

GH BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & ASSEMBLY

NCB415-SRXX-M, NCB420-SRXX-M,

NCB520-SRXX-M, NCB525-SRXX-M, AND NCB725-SRXX-M

SPRING RETURN NUCLEAR SERIES ACTUATORS

PART NUMBER 074948

REVISION "A"

DATE: DECEMBER, 1990

1.0 **INTRODUCTION**

- 1.1 In order to assure and maintain the present level of qualification and auditability to 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 six hundred twenty-five cycles or five years, which ever occurs first.
- 1.2 This service procedure is offered as a guide to enable general maintenance to be performed on GH Bettis NCB Spring Return Series Nuclear Actuators. When the actuator model number has a "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.
- 1.3 This procedure is written with the understanding that the actuator has been removed from the valve.

**COMPLETE ACTUATOR REFURBISHMENT
REQUIRES THAT THE ACTUATOR BE
DISMOUNTED FROM THE VALVE**

2.0 **SUPPORT ITEM AND BASIC TOOLS**

- 2.1 Support Items: Seal/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 deepwell socket set, torque wrench (up to 2,000 in.lbs).

3.0 **REFERENCE GH BETTIS MATERIALS**

- 3.1 NCB420-SR-M, NCB525-SR-M Assembly Drawing Part No. 104373.
- 3.2 NCB415-SR-M, NCB520-SR-M, NCB725-SR-M Assembly Drawing Part No. 104226.

4.0 **GENERAL**

- 4.1 Numbers in parentheses, () indicate the bubble number (reference number) used on GH Bettis Assembly Drawings, Exploded Detail, and Actuator Parts Lists.
- 4.2 When removing or installing seals, use a small screwdriver with sharp edges rounded off or use a commercial seal removing tool.
- 4.3 Use a non-hardening thread sealant on all pipe threads.
- 4.4 Disassembly should be done in a clean area on a work bench.
- 4.5 LUBRICATION REQUIREMENTS: Dow corning Molykote 44 medium grade. Bettis Service/Seal Kit.

5.0 GENERAL DISASSEMBLY

- 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 Remove all operating pressure from actuator, allowing the spring to stroke. The spring will rotate to the fail position.
- 5.3 Rotate the handwheel clockwise until the actuator is at the end of its stroke.
- 5.4 Remove all piping and accessories mounted on the actuator.
- 5.5 Loosen and remove hex nut (2-90) from housing stop screw (2-80). Remove seal washer (3-80) and screw thread seal (3-70) from housing stop screw.
- 5.6 Remove stop screw (2-80) from the housing.
- 5.7 Loosen and remove hex nut (2-90) from end caps stop screw (2-80). 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 NCB 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 the grooved pin (6-20) from the override assembly.
- 6.4 Remove the handwheel (6-10) from the lead screw assembly (2-40).
- 6.5 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.
- 6.6 Remove both of the thrust washers (2-180) and the thrust bearing (2-190) from the end cap (2-20).
- 6.7 Remove the breather (2-130) from the end cap (2-20), discard if the seal/service kit contains a new breather. NOTE: If actuator is piped for spring air assist then there will be no breather.
- 6.8 Remove acorn nut (2-110) from spring cylinder end cap (2-20) 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 the center bar assembly (2-50), rotate the center bar assembly counter-clockwise (CCW). This will cause the spring cylinder end cap (2-20) to gradually unscrew from the center bar assembly (2-50).
- 6.10 Continue to rotate the center bar assembly (2-50) counter-clockwise (CCW) until the spring preload is eliminated. As the preload is reduced it may be necessary to keep the spring cylinder end cap (2-20) from turning by holding the end cap with a wrench.
- 6.11 After the spring preload is eliminated, unscrew and remove the spring cylinder end cap (2-20) from the center bar assembly (2-50).
- 6.12 Remove the spring (4) from within spring cylinder (2-10).

