

BETTIS

OPERATING AND MAINTENANCE

INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

LN3/XX-XX

(EXTERNAL TIE BAR CONSTRUCTION)

LINEAR DOUBLE ACTING

SERIES ACTUATORS

PROCEDURE NUMBER: Service - 083 (SE-083)

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REPLACES: New Release

1.0 **INTRODUCTION**

This service procedure is offered as a guide to enable general maintenance to be performed on Bettis LN3/XX-XX Linear Series Pneumatic Actuators.

**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, two each medium standard screwdrivers, small standard screwdriver with edges removed, 24 oz ball peen hammer, 1-7/8 deepwell socket, internal ring pliers (with tip to fit a .110 diameter hole), torque wrench (up to 5000 inch pounds), razor sharp cutting instrument, commercial testing solution, and non-hardening thread sealant.

3.0 **REFERENCE BETTIS MATERIALS**

- 3.1 Assembly drawing part number 069082 for LN3/XX-XX.
- 3.2 1.75 Wrench part number 069668.
- 3.3 Assembly tool drawing XXXXX.

4.0 **GENERAL**

- 4.1 Numbers in parenthesis, () indicate the bubble number (reference number) used on the Bettis Assembly Drawing and actuator parts lists.
- 4.2 Mating parts should be marked for ease of reassembly.
- 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 piping threads.
- 4.5 Disassembly of actuator should be done in a clean area on a work bench.
- 4.6 **LUBRICATION REQUIREMENTS:**
 - 4.6.1 Standard and high temperature service (-20°F to 350°F) use Kronaplate 100.
 - 4.6.2 Low temperature service (-100°F to 300°F) use Kronaplate 50.
 - 4.6.3 For distributors of Kronaplate in your area, call 800-428-7802.

5.0 GENERAL DISASSEMBLY

- 5.1 Remove all operating pressure from the actuator power cylinder (1-40).
- 5.2 Remove all plumbing and accessories from actuator.
- 5.3 Remove stem nut (3-30) from the piston rod (1-70). Use wrench part number 069668 to retain the piston rod (1-70) during stem nut removal.
- 5.4 Remove the standard hex nuts (3-100) and the lockwashers (3-90).
- 5.5 Remove the actuator from valve and valve mounting bracket.
- 5.6 Remove the stop screw nut (1-150).
- 5.7 Remove the o-ring seal (2-20) from the stop screw nut.
- 5.8 The setting of the stop screw (1-140), should be checked and setting recorded before stop screw is removed.
- 5.9 It is not necessary to remove the stop screw (1-140) for general service.

6.0 UPPER STAGE CYLINDER DISASSEMBLY

- 6.1 Remove the standard hex nuts (1-160) and lockwashers (1-170).
- 6.2 Remove the upper end cap (1-30).
- 6.3 Remove upper end cap to cylinder o-ring seal (2-10).
- 6.4 Remove the upper cylinder (1-40).
- 6.5 Remove the piston "T" seal set (2-50).
- 6.6 Remove the split ring retainer (1-110) from the split ring (1-100).
- 6.7 Remove the split ring set (1-100).
- 6.8 Remove the upper cylinder piston (1-60).
- 6.9 Remove the o-ring seal (2-20) from the piston rod (1-70).
- 6.10 Remove the second split ring retainer (1-110) from the split ring (1-100).
- 6.11 Remove the second split ring set (1-100) from the piston rod (1-70).

7.0 MIDDLE STAGE CYLINDER DISASSEMBLY

- 7.1 Remove the first cylinder adapter (1-20) by sliding adapter off the piston rod (1-70).
- 7.2 Remove the o-ring seals (2-10) from the cylinder adapter (1-20).
- 7.3 Using internal ring pliers, remove the retaining ring (1-130) from the cylinder adapter (1-20).

- 7.4 Remove the adapter bushing (1-90) and the rod seal (2-60) from the cylinder adapter (1-20).
- 7.5 Remove the middle cylinder (1-40).
- 7.6 Remove the piston T-seal set (2-50).
- 7.7 Remove the split ring retainer (1-110) from the split ring set (1-100) located on the upper side of the middle cylinder piston.
- 7.8 Remove the split ring set (1-100).
- 7.9 Remove the middle piston (1-60).
- 7.10 Remove the o-ring seal (2-20) from the piston rod (1-70).
- 7.11 Remove the next split ring retainer (1-110) from the split ring set (1-100).
- 7.12 Remove the second split ring set (1-100) from the piston rod (1-70).

