

OPERATING & MAINTENANCE INSTRUCTIONS

DISASSEMBLY & ASSEMBLY

TRQ10410-M4 PNEUMATIC ACTUATORS

INTRODUCTION

This service procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis TRQ10410-M4 "Scotch-Yoke" type pneumatic actuator with M4 hydraulic override.

BASIC TOOLS

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.

REFERENCE GH-BETTIS MATERIALS

Bettis assembly drawing part number 048193.

Bettis Rail Alignment Tool Drawing Part Number B-064899 (Figure 1).

GENERAL DISASSEMBLY

- NOTES:**
- a. Numbers in parentheses indicate the bubble number (Ref No.) used on the GH-Bettis Assembly Drawing and actuator Bill of Material.
 - b. Front view of actuator: Cylinders perpendicular to worker, side plate with accessory pads facing worker.
 - 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 cylinders (2-10) and (3-10). Remove all plumbing and accessories.
 2. Remove the four hex cap screws (1-170) and gasket seal (6-80) from the position indicator. Remove position indicator (1-410) and yoke weather cover (6-110).
 3. Remove M4 Hydraulic Control (8). NOTE: Plug 3/8" NPT ports as foreign material may enter the system and cause the unit to malfunction.
 4. Drain the hydraulic fluid from hydraulic cylinder by removing the cylinder drain plugs (3-110), located bottom cylinder side of actuator.

PRESSURE CYLINDERS DISASSEMBLY (RIGHT SIDE)

Because actuator is symmetrical about actuator centerline, the following steps will be performed and repeated on the two pressure cylinders. 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
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, can't cylinder 15 to 30 degrees 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) from piston rod (2-70) and slide inner end cap (2-40) off piston rod (2-70) and tie bars (2-60). Set aside end cap and 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 off piston rod (2-70).

TANDEM PRESSURE/HYDRAULIC CYLINDER DISASSEMBLY (LEFT SIDE)

NOTE: Following steps will be performed on rear cylinder assemblies and then repeated on front cylinder assemblies. However, steps 1 thru 24 may be performed simultaneously.

1. Remove stop screw nut (1-100) and o-ring seal (6-60) on "left" side of cylinder.
2. Remove hex nuts (3-90) from tie bars (3-50).
3. Remove hydraulic outer end cap (3-20). The fit between the cylinder (3-10) and the outer end cap is very tight. Break the outer end cap free by tapping with a breaker bar on the lip provided on the end cap.
NOTE: Do not insert the pry bar in the seal groove or damage to the sealing surface may result.

4. Pry hydraulic inner end cap (3-30) away from the power cylinder end cap (3-30). Break the inner end cap free from the cylinder (3-10) by tapping with a breaker bar on the lip provided on the end cap.
5. Remove the hydraulic cylinder (3-10). NOTE: When sliding the cylinder off of the piston, cant the cylinder 15 to 30 degrees to the piston rod.
6. Remove the ring retainer (3-80) and the split ring (3-70) from the outboard side of
7. Remove the piston (3-135) from the piston rod (3-60). The piston will slide off of the piston rod.
8. Remove o-ring seal (5-20).
9. Remove the ring retainer (3-80) and the split ring (3-70) from the inboard side of the piston.
10. Slide the inner end cap (3-30) off over the tie bars (3-50) and piston rod (3-60).
11. Remove rod seal (5-60). The seal will slide off of the end of the piston rod.
12. Remove end cap gasket (101).
13. Remove rod bushing (3-130) by sliding part off piston rod.
14. Remove power cylinder end cap (3-30). The fit between the cylinder (3-10) and the outer end cap is very tight. Break the outer end cap free by tapping with a breaker bar on the lip provided on the end cap. NOTE: Do not insert the pry bar in the seal groove or damage to the sealing surface may result. NOTE: Slide second rod seal (5-60) off piston rod before removing end cap.
15. Pry second inner end cap (3-30) away from the housing (1-10). Break the inner end cap free from the cylinder (3-10) by tapping with a breaker bar on the lip provided on the end cap.
16. Remove the power cylinder (3-10). NOTE: When sliding the cylinder off of the piston, cant the cylinder to the piston rod.
17. Remove the ring retainer (3-80) and the split ring (3-70) from the outboard side of the piston (3-135).
18. Remove the piston (3-135) from the piston rod (3-60). The piston will slide off of the piston rod.
19. Remove o-ring seal (5-20).
20. Remove the ring retainer (3-80) and the split ring (3-70) from the inboard side of the piston.
21. Slide the inner end cap (3-30) off over the tie bars (3-50) and piston rod (3-60).
22. Unscrew the tie bars (3-50) from the housing (1-10). Flats are provided on the outboard end of the tie bars for wrench placement. **DO NOT** use a pipe wrench on the tie bars as it will mark the bar and cause seal leakage.
23. Unscrew piston rod (3-60) from yoke pin nut (1-30) and remove. Flats are provided on the outboard end of the piston rod for wrench placement. **DO NOT** use a pipe wrench on the piston rod as it will mark the rod and cause seal leakage.
24. Remove rod bushing (3-40) and rod seal (5-60). The bushing and seal will slide off of the end of the piston rod.

