

BETTIS

OPERATING & MAINTENANCE INSTRUCTIONS

DISASSEMBLY & ASSEMBLY

FOR THE FOLLOWING MODELS

521-SR-12, 521-SR-M3-12,

521-SR-M3HW-12, 721-SR-12,

721-SR-M3-12, AND 721-SR-M3HW-12

SERIES ACTUATORS

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1.0 INTRODUCTION

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis 521-SRXX-12, 521-SRXX-M3-12, 521-SRXX-M3HW-12, 721-SRXX-12, 721-SRXX-M3-12, and 721-SRXX-M3HW-12 "Scotch-Yoke" type actuators.
- 1.2 The maximum recommended service interval for this actuator series is six hundred twenty-five (625) cycles or five (5) years, which ever occurs first. Storage time counts as part of the service interval.

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

2.0 BASIC TOOLS

All tools are American Standard inch. Two each medium standard screwdriver, small standard screwdriver with edges removed, chain wrench, putty knife, allen wrench set, 3/16" pin punch, 1/2" drive socket set, 7/16" deepwell twelve point socket, 1-5/16" deepwell socket, rubber or leather mallet, torque wrench (up to 2,000 in. lbs.), commercial leak testing solution and non-hardening thread sealant.

3.0 REFERENCE BETTIS MATERIALS

- 3.1 Assembly Drawing Part Number 36294 for clockwise failure (close).
- 3.2 Assembly Drawing Part Number 72602 for counterclockwise failure (open.)
- 3.3 Exploded Detail Drawing Part Number 72600 for N521/N721-SR.
- 3.4 Exploded Detail Drawing Part Number 72601 for N521/N721-SR-M3/M3HW.
- 3.5 General Operating & Maintenance Instructions Part Number 71584.

4.0 GENERAL DISASSEMBLY

- 4.1 Numbers in parenthesis, () indicate the bubble number (reference number) used on the Bettis Assembly Drawings, Exploded Detail Drawing, and actuator Parts List.
- 4.2 This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front side of the actuator.
- 4.3 Refer to Chart 2 for correct actuator weights.
- 4.4 Mating parts should be marked for ease of reassembly, i.e., cylinder to cylinder adapter, cylinder adapter to housing, right and left stop screws.
- 4.5 When removing seals from seal grooves, use a small screwdriver with sharp edges rounded off or use a commercial seal removing tool.
- 4.6 Use a non-hardening thread sealant on all pipe threads.

- 4.7 Disassembly of actuator should be done in a clean area on a work bench.
- 4.8 LUBRICATION REQUIREMENTS: Use Dow Corning Molykote 44, medium grade.

5.0 GENERAL DISASSEMBLY

- 5.1 Remove 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 Remove all piping and accessories mounted on the actuator.
- 5.3 If the actuator is equipped with a M3 jackscrew override, make sure that the jackscrew (2-120) does not engage the piston rod (2-10).
- 5.4 Remove breather (4-20) from end of spring cylinder (4-10).
- 5.5 For actuators equipped with M3HW jackscrew override with handwheel option (8-10) remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10).
- 5.6 The setting of stop screws (1-60) should be checked and setting recorded before stop screws are loosened or removed.
- 5.7 Remove actuator from valve and valve mounting bracket.
- 5.8 Remove snubber (1-130) from housing (1-10).
- 5.9 Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.

6.0 ROD COVER DISASSEMBLY

- 6.1 Unscrew and remove the four rod cover screws (2-100) and gasket seals (6-80).
- 6.2 Carefully remove the rod cover (2-60), taking care not to disengage the rod bushing (2-50).
- 6.3 For actuators equipped with M3 or M3HW jackscrew override, the following steps will be used for disassembly of the M3 from the rod cover (2-60).
 - 6.3.1 With the rod cover (2-60) on a work bench, lubricate jackscrew assembly (2-120) threads with lubricant.
 - 6.3.2 Loosen and thread jam nut (2-130) all the way back to the welded nut.
 - 6.3.3 Thread the jackscrew assembly (2-120) into the rod cover (2-60) until the pin (6-160) and washer (6-170) is exposed.
 - 6.3.4 Using a 3/16 inch pin punch, drive out and remove pin (6-160).
 - 6.3.5 Remove washer (6-170).
 - 6.3.6 Thread the jackscrew assembly (2-120) out and remove.

- 6.3.7 Remove thread screw seal (6-130) and countersunk washer seal (6-120) from jackscrew weld assembly (2-120).

