

GH-BETTIS
OPERATING & MAINTENANCE INSTRUCTIONS
DISASSEMBLY & ASSEMBLY
301D-SRXX-M3-12 & 301D-SRXX-M3HW-12
SPRING RETURN SERIES
RACK & PINION PNEUMATIC ACTUATORS

PART NUMBER: 071583

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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 301-SRXX-M3-12, and 301-SRXX-M3HW-12 Rack and Pinion Spring Return series pneumatic actuators.
- 1.2 The maximum recommended service interval for this actuator series is 625 cycles or 5 years, whichever comes first. Storage time is counted 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. Large adjustable wrench, snap ring pliers, small standard screwdriver with sharp edges removed, chain wrench, allen wrench set, rubber or leather mallet, non-corrosive commercial leak testing solution, and non-hardening thread sealant.

3.0 **REFERENCE GH-BETTIS MATERIALS**

- 3.1 301-SRXX-M3 Assembly Drawing Part Number 71579.
- 3.2 301-SRXX-M3 Exploded Detail Drawing Part Number 71580.
- 3.3 General Operating & Maintenance Instructions Part Number 71584.

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 List.
- 4.2 Mating parts should be marked for ease of reassembly, i.e. cylinder to housing, right and left stop screws, etc.
- 4.3 When removing seals from seal grooves, use a small screwdriver with the sharp edges rounded off or use a commercial seal removing tool.
- 4.4 Use a non-hardening thread sealant on all pipe threads.
- 4.5 Disassembly of actuator should be done in a clean area on a work bench.
- 4.6 **LUBRICATION REQUIREMENTS.** Use Dow Corning Molykote 44, medium grade.

5.0 **GENERAL DISASSEMBLY**

- 5.1 Remove all operating pressure from actuator cylinder assembly (3-10) allowing the spring to stroke. The spring will rotate the yoke to the fail position.

- 5.2 Remove all piping and accessories mounted on actuator.
- 5.3 Make sure that jackscrew assembly (3-20) is not engaging piston and gear rack (2-10).
- 5.4 Remove the hex jam nut (8-20) from end of jackscrew assembly (3-20). Unscrew and remove the handwheel (8-10).
- 5.5 The setting of stop screw (2-30) and jackscrew assembly (3-20) should be checked and settings recorded before they are loosened or removed.
- 5.6 Remove actuator from valve and valve mounting bracket.
- 5.7 Remove the breather (2-50) from housing (1-10).

6.0 SPRING CYLINDER REMOVAL

- 6.1 When the spring cartridge is installed on the actuator the spring is under compression. **DO NOT** remove the spring cartridge until the actuator has the "preload" removed. To remove spring cartridge "preload", apply nominal operating pressure to the pressure inlet port located in the cylinder assembly (3-10). Slightly loosen the hexjam nut (3-30). Thread the jackscrew out until the flat washer (6-80) is up against the end cap of cylinder (3-10). Remove pressure from the pressure inlet port.
- 6.2 **WARNING:** Under no circumstances should the spring cartridge be cut apart, as the spring is pre-loaded and the spring cartridge welded together.
- 6.3 Secure the chain wrench around the spring cylinder (4) as close to the welded end cap as possible. Using the mallet, break the cylinder loose sufficiently so that it can be removed.
- 6.4 Due to added weight and the nature of a preloaded assembly, caution should be exercised when handling the spring cartridge cylinder (4). The spring cartridge (5) is unattached and is only contained by the spring cylinder (4).
- 6.5 Remove the cylinder (4) and when setting the spring cylinder aside, care should be taken to protect the chamfered edge and cylinder threads.
- 6.6 Remove the solid stop screw (2-30) and hex jam nut (2-40) from the spring cylinder.
- 6.7 Remove the gasket seal (6-90) from the stop screw.

7.0 PRESSURE CYLINDER DISASSEMBLY

- 7.1 Secure the chain wrench around the cylinder assembly (3-10) as close to the welded end cap as possible. Using the mallet, break the cylinder loose sufficiently so it can be removed.
- 7.2 Remove the cylinder and when setting the cylinder aside, care should be taken to protect the chamfered edge and cylinder threads.
- 7.3 With the cylinder assembly (3-10) on a work bench, lubricate jackscrew assembly (3-20) threads with lubricant.

