

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY AND REASSEMBLY**

**FOR MODELS**

**HD521-SR-S AND HD721-SR-S**

**SPRING RETURN SEISMIC**

**SERIES PNEUMATIC ACTUATORS**

PART NUMBER: 115871

REVISION: "A"

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## 1.0 **INTRODUCTION**

- 1.1 In order to assure and maintain the present level of qualification and auditable to the Seismic portions only of the Bettis Qualification Report number 037274, the following is required: All maintenance or service work must be performed by a certified technician. Maintain a maximum service interval of five years (complete actuator refurbishment).
- 1.2 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis HD521-SR-S and HD721-SR-S Seismic series pneumatic actuators.
- 1.3 **SAFETY STATEMENT:** Products supplied by Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by a well trained, equipped, prepared and competent technician.

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

**WARNING:** This procedure should not supersede or replace any customers plant safety or work procedures. If a conflict arises between this procedure and the customers procedures the differences should be resolved in writing between an authorized customers representative and a authorized Bettis representative.

### 1.4 **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.

**SR:** Spring Cartridge

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

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

1.7 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator, allowing the spring to stroke and rotate the actuator to its fail position. Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.

**2.0 SUPPORT ITEMS AND TOOLS**

- 2.1 Support Items - Service/Seal Kit, commercial leak testing solution, and non-hardening thread sealant.
- 2.2 Tools - All tools are American Standard inch. Two each medium standard screwdriver, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and a torque wrench (up to 2,000 in.lbs.). For recommended tool list refer to page 10.

**3.0 BETTIS REFERENCE MATERIALS**

- 3.1 Assembly Drawing 108642 for failing clockwise (CW) actuators.

**4.0 GENERAL INFORMATION**

- 4.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- 4.2 Numbers in parenthesis, ( ), indicate the bubble number (reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawing, and actuator parts list.
- 4.3 This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front side of the actuator. Housing cover (1-20) will be considered as top of the actuator.
- 4.4 To help in correct re-assembly all mating parts should be marked or tagged for ease of reassembly, i.e. with spring on same end of housing as was, cylinder to cylinder adapter, cylinder adapter to housing, and right and left stop adjustment screws, ect.
- 4.5 When removing seals from seal groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.
- 4.6 Use a non-hardening thread sealant on all pipe threads.

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

- 4.7 Disassembly should be done in a clean area on a work bench.
- 4.8 Refer to the following chart for the approximate actuator weights.

<b>ACTUATOR MODEL</b>	<b>APPROXIMATE WEIGHT (POUNDS) **</b>						
	<b>SR40</b>	<b>SR60</b>	<b>SR80</b>	<b>SR100</b>	<b>SR125</b>	<b>SR150</b>	<b>SR200</b>
HD521-SR	105	108	110	121	123	125	136
HD721-SR	150	156	162	163	186	188	203

\*\* Weights listed for each model are for bare actuators without valve mounting brackets and accessories.

- 4.9 LUBRICATION REQUIREMENTS: For use in all areas of the actuator. Use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis Service/Seal Kit. NOTE: Lubricants, other Kronaplate 100 should not be used without prior written approval of Bettis Product Engineering.

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

- 4.10 Before starting the general disassembly of the actuator, it is a good practice to operate the actuator with the pressure used by the customer to operate the actuator during normal operation. Notate and record any abnormal symptoms such as jerky or erratic operation.

## 5.0 GENERAL DISASSEMBLY

- 5.1 If not already done remove all operating pressure from actuator spring cylinder (4-10) allowing the spring to stroke. The spring will rotate the yoke to the fail position.
- 5.2 Remove breather (4-20) from end of spring cylinder assembly (4-10).
- 5.3 Mark stop screws (1-60) left and right. Measure and record the exposed length of the right and left stop screws (1-60). The stop screws will be removed later in this procedure.
- 5.4 Record the location of the pressure ports in the cylinder adapter (2-30).
- 5.5 Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 5.6 Remove snubber (1-130) from top of housing (1-10).

## 6.0 ROD COVER DISASSEMBLY

- 6.1 Unscrew and remove four rod cover ferry head screws (2-100) and gasket seals (6-80).
- 6.2 Remove rod cover (2-60), taking care not to disengage grooved rod bushing (2-50).

## 7.0 SPRING CYLINDER REMOVAL

**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.**

- 7.1 Remove cylinder assembly (4-10) stop screw "pre-load" as follows: Apply sufficient pneumatic pressure to the pressure inlet port, located in cylinder adapter (2-30), to move the actuator load off of stop screw (1-60).
- 7.2 Loosen two jam nuts (1-70). Unscrew and remove two stop screws (1-60). Remove pressure from the pressure inlet port.

**CAUTION: Due to the weight and nature of a spring cartridge pre-loaded assembly, caution should be exercised when handling spring cartridge (5). The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).**

- 7.3 Secure the chain wrench around the cylinder assembly (4-10) as close to the welded end cap as possible. Using a mallet, break the cylinder loose and then remove the cylinder by rotating in a counter clockwise direction.

