GH BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR THE MODEL

FS5XX

DOUBLE ACTING SERIES

FIRESAFE ACTUATOR

PART NUMBER: 074954

REVISION: "A"

RELEASE DATE: February, 1992

1.0 INTRODUCTION

1.1 This operating and maintenance procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis FS5 double acting series firesafe pneumatic actuator. When the actuator 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 actuator series is five years.

1.3 This procedure is written with the understanding that the actuator has been removed from the valve, the air or power gas has been removed from the power cylinders and all piping and accessories mounted on the actuator have been removed.

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

2.0 BASIC TOOLS

2.1 Support Items - Service/Seal Kit and commercial leak testing solution.

2.2 All tools are American Standard inch. Large adjustable wrench, standard slot screwdriver, 3/8" drift punch, 1/2" drive socket set, 24 oz. ball peen hammer, Allen wrench set, and pry bar.

3.0 REFERENCE GH-BETTIS MATERIALS

3.1 Assembly drawing part number 067698.

3.2 Pneumatic test assembly schematic number BSK-2369.

4.0 GENERAL

4.1 Numbers in parentheses, ( ) indicate the bubble number (reference number) used on GH-Bettis Assembly 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 of the actuator. The housing cover (1-20) will be the top of the actuator.

4.3 To help in re-assembly, mark or tag right or left and mark mating surfaces.

4.4 When removing seals from seal grooves, use a small screwdriver with the sharp edges rounded off or use a commercial seal removing tool.

4.5 Disassembly of actuator should be done in a clean area on a work bench.

4.6 Lubrication Requirements - Standard and high temperature service (-20^0F to 350^0F) use GH Bettis ESL-5 (Kronaplate 100). ESL-5 is contained in the GH Bettis Service/Seal Kit.

4.7 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 disconnect all operating pressure from actuator power cylinder assembly (2-10).

5.2 The setting of stop screws (1-180) should be checked and settings recorded before stop screws are loosened or removed.

5.3 Remove the snubber valve (1-200) from the housing cover (1-20).

6.0 PRESSURE CYLINDER DISASSEMBLY

6.1 Remove the locknut (2-40) and ring seal (2-240) from the cylinder assembly cover shield (2-20).

6.2 Remove the cylinder assembly cover shield (2-20) from the cylinder (2-10).

6.3 Remove outer end cap insulation (2-70), inner wrap insulation (2-50) and outer wrap installation (2-60). **CAUTION: Be careful when removing the insulation as it is to be reinstalled during reassembly.**

6.4 Remove socket cap screws (2-230) and lockwashers (1-220) from cylinder (2-10).

6.5 Remove the cylinder (2-10).

6.6 Unscrew and remove lock nut (2-160) and retainer washer (2-140) from piston rod (2-110).

6.7 Remove the piston (2-120) from the piston rod (2-110).

6.8 Remove the thrust washer (2-130) from the piston rod (2-110).

7.0 HOUSING GROUP DISASSEMBLY

7.1 Loosen the socket set screw (1-160) enough so as to be able to remove the position indicator (1-150).

7.2 Remove the position indicator (1-150). Mark orientation before removing.

7.3 Unscrew and remove socket cap screws (1-40) with lock washers (1-50) from the position indicator cover (1-230) and pull the position indicator cover (1-230) up off the position indicator drive assembly (1-120).

7.4 Unscrew and remove shoulder screws (1-170) from the position indicator drive assembly (1-120). **NOTE: Mark the position indicator drive assembly so that it can be reinstalled in its correct position.**

7.5 Remove the position indicator drive assembly (1-120).

7.6 Remove the socket cap screws (1-40) and lockwashers (1-50) from the housing cover (1-20).

7.7 Remove the housing cover (1-20). **NOTE: This piece will have a very tight fit due to the cover pins (1-30).**

7.8 Remove the upper yoke bushing (1-90) from the top of the yoke (1-80) or from the bottom of the housing cover (1-20) if it came off with the cover.

7.9 Remove the two socket cap screws (1-140) from the yoke pin retainer (1-130).

7.10 Remove yoke pin retainer (1-130).

7.11 Remove yoke pin (1-100). **NOTE: Remove yoke pin by inserting 1/4"-20 UNC screw into top of yoke pin and pull straight up and out.**

7.12 Rotate the yoke arms counter-clockwise so as to expose the guide block (1-60). **NOTE: The uppermost slide block (1-110) may fall out of yoke slot once the slot clears guide block (1-60).**

7.13 Remove the top and bottom slide blocks (1-110) from the yoke arms.

7.14 Insert a 3/8" dia. rod or punch into and through the small hole on top of the guide block (1-60) and into the hole in the rod extension (2-180). **NOTE: The rod extension (2-180) may need to be rotated to align its hole with hole in the guide block.** Holding this tool in place unscrew the piston rod (2-110) from the piston rod extension (2-180). Flats are provided on the piston rod for wrench placement. DO NOT use a pipe wrench on the piston rod as it will mar the rod and may cause seal leakage.

