

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY AND REASSEMBLY**

**FOR MODELS**

**CBM-SR-S**

**SPRING RETURN SEISMIC**

**SERIES PNEUMATIC ACTUATORS**

PART NUMBER: 119202

REVISION: "B"

RELEASE DATE: November 2000

## 1.0 **INTRODUCTION**

1.1 In order to assure and maintain the present level of qualification and auditability to the seismic portions only of the Bettis Qualification Report number 037274 the following is required:

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

1.1.2 Maintain a service interval of five years.

1.2 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis CBM-SR-S Seismic Series Pneumatic Actuators.

### 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 **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 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.

1.5 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment requires the actuator be dismounted 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 Kit, assembly tool (part number 074113), commercial leak testing solution and non-hardening thread sealant.
- 2.2 **Tools:** All tools are American Standard inch. Two adjustable wrenches, 1/8" punch, Allen wrench set, small screwdriver with sharp edges rounded off, medium size screwdriver, diagonal cutting pliers, external snap ring pliers, flat file, 1/2" drive ratchet and deep-well socket set, torque wrench (up to 2,000 inch pounds).

## **3.0 BETTIS REFERENCE MATERIALS**

- 3.1 CB420M-SR-S, and CB525M-SR-S Seismic Assembly drawing part no. 124269 \*.
- 3.2 CB415M-SR-S, CB520M-SR-S, and CB725M-SR-S Seismic Assembly drawing part no. 109863 \*.

\* Assembly drawings are contained in Bettis Service Kits. The assembly drawings are generic drawings and may not show some items or details that are in the actuator being serviced by this procedure.

## **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 and actuator parts list.
- 4.3 When removing seals from seal groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.
- 4.4 Use a non-hardening thread sealant on all pipe threads.

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

- 4.5 Disassembly of actuator should be done in a clean area on a work bench when possible.
- 4.6 **LUBRICATION REQUIREMENTS:** For temperature service (-20°F to +350°F) use Bettis ESL-4,5 & 10. Bettis Standard Service Kit contains ESL-4,5 & 10 in tubes. Lubricants, other than Bettis ESL-4,5 & 10 should not be used without prior written approval of Bettis Product Engineering.

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

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

## **5.0 GENERAL DISASSEMBLY**

NOTE: In place of the housing stop screw (2-80) the actuator may be equipped with Extended Travel Stop or special length stop screw.

- 5.1 The setting of the stop screws (2-80) should be checked and setting recorded before stop screws are loosened or removed.
- 5.2 If not already removed, disconnect all operating pressure from actuator, allowing the spring to travel to it's extended or relaxed position. The spring will rotate to the actuator to its fail position.
- 5.3 Rotate the handwheel clockwise until the actuator is at the end of its stroke.
- 5.4 Loosen and remove hex nut (2-90) from housing stop screw (2-80).
- 5.5 Remove stop screw (2-80) from housing (1-10).
- 5.6 Loosen and remove hex nut (2-90) from end caps stop screw (2-80).
- 5.7 Remove seal washer (3-80) and thread seal (3-70) from end cap stop screw (2-80). Do not remove stop screw (2-80) from the end cap (2-20) unless the stop screw needs replacement.

## **6.0 SPRING CYLINDER DISASSEMBLY**

- 6.1 The spring in CBM Series Spring Return Actuators are preloaded. Actuator must be disassembled in the following manner.
- 6.2 Make sure the handwheel (6-10) is rotated all the way clockwise (relaxing or extending the spring).
- 6.3 Remove grooved pin (6-20) from handwheel (6-10).
- 6.4 Remove handwheel (6-10) from lead screw assembly (2-40).
- 6.5 Remove grooved pin (2-100) from the lead screw assembly. This will allow the removal of the torque nut from the lead screw assembly.
- 6.6 Remove both thrust washers (2-180) and thrust bearing (2-190) from end cap (2-20).
- 6.7 Remove breather (2-130) from end cap (2-20), discard if the Bettis Service/Seal kit contains a new breather.

NOTE: If actuator is piped for spring air assist then there will be no breather (2-130).

- 6.8 Unscrew and remove acorn nut (2-110) and seal gasket (3-10) from cylinder end of center bar assembly (2-50).

