

GH-BETTIS

OPERATING & MAINTENANCE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR THE FOLLOWING MODELS

521-SR, 521-SR-M3, 521-SR-M3HW,

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

SPRING RETURN SERIES

HYDRAULIC ACTUATORS

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NEW RELEASE

1.0 INTRODUCTION

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis 521-SR, 521-SR-M3, 521-SR-M3HW, 721-SR, 721-SR-M3 AND 721-SR-M3HW hydraulic actuators. When the model number has "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.
- 1.2 The maximum recommended service interval for this series actuators is five years. Storage time is counted as part of the service interval.

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

2.0 SUPPORT ITEMS AND TOOLS

Seal/Service Kit, commercial leak testing solutions and non-hardening thread sealant. General Tools -two each medium standard screwdriver, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet, torque wrench (up to 2,000 in. lbs.), Refer to Chart 3 for recommended tool styles and size.

3.0 REFERENCE GH-BETTIS MATERIALS

- 3.1 Assembly Drawing 065670 for failing clockwise (close) actuators.

4.0 GENERAL

- 4.1 Numbers in parentheses, () indicate the bubble number (reference number) used on the GH-Bettis Assembly Drawing, Exploded Detail Drawing, and actuator parts lists.
- 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 of the actuator and the housing cover (1-20) as the top of the actuator.
- 4.3 Refer to Chart 1 of this instruction for approximate actuator weights.
- 4.4 To ensure correct re-assembly; that is, with spring on same end of housing as was, mark or tag right or left and mark mating surfaces.
- 4.5 When removing seals from seal grooves, use a small screwdriver with sharp corners rounded off or 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 when possible.

4.8 LUBRICATION REQUIREMENTS:

- 4.8.1 Standard and high temperature service (-20°F to +350°F) use Kronaplate 100. This lubricant is provided in the GH-Bettis Service/Seal Kit.
- 4.8.2 Low temperature service (-50°F to +150°F) use Kronaplate 50. This lubricant needs to be purchased from distributors of Kronaplate. For distributors of Kronaplate lubricant in your area, call 800-428-7802.

4.9 FLUID REQUIREMENTS:

- 4.9.1 Standard and high temperature service (-20°F to +350°F) use Dexron II Automatic Transmission Fluid.
- 4.9.2 Low temperature service (-50°F to +150°F) use Exxon Univis J13 Hydraulic Fluid.

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 any accessories mounted on 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 Actuators equipped with M3HW jackscrew override with handwheel option, remove hex nut (8-30), lockwasher (8-20), and handwheel (8-10).
- 5.5 Remove the pipe plug (2-180) and drain the hydraulic fluid from the cylinder.
- 5.6 Remove breather (4-20) from end of spring cylinder assembly (4-10).
- 5.7 Measure the exposed length of the right and left stop screws (1-60) and record each before loosening.
- 5.8 Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 5.9 Remove snubber (1-130) from housing (1-10).
- 5.10 If not already off of valve, then remove actuator from valve and valve mounting bracket.

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 the rod cover (2-60), taking care not to disengage the grooved 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). Unless the M3 is to be removed for replacement the M3 need not be disassembled from the rod cover.
- 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 seal 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 (2-150) and washer (2-160) is exposed.
 - 6.3.4 Using a 3/16 inch pin punch, drive out and remove pin (2-150).
 - 6.3.5 Remove washer (2-160).
 - 6.3.6 Thread the jackscrew assembly (2-120) out and remove from the rod cover.

7.0 SPRING CYLINDER REMOVAL

- 7.1 When the spring cartridge is installed in the spring cylinder, the spring is under compression - "pre-load". DO NOT remove the spring cartridge until the actuator has the "pre-load" removed. Remove Spring cartridge "pre-load" as follows: 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).
- WARNING: Under no circumstances should the spring cartridge (5) be cut apart, as the spring is pre-loaded and the spring cartridge welded together.
- 7.2 Secure the chain wrench around the spring cylinder (4-10) as close to the welded end cap as possible. Using a mallet, break the cylinder loose and then remove the cylinder by rotating in a counter clockwise direction. When setting aside, care should be taken to protect the chamfered edge and cylinder threads.
 - 7.3 Due to the 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).
 - 7.4 Carefully remove spring cartridge (5) from spring cylinder (4-10) by slightly tilting open end of cylinder down.
 - 7.5 Unscrew and remove standard hex lock nut (2-70) from piston rod (2-10).
 - 7.6 Remove the piston (2-20).
 - 7.7 Unscrew and remove the four cylinder adapter ferry head screws (2-90) and seal gaskets (6-80).
 - 7.8 Remove the cylinder adapter (2-30), taking care not to scratch the piston rod (2-10) or disengage the rod bushing (2-40).

