

**BETTIS**

**FIELD CONVERSION FROM**

**T30X/T3XX OR T40X/T4XX**

**DOUBLE ACTING SERIES ACTUATORS**

**TO T30X/T3XX-M4 OR T40X/T4XX-M4**

**DOUBLE ACTING SERIES ACTUATORS**

**WITH AUXILIARY HYDRAULIC CYLINDER**

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## 1.0 INTRODUCTION

- 1.1 This conversion procedure is offered as a guide to field convert a T3 or T4 double acting series actuators to a double acting actuator with an auxiliary hydraulic cylinder on the opposite side of the actuator housing from the power cylinder.
- 1.2 Refer to Figure 1 for suggested tool style and wrench sizes for this actuator.

## 2.0 FLUID REQUIREMENTS

- 2.1 Standard and high temperature service (-20°F to 350°F) use Exxon Dexron II Automatic Transmission Fluid.
- 2.2 Low temperature (-50° to 150°F) use Exxon Unavis J13 Hydraulic Fluid.
- 2.3 If other hydraulic fluid types are to be used, other than those listed in item 2.1 and 2.2, then the fluid type must be compatible with the seal compound and coatings used in the actuator.

## 3.0 PRELIMINARY INSTRUCTIONS

- 3.1 Rotate the actuator to the full open (counter-clockwise) position.
- 3.2 Remove all power (hydraulic or pneumatic) from the actuator power cylinder.
- 3.3 Remove all necessary piping and accessories from the actuator.
- 3.4 All seals and gaskets removed during disassembly should be replaced with new components.
- 3.5 This procedure is written using the stop screw side of the housing (1-10) as the front side of the actuator and the housing cover (1-20) as the top of the actuator.

## 4.0 CONVERSION ASSEMBLY

- 4.1 Slide the piston rod (4-170) into the left side of the housing and thread into the yoke pin nut (1-30). Tighten to a torque of 325 to 350 foot pounds. Flats are provided on the outer end for wrenching purposes.
- 4.2 Apply hydraulic fluid to the rod bushing (4-50), install it over the piston rod and slide it up into the housing.
- 4.3 Coat the rod seal (5-70) with hydraulic fluid and install, lip first, into the recess provided in the inner end cap (4-40).
- 4.4 Install the end cap gaskets (3-10) over the piston rod and rod bushing.
- 4.5 Slide the inner end cap (4-40) over the piston rod (4-170) and the rod bushing (4-50), protruding from the housing. The pressure inlet port should be toward the stop screw side of the actuator or the side of the actuator that the M4 control package is to be mounted.
- 4.6 Install one of the o-ring seals (5-60) onto the inner end cap (4-40).
- 4.7 Install two sets of piston tie bar Tseal components (5-80) into the piston internal seal groove.

