BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR MODEL

F102XX-SR(CW)

SPRING RETURN

PNEUMATIC ACTUATOR

PART NUMBER: 113259

REVISION: "A"

DATE: April, 1994

1.0. INTRODUCTION

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis F102XX-SR(CW) Spring Return "Scotch-Yoke" pneumatic type actuator.

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 well trained, equipped, prepared and competent personnel.

WARNING: For the protection of personnel working on Bettis actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be noted to the WARNINGS, CAUTIONS and NOTES contained in this procedure.

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 dismounted 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. 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 - Seal/Service Kit, razor sharp cutting instrument, Seal removal tool, commercial leak testing solution, and a 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 and wrench sizes refer to Chart 1 on page 17.

3.O REFERENCE BETTIS MATERIALS

3.1 Assembly Drawing part number 113150.

3.2 Base I Standard dimensional drawing part number 113225.

4.0 GENERAL DETAILS

4.1 This procedure should only be implemented by technically competent technicians 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 and actuator Part Lists).

4.3 As referenced in this procedure the front of the actuator is: Yoke bore nearest the technician. The top of the actuator will be the housing cover.

4.4 Due to the extreme size and weight of this actuator and it's parts it is recommended that the actuator be removed from it service location and be taken to a location where a heavy duty lift crane is available. The actuator weight can be determined from the Bettis Base I standard dimensional drawing.

4.5 Lift the actuator by the lifting lug assembly (1-330) on the sides of the housing.

WARNING: Lift the actuator only by the lifting lugs (1-330). Do not attempt to lift the actuator/valve assembly by lifting lugs (1-330).

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

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

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

4.8 LUBRICATION REQUIREMENTS: For use in all areas of the actuator. Lubricants, other than those listed in this procedure should not be used without prior written approval of Bettis Product Engineering. Standard and high temperature service (-20□F to +350□F) use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis Service/Seal Kit.

CAUTION: Actuator operating pressure is not to exceed the maximum operating pressure rating listed on it's name tag.

4.9 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. Also note if the actuator's spring rotates the actuator back to its' full fail position.

5.0 GENERAL DISASSEMBLY

5.1 Unscrew and remove one snubber valve (1-170) from the housing cover and four from the housing mounting plate.

5.2 Remove stop screw nut pipe plug (2-130) and SR cartridge stop screw nut pipe plug.

NOTE: The stop screw (2-100) and SR stop screw have a 1/2" Square X 7/8" deep female hole in their outboard end.

5.3 Hold the stop screw (2-100) in place through the pipe plug hole in the end of the stop nut. Using a 1/2 inch square male drive extension hold the stop screw in place, remove stop nut (2-110).

5.4 Repeat the stop nut removal procedure used in step 5.3 on the spring cartridge SR stop screw and stop nut.

5.5 Measure and record the exposed length of the power cylinder stop screw (2-100) and SR cartridge stop screw.

5.6 Remove two in number breathers (11). One breather is located in outer end cap (2-30) and the other in the adapter (2-170). NOTE: Due to some control systems being of the closed loop design some actuators may not have breathers, but will exhaust through a related control valve.

5.7 Mark and record location of the pressure inlet ports on the cylinder outer end cap (2-30), inner end cap (2-20) and adapter (2-170).

6.0 SPRING CARTRIDGE REMOVAL

6.1 The spring cartridge "pre-load" must be removed before the actuator is disassembled. Remove the spring cartridge "pre-load" as follows: Apply 50 psig pneumatic pressure to both cylinder pressure inlet ports. Unscrew and remove the spring cartridge stop screw located on the spring cartridge (3-10). Remove the pressure from the pressure inlet ports.

CAUTION: Due to the weight and size of the spring cartridge, heavy duty support equipment will be required when removing the spring cartridge from the actuator housing. The approximate weight of the spring cartridge is as follows:

(1) SR1 = 4968 pounds.
(2) SR2 = 4508 pounds.

6.2 NOTE: Removal of SR pull rod may require extra amount of torque for break out due to the use of Loctite - 242 during assembly. Unscrew the spring cartridge pull rod from the yoke pin nut (1-110). The pull rod can be rotated for removal by going through the spring cartridge stop screw hole with a 1/2 inch square male drive extension.

6.3 Remove hex head screws (3-40) from adapter plate (3-20).

6.4 Remove two in number SR nut retainer socket cap screws from outer end cap of the SR cartridge (next to the SR tie bar nuts).

