ENGLISH LANGUAGE

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

CBM-SR (-M) SERIES

SPRING RETURN

PNEUMATIC ACTUATORS

WITH UNIDIRECTIONAL

INTERNAL MANUAL OVERRIDE

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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 models CB415M-SR, CB420M-SR, CB520M-SR, CB525M-SR and CB725M-SR Spring Return Series pneumatic actuators. When the actuator model number has "S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.

NOTE: When the actuator model number has "-S" as a suffix then the actuator is special and may have some differences that may not be 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 interval.

1.1.3 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator.

1.1.4 Remove all piping and mounted accessories that will interfere with the module(s) that are to be worked on.

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 (reference number) used on the Bettis Assembly Drawing and Actuator Parts List.

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

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

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

1.1.9 Bettis recommends that disassembly of the actuator modules 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

1.3.1 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.

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 CB420M-SR, CB525M-SR Assembly Drawing part number 073530.

1.4.2 CB415M-SR, CB520M-SR, CB725M-SR Assembly Drawing part number 073743.

1.5 SERVICE SUPPORT ITEMS

1.5.1 Bettis Service Kit.

1.5.2 Commercial leak testing solution.

1.5.3 Non-hardening thread sealant.

1.6 LUBRICATION REQUIREMENTS

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

NOTE: Lubricants other than those listed in steps 1.6.2 should not be used without prior written approval of Bettis Product Engineering. The lubricant item number on some assembly drawings is item (5) while the Bettis service kits lubricant item number is item number (500).

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 and the tubes are marked ESL-4,5 & 10 lubricant.

1.7 GENERAL TOOL INFORMATION

1.7.1 All threads on CB series actuators are Inch Unified and NPT.

1.7.2 All tools/Hexagons are American Standard inch. Two adjustable wrenches, small punch, Allen wrench set, small standard screwdriver with sharp edges rounded off, medium size standard screwdriver, diagonal cutting pliers, external snap ring pliers, flat file, drive ratchet / deepwell socket set and torque wrench (up to 2,000 inch pounds / 226 N-m).

SECTION 2 - ACTUATOR DISASSEMBLY

2.1 GENERAL DISASSEMBLY

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.

NOTE: Before starting the general disassembly of the actuator it is a good practice to operate 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.

2.1.1 The setting of the stop screws (2-80) should be checked and setting recorded before stop screws are loosened or removed.

2.1.2 If not already removed, disconnect all operating pressure from actuator, allowing the spring to travel to its extended or relaxed position. The spring will rotate to the actuator to its fail position.

2.1.3 Rotate the handwheel clockwise until the actuator is at the end of its stroke.

2.1.4 Loosen and remove hex nut (2-90) from housing stop screw (2-80).

2.1.5 Remove stop screw (2-80) from housing (1-10).

2.1.6 Loosen and remove hex nut (2-90) from end caps stop screw (2-80).

2.1.7 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.

2.2 SPRING CYLINDER DISASSEMBLY

2.2.1 The spring in CBM Series Spring Return Actuators are preloaded. Actuator must be disassembled in the following manner.

2.2.2 Make sure the handwheel (6-10) is rotated all the way clockwise (relaxing or extending the spring).

2.2.3 Remove grooved pin (6-20) from handwheel (6-10).

2.2.4 Remove handwheel (6-10) from lead screw assembly (2-40).

2.2.5 Remove grooved pin (2-100) from the lead screw assembly. This will allow the removal of the torque nut from the lead screw assembly.

2.2.6 Remove both thrust washers (2-180) and thrust bearing (2-190) from end cap (2-20).

2.2.7 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).

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

2.2.9 Using a ratchet wrench 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).

2.2.10 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.

2.2.11 After the spring pre-load is eliminated, unscrew and remove end cap (2-20) from center bar assembly (2-50).

2.2.12 Remove spring (4) from within spring cylinder (2-10).

2.2.13 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.

2.2.14 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.

2.2.15 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.

2.3 HOUSING DISASSEMBLY

2.3.1 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).