- 4.8 Install the piston o-ring seal (5-40) onto the piston rod (4-170).
- 4.9 Coat the ends of the piston rod (4-170) with hydraulic fluid.
- 4.10 Install the two halves of the split ring (4-70) into the inner most groove in the piston rod and retain with one of the spiral retaining rings (4-80).
- 4.11 Slide the piston (4-20) onto the piston rod against the split ring (4-70).
- 4.12 Install the two halves of the remaining split ring (4-70) onto the piston rod and retain with the spiral retaining ring (4-80).
- 4.13 Apply hydraulic fluid to the piston Tseal components (5-90) and install into the piston external seal groove.
- 4.14 Apply hydraulic fluid to the tie bars (2-60) and install them by carefully threading tie bars through the piston (2-20).
- 4.15 Apply hydraulic fluid to two tie bar o-ring seals (5-30) and install into the o-ring groove at the inboard end of the tie bars (4-60).
- 4.16 Insert the tie bars (4-60) through the inner end cap (2-40) and screw them into the housing (1-10). Tighten until threads bottom out, then back out a half-turn. Apply hydraulic fluid to all exposed surfaces of piston rod and tie bars.
- 4.17 Apply hydraulic fluid to the entire bore of the cylinder (4-10) and install over the piston (4-20) and onto the inner end cap (4-40). When sliding the cylinder over the piston seal tilt cylinder 15° to 30° too 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 component could be damaged, becoming a potential source of leakage. **DO NOT** hammer on ends of cylinder. Rotate the cylinder so the bleed port holes will be at the cylinders highest point when the actuator is installed on the valve.
- 4.18 Install two end cap tie bar o-ring seals (5-30) onto the outboard end of the tie bars (4-60) into the o-ring grooves provided.
- 4.19 Install the outer end cap cylinder o-ring seal (5-60) onto the outer end cap (4-30).
- 4.20 Install the outer end cap (4-30) onto the tie bars (5-60) and into the end of the cylinder (4-10).
- 4.21 Install the two tie bar nuts (4-90) onto the tie bars (4-60), using them to draw all of the cylinder components into position. Torque alternately, in 50 ft. lb. increments, until a final torque of 200 to 230 foot pounds has been achieved. **NOTE:** While the tie bar nuts are being tightened, do not allow the tie bars to turn.
- 4.22 Install the nut retainer (4-100), securing in place with the retainer screw (4-120) and lockwasher (4-110). It is necessary that the flats on the hex nuts (4-90) be aligned and parallel before the nut retainer can be installed.
- 4.23 Install the pipe plugs (4-150) into the holes in the bottom of the cylinder and the bleed valves (4-160) into the top holes.

## 5.0 ~~HYDRAULIC CYLINDER TESTING~~

- 5.1 Leakage Test: 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.
- 5.2 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 (5) times. This will allow the seals to seek a normal working attitude.
- 5.3 Remove the snubber (1-190) from the housing cover.
- 5.4 Apply 65 PSIG air pressure to the port in the inner end cap (4-40) of cylinder (4-10) and then apply a leak testing solution to the following areas:
  - 5.4.1 Joint between the outer end cap (4-40) and the cylinder (4-10).
  - 5.4.2 The inlet port in the outer end cap (4-30) of cylinder (4-10). rod seals.
  - 5.4.3 Around the joint between the inner end cap (4-40) and the housing (1-10).
  - 5.4.4 The hole in the cover (1-20) in which the snubber (1-190) was removed.
  - 5.4.5 Remove air pressure from the port in the inner end cap (4-40).
- 5.5 Apply 65 PSIG air pressure to the port in the outer end cap (4-30) of the cylinder (4-10).
- 5.6 Apply a leak testing solution to the following areas:
  - 5.6.1 Joint between the outer end cap (4-30) and the cylinder (4-10).
  - 5.6.2 Around the tie bar nuts (4-90) on the outer end cap (4-30). cap seals.
  - 5.6.3 The inlet port in the inner end cap (4-40) of cylinder (4-10).
  - 5.6.4 Remove air pressure from the port in the outer end cap (4-30).
- 5.7 Install the snubber (1-190) back into the housing cover.

## 6.0 ~~M4 HYDRAULIC CONTROL INSTALLATION~~

- 6.1 Install the M4 control package (8) on the hydraulic cylinder (4-10). The unit must be mounted with reservoir upright with the pump shaft horizontal.
- 6.2 Hook up piping from the M4 hydraulic control block to cylinder ports. Recommend that a non hardening thread sealant, compatible with petroleum base hydraulic fluid (example: Rector seal #5 be used in this system). **NOTE: DO NOT USE TEFLON TAPE TO SEAL HYDRAULIC SYSTEM THREADS.**

## 7.0 **M4 FILLING INSTRUCTIONS**

(See "Fluid Requirements" for fluid specifications)