- 7.4 Loosen and thread hex jam nut (3-30) all the way back to the welded nut.
- 7.5 Thread the jackscrew assembly (3-20) into the cylinder assembly (3-10) until the pin (6-70) and the flat washer (6-80) are exposed.
- 7.6 Using a 3/16 inch pin punch, drive out and remove pin (6-70).
- 7.7 Remove the flat washer (6-80).
- 7.8 Thread the jackscrew assembly (3-20) out and remove.
- 7.9 Remove thread seal (6-50) and countersunk washer (6-60).

8.0 **HOUSING GROUP DISASSEMBLY**

- 8.1 Remove piston seal (6-20) from piston and gear rack (2-10).
- 8.2 Loosen set screw (1-70) and remove the position indicator (1-60).
- 8.3 Remove snap ring (1-30) from torque plug (1-20).
- 8.4 Grasp actuator housing (1-10) and turn unit upside down (square stem down). By slowly pushing down on housing, the torque plug (1-20) should slide out approximately 2.00 inches (50mm).
- 8.5 Remove the torque plug (1-20) from housing.
- 8.6 Remove o-ring seals (6-30) and (6-40) from the torque plug.
- 8.7 Remove piston and gear rack (2-10) from housing (1-10).
- 8.8 Remove cylinder o-ring seals (6-10) from housing (1-10). The seals are located in each end of the housing.

9.0 **PREASSEMBLY NOTES**

- 9.1 Remove all old seals taking care not to scratch or damage seal grooves.
- 9.2 Before starting the assembly of an actuator, all parts should be thoroughly cleaned, inspected, 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 and other foreign material.

10.0 **CENTER HOUSING REASSEMBLY**

- 10.1 Coat the threads in the housing (1-10) with lubricant.
- 10.2 Coat the cylinder o-ring seals (6-10) with lubricant and install into the grooves provided at the end of the threaded portion in each end of the actuator housing (1-10).

- 10.3 Coat the torque plug bores in the housing with lubricant and arrange the housing with the large torque plug bore down and the hole for the breather (2-50) facing away.
- 10.4 Coat all of the teeth on the piston and gear rack (2-10) with lubricant except for the space between the two center teeth. This will provide a visual alignment for later use.
- 10.5 Place the piston and gear rack (2-10) into the housing (1-10) with the gear tooth side of the rack on the side of the housing with the hole for the breather (2-50). Piston seal groove to the right for clockwise actuators and to the left for counterclockwise actuators. Lengthwise, center the rack inside the housing.
- 10.6 Coat the lower torque plug o-ring seal (6-40) with lubricant and install into the bottom groove on the torque plug (1-20).
- 10.7 Coat the upper torque plug o-ring seal (6-30) with lubricant and install into the upper groove on the torque plug (1-20).
- 10.8 **TORQUE PLUG ALIGNMENT AND LUBRICATION.** (Refer to Figure 1.) Coat all of the torque plug gear teeth with lubricant except for one tooth that corresponds with the centerline of one of the flats on top of the torque plug. Figure I shows one face of torque plug is parallel to actuator centerline.
- 10.9 Pick up housing, containing the piston and gear rack, and set it down over the torque plug (1-20). Engage the unlubricated gear tooth on the torque plug with the unlubricated space on the piston and gear rack. Again, refer to Figure 1 (mid-stroke position) for piston/torque plug alignment.
- 10.10 Install the retaining ring (1-30) into the groove at the top of the torque plug.
- 10.11 Coat the piston seal (6-20) with lubricant and install into the groove provided on the piston. Install piston U-cup seal with the lip of the seal pointing away from the housing.
- 11.0 **PRESSURE CYLINDER RE-ASSEMBLY**
- 11.1 The following instructions are for the assembly of an actuator for "spring to close" (clockwise closing) operation. When torque plug (1-20) is in vertical position and breather (2-50) port in housing facing away, the spring cartridge is on the left side of the housing and the air cylinder is on the right. For "spring to open" (counterclockwise) operation, the spring cartridge is on the right side of the housing and the air cylinder is on the left side of the housing.
- 11.2 Preassemble the M3 into the cylinder assembly (3-10) using the following procedure.
- 11.2.1 Apply a light coating of lubricant to the threads of jackscrew assembly (3-20).

