

**GH-BETTIS**

**SERVICE INSTRUCTIONS**

**DISASSEMBLY AND REASSEMBLY**

**FOR THE FOLLOWING MODELS**

**KHD521-SR, KHD521-SR-M3, KHD521-SR-M3HW,**

**KHD721-SR, KHD721-SR-M3 & KHD721-SR-M3HW**

**SPRING RETURN SERIES**

**K-MASS ACTUATORS**

PART NUMBER: 074969

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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 GH-Bettis KHD521-SR, KHD521-SR-M3, KHD521-SR-M3HW, KHD721-SR, KHD721-SR-M3 AND KHD721-SR-M3HW Series K-Mass coated actuators.
- 1.2 The maximum recommended service interval for this series actuators is five years. Storage time is counted as part of the service interval.
- 1.3 This procedure is written with the understanding that all operating power has been removed from the actuator, allowing the spring to stroke and rotate the yoke to the actuators 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.

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

## 2.0 SUPPORT ITEMS AND TOOLS

- 2.1 Support Items - Service Kit, commercial leak testing solution, latex window caulking 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 and a torque wrench (up to 2,000 in. lbs.). For recommended tool list refer to page 8 of 9.

## 3.0 REFERENCE GH-BETTIS MATERIALS

- 3.1 Assembly Drawing 036292 for failing clockwise (close) actuators.
- 3.2 Assembly Drawing 040905 for failing CCW (open) actuators.
- 3.3 Exploded Detail Drawing 063355 for K521-SR and K721-SR actuators.
- 3.4 Exploded Detail Drawing 068091 for K521-SR-M3/HW and K721-SR-M3/HW.

## 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 side of the actuator. The housing cover (1-20) will be considered the top of the actuator.
- 4.3 To help in correct re-assembly; that is, with spring on same end of housing as was, mark or tag mating surfaces.
- 4.4 When removing seals from seal grooves, use a small screwdriver with sharp corners rounded off or a commercial seal removing tool.
- 4.5 Use a non-hardening thread sealant on all pipe threads. **CAUTION: Apply the thread sealant per the manufacture's instructions.**

- 4.6 Disassembly of actuator should be done in a clean area on a work bench when possible.
- 4.7 LUBRICATION REQUIREMENTS: Standard and high temperature service (20°F to 350°F) use GH-Bettis ESL-5(Kronaplate 100). ESL-5 is provided in the GH-Bettis Service Kit.
- 4.8 It is a good practice to operate the actuator with the nominal operating pressure (NOP), as listed on the actuator nametag or the pressure used by the customer to operate the actuator during normal operation, before starting the general disassembly of the actuator. Notate and record any abnormal symptoms such as jerky or erratic operation. NOTE: Pressure is not to exceed the maximum operating pressure rating listed on the name tag.

## **5.0 GENERAL DISASSEMBLY**

- 5.1 If not already removed 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 If the actuator is equipped with a M3 jackscrew make sure that the jackscrew (2-120) does not engage the piston rod (2-10).
- 5.3 Actuators equipped with -M3HW jackscrew with handwheel option, 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 Measure the exposed length of the right and left stop screws (1-60) and record each before loosening.
- 5.6 Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 5.7 Remove snubber (1-130) from housing (1-10).
- 5.8 Remove the latex caulking that covers all the hardware on the housing cover. Cut through the latex caulking that seals all joints where the actuator parts are disassembled.

## **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). NOTE: 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 Using a 3/16 inch pin punch, drive out and remove the spirol pin from the slotted nut located on the outboard end of the M3 jackscrew assembly (2-120).
  - 6.3.3 Remove the slotted nut from the jackscrew assembly (2-120).
  - 6.3.4 Loosen and thread seal nut (2-130) off of the jackscrew assembly (2-120).

- 6.3.5 Thread the jackscrew assembly (2-120) into the rod cover (2-60) until it is disengaged from the rod cover.
- 6.3.6 Remove the jackscrew assembly (2-120) from the open end of the rod cover (2-60).

## 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).
- 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.

**WARNING: Under no circumstances should the spring cartridge (5) be cut apart, as the spring is pre-loaded and the spring cartridge welded together.**

- 7.5 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). The housing cover has a tight fit and will require the use of two pry bars or screw drivers.
- 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 Remove cylinder adapter rod bushing (2-40) and the grooved rod cover rod bushing (2-50) from housing (1-10).
- 8.8 Lift out the yoke (1-140) from the housing cavity.

8.9 Remove the lower yoke roller (1-50).

8.10 Unscrew and 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 and discard all old seals and gaskets, taking care not to scratch or damage seal grooves.

9.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

9.3 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.

9.4 All K-Mass coated parts should be inspected for damage to the coating. Replace or repair all K-Mass parts that are damaged.

9.5 Before installing coat all surfaces of actuators moving parts with lubricant.

9.6 Coat all seals with lubricant, before installing into grooves, also both sides of gaskets.

## **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 housing. 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 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 the cylindrical portion of the yoke.