- 7.1 Filling of the M4 hydraulic control system and actuator cylinder is best accomplished using a pressure pump. Put the actuator in the closed position (CW) and proceed using the following steps.
  - 7.1.1 Remove the shipping plug from the reservoir breather port hole.
  - 7.1.2 Attach the pump discharge line to reservoir breather port.
  - 7.1.3 Open both speed control valves (located on front of M4 block).
  - 7.1.4 Open the two bleed valves (4-160), located at each end of the hydraulic cylinder.
  - 7.1.5 Slowly pump hydraulic fluid into the reservoir. Approximately three (3) to five (5) PSI will be required. As the hydraulic fluid passes through the M4 control block into the cylinder, air will be displaced.
  - 7.1.6 Close each bleed valve (4-160) when the air has been displaced and hydraulic fluid appears.
  - 7.1.7 Remove pump discharge line from reservoir breather port.
  - 7.1.8 Adjust fluid level to 1½" (40mm) from top of reservoir with actuator in open (CCW) position.

## 8.0 **ALTERNATE M4 FILLING INSTRUCTIONS**

- 8.1 Filling the M4 hydraulic control system, during field instruction, often must be done without the use of a pressure pump. Proceed as follows:
  - 8.1.1 Put the actuator in the closed position (CW).
  - 8.1.2 Remove the shipping plug from the reservoir breather port hole.
  - 8.1.3 Fill the reservoir approximately three-fourth (3/4) full (see "Fluid Requirements" for proper fluid specification).
  - 8.1.4 Open both speed control valves (located on the front of the M4 block).
  - 8.1.5 Open the bleed valve (4-160) on the outboard end of the hydraulic cylinder ~~only~~.
  - 8.1.6 Rotate the handle slowly, clockwise, until all air has escaped from the system.
  - 8.1.7 Close the bleed valve opened in step 8.1.5.
  - 8.1.8 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.
  - 8.1.9 Open the bleed valve (4-160) on the inboard end of the hydraulic cylinder.
  - 8.1.10 Rotate the handle slowly, counter-clockwise, until all air has escaped from the system.

- 8.1.11 Close the bleed valve opened in step 8.1.9.
- 8.1.12 During the fill procedure, the piston will not move. This may be determined by observing the position indicator (1-170) on the actuator.
- 8.1.13 Adjust fluid level to 1½" (40mm) from top of reservoir with actuator in open (CCW) positions.

**9.0 ADDITIONAL M4 INSTRUCTIONS**

- 9.1 This is performed to insure air is removed from the system (most likely air in pump) and to test the operation of M4 override.
  - 9.1.1 Turn M4 crank arm CW. The actuator should move clockwise as well. Adjust ~~inboard~~ ~~outboard~~ bleed valve (4-160) to remove air from system.
  - 9.1.2 Turn M4 crank arm CCW. The actuator will move counter-clockwise. Adjust ~~inboard~~ bleed valve to remove air from system.
  - 9.1.3 With bleed valves closed, stroke actuator full 90° degrees, CW and CCW, using M4 override.
  - 9.1.4 Install the breather into the port hole in the top of the M4 hydraulic fluid reservoir.

FIGURE 1  
T3/T4-M4  
CONVERSION TOOLS

ITEM NO.	WRENCH SIZE	LOCATION	RECOMMENDED WRENCH STYLE(*)
1-190	7/8"	SNUBBER	DEEP SOCKET
4-90	1-5/16"	HYD CYL TIE BAR NUTS	DEEP SOCKET
4-120	3/16"	HYD CYL NUT RETAINER	ALLEN
4-170	1-1/4"	HYD CYL PISTON ROD FLAT (1)	CROWS FOOT
NONE	9/16"	U-BOLT TO MTG BKT NUTS	OPEN END
NONE	9/16"	M4 TO MTG BKT SCREWS & NUTS	OPEN OR BOX END

(1) NO ALTERNATE STYLE RECOMMENDED

\* ALL TOOL ARE AMERICAN STANDARD INCH

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