

BETTIS ACTUATOR & CONTROLS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODEL

N721-SR60(CW)-M3HW

NUCLEAR ACTUATOR

PART NUMBER: 123083

REVISION: "A"

DATE: April 10, 1997

For Bettis Sales Order 96-9095A

1.0 INTRODUCTION

- 1.1 In order to assure and maintain the present level of qualification and auditable to the Bettis Qualification Report Part Number 037274 the following is required:
- 1.1.1 All maintenance or service work must be preformed 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 Bettis model N721-SR60(CW)-M3HW nuclear actuator, serial number 96-9095A-11.
- 1.3 **SAFETY STATEMENT:** 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 a certified technician.

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 customers plant safety or work procedures. If a conflict arises between this procedure and the customers procedures the differences should be resolved in writing between an authorized customer representative and a authorized Bettis representative.

1.4 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.

SR: Spring Cartridge

M3HW: Jackscrew assembly with 18" handwheel.

- 1.5 **BASIC SERVICE INFORMATION:** COMPLETE ACTUATOR REFURBISHMENT REQUIRES THE ACTUATOR BE DISMOUNTED FROM THE VALVE OR DEVICE IT IS OPERATING.

- 1.6 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator, allowing the spring to stroke and rotate the actuator to its fail position. Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.

2.0 SUPPORT ITEMS AND TOOLS

- 2.1 **Support Items** - Service/Seal Kit, commercial leak testing solution, and non-hardening thread sealant.
- 2.2 **Tools** - All tools are American Standard inch. Two each medium standard screwdriver, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet, 3/16 inch pin punch and a torque wrench (up to 2,000 inch pounds.). For recommended tool list refer to page 11.

3.0 BETTIS REFERENCE MATERIALS

- 3.1 Assembly Drawing Part Number 038607.
- 3.2 Exploded Detail Part Number 065926.

4.0 GENERAL DETAILS

- 4.1 Numbers in parentheses, () indicate the bubble number (reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawings, and actuator parts lists.
- 4.2 This procedure is written using the stop screw side of housing (1-10) as a reference and this side will be considered the front of the actuator. Housing cover (1-20) will be considered as the top of the actuator.
- 4.3 The approximate actuator weight is 185 pounds.
- 4.4 When removing seals from seal groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.
- 4.5 Use a non-hardening thread sealant on all pipe threads.

CAUTION: **Apply the thread sealant per the manufacturer's instructions.**

- 4.6 Disassembly of actuator must be done in a clean area on a work bench.
- 4.7 **LUBRICATION REQUIREMENTS:** For use in all areas of the actuator. Dow Corning Molykote 44. Lubricants, other than Molykote 44 , should not be used without prior written approval of Bettis Product Engineering.

CAUTION: Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator's name tag.

- 4.8 Before starting General Disassembly of the actuator it is a good practice to operate the actuator with the Nominal Operating Pressure (NOP), as listed on the actuator's name tag or 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.

5.0 GENERAL DISASSEMBLY

- 5.1 If not already removed disconnect all operating pressure from actuator spring cylinder (4-10) allowing the spring to stroke. The spring will rotate the yoke to the fail position.
- 5.2 Confirm that jackscrew assembly (2-120) does not engage piston rod (2-10).
- 5.3 Remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10).
- 5.4 Remove breather (4-20) from end of spring cylinder assembly (4-10).
- 5.5 Mark stop screws (1-60) left and right. Measure and record the exposed length of the right and left stop screws (1-60). The stop screws will be removed later in this procedure.
- 5.6 Record the location of the pressure ports in the cylinder adapter (2-30).
- 5.7 Remove socket cap screws (1-120) from position indicator (1-110).
- 5.8 Remove position indicator (1-110) and yoke weather cover (6-110) from the top of yoke (1-140).
- 5.9 Remove snubber (1-130) from top of housing (1-10).

