

**GH-BETTIS**

**OPERATING & MAINTENANCE INSTRUCTIONS**

**DISASSEMBLY & ASSEMBLY**

**FOR THE**

**T80X-M4-S**

**DOUBLE ACTING SERIES**

**HYDRAULIC ACTUATORS**

**-S INDICATES CYLINDERS ARE IN TANDEM**

PART NUMBER: 100121

REVISION "A"

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\* Signatures on file Waller, Texas

## **1.0 INTRODUCTION**

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on GH-Bettis T80X-M4-S "Scotch-Yoke" type hydraulic double acting series actuators with hydraulic cylinder and override cylinder in tandem.
- 1.2 The maximum recommended service interval for this actuator series is five years. 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, two each large standard screwdriver, small standard screwdriver with sharp edges removed, strap wrench, putty knife, 1-3/8" crowfoot wrench, pipe wrench, 24 oz. ball peen hammer, allen wrench set, pry bar, 1/2" drive socket set, torque wrench (up to 5000 inch pounds), razor sharp cutting instrument, commercial leak testing solution, and non-hardening thread sealant.

## **3.0 REFERENCE GH-BETTIS MATERIALS**

- 3.1 Assembly Drawing 74855 for T80X-M4-S actuator.
- 3.2 Base I standard dimensional drawing 100120.

## **4.0 GENERAL**

- 4.1 Numbers in parenthesis, ( ), indicate the bubble number (reference number) used on the GH-Bettis Assembly Drawing, and actuator parts list.
- 4.2 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.
- 4.3 Mating parts should be marked for ease of reassembly, i.e. left and right stop screws and cylinder to housing.
- 4.4 When removing seals from seal groove, use a small standard screwdriver with the sharp edges rounded off or use a commercial seal removing tool.
- 4.5 Use a non-hardening thread sealant on all pipe threads.
- 4.6 Disassembly should be done in a clean area on a work bench.

#### 4.7 LUBRICATION REQUIREMENTS

- 4.7.1 Standard and high temperature service (20<sup>o</sup> F to 350<sup>o</sup> F) use Kronaplate 100 lubricant. This lubricant is furnished in the GH-Bettis Service Kit.
- 4.7.2 Low temperature service (-50<sup>o</sup> F to +150<sup>o</sup> F) use Kronaplate 50. This lubricant is not furnished in the Service Kit.
- 4.7.3 For distributors of Kronaplate lubricants in your area, call 800-428-7802.

#### 4.8 Fluid Requirements:

- 4.8.1 Standard and high temperature service (20<sup>o</sup>F to +350<sup>o</sup>) use Dexron II automatic Transmission Fluid.
- 4.8.2 Low temperature service (-50<sup>o</sup> to +150<sup>o</sup>) use Exxon Univis J13 Hydraulic Fluid.

### 5.0 GENERAL DISASSEMBLY

- 5.1 Remove all operating pressure from actuator power cylinder (2-40).
- 5.2 Remove all piping and accessories mounted on the actuator.
- 5.3 Mark the stop screws (1-60) left and right. The setting of the stop screws (1-60) should be checked and setting recorded before stop screws are loosened or removed.
- 5.4 Remove actuator from valve and valve mounting bracket.
- 5.5 Remove socket cap screws (1-180) from position indicator (1-170) yoke weather cover (3-140) and remove position indicator/yoke weather cover.
- 5.6 Drain 5" and 7" cylinders of hydraulic fluid by removing pipe plugs (2-230) in each end of cylinder (2-10) and (2-40).
- 5.7 Remove M4 hydraulic override (8) and bracket from 7" cylinder (2-10).

### 6.0 PRESSURE CYLINDER DISASSEMBLY

- 6.1 Remove socket cap screw (2-160), washer (2-150) and nut retainer (2-140) from the end of the 5 inch outer end cap (2-70).
- 6.2 Remove heavy hex nuts (2-130) from tie bars (2-100).
- 6.3 Remove outer end cap (2-70). The fit between the cylinder (2-40) 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. Do not damage o-ring groove on end cap.
- 6.4 Pry the 5 inch inner end cap (2-60) away from the 7 inch inner end cap (2-30). Break the inner end cap (2-60) free from the 5 inch cylinder (2-40) by tapping with a breaker bar on the lip provided on the end cap.