HOUSING GROUP DISASSEMBLY

1. Remove cover screws (1-170) and gasket seals (6-80) from the housing cover (1-20).
2. Remove cover (1-20) and cover gasket (6-10). This should be a very tight fit. Cover pins (1-160) need not be removed.
3. Remove upper yoke bushing (1-110) from upper yoke trunion.

NOTE: Because of "quad-body" design, housing group is symmetrical about horizontal centerline. Steps 4 thru 9 will be performed and then repeated starting at rear section of housing.

4. Remove outer "track-rail" (1-140) by unscrewing first set of socket cap screws (1-420) and gasket seal (1-430). Because tie bars with 'tipped' ends have been removed, the rails should lift out. Hold or support rail when removing socket cap screws to prevent rail from falling or shifting in housing.
5. There are three yoke rollers (1-40) - remove top yoke roller.
6. Remove yoke pin (1-50).
7. Slide yoke pin nut (1-30) out and remove. Located inside yoke pin nut will be second yoke roller (1-40).
8. Remove bottom roller (1-40) inside slot of bottom yoke arm.
9. 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).
10. Remove yoke (1-330) by lifting from lower yoke bushing (1-120).

NOTE: Yoke needs to be rotated 45° degrees in either direction before removal.

11. 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 cleaned, 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 GH-Bettis Engineering Standard ESL-5.
2. Low temperature service (-100°F to 300°F) use Aeroshell 17. Reference GH-Bettis Engineering Standard ESL-4.

FLUID REQUIREMENTS

1. Standard and high temperature service (-35°F to 350°F) use Dexron Automatic Transmission Fluid.
2. Low temperature service (-65°F to 180°F) use Exxon Univis J13 Hydraulic Fluid.

HOUSING GROUP RE-ASSEMBLY

1. If removed, install pipe plugs (1-200).
2. Orientate housing (1-10) with accessory mounting pads toward front.
3. Apply grease to lower yoke bushing (1-120) and yoke bore in housing (1-10). Install lower yoke bushing.
4. Apply grease to lower yoke trunion and yoke arms (1-330). Install yoke into lower yoke bushing, positioned approximately 45° degrees in either direction. The yoke hub with tapped holes faces up.

NOTE: Steps 5 thru 11 will be performed once and then repeated because of symmetrical design.

5. Apply grease to “track-rails” (1-140). Install inner “track-rail” (1-140) by sliding rail into housing between yoke arms and fasten with socket cap screws (1-420) and gasket seal (1-430). Torque tighten socket cap screws to 150 foot pounds lubricated.

NOTE: Tie bars with 'tipped' ends will be added later to support rail. Until that time, an adapter piece (Rail Alignment Tool see Figure 1) may be used as temporary replacements.