- 6.13 Hold housing 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.
- 6.14 Pull piston (2-30) out of housing (1-10) and carefully slide piston off of center bar assembly (2-50). The 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 the 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) NCB-415-SR-M, NCB-520-SR-M and NCB-725-SR-M, remove cylinder gasket (3-20) from cylinder adapter (2-120) and remove cylinder adapter (2-120) from housing
- 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 service kit.
- 7.4 The following steps may need to be taken before disassembly can continue.
 - 7.4.1 If the torque shaft has any raised burrs or sharp edges they should be filled off, removing as little metal as possible.
 - 7.4.2 If there is excessive paint build-up on the torque shaft it should be removed.
- 7.5 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.
- 7.6 Push torque shaft (1-30) back thru housing and pull torque shaft completely out of housing while holding yoke key (1-50) in with your fingers.
- 7.7 Remove yoke key (1-50) and yoke key spring (1-70) from torque shaft (1-30).
- 7.8 Remove yoke (1-20) from housing (1-10).

8.0 PRE-ASSEMBLY NOTES

- 8.1 Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 8.2 All parts should be thoroughly inspected. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. Sealing surfaces must be free of deep scratches, pitting, corrosion and blistering or flaking coating.
- 8.3 After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.
- 8.4 Coat all seals with lubricant, before installing into the seal grooves.

9.0 RE-ASSEMBLY

- 9.1 Apply lubricant to the housing (1-10) torque shafts holes.
- 9.2 Coat the yoke (1-20) with lubricant and insert into housing (1-10).
- 9.3 Insert the yoke key spring (1-70), with the ends pointing down, into the slot in the torque shaft (1-30) and place the yoke key (1-50) on top of the spring with the tapered side outward. Refer to assembly drawing for correct key orientation.
- 9.4 Hold the yoke key (1-50) down with you thumb, insert the torque shaft (1-30) into and thru the housing and yoke. Rotate the torque shaft until the yoke key snaps into the keyway in the yoke.
- 9.5 Push the torque shaft out of one side of the housing until the o-ring groove is clear of the housing.
- 9.6 Install one of the torque shaft o-ring seals (3-40) in the o-ring groove of the torque shaft (1-30).
- 9.7 Carefully push the torque shaft back into the housing until the o-ring groove on the opposite end of the torque shaft is just clear of the housing.
- 9.8 Install the remaining torque shaft o-ring seal (3-40) in the o-ring groove of the torque shaft (1-30).
- 9.9 Install one of the new torque shaft retaining rings (1-80) onto the torque shaft, making certain it is properly seated in the shaft groove.
- 9.10 Push the torque shaft back into the housing and install the remaining new retaining ring (1-80) on the torque shaft.
- 9.11 Rotate the torque shaft so that the yoke arms point outward.
- 9.12 Apply a generous amount of lubricant to the slots in the yoke arms.
- 9.13 Coat the center bar assembly (2-50) with lubricant being sure to coat the exposed threads.
- 9.14 Slide the gasket seal (3-10) on to the center bar assembly (2-50) until it rests against the welded nut.
- 9.15 Insert the 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. Care should be taken during installation of the center bar so as to not scratch it.
- 9.16 Install cylinder gasket (3-30) on housing flange.
- 9.17 On actuators equipped with a cylinder adapter (2-120), NCB-415-SR-M, NCB-520-SR-M and NCB-725-SR-M, install the cylinder adapter (2-120) onto the housing flange, with the stepped outer diameter facing away from the housing, and place a cylinder gasket (3-20) onto the stepped diameter on the cylinder adapter.

10.0 SPRING CYLINDER RE-ASSEMBLY

- 10.1 Lightly recoat the center bar assembly (2-50) with lubricant.
- 10.2 Lightly coat the piston center bar o-ring seal (3-50) with lubricant and install in the internal groove in the head of piston (2-30).

