring to stroke. The spring will rotate the yoke to the fail position.

NOTE: The setting of stop screws (1-60) should be checked and setting recorded before stop screws are loosened or removed. Both stop screws (1-60) will be removed later in this procedure.

- 2.1.2 Mark stop screws (1-60) left and right. Check and record the setting of stop screws (1-60).
- 2.1.3 Remove socket cap screws (1-180) from position indicator (1-170) yoke weather cover (3-130) and remove position indicator/yoke weather cover.
- 2.1.4 Remove breather (11) from inner end cap (2-40).
- 2.1.5 Remove snubber valve (1-190) from cover (1-20).
- 2.1.6 Mark and record location of the pneumatic inlet ports on cylinder outer end cap (2-30) and inner end cap (2-40).

2.2 SPRING CARTRIDGE REMOVAL

WARNING: Under no circumstances should spring cartridge (4-10) be cut open or apart, as the spring is pre-loaded and then the end caps and cylinder permanently attached around the spring with continuous welds.

CAUTION: Due to the weight and size of spring cartridge (4-10) support equipment will be required when removing from the actuator housing (1-10). Spring cartridge weight is 286 pounds.

CAUTION: When spring cartridge (4-10) is installed on actuator housing (1-10) the spring is under compression. Do not remove spring cartridge (4-10) until actuator has spring "pre-load" removed.

2.2.1 Remove spring "pre-load" as follows:

NOTE: If pneumatic pressure is not available then disregard steps 2.2.1.1 and 2.2.1.4. When pneumatic pressure is not used then use manual force to complete steps 2.2.1.2 through 2.2.1.3.

2.2.1.1 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, housing right side, stop screw (1-60).

2.2.1.2 Loosen, housing right side, jam nut (1-120). This jam nut will be on the right side of housing (1-10) and will be on the opposite side of housing (1-10) from spring cartridge (4-10).

2.2.1.3 Unscrew, housing right side, stop screw (1-60) until it runs into inner end cap (2-40).

2.2.1.4 Remove pressure from outer end cap (2-30) pressure inlet port and allow spring cartridge to return actuator to the spring extended position (spring unloaded position).

2.2.2 On the outboard end of spring cartridge (4-10) loosen jam nut on adjustable stop assembly.

2.2.3 Remove two socket cap screws from adjustable stop adapter.

2.2.4 Remove adjustable stop assembly from spring cartridge (4-10).

WARNING: Do not proceed to next step until spring "PRE-LOAD" has been removed (refer to step 2.2.1).

NOTE: The actuator is equipped with a brace plate (4-80) that bolts to housing (1-10). There are four brace rods (4-90) that connect between the brace support lug (lug is part of the spring cartridge band) and the brace plate (4-80).

2.2.5 Remove four hex nuts (4-100) located on the inboard side of brace plate (4-80), next to housing (1-10). The remaining hex nuts (4-100) will be left on brace rods (4-90).

NOTE: The two hex nuts on outboard end of spring cartridge (4-10) are attached to two tie bars with welds which creates two tie bar assemblies. These two tie bar assemblies extend through spring cartridge (4-10) and screw into brace plate (4-80).

2.2.6 Alternately unscrew two hex nuts on outboard end of spring cartridge (4-10) until spring cartridge is free from brace plate (4-10). Care should be taken so that the two tie bar assemblies are not pulled back into spring cartridge (4-10). Place spring cartridge (4-10) to one side.

NOTE: To keep from inadvertently pulling tie bar assemblies back into spring cartridge (4-10) use two each 7/8-9 UNC hex nuts and screw them onto the two exposed tie bar assembly threads.

2.3 PNEUMATIC CYLINDER DISASSEMBLY

2.3.1 Unscrew and remove socket cap screw (2-120) with lockwasher (2-110) from outer end cap (2-30).

2.3.2 Remove nut retainer (2-100) from between hex nuts (2-90).

2.3.3 Unscrew and remove hex nuts (2-90) from tie bars (2-60).

NOTE: The fit between cylinder (2-10) and outer end cap (2-30) is very tight. Break outer end cap (2-30) free from cylinder (2-10) by tapping on the raised lip provided on outer end cap (2-30).