2.3.2 Slide center bar assembly (2-50) out of housing (1-10).

2.3.3 Remove both retaining rings (1-80) from torque shaft (1-30). Do not reuse retaining rings, new ones are provided in the Bettis Service/Seal kit.

2.3.4 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.

2.3.5 The following steps may need to be taken before disassembly can continue.

2.3.5.1 If torque shaft (1-30) has any raised burrs or sharp edges they should be removed.

NOTE: When removing burrs and sharp edges, remove as little metal as possible.

2.3.5.2 If there is excessive paint build-up on outer ends of torque shaft (1-30) the excess paint should be removed.

2.3.6 Push torque shaft (1-30) out one side of housing (1-10) until o-ring seal (3-40) is clear of housing (1-10).

2.3.7 Remove o-ring seal (3-40) from torque shaft (1-30).

2.3.8 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.

2.3.9 Remove yoke key (1-50) and yoke key spring (1-70) from torque shaft (1-30).

2.3.10 Remove yoke (1-20) from housing (1-10).

SECTION 3 - ACTUATOR REASSEMBLY

3.1 GENERAL REASSEMBLY

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

3.1.1 Remove and discard all old seals and gaskets, taking care not to scratch or damage seal grooves.

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, 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.

3.1.4 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.

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

3.2 HOUSING REASSEMBLY

NOTE: In 2001 the shape of housing (1-10) was changed to allow for accessory mounting pads. This housing is interchangeable with all previous CB series housings.

3.2.1 Apply lubricant to the torque shafts holes located in housing (1-10).

3.2.2 Coat yoke (1-20) with lubricant and insert into housing (1-10).

3.2.3 Insert yoke key spring (1-70), with the ends pointing down, into the slot in torque shaft (1-30).

WARNING: If the yoke key (1-50) is installed incorrectly the housing may be damaged when next disassembly occurs. Refer to assembly drawing for correct yoke key spring and yoke key orientation.

3.2.4 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.

3.2.5 Hold the 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.

3.2.6 Push the torque shaft out one side of housing (1-10) until the o-ring seal groove is clear of housing (1-10).

3.2.7 Coat one o-ring seal (3-40) with lubricant and install in the seal groove of torque shaft (1-30).

3.2.8 Carefully push torque shaft (1-30) back into housing (1-10) until the o-ring groove on the opposite end of torque shaft (1-30) is just clear of housing (1-10).

3.2.9 Coat the remaining o-ring seal (3-40) with lubricant and install into the exposed seal groove of torque shaft (1-30).

NOTE: Two new retaining rings (1-80) are contained in the Bettis Service Kit.

3.2.10 Install one of the new retaining rings (1-80) into the torque shaft, making certain it is properly seated in the groove of torque shaft (1-30).

3.2.11 Push torque shaft (1-30) back into housing (1-10) and install second retaining ring (1-80) into torque shaft (1-30).

3.2.12 Rotate the torque shaft (1-30) so that the yoke arms point toward the cylinder end of housing (1-10).

3.2.13 Apply a generous amount of lubricant to the slots in the arms of yoke (1-20).

3.2.14 Install washer seal (3-15) and thread seal (3-90) onto the center bar assembly (2-50). Carefully slide the thread seal and countersunk washer seal until they rest against the center bar nut.

CAUTION: The chamfered side of washer seal (3-15) will be facing thread seal (3-90).

3.2.15 Coat center bar assembly (2-50) with lubricant, being sure to coat the exposed threads.

3.2.16 Insert center bar assembly (2-50) into the center hole of housing (1-10). Slide center bar assembly through housing until washer seal (3-15), thread seal (3-90) and center bar assembly nut are flush against the housing.

WARNING: Care should be taken during installation of center bar assembly so as to not scratch it.

3.2.17 Re-coat center bar assembly (2-50) with lubricant.

3.2.18 Install gasket (3-30) onto housing flange.

3.2.19 Actuators equipped with a cylinder adapter (2-120), models CB415M-SR, CB520M-SR and CB725M-SR, perform the following two steps.

