

OPERATING & MAINTENANCE INSTRUCTIONS DISASSEMBLY & ASSEMBLY TRQ102XX PNEUMATIC ACTUATORS

INTRODUCTION

This service procedure is offered as a guide to enable general maintenance to be performed on Bettis TRQ102XX "Scotch-Yoke" type pneumatic actuators.

BASIC TOOLS

All tools are American Standard inch. Large adjustable wrench, two (2) large screwdrivers, allen wrench set, set of open/box-end wrenches, rubber or leather mallet, torque wrench (up to 2,000 in. lbs.), breaker bar and an 1/2" drive socket set.

BETTIS REFERENCE MATERIALS

Assembly Drawing 048017 and Dimensional Drawing 042410 Operating & Maintenance Instructions (074650) Rail Alignment Tool Drawing Part Number B-064899.

GENERAL DISASSEMBLY

NOTES:

- a. Numbers in parentheses (), indicate the bubble number (Reference No.) used on the Bettis Assembly Drawing and actuator Bill of Material.
 - b. Front view of actuator: Cylinders on right side, side plate with accessory pads facing worker. (Refer to bottom left view -Base I Dimensional Drawing 042410).
 - c. Rotate actuator to mid-stroke position.
 - d. Some components of this actuator are very heavy and will require a means of assistance.
1. Remove all operating pressure from actuator power cylinder (2-10). Remove all plumbing and accessories.
 2. Remove four socket cap screws (1-170) and gasket seal (6-80). Remove position indicator (1-410) and yoke weather cover (6-110).

PRESSURE CYLINDERS DISASSEMBLY

NOTE: Following steps will be performed on rear power cylinder and then repeated on front cylinder. However, steps 1 - 12 may be performed simultaneously.

1. Remove stop screw nut (1-100) and o-ring seal (6-60).
2. Remove tie bar nuts (2-100). Inspect teflon insert - excessive damage may require replacement.
3. Remove outer end cap (2-30) from cylinder (2-10). The fit between the cylinder and the outer end cap is very tight. Break the end cap free by tapping with a breaker bar on lip provided on the end cap. **DO NOT** damage o-ring groove when removing end cap.

NOTE: Stop screw (1-90) may remain in outer end cap. Be careful when setting aside end caps.

4. Pry inner end cap (2-40) from housing, again using breaker bar. Pry cylinder (2-10) from inner end cap (2-40). DO NOT damage o-ring groove on end caps.
5. Remove cylinder from actuator. When sliding the cylinder off, cant cylinder 15° to 30° with respect to actuator centerline to help facilitate removal. Inspect inside diameter for corrosion and scratches.
6. Remove split ring (2-80) and split ring retainer (2-90) set - outboard end of piston.
7. Slide piston (2-20) off piston rod (2-70) and tie bars (2-60)
8. Remove second set of split ring (2-80) and split ring retainer (2-90) - inboard end.
9. Remove o-ring seal (4-20) and slide inner end cap (2-40) off piston rod (2-70) and tie bars (2-60). Set aside. Remove end cap gasket (6-20) as well.
10. Remove tie bars (2-60) from housing (1-10). NOTE: Flats on outboard end are provided for wrench placement. Using flats will prevent damage to surfaces of tie bars. (DO NOT USE PIPE WRENCH)
11. Remove piston rod (2-70) from yoke pin nut (1-30). Again, note wrench flats on outboard end. Using flats will prevent damage to surfaces to piston rod. (DO NOT USE PIPE WRENCH).
12. Remove rod bushing (2-50) and rod seal (4-60) by carefully sliding both parts over piston rod (2-70).

HOUSING GROUP DISASSEMBLY

1. Blind end cap side of actuator: Remove stop screw nut (1-100) - 2 places. Remove o-ring seal (6-60).
2. Remove hex cap screws (3-20).
3. Remove blind end cap (3-10) and end cap gasket (6-20) - 2 places. Stop screw (1-90) may remain in end cap. Be careful when setting aside blind end cap.
4. Remove cover screws (1-170) and gasket seal (6-80).
5. Remove cover (1-20). This should be a very tight fit. Cover pins (1-160) need not be removed. Remove cover gasket (6-10) as well.
6. Remove upper yoke bushing (1-110) around upper yoke trunion.

NOTE: Because of 'Quad-body' symmetrical design, steps 7 - 12 will be performed first in rear section of actuator housing and then repeated on front side.

7. Remove outer 'track-rail' (1-140) by unscrewing first set of socket cap screws (1-420) and gasket seal (1-430). Because tie bars and blind end cap screws with 'tipped' ends have been removed, the rails should lift out. Hold or support rail when removing socket cap screws to prevent rail falling or shifting in housing.
8. There are three yoke rollers (1-40) - remove top yoke roller.
9. Remove yoke pin (1-50).
10. Slide yoke pin nut (1-30) out and remove. Located inside yoke pin nut will be second yoke roller. Stop screw stud (3-30) may be removed if necessary - check for excessive wear.
11. Remove bottom roller (1-40) inside slot of bottom yoke arm.
12. Remove inner 'track-rail' (1-140) by unscrewing second set of socket cap screws (1-420) and gasket seal (1-430). Slide rail from between yoke arms and remove from housing (1-10).
13. Remove yoke (1-330) by lifting from lower yoke bushing (1-120). Yoke must be rotated to full clockwise or counter-clockwise position in order to proceed with this step.
14. Remove lower yoke bushing (1-120).