6.0 ROD COVER DISASSEMBLY

- 6.1 Unscrew and remove the four rod cover ferry head screws (2-100) and gasket seals (6-80).
- 6.2 Remove rod cover (2-60), taking care not to disengage grooved rod bushing (2-50).
- 6.3 M3HW jackscrew override disassembly from rod cover (2-60).
- 6.1.1 With rod cover (2-60) on a work bench, lubricate jackscrew assembly (2-120) threads with lubricant.
- 6.1.2 Using a 3/16 inch pin punch, drive out and remove the spiral pin from slotted nut located on outboard end of jackscrew assembly (2-120).
- 6.1.3 Remove the slotted nut from jackscrew assembly (2-120).
- 6.1.4 Loosen and screw jam nut (2-130) off of the jackscrew assembly (2-120).
- 6.1.5 Screw jackscrew assembly (2-120) into the rod cover (2-60) until it is disengaged from the rod cover.
- 6.1.6 Remove jackscrew assembly (2-120) from the open end of the rod cover (2-60).

7.0 SPRING CYLINDER REMOVAL

WARNING: When cylinder assembly (4-10) is installed on the actuator, spring cartridge (5) is under compression. Do not remove cylinder assembly (4-10) until actuator has the "pre-load" removed.

7.1 Remove stop screw "pre-load" as follows:

7.1.1 Apply sufficient pneumatic pressure to the pressure inlet port, located in cylinder adapter (2-30), to move the actuator load off of stop screw (1-60).

7.1.2 On the front side of housing (1-10) loosen two jam nuts (1-70).

7.1.3 On the front side of housing (1-10) unscrew and remove two stop screws (1-60) with jam nuts (1-70) and gasket seals (6-90).

7.1.4 Remove pressure from the pressure inlet port.

CAUTION: Due to the weight and nature of a spring cartridge pre-loaded assembly, caution should be exercised when handling spring cartridge (5).

7.2 Secure a chain wrench around cylinder assembly (4-10) as close to the welded end cap as possible. Using a mallet, break the cylinder loose sufficiently so it can be removed.

WARNING: The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).

7.3 Remove cylinder assembly (4-10) from cylinder adapter (2-30) by rotating in a counter clockwise direction.

NOTE: When removing and setting cylinder assembly (4-10) aside, care should be taken to protect the chamfered edge and cylinder threads.

7.4 Carefully remove spring cartridge (5) from cylinder assembly (4-10) by slightly tilting open end of cylinder down.

WARNING: Under no circumstances should spring cartridge (5) be disassembled, as the spring is pre-loaded.

7.5 Unscrew and remove standard hex nut (2-70) from piston rod (2-10).

7.6 Remove lockwasher (2-80) from piston rod (2-10).

7.7 Remove piston (2-20) from piston rod (2-10).

NOTE: Record inlet port location on cylinder adapter (2-30).

7.8 Unscrew and remove four ferry cap screws (2-90) from cylinder adapter (2-30).

7.9 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).

8.0 HOUSING GROUP DISASSEMBLY

- 8.1 Remove four cover screws (1-30) with gasket seals (6-100).
- 8.2 Remove housing cover (1-20). NOTE: Housing cover has a tight fit and will require the use of two pry bars or screw drivers to assist in removal.
- 8.3 Rotate the yoke arms to center position.
- 8.4 Remove upper yoke roller (1-50).
- 8.5 Remove yoke pin (1-40).
- 8.6 Holding rod bushing (2-40) in place, pull piston rod (2-10) out through this rod bushing.
- 8.7 Remove lower yoke roller (1-50).
- 8.8 Remove rod bushing (2-40) and grooved rod bushing (2-50) from housing (1-10).
- 8.9 Remove yoke (1-140) from the housing cavity.

CAUTION: The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of torque output. This can only be accomplished by removing the yoke from the housing which requires removing the actuator from the valve.

- 8.10 It is not necessary to remove housing pipe plug (1-100) or cylinder adapter pipe plug (2-110).

9.0 GENERAL RE-ASSEMBLY

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

- 9.1 Remove and discard all seals and gaskets.
- 9.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 9.3 All parts should be visually 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 and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

CAUTION: Actuator parts that reflect any of the above listed characteristics must be replaced with new parts.

- 9.4 Before installation coat all moving parts with a complete film of lubricant.
- 9.5 Before installation coat all seals with a complete film of lubricant, before installing into seal grooves.