- 11.2.2 Install hex jam nut (3-30), countersunk washer (6-60) and thread screw seal (6-50), onto jackscrew assembly (3-20). The countersink of washer (6-60) should face the thread screw seal (6-50). Thread these items until they are up against the welded nut.
- 11.2.3 Thread the jackscrew assembly (3-20) into the end cap of cylinder (3-10). Turn the jackscrew until the end of the assembly protrudes out of the threaded end of the cylinder.
- 11.2.4 Install the flat washer (6-80) and spirol pin (6-70) as shown on the assembly drawing.
- 11.2.5 Turn the jackscrew until the flat washer (6-80) comes into contact with the cylinder end cap.
- 11.2.6 If desirable, wipe away excess lubricant on jackscrew after operation. If preferred, lubricant may be left on jackscrew to provide additional corrosion protection.
- 11.2.7 Tighten jam nut (3-30) against the countersunk washer (6-60) and the thread screw seal (6-50) until fully tight against end cap.
- 11.3 Apply a very light coating of lubricant to the cylinder threads and the bore of the cylinder (3-10) for a distance of approximately eight inches (203mm). **CAUTION:** Excess lubricant in the cylinder bore may cause erratic or jumpy/jerky operation.
- 11.4 Install the cylinder assembly (3-10) over the piston, screwing into the housing (1-10). Tighten with a chain wrench. Exercise caution to prevent pinching of the piston cup seal lip during installation. It is necessary to depress the seal lip while working the cylinder over it. The chain wrench should be secured as close to the welded end cap as possible.

12.0 **SPRING CYLINDER RE-ASSEMBLY**

- 12.1 Rotate the torque plug clockwise by pushing the exposed end of the piston and gear rack (2-10) into the housing.
- 12.2 Very lightly coat the cylinder threads and the cylinder bore with lubricant.
- 12.3 Coat the outside of the spring with lubricant and insert the spring cartridge assembly (5) into the spring cylinder (4). The end of the spring cartridge assembly, having a deep hole in the center, should be inserted into the cylinder first.
- 12.4 Install the spring cylinder (4), containing the spring cartridge assembly, and screw into the end of the housing (1-10).
- 12.5 Tighten the cylinder (4) using a "chain wrench" secured as close to the welded end cap as possible. **DO NOT** over tighten. When the cylinder cannot be turned any further with the wrench, rap the handle of the wrench with a mallet, this will tighten the cylinder sufficiently.

- 12.6 Install the solid stop screw (2-30) and nut (2-40) with gasket seal (6-90) into the end of the spring cylinder (4).
- 12.7 Adjust the stop screws (2-30) and the jackscrew assembly (3-20) back to the setting recorded in step 5 under General Disassembly. Tighten both of the hex jam nuts (2-40) and (3-30) securely.

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 nametag 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 gear rack 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 port in the end of cylinder assembly (3-10).
- 13.3.2 Apply leak testing solution to the following areas:
 - 13.3.2.1 The breather port hole in the housing checks the piston seal to cylinder wall.
 - 13.3.2.2 The jackscrew assembly hex jam nut (3-30).
- 13.3.3 If excessive leakage 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.
- 13.3.4 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 is to be done off of the valve or when the valve stem is not coupled to the actuator torque plug.

- 13.4.1 Adjust the pressure regulator to the pressure rating indicated in Column "B" of Chart 1 for the model actuator being tested.
- 13.4.2 Apply the above pressure to the actuator pressure inlet port and allow the actuator to stabilize. The actuator should stroke full travel.

