

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR THE FOLLOWING MODELS

H25X.X-SR-S

SPRING RETURN SERIES

DIRECT GAS ACTUATORS

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SECTION 1 - INTRODUCTION

1.1 GENERAL

1.1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis H25X.X-SR-S Spring Return Series Direct Gas Actuators.

1.1.3 This procedure is applicable with the understanding that all electrical power and hydraulic pressure has been removed from the actuator.

1.2 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.

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 well trained, equipped, prepared and competent personnel.

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

1.4 BETTIS REFERENCE MATERIALS

1.4.1 Assembly Drawing Part Number 134411

1.5 SUPPORT ITEMS AND TOOLS

1.5.1 Bettis Service Kit.

1.5.3 Non-hardening thread sealant.

1.5.4 Tools: All tools are American Standard inch. Large adjustable wrench, two each medium standard screwdrivers, small standard screwdriver with edges removed, chain wrench, putty knife, Allen wrench set, 3/16" pin punch, 1/2" drive socket set, rubber or leather mallet, torque wrench (up to 2,000 in. lbs.), and non-hardening thread sealant. Refer to the following table for recommended tool style and size.

H25X-SR TOOL STYLE AND WRENCH SIZES				
ITEM NO.	ITEM QTY.	HD25X-SR WRENCH SIZE	DESCRIPTION OR LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	9/16"	Cover Screws	Socket
1-60	2	3/8"	Stop Screws	Open End or Adjustable
1-70	2	15/16"	Hex Jam Nut	Open End or Adjustable
1-120	4	3/16"	Socket Cap Screws	Allen (1)
1-130	1	7/8"	Snubber Valve	Deep Socket
2-30	4	3/8"	Socket Cap Screws	Allen (1)
2-100	1	1-1/4"	Standard Hex Nut	Socket
2-110	4	7/16"	Ferry Cap Screws	12 Point Socket (1)
2-120	1	7/16"	Pipe Plug	Open End
4-10	1	(2)	SR Cylinder Assy.	Chain Wrench (1)
(1) No alternate style tool recommended.				
(2) Bettis recommends a short handled Chain Wrench with a 40" inch chain.				

1.6 LUBRICATION REQUIREMENTS

NOTE: Lubricants, other than listed in step 1.6.1 should not be used without prior written approval of Bettis Product Engineering.

1.6.1. All temperature services (-50°F to +350°F)/(-45.5°C to 176.6°C) use Bettis ESL-5 lubricant. ESL-5 lubricant is contained in the Bettis Service Kit in tubes.

1.7 BASIC SERVICE INFORMATION:

1.7.1 Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is operating.

1.7.2 Normal recommended service interval for this actuator series is five years to maximum total life cycle.

NOTE: Storage time is counted as part of the service interval.

1.8 GENERAL INFORMATION

1.8.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.

1.8.2 Numbers in parenthesis () indicate the bubble number (item reference number) used on the Bettis assembly drawing and actuator parts list.

1.8.3 This procedure is written using the following Actuator references:

1.8.3.1 Stop screw side of housing (1-10) will be considered the front of the actuator.

1.8.3.2 Housing cover (1-20) will be the top of the actuator.

- 1.8.4 Mating parts should be marked for ease of reassembly, i.e. with spring cartridge on same end of housing as was, cylinder to cylinder adapter, cylinder adapter to housing, ram cover to housing and right and left stop adjustment screws, ect.
- 1.8.5 When removing seals from seal groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.
- 1.8.6 Use a non-hardening thread sealant on all pipe threads.

CAUTION: Apply thread sealant per the manufacture's instructions.

- 1.8.7 Bettis recommends that disassembly of the actuator should be done in a clean area on a workbench.
- 1.8.8 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.

SECTION 2 - ACTUATOR DISASSEMBLY

2.1 GENERAL DISASSEMBLY

NOTE: Review Section 1 Introduction before proceeding with Actuator Disassembly.

- 2.1.1 If not already removed disconnect all operating pressure from actuator ram cover (3), allowing the spring to stroke. NOTE: The spring will rotate the actuator to its fail position.

WARNING: It is possible, that the actuator may contain a dangerous gas (Sour gas/H₂S, Oxygen, Nitrogen, etc.) or liquid (Chlorine, Condensates, etc.). Ensure that all proper measures have been taken to prevent dangerous exposure or release of these types of residues before commencing any work.