NOTE: All parts and seals used in the actuator housing assembly and power/spring cylinder will be assembled using lubricant as identified in step 4.8.

10.0 CENTER HOUSING GROUP RE-ASSEMBLY

- 10.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10).
- 10.2 Apply lubricant to the raised rib (cast rib) in the bottom of housing (1-10).
- 10.3 Apply lubricant to the yoke bore in the housing and position the housing so that the yoke bore is nearest to you.
- 10.4 Install o-ring seal (6-20) into seal groove in the housing bore.
- 10.5 Apply a generous amount of lubricant to the slots in the upper and lower yoke arms of yoke (1-140).
- 10.6 Coat bearing surfaces of yoke (1-140) with lubricant and install yoke into housing (1-10). The wide yoke arm should be installed toward top of the housing.
- 10.7 Coat piston rod bushing (2-40) with lubricant and install into the left side of housing (1-10).
- 10.8 Coat grooved rod bushing (2-50) with lubricant and install into right side of housing (1-10).
- 10.9 Coat one yoke roller (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.
- 10.10 Apply lubricant to piston rod (2-10) and install into the housing through the rod bushings. The threaded end should be on the left side of housing (1-10).
- 10.11 Coat yoke pin (1-40) with lubricant and install through piston rod (2-10) into lower yoke roller (1-50).
- 10.12 Coat remaining yoke roller (1-50) with lubricant and install over yoke pin (1-40) and into the slot in the upper yoke arm.
- 10.13 Coat the yoke bore in cover (1-20) with lubricant.
- 10.14 Install remaining o-ring seal (6-20) into housing cover (1-20).
- 10.15 Install cover gasket (6-60) onto housing (1-10).
- 10.16 Install four gasket seals (6-100) onto four hex cap screws (1-30).
- 10.17 Install housing cover (1-20) onto housing (1-10).
- 10.18 Install four hex cap screws (1-30) with gasket seals (6-100) through housing cover (1-20) and into housing (1-10).
- 10.19 Torque tighten hex cap screws (1-30) with gasket seals (6-100) to 16 ±5 foot pounds lubricated.

11.0 SPRING CYLINDER RE-ASSEMBLY

- 11.1 Coat rod seal (6-30) with lubricant and install, lip first, into cylinder adapter (2-30).

CAUTION: Energizer ring (O-ring) of rod seal (6-30) must face into cylinder adapter (2-30) or when cylinder is installed on the actuator the rod seal o-ring will be facing towards piston (2-20).

11.2 Install one cylinder adapter gasket (6-70) onto the left side of housing (1-10).

11.3 Install four gasket seals (6-80) onto four ferry cap screws (2-90).

CAUTION: Do not apply lubricant to the internal threads of cylinder adapter (2-30).

11.4 Install cylinder adapter (2-30) over the end of piston rod (2-10) and onto the left side of housing (1-10). Arrange the cylinder adapter with the pressure inlet port in the same position as recorded in step 5.6.

CAUTION: Care should be taken not to scratch the piston rod when installing the cylinder adapter.

11.5 Install and tighten ferry cap screws (2-90) with gasket seals (6-80).

11.6 Torque tighten ferry cap screws (2-90) to 30 ±5 foot pounds lubricated.

11.7 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in step 5.6.

11.8 Coat o-ring seal (6-40) with lubricant and install into cylinder adapter (2-30). NOTE: Install o-ring into the groove at the inner end of the cylinder adapter inner diameter threads.

11.9 Install o-ring seal (6-50) onto piston rod (2-10). NOTE: The o-ring should be installed against the shoulder of the piston rod.

11.10 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that is counter bored to accept the o-ring installed in step 11.9. The counter bore side of the piston should be installed against the shoulder of piston rod (2-10) and over o-ring seal (6-50).

11.11 Install standard hex nut (2-70) onto piston rod (2-10).

11.12 Torque tighten standard hex nut (2-70) to approximately 146 foot pounds lubricated.

11.13 Coat piston seal grooves with lubricant.

11.14 Coat u-cup piston seal (6-10) with lubricant.

11.15 Install cup piston seal (6-10) into the innermost piston groove. NOTE: The seal lip of piston cup seal (6-10) should point toward the side of the piston that is facing cylinder adapter (2-30).