8.0 LOWER STAGE CYLINDER DISASSEMBLY

- 8.1 Remove the second cylinder adapter (1-20) by sliding adapter off of the piston rod (1-70).
- 8.2 Remove the o-ring seals (2-10) from the cylinder adapter (1-20).
- 8.3 Remove the retaining ring (1-130) from the cylinder adapter (1-20).
- 8.4 Remove the adapter bushing (1-90) and the rod seal (2-60) from the cylinder adapter (1-20).
- 8.5 Remove the lower cylinder (1-40).
- 8.6 Remove the piston T-seal set (2-50).
- 8.7 Remove the split ring retainer (1-110) from the split ring set (1-100), located on the upper side of the lower cylinder piston.
- 8.8 Remove the split ring set (1-100).
- 8.9 Remove the lower cylinder piston (1-60).
- 8.10 Remove the o-ring seal (2-20) from the piston rod (1-70).
- 8.11 Remove the final split ring retainer (1-110) from the split ring set (1-100).
- 8.12 Remove the final split ring set (1-100).
- 8.13 Remove the o-ring seal (2-10) from the lower end cap (1-10).
- 8.14 Remove the piston rod (1-70).
- 8.15 Remove the rod wiper (2-70) from the lower end cap.

- 8.16 Remove the retaining ring (1-130) from the lower end cap (1-10).
- 8.17 Remove the end cap rod bushing (1-80) and the rod seal (2-60).
- 8.18 The tie bars (1-50) do not need to be disassembled from the lower end cap (1-10) when normal maintenance is performed.

9.0 GENERAL RE-ASSEMBLY

- 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.
- 9.4 Coat all seals with lubricant, before installing into seal grooves.
- 9.5 T-seal set installation – The T-seal is composed of one rubber seal and two split skive-cut back-up rings.
 - 9.5.1 Install the T-seal into the seal groove.
 - 9.5.2 Install a back-up ring on each side of the T-seal.
 - 9.5.3 When installing the back-up rings, do not align the skive-cuts.
 - 9.5.4 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.

10.0 LOWER CYLINDER RE-ASSEMBLY

- 10.1 Coat one rod seal (2-60) with lubricant and install into the lower end cap (1-10) with the energizer ring of rod seal facing the outboard side of the end cap.
- 10.2 Coat one rod bushing (1-80) with lubricant and install in the lower end cap (1-10).
- 10.3 Retain the rod bushing (1-80) with the retaining ring (1-130).
- 10.4 Install the rod wiper (2-70) into the lower end cap (1-10).
- 10.5 Coat the piston rod (1-20) with lubricant.
- 10.6 Install one of the three o-ring seals (2-20) into the seal groove on the piston rod that is closest to the threaded end of the piston rod.
- 10.7 Install the piston rod (1-70) through the lower end cap (1-10).
- 10.8 Install one set of split rings (1-100) in the groove closest to the lower end cap (1-10).
- 10.9 Retain the split ring set with the split ring retainer (1-110).

- 10.10 Install the o-ring seal (2-10) into seal groove on the lowest end cap (1-10).
- 10.11 Install lower cylinder piston (1-60) by carefully sliding the piston over the piston rod and up against the split ring set (1-100).
- 10.12 Install the two halves of another split ring (1-100) onto the piston rod next to the installed lower cylinder piston and retain with the split ring retainer (1-110).
- 10.13 Install the T-seal set (2-50) into the piston seal groove.
- 10.14 Apply a light coat of lubricant to the bore of the cylinder (1-40).
- 10.15 Slide the end of the cylinder (1-40) over the piston (1-60) and onto the lower end cap (1-10). When sliding the cylinder over the piston seal cant cylinder 15° to 30° degrees to piston rod, make certain the back-up rings, components of the piston seal, are seated into the seal groove. Should the back-up rings or seal member be pinched between the piston and cylinder, the components could be damaged, becoming a potential source of leakage. **DO NOT** hammer on end of cylinder.
- 10.16 Coat a second rod seal (2-60) with lubricant and install into the first cylinder adapter (1-20).
- 10.17 Coat the adapter bushing (1-90) with lubricant and install in the cylinder adapter (1-20).
- 10.18 Retain the adapter bushing (1-90) with the retaining ring (1-130).
- 10.19 Install the o-ring seals (2-10) onto both sides of the lower cylinder – cylinder adapter (1-20).
- 10.20 Install the lower cylinder – cylinder adapter (1-20) over the tie bars (1-50) then over the piston rod (1-70) and into the lower cylinder (1-40).