6. Rotate yoke (1-330) to mid-stroke position. Check if yoke rollers (1-40) 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.
7. Grease the upper and lower surfaces of yoke pin nut (1-30) and install between yoke arms parallel to rail inside housing.
8. Install second yoke roller (1-40) into slot of yoke pin nut and align holes of both middle and lower 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. Install outer “track-rail” (1-140) with socket cap screws (1-420) and gasket seal (1-430). Again, use adapter piece to support rail until tie bars are installed. Torque tighten socket cap screws to 150 foot pounds lubricated.
12. Apply grease to surfaces of upper yoke trunion (1-330) and upper yoke bushing (1-110).
13. Install upper yoke bushing (1-110) over yoke trunion.
14. Apply grease to four rod bushings (2-50)/(3-40) and install into housing (1-10) - 2 per side.

15. Install piston rods (2-70)/(3-60) through rod bushings in housing and into yoke pin nut (4 places). Use wrench flats on outboard end. **DO NOT TIGHTEN.**
16. Lightly apply grease to cover gasket (6-10) and install cover gasket onto housing.
17. Install cover (1-20) on housing (1-10) with hex cap screws (1-170) and gasket seal (6-80). **DO NOT TIGHTEN.**
18. If removed, install cover pins (1-160) into housing until the cover pins are flush with top of cover.
19. Tighten the cover screws (1-170).
20. Tighten piston rods (2-70) and (3-60) to a torque of approximately 166 foot pounds lubricated. Flats are provided on the outer end cap for wrenching purposes. (DO NOT USE PIPE WRENCH). Remove any burrs from the flats after tightening.
21. Install position indicator (1-410) and yoke weather cover (6-110) with the four hex cap screws (1-170) and gasket seals (6-80).

NOTE: With yoke at mid-stroke, position indicator will point away at approximately 45° degrees to the right (about 2 o'clock position).

POWER CYLINDER RE-ASSEMBLY (RIGHT SIDE)

NOTE: Because of "quad-body" symmetry, the following steps will be performed two places.

1. Lightly apply grease to end cap gasket (6-20) and install to housing side by sliding over piston rod (2-70).
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).
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, it was observed that these 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: Rail Alignment Tool (Figure 1), if used, will help with alignment. Pressure ports in the end caps should be above the 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 (2) 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 section of piston must 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) and install into outer diameter seal groove on piston (2-20).

NOTE: Seal is composed of rubber seal and two (2) back-up rings. The rings serve as anti-extrusion back-ups.

11. Install tie bars (2-60) into housing by sliding bars through pistons and end caps.

NOTE: Remove Rail Alignment Tool 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 and back screws as far out as possible.

NOTE: Stop screws will be adjusted following assembly of actuators.

14. Apply grease to the bore of cylinder (2-10).

15. Install cylinder (2-10) over piston and onto inner end caps. Cylinder will have to be canted approximately 15° to 30° degrees 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.

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. Torque tighten tie bar nuts to approximately 150 foot pounds lubricated.

TANDEM PRESSURE/HYDRAULIC CYLINDER (LEFT SIDE)

NOTE: Because of “quad-body” symmetry, the following steps will be performed two places or simultaneously..

1. Coat the end cap gasket (6-20) with grease on both sides and install over the piston rod and rod bushing.

2. Coat the rod seal (5-60) with grease and install into the recess provided in the inner end cap. Install with energizer ring facing outboard side (away from housing).
3. Coat two tie bar o-ring seals (5-10) with grease and install onto the inboard end of the inner end cap (3-30) in the o-ring grooves provided.
4. Slide the inner end cap (3-30) over the piston rod (3-60) and the rod bushing (5-60), protruding from the housing. Install with the large raised boss toward the housing (flat side outward). The pressure inlet should be toward the top of the actuator.

NOTE: Exercise extreme care during installation, in order to prevent damage to the rod seal (5-60).