13.4.3 Remove pressure from the pressure inlet port.

14.0 **RETURN TO SERVICE**

- 14.1 Install breather (2-50) in the housing (1-10).
- 14.2 Install position indicator (1-60) and tighten socket set screw (1-70).
- 14.3 Reinstall actuator to valve mounting bracket and valve.
- 14.4 Reinstall any piping and accessories that were removed.
- 14.5 For actuators equipped with an M3 jackscrew override and which require an optional handwheel, install the handwheel using the following procedure.
 - 14.5.1 Thread the handwheel (8-10) onto the jackscrew assembly (3-20) and up against the welded nut.
 - 14.5.2 Place the hex jam nut onto the M3 and thread up against the handwheel.
- 14.6 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up and tested for proper operations and replaced, if found defective.
- 14.7 Refer to General Operating & Maintenance Instructions for -12 Trim Series Actuators Part Number 71584 for actuator start-up procedures.

CHART 1

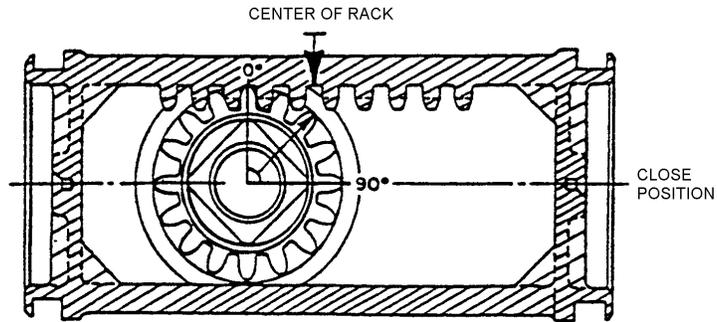
PRESSURE REQUIREMENTS & LIMITATIONS FOR MODELS

301D-SR-M3-12

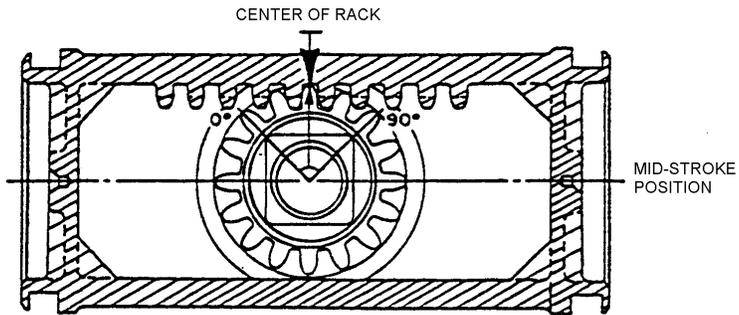
<u>ACTUATOR MODEL</u> *	<u>NOMINAL OPERATING PRESSURE (NOP)</u>	<u>MAXIMUM OPERATING PRESSURE (MOP)</u>	<u>MAXIMUM HYDROSTATIC TEST PRESSURE</u>	<u>MAXIMUM AIR ASSIST PRESSURE (MAAP)</u>	<u>COLUMN B SPRING SELECTION PRESSURE</u>
301D-SR80-M3-12	90	300	300	202	60

* The SR number for this actuator was changed from SR12 to SR80.

301(90° ACTUATOR) ROTATED TO CLOSED POSITION (0°)



301 (90° ACTUATOR) INITIAL ASSEMBLY POSITION



301 (90° ACTUATOR) ROTATED TO OPEN POSITION (90°)

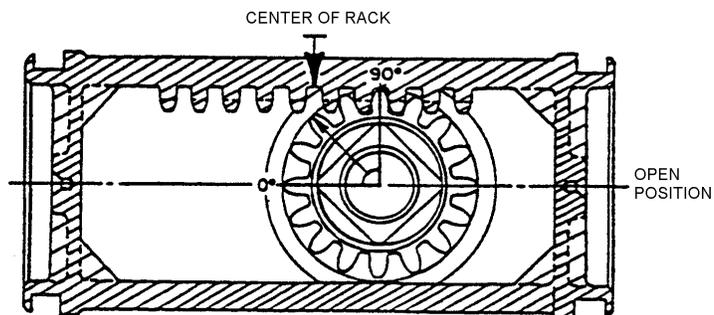


FIGURE 1: PISTON GEAR/RACK AND TORQUE PLUG ALIGNMENT FOR 301D-SRXX-M3HW

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