11.16 Push piston (2-20) in towards housing (1-10) as far as it will go.

CAUTION: Do not apply lubricant to the outer diameter threads of spring cylinder (4-10).

11.17 Very lightly coat the bore of cylinder assembly (4-10) with lubricant.

CAUTION: Excess lubricant in the bore of cylinder assembly (4-10) may cause erratic or jumpy/jerky operation.

11.18 Coat the outside of the spring with lubricant and insert spring cartridge assembly (5) into spring cylinder (4-10). NOTE: One end of spring cartridge assembly has a flat face with a deep hole in it, this end should be inserted into the cylinder assembly first.

11.19 Apply Loctite 271 to external threads of cylinder assembly (4-10) as follows:

CAUTION: Loctite 271 set up time is a maximum of ten (10) minutes.

11.19.1 Verify that there is no lubricant on the inner diameter threads of cylinder adapter (2-30) and outer diameter threads of spring cylinder (4-10). NOTE: These surfaces must be clean and dry.

11.19.2 Apply two 1/4" inch wide beads of Loctite 271 to outer diameter threads of spring cylinder (4-10). The two beads will be applied perpendicular to the threads and in circumferentially opposing positions on the cylinder threads. NOTE: Do not apply Loctite to the internal threads of the cylinder adapter.

11.19.3 Set-up time for Loctite 271 is thirty (30) minutes and full cure time is twenty four (24) hours. The actuator can be stroked or pressurized after thirty minutes (30).

11.19 Install the spring cylinder (4-10), containing the spring cartridge, over the piston and thread into the cylinder adapter (2-30). Tighten with a chain wrench.

11.20 Rotate the yoke to the full clockwise (CW) position. Position yoke weather cover (6-110) and position indicator (1-110) on yoke (1-140) with the pointer facing the piston rod (2-10) and perpendicular to the SR cylinder (4-10) and rod cover (2-60).

11.21 Install and tighten yoke position indicator/yoke weather cover screws (1-120). These screws will need to be rechecked for tightness after the actuator has been cycled and tested.

11.22 Install gasket seals (6-90) and jam nuts (1-70) onto stop screws (1-60).

11.23 Install stop screws (1-60) with gasket seals (6-90) and jam nuts (1-70) into housing (1-10) in the position as recorded in step 5.5.

12.0 ROD COVER RE-ASSEMBLY

- 12.1 Apply a light coating of lubricant to the threads of jackscrew assembly (2-120).
- 12.2 Insert jackscrew assembly (2-120) through the open end of the rod cover (2-60). Screw the jackscrew into the rod cover end cap until the end of the assembly protrudes out of the outboard end of rod cover (2-60).
- 12.3 Turn the jackscrew until the retaining washer/nut comes into contact with the inside of the rod cover.
- 12.4 Install thread screw seal (6-130) onto the jackscrew assembly (2-120).
- 12.5 Install countersunk washer (6-120), with countersunk facing thread seal (6-130), onto the jackscrew assembly (2-120).
- 12.6 Install heavy hex jam nut (2-130) onto the jackscrew assembly (2-120). Turn the nut until it is up against the countersunk washer, thread seal and rod cover.
- 12.7 Screw the slotted nut onto the outboard end of the jackscrew stud with the slot facing toward the rod cover. Screw the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.

CAUTION: When aligning the slot and the cross drilled hole make certain that the back of the slot is at least one thread from being aligned with the hole.

- 12.8 Insert spiral pin through slotted nut and jackscrew stud making sure that equal amounts of the spiral pin is exposed on both sides of slotted nut and jackscrew stud.
- 12.9 Turn heavy hex jam nut until fully tight against the rod cover.
- 12.10 If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.
- 12.11 Install end cap gasket (6-70) onto right side of housing (1-10).
- 12.12 Install rod cover (2-60) over exposed piston rod (2-10).
- 12.13 Install four seal gaskets (6-80) onto four ferry cap screws (2-100).
- 12.14 Install and tighten ferry cap screws (2-100) with seal gaskets (6-80).
- 12.15 Torque tighten ferry cap screws (2-100) to 30 ±5 foot pounds lubricated.
- 12.16 Adjust both stop screws (1-60) back to settings recorded in section 5 under General Disassembly.
- 12.17 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).