2.3.4 Remove outer end cap (2-30) from outer end of cylinder (2-10).

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

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

NOTE: The fit between cylinder (2-10) and inner end cap (2-40) is very tight. Break inner end cap (2-40) free by tapping on the raised lip provided on inner end cap (2-40).

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

2.3.6 Remove cylinder (2-10). When removing cylinder (2-10) off of piston (2-20), tilt cylinder (2-10) approximately 15° to 30° degrees to piston rod (2-170).

NOTE: Flats are provided on the outboard end of tie bars (2-60) for wrench placement.

2.3.7 Unscrew tie bars (2-60) from housing (1-10).

2.3.8 Pull tie bars (2-60) out of inner end cap (2-40) far enough to expose o-ring seals (3-30).

2.3.9 Remove o-rings (3-30) from inboard end of tie bars (2-60).

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

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

NOTE: Keep split ring set (2-70) as a matched set.

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

2.3.13 Remove split ring retainer (2-80) and split ring set (2-70) from inboard side of piston (2-20).

NOTE: Keep split ring (2-70) as a matched set.

2.3.14 Remove inner end cap (2-40) off of piston rod (2-170).

2.4 HOUSING DISASSEMBLY

2.4.1 Unscrew push rod (4-20) from yoke pin nut (1-30) and remove from housing (1-10).

2.4.2 Unscrew piston rod (2-170) from yoke pin nut (1-30) and remove, including rod bushing (2-50), from housing (1-10).

CAUTION: Do not use a pipe wrench on the piston rod as it may mark piston rod (2-170) and cause seal leakage. Flats are provided on the outboard end of piston rod (2-170) for wrench placement.

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

2.4.4 Remove hex head screws (1-90) with gasket seals (3-100) from cover (1-20).

NOTE: Cover (1-20) has a tight fit to housing (1-10). The tight fit is due to four pins (1-130) driven through cover (1-20) and into housing (1-10).

2.4.5 Remove cover (1-20) from housing (1-10).

NOTE: When cover (1-20) is removed from housing (1-10), cover pins (1-130) will remain in cover (1-20). It is not necessary to remove cover pins (1-130) from cover (1-20).

2.4.6 Remove top two yoke rollers (1-50) from yoke pin (1-40). These two yoke rollers will be located in oblong slot in the upper yoke arm of yoke (1-160).

2.4.7 Remove yoke pin (1-40) from yoke (1-160) and yoke pin nut (1-30).

2.4.8 Remove yoke pin nut (1-30) from between arms of yoke (1-160).

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

2.4.10 Remove yoke (1-160) by lifting it from housing (1-10).

CAUTION: The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of actuator torque output. This can only be accomplished by removing yoke (1-160) from housing (1-10) which requires removing the actuator from the device it is operating.

- 2.4.11 Remove two stop screws (1-60) with jam nuts (1-120) and seal gaskets (3-110). Be sure to mark both or identify both stop screws as instructed in section 2.0 line 2.1.2.
- 2.4.12 It is not necessary to remove pipe plug (1-80) or grease fittings (1-70) to service the actuator.
- 2.4.13 Remove hex cap screws (1-220) from brace plate (4-80).
- 2.4.14 Remove brace plate (4-80) from housing (1-10).

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 into the actuator being refurbished.

- 3.1.1 Remove and discard all 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 LUBRICATION INSTRUCTIONS: Use the correct lubrication as defined in step 1.6.

- 3.1.4.1 Before installation coat all moving parts with lubricant.

- 3.1.4.2 Coat all seals with lubricant, before installing into seal grooves.

- 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 lubricated T-seal into the lubricated seal groove.

- 3.1.5.2 Install a lubricated back-up ring on each side of the T-seal installed in the previous step.