5. Apply grease to the o-ring seal (5-30) and install on the inner end cap (3-30).
6. Apply grease to two sets of piston tie bar o-ring components (5-10) and install into the piston (3-20).
7. Apply grease to the piston o-ring (5-20) and place onto the piston rod (3-60).
8. Coat the first section (inboard) of grooves on the piston rod (3-60) with grease.
9. Install the two halves of the split ring (3-70) into the inner most groove in the piston rod and retain with one of the retaining rings (3-80).
10. Slide the piston (3-135) onto the piston rod against the split ring (3-70).

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

11. Install the two halves of the remaining split ring (3-70) onto the piston rod and retain with the spiral retaining ring (3-80).
12. Coat the Piston T seal components (5-50) with grease and install on the piston (3-135).
13. Install the tie bars (3-50) (end without wrench flat), by carefully threading tie bars through the piston (3-135) and inserting through the inner end cap (3-30) and screwing into the housing (1-10).

NOTE: Remove Rail Alignment Tool 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.

14. Apply grease to the bore of the cylinder (3-10).
15. Install cylinder (3-10) over the piston (3-135) and onto the inner end cap (3-30).

NOTE: When sliding the cylinder over the piston seal, cant the 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.

16. Apply grease to two end cap tie bar o-ring seals (5-10) and install into the new inner end cap (3-30) in the o-ring grooves provided.

17. Apply grease to the outer end cap cylinder o-ring seal (5-30) and install onto the inner end cap (3-30).
18. Install the inner end cap (3-30) onto the tie bars and piston rod and into the end of the cylinder (3-10). Rod seal cavity facing away from housing.

HYDRAULIC CYLINDER ASSEMBLY

1. Coat rod seal (5-60) with grease and install with energizer ring facing housing into recess, provided in the inner end cap (3-30) seal will slide over piston rod (3-60).
2. Apply grease to the rod bushing (3-130), install it over the piston rod and slide it up into the end cap (3-10) installed in the last step.
3. Coat the end cap gasket (101) with grease on both sides and install over the piston rod and rod bushing, slot facing down.
4. Coat the rod seal (5-60) with fluid and install into the recess provided in the next inner end cap (3-10). Install with energizer facing outboard side (away from housing).
5. Coat two tie bar o-ring seals (5-10) with fluid and install onto the next inner end cap (3-30) in the o-ring grooves provided.
6. Slide the next inner end cap (3-30) over piston rod (3-60), tie bars (3-50) and rod bushing (3-130), protruding from the end cap. The pressure inlet port should be facing down.

NOTE: Exercise extreme care during installation, in order to prevent damage to the rod seals (5-60).

7. Apply fluid to the o-ring seal (5-30) and install on the inner end cap (3-60).
8. Apply fluid to two sets of piston tie bar o-ring components (5-10) and install into the piston (3-135).
9. Apply fluid to the piston o-ring (5-20) and place onto the piston rod (3-60).
10. Coat the second section of grooves (inboard side) of the piston rod (3-60) with fluid.
11. Install the two halves of the split ring (3-70) into the inner most groove in the piston rod and retain with one of the spiral retaining rings (3-80).
12. Slide the piston (3-135) onto the piston rod against the split ring (3-70).

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

13. Install the two halves of the remaining split ring (3-70) onto the piston rod and retain with the spiral retaining ring (3-80).
14. Coat the piston T seal components (5-50) with fluid and install on the piston (3-135).
15. Apply fluid to the bore of the cylinder (3-10).

16. Install cylinder (3-10) over the piston (3-135) and onto the inner end cap (3-30).

NOTE: 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. Bleed valve and pipe plug holes must face top and bottom, respectively.

17. Apply fluid to two end cap tie bar o-ring seals (5-10) and install into the outboard (outer) end cap (3-20) in the o-ring grooves provided.
18. Apply fluid to the outer end cap cylinder o-ring seal (5-30) and install onto the outer end cap (3-70).
19. Install the outer end cap (3-20) onto the tie bars and into the end of the cylinder (3-10).
20. Install the two tie bar nuts (3-90) on the tie bars (3-50) using them to draw all of the cylinder components into position. Torque alternately, in 50 ft. lb. increments, until a final torque of 150 foot pounds lubricated has been achieved.
21. Install stop screw (1-90) into outer end cap (3-20).
22. Coat o-ring (6-60) with grease and install into stop screw nut (1-100).
23. Position stops (1-90) for actuator travel.
24. Install stop screw nut (1-100) over stop screw (1-90) until seal tight.