- 10.3 Lightly coat the piston cylinder T-seal (3-60) with lubricant and install onto the piston. T-Seal is composed of rubber (EP) seal and two back-up rings. The rings serve as anti-extrusion back-ups.
- 10.4 Lightly coat the heel of the piston along with the exposed ends of yoke pin (1-40) with lubricant.
- 10.5 With the piston head facing away from the housing (1-10) and with the yoke pin (1-40) up, carefully slide the piston (2-30) onto the center bar assembly (2-50).
- 10.6 Slide the piston (2-30) along the center bar assembly (2-50) until the yoke pin (1-40) engages the yoke slots. Push the piston into the housing as far as it will go, while holding the center bar assembly flush against the housing.
- 10.7 Apply a very thin coating of lubricant to the cylinder bore of cylinder (2-10).
 - 10.7.1 **CAUTION:** EXCESS LUBRICANT IN THE CYLINDER BORE MAY CAUSE ERRATIC OR JUMPY/JERKY OPERATION.
- 10.8 Slip the 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 NCB415-SR-M, NCB520-SR-M, and NCB725-SR-M models.
- 10.9 Apply a coat of lubricant on the spring and carefully slide the spring into the open cylinder until it contacts the piston head.
- 10.10 Screw the spring cylinder end cap (2-20) onto the center bar assembly (2-50).
- 10.11 Position the spring cylinder 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 the center bar assembly (2-50), rotate the center bar assembly clockwise (CW). This will cause the spring cylinder end cap (2-20) to gradually screw further onto the center bar assembly (2-50).
- 10.13 Continue to rotate the center bar assembly (2-50) clockwise until the spring (4) is fully compressed, the cylinder is seated against the housing flange or adapter (2-120) and the spring cylinder end cap (2-20) is properly seated against the cylinder (2-10).
- 10.14 Tighten the center bar assembly to the proper torque as specified in Chart 1.
- 10.15 If removed, insert stop screw (2-80) into the cylinder end cap (2-20).
- 10.16 Coat the stop screw (2-80) with lubricant and insert into the housing (1-10). Thread the stop screw in until stop screw contacts the piston.
- 10.17 Thread both of the stop screw thread seals (3-70) onto the stop screws (2-80) until they are flush with the housing or cylinder end cap.
- 10.18 Slip the seal washer (3-80) onto both stop screws with the chamfer facing the thread seal (3-70).
- 10.19 Thread the stop screw nut (2-90) onto the stop screws (2-80) until hand tight.
- 10.20 Adjust both stop screws (2-80) back to setting recorded in step 5.1 under General Disassembly. Tighten both stop screw hex nuts (2-90) securely, while holding stop screws (2-80).

- 10.21 Slip the remaining gasket seal (3-10) onto the exposed end of center bar assembly (2-50) and screw the acorn nut (2-110) on and tighten securely.
- 10.22 Lubricate the 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 remaining thrust washer.
- 10.23 Install the O-ring seal (3-100) onto the groove in the torque nut.
- 10.24 Install the torque nut over the lead screw assembly shaft, aligning the hole in torque nut with the hole in the lead screw shaft.
- 10.25 Insert the groove pin (2-100) in the torque nut and drive it onto lead screw shaft.
- 10.26 Install the o-ring seal (3-110) onto the groove in the handwheel (6-10).
- 10.21 Install the handwheel (6-10) into the torque nut and retain with the groove pin (6-20).

11.0 ACTUATOR TESTING

11.1 Leakage Test

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

11.2 Procedure

- 11.2.1 Cycle the actuator five times at the Nominal Operating Pressure as per Chart 2 (for the model being tested). This will allow the seals to seek their proper working attitude.
- 11.2.2 Stroke the actuator with the Nominal Operating Pressure and allow the unit to stabilize.
- 11.2.3 Apply a leak testing solution to the following areas:
 - 11.2.3.1 Cylinder to housing joint on NCB420-SR-M, and NCB525-SR-M or cylinder to cylinder adapter to housing joints on NCB415-SR-M, NCB520-SR-M, and NCB725-SR-M actuators.
 - 11.2.3.2 Center bar seal and nut to housing.
 - 11.2.3.3 Housing stop screw and stop screw thread seal.
 - 11.2.3.4 Torque shaft to housing.
 - 11.2.3.5 Cylinder breather port hole.
- 11.2.4 If excessive leakage across the piston is noted (generally a bubbly 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.
- 11.2.5 If an actuator was disassembled and repaired as result of this procedure, the above leakage must be performed again.

11.3 Operational (Functional) Test

This test is used to verify proper function of the actuator. THIS TEST IS TO BE DONE OFF OF THE VALVE OR WHEN VALVE STEM IS NOT COUPLED TO THE ACTUATOR TORQUE PLUG.