WARNING: When installing T-seal back-up rings, do not align the split skive-cuts.

3.1.5.3 If the back-up rings are too long and the back-up ring overlap beyond the split skive-cuts, then back-up rings must be trimmed with a razor sharp instrument.

3.2 HOUSING REASSEMBLY

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

3.2.2 If removed, install grease fitting (1-70) in actuator housing (1-10) and cover (1-20).

NOTE: The grease fitting in housing (1-10) is located on the bottom of housing (1-10), next to the lower yoke bore area. The grease fitting in cover (1-20) is located on top of cover (1-20) in the upper yoke bore area.

3.2.3 Inside housing (1-10) apply lubricant to the track, yoke bore seal groove and yoke bore.

3.2.4 Coat one o-ring seal (3-50) with lubricant and install into housing (1-10).

3.2.5 Yoke (1-160) needs to have lubricant applied to the following areas: Slot in the upper arm, slot in lower arm and the lower outer diameter of yoke (1-160).

3.2.6 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 housing (1-10). Rotate the yoke arms back to approximately mid-stroke (center) housing position.

NOTE: The hub of yoke (1-160), with tapped holes, faces up.

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

3.2.8 Place one yoke pin roller (1-50) into the track in the bottom of housing (1-10) and position the yoke roller under the yoke arm slots of yoke (1-160).

3.2.9 Place a second yoke pin roller (1-50) on top of the first yoke pin roller which will place the yoke pin roller in the lower yoke arm slot of yoke (1-160). Align the holes in the two yoke pin rollers.

3.2.10 Coat the upper and lower surfaces of yoke pin nut (1-30) with lubricant and insert into position between the arms of yoke (1-160) and parallel to the track in housing (1-10). Align the yoke pin hole with the yoke rollers.

3.2.11 Lubricate yoke pin (1-40) and insert through yoke pin nut (1-30) and two yoke rollers (1-50) install in steps 3.2.8 and 3.2.9.

3.2.12 Install the third yoke pin roller (1-50) over yoke pin (1-40) and down into the upper yoke arm slot of yoke (1-160).

3.2.13 Install the fourth and last remaining yoke pin roller (1-50) on top of the yoke pin roller you installed in step 3.2.12. The top yoke pin roller will remain partially above the upper yoke arm and will engage the track in cover (1-20) when cover (1-20) is installed later in this procedure.

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

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

3.2.15 Install piston rod (2-170) with rod bushing (2-50) into right side of housing (1-10) for fail clockwise (CW) actuators or into left side of housing (1-10) for fail counter clockwise (CCW) actuators. Slide new rod bushing (2-50) along the piston rod and into the counter bore in the side of housing (1-10).

3.2.16 Screw piston rod (2-170) into yoke pin nut (1-30).

NOTE: Do not torque tighten piston rod (1-170) until cover (1-20) is installed later in this procedure.

3.2.17 Install push rod (4-20) into other side of housing (1-10) and screw into yoke pin nut (1-30).

NOTE: When installing push rod do not tighten until housing cover (1-20) has been installed later in this procedure.

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

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

3.2.20 Place cover gasket (3-20) onto housing (1-10).

3.2.21 Apply lubricant to the upper external outer diameter of yoke (1-160).

3.2.22 Apply lubricant to cover (1-20) in the following areas: yoke bore, seal groove in yoke bore and the track located in the under side of the cover.

3.2.23 Coat remaining o-ring seal (3-50) with lubricant and install into seal groove located in bore of cover (1-20).

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

3.2.25 Install new seal gaskets (3-100) onto hex head screws (1-90).

3.2.26 Install cover screws (1-90), with new seal gaskets (3-100), into cover (1-20).

NOTE: Leave cover screws loose, do not tighten.