- 6.5 Remove the 5 inch cylinder (2-40). When sliding the cylinder off of the piston, cant the cylinder 15° to 30° to the piston rod.
- 6.6 Remove the split ring retainer (2-120) and the split ring (2-110) from the outboard side of the piston (2-50).
- 6.7 Remove the piston (2-50) from the piston rod (2-170). The piston will slide off of the piston rod and tie bars (2-100).
- 6.8 Remove the piston rod o-ring seal (3-40) from the piston rod (2-170).
- 6.9 Remove the next split ring retainer (2-120) and the split rings (2-110) from the piston rod.
- 6.10 Slide the inner end cap (2-60) off over the tie bars (2-100) and piston rod (2-170).
- 6.11 Remove rod bushing (2-90). The bushing will slide off of the end of the piston rod.
- 6.12 Remove outer end cap (2-30). The fit between the 7" cylinder (2-10) and the 7" inner end cap (2-30) is very tight. Break the end cap free by tapping with a breaker bar on the lip provided on the end cap.
- 6.13 Pry inner end cap (2-30) away from the housing (1-10). Break the inner end cap (2-30) free from the cylinder (2-10) by tapping with a breaker bar on the lip provided on the end cap.
- 6.14 Remove the 7" cylinder (2-10). When sliding the cylinder off of the piston, cant the cylinder 15° to 30° to the piston rod.
- 6.15 Remove the split ring retainer (2-120) and the split rings (2-110) from the outboard side of the 7" piston (2-20).
- 6.16 Remove the 7" piston (2-20) from the piston rod (2-170). The piston will slide off of the piston rod.
- 6.17 Remove piston o-ring seal (3-40) from the piston rod (2-170).
- 6.18 Remove the split ring retainer (2-120) and the split ring (2-110) from the piston rod.
- 6.19 Slide the inner end cap (2-30) off over the tie bars (2-100) and piston rod (2-170).
- 6.20 Remove rod bushing (2-80) and rod seal (3-80). The bushing and seal will slide off of the end of the piston rod.
- 6.21 Remove socket cap screw (6-90), lockwasher (6-80) and nut retainer (6-70).
- 6.22 Remove hex nuts (6-20) and gasket seal (6-30).
- 6.23 Slide blind end cap (6-10) and end cap gasket (3-10) off tie bars (2-100).

- 6.24 Slide the tie bars (2-100) 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.

## **7.0 HOUSING GROUP DISASSEMBLY**

- 7.1 Unscrew and remove the snubber valve (1-190) from the housing cover.
- 7.2 Unscrew piston rod (2-170) 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 rods as it will mark the rod and cause seal leakage.
- 7.3 Remove cover hex cap screws (1-90) & (10-90) and gasket seals (3-120).
- 7.4 Remove the housing cover (1-20). The cover will have a very tight fit. It is not necessary to remove cover pins (10-130) and (1-130).
- 7.5 Remove the top two rollers (1-50) and roller spacer (1-110) from the top of the yoke pin (1-40).
- 7.6 Remove the yoke pin (1-40).
- 7.7 Remove the yoke pin nut (1-30).
- 7.8 Remove the lower two yoke rollers (1-50) and roller spacers (1-110) from the bottom of the yoke and housing.
- 7.9 The yoke (1-160) can now be removed by lifting it from the housing.
- 7.10 Remove the stop screws (1-60), stop jam nuts (1-120), and gasket seals (3-130).
- 7.11 Using putty knife, remove the end cap gasket (3-10) and the cover gasket (3-20).
- 7.12 It is not necessary to remove the pipe plugs (1-80) or the bleed valves (2-240) to service the actuator.