7.15 Remove the socket cap screws (2-200) from the rod extension flange (2-190).

7.16 Remove the rod extension flange (2-190) from guide block (1-60).

7.17 Remove the rod extension from the Guide block (1-60).

7.18 Remove the spherical washer (2-220) from the rod extension (2-180).

7.19 Remove the other spherical washer (2-220) from the guide block (1-60).

7.20 Remove the hex cap screws (6-20), hex jam nuts (6-30) and gasket seals (4-100) from the blind end cap (6-10).

7.21 Remove the blind end cap (6-10) from the housing (1-10).

7.22 Remove guide bar (1-70) by sliding out of the guide block (1-60) and out of the blind end cap side of the housing.

7.23 Remove the guide block (1-60).

7.24 Remove yoke (1-80) by lifting yoke out of housing (1-10).

7.25 Remove lower yoke bushing (1-90) from the bottom of the housing or from the lower end of the yoke (1-80).

7.26 Remove stop screws (1-180), jam nuts (1-190), thread seals (6-30) and the countersunk washers (5-40). Before removing the stop screws refer to step 5.2 under General Disassembly.

7.27 Remove the hex cap screws (1-210) with lock washers (1-220) from inside of the housing. This will release and allow the removal of the following items: the cover shield (4-120), the inner end cap insulation (2-80), cylinder adapter (2-30) and the inner end cap (2-90).

7.28 Remove the socket cap screws (2-100) from the cylinder adapter (2-30).

7.29 Separate the cylinder adapter (2-30) and inner end cap insulation (2-80) from the inner end cap (2-90). Remove the cover shield seal (4-120) from the cylinder adapter (2-30).

7.30 Remove the retaining ring (2-170) from the inner end cap (2-90).

7.31 Remove the rod bushing (2-150) and the rod wiper (4-80) from the inner end cap (2-90).

8.0 GENERAL REASSEMBLY

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

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

8.3 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.

8.4 **CAUTION: The insulation used for the inner end cap insulation (2-80), inner wrap insulation (2-50), outer wrap insulation (2-60) and the outer end cap insulation (2-70) is not field repairable. If any of the insulation is damaged or torn then it must be replaced, if not replaced then the actuator may not be firesafe.**

8.5 **CAUTION: When installing gaskets DO NOT use lubricant on the gasket or on the mating surfaces. These gaskets (4-10) and (5-10) act as thermal barriers. If lubricant is used on these gaskets, the lubricant will act as a thermal transmitter and help defeat the firesafe characteristics of the actuator.**

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

8.7 All seals and the grooves they fit in are to be lightly lubricated prior to installation.

8.8 T-Seal Set installation - The T-seal is composed of one rubber seal and two split skive-cut back-up rings.

8.8.1 Install the T-seal into the seal groove.

8.8.2 Install a back-up ring on each side of the T-seal.

8.8.3 When installing the back-up rings, stagger the skive-cuts of the two back-up rings.

8.8.4 If the back-up rings are too long and the rings overlap beyond the skive-cuts, then the rings must be trimmed with a razor sharp instrument. When trimming back-up rings leave no more than 1/8" inch gap.

9.0 INNER END CAP PRE-ASSEMBLY

9.1 Install the rod wiper (4-80) into the center hole in the inner end cap (2-90).

9.2 Install the o-ring seal (4-50) into the rod bushing (2-150) outer diameter o-ring groove.

9.3 Install the rod seal (4-40) into the rod bushing inner diameter seal groove such that the seal lips face the closest side of the bushing.

9.4 Install the rod bushing (2-150) into the inner end cap (2-90) such that the rod seal lips are facing toward the retaining ring groove in the inner end cap.

9.5 Install the retaining ring (2-170) into the ring groove next to the rod bushing in the inner end cap (2-90).

9.6 Install the o-ring seal (4-90) into the o-ring groove in the cylinder adapter (2-30). Replace the cover shield seal (4-120) around the outer perimeter of the cylinder adapter (2-30).

