

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR CB-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 CB315-SR, CB415-SR, CB420-SR, CB520-SR, CB525-SR and CB725-SR spring return series actuators.

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 customer representative and an authorized Bettis representative.

1.4 BETTIS REFERENCE MATERIALS

1.4.1 CB315-SR, CB420-SR, and CB525-SR Assembly Drawing part number 041006.

1.4.2 CB315-SR, CB420-SR, and CB525-SR Exploded Detail Drawing part number 062908.

1.4.3 CB415-SR, CB520-SR, and CB725-SR Assembly Drawing part number 041007.

1.4.4 CB415-SR, CB520-SR, and CB725-SR Exploded Detail Drawing part number 062910.

1.4.5 BASE I Standard Dimensional Drawing part number 041875.

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, 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 Remove all operating pressure from actuator, allowing the spring to stroke. The spring will rotate the yoke to its fail position.
- 2.1.2 Record the settings of stop screw (2-70) and (2-80) before stop screws are loosened or removed.
- 2.1.3 Loosen and remove hex nut (2-90) from housing stop screw (2-80).
- 2.1.4 Loosen and remove hex nut (2-90) from SR stop screw (2-70).

NOTE: It is not necessary to remove stop screws (2-70) or (2-80) unless they are damaged and require replacement.

2.2 SPRING CYLINDER DISASSEMBLY

CAUTION: The spring in CB Series Spring Return Actuators are preloaded.

WARNING: Actuator must be disassembled in the following manner.

- 2.2.1 Remove acorn nut (2-110) from end cap (2-20).
- 2.2.2 Use a ratchet and socket on the welded nut, located on the housing end of center bar assembly (2-50), rotate center bar assembly (2-50) counter-clockwise (CCW). This will cause end cap (2-20) to gradually unscrew from center bar assembly (2-50).

- 2.2.3 Continue to rotate center bar assembly (2-50) counter-clockwise (CCW) until the spring preload is eliminated. As preload is reduced it may be necessary to keep end cap (2-20) from turning. The end cap can be held in position by holding end cap stop screw nut (2-90) with an adjustable wrench.
- 2.2.4 After the spring preload is eliminated, unscrew and remove end cap (2-20) from center bar assembly (2-50).
- 2.2.5 Remove spring (4) from within cylinder (2-10).
- 2.2.6 Hold torque shaft (1-30) and pull cylinder (2-10) away from housing (1-10); slide cylinder over piston (2-30) and remove.
- 2.2.7 Pull piston (2-30) out of housing (1-10) and carefully slide piston off of center bar assembly (2-50).

NOTE: Piston (2-30) is an assembly made up of the piston (2-30), roll pin (1-60), and yoke pin (1-40), do not attempt to disassemble the piston assembly.

- 2.2.8 On models CB415, CB520, and CB725 remove cylinder adapter (2-140).

2.3 HOUSING DISASSEMBLY

- 2.3.1 Remove center bar assembly (2-50) from housing (1-10).
- 2.3.2 Remove both retaining rings (1-80) from torque shaft (1-30).
- 2.3.3 The following steps may be required before disassembly can continue.
 - 2.3.3.1 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.
 - 2.3.3.2 If there is excessive paint build-up on torque shaft it should be removed.
- 2.3.4 Push torque shaft (1-30) out one side of housing (1-10) until torque shaft o-ring seal (3-40) is clear of housing. Remove exposed o-ring seal (3-40) from torque shaft.
- 2.3.5 Push torque shaft (1-30) back through housing and pull torque shaft completely out of housing while holding yoke key (1-50) in place.
- 2.3.6 Remove yoke key (1-50) and yoke key spring (1-70) from torque shaft (1-30).
- 2.3.7 Remove yoke (1-20) from housing (1-10).
- 2.3.8 It may not be necessary to remove breather (2-130)/(11) to service the actuator.

SECTION 3 - ACTUATOR REASSEMBLY

3.1 GENERAL REASSEMBLY

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

3.1.1 Remove and discard all old 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, 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 may need replacement with new parts.

3.1.4 INSTALLATION LUBRICATION INSTRUCTIONS: Use the correct lubrication as defined in section 1.0 step 1.6.

3.1.4.1 Before installation coat all moving parts with lubricant.

3.1.4.2 Coat all seals with lubricant, before installing into seal grooves.

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 a coating of lubricant to housing (1-10) in the area of torque shaft holes.

3.2.2 Coat yoke (1-20) with lubricant and install 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).

NOTE: Actuators manufactured prior to August, 1981 were not equipped with washer seal (3-15) and thread seal (3-90). A single soft copper washer was used to seal center bar assembly (2-50) to housing (1-10). The thread seal (3-90) and seal washer (3-15) replace the single soft copper washer.