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

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

3.2.27.1 Install four cover pins (1-130), smooth end first, into housing cover (1-20).

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

3.2.28 Torque tighten hex head screws (1-90) to 8 foot pounds $\pm 5\%$ percent.

- 3.2.29 Install one end cap gasket (3-10) over push rod (4-20).
- 3.2.30 Install brace plate (4-80) with hex cap screws (1-220) to housing (1-10). Torque tighten hex cap screws to 85 foot pounds $\pm 5\%$ per cent.
- 3.2.31 TIGHTEN PISTON ROD (2-170) AND PUSH ROD (4-20) AS FOLLOWS:
- 3.2.31.1 Torque tighten piston rod (2-170) approximately 150 ± 7 foot pounds. Flats are provided on the outboard end of the piston rod for wrenching purposes.
- 3.2.31.2 Tighten push rod (4-20), with a strap wrench, until tight.
- 3.2.32 Rotate yoke (1-160) to the full clockwise (CW) position (as shown on assembly drawing P/No. 119825). Arrange yoke weather cover (3-130) and position indicator (1-170) on top of yoke (1-160) with pointer of position indicator (1-170) facing front of cover (1-20).
- 3.2.33 Install socket cap screws (1-180) through position indicator (1-170), yoke weather cover (3-130) and into tapped holes located on top of yoke (1-160).
- NOTE: Due to the softness of the yoke weather cover (3-130) socket cap screws (1-180) will require the tightness be re-checked after the actuator is cycled a few times.
- 3.2.34 Rotate yoke (1-160) to a position that will leave a minimum of piston rod (2-170) protruding from housing (1-10).

3.3 PNEUMATIC CYLINDER REASSEMBLY

- 3.3.1 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 of inner end cap (2-40).

- 3.3.2 Apply lubricant to end cap gasket (3-10) and install over piston rod (2-170) and rod bushing (2-50).
- 3.3.3 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 housing (1-10). End cap pressure inlet port should be positioned as recorded in step 2.1.6.

- 3.3.4 Apply lubricant to o-ring seal (3-60) and install into outer diameter seal groove on inner end cap (2-40).
- 3.3.5 Apply lubricant to exposed areas of piston rod (2-170).
- 3.3.6 Apply lubricant to o-ring seal (3-40) and install onto outboard end of piston rod (2-170).

NOTE: New retaining rings (2-80) are provided in Bettis Service Kit.

3.3.7 Install matched set of split rings (2-70) into inner most groove on piston rod (2-170) and retain with a new retaining ring (2-80).

3.3.8 Apply lubricant to two sets of piston tie bar T-seal components (3-80) and install into piston (2-20) internal seal grooves. Refer to step 3.1.5 for proper T-seal installation instructions.

NOTE: When installing piston (2-20), install with cast ribs facing outboard of housing (1-10).

3.3.9 Install piston (2-20) onto piston rod (2-170) and up against split ring set (2-70).

3.3.10 Install matched set of split rings (2-70) onto piston rod and retain with new retaining ring (2-80).

3.3.11 Apply lubricant to threads and end of tie bars (2-60), end without flats.

3.3.12 Install two tie bars (2-60) by carefully inserting through piston (2-20).

NOTE: Install tie bars (2-60) far enough through piston to expose inboard seal groove.

3.3.13 Apply lubricant to two o-ring seals (3-30) and install into exposed seal groove on inboard end of tie bars (2-60).

3.3.14 Insert tie bars through inner end cap (2-40) and screw into housing (1-10).

CAUTION: Tighten the tie bars until the threads bottom out, then back out each tie bar one-half (1/2) turn.

3.3.15 Apply a coat of lubricant to the bore of cylinder (2-10).

3.3.16 Apply lubricant to Tseal components (3-90) and install into piston outer diameter 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 piston (2-20) and cylinder (2-10), the component could be damaged, becoming a potential source of leakage.

NOTE: When installing cylinder (2-10) over piston seal (3-90), tilt cylinder 15° to 30° degrees to piston rod (2-170).