9.7 Install the inner end cap insulation (2-80) into the cylinder adapter (2-30).

9.8 Install the cylinder adapter (2-30) into the inner end cap (2-90) and retain with socket cap screws (2-100).

10.0 HOUSING GROUP REASSEMBLY

10.1 Place lock washers 1-220 on to the hex cap screws (1-210).

10.2 Insert the hex cap screws thru the inside of housing (1-10).

10.3 Position the gasket (4-10) over the hex cap screws installed in step 10.2. **Refer to step 8.5 for gasket caution information.**

10.4 Bolt the pre-assembled inner end cap (2-90) onto the housing and retain with the hex cap screws (1-210) installed in step 10.2.

10.5 Apply lubricant to the yoke bushing bore in the housing (1-10) and arrange the housing with the yoke bore nearest you.

10.6 Install the o-ring seals (5-80) into both of the outer diameter o-ring grooves on the yoke bushings (1-90).

10.7 Install the one of the yoke bushings (1-90) into the bottom of the housing.

10.8 Install o-ring seals (5-20) into the upper and lower o-ring grooves on the outer diameter of the yoke (1-80).

10.9 Coat the bearing surfaces of the yoke (1-80) with lubricant and install into the lower yoke bushing (1-90).

10.10 Install the remaining yoke bushing (1-90) onto the upper bearing surface of yoke (1-80).

10.11 Install thread seals (5-30) and countersunk washers (5-40) on to the stop screws (1-180). Thread jam nuts (1-190) onto the stop screws (1-180).

10.12 Install the assembled stop screw assemblies into housing (1-10) at their previously marked settings, recorded in step 5.2 under General Disassembly.

10.13 Apply lubricant to the guide block (1-60) and guide bar (1-70).

10.14 Install one of the spherical washers (2-220) into the right side of the guide block (1-60). **NOTE: The spherical side of the washer will be facing to the right or to the outside of the guide block.**

10.15 Install the second spherical washer over the threaded end of the rod extension (2-180). **NOTE: The spherical side of the washer will go on the rod extension facing the head of the rod extension.**

10.16 Install the rod extension into the right side of the guide block (1-60) and up against the first spherical washer (2-220).

10.17 Install the rod extension flange (2-190) over the rod extension (2-180) and retain with socket cap screws (2-200).

10.18 Install guide bar (1-70) into left side of housing (1-10). Take the guide block (1-60) and insert the guide bar through it and into the right side of the housing.

10.19 Install the gasket (4-110) onto the left side of housing (1-10). **Refer to Section 8, step 8.5 for gasket caution information.**

10.20 Install the blind end cap (6-10) using hex cap screws (6-20) with gasket seals (4-100). Retain the blind end cap with hex jam nuts (6-30).

10.21 Install the piston rod (2-110) by inserting thru the inner end cap (2-90). **NOTE: Be careful not to damage the rod seal (4-40) when inserting the piston rod thru the rod bushing (2-150).**

10.22 Clean and dry the rod extension and piston rod mating threads. Coat rod extension threads with Locktite Studlocker #271 prior to assembling. Thread the piston rod (2-110) into the rod extension (2-180). Secure the piston rods in the rod extension by inserting a 3/8" inch diameter punch into the hole in the head of the rod extension (2-180) and using a wrench on the piston rod outer end to tighten the piston rod onto the piston rod extension (2-180). **CAUTION: Allow sufficient time for Locktite compound to dry.**

10.23 Install the sliding blocks (1-110) by installing one sliding block down into the lower yoke arm with the two tapped holes facing down.

10.24 While holding the second sliding block (1-110) in the upper yoke arm, place guide block (1-60) in between the yoke arms and sliding blocks.

10.25 Align holes in sliding blocks with hole in guide block. Install the yoke pin (1-100) by inserting into the hole in the sliding block (1-110). The yoke pin can be held in place by threading a screw into the tapped hole in the upper end of the yoke pin.

10.26 While holding the yoke pin in place slide the yoke pin retainer (1-130) into the yoke pin groove and attach to the sliding block (1-110) using socket cap screws (1-140).

11.0 PRESSURE CYLINDER REASSEMBLY

11.1 Install o-ring seal (4-30) into the o-ring groove on the inner end cap (2-90).

11.2 Install the thrust washer (2-130) over the outer end of the piston rod (2-110) and up against the shoulder of the piston rod.

11.3 Install o-ring seal (4-60) into the piston (2-120).

11.4 Install the piston (2-120) onto the piston rod (2-110) and retain with retainer washer (2-140) and lock nut (2-160).