10.9 Apply lubricant to the piston rod (2-10) and install into the housing thru the rod bushings. 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 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 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 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.
- 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 Install the cylinder adapter o-ring seal (6-40) into the cylinder adapter (2-30) in the groove at the inner end of the threads.
- 11.6 Install the piston o-ring seal (6-50) 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. Teflon insert of locknut (2-70) should rest up against piston. Torque the piston hex lock nut (2-70) to approximately 146 foot pounds.
- 11.8 Coat piston U-cup seal (6-10) with lubricant and install into the innermost piston groove. The lips of the seals should point toward the cylinder adapter.
- 11.9 Push the piston in towards the housing as far as it will go.
- 11.10 Coat the cylinder threads and the entire surface of cylinder bore with lubricant.
- 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 Apply a light coating of lubricant to the threads of jackscrew assembly (2-120).

12.1.2 Insert the jackscrew assembly (2-120) through the open end of the rod cover (2-60). Thread the jackscrew into the rod cover end cap until the end of the assembly protrudes out of the rod cover.

12.1.3 Turn the jackscrew until the retaining nut comes into contact with the inside of the rod cover.

12.1.4 Install seal nut (3-30) onto the jackscrew assembly (2-120). Thread the seal nut until it is up against the rod cover.

12.1.5 Thread the slotted nut onto the outboard end of the jackscrew stud with the slot facing toward the rod cover. Thread the nut until one of the slots in the nut is aligned with the cross drilled "thru 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.**

12.1.6 Insert the spirol pin thru the slotted nut and thru the jackscrew stud making sure that equal amounts of the spirol pin is exposed on both sides of the slotted nut and the jackscrew stud.

12.1.7 Turn seal nut until fully tight against the rod cover.

12.1.8 If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.

12.2 Install the remaining end cap gasket (6-70) 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. 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 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 an actuator was disassembled and repaired, the above leakage test must be performed again.
- 13.8 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.
- 13.9 Adjust the pressure regulator to the pressure rating indicated in Column "B" of Chart 1, for the model actuator being used.
- 13.10 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.
- 13.11 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 Replace the software components of the snubber (1-130) and then install the snubber into the housing.
- 14.3 Adjust both stop screws (1-60) back to settings recorded in step 5.5 under General Disassembly.
- 14.4 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).
- 14.5 Re-install any piping and accessories that were removed.
- 14.6 For actuators equipped with M3 jackscrew override and require an optional handwheel, M3HW, install the handwheel using the following procedure:
  - 14.6.1 Place the handwheel (8-10) onto the welded nut. The handwheel hub has a cast hexagon hole that fits over the welded nut.
  - 14.6.2 Place lockwasher (8-20) onto M3 up against handwheel hub.

14.6.3 Place hex nut (8-30) onto M3 and thread up against lockwasher.

- 14.7 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up and tested for proper operation and replaced, if found defective.
- 14.8 Using a tube of latex window caulk seal all joints that were removed or cut through during disassembly.
- 14.9 The actuator is now ready to be returned to service.

## 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	12 Point Socket
2-100	7/16"	Rod Cover Screws	12 Point Socket
2-110	7/16"	Cylinder Adapter Port Plug	Allen
2-130	1-11/16"	M3 Nut Seal	Open End or Adjustable
2-150	3/16"	Spiral Pin	Pin Punch
4-10	---	7-1/2 O.D. Cylinder	Chain Wrench
4-20	11/16"	Cylinder Breather	Open End
8-30	1-11/16"	M3 handwheel Jam Nut	Open End or Adjustable

\*\* All tools are American standard inch.

**CHART 1****PRESSURE REQUIREMENTS & LIMITATIONS****FOR MODELS****K521-SRXX & K721-SRXX PNEUMATIC ACTUATORS**

ACTUATOR MODEL *	NOMINAL OPERATING PRESSURE SELECTION (NOP)	MAXIMUM OPERATING PRESSURE (MOP)	MAXIMUM ALLOWABLE WORKING PRESSURE	MAXIMUM AIR ASSIST PRESSURE (MAAP)	COLUMN B SPRING PRESSURE
K521-SR40	40	330	400	228	27
K521-SR60	60	345	400	217	40
K521-SR80	80	360	400	207	52
K521-SR100	100	375	400	197	70
K521-SR125	125	390	450	183	84
K521-SR150	150	410	450	169	100
K521-SR200	200	440	450	142	136
K721-SR40	40	180	250	129	28
K721-SR60	60	195	250	116	42
K721-SR80	80	210	250	104	55
K721-SR100	100	225	300	93	69
K721-SR125	125	240	300	79	85
K721-SR150	150	260	300	66	100
K721-SR200	200	300	300	7	165

\* Includes actuator models that have -M3 and -M3HW included in their model numbers, i.e., K521-SR40-M3.

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