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

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

**WARNING:** Under no circumstances should the spring cartridge (5) be disassembled, as the spring is pre-loaded.

- 7.5 Unscrew and remove hex nut (2-70) and lockwasher (2-80) from piston rod (2-10).
- 7.6 Remove piston (2-20) from piston rod (2-10).
- 7.7 Identify cylinder adapter (2-30) location and record the inlet port locations.
- 7.8 Unscrew and remove four ferry head screws (2-90) from cylinder adapter (2-30).
- 7.9 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).

## **8.0 HOUSING GROUP DISASSEMBLY**

- 8.1 Remove cover screws (1-30).
- 8.2 Remove housing cover (1-20). NOTE: Housing cover has a tight fit and will require the use of two pry bars or screw drivers to assist in removal.
- 8.3 Rotate the yoke arms to center position.
- 8.4 Remove upper yoke roller (1-50).
- 8.5 Remove yoke pin (1-40).
- 8.6 Holding rod bushing (2-40) in place, pull piston rod (2-10) out through this rod bushing.
- 8.7 Remove lower yoke roller (1-50).
- 8.8 Remove rod bushing (2-40) and grooved rod bushing (2-50) from housing (1-10).
- 8.9 Remove yoke (1-140) from the housing cavity.

**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 valve.

- 8.10 It is not necessary to remove housing pipe plug (1-100) or cylinder adapter pipe plug (2-110).

## 9.0 GENERAL RE-ASSEMBLY

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

- 9.1 Remove and discard all seals and gaskets.
- 9.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 9.3 All parts should be thoroughly inspected for excessive wear, stress cracking, galling and pitting. Attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding or rotating motion. Sealing surfaces of the cylinder and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

**CAUTION:** Actuator parts that reflect any of the above listed characteristics must be replaced with new parts.

- 9.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of lubricant, before installing into seal grooves. NOTE: The parts and seals used in the actuator housing assembly, power/spring cylinder will be assembled using lubricant as identified in step 4.9.

## 10.0 CENTER HOUSING GROUP RE-ASSEMBLY

- 10.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10).
- 10.2 Apply lubricant to the yoke bore in the housing and position the housing so that the yoke bore is nearest to you. Lubricate the raised ribs in the bottom of the housing.
- 10.3 Install o-ring seal (6-20) into seal groove in the housing bore.
- 10.4 Apply a generous amount of lubricant to the slots in the upper and lower yoke arms of yoke (1-140).
- 10.5 Coat the bearing surfaces of yoke (1-140) with lubricant and install yoke into housing (1-10). The wide yoke arm should be installed toward top of the housing.
- 10.6 Coat the piston rod bushing (2-40) with lubricant. Install into the left side of the housing (1-10).
- 10.7 Coat grooved rod bushing (2-50) with lubricant. Install into right side of housing (1-10).
- 10.8 Coat one yoke roller (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.
- 10.9 Apply lubricant to piston rod (2-10) and install into the housing through the rod bushings. The threaded end should be on the left.
- 10.10 Coat yoke pin (1-40) with lubricant and install through piston rod (2-10) into lower yoke roller (1-50).

- 10.11 Coat remaining yoke roller (1-50) with lubricant and install over yoke pin (1-40) and into the slot in the upper yoke arm.
- 10.12 Coat the yoke bore in cover (1-20) with lubricant.
- 10.13 Install remaining o-ring seal (6-20) into housing cover (1-20).
- 10.14 Install cover gasket (6-60) onto housing (1-10).
- 10.15 Install four gasket seals (6-100) onto four screws (1-30).
- 10.16 Install housing cover (1-20) onto housing (1-10).
- 10.17 Install and tighten hex cap screws (1-30) with gasket seals (6-100) into housing cover (1-20).

## 11.0 **SPRING CYLINDER RE-ASSEMBLY**

- 11.1 Coat rod seal (6-30) with lubricant and install, lip first, into cylinder adapter (2-30).

**CAUTION: Energizer ring of rod seal (6-30) must face into the cylinder adapter (piston side).**

- 11.2 Install cylinder adapter gasket (6-70) onto the left side of the housing (1-10).
- 11.3 Install four gasket seals (6-80) onto four ferry head screws (2-90).
- 11.4 Install cylinder adapter (2-30) over the end of piston rod (2-10) and onto the left side of the housing (1-10). Arrange the cylinder adapter with the pressure inlet port in the same position as recorded in step 5.4. The location of the port may be different on your actuator depending on customer, plumbing, and accessory requirements.