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 Rotate the yoke arms to the center position.
- 8.4 Remove the upper yoke roller (1-50).
- 8.5 Lift out and remove yoke pin (1-40).
- 8.6 Holding rod bushing (2-40) in place, pull the piston rod (2-10) out through the rod bushing (2-40).
- 8.7 Lift out the yoke (1-140) from the housing cavity.
- 8.8 Remove the lower yoke roller (1-50).
- 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 remaining stop screw (1-60), jam nut (1-70), and gasket seal (6-90). Be sure to identify this stop screw.
- 8.11 It is not necessary to remove housing pipe plug (1-100) or cylinder adapter pipe plug (2-110).

9.0 GENERAL RE-ASSEMBLY

- 9.1 Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 9.2 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.
- 9.3 After inspection, the parts should be carefully cleaned to remove all dirt and gasket material.

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 Install one of the yoke o-ring seals (6-20) into groove in the housing bore.
- 10.3 Apply lubricant to the yoke bore in the body and arrange the body so that the yoke bore is nearest to 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 hydraulic fluid. Install into the left side of the housing (1-10) for clockwise actuators and on right side counterclockwise 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 counterclockwise 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 lubricant to the piston rod (2-10) and install into the housing thru the rod bushing. The threaded end should be on the left for clockwise actuators and on the right for counterclockwise 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 Install the remaining yoke seal (6-20) into the housing cover (1-20).
- 10.13 Coat the yoke bore in the cover (1-20) with lubricant.
- 10.14 Install the cover gasket (6-60) 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 hydraulic fluid and install, lip first, into the cylinder adapter (2-30). Energizer ring of rod seal must face the cylinder adapter (piston side).
- 11.2 Install one cylinder adapter gasket (6-70) onto the left side of the housing for clockwise actuators or on the right for counterclockwise actuators.
- 11.3 Install the cylinder adapter (2-30) over the piston rod and retain with the cylinder adapter ferry screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter (2-30) so that the bleed valve (2-170) will be at the cylinders highest point when the actuator is installed on the valve. 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's spare pressure port.
- 11.5 Coat the cylinder adapter o-ring seal (6-40) with hydraulic fluid and install in the groove at the inner end of the threads of the cylinder adapter (2-30).
- 11.6 Coat the piston o-ring seal (6-50) with hydraulic fluid and install onto the piston rod.
- 11.7 Install the piston (2-20) onto the piston rod and retain with hex lock 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 lock nut (2-70) to approximately 146 ft. pounds.

11.8 PISTON SEAL INSTALLATION

11.8.1 Standard and High Temp Actuators: Coat one piston U-cup seals (6-10) with hydraulic fluid and install into the innermost piston groove. The lips of the seals should point toward the cylinder adapter.

11.8.2 Low Temp Actuators: Apply hydraulic fluid to piston T-seal assembly (6-10) and install into the innermost piston seal groove. Install back-up ring on each side of T-seal. The T-seal assembly is composed of a rubber seal and two back-up rings.

11.9 Push the piston in towards the housing as far as it will go.

11.10 Coat the cylinder threads and the piston stroke surface of cylinder bore with hydraulic fluid.

11.11 Coat the outside of the spring 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.

11.12 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.

11.13 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 (counterclockwise), rotate the yoke (1-140) to full counterclockwise (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 If the M3 jackscrew was removed from the rod cover then pre-assemble the M3 into rod cover (2-60), using the following procedure.

12.1.1 Install nut seal (2-130), onto jackscrew assembly (2-120) and thread until up against the welded nut.

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 (2-160) and pin (2-150) 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 (2-160) 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 nut seal until fully tight against the rod cover.
 - 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 counterclockwise 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 All areas, where leakage to atmosphere may occur, are to be checked using a leak testing solution.
 - 13.2 All leak testing will use the nominal operating pressure (NOP) as listed on the actuator nametag or from Chart number 1 of this procedure.
 - 13.3 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.
 - 13.4 Apply NOP pressure to the pressure inlet port located in the cylinder adapter (2-30).
 - 13.5 Apply leak testing solution to the following areas:
 - 13.5.1 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.
 - 13.5.2 The threaded joint between the SR cylinder (4-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.
 - 13.5.3 The joint between the cylinder adapter and the housing.
 - 13.5.4 The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.
 - 13.6 Remove pressure from pressure inlet port located in the SR cylinder adapter.
 - 13.7 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.

- 13.8 If an actuator was disassembled and repaired, the above leakage test must be performed again.
- 13.9 Operational Test the actuator to verify proper function of the actuator. This test must be done when the actuator is off of the valve or when the valve stem is not coupled to the actuator yoke.
- 13.10 Adjust the pressure regulator to the pressure rating indicated in Column "B" of Chart 1, for the model actuator being used.
- 13.11 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.
- 13.12 Remove pressure from pressure inlet port located in the SR cylinder adapter.