6.5 Loosen spring cartridge tie bar hex nuts one turn.

6.6 NOTE: Flats are provided on the outboard end of the SR tie bars for wrench placement. Unscrew the spring cartridge tie bars from adapter plate (3-20). Pull the cartridge (3-10) away from and off of the adapter plate (3-20).

6.7 To keep from inadvertently pulling the SR tie bars back into the spring cartridge use 1-3/8 inch 12 UNC hex nuts and screw them on to the spring cartridge tie bars. Place the spring cartridge to one side.

WARNING: Under no circumstances should the spring cartridge be cut apart, as the spring is pre-loaded and the spring cartridge welded together.

7.0 TANDEM PRESSURE CYLINDERS DISASSEMBLY

7.1 Remove two in number tie bar hex nuts (2-120) from the outboard side of outer end cap (2-30).

CAUTION: Do not damage o-ring groove when removing end cap.

7.2 The fit between the cylinder and the outer end cap is very tight. Break the end cap free by tapping with a breaker bar on lip provided on the end cap. Remove outer end cap (2-30) from cylinder (2-180).

7.3 Remove cylinder (2-180) from cylinder adapter (2-170). When removing the cylinder off of the piston, tilt the cylinder 15□ to 30□ degrees with respect to actuator centerline to help facilitate removal.

7.4 NOTE: Flats on outboard end of tie bars are provided for wrench placement. Unscrew and remove outer tie bars (2-40) from the cylinder adapter (2-170).

7.5 Refer to assembly drawing page 2 of 2 Detail "F". NOTE: Keep the split rings in matched sets. Remove split ring set (2-70) and split ring retainer (2-90) from the outboard end of piston rod (2-50).

NOTE: The piston (2-60) acts as the retainer for the inboard split rings (2-70). When removing the piston be careful to not loose the split rings (2-70).

7.6 Remove the outboard piston (2-60) and the inboard split rings from piston rod (2-50). Refer to step 7.7 for disassembly of the pistons tie bar bushings (2-140).

7.7 Piston disassembly (refer to assembly drawing sheet 2 of 2 detail "F").

7.7.1 Remove the retaining rings (2-150) from the piston.

7.7.2 NOTE: The piston tie bar bushing should be replaced each time the actuator is refurbished (refer to section 1 for recommended service interval). Remove the piston tie bar bushing (2-140) from the piston. NOTE: The Bettis Service Kit should contain new piston tie bar bushings.

7.8 Refer to assembly drawing page 2 of 2 Detail "F". Remove o-ring seal (5-20) from outboard end of piston rod (2-50).

7.9 Refer to assembly drawing page 2 of 2 Detail "C". Remove two in number nut retainer socket cap screws (2-210) with flat washers (2-220) from adapter (2-170), next to the adapter tie bar nuts (2-120).

7.10 Unscrew and remove two in number tie bar nuts (2-120) from the outboard side of cylinder adapter (2-170).

7.11 Remove cylinder adapter (2-170) from piston rod (2-50).

7.12 Refer to assembly drawing page 2 of 2 Detail "C". Remove two in number retaining rings (2-200) and rod bushings (2-190) from cylinder adapter (2-170).

7.13 NOTE: When removing the cylinder off of the piston, tilt the cylinder 15□ to 30□ degrees with respect to actuator centerline. Remove cylinder (2-10) from inner end cap (2-20).

CAUTION: Do not use pipe wrench to remove tie bars.

7.14 NOTE: Flats on outboard end of tie bars (2-40) are provided for wrench placement. Unscrew and remove tie bars (2-40) from adapter (2-160).

7.15 Refer to assembly drawing page 2 of 2 Detail "F". NOTE: Keep the split rings in matched sets. Remove split ring set (2-70) and split ring retainer (2-90) from the outboard side of inner piston (2-60).

NOTE: The piston (2-60) acts as the retainer for the inboard split rings (2-70). When removing the piston be careful to not loose the split rings (2-70).

7.16 Remove the inner piston (2-60) and inboard split rings (2-70) from the piston rod (2-50). Refer to step 7.7 for disassembly of the pistons tie bar bushings (2-140).

7.17 Remove o-ring seal (5-20) and remove inner end cap (2-20) off of piston rod (2-50).

8.0 HOUSING DISASSEMBLY

8.1 Refer to assembly drawing page 2 of 2 Detail "J". Before removing the position indicator, record or mark it's position. Loosen two each socket set screws (1-370) and remove position indicator (1-340).

8.2 Refer to assembly drawing page 2 of 2 Detail "H". Unscrew and remove hex cap screws (1-320) with seal gaskets (4-30) from position indicator cover (1-310).