- 6.9 Using a (1/2" drive) ratchet and socket on the welded nut, located on the housing end of center bar assembly (2-50), rotate the center bar assembly counter-clockwise (CCW). This will cause end cap (2-20) to gradually unscrew from center bar assembly (2-50).
  - 6.10 Continue to rotate the center bar assembly (2-50) counter-clockwise (CCW) until the spring pre-load is eliminated. As the pre-load is reduced it may be necessary to keep end cap (2-20) from turning by holding the end cap with a wrench.
  - 6.11 After the spring pre-load is eliminated, unscrew and remove end cap (2-20) from center bar assembly (2-50).
  - 6.12 Remove spring (4) from within spring cylinder (2-10).
  - 6.13 Hold housing torque shaft (1-30) with a wrench, pull cylinder (2-10) away from housing (1-10); slide cylinder over piston (2-30) and remove.
  - 6.14 Pull piston (2-30) out of housing (1-10) and carefully slide piston off of center bar assembly (2-50).
- NOTE: Lead screw assembly (2-40) and tie bar (2-140) will stay assembled with the piston. Unless worn out or failed parts are being replaced it is not necessary to disassembly lead screw assembly (2-40) and tie bar from the piston.
- 6.15 Roll pin (1-60) and yoke pin (1-40) are removed as part of the piston (2-30) and they do not need to be disassembled from the piston.

## **7.0 HOUSING DISASSEMBLY**

- 7.1 On actuators equipped with a cylinder adapter (2-140) CB415M-SR, CB520M-SR and CB725M-SR; remove cylinder adapter (2-120) from housing (1-10).
- 7.2 Slide center bar assembly (2-50) out of housing (1-10).
- 7.3 Remove both retaining rings (1-80) from torque shaft (1-30). Do not reuse retaining rings, new ones are provided in the Bettis Service Kit.
- 7.4 Record and mark the orientation of the flats on torque shaft (1-30) in relationship to the side of the housing each flat is exposed on.
- 7.5 The following steps may need to be taken before disassembly can continue.
  - 7.5.1 If outer ends of torque shaft (1-30) has any raised burrs or sharp edges they should be filled off, removing as little metal as possible.
  - 7.5.2 If there is excessive paint build-up on outer ends of torque shaft (1-30) the excess paint should be removed.
- 7.6 Push torque shaft (1-30) out one side of housing (1-10) until o-ring seal (3-40) is clear of housing (1-10).

- 7.7 Remove o-ring seal (3-40) from torque shaft (1-30).
- 7.8 Push torque shaft (1-30) back through housing (1-10) and pull torque shaft completely out the opposite side of housing (1-10) while holding yoke key (1-50) in place.
- 7.9 Remove yoke key (1-50) and yoke key spring (1-70) from torque shaft (1-30).
- 7.10 Remove yoke (1-20) from housing (1-10).

## 8.0 PRE-ASSEMBLY NOTES

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

- 8.1 Remove and discard all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 8.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 8.3 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, torque shaft, and center bar assembly 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.**

- 8.4 Before installation coat all actuator 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 section 4 step 4.6.
- 8.5 The torque requirements for critical fasteners are specified at the appropriate step of the assembly procedure.

## 9.0 RE-ASSEMBLY

- 9.1 Apply lubricant to the torque shafts holes located in housing (1-10).
- 9.2 Coat yoke (1-20) with lubricant and insert into housing (1-10).
- 9.3 Insert yoke key spring (1-70), with the ends pointing down, into the slot in torque shaft (1-30).
- 9.4 With the tapered side facing outward place yoke key (1-50) on top of spring (1-70). Refer to assembly drawing for correct key orientation.

- 9.5 Refer to step 7.4 for correct orientation of torque shaft flats. Hold yoke key (1-50) down and insert torque shaft (1-30) into the hole on one side of housing (1-10), then through yoke (1-20) and out the other side of housing (1-10).