14.0 RETURN TO SERVICE

- 14.1 Re-install the breather (4-20) into the end of the spring cylinder (4-10).
- 14.2 If supplied in the service kit, replace the software components of the snubber (1-190) and then install the snubber into the housing.
- 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 optional 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.

CHART 1

PRESSURE REQUIREMENTS & LIMITATIONS
FOR MODELS
521-SRXX & 721-SRXX PNEUMATIC ACTUATORS

| <u>ACTUATOR MODEL *</u> <u>PRESSURE</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>COLUMN B SPRING SELECTION</u> |
|--|---|---|--|---|--|
| 521-SR40 | 40 | 330 | 400 | 228 | 27 |
| 521-SR60 | 60 | 345 | 400 | 217 | 40 |
| 521-SR80 | 80 | 360 | 400 | 207 | 52 |
| 521-SR100 | 100 | 375 | 400 | 197 | 70 |
| 521-SR125 | 125 | 390 | 450 | 183 | 84 |
| 521-SR150 | 150 | 410 | 450 | 169 | 100 |
| 521-SR200 | 200 | 440 | 450 | 142 | 136 |
| | | | | | |
| 721-SR40 | 40 | 180 | 250 | 129 | 28 |
| 721-SR60 | 60 | 195 | 250 | 116 | 42 |
| 721-SR80 | 80 | 210 | 250 | 104 | 55 |
| 721-SR100 | 100 | 225 | 300 | 93 | 69 |
| 721-SR125 | 125 | 240 | 300 | 79 | 85 |
| 721-SR150 | 150 | 260 | 300 | 66 | 100 |
| 721-SR200 | 200 | 300 | 300 | 7 | 165 |

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

CHART 2

WEIGHTS FOR MODELS
521-SRXX & 721-SRXX

APPROXIMATE WEIGHT (LBS) **

| <u>ACTUATOR MODEL</u> | <u>SR40</u> | <u>SR60</u> | <u>SR80</u> | <u>SR100</u> | <u>SR125</u> | <u>SR150</u> | <u>SR200</u> |
|---------------------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|
| 521-SRXX | 105 | 108 | 110 | 121 | 123 | 125 | 136 |
| 521-SRXX-M3 | 112 | 116 | 117 | 126 | 128 | 131 | 141 |
| 521-SRXX-M3HW | 117 | 121 | 122 | 131 | 133 | 135 | 146 |
| 721-SRXX | 150 | 156 | 162 | 163 | 186 | 188 | 203 |
| 721-SRXX-M3 | 155 | 161 | 167 | 168 | 191 | 193 | 208 |
| 721-SRXX-M3HW | 160 | 166 | 172 | 176 | 196 | 198 | 213 |

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

CHART 3
521/721-SR & M3/HW
TOOL STYLE AND WRENCH SIZES

| ITEM NO. | WRENCH SIZE ** | DESCRIPTION | RECOMMENDED WRENCH STYLE |
|----------|----------------|--------------------------|----------------------------|
| 1-30 | 9/16" | COVER SCREWS | SOCKET |
| 1-60 | 7/16" | STOP SCREW | OPEN END OR ADJUSTABLE |
| 1-70 | 15/16" | STOP SCREW NUT | OPEN END OR ADJUSTABLE |
| 1-100 | 7/16" | HOUSING DRAIN PLUG | OPEN END OR ADJUSTABLE |
| 1-120 | 3/16" | WEATHER COVER SCREWS | ALLEN |
| 1-130 | 7/8" | SNUBBER | DEEP SOCKET |
| 2-70 | 1-1/4" | PISTON/PISTON ROD NUT | SOCKET |
| 2-90 | 7/16" | CYLINDER ADAPTER SCREWS | (1) (3) 12 POINT SOCKET |
| 2-100 | 7/16" | ROD COVER SCREWS | (1) (3) 12 POINT SOCKET |
| 2-110 | 7/16" | CYL ADPT SPARE PORT PLUG | ALLEN |
| 2-130 | 1-11/16" | M3 NUT SEAL | (2) OPEN END OR ADJUSTABLE |
| 2-150 | 3/16" | SPIRAL PIN | (1) PIN PUNCH |
| 4-10 | --- | 7-1/2 O.D. CYLINDER | (1) CHAIN WRENCH |
| 4-20 | 11/16" | CYLINDER BREATHER | (1) OPEN END |
| 8-30 | 1-11/16" | M3 HANDWHEEL JAM NUT | (2) OPEN END OR ADJUSTABLE |

** All tools are American standard inch.

(1) No alternate style recommended

(2) Some actuators used heavy hex nuts in this location - wrench size will change to 1-13/16"

(3) Early models used socket head cap screws - wrench style will change to allen.

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