

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY AND REASSEMBLY**

**FOR CB DOUBLE ACTING**

**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, CB415, CB420, CB520, CB525 and CB725 double acting series pneumatic 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's representative and an authorized Bettis representative.

### **1.4 BETTIS REFERENCE MATERIALS**

1.4.1 CB315, CB420, and CB525 Assembly drawing part number 041005.

1.4.2 CB315, CB420, and CB525 Exploded Detail drawing part number 062907.

1.4.3 CB520 and CB725 Assembly drawing part number 035053.

1.4.4 CB520 and CB725 Exploded Detail drawing part number 062909.

1.4.5 Standard Dimensional Base I drawing part number 041876.

### **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.

**CAUTION:** Actuator operating pressure is not to exceed the maximum operating pressure rating listed on it's name tag (Refer to Chart No. 1).

**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 If not already done, remove all operating pressure from the actuator.
- 2.1.2 The setting of both stop screws (2-80) should be checked and setting recorded before stop screws are loosened or removed.
- 2.1.3 Loosen and remove hex nut (2-90) from cylinder stop screw (2-80).
- 2.1.4 Loosen and remove hex nut (2-90) from housing stop screw (2-80).

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

### 2.2 PNEUMATIC CYLINDER DISASSEMBLY

2.2.1 Hold housing side acorn nut (2-110), loosen and remove cylinder side acorn nut (2-110) from center bar (2-50).

#### 2.2.2 CYLINDER REMOVAL

##### 2.2.2.1 TWO PIECE STEEL CYLINDER ASSEMBLY

2.2.2.1.1 Remove outer end cap (2-20).

2.2.2.1.2 While holding housing torque shaft (1-30), pull cylinder (2-10) away from housing (1-10).

2.2.2.1.3 Slide cylinder (2-10) over piston (2-30) and remove.

#### 2.2.2.2 ONE PIECE ALUMINUM CYLINDER ASSEMBLY

2.2.2.2.1 While holding housing torque shaft (1-30), pull cylinder (2-10) away from housing (1-10).

2.2.2.2.2 Slide cylinder (2-10) over piston (2-30) and remove.

NOTE: To replace the one piece aluminum cylinder (this cylinder is no longer manufactured) a cylinder kit must be ordered which will include a new steel cylinder, cast end cap and a new longer center bar.

**CAUTION: Do not use the center bar used on one-piece aluminum cylinder assemblies for assembling with the steel cylinder and cast end cap.**

2.2.3 Pull piston (2-30) out of housing (1-10) and remove by carefully slide piston off center bar (2-50).

NOTE: Roll pin (1-60) and yoke pin (1-40) are removed as part of the piston (2-30).

### 2.3 HOUSING DISASSEMBLY

2.3.1 On actuators equipped with cylinder adapter (2-140), models CB415, CB520 and CB725, remove cylinder adapter (2-140) from housing (1-10).

2.3.2 Remove center bar (2-50) from housing (1-10).

2.3.3 Remove both retaining rings (1-80) from torque shaft (1-30).

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

2.3.4.1 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.

2.3.4.2 If there is excessive paint build-up on torque shaft it should be removed.

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

2.3.6 Push torque shaft (1-30) back through housing. Pull torque shaft completely out of housing while holding yoke key (1-50) in with your fingers.

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

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

- 2.3.9 Acorn nut (2-110), that is still on center bar (2-50), does not require removal unless center bar or acorn nut are being replaced with new parts.

## SECTION 3 - ACTUATOR REASSEMBLY

### 3.1 GENERAL REASSEMBLY

**CAUTION:** Only new seals that are still within the seal's expectant shelf life should be install 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 Coat center bar (2-50) with lubricant, being sure to coat the exposed threads.
- 3.2.15 Install gasket seal (3-10) onto one end of center bar (2-50) and screw acorn nut (2-110) onto end of center bar (2-50).
- 3.2.16 Insert center bar (2-50) into the center hole in of housing (1-10). Slide center bar through housing until gasket seal (3-10) and acorn nut (2-110) are flush against housing (1-10).

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

- 3.2.17 Re-coat center bar assembly (2-50) with lubricant.
- 3.2.18 Install gasket (3-30) on housing flange.



3.2.19 Actuators equipped with cylinder adapter (2-140), models CB415, CB520 and CB725, 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 PNEUMATIC 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 piston 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 Iron 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, CB415, and CB725 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 and CB525 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 (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 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 TWO PIECE STEEL CYLINDER

3.3.7.1 On CB315, CB420, and CB525 models, install cylinder (2-10) over piston (2-30) and onto the cylinder flange of housing (1-10).

NOTE: When cylinder (2-10) engages housing flange be careful that gasket (3-30) is correctly positioned between cylinder and housing flange.

3.3.7.2 On CB415, CB520, and CB725 models, install cylinder (2-10) over piston (2-30) and onto the cylinder adapter (2-140).

NOTE: When cylinder (2-10) engages cylinder adapter (2-140) be careful that gaskets (3-20) and (3-30) are correctly positioned between cylinder, cylinder adapter and housing flange.