7.0 SPRING CYLINDER REMOVAL

- 7.1 When the spring cartridge is installed in the spring cylinder actuator, the spring is under compression. **DO NOT** remove the spring cartridge until the actuator has the “pre-load” removed.
- 7.2 Spring cartridge “pre-load”. Apply nominal operating pressure to the pressure inlet port located in the cylinder adapter (2-30). Locate the stop screw (1-60) that is on the opposite side of the housing from the spring cylinder (4-10). Loosen jam nut (1-70). Unscrew and remove stop screw (1-60). Remove pressure from the pressure inlet port.
- 7.3 **WARNING:** Under no circumstances should the spring cartridge (5) be cut apart, as the spring is pre-loaded and the spring cartridge welded together.
- 7.4 Secure the chain wrench around the spring cylinder (4-10) as close to the welded end cap as possible. Using the mallet, break the cylinder loose sufficiently so that it can be removed.
- 7.5 Due to added weight and the nature of a pre-loaded assembly, caution should be exercised when handling the spring cartridge (5). The spring cartridge (5) is unattached and is only contained by the spring cylinder (4-10).
- 7.6 Remove the cylinder (4-10) and when setting aside, care should be taken to protect the chamfered edge and cylinder threads.
- 7.7 Remove spring cartridge (5) from spring cylinder (4-10).
- 7.8 Remove the piston cup seal (6-10) from the piston.
- 7.9 Unscrew and remove standard hex nut (2-70) and lockwasher (2-80) from piston rod (2-10). Some actuators will not have lockwasher (2-80) but will use a self-locking jam nut (2-70).
- 7.10 Remove the piston (2-20).
- 7.11 Remove the o-ring seal (6-50).
- 7.12 Unscrew and remove the four cylinder adapter screws (2-90) and seal gaskets (6-80).
- 7.13 Remove the cylinder adapter (2-30), taking care not to scratch the piston rod (2-10) or disengage the rod bushing (2-40).
- 7.13.1 Scratching piston rod can be prevented by carefully removing cylinder adapter, thus averting disengagement of rod bushing.
- 7.14 Remove rod seal (6-30) from housing side of cylinder adapter (2-30).
- 7.15 Remove o-ring seal (6-40) from the cylinder adapter (2-30).

8.0 HOUSING GROUP DISASSEMBLY

- 8.1 Remove cover screws (1-30) and seal gaskets (6-100).
- 8.2 Remove the housing cover (1-20).
- 8.3 Remove o-ring seal (6-20) from cover (1-20).
- 8.4 Move the yoke arms to the center position.
- 8.5 Remove the upper yoke roller (1-50).
- 8.6 Lift out and remove yoke pin (1-40).
- 8.7 Holding rod bushing (2-40) in place, pull the piston rod (2-10) out through the rod bushing (2-40).
- 8.8 Lift out the yoke (1-140) from the housing cavity.
- 8.9 Remove cylinder adapter rod bushing (2-40) and the grooved rod cover rod bushing (2-50) from housing (1-10).
- 8.10 Remove the lower yoke roller (1-50).
- 8.11 Remove o-ring seal (6-20) from the housing.
- 8.12 Remove the remaining stop screw (1-60), jam nut (1-70), and gasket seal (6-90). Be sure to identify this stop screw.
- 8.13 It is not necessary to remove housing pipe plug (1-100) or cylinder adapter pipe plug (2-110).
- 8.14 Using putty knife, remove cover gasket (6-60) and cylinder adapter gaskets (6-70).

9.0 GENERAL RE-ASSEMBLY

- 9.1 Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 9.2 Before starting the assembly of an actuator, all parts should be thoroughly inspected, cleaned and de-burred. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion.
- 9.3 After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.
- 9.4 Coat all seals with lubricant, before installing into seal grooves.

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 Coat one of the yoke o-ring seals (6-20) with lubricant and install into the housing (1-10).
- 10.3 Apply lubricant to the yoke bore in the body and arrange the body with the yoke bore nearest you. Lubricate the raised ribs in the bottom of the housing.
- 10.4 Apply a generous amount of lubricant to the slots in the upper and lower yoke arms of yoke (1-140).
- 10.5 Coat the bearing surfaces of the yoke (1-140) with lubricant and install into the body. The wide yoke arm should be installed toward the top of the housing.
- 10.6 Coat the piston rod bushing (2-40) with lubricant. Install into the left side of the housing (1-10) for clockwise actuators and on right side for counter clockwise actuators.
- 10.7 Coat the grooved rod cover bushing (2-50) with lubricant. Install into right side of the housing (1-10) for clockwise actuators and on left side for counter clockwise actuators.
- 10.8 Coat one of the yoke roller (1-50) with lubricant and place into the lower yoke arm slot nearest yoke trunnion.
- 10.9 Apply a light coat of lubricant to the piston rod (2-10) and install thru the bushing, in the housing. The threaded end should be on the left for clockwise actuators and on the right for counter clockwise actuators.
- 10.10 Coat the yoke pin (1-40) with lubricant and install thru the piston rod (2-10) into the lower yoke roller (1-50).
- 10.11 Coat the remaining yoke roller (1-50) with lubricant and install over the yoke pin and into the slot in the upper yoke arm.
- 10.12 Coat the yoke bore in the cover (1-20) with lubricant.
- 10.13 Coat the remaining yoke seal (6-20) with lubricant and install into the housing cover (1-20).
- 10.14 Lightly coat the cover gasket (6-60) with lubricant and place onto the housing.
- 10.15 Install the housing cover (1-20) and the four cover screws (1-30) with gasket seals (6-100) onto the housing (1-10).

