

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY AND REASSEMBLY**

**FOR THE FOLLOWING MODELS**

**HD722-SR AND HD732-SR**

**SPRING RETURN SERIES**

**PNEUMATIC ACTUATORS**

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## **SECTION 1 - INTRODUCTION**

### **1.1 GENERAL SERVICE INFORMATION**

1.1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis HD722-SR, HD722-SR-M3, HD722-SR-M3HW, HD732-SR, HD732-SR-M3, and HD732-SR-M3HW Spring Return Series Pneumatic Actuators (includes actuator models that have a -10 or -11 suffix at the end of the model number).

NOTE: When actuator model number has "-S" as a suffix then actuator is special and may have some differences that are not included in this procedure.

1.1.2 Normal recommended service interval for this actuator series is five years.

NOTE: Storage time is counted as part of the service.

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

1.1.4 Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.

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

1.1.6 Numbers in parentheses ( ) indicate the bubble number (item reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawings, and actuator parts lists.

1.1.7 This procedure is written using the following Actuator references:

1.1.7.1 Stop screw side of housing (1-10) will be considered the front of the actuator.

1.1.7.2 Housing cover (1-20) will be the top of the actuator.

1.1.8 Some HD series actuator models are heavy and will require a means of assistance. For actuator approximate weight refer to Section 4 table 4.2.

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

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

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

1.1.11 Bettis recommends that disassembly of the actuator should be done in a clean area on a workbench.

## 1.2 **DEFINITIONS:**

**WARNING:** If not observed, user incurs a high risk of severe damage to actuator and/or fatal injury to personnel.

**CAUTION:** If not observed, user may incur damage to actuator and/or injury to personnel.

**NOTE:** Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.

## 1.3 **GENERAL SAFETY INFORMATION**

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 customer's plant safety or work procedures. If a conflict arises between this procedure and the customer's procedures the differences should be resolved in writing between an authorized customers representative and an authorized Bettis representative.

## 1.4 **BETTIS REFERENCE MATERIALS**

1.4.1 Assembly Drawing Part Number 036312 for fail clockwise (CW) actuators.

1.4.2 Assembly Drawing Part Number 040906 for fail counter clockwise (CCW) actuators.

1.4.3 Exploded Detail Drawing Part Number 063354\* for HD722-SR.

1.4.4 Exploded Detail Drawing Part Number 069248\* for HD732-SR.

1.4.5 Exploded Detail Drawing Part Number 068096\* for HD722-SR-M3/M3HW.

1.4.6 Exploded Detail Drawing Part Number 068094\* for HD732-SR-M3/M3HW.

\* Exploded Detail drawings are contained in the standard Bettis Service Kit.

## 1.5 **SUPPORT ITEMS AND TOOLS**

1.5.1 **Support Items** - Service Kit, commercial leak testing solution, and non-hardening thread sealant.

- 1.5.2 **Tools** - All tools / Hexagons are American Standard inch (Imperial). Two each medium standard screwdrivers, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and a torque wrench (up to 2,000 inch pounds / 226 N-m). Refer to Section 4 Tool Table 4.3 for recommended tool style and size.

## 1.6 **LUBRICATION REQUIREMENTS**

- 1.6.1 The actuator should be re-lubricated at the beginning of each service interval using the following recommended lubricant.

NOTE: Lubricants other than those listed in step 1.6.2 should not be used without prior written approval of Bettis Product Engineering.

- 1.6.2 All temperature services (-50°F to +350°F)/(-45.5°C to 176.6°C) use Bettis ESL-5 lubricant. ESL-5 lubricant is contained in the Bettis Module Service Kit in tubes or cans and are marked ESL-4,5 & 10 lubricant.

## **SECTION 2 – ACTUATOR DISASSEMBLY**

### 2.1 **GENERAL DISASSEMBLY**

NOTE: Review Section 1 General Service Information prior to starting Section 2.

**WARNING:** It is possible, that the actuator may contain a dangerous gas and/or liquids. Ensure that all proper measures have been taken to prevent exposure or release of these types of contaminants before commencing any work.

**WARNING:** **DO NOT REMOVE SPRING CYLINDER WHILE SPRING IS COMPRESSED**

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

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

- 2.1.2 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. Note and record any abnormal symptoms such as jerky or erratic operation.

- 2.1.3 To help in correct re-assembly all mating parts should be marked or tagged for ease of reassembly, i.e. with spring cartridge on same end of housing as was, cylinder to cylinder adapter, cylinder adapter to housing, and right and left stop adjustment screws, etc.

2.1.4 If not already removed disconnect all operating pressure from cylinder (3) or cylinder assembly M3 (3-10).

NOTE: If the actuator is equipped with a M3 confirm that jackscrew assembly (3-20) does not engage piston rod (2-10).

2.1.5 Actuators equipped with M3HW jackscrew with handwheel option, remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10). Refer to Section 4 step number 4.3.10 for information on actuators equipped with a non-removable handwheel.

2.1.6 Mark or record the following:

2.1.6.1 Mark stop screws (1-60) left and right.

2.1.6.2 Measure and record the exposed length of the right and left stop screws (1-60).

NOTE: The stop screws will be removed later in this procedure.