11.5 Install the piston T-seal components (4-20) into the piston external seal groove. **Refer to step 8.8 for proper T-seal installation instructions.**

11.6 Move or push the piston (2-120) in until it is stroked towards the inner end cap as far as it will travel.

11.7 Coat the cylinder bore of cylinder (2-10) with lubricant.

11.8 Install the cylinder (2-10) by sliding cylinder over the piston (2-120). When sliding the cylinder over the piston seal, tilt cylinder 15^0 to 30^0 to the piston rod, make certain the back-up rings (components of the piston seal) are seated into the seal groove. **CAUTION: Should the back-up rings or seal member be pinched between the piston and cylinder, the component could be damaged, becoming a potential source of leakage.**

11.9 Push the cylinder over the inner end cap o-ring seal (4-30) until the cylinder comes face to face with the inner end cap. Install socket cap screws (2-230) and lock washers (1-220).

11.10 Place the housing cover gasket (5-10) on the housing (1-10). **NOTE: Refer to Section 8, step 8.5 for gasket caution information.**

11.11 Install the housing cover (1-20), being careful not to damage the cover gasket (5-10).

11.12 Install the housing cover socket cap screws (1-40) with lock washers (1-50). **Leave finger tight - do not tighten.**

11.13 **NOTE: Do this step <u>only</u> if the cover pins (1-30) have been pulled or if the pins are being replaced.** Drive the pins (1-30) through the cover (1-20) and into the housing (1-10). The pins should be flush with the cover. The pins are deeply grooved at one end and taper to a smooth diameter at the other end. The pins should be installed smooth end first.

11.14 Tighten the housing cover socket cap screws (1-40).

11.15 Install the position indicator drive assembly (1-120) onto the top of the yoke (1-80) and retain with shoulder screws (1-170). **NOTE: Refer to step 7.4 for correct installation position.**

11.16 Install the o-ring seal (5-50) into the bottom seal groove inside the position indicator cover (1-230).

11.17 Install the wiper ring (5-60) into the top seal groove inside position indicator cover (1-230).

11.18 Install the o-ring seal (5-70) into the seal groove on the bottom face of the position indicator cover (1-230).

11.19 Install the position indicator cover (1-230), being careful not to damage the o-ring seals (5-50), (5-70) and wiper ring (5-60).

11.20 Install and tighten position indicator cover socket cap screws (1-40) with lock washers (1-50).

11.21 Install the position indicator (1-150) over the exposed shaft of the position indicator drive assembly (1-120) and retain in this position by tightening socket set screw (1-160). **NOTE: Refer to step 7.2 for correct placement.**

12.0 <u>ACTUATOR TESTING</u>

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

12.2 All leak testing will use the nominal operating pressure (NOP) 85 PSIG pressure also listed on the actuator nametag.

12.3 If excessive leakage across the piston is noted (generally a bubble which breaks three seconds or less after starting to form), the actuator must be disassembled and the cause of leakage must be determined and corrected.

12.4 Before testing for leaks, alternately apply and release NOP to each 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.

12.5 Apply NOP to the pressure inlet port in the inner end cap (2-90).

12.6 Apply a leak testing solution to the following areas:

12.6.1 The snubber port hole located in the housing cover. Checks the inner end cap to piston rod seal.

12.6.2 To the joint between the cover shield seal (4-120) and the housing (1-10).

12.6.3 The pressure inlet port in the outboard end of cylinder (2-10). Checks piston to cylinder and piston to piston rod seal.

12.7 Remove pressure from the inlet port in the inner end cap (2-90).

12.8 Apply 65 psig air pressure to the inlet port on the outboard of cylinder (2-10).

12.9 Apply a leak testing solution to the pressure inlet port in the inner end cap (2-40). Check piston to cylinder and piston to piston rod seals.

12.10 Remove the pressure from the inlet port on the outer end cap.

12.11 If excessive leakage across the piston is noted, generally a bubble which breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected.

12.12 If an actuator was disassembled and repaired, the above leakage test must be performed again.

13.0 CYLINDER SHIELD INSTALLATION

13.1 Install the inner wrap insulation (2-50), outer wrap insulation (2-60) and the outer end cap insulation (2-70) onto the cylinder (2-10). **NOTE: Refer to Section 8, step 8.4 for insulation caution information.**

13.2 Very Carefully install the cover shield (2-20) and retain with the ring seal (2-240) and the lock nut (2-40).

14.0 OPERATIONS TEST

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

14.2 Cycle the actuator at 10% of the maximum operating pressure as per actuator nametag (1-240). The actuator should stroke a full 90^0 travel with the stop screws properly set. Leave the actuator in the full clockwise position.

15.0 RETURN TO SERVICE

15.1 Replace the software components of the snubber valve (1-200) and then install the snubber valve into the housing cover.

15.2 Check to make sure that both sets of stop screws (1-180) have been returned back to settings recorded in step 5.2 under General Disassembly.

15.3 Tighten stop screw jam nuts (1-190) securely, while holding stop screws (1-180).

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

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