13.0 ACTUATOR TESTING

- 13.1 General Leak Testing: A small amount of leakage may be tolerated. Generally, a small bubble which breaks about three seconds after starting to form is considered acceptable.
- 13.2 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.

- 13.3 Unless otherwise listed 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 actuator during normal operation. NOTE: When testing the actuator use a proper adjusted regulator to apply pressure to the actuator.
- 13.4 Before testing for leaks, alternately apply and release pressure, as defined in step 13.3, to the pressure side of the piston to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 13.5 Apply pressure, as defined in step 13.3, to pressure inlet port located in cylinder adapter (2-30).
- 13.6 Apply leak testing solution to the following areas:
- 13.6.1 The breather port hole in the end of the SR cylinder (4-10), checks the piston to cylinder wall and piston to piston rod seals.
 - 13.6.2 The threaded joint between the SR cylinder (4-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.
 - 13.6.3 The joint between the cylinder adapter and the housing.
 - 13.6.4 The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.
- 13.7 If an actuator was disassembled and repaired, the above leakage test must be performed again.
- 13.8 Operation test the actuator to verify proper function of the actuator. This test is to be done off of the device that the actuator is mounted.
- 13.8.1 Adjust the pressure regulator to the pressure as defined in step 13.3.
 - 13.8.2 Apply the above pressure to the cylinder adapter pressure inlet port and allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.
- 13.9 Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, should be corrected and the above test performed again.
- 13.10 Remove pressure from pressure inlet port located in cylinder adapter (2-30).

14.0 RETURN TO SERVICE

- 14.1 Re-install breather (4-20) into the end of spring cylinder (4-10). NOTE: A new breather is provided in the service kit.
- 14.2 Replace software components of snubber (1-130) and install snubber into housing (1-10).
- 14.3 Place handwheel (8-10) onto M3 and over the pinned nut. The handwheel hub has a cast hexagon hole that fits over the pinned nut.
- 14.4 Place lockwasher (8-20) onto M3 up against handwheel hub.
- 14.5 Place hex nut (8-30) onto M3 and screw up against lockwasher, torque to 250 foot pounds.
- 14.6 After actuator is reinstalled on the device it is to operate, all accessories, should be hooked up and tested for proper operation and replaced, if found defective.
- 14.7 The actuator is now ready for returning to service.

TOOL STYLE AND WRENCH SIZES

ITEM NO.	WRENCH SIZE	QTY	DESCRIPTION	RECOMMENDED WRENCH STYLE
1-30	9/16"	4	Hex Cap Screws	Socket
1-60	3/8"Sq.	2	Stop Screw	Open End or Adjustable
1-70	15/16"	2	Hex Jam Nut	Open End or Adjustable
1-100	7/16"Sq.	1	Pipe Plug, 3/8 NPT	Open End or Adjustable
1-120	3/16"	4	Socket Cap Screws	Allen (1)
1-130	7/8"	1	Snubber Assembly	Deep Socket
2-70	1-5/16"	1	Standard Hex Nut	Socket
2-90	7/16"	4	Ferry Cap Screws	12 Point Socket (1)
2-100	7/16"	4	Ferry Cap Screws	12 Point Socket (1)
2-110	7/16"Sq.	1	Pipe Plug, 3/8 NPT	Open End or Adjustable
2-130	1-13/16"	1	Heavy Hex Jam Nut	Open End or Adjustable
4-10	(2)	1	Cylinder Assembly	Chain Wrench (1)
4-20	11/16"	1	Breather	Open End (1)
8-30	1-13/16"	1	Heavy Hex Nut	Open End or Adjustable

NOTES: (1) No alternate style recommended
 (2) Bettis recommends a short handled Chain wrench with a 40" chain.

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			APPROVED Robert McEver	10 April, 1997

* Signatures on file Waller, Texas