## **8.0 GENERAL RE-ASSEMBLY**

- 8.1 Remove all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 8.2 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.
- 8.3 After inspection, the parts should be carefully cleaned to remove all dirt, gaskets and other foreign material.
- 8.4 Coat all moving parts and seals with hydraulic fluid or lubricant, before installing into the actuator.

- 8.5 T-seal set installation - The T-seal is composed of one rubber seal and two split skive-cut back-up rings.
  - 8.5.1 Install the T-seal into the seal grooves.
  - 8.5.2 Install a back-up ring on each side of the T-seal.
  - 8.5.3 When installing the back-up rings, do not align the skive-cuts.
  - 8.5.4 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.

## **9.0 CENTER HOUSING GROUP RE-ASSEMBLY**

- 9.1 If removed install drain plug (1-80) in actuator housing (1-10).
- 9.2 Take all the yoke rollers (1-50) and check to see if they will run (move) freely thru the tracks in the bottom of the housing and the housing cover.
- 9.3 Coat one of the yoke o-ring seal (3-50) with lubricant and install into the housing (1-10).
- 9.4 Inside the housing (1-10) apply lubricant to the tracks and yoke bore and position the housing with the yoke bore nearest you.
- 9.5 Apply lubricant to the slots in the upper/lower yoke arms and the lower bearing surface.
- 9.6 Install the yoke (1-160) into the housing (1-10) as follows: Arrange the yoke arm to approximately a 45° degree position in either direction and lower into the housing. The hub with tapped holes faces up. Rotate the yoke back to approximately the mid-stroke (center) position.
- 9.7 Apply lubricant to all surfaces of two of the yoke rollers (1-50) and two roller spacers (1-110). Place one yoke roller in the track in the bottom of the housing and position it under the slot in the yoke arms. Place a roller spacer (1-110) on top of the bottom yoke roller (1-50). Place a second yoke roller on top of the roller spacer in the slot in the lower yoke arm. Place another roller spacer (1-110) on top of the second yoke roller (1-50) and align the holes in the roller spacer and the yoke rollers.
- 9.8 Coat the upper and lower surfaces of the yoke pin nut (1-30) with lubricant and insert into position between the yoke arm, parallel to the track in the housing. Align the yoke pin hole with the yoke rollers and roller spacers.
- 9.9 Lubricate the yoke pin (1-40) and insert through the yoke pin nut (1-30), the two yoke rollers (1-50) and the two roller spacers (1-110).
- 9.10 Apply lubricant to all the surfaces of the two remaining yoke rollers (1-50) and two remaining roller spacers (1-110). Place one roller spacer on top of the yoke pin nut (1-30) then install the third yoke roller (1-50). Place the last roller spacer on top of the third yoke roller (1-50). Place the fourth and final yoke roller on to the yoke pin. The top roller will remain above the yoke arm and will engage the cover track when cover is installed.

- 9.11 Lubricate the piston rod (2-170) and slide into the right side of the housing. Screw the piston rod into the yoke pin nut (1-30). (DO NOT TIGHTEN) Flats are provided on the outboard end of the piston rod. These flats should be used to put a wrench on to tighten the piston rod. DO NOT use a pipe wrench on the piston rod, as it will cause seal leakage.
- 9.12 Place gaskets (3-130) and jam nuts (1-120) on the stop screws (1-60). Install both assemblies into the housing.
- 9.13 Apply a thin coating of lubricant to both sides of the housing cover gasket (3-20).
- 9.14 Apply a thin coat of lubricant to the housing gasket surface.
- 9.15 Place the housing cover gasket (3-20) on the housing (1-10).
- 9.16 Coat the remaining yoke o-ring seal (3-50) with lubricant and install in cover (1-20).
- 9.17 Apply lubricant to the yoke bore and the track in the housing cover (1-20).
- 9.18 Apply lubricant to the yoke upper bearing surface.
- 9.19 Install the housing cover (1-20), being careful not to damage the gasket (3-20) or yoke o-ring seal (3-50). If the housing cover does not want to go down against the housing then the cover may be hanging on the top yoke roller.
- 9.20 Install the cover screws (1-90)/(10-90) and seal gasket (3-120). **LEAVE FINGER TIGHT - DO NOT TIGHTEN.**
- 9.21 Do this step only if you have pulled the cover pins (1-130)/(10-130) or if you are replacing the cover pins. Drive the pins through the cover (1-20) and into the housing (1-10) until the pin is flush with the cover. The pins are deeply grooved at one end, tapering to a smooth diameter at the other end. The pin should be installed smooth end first.
- 9.22 Tighten the cover screws (1-90)/(10-90) and torque to 12 foot pounds.
- 9.23 Apply lubricant to the rod bushing (2-80), install it over the piston rod and slide it up into the housing.
- 9.24 Tighten the piston rod (2-170) to a torque of approximately 150 foot pounds. Flats are provided on the outer end for wrenching purposes.
- 9.25 With the yoke rotated to the full clockwise (cw) position (as shown on the assembly drawing) position the yoke weather cover (3-140)/position indicator (1-170) on the yoke with the pointer facing to the front and perpendicular to the piston rod (2-170), secure with socket head cap screws (1-180).
- 9.26 Rotate the yoke to a position that will leave a minimum of the piston rod (2-170) protruding from the actuator housing.