11.0 SPRING CYLINDER RE-ASSEMBLY

- 11.1 Coat the piston rod seal (6-30) with lubricant and install, lip first, into the cylinder adapter (2-30). Energizer ring of rod seal must face the cylinder adapter (piston side).
- 11.2 Lightly coat the cylinder adapter gasket (6-70) with lubricant and install onto the left side of the housing for clockwise actuators and on the right for counter clockwise actuators.

- 11.3 Install the cylinder adapter (2-30) over the piston rod and retain with the cylinder adapter screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter with the single cast stiffening rib on the housing side pointing toward the yoke bore and up at 45 degrees. The arrangement of the ports may be different on your actuator depending on plumbing and accessory requirements. Care should be taken at this point not to scratch the piston rod when installing the cylinder adapter.
- 11.4 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port that is pointing away from the yoke bore and down at 45 degrees.
- 11.5 Coat the cylinder adapter o-ring seal (6-40) with lubricant and install into the cylinder adapter (2-30) in the groove at the inner end of the threads.
- 11.6 Coat the piston o-ring seal (6-50) with lubricant and install onto the piston rod.
- 11.7 Install the piston (2-20) onto the piston rod and retain with lockwasher (2-80) and standard hex nut (2-70). One side of the piston has a raised boss in the center that is counter bored to accept an "O" ring. This side should be installed against the shoulder of the piston rod. Torque the piston hex nut (2-70) to approximately 1,750 inch pounds or 146 ft. pounds.
- 11.8 Coat piston cup seal (6-10) with lubricant and install into the inner most piston groove. The seal lip should point toward the side of the piston facing the cylinder adapter.
- 11.9 Push the piston in towards the housing as far as it will go, to ease with the installation of the cylinder/ spring assembly.
- 11.10 Very lightly coat the cylinder threads and the cylinder bore with lubricant.
 - 11.10.1 **CAUTION:** Excess lubricant in the cylinder bore may cause erratic or jumpy/jerky operation.
- 11.11 Coat the outside of the sprig with lubricant and insert the spring cartridge assembly (5) into the spring cylinder (4-10). One end of the spring cartridge assembly has a flat face with a deep hole in it. This end should be inserted into the cylinder first.
 - 11.11.1 **CAUTION:** Care should be taken at this point not to scratch the cylinder wall when installing the spring cartridge.
- 11.12 Install the spring cartridge (4-10), containing the spring cartridge, over the piston and thread into the cylinder adapter (2-30). Tighten with a chain wrench. Exercise caution to prevent pinching of the piston cup seal lip during installation. It is necessary to depress the lip while working the cylinder over it.
 - 11.12.1 The chain wrench should be secured as close to the welded end cap as possible.

11.13 Position Indicator Installation

- 11.13.1 For spring to close actuators (clockwise), rotate the yoke to the full clockwise (CW) position. Position the yoke weather cover (6-110) and position indicator (1-110) on the 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).
- 11.13.2 For spring to open actuators (counter clockwise), rotate the yoke (1-140) to full counter clockwise (CCW) position. Position the yoke weather cover (6-110) and position indicator (1-110) on the yoke (1-140) with the pointer facing the rod cover (2-60) and parallel to the piston rod (2-10).
- 11.13.3 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.

11.14 Install the stop screws (1-60), gasket seals (6-90) and jam nuts (1-70).

12.0 ROD COVER RE-ASSEMBLY

- 12.1 For actuators equipped with M3 jackscrew overrides, pre-assembly the M3 into rod cover (2-60), using the following procedure.
 - 12.1.1 Install jam nut (2-130), countersunk seal washer (6-120) and thread screw seal (6-130), with countersunk facing thread seal onto jackscrew assembly (2-120). Thread these items until they are up against the welded nut. Seal (6-130) must be threaded on very carefully or damage to the seal may occur.
 - 12.1.2 Apply a generous coating of lubricant to the M3 threads (2-120).
 - 12.1.3 Thread the jackscrew assembly into the rod cover (2-60). Turn the jackscrew until the end of the assembly protrudes out of the end of the rod cover.
 - 12.1.4 Install washer (6-170) and pin (6-160) as shown on assembly drawing. The pin should be centered in the end of the jackscrew so it will not touch the walls of the rod cover.
 - 12.1.5 Turn the jackscrew until the washer (6-170) just comes into contact with the end of the rod cover (2-60).
 - 12.1.6 If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.
 - 12.1.7 Turn jam nut until fully tight against countersunk washer (6-120).