LEAKAGE

For all but the most demanding applications, a small amount of leakage may be tolerated. Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable.

PRESSURE CYLINDER TESTING

Before testing for leaks, alternately apply air at 65 PSIG to each side of the piston allowing the actuator to stroke fully in each direction. Repeat this cycle approximately five times. This will allow the seals to seek a normal working attitude.

1. Apply ten PSIG air pressure to the inner end of the cylinder (2-10) and outer end of cylinder (3-10).
2. Apply a leak testing soap solution, using a soft III wide brush, to the following areas:
 - a. Joint between the inner end cap (2-40) and the cylinder (2-10). Also end cap (3-30) and cylinder (3-10). (Checks the end cap to cylinder seal).
 - b. The air inlet in the outer end of the cylinder. (Checks piston to cylinder, piston to tie bars and piston to push rod seals).
 - c. Around the joint between the inner end cap (2-40) and the housing (1-10) right side, inner end cap (3-30) and hydraulic inner end cap (3-30) on left hand side.

- d. The hole in the cover into which the breather (1-270) is to be installed. (Check the following seals; inner end cap to tie bars and inner end cap to rod seal).
 - e. Increase the air pressure to 65 PSIG and repeat steps a, b, c and d above.
3. Reduce the air pressure to ten PSIG and apply it to the outer end of the cylinder (2-10) and inner end of the cylinder (3-10).
 4. Apply a leak testing soap solution, using a soft I " wide brush to the following areas:
 - a. Joint between the outer end cap (2-30), the cylinder (2-10), inner end cap (3-30) and cylinder (3-10), next to housing on left side. (Check cylinder to end cap seal).
 - b. Around the tie bar nuts (2-90) on the cylinder end - right side. (Check tie bar to end cap seals).
 - c. The air inlet to the inner end of the cylinder (2-10) and cylinder (3-10). (Check piston to cylinder, piston to tie bar and piston to piston rod seals).
 - b. Increase air pressure to 65 PSIG and repeat steps a, b and c above.

HYDRAULIC CYLINDER TESTING

Before testing for leaks, alternately apply air at 65 PSIG to each side of the piston allowing the actuator to stroke fully in each direction. Repeat this cycle approximately five times. This will allow the seals to seek a normal working attitude.

1. Apply ten PSIG air pressure to the inner end of the cylinder (3-30).
2. Apply a leak testing soap solution, using a soft 1" inch wide brush, to the following areas:
 - a. Joint between the inner end cap (3-30) and the cylinder (3-10). (Check the end cap to cylinder seal).
 - b. The air inlet in the outer end of the cylinder. (Check piston to cylinder, piston to tie bars and piston to push rod seals).
 - c. Around the joint between the inner end cap (3-30) and the pneumatic power inner end cap (3-30).
 - d. Increase the air pressure to 65 PSIG and repeat steps a, b, and c above.
3. Reduce the air pressure to ten PSIG and apply it to the outer end cap (3-70).
4. Apply a leak testing soap solution, using a soft III wide brush to the following areas:
 - a. Joint between the outer end cap (3-90) and the cylinder (3-10). (Check cylinder to end cap seal).
 - b. Around the tie bar nuts (3-90) on the cylinder end. (Check tie bar to end cap seals).
 - c. The hydraulic inlet to the inner end of the cylinder (3-10). (Check piston to cylinder, piston to tie bar and piston to piston rod seals).
 - d. Increase air pressure to 65 PSIG and repeat steps a, b and c above.

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 (MOP) per actuator name tag. 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.

M4 HYDRAULIC CONTROL INSTALLATION

1. Re-install the M4 control package (8) on the hydraulic cylinder (3-10).

NOTE: The M4 must be mounted with reservoir upright with the pump shaft horizontal.