3.3.17 Install end of cylinder (2-10) over piston (2-20) and onto inner end cap (2-40).

3.3.18 Apply lubricant to two o-ring seals (3-30) and install into seal groove on outboard end of tie bars (2-60).

3.3.19 Install o-ring seal (3-60) into outer diameter seal groove of outer end cap (2-30).

- 3.3.20 Install outer end cap (2-30) onto tie bars (2-60) and into open end of cylinder (2-10).
- 3.3.21 Install heavy hex nuts (2-90) onto tie bars (2-60), using the heavy hex nuts (2-90) to draw all of the cylinder components into position.

CAUTION: While heavy hex nuts (2-90) are being tightened, do not allow tie bars (2-60) to turn.

- 3.3.22 Torque tighten heavy hex nuts (2-90) alternately, in 50 foot pounds, increments, until a final torque of 67 ± 7 foot pounds has been achieved. It is necessary that the flats on heavy hex nuts (2-90) be aligned and parallel before nut retainer (2-100) can be installed.
- 3.3.23 Install nut retainer (2-100) between the parallel flats of heavy hex nuts (2-90).
- 3.3.24 Install socket cap screw (2-120) and lockwasher (2-110).

3.4 SPRING CARTRIDGE INSTALLATION

- 3.4.1 Install gasket (3-10) over push rod (4-20) and up against brace plate (4-80).

NOTE: Before attempting to install spring cartridge (4-10) check that stop screws (1-60) have not been screwed in to the point that "pre-load" will be created on the spring cartridge during installation.

- 3.4.2 Remove the safety nuts from the inboard end of spring cartridge (4-10).
- 3.4.3 Engage spring cartridge (4-10) onto push rod (4-20). Align the two spring cartridge tie bar assemblies with holes located in brace plate (4-80). Also align brace rods (4-90) with holes in brace plate (4-80).

NOTE: It is necessary that the flats on the two spring cartridge hex nuts, located on outboard end of spring cartridge (4-10), be aligned and parallel before limit stop adapter can be installed between these two hex nuts.

- 3.4.4 Screw the two spring cartridge tie bar assemblies into brace plate (4-80). Alternately tighten the two tie bar assemblies hex nuts until spring cartridge (4-10) is firmly against brace plate (4-80).
- 3.4.5 Torque tighten the two spring cartridge tie bar assemblies to 65 ± 7 foot pounds.
- 3.4.6 Coat adjustable stop adapter internal threads with lubricant.
- 3.4.7 Coat adjustable stop assembly threads with lubricant.
- 3.4.8 Install adjustable stop adapter onto adjustable stop assembly. The small round portion of adjustable stop adapter will be screwed onto adjustable stop assembly facing the fixed nut located on the inboard end of the assembly.
- 3.4.9 Rotate adjustable stop assembly counter clockwise until it has moved to a position that places the adjustable stop's fixed nut, or inboard end, against adjustable stop adapter.

- 3.4.10 Install adjustable stop assembly, assembled with adjustable stop adapter, into outboard end of spring cartridge (4-10) by inserting the adjustable stop adapter between the two spring cartridge tie bar assemblies hex nuts.
- 3.4.11 Install two socket cap screws through the adjustable stop adapter and into the out board end of spring cartridge (4-10).
- 3.4.12 Torque tighten two socket head cap screws, installed in step 4.2.6 to a torque of 45 foot pounds \pm 5%.
- 3.4.13 Install lockwasher onto adjustable stop assembly.
- 3.4.14 Install jam nut onto adjustable stop assembly.
- 3.4.15 Tighten jam nut against lock washer.
- 3.4.16 On inboard side of brace plate (4-80), install four hex nuts (4-100) onto brace rods (4-90).
- 3.4.17 Adjust both stop screws (1-60) back to settings recorded in Section 2.1, step 2.1.2, under General Disassembly.
- 3.4.18 Tighten both jam nuts (1-120) securely, while holding stop screws (1-60).

3.5 **ACTUATOR TESTING**

- 3.5.1 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.**

- 3.5.2 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.