- 2.1.2 Remove all piping and mounted accessories that will interfere with disassembly of actuator.
- 2.1.3 The setting of stop screws (1-60) should be checked and settings recorded before stop screws are loosened or removed.

2.2 SPRING CYLINDER DISASSEMBLY

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.

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

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

2.2.1.2 On the front side of housing (1-10) unscrew and remove two stop screws (1-60).

WARNING: Do not tilt the open end of cylinder assembly (4-10) down. The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).

2.2.2 Secure the chain wrench around the 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.

2.2.3 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.

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

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

2.2.5 Unscrew and remove light hex Lok nut (2-100) from piston rod (2-10).

2.2.6 Remove piston (2-70) from piston rod (2-10).

NOTE: Identify cylinder adapter (2-80) location and record it's port locations.

2.2.7 Unscrew and remove four ferry cap screws (2-110) from cylinder adapter (2-80).

2.2.8 Remove cylinder adapter (2-80), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-90).

2.3 RAM COVER DISASSEMBLY

2.3.1 Unscrew four socket cap screws (2-30) from ram cover (3) and remove with gasket seals (6-20).

2.3.2 Remove ram cover (3) from piston rod (2-10), taking care not to disengage the rod bushing (2-20).

2.4 HOUSING DISASSEMBLY

- 2.4.1 Remove vent check (1-130) from the housing (1-10).
- 2.4.2 Remove socket cap screws (1-120) from position indicator (1-110) yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 2.4.3 Remove hex cap screws (1-30) from housing cover (1-20).

NOTE: The housing cover has a tight fit and will require the use of two pry bars or screw drivers to assist in removal.

- 2.4.4 Remove housing cover (1-20) from housing (1-10).
- 2.4.5 Rotate the arms of yoke (1-140) to the center position in the cavity of housing (1-10).
- 2.4.6 Remove the upper yoke roller (1-50) from yoke pin (1-40).
- 2.4.7 Remove yoke pin (1-40) from the slot in the upper arm of yoke (1-140).
- 2.4.8 Holding rod bushing (2-20) in place, pull the piston rod (2-10) out through the rod bushing (2-20).
- 2.4.9 Remove both rod bushings (2-20) and (2-90) from housing (1-10).
- 2.4.10 Remove yoke (1-140) from the cavity of housing (1-10).

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 device it is mounted on.**

- 2.4.11 Remove lower yoke roller (1-50) from the bottom of housing (1-10).

SECTION 3 - ACTUATOR REASSEMBLY

3.1 GENERAL REASSEMBLY

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

- 3.1.1 Taking care not to scratch or damage seal grooves, remove and discard all seals and gaskets.
- 3.1.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 3.1.3 All parts should be thoroughly 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 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.

NOTE: The parts and seals used in the actuator housing assembly, power/spring cylinder will be assembled using lubricant as identified in step 1.6.

- 3.1.4 Before installation coat all moving parts with a complete film of lubricant.
- 3.1.5 Coat all seals with a complete film of lubricant, before installing into seal grooves.
- 3.1.6 The torque requirements for critical fasteners are specified at the appropriate step of the assembly procedure.

3.2 HOUSING REASSEMBLY

NOTE: The parts and seals used in the actuator housing (1-10) will be assembled using lubricant as identified in step 1.6.

NOTE: Position housing (1-10) so that the yoke bore is nearest to you.

- 3.2.1 In the bottom area of housing (1-10) apply lubricant to the cast raised ribs, to the yoke bore and inner diameter seal groove.
- 3.2.2 Coat one o-ring seal (6-60) with lubricant and install into the seal groove located in the yoke bore in the bottom area of housing (1-10).

- 3.2.3 Lubricate yoke (1-140) with a generous amount of lubricant to all bearing surfaces and the slot in the upper and lower arms.

NOTE: The wide arm of yoke (1-140) should be installed toward the top of housing (1-10).

- 3.2.4 Install yoke (1-140) into the bore located in the bottom area of housing (1-10).
- 3.2.5 Coat rod bushing (2-90) with lubricant and install into left side of housing (1-10) for fail clockwise (CW) actuators and into the right side for fail counter-clockwise (CCW) actuators.
- 3.2.6 Coat rod bushing (2-20) with lubricant.
- 3.2.7 Coat o-ring seal (6-70) with lubricant and install into the groove on the outer diameter (O.D.) of rod bushing (2-20).
- 3.2.8 Install backup rings (6-80) into the groove on the outer diameter (O.D.) of rod bushing (2-20). NOTE: One backup ring on each side of the o-ring (6-70) with the concave side of backup ring facing the o-ring.
- 3.2.9 Coat seal (6-50) with lubricant and install into the seal groove on the inner diameter (I.D.) of rod bushing (2-20). NOTE: The seal is to be installed with the energizer ring (open side of the seal) facing ram cover (3).
- 3.2.10 Install rod bushing (2-20) into the right side of housing (1-10) for fail clockwise (CW) actuators and into the left side for fail counter-clockwise (CCW) actuators.
- 3.2.11 Coat one of the yoke rollers (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.