## 10.0 TANDEM CYLINDER RE-ASSEMBLY

- 10.1 Coat all moving parts and seals with hydraulic fluid before installing into the tandem cylinders.
- 10.2 Install the rod seal (3-80), lip first, into the recess provided in the inner end cap (2-30).
- 10.3 Install the end cap gasket (3-10) over the piston rod and rod bushing.
- 10.4 Install two tie bar o-ring seals (3-30) into the inner end cap (2-30).
- 10.5 Slide the inner end cap (2-30) over the piston rod (2-170) and the rod bushing (2-80), protruding from the housing. Looking at the right end of the housing (1-10) the inner end cap (2-30) will be installed with the pressure inlet port at a 45<sup>o</sup> down position (refer to drawing part number 100120).
- 10.6 Install the end cap o-ring seal (3-60) into the inner end cap (2-30).
- 10.7 Install two sets of piston tie bar Tseal components (3-90) into the piston internal seal groove.
- 10.8 Install one of the piston o-ring seals (3-40) into the innermost groove in the piston rod (2-170).
- 10.9 Install the two halves of the split ring (2-110) into the inner most groove in the piston rod and retain with one of the split ring retainers (2-120).
- 10.10 Slide the 7" piston (2-20) onto the piston rod against the split ring (2-70). Raised side of the piston must face away from housing.
- 10.11 Install the two halves of a split ring (2-110) onto the piston rod and retain with a split ring retainer (2-120).
- 10.12 Install the 7" piston T seal components (3-100) into the piston external seal groove. Refer to step 8.5 for proper T-seal installation instructions.
- 10.13 Take housing-end of the tie bars (2-100), end without wrench flat, and install by carefully threading tie bars through the 7" piston (2-20) and inserting through the inner end cap (2-30), the end cap gasket (3-10), the housing (1-10) until the tie bars protrudes from the housing on the left side. Lubricate all exposed surfaces of piston rod and tie bars.
- 10.14 Install the remaining end cap gasket (3-10) with blind end cap (6-10) over tie bars and install up against the housing. Retain with hex nuts (6-20) and gasket seals (6-30). Thread the hex nuts on the tie bars as far as they will go.
- 10.15 Install the nut retainer (6-70), securing in place with the retainer screw (6-90) and lockwasher (6-80). It is necessary that the flats on the hex nuts (6-20) be aligned and parallel before the nut retainer can be installed.
- 10.16 Apply a light coat of hydraulic fluid to the bore of the cylinder (2-10).