2.1.6.3 Record the location of the pressure ports in both cylinder adapters (2-30).

## 2.2 SPRING CYLINDER DISASSEMBLY

NOTE: Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with Spring Cylinder Disassembly.

**WARNING:** When cylinder assembly (4-10) is installed on the actuator, spring cartridge (5) is under compression. Do not remove cylinder assembly (4-10) until actuator has the "pre-load" removed.

2.2.1 Remove stop screw "pre-load" as follows:

NOTE: If the actuator is equipped with a M3 jackscrew confirm that jackscrew (3-20) does not engage piston rod (2-10).

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

2.2.1.1 Simultaneous apply sufficient pneumatic pressure to the pressure inlet ports, located in spring cartridge cylinder adapter (2-30) and cylinder (3) or (3-10), to move the actuator load off of stop screw (1-60). NOTE: If pneumatic supply is not available then proceed on to step 2.2.1.2 and complete the steps 2.2.1.2 and 2.2.1.3.

2.2.1.2 On the front side of housing (1-10) loosen two jam nuts (1-70).

2.2.1.3 On the front side of housing (1-10) unscrew and remove two stop screws (1-60).

2.2.1.4 Remove pressure from the pressure inlet ports.

2.2.2 Remove two breathers (4-20). One is located in the end of spring cylinder (4-10) and the other is located in the port of cylinder adapter (2-30). Refer to Section 4 step number 4.3.5 for additional information.

**CAUTION:** Due to the weight and nature of a spring cartridge pre-loaded assembly, caution should be exercised when handling spring cartridge (5).

2.2.3 Secure the chain wrench around cylinder assembly (4-10) as close to the welded end cap as possible. Using a mallet on the handle of the chain wrench, break the cylinder loose from the cylinder adapter (2-30) sufficiently so it can be removed.

**WARNING:** Do not tilt the open end of cylinder assembly (4-10) down. The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).

2.2.4 Remove cylinder assembly (4-10) from cylinder adapter (2-30) by rotating in a counter clockwise direction.

**NOTE:** When removing and setting cylinder assembly (4-10) aside, care should be taken to protect the cylinders chamfered edge and threads.

2.2.5 Carefully remove spring cartridge (5) from cylinder assembly (4-10) by slightly tilting open end of cylinder down.

**WARNING:** Spring cartridge (5) is not field repairable. Under no circumstances should spring cartridge (5) be disassembled, as the spring assembly is pre-loaded.

2.2.6 Unscrew and remove light hex Lok nut (2-70) from piston rod (2-10).

2.2.7 Remove piston (2-20) from piston rod (2-10).

## 2.3 PRESSURE CYLINDER DISASSEMBLY

**NOTE:** Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with Pressure Cylinder Disassembly.

2.3.1 Secure a chain wrench around cylinder (3) or (3-10) as close to the welded end cap as possible. Using a mallet on the chain wrench handle, break the cylinder loose from the cylinder adapter (2-30) sufficiently so it can be removed.

2.3.2 Remove cylinder (3-10) from cylinder adapter (2-30) by rotating in a counter clockwise direction.

**NOTE:** When removing and setting cylinder (3) or (3-10) aside, care should be taken to protect the cylinders chamfered edge and threads.

2.3.3 Unscrew and remove hex lock nut (2-70) from piston rod (2-10).

2.3.4 Remove piston (2-20) from piston rod (2-10).

- 2.3.5 On cylinder (3) or (3-10) side of the actuator, unscrew and remove four ferry cap screws (2-90), from cylinder adapter (2-30). Refer to Section 4, step 4.3.11, for information when ferry cap screw are not used in this location.
- 2.3.6 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).
- 2.3.7 On spring cylinder (4-10) side of the actuator, unscrew and remove four ferry cap screws (2-90) from remaining cylinder adapter (2-30).
- 2.3.8 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).
- 2.3.9 For actuators equipped with M3 or M3HW jackscrew assembly, it is not necessary to disassemble the M3 Jackscrew assembly (3-20) from cylinder assembly (3-10). If the M3 stud or seal nut (3-30) needs replacement then refer to Section 2.5 M3 Jackscrew Disassembly.
- 2.3.10 It is not necessary to remove pipe plugs (2-110) from cylinder adapters (2-30).

## **2.4 HOUSING DISASSEMBLY**

NOTE: Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with Housing Disassembly.

- 2.4.1 Remove snubber (1-130) from top of housing (1-10).
- 2.4.2 Remove the socket cap screws (1-120) from position indicator (1-110) yoke weather cover (6-110) and remove position indicator/yoke weather cover. Refer to Section 4 step 4.3.4 for information early model actuators and the use of a weather cover.
- 2.4.3 Remove hex cap screws (1-30) from housing cover (1-20).
- 2.4.4 Remove housing cover (1-20) from housing (1-10).

NOTE: Housing cover has a tight fit and will require the use of two pry bars or screw drivers to assist in removal.