8.3 Refer to assembly drawing page 2 of 2 Section A-A. Remove position indicator cover (1-310).

8.4 Refer to assembly drawing page 2 of 2 Section A-A. NOTE: Mark and record the orientation of the position indicator drive (1-280) in relation to the top of the yoke (1-70).

8.5 Refer to assembly drawing page 2 of 2 Detail "H". Unscrew and remove eight in number hex cap screws (1-290) with lock-washers (1-300) from position indicator drive (1-280).

8.6 Refer to assembly drawing page 2 of 2 Section A-A. Remove position indicator drive (1-280) from top of yoke (1-70).

8.7 Refer to assembly drawing page 2 of 2 Detail "H". Located on upper yoke bushing (1-80), remove sixteen in number hex cap screws (1-150) with lock-washers (1-160) from four in number yoke bushing retainers (1-140).

8.8 Refer to assembly drawing page 2 of 2 Detail "H". Remove four in number yoke bushing retainers (1-140).

8.9 NOTE: The ten cover screws (1-240), that stick up with hex nut (1-250) on them, are not to be removed. Remove forty eight in number cover screws (1-40) and gasket seals (4-30).

8.10 To help in removing the housing cover (1-20) loosen the ten hex nuts (1-250). Alternately rotate the ten raised cover screws (1-240) clockwise until the cover is clear of the ten in number dowel pins (1-30).

8.11 Remove the housing cover (1-20). NOTE: The cover will have a very tight fit. It is not necessary to remove dowel pins (1-30) from the actuator.

8.12 Refer to assembly drawing page 2 of 2 Detail "H". Remove the upper yoke bushing (1-80) from the top of the yoke (1-70).

8.13 Refer to assembly drawing page 2 of 2 Detail "H". Remove two in number socket cap screws (1-120) and lock-washers (1-130) from the yoke pin retainer (1-110). Remove yoke pin retainer (1-110).

8.14 Refer to assembly drawing page 2 of 2 Section A-A. NOTE: Remove yoke pin by inserting 1/2"-13 UNC screw into top of yoke pin and pull straight up and out. Remove yoke pin (1-90).

8.15 Refer to assembly drawing page 1 of 2 main view and page 2 of 2 Detail "D". Rotate the yoke arms, so as, to expose the guide block (1-50). NOTE: The uppermost slide block (1-100) may fall out of yoke slot once the slot clears guide block (1-50).

8.16 Refer to assembly drawing page 2 of 2 Detail "H" and Section A-A. Remove the top and bottom slide blocks (1-100) from the yoke arms.

8.17 Refer to assembly drawing page 2 of 2 Detail "D". Before starting this step refer to "Notes for step 8.17". Insert a 3/8" diameter rod/punch through the small hole on top of the guide block (1-50) and into the hole in the rod extension (1-200). Holding this tool in place unscrew the piston rod (2-50) from the piston rod extension (1-200).

NOTES FOR STEP 8.17:

1. The rod extension (1-200) may need to be rotated to align its hole with hole in the guide block.

2. Flats are provided on the piston rod for wrench placement. Removal of piston rod may require extra amount of torque for break out due to the use of Loctite - 242 during assembly.

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

8.18 Remove eight in number hex cap screws (1-270) and lock washers (1-360). NOTE: Four in number hex cap screws (1-270) and lock washers (1-360) will be removed from inside each side of housing (1-10).

8.19 Refer to assembly drawing page 1 of 2 main view and page 2 of 2 Detail "E". Remove adapter (2-160) and piston rod bushing (2-80).adapter plate (3-20).

8.20 Refer to assembly drawing page 1 of 2 main view and Detail "B". Remove adapter plate (3-20) and pilot bushing (3-30).

8.21 Refer to assembly drawing page 2 of 2 Detail "D". Remove eight in number socket cap screws (1-220) from rod extension flange (1-210).

8.22 Refer to assembly drawing page 2 of 2 Detail "D". Remove rod extension flange (1-210) and rod extension (1-200) from guide block (1-50). NOTE: One in number spherical washer (1-230) will be removed with rod extension (1-200).

8.23 Remove one in number spherical washer (1-230) from rod extension (1-200).

8.24 Refer to assembly drawing page 1 of 2 main view. Remove guide bar (1-60) by sliding out of the guide block (1-50) and housing (1-10).

8.25 Refer to assembly drawing page 2 of 2 Section A-A. Remove the guide block (1-50).

8.26 Refer to assembly drawing page 2 of 2 Section A-A. Remove yoke (1-70) by lifting yoke up and out of the housing (1-10).