- 10.17 Slide the lubricated cylinder (2-10) over the piston (2-20) and onto the inner end cap (2-30). When sliding the cylinder over the piston seal cant cylinder 15° to 30° 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 ends of the cylinder.
- 10.18 Install two end cap tie bar o-ring seals (3-30) into the remaining 7" inner end cap (2-30).
- 10.19 Install the remaining 7" inner end cap cylinder o-ring seal (3-60) and install onto the outer end cap (2-30).
- 10.20 Install the remaining 7" inner end cap (2-30) onto the tie bars/piston rod and into the end of the 7" cylinder (2-10). Make certain that the inlet port(s) are positioned with the inlet port on the same side of the actuator as the other 7" inner end cap.
- 10.21 Install two end cap tie bar o-ring seals (3-30) into the 5" inner end cap (2-60).
- 10.22 Install a 5" inner end cap cylinder o-ring seal (3-70) and install onto the 5" inner end cap (2-60).
- 10.23 Install rod seal (3-80) into inner end cap (2-30). Energize ring faces housing. Care should be taken during installation to prevent seal damage.
- 10.24 Apply lubricant to the rod bushing (2-90), install it over the piston rod and slide it up into the 7" inner end cap (2-30).
- 10.25 Install a second rod seal (3-80) into the recess provided in the 5" inner end cap (2-60). Energize ring faces away from housing.
- 10.26 Install the end cap gasket (3-10) over the piston rod, tie bars and rod bushing (2-90).
- 10.27 Install the two tie bar o-ring seals (3-30) into the 5" inner end cap (2-60).
- 10.28 Slide the 5" inner end cap (2-60) over the tie bars/piston rod and the rod bushing (2-90), protruding from the inner end cap (2-30). The pressure inlet port should be toward the top side of actuator. Exercise extreme care during installation, in order to prevent damage to the rod seal (3-80).
- 10.29 Install to two sets of piston tie bar T-seal components (3-90) into the 5" piston (2-50).
- 10.30 Install the remaining piston o-ring (3-40) and place onto the piston rod (2-170).
- 10.31 Install the two halves of the split ring (2-110) into the innermost exposed groove in the piston rod and retain with one of the split retaining rings (2-120).
- 10.32 Slide the 5" piston (2-50) onto the piston rod against the split rings (2-110). Piston seal groove will face housing.

- 10.33 Install the two halves of the remaining split ring (2-110) onto the piston rod and retain with the split retaining ring (2-120).
- 10.34 Install the piston T-seal components (3-10) on to the 5" piston (2-50).
- 10.35 Apply fluid to the bore of the 5" cylinder (2-40).
- 10.36 Slide the lubricated cylinder (2-40) over the piston (2-50) and onto the inner end cap (2-60).  
When sliding the cylinder over the piston seal cant cylinder 15° to 30° 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 ends of cylinder.
- 10.37 Install two end cap tie bar o-ring seals (3-30) into the outer end cap (2-70).
- 10.38 Install the outer end cap cylinder o-ring seal (3-70) onto the outer end cap (2-70).
- 10.39 Install the outer end cap (2-70) onto the tie bars and into the end of the cylinder (2-40). Bleed plugs (2-240) should be facing up.
- 10.40 Install the two tie bar nuts (2-130) on the tie bars (2-100), using them to draw all of the cylinder components into position. Torque alternately, in 50 ft. lb. increments until a final torque of 125 foot pounds has been achieved.
- 10.41 Install the nut retainer (2-140), securing in place with the socket cap screw (2-160) and lockwasher (2-150). It is necessary that the flats on the hex nuts (2-90) be aligned and parallel before the nut retainer can be installed. It is permissible to exceed the 125 foot pound figure to align the hex nut flats.
- 10.42 Mount the M4 hydraulic override (8) and bracket to the 7" cylinder (2-10).
- 10.43 Reconnect all plumbing between the M4 hydraulic override and both inboard and outboard of the 7" cylinder.  
Recommend that a non hardening 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 CONTROL SYSTEM THREADS.

## 11.0 **ACTUATOR TESTING**

- 11.1 Leakage Test. All areas, where leakage to atmosphere may occur, are to be checked using hydraulic pressure.
- 11.2 Procedure:
  - 11.2.1 Cycle the actuator five (5) times at 100% of the normal operating pressure (NOP), as per actuator name tag. This will allow the seals to seek a service ready condition.