- 2.4.5 Rotate the arms of yoke (1-140) to the center position in the cavity of housing (1-10).
- 2.4.6 Remove the upper yoke roller (1-50) from yoke pin (1-40).
- 2.4.7 Remove yoke pin (1-40) from the slot in the upper arm of yoke (1-140).
- 2.4.8 Holding rod bushings (2-40) in place, pull piston rod (2-10) out through rod bushings.
- 2.4.9 Remove both rod bushings (2-40) from each end of housing (1-10).
- 2.4.10 Remove yoke (1-140) from the cavity of housing (1-10).

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

2.4.11 Remove lower yoke roller (1-50) from bottom area of housing cavity.

2.4.12 If the housing has a pipe plug (1-100) it is not necessary to remove it from housing (1-10).

## **2.5 JACKSCREW DISASSEMBLY FROM CYLINDER ASSEMBLY M3**

NOTE: Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with M3 jackscrew disassembly.

NOTE: If the age of the actuator is unknown or if the M3 jackscrew has been replaced at some unknown point in time, then review all of section 15 for a M3 jackscrew description that is installed on the actuator being disassembled.

2.5.1 Disassembly of M3 Jackscrews manufactured after December, 1990 (current M3 design).

2.5.1.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.

2.5.1.2 Using a 3/16 inch pin punch, drive out and remove the roll pin from the slotted nut located on outboard end of M3 jackscrew assembly (3-20).

2.5.1.3 Remove the slotted nut from jackscrew assembly (3-20).

2.5.1.4 Loosen and screw seal nut (3-30) off of jackscrew assembly (3-20).

2.5.1.5 Screw jackscrew assembly (3-20) into cylinder (3-10) until it is disengaged from the cylinder end cap.

2.5.1.6 Remove jackscrew assembly (3-20) from the open end of cylinder (3-10).

2.5.2 Disassembly of M3 Jackscrews manufactured March 1982 through December 1990.

2.5.2.1 With cylinder (3-10) on a work bench, lubricate jackscrew assembly (3-20) threads with lubricant.

2.5.2.2 Loosen and thread seal nut (3-30) all the way back to the welded nut.

2.5.2.3 Screw jackscrew assembly (3-20) into cylinder (3-10) until the pin and washer are exposed.

2.5.2.4 Using a 3/16 inch pin punch, drive out and remove the pin.

2.5.2.5 Remove the washer.

2.5.2.6 Screw jackscrew assembly (3-20) out and remove.

- 2.5.2.7 Remove seal nut (2-130) from the M3 jackscrew stud.
- 2.5.3 Disassembly of M3 Jackscrews manufactured July 1978 through February 1982.
  - 2.5.3.1 With cylinder (3-10) on a work bench, lubricate jackscrew assembly (3-20) threads with lubricant.
  - 2.5.3.2 Loosen and thread seal nut (3-30) all the way back to the welded nut.
  - 2.5.3.3 Screw jackscrew assembly (3-20) into cylinder (3-10) until the retaining screw is exposed.
  - 2.5.3.4 Remove the retaining screw from the M3.
  - 2.5.3.5 Screw the jackscrew assembly (3-20) out and remove.
  - 2.5.3.6 Remove seal nut (2-130) from the M3 jackscrew stud.
- 2.5.4 Disassembly of M3 Jackscrews manufactured before July, 1978.
  - 2.5.4.1 With the cylinder (3-10) on a work bench, lubricate jackscrew assembly (3-20) threads with lubricant.
  - 2.5.4.2 Loosen seal nut (3-30).
  - 2.5.4.3 Screw the jackscrew assembly (3-20) out and remove.
  - 2.5.4.4 Remove seal nut (2-130) from the M3 jackscrew stud.

## **SECTION 3 – ACTUATOR REASSEMBLY**

### **3.1 GENERAL REASSEMBLY**

NOTE: Review Section 1 General Service Information prior to starting Section 3.

**CAUTION: Only new seals, which are still within the seal's expectant shelf life, should be install into 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 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 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 housing assembly, power cylinder and spring cylinder will be assembled using lubricant as identified in Section 1.6.

3.1.5 The torque requirements for critical fasteners are specified at the appropriate step of the assembly procedure.

## **3.2 HOUSING REASSEMBLY**

NOTE: Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with housing reassembly.

NOTE: The parts and seals used in the actuator housing (1-10) will be assembled using lubricant as identified in Section 1.6

3.2.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10). Refer to Section 4 step 4.3.12 for housing pipe plug information.

NOTE: Position housing (1-10) so that the yoke bore is nearest to you.

3.2.2 In the bottom area of housing (1-10) apply lubricant to the cast raised ribs, to the yoke bore and inner diameter seal groove.

3.2.3 Coat one o-ring seal (6-20) with lubricant and install into the seal groove located in the yoke bore in the bottom area of housing (1-10). Refer to Section 4 step 4.3.1 for "B" model yoke o-ring information.

3.2.4 Lubricate yoke (1-140) with a generous amount of lubricant to all bearing surfaces and the slot in the upper and lower arms.

NOTE: The wide arm of yoke (1-140) should be installed toward the top of housing (1-10).

