

**BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY & REASSEMBLY**

**FOR CBM (-M) SERIES**

**DOUBLE ACTING**

**PNEUMATIC ACTUATORS**

**WITH UNIDIRECTIONAL**

**INTERNAL MANUAL OVERRIDE**

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## **SECTION 1 - INTRODUCTION**

### **1.1 GENERAL SERVICE INFORMATION**

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis CB415M, CB420M, CB520M, CB525M and CB725M Double Acting Series Actuators with internal single direction manual control.

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 CB415M, CB520M, CB725M Assembly Drawing Part Number 102070.

1.4.2 CB420M, CB525M Assembly Drawing Part Number 102071.

1.4.3 Assembly tool drawing D-074113

1.4.4 CBM BASE I Dimensional Drawing 102076 (Manual to close).

1.4.5 CBM BASE I Dimensional Drawing 102077 (Manual to open).

### **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 the actuators name tag.

**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 the stop screw is loosened or removed.
- 2.1.2 Rotate the handwheel clockwise until the actuator is at the end of its stroke.
- 2.1.3 Loosen and remove hex nut (2-90) from housing stop screw (2-80) and end cap stop screw (2-80).
- 2.1.4 Remove seal washer (3-80) and screw thread seal (3-70) from housing stop screw (2-80) and end cap stop screw (2-80).
- 2.1.5 Remove stop screws (2-80) from the housing (1-10) and the end cap (2-20).

### **2.2 PNEUMATIC CYLINDER DISASSEMBLY**

- 2.2.1 Remove the grooved pin (6-20) from the handwheel (6-10).
- 2.2.2 Remove the handwheel (6-10) from the lead screw assembly (2-40).
- 2.2.3 Remove the grooved pin (2-100) from the lead screw assembly. This will allow the removal of the torque nut from the lead screw assembly.

- 2.2.4 Remove both of the thrust washers (2-180) and the thrust bearing (2-190) from the end cap (2-20).
- 2.2.5 Unscrew and remove acorn nut (2-110) and seal washer (3-10) from center bar assembly (2-50).
- 2.2.6 Using a drive ratchet and socket on the welded nut, located on the housing end of the center bar assembly (2-50), rotate the center bar assembly counter clockwise (CCW). This will cause the cylinder end cap (2-20) to gradually unscrew from the center bar assembly (2-50). Unscrew and remove the cylinder end cap (2-20) from the center bar assembly (2-50).
- 2.2.7 Hold torque shaft (1-30) with a wrench and pull cylinder (2-10) away from housing (1-10); slide cylinder over piston (2-30) and remove.
- 2.2.8 Pull piston (2-30) out of housing (1-10) and remove by carefully sliding piston off of center bar assembly (2-50). The lead screw assembly (2-40) and tie bars (2-140) will stay assembled with the piston.
- 2.2.9 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 removed from the piston.

### **2.3 HOUSING DISASSEMBLY**

- 2.3.1 On actuators equipped with a cylinder adapter (2-120) CB415M, CB520M and CB725M, 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 re-use retaining rings when new retaining rings are provided in the Service/Seal Kit.
- 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 thru housing and pull torque shaft completely out of housing while holding yoke key (1-50) in place with your fingers.
- 2.3.7 Remove yoke key (1-50) and yoke key spring (1-70) from torque shaft (1-30).
- 2.3.8 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 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 lubricant to the housing (1-10) torque shaft holes.

3.2.2 Coat the 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 of one side of the housing until the o-ring groove is clear of the 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 the center bar assembly (2-50) with lubricant, being sure to coat the exposed threads.
- 3.2.16 Insert the center bar assembly (2-50) into the center hole of housing (1-10) and slide center bar assembly through housing until washer seal (3-15), thread seal (3-90) and the welded 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 (1-120), models CB415M, CB520M and CB725M, perform the following 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 **PNEUMATIC 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.

<b>TORQUE REQUIREMENTS – TIE BARS (2-140)</b>		
<b>ACTUATOR MODEL</b>	<b>FOOT POUNDS</b>	<b>N-m</b>
CB415M	12 ± 5%	16 ± 5%
CB420M	12 ± 5%	16 ± 5%
CB520M	20 ± 5%	27 ± 5%
CB525M	20 ± 5%	27 ± 5%
CB725M	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 heel 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, CB520M, and CB725M models.
- 3.3.13 Screw end cap (2-20) onto the center bar assembly (2-50).
- 3.3.14 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 assembly tool part number 074113, through the end cap hole and thread the tool into the lead screw assembly (2-40).
- 3.3.15 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 the cylinder end cap (2-20) to gradually screw further onto the center bar assembly (2-50).
- 3.3.16 Continue to rotate the center bar assembly (2-50) clockwise until the cylinder is seated against the housing flange or adapter (2-140) and the end cap (2-20) is properly seated against the cylinder (2-10).
- 3.3.17 Torque tighten the center bar assembly (2-50) to the proper torque as specified in the following chart.

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

- 3.3.18 Place the acorn nut (2-110) and seal washer (3-10) on the exposed end of the center bar assembly (2-50) and tighten securely.
- 3.3.19 Remove assembly tool part number 074113 from end cap (2-20).