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

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

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

3.3 SPRING CYLINDER REASSEMBLY

3.3.1 If the leadscrew assembly (2-40) was not removed from the piston then start re-assembly at step 3.3.5. If the leadscrew assembly (2-40) and tie bars (2-140) were removed from the piston (2-30) then start re-assembly at step 3.3.2.

3.3.2 Install the tie bars (2-140) into the threaded holes in the face of the piston (2-30). Torque tighten the tie bars per the following table.

TORQUE REQUIREMENTS - TIE BARS (2-140)		
ACTUATOR MODEL	**FOOT POUNDS**	**N-m**
CB415M-SR	12 ± 5%	16 ± 5%
CB420M-SR	12 ± 5%	16 ± 5%
CB520M-SR	20 ± 5%	27 ± 5%
CB525M-SR	20 ± 5%	27 ± 5%
CB725M-SR	30 ± 5%	41 ± 5%

NOTE: There are flats provided on the tie bars for wrenching.

3.3.3 Install the leadscrew assembly (2-40) on the tie bars (2-140) by inserting the tie bars through the bronze half nut and then through the guide flange.

3.3.4 Retain the guide flange with hex nuts (2-150) and lock-washers (2-160).

3.3.5 Coat o-ring seal (3-50) with lubricant and install into the internal seal groove in the head of piston (2-30).

3.3.6 Coat o-ring seal (3-60) with lubricant and install into outer diameter seal groove of piston (2-30).

3.3.7 Coat the heal of piston (2-30) and the exposed ends of yoke pin (1-40) with lubricant. Also lubricate the lead screw assembly (2-40) and the tie bars (2-140).

3.3.8 Re-coat exposed areas of center bar assembly (2-50) with lubricant.

3.3.9 With the head of piston (2-30) facing away from the housing (1-10) and with the yoke pin (1-40) positioned in the up direction, carefully install the piston (2-30) onto the center bar assembly (2-50).

3.3.10 Slide the piston (2-30) along the center bar assembly (2-50) until the yoke pin (1-40) engages the slots of yoke (1-20). Push the piston into the housing as far as it will go, while holding the center bar assembly flush against the housing (1-10).

3.3.11 Apply a light coating of lubricant to the entire bore of cylinder (2-10).

3.3.12 Install lubricated cylinder (2-10) over the piston (2-40) and onto the flange of housing (1-10).

NOTE: Cylinder (2-10) will install onto the flange of cylinder adapter (2-140) on CB415M-SR, CB520M-SR, and CB725M-SR models.

3.3.13 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).

3.3.14 Screw end cap (2-20) onto center bar assembly (2-50).

3.3.15 Position the end cap (2-20) so that the lead screw assembly shaft is lined up with the hole in the end cap (2-20). Insert tool part number 074113, through the end cap hole and thread the tool into the lead screw assembly (2-40).

3.3.16 Using a drive ratchet (or a power 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).

3.3.17 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).

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

ACTUATOR MODEL	MAXIMUM TORQUE	
	FOOT POUNDS	N-m
CB415M-SR	55	75
CB420M-SR	100	136
CB520M-SR	100	136
CB525M-SR	130	176
CB725M-SR	130	176

3.3.19 If removed, install the stop screw (2-80) into end cap (2-20).

3.3.20 Coat stop screw (2-80) with lubricant and install into housing (1-10). Turn the stop screw until it contacts piston (2-30).

3.3.21 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).

3.3.22 Install seal washers (3-80) onto both stop screws. Install with the chamfer (countersink) side of washers facing thread seals (3-70).

3.3.23 Screw hex nuts (2-90) onto stop screws (2-80) until hand tight.

3.3.24 Adjust both stop screws (2-80) back to setting recorded in Section 2.1, step 2.1.1 under General Disassembly.

NOTE: If the stop screw settings were not recorded and cannot be determined, then refer to "Operating & Maintenance Instructions For Initially Setting Travel Stop Screws on CB-Series Spring Return Actuators", part number 074943.