GENERAL RE-ASSEMBLY

Remove all old seals and gaskets, taking care not to scratch or damage sealing surface areas. Before starting the assembly of an actuator, all parts should be thoroughly inspected and de-burred. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.

LUBRICATION REQUIREMENTS

1. Standard and high temperature service (-20° F to 350° F) use Kronaplate 100. Reference Bettis Engineering Standard ESL 5.
2. Low temperature service (-100° F to 300° F) use Aeroshell 17. Reference Bettis Engineering Standard ESL-4.

FLUID REQUIREMENTS

1. Standard and high temperature service (-35° F to 350° F) use Exxon Dexron II Automatic Transmission Fluid. Identification #D-20106. Reference Bettis Engineering Standard ESF-1.
2. Low temperature service (-65° F to 180° F) use Exxon Univis J13 Hydraulic Fluid. Reference Bettis Engineering Standard ESF-2.

HOUSING GROUP RE-ASSEMBLY

1. If removed, install pipe plugs (1-200).
2. Orient housing (1-10) with yoke bore toward front.
3. Apply grease to lower yoke bushing (1-120) and yoke bore in housing. Install lower yoke bushing.
4. Apply grease to lower yoke trunion and yoke arms (1-330). Install yoke into lower yoke bushing, positioned approximately in either direction. Rotate yoke to mid-stroke position. The yoke hub with tapped holes faces up.

NOTE: Steps 5 - 14 will be completed once (front or back) then repeated because of "quad-body" symmetrical design. Again, following steps may also be performed simultaneously.

5. Check if yoke rollers will run freely in slots of yoke arms. Apply grease to all surfaces of yoke rollers (1-40) and slots in yoke arms. Install one (1) roller into slot of bottom yoke arm.
6. Apply grease to 'track-rails' (1-140). Install inner 'track-rail' (1-140). Slide rail into housing between yoke arms and fasten with socket cap screws (1-420) and gasket seal (1-430). Torque socket cap screws to 1800 in.lbs. (150 ft. lbs.).

NOTE: Tie bars and blind end cap screws (3-20) with 'tipped' ends will be added later to support rail. Until that time, an adapter piece (see Drawing B-64899) may be used as temporary replacements.

7. Grease the upper and lower surfaces of yoke pin nut (1-30) and install between yoke arms and parallel to rail inside housing.
8. Install second yoke roller (1-40) into slot of yoke pin nut and align holes of both rollers.
9. Apply grease to yoke pin (1-50) and install into middle and bottom yoke rollers.
10. Install final yoke roller (1-40) on yoke pin (1-50).
11. If removed, install stop screw stud (3-30) into yoke pin nut.
12. Install outer 'track-rail' (1-140) with socket cap screws (1-420) and gasket seal (1-430) - 2 places. Again, use adapter piece to support rail until tie bars are installed. Torque socket cap screws to 1800 in. lbs.(150 ft. lbs.).
13. Apply grease to rod bushing (2-50) and install into housing.
14. Install piston rod (2-70) into yoke pin nut. DO NOT TIGHTEN. Use wrench flats on outboard end.
15. Apply grease to surfaces of upper yoke trunion (1-330) and upper yoke bushing (1-110).
16. Install upper yoke bushing (1-110) over yoke trunion.

17. Lightly apply grease to cover gasket (6-10) and install cover gasket onto housing.
 18. Install cover (1-20) to housing with hex cap screws (1-170) and gasket seal (6-80). DO NOT TIGHTEN.
 19. If removed, install cover pins (1-160) into housing until the cover pins are flush with top of cover.
 20. Tighten the cover screws (1-170).
 21. Tighten piston rods (2-70) to a torque of approximately 166 ft. lbs. (2000 inch pounds). Flats are provided on the outer end cap for wrenching purposes. (DO NOT USE PIPE WRENCH). Remove any burrs from the flats after tightening.
 22. Install position indicator (1-410) and yoke weather cover (6-110) with hex cap screw (1-170) and gasket seal (6-80).
- NOTE: With yoke at mid-stroke, position indicator will point away at approximately 45° to the right (about two o'clock position).
23. If removed, install stop screws (1-90) into blind end caps (3-10).
 24. Apply grease to end cap gaskets (6-20).
 25. Install blind end caps with end cap gaskets to housing with hex cap screws (3-20). NOTE: Back stop screw out, as far as possible.

POWER CYLINDER RE-ASSEMBLY

NOTE: Again, because of "quad-body" symmetry, following steps may be performed on rear, then front cylinders or simultaneously on both cylinders.

1. Lightly apply grease to end cap gasket (6-20) and install to right-hand housing side by sliding over piston rod.
2. Apply grease to rod seal (4-60) and install into recess (counter bore) provided in inner end cap (2-40). Install with energizer ring facing outboard side (away from housing).