3.2.5 Install yoke (1-140) into the bore located in the bottom area of housing (1-10).

3.2.6 Coat two rod bushings (2-40) with lubricant and install one into each end of housing (1-10).

3.2.7 Coat one yoke roller (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.

- 3.2.8 Apply lubricant to piston rod (2-10) and install through both bushings (2-40) in housing (1-10).
- 3.2.9 Coat yoke pin (1-40) with lubricant and install through the slot in the upper arm of yoke (1-140), through piston rod (2-10) and into lower yoke roller (1-50).
- 3.2.10 Coat remaining yoke roller (1-50) with lubricant and install over yoke pin (1-40) and into the slot of the upper arm of yoke (1-140).
- 3.2.11 Apply lubricant to the yoke bore and seal groove of housing cover (1-20).
- 3.2.12 Coat o-ring seal (6-20) with lubricant and install into the seal groove in the yoke bore area of housing cover (1-20). Refer to Section 4 step 4.3.1 for "B" model yoke o-ring information.
- 3.2.13 Install cover gasket (6-60) onto top area of housing (1-10).
- 3.2.14 Install housing cover (1-20) over cover gasket (6-60) and onto top area of housing (1-10).
- 3.2.15 Install four gasket seals onto four hex cap screws (1-30) as follows:
- NOTE: Refer to Section 4 step 4.3.7 for information when gasket seals have not been in prior use for this location.
- 3.2.15.1 HD722-SR install gasket seals (6-100) on to hex cap screws (1-30).
- 3.2.15.2 HD732-SR install gasket seals (6-80) on to hex cap screws (1-30).
- 3.2.16 Install four hex cap screws (1-30) with gasket seals through housing cover (1-20) and into housing (1-10) and tighten.

### **3.3 PRESSURE CYLINDER REASSEMBLY**

NOTE: Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with pressure cylinder reassembly.

NOTE: The parts and seals used in the actuator cylinder assembly (3) or (3-10) will be assembled using lubricant as identified in Section 1.6.

- 3.3.1 If the actuator cylinder is equipped with a M3 or M3HW assembly and it was removed then reassemble cylinder assembly M3 (3-10) per appropriate steps in Section 3.5.
- 3.3.2 Coat rod seal (6-30) with lubricant and install, lip first, into cylinder adapter (2-30). Refer to Section 4 step 4.3.2 for information pertaining to early model actuator rod seal configurations.

**CAUTION:** Energizer ring (o-ring) of rod seal (6-30) must face into cylinder adapter (2-30) or when cylinder is installed on the actuator the rod seal o-ring will be facing towards piston (2-20).

- 3.3.3 Install cylinder adapter gasket (6-70) as follows:
- 3.3.3.1 Onto the left end of housing (1-10) for fail clockwise actuators.
  - 3.3.3.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.
- 3.3.4 Install four gasket seals (6-80) onto four ferry cap screws (2-90). NOTE: Refer to Section 4 step 4.3.8 for information pertaining to the use of lockwashers.

**CAUTION: Care should be taken not to scratch the piston rod when installing the cylinder adapter (2-30).**

- 3.3.5 Install cylinder adapter (2-30) over the end of piston rod (2-10) as follows:

NOTE: Arrange cylinder adapter (2-30) with the pressure inlet port in the same position as recorded in Section 2 step 2.1.6.3. The location of the port may be different on your actuator depending on customer, plumbing, and accessory requirements.

- 3.3.5.1 Onto the left end of housing (1-10) for fail clockwise actuators.
  - 3.3.5.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.
- 3.3.6 Install and tighten ferry cap screws (2-90) with gasket seals (6-80) through cylinder adapter (2-30) and into housing (1-10).
- 3.3.7 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in Section 2 step 2.1.6.3.
- 3.3.8 Coat o-ring seal (6-40) with lubricant and install into cylinder adapter (2-30). NOTE: Install the o-ring seal into the groove at inner end of the cylinder adapter inner diameter threads.
- 3.3.9 Install o-ring seal (6-50) onto piston rod (2-10). NOTE: The o-ring seal should be installed against the shoulder of the piston rod (2-10).
- 3.3.10 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that is counter bored to accept the o-ring installed in step 3.3.9. The counter bore side of the piston should be installed against the shoulder of piston rod (2-10) and over o-ring seal (6-50).

**CAUTION: When installing hex lock nut (2-70) the flat side of the nut should rest up against piston (2-20).**

- 3.3.11 Install hex lock nut (2-70) onto piston rod (2-10).
- 3.3.12 Torque tighten hex lock nut (2-70) to 146 foot pounds / 198 N-m  $\pm 5$  % lubricated.

### 3.3.13 Piston Seal Installation

#### 3.3.13.1 Standard and High Temperature actuators:

- 3.3.13.1.1 Coat piston outer diameter seal grooves with lubricant.
- 3.3.13.1.2 Coat two u-cup seals (6-10) with lubricant.
- 3.3.13.1.3 Install one u-cup seal (6-10) into innermost piston seal groove. The lip of the cup seal should point outward toward the outside of the piston.
- 3.3.13.1.4 Install one u-cup seal (6-10) into outermost piston seal groove. The lip of the cup seal should point outward toward the outside of the piston.

#### 3.3.13.2 Low Temperature or trim -11 T-Seal Set installation as follows:

NOTE: The low temperature T-seal is composed of one rubber seal and two split skive-cut back-up rings.