11.0 LOWER CYLINDER LEAK TEST

- 11.1 Install first stage test spacers over the tie bars and retain with the standard hex nuts (1-160).
- 11.2 Apply 100 psig pressure to the inlet port in the lower end cap.
- 11.3 Apply a leak testing solution to the following areas:
 - 11.3.1 Joint between the lower end cap (1-10) and the lower cylinder (1-40). Check cylinder to end cap seal.
 - 11.3.2 Around the piston rod in the rod wiper area. Check the piston rod to rod seal.
 - 11.3.3 Inlet port in the lower cylinder – cylinder adapter. Check piston to cylinder and piston to piston rod seal.
- 11.4 Remove the pressure from the inlet port in the lower end cap.
- 11.5 Apply 100 psig pressure to the pressure inlet port in the lower cylinder – cylinder adapter.

- 11.6 Apply a leak testing solution to the following areas:
 - 11.6.1 Joint between the cylinder adapter (1-20) and the lower cylinder (1-40). Check cylinder to end cap seal.
 - 11.6.2 Joint between the cylinder adapter (1-20) and the piston rod.
- 11.7 If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the cylinder must be disassembled and the cause of leakage must be determined and corrected.
- 11.8 Remove pressure from the pressure inlet port in the lower cylinder – cylinder adapter.
- 11.9 Remove the standard hex nuts (1-160) and the first stage test spacers from the tie bars (1-50).

12.0 MIDDLE CYLINDER RE-ASSEMBLY

- 12.1 Install one set of split rings (1-100) in the groove closest to the lower cylinder adapter (1-20).
- 12.2 Retain the split ring set with the split ring retainer (1-110).
- 12.3 Coat the second piston rod o-ring seal (2-20) with lubricant and install into the middle o-ring groove of the piston rod (1-70).
- 12.4 Install the middle cylinder piston (1-60) by carefully sliding the piston over the piston rod and up against the split ring set (1-100).
- 12.5 Install the two halves of another split ring (1-100) onto the piston rod next to the middle cylinder piston and retain with the split ring retainer (1-110).
- 12.6 Install the T-seal set (2-50) into the piston seal groove.
- 12.7 Apply a light coat of lubricant to the bore of the cylinder (1-40).
- 12.8 Slide the end of the cylinder (1-40) over the middle piston (1-60) and onto the lower end cap (1-10).
- 12.9 Coat the final rod seal (2-60) with lubricant and install into the second cylinder adapter (1-20).
- 12.10 Coat the final adapter bushing (1-90) with lubricant and install in the cylinder adapter (1-20).
- 12.11 Retain the adapter bushing in the cylinder adapter (1-20) with the retaining ring (1-130).
- 12.12 Install the o-ring seals (2-10) onto both sides of the middle cylinder – cylinder adapter (1-20).
- 12.13 Install the middle cylinder – cylinder adapter (1-20) over the tie bars (1-50), then over the piston rod (1-70) and into the middle cylinder (1-40).