11.4 Procedure:

11.4.1 Adjust the pressure regulator to the pressure rating indicated in Column "B" of Chart 2, on the following pages for the model actuator being tested.

11.4.2 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 the breather (2-130).

12.2 Actuator is ready for service and now can be re-installed on the valve.

12.3 Re-install any piping and accessories that were removed.

12.4 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up at this point and tested for proper operations and replaced if found defective.

CHART 1

TORQUE REQUIREMENTS

FOR NCB-SR-M SERIES CENTER BARS

<u>ACTUATOR MODEL</u>	<u>MAXIMUM IN.LBS.</u>	<u>TORQUE FT.LBS.</u>
NCB415-SRXX-M	660	55
NCB420-SRXX-M	1,200	100
NCB520-SRXX-M	1,200	100
NCB525-SRXX-M	1,560	100
NCB725-SRXX-M	1,560	130

CHART 2

PRESSURE REQUIREMENTS & LIMITATIONS

FOR NCB-SR-M ACTUATOR SERIES

COLUMN B <u>ACTUATOR MODEL</u>	<u>NOMINAL OPERATING PRESSURE (NOP)</u>	<u>MAXIMUM OPERATING PRESSURE (MOP)</u>	<u>MAXIMUM HYDROSTATIC TEST PRESSURE</u>	<u>MAXIMUM AIR ASSIST PRESSURE (MAAP)</u>	<u>MAXIMUM SPRING SELECTION PRESSURE</u>
NCB415-SR40-M	40	90	160	56	30
NCB415-SR60-M	60	100	160	48	44
NCB415-SR80-M	80	115	160	33	57
NCB420-SR40-M	40	140	240	96	29
NCB420-SR60-M	60	155	240	83	45
NCB420-SR80-M	80	165	240	71	58
NCB520-SR40-M	40	100	160	55	30
NCB520-SR60-M	60	110	160	43	44
NCB520-SR80-M	80	125	160	31	59
NCB525-SR40-M	40	160	240	97	28
NCB525-SR60-M	60	175	240	84	42
NCB525-SR80-M	80	190	240	71	57
NCB725-SR40-M	40	95	160	56	28
NCB725-SR60-M	60	105	160	43	44
NCB725-SR80-M	80	120	160	30	58

World Area Configuration Centers (WACC) offer sales support, service, inventory and commissioning to our global customers. Choose the WACC or sales office nearest you:

NORTH & SOUTH AMERICA

19200 Northwest Freeway
Houston, TX 77065
USA
T +1 281 477 4100
F +1 281 477 2809

Av. Hollingsworth,
325, Iporanga Sorocaba
SP 18087-105
Brazil
T +55 15 3238 3788
F +55 15 3228 3300

ASIA PACIFIC

No. 9 Gul Road
#01-02 Singapore 629361
T +65 6501 4600
F +65 6268 0028

No.1 Lai Yuan Road
Wuqing Development Area
Tianjin 301700
P.R.China
T +86 22 8212 3300
F +86 22 8212 3308

MIDDLE EAST & AFRICA

P. O. Box 17033
Dubai
United Arab Emirates
T +971 4 811 8100
F +971 4 886 5465

P. O. Box 10305
Jubail 31961
Saudi Arabia
T +966 3 340 8650
F +966 3 340 8790

24 Angus Crescent
Longmeadow Business Estate
East P.O. Box 6908; Greenstone
1616 Modderfontein, Extension 5
South Africa
T +27 11 451 3700
F +27 11 451 3800

EUROPE

Berenyi u. 72- 100
Videoton Industry Park,
Building #230
Székesfehérvár 8000
Hungary
T +36 22 530 950
F +36 22 543 700

For complete list of sales and manufacturing sites, please visit
www.emersonprocess.com/valveautomationlocations
Or contact us at info.valveautomation@emerson.com

www.emersonprocess.com/bettis

©2016 Emerson Process Management. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. Bettis is a mark of one of the Emerson Process Management family of companies. All other marks are property of their respective owners.

The contents of this publication are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

BETTIS™



EMERSON™
Process Management