- 3.3.13.2.1 Coat piston outer diameter seal grooves with lubricant.
- 3.3.13.2.2 Apply lubricant to one T-seal (6-10). T-Seal is composed of one rubber seal and two skive-cut back-up rings.
- 3.3.13.2.3 Install T-seal into piston outboard seal groove.
- 3.3.13.2.4 Install a back-up ring on each side of the T-seal. NOTE: When installing the back-up rings, do not align the skive-cuts.

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

- 3.3.14 Apply a coating of lubricant to the cylinder outer diameter threads and the entire bore of cylinder (3-10).

**CAUTION:** Exercise caution during cylinder installation to prevent pinching lip of the u-cup seal during installation. It is necessary to depress the seal lip while working the cylinder over it.

- 3.3.15 Install cylinder (3) or (3-10) over piston (2-20). Rotate the cylinder clockwise and screw into the cylinder adapter.

**CAUTION:** When using the chain wrench on the cylinder it should be secured as close to the end cap as possible.

- 3.3.16 Using a chain wrench tighten cylinder assembly (3-10) into cylinder adapter (2-30).

NOTE: While the chain wrench is still positioned on the cylinder and after the cylinder is tight, take a mallet and rap (hit) the chain wrench handle a couple of times. This will seat the cylinder assembly into the o-ring seal located in the cylinder adapter. Repeat this step if during testing the area between the cylinder assembly and the cylinder adapter is leaking pressure at an unacceptable rate.

### 3.4 SPRING CYLINDER REASSEMBLY

NOTE: Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with spring cylinder reassembly.

NOTE: The parts and seals used in the actuator spring cylinder (4-10) will be assembled using lubricant as identified in Section 1.6.

**CAUTION:** Energizer ring (o-ring) of rod seal (6-30) must face into cylinder adapter (2-30) or when cylinder is installed on the actuator the rod seal o-ring will be facing towards piston (2-20).

3.4.1 Coat rod seal (6-30) with lubricant and install; lip first, into cylinder adapter (2-30). Refer to Section 4 step 4.3.2 for information pertaining to early model actuator rod seal configurations.

3.4.2 Install cylinder adapter gasket (6-70) as follows:

3.4.2.1 Onto the left end of housing (1-10) for fail clockwise actuators.

3.4.2.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.

3.4.3 Install four gasket seals (6-80) onto four ferry cap screws (2-90). NOTE: Refer to Section 4 step 4.3.8 for information pertaining to the use of lockwashers.

**CAUTION:** Care should be taken not to scratch the piston rod (2-10) when installing the cylinder adapter (2-30).

3.4.4 Install cylinder adapter (2-30) over the end of piston rod (2-10) as follows:

NOTE: Arrange cylinder adapter (2-30) with the pressure inlet port in the same position as recorded in Section 2 step 2.1.6.3. The location of the port may be different on your actuator depending on customer, plumbing, and accessory requirements.

3.4.4.1 Onto the left end of housing (1-10) for fail clockwise actuators.

3.4.4.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.

3.4.5 Install ferry cap screws (2-90) with gasket seals (6-80) through the cylinder adapter and screw into housing (1-10).

3.4.6 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in Section 2 step 2.1.6.3.

- 3.4.7 Coat o-ring seal (6-40) with lubricant and install into cylinder adapter (2-30). NOTE: Install o-ring into the groove at the inner end of the cylinder adapter inner diameter threads.
- 3.4.8 Install one o-ring seal (6-50) onto piston rod (2-10). NOTE: The o-ring should be installed against the shoulder of the piston rod.
- 3.4.9 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that is counter bored to accept the o-ring installed in step 3.4.8. The counter bore side of the piston should be installed against the shoulder of piston rod (2-20) and over o-ring seal (6-50).

**CAUTION: When installing hex lock nut (2-70) the flat side of the nut should rest up against piston (2-20).**

- 3.4.10 Install hex lock nut (2-70) onto piston rod (2-10).
- 3.4.11 Torque tighten hex lock nut (2-70) to approximately 146 foot pounds / 198 N-m  $\pm 5$  % lubricated.
- 3.4.12 Piston Seal Installation:

3.4.12.1 Standard and High Temperature actuators:

- 3.4.12.1.1 Coat piston seal grooves with lubricant.
- 3.4.12.1.2 Coat one u-cup seal (6-10) with lubricant.
- 3.4.12.1.3 Install one u-cup seal (6-10) into the innermost piston groove. The lip of the cup seal should point outward toward the side of the piston.

3.4.12.2 Low Temp Actuators:

- 3.4.12.2.1 Coat piston seal grooves with lubricant.
- 3.4.12.2.2 Apply lubricant to one T-seal (6-10). T-Seal is composed of rubber seal and two back-up rings.
- 3.4.12.2.3 Install T-seal set (6-10) into piston outboard seal groove.

- 3.4.13 Push piston in towards the housing as far as it will go.
- 3.4.14 Apply a coating of lubricant to the cylinder outer diameter threads and the entire bore of cylinder assembly (4-10).
- 3.4.15 On the spring cartridge assembly (5) coat the outside of the spring with lubricant and insert spring cartridge assembly (5) into cylinder assembly (4-10).