2. Hook up piping from the M4 hydraulic control block to cylinder ports.

NOTE: Recommend that a non-hardening thread sealant, compatible with petroleum base hydraulic fluid.

NOTE: DO NOT USE TEFLON TAPE TO SEAL HYDRAULIC SYSTEM THREADS.

M4 REFILLING INSTRUCTIONS

(See "Fluid Requirements" for fluid specifications).

Refilling of the M4 hydraulic control system and actuator cylinder is best accomplished using a pressure pump. Put the actuator in the clockwise (CW) position and proceed using the following steps.

1. Remove the breather from the reservoir. **NOTE:** Be sure drain plugs (3-110) are installed by hydraulic cylinder.
2. Attach the pump discharge line to reservoir breather port.
3. Open both speed control valves.
4. Open the two bleed valves (3-120), located at each end of the hydraulic cylinder.
5. Slowly pump hydraulic fluid into the reservoir. Approximately three to five PSI will be required. As the hydraulic fluid passes through the M4 control block into the cylinder, air will be displaced.
6. Close each bleed valve (3-120) when the air has been displaced and hydraulic fluid appears.
7. Remove pump discharge line from reservoir breather port.
8. Adjust fluid level to 1-1/2" (40mm) from top of reservoir with actuator in counter-clockwise (CCW) position.
9. Re-install breather removed, in step 1.

ALTERNATE REFILLING INSTRUCTIONS

Refilling the M4 hydraulic control system, during field service, often must be done without the use of a pressure pump. Proceed as follows:

1. Put the actuator in the clockwise (CW) position.
2. Remove the breather from the reservoir.
3. Fill the reservoir approximately three-fourths (3/4) full (see "Fluid Requirements" for proper fluid specifications).
4. Open both speed control valves.
5. open the bleed valve (3-120) on the outboard end of the hydraulic cylinder ~~only~~.
6. Rotate the handle slowly, clockwise, until all air has escaped from the system.
7. Close the bleed valve opened in step 5.

NOTE: During the fill procedure, it is important that the lowest fluid level be not less than approximately one-fourth (1/4) of the reservoir volume at any time.

8. open the bleed valve (3-120) on the inboard end of the hydraulic cylinder.
9. Rotate the handle slowly, counter-clockwise, until all air has escaped from the system.
10. Close the bleed valve opened in step 8.

NOTE: During the fill procedure, the piston will not move. This may be determined by observing the position indicator (1-170) on the actuator.

11. Adjust fluid level to 1-1/2" (40mm) from top of reservoir with actuator in counter-clockwise (CCW) position.
12. Re-install breather removed in step 2.

ADDITIONAL M4 INSTRUCTIONS

This is performed to insure air is removed from the system (most likely air in pump) and to test the operation of M4 override.

1. Turn M4 crank arm clockwise (CW). The actuator should move clockwise (CW). Adjust ~~outboard~~ bleed valve (3-120) to remove air from system.
2. Turn M4 crank arm counter-clockwise (CCW). The actuator will move counter-clockwise (CCW). Adjust ~~inboard~~ bleed valve to remove air from system.
3. With bleed valves closed, stroke actuator full 90°, clockwise (CW) and counter-clockwise (CCW), using M4 override.

RETURN TO SERVICE

1. Install breather (1-270) and elbow (1-260).
2. After actuator is reinstalled on the device it is to operate all accessories should be hooked up, leak tested, and then tested for proper operation and replaced if found defective.
3. The actuator should now be ready to return to service.

PRESSURE REQUIREMENTS & LIMITATIONS

FOR

TRQ10410-M4 PNEUMATIC ACTUATORS

AVAILABLE CONFIGURATION MODEL	NOMINAL OPERATING PRESSURE (NOP)	MAXIMUM OPERATING PRESSURE (MOP)	MAXIMUM ALLOWABLE WORKING PRESSURE (MAWP)
TRQ10410-M4	Customer spec or N.A.	200 PSIG	200 PSIG

FIGURE 1 - RAIL ALIGNMENT TOOL FOR TR/TRQ ACTUATORS