8.27 Located on lower yoke bushing (1-80) remove sixteen in number hex cap screws (1-150) with lock-washers (1-160) from four in number yoke bushing retainers (1-140).

8.28 Remove four in number yoke bushing retainers (1-140).

8.29 Remove lower yoke bushing (1-80) from the bottom of the housing or from the lower end of the yoke (1-70).

8.30 The following items need not be removed for standard actuator refurbishment: Stop screws (2-100), eight in number pipe plugs (1-260) and one in number pipe plug (1-380).

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 old 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 should 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. NOTE: The parts and seals used in the actuator will be assembled using lubricant as identified in step 4.8..

9.5 Piston T-seal and Rod T-seal installation instructions - The T-seal is a set composed of one rubber seal and two split skive-cut back-up rings.

9.5.1 Install the T-seal into the seal grooves.

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.

9.6 Prime and apply master gasket (510) to all surfaces as indicated on the assembly drawing (reference note flag number 6). Master Gasket should be applied per the manufactures instructions. In general a small continuous bead of sealant should be applied to one of the jointing surfaces. This sealant bead should be applied as close to the edge of jointing surfaces. This sealant bead should also be applied around any unsealed passages that passes through either surfaces to the atmosphere.

10.0 HOUSING GROUP REASSEMBLY

NOTE: For ease of assembly position the housing (1-10) with the bottom of housing in the up position. Re-position the housing as required to proceed with re-assembly.

10.1 Apply lubricant to the yoke bushing bore in the housing (1-10) and arrange the housing with the yoke bore nearest you.

10.2 Install two in number o-ring seals (4-10) into outer diameter o-ring groove on two in number yoke bushings (1-80).

10.3 Install two in number o-ring seals (4-20) into inner diameter o-ring groove in two in number yoke bushings (1-80).

10.4 Install the one of the yoke bushings (1-80) into the bottom of the housing. Install four in number yoke bushing retainers (1-140). Fasten the yoke bushing retainers with sixteen in number hex cap screws (1-150) and lock-washers (1-160).

10.5 Coat the bearing surfaces of the yoke (1-70) with lubricant and install into the lower yoke bushing (1-80).

10.6 Refer to assembly drawing page 2 of 2 Detail "H". Install the remaining yoke bushing (1-80) onto the upper bearing surface of yoke (1-70).

10.7 Apply lubricant to the guide block (1-50) and guide bar (1-60).

NOTE: Refer to assembly drawing page 2 of 2 Detail "D" for steps 10.8 through 10.11.

10.8 Install one of the spherical washers (1-230) into side of the guide block (1-50). NOTE: The spherical side of the washer will be facing to the right or to the outside of the guide block.

10.9 Install the second spherical washer (1-230) over the threaded end of the rod extension (1-200). NOTE: The spherical side of the washer will go on the rod extension facing the head of the rod extension.

10.10 Install the rod extension (1-200) into guide block (1-50) and up against the first spherical washer (1-230).

10.11 Install the rod extension flange (1-210) over the rod extension (1-200) and retain with eight in number socket cap screws (1-220).

10.12 Install guide bar (1-60) into left side of housing (1-10). Take the guide block (1-50) and insert the guide bar (1-60) through the guide block and then insert the guide bar into the right side of the housing (1-10).

10.13 Prepare the mounting surface of adapter (2-160), adapter plate (3-20) and both adapter mounting areas of the housing (1-10) per master gasket instructions (reference step 9.6).

10.14 Place eight in number lock washers (1-360) on to hex cap screws (1-270).

10.15 Refer to assembly drawing page 1 of 2 main view and page 2 of 2 Detail "E". Install o-ring seal (4-40) into the adapter (2-160).

10.16 Refer to assembly drawing page 1 of 2 main view and page 2 of 2 Detail "E". Position the adapter (2-160) on the left side of housing (1-10), as viewed on page 1 of 2 of the assembly drawing part number 113150, and install rod bushing (2-80) through the adapter (2-160) and then into the side of housing (1-10).

10.17 From inside the housing insert four in number hex cap screws (1-270) through the housing (1-10) and into matching holes in adapter (2-160). Torque tighten the hex cap screws (1-270) to 1020 ±5% foot pounds lubricated.

10.18 Refer to assembly drawing page 1 of 2, Detail "B". Install o-ring seal (4-40) into the adapter plate (3-20).

10.19 Refer to assembly drawing page 1 of 2, main view and detail "B". Position the adapter plate (3-20) on the right side of housing (1-10) and install pilot bushing (3-30) through the adapter plate (3-20) and into the side of housing (1-10).