NOTE: The threaded end of piston rod (2-10) should be on the left for fail clockwise (CW) actuators and on the right for fail counter-clockwise (CCW) actuators.

- 3.2.12 Apply lubricant to piston rod (2-10) and install into the housing through the rod bushings.
- 3.2.13 Coat the yoke pin (1-40) with lubricant and install through the piston rod (2-10) into the lower yoke roller (1-50).
- 3.2.14 Coat the remaining yoke roller (1-50) with lubricant and install over the yoke pin and into the slot in the upper yoke arm.
- 3.2.15 Apply lubricant to the yoke bore and seal groove of housing cover (1-20).
- 3.2.16 Coat the remaining o-ring seal (6-60) with lubricant and install into the inner diameter seal groove in housing cover (1-20).
- 3.2.17 Place cover gasket (6-10) onto the top area of housing (1-10).
- 3.2.18 Install housing cover (1-20) over cover gasket (6-60) and onto top area of housing (1-10).

- 3.2.19 Install four gasket seals (6-90) onto four hex cap screws (1-30).
- 3.2.20 Install four hex cap screws (1-30) with gasket seals through housing cover (1-20) and into housing (1-10).
- 3.2.21 Torque tighten hex cap screws (1-30) to 20 foot pounds ($\pm 5\%$).

3.3 SPRING CYLINDER REASSEMBLY

NOTE: The parts and seals used in the actuator spring cylinder (4-10) will be assembled using lubricant as identified in step 1.6.

- 3.3.1 Coat rod seal (6-55) with lubricant and install, lip first, into cylinder adapter (2-80).

CAUTION: Energizer ring (O-ring) of rod seal (6-55) must face into cylinder adapter (2-80) or when cylinder is installed on the actuator the rod seal o-ring will be facing towards piston (2-70).

- 3.3.2 Install cylinder adapter gasket (6-30) as follows:

- 3.3.2.1 Onto the left end of housing (1-10) for fail clockwise (CW) actuators.

- 3.3.2.2 Onto the right end of housing (1-10) for fail counter clockwise (CCW) actuators.

- 3.3.3 Install four gasket seals (6-20) onto four ferry cap screws (2-100).

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

- 3.3.4 Install cylinder adapter (2-80) over the end of piston rod (2-10) as follows:

- 3.3.4.1 Onto the left end of housing (1-10) for fail clockwise actuators.

- 3.3.4.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.

NOTE: Arrange cylinder adapter (2-30) with the pressure inlet port in the same position as recorded in note that goes with step 2.2.6. The location of the port may be different on your actuator depending on customer, plumbing, and accessory requirements.

- 3.3.5 Install and tighten ferry cap screws (2-110) with gasket seals (6-20) through cylinder adapter (2-80) and into housing (1-10).

- 3.3.6 If removed, install a pipe plug (2-120) into the cylinder adapter pressure port in the same position as recorded in the note with step 2.2.6.

- 3.3.7 Coat o-ring seal (6-120) with lubricant and install into cylinder adapter (2-80). NOTE: Install o-ring into the groove at the inner end of the cylinder adapter inner diameter threads.

3.3.8 Install piston (2-70) onto piston rod (2-10). NOTE: The counter bore side of the piston should be installed against the shoulder of piston rod (2-10).

3.3.9 Install light hex Lok nut (2-100) onto piston rod (2-10).

CAUTION: When installing hex lock nut (2-100) the flat side of the nut should rest up against piston (2-70).

3.3.10 Torque tighten light hex Lok nut (2-100) to approximately 146 foot pounds lubricated.

NOTE: No Seals are installed in the outer diameter seal grooves of piston (2-70).

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

3.3.12 Coat the threads and the bore of SR cylinder assembly (4-10) with lubricant.

3.3.13 Coat outside of the spring with lubricant and insert the spring cartridge assembly (5) into spring cylinder (4-10).