3.3.7.3 On CB415, CB520 and CB725 models, install gasket (3-20) on the flange of the outer end cap (2-20).

3.3.7.4 On CB315, CB420 and CB525 models, install gasket (3-30) onto the flange of outer end cap (2-20).

3.3.7.5 Slip the outer end cap (2-20) over the center bar (2-50) and into the cylinder (2-10).

3.3.7.6 Position the outer end cap (2-20) so that the pressure inlet port is at the bottom and the stop screw hole is at the top.

3.3.8 ONE PIECE ALUMINUM CYLINDER (CB315 AND CB420 MODELS ONLY)

3.3.8.1 Apply a coating of lubricant to the cylinder bore of cylinder (2-10).

3.3.8.2 Install cylinder (2-10) over piston (2-30) and onto the flange of housing (1-10).

3.3.8.3 Position the cylinder (2-10) so that the pressure inlet port is at the bottom and the stop screw hole is at the top.

3.3.9 Place the remaining seal gasket (3-10) on the exposed end of the center bar (2-50) and screw the acorn nut (2-110) on the center bar hand tight.

**WARNING: Do not allow end cap (2-20) to rotate during center bar tightening. The end cap must maintain the position as described in steps 3.3.8.3 or 3.3.7.6.**

- 3.3.10 Hold the cylinder side acorn nut (2-110) with a wrench and tighten the housing side acorn nut (2-110) to the proper torque as specified in the following chart.

ACTUATOR MODEL	MAXIMUM TORQUE	
	FOOT POUNDS	N-m
CB315 (Alum. Cylinder)	45	61
CB315 (Steel Cylinder)	55	75
CB415	55	75
CB420 (Alum. Cylinder)	90	122
CB420 (Steel Cylinder)	100	136
CB520	100	136
CB525	130	176
CB725	130	176

- 3.3.11 Install stop screw (2-80) into end cap (2-20) or into cylinder (2-10) and screw in approximately half way.
- 3.3.12 Install thread seal (3-70) onto stop screw (2-80) until it is flush with end cap (2-20) or cylinder (2-10).
- 3.3.13 Install seal washer (3-80) onto stop screw (2-80) with the seal washer chamfer facing thread seal (3-70).
- 3.3.14 Install stop screw nut (2-90) onto the cylinder stop screw (2-80) until hand tight.
- 3.3.15 Repeat steps 3.3.11 through 3.3.14 for housing stop screw (2-80).
- 3.3.16 Adjust both stop screws back to settings recorded in Step 5.2 under General Disassembly. Tighten both stop screw hex nuts (2-90) securely, while holding stop screws (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 Double Acting Actuators", part number 074942.

## 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 (Refer to Chart No. 1).**

- 4.1.3 All leak testing will use 65 psig (1.48 barg) operating pressure or the customer normal operating pressure. NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.
- 4.1.4 Before testing for leaks, apply the pressure listed in step 4.1.3 to the housing side of the piston and then to the cylinder side of the piston. Repeat this cycle approximately five times. 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, CB420, and CB525 or cylinder to cylinder adapter to housing joints on CB415, CB520 and CB725 actuators.
  - 4.1.6.2 Center bar gasket seal and acorn nut to housing.
  - 4.1.6.3 Housing stop screw and stop screw thread seal.
  - 4.1.6.4 Torque shaft seals.
  - 4.1.6.5 Cylinder or end cap inlet pressure port.
  - 4.1.6.6 Remove pressure from pressure inlet port in the housing (1-10).
- 4.1.7 Apply the pressure listed in step 4.1.3 to the cylinder pressure inlet port.
- 4.1.8 Apply a leak testing soap solution to the following areas:
  - 4.1.8.1 Cylinder to end cap joint.
  - 4.1.8.2 Center bar gasket seal and acorn nut to cylinder or end cap.
  - 4.1.8.3 Cylinder or end cap stop screw and stop screw thread seal.
  - 4.1.8.4 Body pressure inlet port.
  - 4.1.8.5 Remove pressure from pressure inlet port in the end cap.
- 4.1.9 If excessive leakage across the piston is noted, generally a bubble which breaks three seconds or less after starting to form, the unit must be disassembled and the cause of leakage must be determined and corrected.
- 4.1.10 If an actuator was disassembled and repaired as a result of this procedure, the above leakage test must be performed again.

**4.2 RETURN TO SERVICE**

4.2.1 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 SERIES DOUBLE ACTING ACTUATORS**

4.3.1 Chart number 1.

ACTUATOR MODEL	NOMINAL OPETATING PRESSURE		MAXIMUM OPETATING PRESSURE	
	psig	barg	psig	barg
CB315	(1)	(1)	120	8.27
CB415	(1)	(1)	80	5.52
CB420	(1)	(1)	120	8.27
CB520	(1)	(1)	80	5.52
CB525	(1)	(1)	120	8.27
CB725	(1)	(1)	80	5.52
(1) Customer Specification or Not Available				

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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