NOTE: Rod seal is a bi-directional seal and will seal in both directions.

3. Apply grease to o-ring seals (4-10). Install seals in both inner and outer end caps.

NOTE: When end caps were disassembled and seals removed, one observed seals were kept in place with 'staked' washers. Check position and placement of washers before installing o-ring seals.

4. Install inner end cap (2-40) by sliding over piston rod and rod bushing. Align tie bar holes.

NOTE: Adapter piece (Figure 1), if used, will help with alignment. Pressure ports above actuator centerline. Exercise extreme care during installation in order to prevent damage to the rod seal (4-60).

5. Coat the grooves on the piston rod (2-70) with grease. Install the two halves of the split ring (2-80) into the inner most groove in both piston rods and retain with the spiral retaining ring (2-90).
6. Apply grease to o-ring seals (4-20), (4-30) and (4-10).
 - a. Install seal (4-20) onto piston rod.
 - b. Install seal (4-30) on inner end cap.
 - c. Install seals (4-10) into tie bar bores in piston.
7. Install piston (2-20) onto piston rod (2-70).

NOTE: Ribbed sections of piston will face away from housing.

8. Install second set of split ring (2-80) and ring retainer (2-90).
9. Apply grease to piston seal (4-50).

NOTE: Seal is composed of rubber seal and two back-up rings. The rings serve as anti-extrusion back-ups.

10. Install seal (4-50) onto piston (2-20).
11. Install tie bars (2-60) into housing by sliding bars through pistons and end caps. NOTE: Remove temporary adapter pieces one at a time. As the tie bars are installed, all tie bar surfaces, except threads, can be coated with grease. Be careful not to damage seals in piston when inserting tie bars.
12. Tighten tie bars (2-60). Use wrench flats provided on outboard end of tie bars.
13. If removed, install stop screw (1-90) into outer end cap. Back screws as far out as possible.
14. Apply grease to cylinder (2-10) approximately four inches (approx. 100 mm) on one side.
15. Greased side first, slide cylinder (2-10) over piston and onto inner end caps. Cylinder will have to be canted approximately 15° to 30° across piston to facilitate installation. 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 ends of cylinder.
16. Apply grease to o-ring seal (4-30) and install onto outer end cap (2-30).
17. Install outer end cap (2-30) onto tie bars and slip inside cylinder.
18. Secure assembly with tie bar nut assembly (2-100). Use tie bar nuts to draw all cylinder components into position. Tie bar nuts should be torqued to approximately 2000 inch pounds (166 ft. lbs.) each. NOTE: Teflon insert inside tie bar nut faces housing.

19. Apply grease to o-ring seals (6-60) and install in stop screw nuts (1-100).
20. Adjust actuator for 90° travel using stop screws (1-90). (See start-up procedures in part number 074650)
21. Install stop screw nuts (1-100) onto outer end cap (2-30) and blind end cap (3-20), over stop screws (1-90).

NOTE: Sides (faces) of tie bar nut assembly (2-100) must be parallel before stop screw nut can be installed - this will prevent the tie bar nuts from coming loose.

TESTING

A. Leakage Test

NOTE: All areas where leakage to atmosphere may occur are to be checked, using a soapy solution.

Procedure:

1. Apply air pressure (65 psig) to one side of the piston and allow the unit to stabilize. If any leakage to atmosphere is noted, the actuator must be disassembled and the cause of leakage must be determined and corrected.
2. If excessive leakage across the piston is noted, generally a bubble which breaks three (3) seconds or less after starting to form, cycle the actuator five (5) times to allow the seals to seek their proper working attitude and retest. If excessive leakage across the piston remains, the unit must be disassembled and the cause of leakage must be determined and corrected.
3. Repeat the above procedure for the opposite side of the piston.
4. If an actuator was disassembled and repaired, the above leakage test must be performed again.

B. Operational (Functional Test)

NOTE: This test is used to verify proper function of the actuator and its' related system (accessories).

Procedure:

1. Cycle the actuator at 10% of the maximum operating pressure. Any jumpy or jerky operation, not attributed to seal drag or limited flow capacity, must be corrected.
2. All accessories, including solenoid valves, positioners, pressure switches, etc., must be hooked up and tested for proper operations and replaced if found defective.

**PRESSURE REQUIREMENTS AND LIMITATIONS
FOR
TRQ102XX DOUBLE ACTING ACTUATORS**

<u>AVAILABLE CONFIGURATIONS MODEL</u>	NOMINAL OPERATING PRESSURE <u>(NOP)</u> Customer spec or NA	MAXIMUM OPERATING PRESSURE <u>(MOP)</u>	MAXIMUM ALLOWABLE WORKING PRESSURE <u>(MAWP)</u>
TRQ10210	"	680	940
TRQ10212	"	470	750
TRQ10216	"	290	420
TRQ10220	"	180	265

RETURN TO SERVICE

1. Install elbow (1-260) and breather (1-270).
2. Re-install all piping and accessories that were removed.
3. Refer to "Operating & Maintenance Instructions for Bettis Pneumatic Rotary Valve Actuators" (074650) for actuator start-up procedures.