10.20 From inside the housing insert four in number hex cap screws (1-270) through the housing (1-10) and into matching holes in adapter plate (3-20). Torque tighten the hex cap screws (1-270) to 1020 ±5% foot pounds lubricated.

10.21 Apply Loctite - 242 to external threads on piston rod (2-50). NOTE: Loctite cure time is 10 - 30 minutes.

10.22 Refer to assembly drawing page 1 of 2 main view and page 2 of 2 Detail "D". Lubricate piston rod (2-50) and insert it into and through adapter (2-160) and rod bushing (2-80). Screw piston rod (2-50) into the rod extension (1-200). Secure the piston rod in the rod extension by inserting a 3/8" inch diameter punch into the hole in the head of the rod extension (1-200). Use a wrench on the piston rod outer end to tighten the piston rod onto the piston rod extension (1-200).

10.23 Refer to assembly drawing page 2 of 2 Section A-A and Detail "H". Install the sliding blocks (1-100) by mounting one sliding block down into the lower yoke arm with the two tapped holes facing up.

10.24 While holding the second sliding block (1-100) in the upper yoke arm, move guide block (1-50) into position between the yoke arms and sliding blocks.

10.25 Refer to assembly drawing page 2 of 2 Section A-A. Align holes in upper sliding block with the matching holes in the guide block. Install the yoke pin (1-90) by inserting into the hole in the sliding block (1-100). The yoke pin can be held in place by fastening a screw into the tapped hole in the upper end of the yoke pin.

10.26 Refer to assembly drawing page 2 of 2 Detail "H". While holding the yoke pin in place slide the yoke pin retainer (1-110) into the yoke pin groove and attach to the sliding block (1-100) using socket cap screws (1-120) with lock-washers (1-130).

11.0 PRESSURE CYLINDER RE-ASSEMBLY

11.1 Prepare the mounting surface of the inner end cap (2-20) per master gasket instructions (reference step 9.6).

11.2 Refer to assembly drawing page 2 of 2 Detail "E". Coat the rod seal (5-70) with lubricant and install, lip first, into the recess provided in the inner end cap (2-20).

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

11.3 Refer to assembly drawing page 1 of 2 main view. Install adapter o-ring seal (5-10) into the seal groove in the adapter (2-160).

11.4 Refer to assembly drawing page 2 of 2 Detail "G". Coat two tie bar o-ring seals (5-20) with lubricant and install into the inner end cap (2-20).

11.5 Apply lubricant to the end cap o-ring seal (5-40) and install into the O.D. o-ring groove of inner end cap (2-20).

11.6 Install the inner end cap (2-20) over the piston rod (2-50), rod bushing (2-80) and up against adapter (2-160). NOTE: The pressure inlet port should be positioned in the same position as recorded in section 5.

NOTE: Refer to assembly drawing page 2 of 2 Detail "F" for steps 11.7 through 11.13.

11.7 Install the o-ring seals (5-30) into the O.D. groove on the tie bar bushings (2-140).

11.8 NOTE: Refer to section 9 for proper T-seal installation instructions. Apply lubricant to four sets of T-seal components (5-60). Install the four sets of T-seals into the I.D. seal grooves of four in number tie bar bushings (2-140).

11.9 Install four in number tie bar bushings (2-140) into two in number pistons (2-60). Retain tie bar bushings with four in number retaining rings (2-150).

11.10 Coat outboard end of piston rod (2-50) with lubricant.

11.11 Apply lubricant to o-ring (5-20) and install into innermost o-ring groove in piston rod (2-50).

11.12 Install a matched set of split rings (2-70) into the inner most groove in the piston rod and retain by installing the recessed area of piston (2-60) onto the piston rod and over the split ring set (2-70).

11.13 Install a matched set of split rings (2-70) into the piston rod and retain with the split ring retainer (2-90).

11.14 Coat one of the piston T-seal components (5-50) with lubricant and install into the piston external seal groove. Refer to section 9 for proper "T" seal installation instructions.

CAUTION: Make certain the back-up rings, components of the rod T-seal (5-60), are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and tie bar, the components could be damaged, becoming a potential source of leakage.

11.15 Take "housing-end" of two in number tie bars (2-40), end without wrench flat, and install by carefully pushing tie bars through piston (2-60) and rod T-seal (5-60).