NOTE: One end of the spring cartridge assembly has a flat face with a deep hole in it, this end should be inserted into the cylinder first.

- 3.4.16 Install spring cylinder assembly (4-10), containing spring cartridge assembly (5), over piston (2-20). Rotate the cylinder assembly clockwise and screw into cylinder adapter (2-30).

**CAUTION:** When using the chain wrench on the cylinder it should be secured as close to the end cap as possible.

- 3.4.17 Using a chain wrench tighten spring cylinder assembly (4-10) into cylinder adapter (2-30).

**NOTE:** While the chain wrench is still positioned on the cylinder and after the cylinder is tight, take a mallet and rap (hit) the chain wrench handle a couple of times. This will seat the cylinder assembly into the o-ring seal located in the cylinder adapter. Repeat this step if during testing the area between the cylinder assembly and the cylinder adapter is leaking pressure at an unacceptable rate.

- 3.4.18 Position Indicator Installation as follows:

3.4.18.1 For spring to fail clockwise actuators, rotate the yoke to the full clockwise (CW) position. Install yoke weather cover (6-110) and position indicator (1-110) onto yoke (1-140) with the pointer facing piston rod (2-10) and perpendicular to cylinder assembly (4-10) and cylinder (3) / (3-10).

3.4.18.2 For spring to fail counter clockwise actuators, rotate yoke (1-140) to full counter clockwise (CCW) position. Install yoke weather cover (6-110) and position indicator (1-110) onto yoke (1-140) with the pointer parallel to cylinder assembly (4-10), cylinder (3) / (3-10) and to piston rod (2-10).

3.4.18.3 Install and tighten socket cap screws (1-120) through position indicator (1-110), weather cover (6-110) and into the top of yoke (1-140).

**NOTE:** Socket cap screws (1-120) will require rechecking for tightness after the actuator has been cycled a few times.

- 3.4.19 Install gasket seals (6-90) and hex jam nuts (1-70) onto stop screws (1-60).

- 3.4.20 Install stop screws (1-60) with gasket seals (6-90) and hex jam nuts (1-70) into housing (1-10) in the position as recorded in Section 2 step 2.1.6.1.

- 3.4.21 Adjust both stop screws (1-60) back to settings recorded in Section 2 step 2.1.6.2.

- 3.4.22 Tighten both hex jam nuts (1-70) securely, while holding stop screws (1-60).

### **3.5 M3 JACKSCREW REASSEMBLY TO PRESSURE CYLINDER**

**NOTE:** Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with M3 jackscrew reassembly.

**NOTE:** If the age of the actuator is unknown or if the M3 jackscrew has been replaced at some unknown point in time, then review all of Section 3.5 for a M3 jackscrew description that is installed on the actuator being reassembled.

- 3.5.1 Reassembly of M3 jackscrew for actuators manufactured after December 1990 (current M3 design).
- 3.5.1.1 Apply a light coating of lubricant to the threads of jackscrew assembly (3-20).
- 3.5.1.2 Insert jackscrew assembly (3-20) through the threaded end of cylinder (3-10). Rotate the jackscrew into the cylinder end cap until the end of the assembly protrudes out of the end cap of the cylinder.
- 3.5.1.3 Rotate the jackscrew until the welded nut comes into contact with the inside of the cylinder's end cap.
- 3.5.1.4 Install seal nut (3-30) onto jackscrew assembly (3-20). Rotate the seal nut until it is up against the cylinder end cap.
- 3.5.1.5 Rotate the slotted nut onto the outboard end of the jackscrew stud with the slot facing toward the cylinder end cap. Rotate the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.

**CAUTION: When aligning the slot and the cross drilled hole make certain that the back of the slot is at least one thread from being aligned with the hole.**

- 3.5.1.6 Insert the roll pin through the slotted nut and through the jackscrew stud making sure that equal amounts of the roll pin is exposed on both sides of the slotted nut and the jackscrew stud.
- 3.5.1.7 Rotate seal nut until fully tight against end cap.

**NOTE:** If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.

- 3.5.2 Reassembly of M3 Jackscrew for actuators manufactured March 1982 through December 1990.
- 3.5.2.1 If removed, install seal nut (3-30) onto jackscrew assembly (3-20) with the insert side facing away from the retaining nut.
- 3.5.2.2 Rotate the seal nut until it is up against the retaining nut.
- 3.5.2.3 Apply a generous coating of lubricant to the M3 threads.
- 3.5.2.4 Rotate jackscrew assembly (3-20) into the cylinder end cap. Rotate the jackscrew until the end of the assembly protrudes out of the threaded end of the cylinder.
- 3.5.2.5 Install a washer and pin onto the turndown end of the M3.
- 3.5.2.6 Rotate the jackscrew until the washer just comes into contact with the cylinder end cap.

3.5.2.7 Rotate seal nut until fully tight against end cap.

NOTE: If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.

3.5.3 Reassembly of M3 Jackscrew for actuators manufactured July 1978 through February 1982.

3.5.3.1 If removed, install seal nut (3-30) onto jackscrew assembly (3-20) with the insert side facing away from the retaining nut.