CAUTION: **Test the actuator by applying pneumatic pressure through a properly adjusted self relieving regulator, with gauge.**

- 3.5.3 Before testing for leaks, alternately apply and release NOP pressure 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.
- 3.5.4 Apply pressure, as defined in step 3.5.2, to pressure inlet port in outer end cap (2-30).
- 3.5.5 Apply a leak testing solution to the following areas:
 - 3.5.5.1 Joint between the outer end cap (2-30) and the cylinder (2-10). Checks cylinder to end cap seal.
 - 3.5.5.2 Around heavy hex nuts (2-90). Checks tie bars (2-60) to outer end cap seals.

- 3.5.5.3 Form a leak testing solution bubble over the breather port hole 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.
- 3.5.6 Operation test the actuator to verify proper function of the actuator. This test is to be done off of the valve or the device it is normally mounted on.
 - 3.5.6.1 Adjust the pressure regulator to the pressure as defined in step 3.5.2.
 - 3.5.6.2 Apply the above pressure to the outer end cap (2-30) pressure inlet port and allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.
- 3.5.7 Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, should be corrected and the above test performed again.
- 3.5.8 Remove pressure from pressure inlet port in outer end cap (2-30).
- 3.5.9 SPRING CARTRIDGE ADJUSTABLE STOP ASSEMBLY TESTING - This test is used to verify proper function of the spring cartridge adjustable stop assembly.
 - 3.5.9.1 On the outboard end of spring cartridge (4-10) loosen jam nut on adjustable stop assembly.
 - 3.5.9.2 Set adjustable stop assembly to the customers required degree open position.
 - 3.5.9.3 Tighten jam nut against lock washer.
 - 3.5.9.4 Apply operating pressure, as described in step 3.5.2 to the pressure inlet port in outer end cap (2-30).
 - 3.5.9.5 The actuator should go to the customers required setting, as set in step 3.5.9.2.
 - 3.5.9.6 Remove the operating pressure from outer end cap (2-30).
 - 3.5.9.7 On the outboard end of spring cartridge (4-10) loosen jam nut on adjustable stop assembly.
 - 3.5.9.8 Adjust adjustable stop assembly to the position that will allow full 90° degree actuator travel.
 - 3.5.9.9 Tighten jam nut against lock washer.
 - 3.5.9.10 Apply operating pressure, as described in step 3.5.2 to the pressure inlet port in outer end cap (2-30).
 - 3.5.9.11 The actuator should travel to the full open, counter clockwise, position.
 - 3.5.9.12 Remove operating pressure from outer end cap (2-30).

3.6 RETURN TO SERVICE

- 3.6.1 Install breather (11) into inner end cap (2-30) of cylinder (2-10). A new breather is provided in the service kit. Use this breather if it is the same NPT size as the original breather (11).
- 3.6.2 Replace the software components of snubber (1-190) and then install the snubber (1-190) in cover (1-20).
- 3.6.3 If not already done adjust both stop screws (1-60) back to settings recorded in Section 2.1, step 2.1.2, under General Disassembly.
- 3.6.4 Tighten both jam nuts (1-120) securely, while holding stop screws (1-60).
- 3.6.5 After actuator is installed on the device it is to operate, all accessories, should be hooked up, leak tested, and then tested for proper operation and replaced, if found defective.
- 3.6.6 Set adjustable stop per the facilities operational requirements and torque tighten adjustable stop jam nut to 465 foot pounds $\pm 5\%$ percent.
- 3.6.7 Actuator is now ready for returning to service.

SECTION 4.0

4.1 SPRING CARTRIDGE ADJUSTABLE STOP REMOVAL

- 4.1.1 If not already removed, disconnect all operating pressure from actuator pneumatic cylinder outer end cap (2-30), allowing the spring to travel to it's extended or spring unloaded position. The spring cartridge (4-10) will rotate the actuator to it's fail position.
- 4.1.2 On the outboard end of spring cartridge (4-10) loosen jam nut on adjustable stop assembly.
- 4.1.3 Remove two socket cap screws from adjustable stop adapter.
- 4.1.4 Remove adjustable stop assembly from spring cartridge (4-10).