- 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 cylinder adapter (2-140), models CB415-SR, CB520-SR and CB725-SR, do steps 3.2.19.1 and 3.2.19.2.

3.2.19.1 Install cylinder adapter (2-140) onto housing flange, with the stepped outer diameter, of cylinder adapter (2-140), facing away from housing (1-10).

3.2.19.2 Install gasket (3-20) onto stepped diameter of cylinder adapter (2-140).

3.3 SPRING CYLINDER REASSEMBLY

3.3.1 Coat piston (2-30) outer diameter seal groove, inner diameter seal groove, head of piston and exposed ends of yoke pin (1-40) with lubricant.

WARNING: Aluminum pistons manufactured since 1982 are an assembly. The piston head may have a staked-in washer, which holds the piston to center bar o-ring seal in sealing position. Verify that the washer is firmly held in position by its staking. If washer staking is loose then re-stake or replace piston.

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

3.3.3 Coat seal (3-60) with lubricant and install into outer diameter seal groove of piston (2-30). The piston seal will fit very loosely in the outer diameter seal groove.

- NOTES:
1. In June, 1981 all standard pistons (Cast Aluminum, Cast Ductile or Nylon) with an outer diameter double lip seal groove was replaced with a narrow o-ring seal groove Aluminum piston.
 2. In all instances the o-rings provided in the Bettis Service Kit will perform the same sealing function as the original double lip seal.
 3. The CB315-SR, CB415-SR, and CB725-SR pistons have a different outer diameter seal groove dimension than the original double lip seal groove. Service Kits for these actuators will have piston seals for two different cross section o-rings included the kit.
 4. The CB520-SR and CB525-SR outer diameter seal groove dimensions are the same for the o-ring and the double lip seal. Service kits for these actuators will have only one size cross section o-ring piston seal.

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

3.3.5 Carefully slide piston (2-30) along center bar (2-50) until yoke pin (1-40) engages the yoke slots.

NOTE: While holding the center bar assembly flush against the housing, push piston (2-30) into housing (1-10) as far as the piston will go.

- 3.3.6 Apply a coating of lubricant to entire bore of cylinder (2-10).
- 3.3.7 Cylinder installation:
- 3.3.7.1 For CB415-SR, CB520-SR and CB725-SR models install the lubricated cylinder (2-10) over the piston and onto the stepped diameter flange of cylinder adapter (2-140).
 - 3.3.7.2 For CB315-SR, CB420-SR and CB525-SR models install the lubricated cylinder (2-10) over the piston and onto the flange of housing (1-10).
- 3.3.8 Apply a coat of lubricant to the spring (4). Install the spring into the cylinder by carefully sliding the spring into the open cylinder end until the spring contacts the piston.
- 3.3.9 End cap gasket installation. NOTE: Gasket (3-20) or (3-30) was added to the end cap (2-20) as a product improvement in 1992.
- 3.3.9.1 For CB415-SR, CB520-SR and CB725-SR models install end cap gasket (3-20) onto end cap (2-20).
 - 3.3.9.2 For CB315-SR, CB420-SR and CB525-SR models install end cap gasket (3-30) onto end cap (2-20).
- 3.3.10 If removed install stop screw (2-70) into end cap (2-20) and set stop screw to the approximated setting recorded in step 2.1.2.
- 3.3.11 Screw end cap (2-20) onto center bar assembly (2-50).
- 3.3.12 Position the spring cylinder end cap (2-20) so that the breather port is at the bottom and the stop screw (2-70) is at the top.
- WARNING: Do not allow end cap (2-20) to rotate during center bar assembly tightening. The end cap must maintain the position as described in step 3.3.12.**
- 3.3.13 Keep end cap (2-20) from turning by holding end cap stop screw nut (2-90) with an adjustable wrench.
- 3.3.14 Using a drive ratchet (or a power wrench) on the center bar assembly nut, rotate center bar assembly clockwise (CW). This will cause end cap (2-20) to gradually screw further onto center bar assembly (2-50).
- 3.3.15 Continue to rotate center bar assembly (2-50) clockwise until spring (4) is fully compressed, the cylinder is seated against the housing flange or adapter (2-140) and end cap (2-20) is properly seated against cylinder (2-10).

3.3.16 Tighten center bar assembly (2-50) to the proper torque as specified in the following chart.

ACTUATOR MODEL	MAXIMUM TORQUE	
	FOOT POUNDS	N-m
CB315-SR	55	75
CB415-SR	55	75
CB420-SR	100	136
CB520-SR	100	136
CB525-SR	130	176
CB725-SR	130	176

3.3.17 Place the remaining seal gasket (3-10) on the exposed end of the center bar assembly (2-50).

3.3.18 Place acorn nut (2-110) on the exposed outboard end of center bar assembly (2-50) and tighten securely.

3.3.19 If removed install stop screw (2-80) into housing (1-10) and screw in until stop screw contacts the piston.

3.3.20 Install thread seal (3-70) onto stop screw (2-80) until it is flush with the housing.

3.3.21 Install washer seal (3-80) onto stop screw (2-80) with the chamfer facing the thread seal (3-70).

3.3.22 Thread stop screw nut (2-90) onto stop screw (2-80) until hand tight.

3.3.23 Install thread seal (3-70) onto the stop screw (2-70) until it is flush with the end cap. NOTE: The seal washer (3-80) and the screw thread seal was added to the cylinder stop screw (2-70) as a product improvement in 1992.