- 12.2 Coat the remaining end cap gasket (6-70) with lubricant and install onto the right side of the housing (1-10) for clockwise actuators, or the left side of the housing for counter clockwise actuators.
- 12.3 Install the rod cover (2-60) over the exposed piston rod end (2-10).
- 12.4 Install and tighten the four rod cover screws (2-100) and seal gaskets (6-80).

13.0 ACTUATOR TESTING

13.1 Leakage Test - General

- 13.1.1 All areas, where leakage to atmosphere may occur, are to be checked using a leak testing solution.
- 13.1.2 All leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag or from Chart Number 1 of this procedure.

- 13.2 Before testing for leaks, alternately apply and release NOP pressure 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 proper working attitude.

13.3 Leakage Test - Procedure

- 13.3.1 Apply NOP pressure to the pressure inlet port located in the cylinder adapter (2-30).
- 13.3.2 Apply leak testing solution to the following areas:
 - 13.3.2.1 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.
 - 13.3.2.2 The threaded joint between the SR cylinder (4-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.
 - 13.3.2.3 The joint between the cylinder adapter and the housing.
 - 13.3.2.4 The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.
- 13.3.3 Remove pressure from pressure inlet port located in the SR cylinder adapter.
- 13.3.4 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.
- 13.3.5 If an actuator was disassembled and repaired, the above leakage test must be performed again.

13.4 Operational (Functional) Test

This test is used to verify proper function of the actuator and must be done when actuator is off of the valve or when the valve stem is not coupled to the actuator yoke.

13.4.1 Procedure

13.4.1.1 Adjust the pressure regulator to the pressure rating indicated in Column "B" of Chart 1, for the model actuator being used.

13.4.1.2 Apply the above pressure to the actuator and allow the unit to stabilize. The actuator should stroke a full 90 degrees travel with stops properly set.

13.4.1.3 Remove pressure from pressure inlet port located in the SR cylinder adapter.

14.0 RETURN TO SERVICE

14.1 Install the breather (4-20) in the end of the spring cylinder (4-10).

14.2 Install the snubber (1-130) in the housing next to the housing cover.

14.3 Re-install actuator to valve mounting bracket and valve.

14.4 Adjust both stop screws (1-60) back to settings recorded in step 5.6 under General Disassembly.

14.5 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).

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

14.7 For actuators equipped with M3 jackscrew override and require an option handwheel, M3HW, install the handwheel using the following procedure:

14.7.1. Place the handwheel (8-10) onto the welded nut. The handwheel hub has a cast hexagon hole that fits over the welded nut.

14.7.2 Place lockwasher (8-20) onto M3 up against handwheel hub.

14.7.3 Place hex nut (8-30) onto M3 and thread up against lockwasher, torque to 250 foot pounds.

14.8 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up and tested for proper operation and replaced, if found defective.

14.9 Refer to General Operating & Maintenance Instructions Part Number 71584 for actuator start-up procedures.

CHART 1

PRESSURE REQUIREMENTS & LIMITATIONS FOR MODELS 521-SRXX-12 & 721-SRXX-12

<u>ACTUATOR MODEL *</u>	<u>NOMINAL OPERATING PRESSURE (NOP)</u>	<u>MAXIMUM OPERATING PRESSURE (MOP)</u>	<u>MAXIMUM HYDROSTATI C TEST PRESSURE</u>	<u>MAXIMUM AIR ASSIST PRESSURE (MAAP)</u>	<u>COLUMN B SPRING SELECTION PRESSURE</u>
521-SR40-12	40	330	400	228	27
521-SR60-12	60	345	400	217	40
521-SR80-12	80	360	400	207	52
721-SR40-12	40	180	250	129	28
721-SR60-12	60	195	250	116	42
721-SR80-12	80	210	250	104	55

* Includes actuator models that have -M3 and -M3HW included in their model numbers, i.e., 521-SR40-M3-12

CHART 2

WEIGHTS FOR MODELS 521-SRXX-12 & 721-SRXX-12

<u>ACTUATOR MODEL</u>	<u>APPROXIMATE WEIGHT (LBS) **</u>		
	<u>SR40</u>	<u>SR60</u>	<u>SR80</u>
521-SRXX-12	120	124	125
521-SRXX-M3-12	125	129	130
521-SRXX-M3HW-12	131	135	136
721-SRXX-12	167	174	180
721-SRXX-M3-12	172	179	185
721-SRXX-M3HW-12	178	185	191

** Weights listed for each model are for bare actuators without valve mounting brackets and accessories.

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