13.0 MIDDLE CYLINDER LEAK TEST

- 13.1 Install the second stage test spacers onto the tie bars and retain with the standard hex nuts (1-160).
- 13.2 Apply 100 psig pressure to the inlet port in the middle cylinder adapter.
- 13.3 Apply a leak testing solution to the following areas:
 - 13.3.1 Joint between the middle cylinder adapter (1-20) and the middle cylinder (1-40). Check cylinder to cylinder adapter seal.
 - 13.3.2 Around the piston rod in the rod seal area. Check the piston rod to rod seal.
 - 13.3.3 Inlet port in the lower cylinder adapter (1-20). Check piston to cylinder and piston to piston rod seal.
- 13.4 Remove the pressure from the inlet port in the middle cylinder adapter.
- 13.5 Apply 100 psig pressure to the pressure inlet port in the lower cylinder – cylinder adapter.
- 13.6 Apply a leak testing solution to the following areas:
 - 13.6.1 Joint between the cylinder adapter (1-20) and the lower cylinder (1-40). Check cylinder to cylinder adapter seal.
- 13.7 Remove the pressure from the inlet port in the lower cylinder – cylinder adapter.
- 13.8 If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the cylinder must be disassembled and the cause of leakage must be determined and corrected.
- 13.9 Remove pressure from the pressure inlet port in the lower cylinder – cylinder adapter.
- 13.10 Remove the standard hex nut (1-160) and the second stage test spacers from the tie bars (1-50).

14.0 UPPER CYLINDER RE-ASSEMBLY

- 14.1 Install one set of split rings (1-100) in the groove closest to the middle cylinder adapter (1-20).
- 14.2 Retain the split ring set with the split ring retainer (1-110).
- 14.3 Coat the final piston rod o-ring seal (2-20) with lubricant and install into the upper o-ring groove of the piston rod (1-70).
- 14.4 Install the upper cylinder piston (1-60) onto the piston rod and up against the split ring set (1-100).
- 14.5 Install the two halves of the final split ring set (1-100) onto the piston rod and retain with the split ring retainer (1-110).

- 14.6 Install the T-seal set (2-50) into the piston seal groove.
- 14.7 Apply a light coat of lubricant to the bore of the cylinder (1-40).
- 14.8 Slide the end of the cylinder (1-40) over the upper piston (1-60) and onto the middle cylinder adapter (1-20).
- 14.9 Install the final o-ring seal (2-10) onto the upper end cap (1-30).
- 14.10 Install the upper end cap (1-30) over the tie bars (1-50) and into the upper cylinder (1-40).
- 14.11 Install the lockwasher (1-170) and the standard hex nut (1-160). Torque to 300 foot pounds.
- 14.12 If removed, install stop screw (1-140) and reposition to setting recorded in Step 5.8.
- 14.13 Install o-ring seal (2-20) into stop screw nut (1-150).
- 14.14 Install stop screw nut (1-150) into stop screw (1-140) and tighten.

15.0 UPPER CYLINDER LEAK TEST

- 15.1 Apply 100 psig pressure to the inlet port in the upper end cap (1-30).
- 15.2 Apply a leak testing solution to the following areas:
 - 15.2.1 Joint between the upper end cap and upper cylinder.
 - 15.2.2 Joint between upper end cap and the stop screw nut.
 - 15.2.3 Inlet port in the middle cylinder adapter. Check the piston to cylinder and piston to piston rod seals.
- 15.3 Remove the pressure from the inlet port in the upper end cap.
- 15.4 Apply 100 psig pressure to the pressure inlet port in the middle cylinder – cylinder adapter.
- 15.5 Apply a leak testing solution to the following areas:
 - 15.5.1 Joint between upper cylinder and middle cylinder – cylinder adapter.
 - 15.5.2 Inlet port in the upper end cap.
- 15.6 Remove the pressure from the inlet port in the middle cylinder – cylinder adapter.

16.0 OPERATIONAL (FUNCTIONAL) TEST

- 16.1 This test is used to verify proper function of the actuator and is to be done off of the valve.
 - 16.1.1 Before the operational testing may be accomplished, it will be necessary to provide a piping system whereby pressure may be applied simultaneously to all common pressure ports.
 - 16.1.2 Adjust the pressure regulator to the actuator supply pressure or 100 psig, whichever is less.
 - 16.1.3 Apply the above pressure to the actuator pressure inlet ports and allow the actuator to stabilize. The actuator should stroke a full 90° degree travel.
 - 16.1.4 Remove pressure from the pressure inlet port.

17.0 RETURN TO SERVICE

- 17.1 Install stem nut (3-30) onto piston rod (1-70).
- 17.2 Re-install actuator to valve.
- 17.3 Re-install any piping and accessories that were removed.
- 17.4 All accessories, including solenoid valves, positioners, pressure switches, etc., should be hooked up and tested for proper operation and replaced, if found defective.
- 17.5 Actuator is now ready to be returned to service.