- 3.3.20 Reference View C-C on assembly drawing. Lubricate thrust bearing (2-190) and both thrust washers (2-180). Install one thrust washer into the end cap then install the thrust bearing and then install the last thrust washer.
- 3.3.21 Install the o-ring seal (3-100) onto the groove in the torque nut.
- 3.3.22 Install the torque nut over the shaft of lead screw assembly (2-40). Aligning the hole in torque nut with the hole in the shaft of lead screw assembly (2-40).
- 3.3.23 Apply Master Gasket to the groove pin (2-100) per the manufactures instructions. Insert the grooved pin (2-100) in the torque nut and drive it into lead screw shaft.
- 3.3.24 Install the o-ring seal (3-110) into the handwheel (6-10) seal groove.
- 3.3.25 Install the handwheel (6-10) into the torque nut and retain with the grooved pin (6-20)
- 3.3.26 Coat the stop screws (2-80) with lubricant and insert into the housing (1-10) and end cap (2-20).
- 3.3.27 Thread the stop screw thread seals (3-70) onto the stop screws (2-80) until they are flush with the housing (1-10) or end cap (2-20).
- 3.3.28 Slip the countersunk washers (3-80) onto the stop screws (2-80) with the chamfer facing the thread seals (3-70).
- 3.3.29 Thread the stop screw nuts (2-90) onto the stop screws (2-80) until hand tight.
- 3.3.30 Adjust both stop screws (2-80) back to setting recorded in Section 2.1 step 2.1.1 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 SUPPORT INFORMATION**

### **4.1 TESTING**

- 4.1.1 Leakage Test - All areas where leakage to atmosphere may occur are to be checked using a leak testing solution.

- 4.1.2 Procedure - Cycle the actuator five times at 65 psig (1.48 barg) operating pressure. This will allow the seals to seek their proper service condition. 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.
- 4.1.3 Apply 65 psig (1.48 barg) operating pressure to the actuator housing inlet port and allow the actuator to move against the cylinder stop screw and stabilize.
- 4.1.4 Apply leak testing solution to the following areas:
  - 4.1.4.1 Cylinder (2-10) to housing (1-10) joint on CB420M and CB525M or cylinder (2-10) to cylinder adapter (2-120) to housing (1-10) joints on CB415M, CB520M and CB725M.
  - 4.1.4.2 The center bar thread seal (3-90) at the housing (1-10).
  - 4.1.4.3 The housing stop screw and stop screw thread seal.
  - 4.1.4.4 The torque shaft seals.
  - 4.1.4.5 The cylinder end cap inlet port.
- 4.1.5 Apply 65 psig (1.48 barg) operating pressure to the actuator cylinder inlet port and allow the actuator to move against the housing stop screw and stabilize.
- 4.1.6 Apply leak testing solution to the following areas:
  - 4.1.6.1 The cylinder (2-10) to end cap (2-20) joint.
  - 4.1.6.2 The cylinder end cap stop screw (2-80) and stop screw thread seal (3-70).
  - 4.1.6.3 The center bar seal (3-10) at the acorn nut (2-110) and end cap (2-20).
  - 4.1.6.4 The grooved pin (2-100) and the torque nut.
  - 4.1.6.5 The housing inlet port.
- 4.1.7 Remove all pressure from the actuator.
- 4.1.8 If an actuator was disassembled and repaired as a result of this procedure, the above leakage test must be performed again.

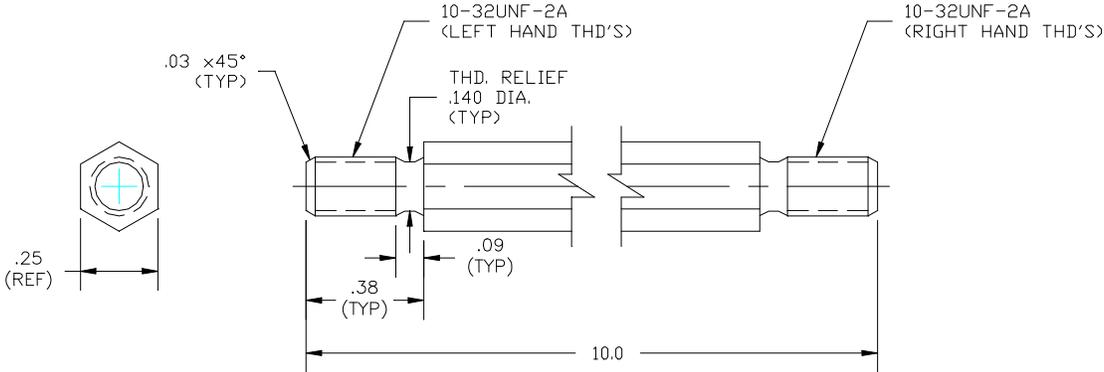
## **4.2 RETURN TO SERVICE**

- 4.2.1 After the actuator is installed on the valve all accessories should be hooked up and tested for proper operations and replaced, if found defective.

4.3 ASSEMBLY TOOL PART NUMBER 074113

THREAD DATA:

MAJOR DIA. .1891"-.1831"  
PITCH DIA. .1688"-.1658"  
MINOR DIA. .1508"



ECN	DATE	REV	BY	DATE
102015	20 November 1989	A	COMPILED B. Cornelius	17 December 2001
17787	December 2001	B	CHECKED B. Cornelius	17 December 2001
			APPROVED R. Smith	17 December 2001

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