**CAUTION: Care should be taken not to scratch the piston rod when installing the cylinder adapter.**

- 11.5 Install and tighten ferry head screws (2-90) with gasket seals (6-80).
- 11.6 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in step 5.4.
- 11.7 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.
- 11.8 Install o-ring seal (6-50) onto piston rod (2-10). NOTE: The o-ring should be installed against the shoulder of the piston rod.
- 11.9 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 11.8. 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).
- 11.10 Install lockwasher (2-80) onto piston rod (2-10).

- 11.11 Install hex nut (2-70) onto piston rod (2-10). Torque hex nut (2-70) to approximately 146 foot pounds.
  - 11.12 Coat piston seal grooves with lubricant.
  - 11.13 Coat one u-cup seal (6-10) with lubricant.
  - 11.14 Install one u-cup seal into the innermost piston groove. The lip of the cup seal should point outward toward inboard side of the piston.
  - 11.15 Push the piston in towards the housing as far as it will go.
  - 11.16 Coat the cylinder threads and the cylinder bore with lubricant.
  - 11.17 Coat outside of the spring with lubricant and insert spring cartridge assembly (5) into spring cylinder (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.
- 11.18 Install spring cylinder (4-10), containing the spring cartridge, over the piston and screw into cylinder adapter (2-30). Tighten with a chain wrench.

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

- 11.19 Rotate the yoke to the full clockwise (CW) position. Position 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 rod cover (2-60).
- 11.20 Install and tighten yoke position indicator/yoke weather cover screws (1-120).

NOTE: Screws (1-120) will require rechecking for tightness after the actuator has been cycled and tested.

- 11.21 Install gasket seals (6-90) and jam nuts (1-70) onto stop screws (1-60).
- 11.22 Install stop screws (1-60) with gasket seals (6-90) and jam nuts (1-70) into housing (1-10) in the position as recorded in step 5.3.

## **12.0 ROD COVER RE-ASSEMBLY**

- 12.1 Install end cap gasket (6-70) onto right side of housing (1-10).
- 12.2 Install rod cover (2-60) over exposed piston rod (2-10).
- 12.3 Install four seal gaskets (6-80) onto four ferry head screws (2-100).
- 12.4 Install and tighten ferry head screws (2-100) with seal gaskets (6-80).
- 12.5 Adjust both stop screws (1-60) back to settings recorded in section 5 under General Disassembly.

### 13.0 ACTUATOR TESTING

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

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

- 13.3 Unless otherwise listed all leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag or the pressure used by the customer to operate actuator during normal operation. NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.
- 13.4 Before testing for leaks, alternately apply and release pressure, as defined in step 13.3, to the pressure side of the piston to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 13.5 Apply pressure, as defined in step 13.3, to pressure inlet port located in cylinder adapter (2-30).
- 13.6 Apply leak testing solution to the following areas:
- 13.6.1 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.
  - 13.6.2 The threaded joint between the SR cylinder (4-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.
  - 13.6.3 The joint between the cylinder adapter and the housing.
  - 13.6.4 The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.
- 13.7 If an actuator was disassembled and repaired, the above leakage test must be performed again.
- 13.8 Operation test the actuator to verify proper function of the actuator. This test is to be done off of the valve.
- 13.8.1 Adjust the pressure regulator to the pressure as defined in step 13.3.
  - 13.8.2 Apply the above pressure to the cylinder adapter pressure inlet port and allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.
- 13.9 Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, should be corrected and the above test performed again.
- 13.10 Remove pressure from pressure inlet port located in cylinder adapter (2-30).

**14.0 RETURN TO SERVICE**

- 14.1 Install breather (4-20) into port in outboard end of cylinder assembly (4-10).
- 14.2 Replace software components of snubber (1-130) and then install snubber into housing (1-10).
- 14.3 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).
- 14.4 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.
- 14.5 The actuator is now ready for returning to service.

**TOOL STYLE AND WRENCH SIZES**

ITEM NO.	WRENCH SIZE	QTY	LOCATION	RECOMMENDED WRENCH STYLE
1-30	9/16"	4	Cover Screws	Socket
1-60	7/16"	2	Stop Screws	Open End or Adjustable
1-70	15/16"	2	Hex Jam Nut	Open End or Adjustable
1-100	7/16"	1	Pipe Plug	Open End or Adjustable
1-120	3/16"	4	Socket Cap Screws	Allen <b>(1)</b>
1-130	7/8"		Snubber Valve	Deep Socket
2-70	1-1/4"	1	Light Hex Lok Nut	Socket
2-90	7/16"	4	Ferry Cap Screws	12 Point Socket <b>(1)</b>
2-100	7/16"	4	Ferry Cap Screws	12 Point Socket <b>(1)</b>
2-110	7/16"	1	Pipe Plug	Allen
4-10	--	1	Cylinder Assembly	Chain Wrench <b>(1) (2)</b>
4-20	11/16"	1	Breather	Open End <b>(1)</b>

NOTES: (1) No alternate style tool recommended.

(2) Bettis recommends a short handled Chain Wrench with a 40" chain.

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\* Signatures on file Waller, Texas