**CAUTION: Rotate the torque shaft until the yoke key snaps into the keyway in the yoke.**

- 9.6 Push the torque shaft out one side of housing (1-10) until the o-ring seal groove is clear of housing (1-10).
- 9.7 Install one o-ring seal (3-40) into the o-ring groove of torque shaft (1-30).
- 9.8 Carefully push the torque shaft back into housing (1-10) until the o-ring groove on the opposite end of torque shaft (1-30) is just visible and clear of housing (1-10).
- 9.9 Install remaining o-ring seal (3-40) into the o-ring groove of torque shaft (1-30).
- 9.10 Install one of the new retaining rings (1-80) onto the torque shaft, making certain it is properly seated in the torque shaft groove.
- 9.11 Push the torque shaft back into the housing and install the remaining new retaining ring (1-80) onto the torque shaft.
- 9.12 Rotate torque shaft (1-30) so that the yoke arms point toward the cylinder end of housing (1-10).
- 9.13 Apply a generous amount of lubricant to the slots in the yoke arms.
- 9.14 Install gasket seal (3-10) onto center bar assembly (2-50) slide it down the center bar until it rests against the welded nut.
- 9.15 Coat entire length of center bar assembly (2-50) with lubricant.
- 9.16 Insert lubricated center bar assembly into the center hole of housing (1-10) and slide center bar assembly through housing until gasket seal (3-10) and welded nut are flush against the housing.

NOTE: Care should be taken during installation of center bar assembly (2-50) so as to not scratch or mar its finish.

- 9.17 Install cylinder gasket (3-30) on housing flange.
- 9.18 Actuators equipped with a cylinder adapter (2-120), models CB415M-SR, CB520M-SR and CB725M-SR, perform the following two steps.

NOTE: The cylinder adapter is to have its stepped outer diameter facing away from housing (1-10).

9.18.1 Install cylinder adapter (2-120) onto the flange of housing (1-10).

9.18.2 Install cylinder gasket (3-20) onto the stepped diameter of cylinder adapter (2-120).

## 10.0 SPRING CYLINDER RE-ASSEMBLY

- 10.1 Re-coat exposed areas of center bar assembly (2-50) with lubricant.
- 10.2 Coat o-ring seal (3-50) with lubricant and install into the internal seal groove in the head of piston (2-30).
- 10.3 Coat T-seal (3-60) with lubricant and install into outer diameter seal groove of piston (2-30).  
NOTE: The T-Seal is composed of rubber seal and two back-up rings. The rings serve as anti-extrusion back-ups.
- 10.4 Coat the heel of piston (2-30) and the exposed ends of yoke pin (1-40) with lubricant.
- 10.5 With the piston head facing away from housing (1-10) and with yoke pin (1-40) up, carefully install piston (2-30) onto center bar assembly (2-50).
- 10.6 Slide piston (2-30) along center bar assembly (2-50) until yoke pin (1-40) engages the slots in the arms of yoke (1-20). While holding the nut of center bar assembly (2-50) flush against housing (1-10) push piston (2-30) into housing (1-10) as far as it will go.
- 10.7 Coat the entire bore of cylinder (2-10) with a coating of lubricant.
- 10.8 Install lubricated cylinder (2-10) over the piston/lead screw assembly (2-40)/tie bars (2-140) and onto the flange of housing (1-10). Cylinder (2-10) will slip onto the flange of cylinder adapter (2-140) on CB415M-SR, CB520M-SR, and CB725M-SR models.
- 10.9 Apply a coat of lubricant on spring (4) and carefully slide the spring into the open cylinder until it contacts the head of piston (2-30).
- 10.10 Screw end cap (2-20) onto center bar assembly (2-50).
- 10.11 Position end cap (2-20) so that the lead screw assembly shaft is lined up with the hole in the end cap. Insert tool part number 074113, through the end cap hole and thread the tool into the lead screw assembly (2-40).
- 10.12 Using a (1/2" drive) ratchet (or an impact wrench) and socket on the welded nut, located on the housing end of center bar assembly (2-50), rotate the center bar assembly clockwise (CW). This will cause end cap (2-20) to gradually screw further onto center bar assembly (2-50).
- 10.13 Continue to rotate center bar assembly (2-50) clockwise until spring (4) is fully compressed, cylinder (2-10) is seated against the flange of housing (1-10) or cylinder adapter (2-120) and end cap (2-20) is properly seated against cylinder (2-10).

10.14 Torque tighten center bar assembly (2-50) to the torque as specified in the following Chart.

<b>TORQUE REQUIREMENTS FOR CBM-SR-S CENTER BARS</b>		
ACTUATOR MODEL	MAXIMUM TORQUE	
	INCH POUNDS	FOOT POUNDS
CB415M-SRXX	660	55
CB420M-SRXX	1,200	100
CB520M-SRXX	1,200	100
CB525M-SRXX	1,560	100
CB725M-SRXX	1,560	130