11.16 Apply Loctite - 242 to the exposed external threads on two in number tie bars (2-40) that was install in step 11.15. NOTE: Loctite cure time is 10 - 30 minutes.

11.17 Insert the tie through inner end cap (2-20) and screw into the adapter (2-160).

CAUTION: Tighten the tie bars (2-40) until the threads bottom out, then back out each tie bar one-half turn.

11.18 Apply lubricant to the bore of the cylinder (2-10).

11.19 Install lubricated cylinder (2-10) over piston (2-60) and onto inner end cap (2-20). When sliding the cylinder over the piston seal tilt cylinder 15□ to 30□ degrees to piston rod.

CAUTION: If needed, when installing the cylinder, hammer on the end of the cylinder only with a non metallic object.

CAUTION: Make certain the back-up rings, components of the piston T-seal (5-50), are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and cylinder, the components could be damaged, becoming a potential source of leakage.

11.20 Install two in number o-ring seals (5-40) onto the O.D. seal groove of cylinder adapter (2-170).

NOTE: Refer to assembly drawing page 2 of 2 Detail "C" for steps 11.21 through 11.23.

11.21 Install rod seal (5-70) into recess (counter-bore) provided in the cylinder adapter (2-170). Install with energizer ring facing into the adapter (2-170).

11.22 Install the rod bushing (2-190) into the counter bore in the cylinder adapter (2-170) and retain by installing the retaining ring (2-200).

11.23 Install two in number o-ring seals (5-20) in the cylinder adapter (2-170).

11.24 Install the cylinder adapter (2-170) over the piston rod (2-50), tie bars (2-40) and into cylinder (2-10). The cylinder adapter should be install with the rod bushing recess facing the housing (1-10) or into the cylinder (2-10).

CAUTION: While the tie bar nuts (2-120) are being tightened, do not allow the tie bars (2-40) to turn.

11.25 Install the tie bar nuts (2-120) on the tie bars (2-40). Torque tighten the tie bar nuts, alternately in 100 ft.lb increments, until a final torque of 1500 ±150 foot pounds lubricated has been achieved.

11.26 Refer to assembly drawing page 2 of 2 Detail "C". NOTE: It is necessary that the flats on the tie bar hex nuts (2-120) be positioned in such a manner that flat washer (2-220) and socket head cap screws (2-210) can be installed. Secure the hex nuts in place with flat washers (2-220) and socket head cap screws (2-210).

11.27 Apply Loctite - 242 to the external threads on two in number tie bars (2-40). NOTE: Loctite cure time is 10 - 30 minutes.

11.28 Install the outer tie bars (2-40) into the cylinder adapter (2-170). Tighten until threads bottom out, then back out one half-turn.

11.29 Install o-ring seal (5-20) into the o-ring seal groove on piston rod (2-50).

11.30 Coat the grooves on the piston rod (2-50) with lubricant.

11.31 Refer to assembly drawing page 2 of 2 Detail "F". Install a matched set of split rings (2-70) into the inner most groove in the piston rod and retain by installing the recessed area of the remaining piston (2-60) onto the piston rod and over the split ring set (2-70).

11.32 Refer to assembly drawing page 2 of 2 Detail "F". Install a matched set of split rings (2-70) and ring retainer (2-90).

11.33 Install a piston T-seal (5-50) into the O.D. groove on the outboard piston (2-60).

11.34 Apply lubricant to the bore of cylinder (2-180).

CAUTION: Make certain the back-up rings (components of the rod T-seal) are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and tie bar, the components could be damaged, becoming a potential source of leakage.

CAUTION: If needed, when installing the cylinder, hammer on the end of the cylinder only with a non metallic object.

11.35 Install lubricated cylinder (2-180) over the piston and onto cylinder adapter (2-170). Cylinder will have to be tilted approximately 15□ to 30□ degrees across piston to facilitate installation.

11.36 If removed, install stop screw (2-100) into outer end cap (2-30).

11.37 Install two in number o-ring seals (5-20) in the outer end cap (2-30).

11.38 Install o-ring seal (5-40) onto the O.D. seal groove on outer end cap (2-30).

11.39 Install the outer end cap (2-30) onto tie bars (2-40) and into cylinder (2-180).

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

11.40 Install two in number tie bar hex head nuts (2-120) onto outer tie bars (2-130). Torque tighten the tie bar nuts, alternately in 100 foot pound increments, until a final torque of 1500 ±150 foot pounds lubricated has been achieved.