4.2 SPRING CARTRIDGE ADJUSTABLE STOP INSTALLATION

- 4.2.1 Coat adjustable stop adapter internal threads with lubricant.
- 4.2.2 Coat adjustable stop assembly threads with lubricant.
- 4.2.3 Install adjustable stop adapter onto adjustable stop assembly. The small round portion of adjustable stop adapter will be screwed onto adjustable stop assembly facing the fixed nut located on the inboard end of the assembly.

- 4.2.4 Rotate adjustable stop assembly counter clockwise until it has moved to a position that places the adjustable stop's fixed nut, or inboard end, against adjustable stop adapter.
 - 4.2.5 Install adjustable stop assembly, assembled with adjustable stop adapter, into outboard end of spring cartridge (4-10) by inserting the adjustable stop adapter between the two spring cartridge tie bar assemblies hex nuts.
 - 4.2.6 Install two socket cap screws through the adjustable stop adapter and into the out board end of spring cartridge (4-10).
 - 4.2.7 Torque tighten two socket head cap screws, installed in step 4.2.6 to a torque of 45 foot pounds $\pm 5\%$.
 - 4.2.8 Install lockwasher onto adjustable stop assembly.
 - 4.2.9 Install jam nut onto adjustable stop assembly.
 - 4.2.10 Tighten jam nut against lock washer.
- NOTE: To test the Adjustable Stop Assembly refer to Section 3.5 step 3.5.9.
- 4.2.11 Set adjustable stop per the facilities operational requirements and torque tighten adjustable stop jam nut to 465 foot pounds $\pm 5\%$ percent.
 - 4.2.12 The adjustable stop assembly is now ready for service.

SECTION 5.0 - TOOL INFORMATION

5.1 GENERAL TOOL INFORMATION - All tools are American Standard inch. Two each medium screwdriver, small standard screwdriver with corners rounded, putty knife, strap wrench, 3/16" in punch, rubber or leather mallet, and torque wrench (up to 5,000 inch pounds).

5.2 RECOMMENDED TOOL AND TORQUE CHART.

ITEM NO.	WRENCH SIZE (INCHES)	DESCRIPTION	RECOMMENDED WRENCH STYLE	TORQUE FT-LB ($\pm 5\%$)
1-60	1/2	Stop Screw	Open End or Adjustable	(2)
1-70	7/16	Grease Fitting	Open End or Box	(3)
1-80	9/16	Pipe Plug	Open End or Adjustable	(3)
1-90	9/16	Hex Cap Screw	Socket	12
1-120	1-5/16	Hex Jam Nut	Box End (1)	240
1-180	3/16	Socket Cap Screw	Allen	4
1-190	7/8	Snubber Valve	Deep Socket	(3)
1-220	15/16	Hex Cap Screw	Socket	85
2-60	1/2	Tie Bar Flats	Open End or Adjustable	(2)
2-90	1-7/16	Heavy Hex Nut	Deep Socket	67
2-120	3/16	Socket Cap Screw	Allen	4
2-170	1-1/4	Piston Rod Flats	Crows Foot (1)	157
4-100	1-5/16	Standard Hex Nut	Open End or Adjustable	160
11	11/16	Breather	Thin Open End (1)	(2)
-	5/8 Sq.	Limit Stop Stud	Open End or Adjustable	(2)
-	1-13/16	Heavy Hex Jam Nut	Open End or Adjustable	465
-	3/8	Socket Cap Screw	Allen	45
<p>(1) No alternate style tool recommended. (2) Not required. (3) Tight plus 1/4 turn.</p>				

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	BY	DATE
COMPILED	Bill Cornelius	7 March 1996
CHECKED	Bill Cornelius	7 March 1996
APPROVED	Robert McEver	7 March 1996

* Signatures on file Waller, Texas