3.5.3.2 Screw the seal nut until it is up against the retaining nut.

3.5.3.3 Apply a generous coating of lubricant to the M3 threads.

3.5.3.4 Screw jackscrew assembly (3-20) into the cylinder end cap. Rotate the jackscrew until the end of the assembly protrudes out of the threaded end of the cylinder.

3.5.3.5 To retaining the M3 in the cylinder screw a hex head cap screw into the threaded hole in the turndown area of the M3 stud.

3.5.3.6 Rotate the jackscrew until the retaining screw just comes into contact with the cylinder end cap.

3.5.3.7 Rotate seal nut until fully tight against end cap.

NOTE: If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, grease may be left on jackscrew to provide additional corrosion protection.

3.5.4 Reassembly of M3 Jackscrew for actuators manufactured before July, 1978.

3.5.4.1 If removed, install seal nut (3-30) onto jackscrew assembly (3-20) with the insert side facing away from the retaining nut.

3.5.4.2 Rotate the seal nut until it is up against the retaining nut.

3.5.4.3 Apply a generous coating of lubricant to the M3 threads.

3.5.4.4 Rotate jackscrew assembly (3-20) into the cylinder end cap. Rotate the jackscrew until the end of the assembly protrudes just out of the cylinder end cap.

3.5.4.5 Rotate seal nut until fully tight against end cap.

NOTE: If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, grease may be left on jackscrew to provide additional corrosion protection.

### 3.6 ACTUATOR TESTING

3.6.1 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. A small amount of leakage may be tolerated. Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable.

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

3.6.2 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 using a properly adjusted self relieving regulator, with gauge.**

3.6.3 Prior to testing for leaks, alternately apply and release pressure, as defined in step 3.6.2, to the pressure side of both pistons. Allow each application of pressure to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.

3.6.4 Simultaneously apply pressure, as defined in step 3.6.2, to the pressure port in the end of cylinder (3-10) and to the pressure port in the SR cylinder adapter (2-30).

3.6.5 Apply leak-testing solution to the following areas:

3.6.5.1 The breather port hole in the cylinder adapter (2-30) and the breather port hole in the end of the SR cylinder (4-10). Checks the piston to cylinder wall and piston to piston rod seals.

3.6.5.2 The threaded joint between the SR cylinder (4-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.

3.6.5.3 The joint between the cylinder adapter (2-30) and the housing (1-10).

3.6.5.4 The snubber port hole located in the housing (1-10), checks the cylinder adapter to piston rod seal.

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

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

3.6.7.1 Adjust the pressure regulator to the pressure as defined in step 3.6.2.

3.6.7.2 Simultaneously apply the above pressure to the pressure port in outboard end of cylinder (3-10) and to pressure port in SR cylinder adapter (2-30). Allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.

3.6.8 Remove pressure from the pressure inlet ports.

### **3.7 RETURN TO SERVICE**

3.7.1 Install one breather (4-20) into port in outboard end cap of cylinder assembly (4-10).

3.7.2 Install the remaining breather (4-20) into the cylinder adapter (2-30) of cylinder (3) or (3-10).

3.7.3 Replace software components of snubber (1-130) and then install into housing (1-10).

3.7.4 For actuators equipped with a M3 jackscrew assembly (3-20) and require an optional handwheel, install handwheel (8-10) using the following procedure:

3.7.4.1 Place the handwheel (8-10) onto jackscrew assembly (3-20) and over the pinned slotted nut. NOTE: The hub of handwheel (8-10) has a cast hexagon hole that fits over the pinned slotted nut.

3.7.4.2 Place lockwasher (8-20) onto jackscrew assembly (3-20) up against handwheel hub.

3.7.4.3 Install and tighten hex nut (8-30) onto jackscrew assembly (3-20) and screw nut up against lockwasher (8-20).

3.7.5 Check yoke position indicator/yoke weather cover screws (1-120) for tightness

3.7.6 After actuator is reinstalled on the device it is to operate, all accessories, should be hooked up and tested for proper operation and replaced, if found defective.

3.7.7 The actuator is now ready for returning to service.

## SECTION 4 – ACTUATOR SUPPORT INFORMATION

### 4.1 ACTUATOR WEIGHT TABLE

ACTUATOR MODEL	APPROXIMATE WEIGHT (1)											
	SR40		SR60		SR80		SR100		SR125		SR150	
	Lbs.	Kg	Lbs.	Kg	Lbs.	Kg	Lbs.	Kg	Lbs.	Kg	Lbs.	Kg
HD722-SR	215	97.5	229	104	235	106	249	113	N/A	N/A	N/A	N/A
HD722-SR-M3	220	99.8	234	106	240	109	255	116	N/A	N/A	N/A	N/A
HD722-SR-M3HW	225	103	239	108	245	111	259	117	N/A	N/A	N/A	N/A
HD732-SR	275	125	291	132	316	143	326	148	352	159	366	166
HD732-SR-M3	280	127	296	134	321	146	331	150	357	162	371	168
HD732-SR-M3HW	285	129	301	137	326	148	336	152	362	164	376	171