12.0 SPRING CARTRIDGE INSTALLATION

12.1 If installed remove the safety nuts from the inboard end of the spring cartridge (3-10).

12.2 Refer to assembly drawing page 1 of 2 Detail "B". Install the o-ring seal (6-40) over the SR tie bars and Into the o-ring groove in the adapter plate (3-20).

CAUTION: While installing the pull rod do not allow the spring cartridge tie bars to be pushed back into the spring cartridge.

12.3 Bring the spring cartridge up to the housing and insert the pull rod through the adapter plate, housing and then screw pull rod into the yoke pin nut (1-110). The pull rod can be rotated by going through the spring cartridge stop screw hole (in the outboard end of the cartridge) with a 3/4 inch square drive extension. Torque tighten the pull rod to 166 foot pounds lubricated.

12.4 Apply Loctite - 242 to the external threads on two in number SR tie bars, housing end only. NOTE: Loctite cure time is 10 - 30 minutes.

12.5 Screw the SR tie bars into adapter plate (3-20) Tighten each tie bar until the threads bottom out, then back out one half-turn.

12.6 Use the spring cartridge tie bar nuts to draw the spring cartridge firmly against the adapter plate (3-20). NOTE: While the nuts are being tightened, do not allow the tie bars to turn.

12.7 Install four in number hex head screws (3-60) with lock washers (3-70) through the adapter plate (3-20) and into the spring cartridge end plate. Torque tighten to 130 foot pounds lubricated.

12.8 Remove the SR tie bar nuts on outboard end of the spring cartridge. Removed old thread seals (6-10) and countersunk washers (6-20).

12.9 Install new thread seals (6-10) and countersunk washers (6-20). Re-install the SR tie bar nuts onto the SR tie bars.

12.10 NOTE: While the nuts are being tightened, do not allow the tie bars to turn. Torque tighten the SR tie bar nuts, alternately in 50 ft.lb increments, until a final torque of 150 ±15 foot pounds has been achieved.

12.11 Install the SR stop screw into the outboard end of the spring cartridge (3-10).

13.0 HOUSING COVER INSTALLATION

13.1 Prepare the mounting surfaces of the housing (1-10) and the housing cover (1-20) per master gasket instructions (reference step 9.6).

13.2 Place the housing cover gasket (4-90) on the housing (1-10).

13.3 Remove forty eight in number housing cover hex cap screws (1-40) and replace the gasket seals (4-30) with new seals.

13.4 Install the housing cover (1-20), being careful not to damage the cover gasket (4-90).

13.5 Using the ten in number hex cap screws (1-240) lower the housing cover onto the housing (1-10).

13.6 Install forty eight in number housing cover hex cap screws (1-40) with gasket seals (4-30). NOTE: Leave finger tight - do not tighten.

13.7 NOTE: Do this step only if the cover pins (1-30) have been pulled or if the pins are being replaced. Drive the ten in number dowel pins (1-30) through the cover (1-20) and into the housing (1-10). The pins should be flush with the cover.

13.8 Tighten the housing cover hex cap screws (1-40).

13.9 NOTE: Hold hex cap screws (1-240) in place, make sure the screws do not contact the housing (1-10), while tightening the hex nuts (1-250). Tighten the ten in number hex nuts (1-250).

13.10 Install four in number yoke bushing retainer (1-140). Fasten sixteen in number hex cap screws (1-150) and lock-washers (1-160).

13.11 Install the position indicator drive (1-280) onto the top of the yoke (1-70) and retain with eight in number hex cap screws (1-290) with lock-washers (1-300). NOTE: Refer to step 8.4 for correct installation position.

NOTE: Refer to assembly drawing page 2 of 2 Detail "J" for steps 13.12 through 13.14.

13.12 Install the wear ring (4-60) into bottom groove inside the position indicator cover (1-310).

13.13 Install the o-ring seal (4-50) into the seal groove on the middle area of the position indicator cover (1-310).

13.14 Install the rod wiper (4-100) into the top groove inside position indicator cover (1-310).

13.15 Prepare the position indicator cover mounting surface of the housing cover (1-20) and the mounting surface of the position indicator cover per master gasket instructions (reference step 9.6).

13.16 Refer to assembly drawing page 2 of 2 Detail "H". Install the o-ring seal (4-80) into the seal groove on the position indicator cover (1-310).

13.17 Refer to assembly drawing page 2 of 2 Section A-A and Detail "H". Install the position indicator cover (1-310), being careful not to damage the o-ring seal (4-50), wear ring (4-60) and rod wiper (4-100).

13.18 Refer to assembly drawing page 2 of 2 Detail "H". Install and tighten position indicator cover hex cap screws (1-320) with seal gaskets (4-30).