3.3.25 Tighten both stop screw hex nuts (2-90) securely, while holding stop screws (2-80) in position.

3.3.26 Install remaining gasket seal (3-10) onto the exposed end of center bar assembly (2-50).

3.3.27 Remove assembly tool part number 074113 from end cap (2-20).

3.3.28 Install acorn nut (2-110) onto center bar assembly (2-50) and tighten securely.

3.3.29 Lubricate thrust bearing (2-190) and both thrust washers (2-180).

3.3.30 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).

3.3.31 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).

3.3.32 Install the torque nut over the lead screw assembly shaft, aligning the hole in torque nut with the hole in the lead screw shaft.

3.3.33 Insert groove pin (2-100) in the torque nut and drive it through the lead screw shaft.

3.3.34 Install o-ring seal (3-110) into the outer diameter seal groove in handwheel (6-10).

3.3.35 Install handwheel (6-10) into the torque nut.

3.3.36 Insert groove pin (6-20) into the torque nut and drive it through the shaft of handwheel (6-10).

SECTION 4 - ACTUATOR SUPPORT INFORMATION

4.1 TESTING

4.1.1 Leak Testing Criteria:

4.1.1.1 In general all areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution.

4.1.1.2 Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable.

4.1.1.3 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.

4.1.2 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.

4.1.3 Before testing for leaks, alternately apply and release operating pressure, as described in step 4.1.2, 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.

4.1.4 Apply operating pressure, as described in step 4.1.2 to the pressure inlet port in actuator housing (1-10).

4.1.5 Apply leak testing solution to the following areas:

4.1.5.1 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).

4.1.5.2 Center bar assembly nut to housing. Checks gasket seal (3-10).

4.1.5.3 Housing stop screw (2-80), hex nut (2-90), washer seal (3-80), and thread seal (3-70).

4.1.5.4 Two locations for torque shaft (1-30) to housing (1-10) interfaces. Checks the two o-ring seals (3-40).

4.1.5.5 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).

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

4.1.7 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.

4.1.7.1 Adjust the pressure regulator to the pressure as described in step 4.1.2.

4.1.7.2 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 adjusted.

4.2 RETURN TO SERVICE

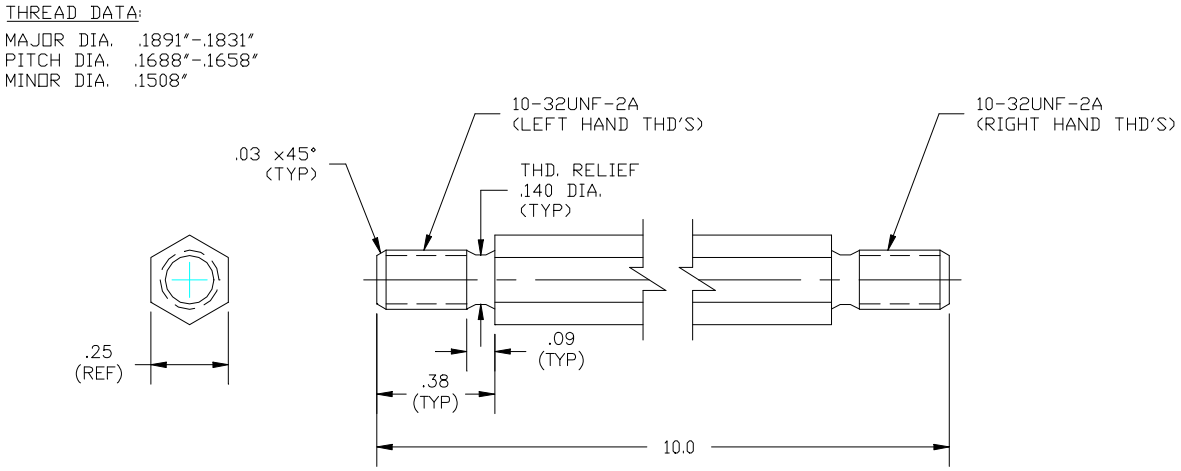
4.2.1 Install breather (2-130) into end cap (2-20). Actuators that are piped for spring air assist will not use breather (2-130).

4.2.2 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.

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

4.3 ASSEMBLY TOOL PART NUMBER 074113



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*** Signatures on file Bettis, Waller, Texas**