**NOTES:** (1) Weights listed for each model are for bare actuators without valve mounting brackets and accessories.

### 4.2 TOOL TABLE

HD-SR/M3/HW TOOL STYLE AND WRENCH SIZES					
ITEM NO.	ITEM QTY.	HD722-SR WRENCH SIZE	HD732-SR WRENCH SIZE	DESCRIPTION OR LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	9/16"	3/4"	Cover Screws	Socket
1-60	2	3/8" (4)	1/2" (5)	Stop Screws	Open End or Adjustable
1-70	2	15/16"	1-5/16"	Hex Jam Nut	Open End or Adjustable
1-100	1	7/16"	7/16"	Pipe Plug	Open End
1-120	4	3/16"	3/16"	Socket Cap Screws	Allen (1)
1-130	1	7/8"	7/8"	Snubber Valve	Deep Socket
2-70	2	1-1/4"	1-5/8"	Standard Hex Nut	Socket
2-90	8	7/16"	1/2"	Ferry Cap Screws	12 Point Socket (1) (3)
2-110	1	7/16"	7/16"	Pipe Plug	Open End
3-10	1	(2)	(2)	Cylinder Assembly	Chain Wrench (1)
3-30	1	1-13/16"	1-13/16"	M3 Seal Nut	Open End or Adjustable
4-10	1	(2)	(2)	SR Cylinder Assy.	Chain Wrench (1)
4-20	2	11/16"	11/16"	Breather	Open End
8-30	1	1-13/16"	1-13/16"	Heavy Hex Nut	Open End or Adjustable
-	1	1-13/16"	1-13/16"	M3 Slotted Hex Nut	Open End or Adjustable

**NOTES:**

- (1) No alternate style tool recommended.
- (2) Bettis recommends a short handled Chain Wrench with a 40" inch chain.
- (3) Early models used socket head cap screws - wrench style will change to Allen.
- (4) Actuators manufactured prior to 1980 used square head stop screws – wrench size changes to 1/2" inch Open End or Adjustable.
- (5) Actuators manufactured prior to middle of 1994 used square head stop screws - wrench size changes to 5/8" inch Open End or Adjustable.

### 4.3 PRODCR IMPROVEMENT AND REVISIONS

- 4.3.1 On HD-SR series "B" models the yoke o-ring grooves are in the yoke journals. On the HD-SR series "C" and current models the yoke o-ring grooves will be in the housing cover and in the housing.
- 4.3.2 HD-SR actuators manufactured through the late 1970's where originally shipped with a rod seal and a anti-extrusion seal. This combination is replaced with the current Polypak seal. The dimensional stack of the rod seal and the anti-extrusion seal is greater than the rod seal provided in the current Service kit. This dimensional difference does not affect the ability of the current Polypak seal to provide sealing in this application.
- 4.3.3 HD-SR series actuators manufactured prior to 1974 may have a single seal groove piston as the SR cylinder piston.
- 4.3.4 Early model actuators may not have a position indicator or a weather cover. Bettis would recommend these items be retrofitted to your actuator.
- 4.3.5 Most HD-SR series actuators manufactured through the 1970's used a snubber valve instead of a breather for items (4-20). For most applications it is recommended that the snubber valves for items (4-20) be replaced with a Bettis part number 029198.
- 4.3.6 Early model actuators used nylon "Zytel 101" stop screw seal (25). For most applications the nylon seal is replaced with a wrought copper alloy (ASTM B-152 C11000) gasket seal.
- 4.3.7 Early model actuators did not use any gasket seal washers (6-100) on the housing cover screws (1-30). The current Service kits provide wrought copper alloy (ASTM B-152 C11000) gasket seal washers. If the cover screws are long enough then for most applications Bettis would recommend that the gasket seals be installed on your actuator housing cover screws (1-30).
- 4.3.8 Early model actuators used lockwashers on the cylinder adapter retaining screws (2-90). During the early 1970's the lockwashers where replaced with wrought copper alloy (ASTM B-152 C11000) gasket seal washers (6-90). The current Service kits provide these wrought copper alloy washers and for most applications Bettis would recommend that they be used in place of the original lockwashers.
- 4.3.9 Starting in 1990 asbestos was eliminated from the gasket material used in Bettis Actuators. The current gasket material used is Non Asbestos Synthetic Fiber.
- 4.3.10 All jackscrew handwheel assemblies manufactured prior to January, 1981 had non-replaceable handwheel. This style M3 jackscrew with handwheel was a weldment and the handwheel is not removable or replaceable as an option. NOTE: When replacing this style M3HW it will require a complete new M3 stud and handwheel option.
- 4.3.11 Early model actuators used socket cap screws instead of ferry cap screws as cylinder adapter retaining screws (2-90).

4.3.12 Actuators manufactured after mid year 2000 may not have a pipe plug, item (1-100), in the housing (1-10).

<b>ECN</b>	<b>RELEASE DATE</b>	<b>REV</b>		<b>BY *</b>	<b>DATE</b>
Released	July 1993	A	COMPILED	Bill Cornelius	28 May 2002
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\* Signatures on file Bettis, Waller, Texas