- 10.15 If removed, install stop screw (2-80) into end cap (2-20).
- 10.16 Coat stop screw (2-80) with lubricant and install into housing (1-10). Turn the stop screw until it contacts piston (2-30).
- 10.17 Screw thread seals (3-70) onto both stop screws (2-80). Rotate thread seals until they are seated against housing (1-10) and end cap (2-20).
- 10.18 Install seal washers (3-80) onto both stop screws. Install with the chamfer (countersink) side of washers facing thread seals (3-70).
- 10.19 Screw hex nuts (2-90) onto stop screws (2-80) until hand tight.
- 10.20 Adjust both stop screws (2-80) back to setting recorded in section 5, step 5.1 under General Disassembly.
- 10.21 Tighten both stop screw hex nuts (2-90) securely, while holding stop screws (2-80) in position.
- 10.22 Install remaining gasket seal (3-10) onto the exposed end of center bar assembly (2-50).
- 10.23 Install acorn nut (2-110) onto center bar assembly (2-50) and tighten securely.
- 10.24 Lubricate thrust bearing (2-190) and both thrust washers (2-180).
- 10.25 Install one thrust washer (2-180) into end cap (2-20), then install thrust bearing (2-190), and then install remaining thrust washer (2-180) next to thrust bearing (2-190).
- 10.26 Install the o-ring seal (3-100) onto the outer diameter seal groove in torque nut (refer to view C on the actuator assembly drawing).
- 10.27 Install the torque nut over the lead screw assembly shaft, aligning the hole in torque nut with the hole in the lead screw shaft.

- 10.28 Insert groove pin (2-100) in the torque nut and drive it through the lead screw shaft.
- 10.29 Install o-ring seal (3-110) into the outer diameter seal groove in handwheel (6-10).
- 10.30 Install handwheel (6-10) into the torque nut.
- 10.31 Insert groove pin (6-20) into the torque nut and drive it through the shaft of handwheel (6-10).

## 11.0 **ACTUATOR TESTING**

- 11.1 In general all areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable. If excessive leakage is noted, the formed bubble breaks before three seconds, the actuator must be disassembled and the cause of leakage must be determined and corrected.

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

- 11.2 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 the actuator during normal operation.

**CAUTION: Test the actuator using a properly adjusted self relieving regulator, with gauge.**

- 11.3 Before testing for leaks, alternately apply and release operating pressure, as described in step 11.2, to the pressure side of the pistons to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their proper service condition.
- 11.4 Apply operating pressure, as described in step 11.2 to the pressure inlet port in actuator housing (1-10).
- 11.5 Apply leak testing solution to the following areas:
  - 11.5.1 Cylinder to housing joint on CB420M-SR, and CB525M-SR or cylinder to cylinder adapter to housing joints on CB415M-SR, CB520M-SR, and CB725M-SR actuators. Checks gaskets (3-20) or (3-30).
  - 11.5.2 Center bar assembly nut to housing. Checks gasket seal (3-10).
  - 11.5.3 Housing stop screw (2-80), hex nut (2-90), washer seal (3-80), and thread seal (3-70).
  - 11.5.4 Two locations for torque shaft (1-30) to housing (1-10) interfaces. Checks the two o-ring seals (3-40).

11.5.5 Form a leak testing solution bubble over the breather port hole in outer end cap (2-20). Checks the piston to cylinder wall and piston to center bar seals (3-60) and (3-50).

11.6 If actuator was disassembled and repaired as result of this procedure, the above leakage must be performed again.

11.7 Operational (Functional) Test This test is used to verify proper function of the actuator.

NOTE: This test is to be done off of the valve or when valve stem is not coupled to the actuator torque plug.

11.7.1 Adjust the pressure regulator to the pressure as described in step 11.2.

11.7.2 Apply the above pressure to the actuator and allow the unit to stabilize. The actuator should stroke a full 90 degrees travel with the stops properly set.

**12.0 RETURN TO SERVICE**

12.1 Install new breather (2-130) into end cap (2-20). Actuators that are piped for spring air assist will not use breather (2-130).

12.2 After actuator is reinstalled on the device it is to operate all pneumatic accessories are to be hooked up, leak tested, and then each accessory checked for proper operation.

**WARNING: Any defective or malfunctioning accessory is to be replaced before actuator is placed into service.**

12.3 The actuator should now be ready to return to service.

ECN	DATE	REV	BY *	DATE
Released	December 1995	A	COMPILED	
17464	November 2000	B	APPROVED	
			APPROVED	

\* Signatures on file Bettis Actuator & Controls, Waller, Texas