13.19 NOTE: Refer to step 8.1 for correct position indicator placement. Refer to assembly drawing page 2 of 2 Detail "J". Install the position indicator (1-340) over the exposed shaft of the position indicator drive (1-280) and retain in this position by tightening two in number socket set screw (1-370).

13.20 Adjust both stop screws (2-100) back to settings recorded in section five under General Disassembly.

13.21 Install two in number o-ring seals (5-30) into stop screw nuts (2-110).

13.22 Tighten both stop nuts (1-110) securely.

14.0 ACTUATOR TESTING

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

14.2 Cycle the actuator five time at the nominal operating pressure (NOP) as listed on the actuator name tag or the customers normal actuator supply pressure. If excessive leakage across the pistons is noted, generally a bubble which breaks three seconds or less after starting to form, cycle the actuator five times as this will allow the seals to seek their proper service condition. If excessive leakage across the piston remains, the actuator must be disassembled and the cause of leakage must be determined and corrected.

14.3 Simultaneous apply NOP pressure to the pressure port in the inner end cap (2-20) and to the adapter (2-170) and allow the actuator to stabilize.

14.4 Apply a commercial leak testing solution to the following areas:

14.4.1 Joint between the inner end cap (2-20) and the cylinder (2-10). This checks cylinder to inner end cap o-ring seal.

14.4.2 The breather port hole in the cylinder adapter (2-170). This checks the inner piston to cylinder (2-10) "T"seal (5-50), the o-ring seal (5-10), (5-20) and rod seal (5-60).

14.4.3 The snubber valve port hole in housing cover. This checks o-ring seals that seals tie bars to inner end cap. Also checks rod seal (5-60) that seals piston rod to inner end cap.

14.4.4 Joint between cylinder adapter (2-170) and cylinder (2-110). This checks cylinder to cylinder adapter (2-170) o-ring seal.

14.4.5 The breather port hole in the outer end cap (2-30). This checks outer piston to cylinder (2-180), piston to tie bars, and piston to piston rod o-ring seal.

14.4.6 The breather port hole in the cylinder adapter (2-170). This checks piston rod seal (5-70) and o-ring seal (5-20) installed in the cylinder adapter (2-170).

14.4.7 Remove pressure from the pressure inlet ports.

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

15.0 RETURN TO SERVICE

15.1 Replace the software components of five in number snubber valves (1-170). Install one snubber valve in the housing cover (1-20) and four in number snubber valves into the housing mounting ring.

15.2 Actuator is ready to be returned to service.

15.3 After the actuator is installed on the valve all accessories should be hooked up and tested for proper operation and replaced if found defective.

CHART NO. 1 - TOOL STYLE AND WRENCH SIZES

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED WRENCH STYLE
1-40	3/4"	48	Cover Screws	Socket
1-120	3/8"	2	Yoke pin retainer	Allen
1-150	9/16"	32	Yoke bushing retainer	Socket
1-170	7/8"	5	Snubber	Deep socket
1-220	1/2"	16	Rod extension	Allen
1-240	3/4"	10	Cover lifting screws	Socket
1-250	3/4"	10	Cover lifting nuts	Open end
1-270	2-3/16"	8	Housing to adapter	Socket
1-290	7/16"	8	Position indicator drive	Socket
1-320	3/4"	8	Position indicator cover	Socket
1-350	1-1/2"	16	Lifting lug screws	Socket
1-370	1/8"	2	Position indicator	Allen
2-40	1-1/4"	4	Tie bars flats	Open end or adjustable
2-50	1/2 Sq.	1	Piston rod	Male square (1)
2-100	1-1/4"	1	Stop screw	Open end or adjustable
2-110	3-3/4"	1	Stop Screw nut	Open end or adjustable
2-120	3-1/2"	4	Tie bar nuts	Crows foot or deep socket
	1-1/4"	1	SR Stop screw	Open end or adjustable
2-210	3/16"	2	Tie bar nut retainer	Allen
	3 "	1	SR Stop Screw nut	Open end or adjustable
3-60	1-1/8"	4	SR adapter plate screws	Socket
	2-3/16"	2	SR Tie bar nuts	Crows foot or deep socket

(1) Alternate size is 3/8 inch male square drive (only in early models).

ECN	DATE	REV		BY *	DATE
Released	March, 1994	A	COMPILED	BC	2 March 1994
			CHECKED	BJ	2 March 1994
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* **Signatures on file Bettis Actuator & Controls, Waller, Texas**