NOTE: 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.

3.3.14 Install spring cylinder assembly (4-10), containing spring cartridge (5), over piston (2-70). Rotate the spring cylinder assembly clockwise and screw into cylinder adapter(2-80).

CAUTION: When using a chain wrench on the cylinder the wrench should be secured as close to the cylinder end cap as possible.

3.3.15 Using a chain wrench tighten spring cylinder assembly (4-10) into cylinder adapter (2-80).

NOTE: While the chain wrench is still positioned on the cylinder and after the cylinder is tight, take a mallet and rap (hit) the chain wrench handle twice. This will seat the cylinder assembly into the o-ring seal located in the cylinder adapter. Repeat this step if, during testing, the area between the cylinder assembly and the cylinder adapter is leaking.

3.3.16 Position Indicator Installation as follows:

3.3.16.1 For spring to fail clockwise actuators, rotate the yoke to the full clockwise (CW) position. Install yoke weather cover (6-110) and position indicator (1-110) onto yoke (1-140) with the pointer facing piston rod (2-10) and perpendicular to cylinder assembly (4-10) and ram cover (3).

3.3.16.2 For spring to fail counter-clockwise actuators, rotate yoke (1-140) to full counter-clockwise (CCW) position. Install yoke weather cover (6-110) and position indicator (1-110) onto yoke (1-140) with the pointer facing and parallel to ram cover (3) and piston rod (2-10).

3.3.16.3 Install and tighten socket cap screws (1-120) through position indicator (1-110), weather cover (6-110) and into the top of yoke (1-140).

NOTE: Socket cap screws (1-120) will require rechecking for tightness after the actuator has been cycled.

- 3.3.17 Install gasket seals (6-40) and hex jam nuts (1-70) onto stop screws (1-60).
- 3.3.18 Install stop screws (1-60) with gasket seals (6-40) and jam nuts (1-70) into housing (1-10).
- 3.3.19 Adjust both stop screws (1-60) back to settings recorded in section 2 step 2.1.3.
- 3.3.20 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).

3.4 RAM COVER REASSEMBLY

NOTE: The parts and seals used in the actuator ram cover (3) will be assembled using lubricant as identified in step 1.6.

- 3.4.1 Install the remaining end cap gasket (6-30) onto the right side of the housing (1-10) for fail clockwise (CW) actuators, or on the left side of the housing for fail counter-clockwise (CCW) actuators.
- 3.4.2 Install the ram cover (3) over the exposed piston rod end (2-10).
- 3.4.3 Install seal gaskets (6-20) onto four socket cap screws (2-30).
- 3.4.4 Install and tighten the four socket cap screws (2-30) with seal gaskets (6-20).

SECTION 4 - ACTUATOR TESTING

4.1 ACTUATOR GENERAL LEAK TESTING

- 4.1.1 A small amount of leakage may be tolerated. Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable.
- 4.1.2 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 nametag.**

- 4.1.3 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.
- 4.1.4 Prior to testing for leaks, alternately apply and release pressure, as defined in step 4.1.3, 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.
- 4.1.5 Apply pressure, as defined in step 4.1.3, to pressure inlet port located in out board end of ram cover (3).

NOTE: If excessive leakage is noted, generally a leak testing solution bubble which is formed over the area that is to be checked and this bubble breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected.

4.2 ACTUATOR LEAK TESTING PROCEDURE

- 4.2.1 Apply leak-testing solution to the following areas:
 - 4.2.1.1 Apply pressure as listed in step 4.1.3 to the pressure port in the out board end of the ram cover (3) and check for leaks.
 - 4.2.1.2 Remove pressure from pressure inlet port in the end of the ram cover (3).
 - 4.2.1.3 If excessive leakage is noted, the actuator must be disassembled and the cause of leakage must be determined and corrected.
 - 4.2.1.4 If an actuator was disassembled and repaired, the above leakage test must be performed again.

SECTION 5 – FINAL REASSEMBLY AND RETURN TO SERVICE

5.1 ACTUATOR FINAL REASSEMBLY

- 5.1.1 Install the vent check (1-130) in the housing next to the housing cover.
- 5.1.2 Adjust both stop screws (1-60) back to settings recorded in Section 2 step 2.1.6 under General Disassembly.
- 5.1.3 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).

5.2 ACTUATOR RETURN TO SERVICE

- 5.2.1 Reinstall any piping and accessories that were removed.
- 5.2.2 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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