3.3.24 Install washer seal (3-80) onto stop screw (2-70) with the chamfer facing the thread seal (3-70).

3.3.25 Thread stop screw nut (2-90) onto stop screw (2-70) until hand tight.

3.3.26 Adjust both stop screws (2-70) and (2-80) back to setting recorded in Step 2.1.2 under General Disassembly. Tighten both stop screw hex nuts (2-90) securely, while holding stop screw (2-70) and (2-80).

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', procedure part number 074943.

SECTION 4 - ACTUATOR TESTING

4.1 TESTING

4.1.1 Leak Test - General - A small amount of leakage may be tolerated. Generally, a small bubble which breaks about three seconds after starting to form is considered acceptable.

4.1.2 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.

4.1.3 All leak testing will use the customer normal operating pressure or the actuator name tag normal operating pressure (NOP). NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.

4.1.4 Before testing for leaks, apply and release the pressure listed in step 4.1.3 to the housing side of the piston. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.

4.1.5 Apply the pressure listed in step 4.1.3 to the housing side of the piston and allow the actuator to stabilize.

4.1.6 Apply a leak testing solution to the following areas:

4.1.6.1 Cylinder to housing joint on CB315-SR, CB420-SR, and CB525-SR or cylinder to cylinder adapter to housing joints on CB415-SR, CB520-SR, and CB725-SR actuators.

4.1.6.2 On the housing end, center bar seal (3-90) and center bar assembly nut. Checks the center bar to housing seal (3-90).

4.1.6.3 Housing stop screw thread seal (3-70).

4.1.6.4 Torque shaft (1-30) to housing (1-10) interface. Checks torque shaft seals (3-40).

4.1.6.5 End cap (2-20) port hole. Checks the piston to cylinder seal (3-60) and piston to center bar seal (3-50).

4.1.6.6 Remove pressure from pressure inlet port in the housing (1-10).

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

4.1.8 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.

4.1.8.1 Adjust the pressure regulator to the pressure rating that the customer uses to operate the actuator during normal service.

4.1.8.2 Apply the above pressure to the actuator and allow the actuator to stabilize. The actuator should stroke a full 90° degree travel with the stops properly set.

4.2 RETURN TO SERVICE

4.2.1 If removed, install breather (2-130) into end cap (2-20).

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

4.3 PRESSURE REQUIREMENT & LIMITATIONS FOR CB-SR SERIES ACTUATORS

4.3.1 Chart number 1.

ACTUATOR MODEL	NOMINAL OPERATING PRESSURE		MAXIMUM OPERATING PRESSURE	
	psig	barg	psig	barg
CB315-SR40	40	2.76	145	10.00
CB315-SR60	60	4.14	160	11.03
CB315-SR80	80	5.52	170	11.72
CB315-SR100	100	6.89	180	12.41
CB415-SR40	40	2.76	90	6.21
CB415-SR60	60	4.14	100	6.89
CB415-SR80	80	5.52	115	7.93
CB415-SR100	100	6.89	130	8.96
CB420-SR40	40	2.76	140	9.65
CB420-SR60	60	4.14	155	10.69
CB420-SR80	80	5.52	165	11.38
CB420-SR100	100	6.89	180	12.41

ACTUATOR MODEL	NOMINAL OPERATING PRESSURE		MAXIMUM OPERATING PRESSURE	
	psig	barg	psig	barg
CB520-SR40	40	2.76	100	6.89
CB520-SR60	60	4.14	110	7.58
CB520-SR80	80	5.52	125	8.62
CB520-SR100	100	6.89	135	9.31
CB525-SR40	40	2.76	160	11.03
CB525-SR60	60	4.14	175	12.07
CB525-SR80	80	5.52	190	13.10
CB525-SR100	100	6.89	200	13.79
CB725-SR40	40	2.76	95	6.55
CB725-SR60	60	4.14	105	7.24
CB725-SR80	80	5.52	120	8.27
CB725-SR100	100	6.89	135	9.31

ECN	DATE	REV		BY *	DATE
08864	March 1986	A	COMPILED	B. Cornelius	17 December 2001
14726	January 1994	B	CHECKED	B. Cornelius	17 December 2001
17787	December 2001	C	APPROVED	R. Smith	17 December 2001

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