- 11.2.2 Apply 100% of the maximum operating pressure (MOP), as marked on actuator name tag or per Chart 1, and allow unit to stabilize.
- 11.2.3 If there is any notable leakage, the actuator must be disassembled and the cause of leakage must be determined and corrected.
- 11.2.4 If an actuator was disassembled and repaired, the above leakage test must be performed again.
- 11.3 Optional Shell Test. This test should be performed if any one of the following items are replaced: tie bar, piston, piston rod, end cap or cylinder.
- 11.3.1 All air should be bled from the cylinder before shell testing.
- 11.3.2 Shell test the actuator by applying 1.5 times the maximum test pressure, as marked on actuator name tag, to both sides of the piston simultaneously for a period of two (2) minutes.
- 11.3.3 If any leakage occurs, the unit must be disassembled and the cause of leakage must be determined and corrected.
- 11.4 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 yoke.
- 11.5 Procedure:
- 11.5.1 Cycle the actuator at 10% of the maximum operating pressure (MOP) per actuator name tag. Any jumpy or jerky operation no attributed to seal drag or limited flow capacity, must be corrected.
- 11.5.2 All accessories, including solenoid valves, positioners, pressure switches, etc., must be hooked up and tested for proper operations and replaced if found defective.

## CHART 1

### PRESSURE REQUIREMENTS AND LIMITATIONS FOR T805-M4 DOUBLE ACTING ACTUATORS

ACTUATOR MODEL	NOMINAL OPERATING PRESSURE (NOP)	MAXIMUM OPERATING PRESSURE (MOP)	MAXIMUM HYDROSTATIC TEST PRESSURE
T805-M4	(1)	2075	2075

(1) Per customer specification or not applicable

## **12.0 M4 REFILLING INSTRUCTIONS**

- 12.1 See paragraph 4.8 "Fluid Requirements" for fluid specifications.
- 12.2 Refilling 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.
- 12.3 Remove the breather from the reservoir.
- 12.4 Attach the pump discharge line to reservoir breather port.
- 12.5 Open both speed control valves.
- 12.6 Open the two bleed valves (2-240), located at each end of the 7" cylinder.
- 12.7 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. Close each bleed valve (2-240) when the air has been displaced and hydraulic fluid appears.
- 12.8 Remove pump discharge line from reservoir breather port.
- 12.9 Adjust fluid level to 1-1/2" (40mm) from top of reservoir with actuator in open (ccw) position.
- 12.10 Re-install breather removed, in step 12.3.

## **13.0 ALTERNATE REFILLING INSTRUCTIONS**

- 13.1 Refilling the M4 hydraulic control system, during field service, often must be done without the use of a pressure pump. Proceed as follows:
- 13.2 Put the actuator in the closed position (cw).
- 13.3 Remove the breather from the reservoir.
- 13.4 Fill the reservoir approximately three-fourths (3/4) full.
- 13.5 Open both speed control valves.
- 13.6 Open the bleed valve (2-240) on the outboard end of the 7" cylinder only.
- 13.7 Rotate the handle slowly, clockwise, until all air has escaped from the system.
- 13.8 Close the bleed valve opened in step 13.6.
- 13.9 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.
- 13.10 Open the bleed valve (2-240) on the inboard end of the 7" cylinder.

- 13.11 Rotate the handle slowly, counter-clockwise, until all air has escaped from the system.
- 13.12 Close the bleed valve opened in step 13.10.
- 13.13 During the fill procedure, the piston will not move. This may be determined by observing the position indicator (1-170) on the actuator.
- 13.14 Adjust level to 1-1/2" (40mm) from top of reservoir with actuator in open (ccw) position.
- 13.15 Re-install breather removed in step 13.3

#### **14.0 ADDITIONAL M4 INSTRUCTIONS**

- 14.1 This procedure is preformed to insure air is removed from the system (most likely air in pump) and to test the operation of M4 override.
- 14.2 Turn M4 crank cw. The actuator should move clockwise as well. Adjust outboard bleed valve (2-240) to remove air from system.
- 14.3 Turn M4 crank arm ccw. The actuator will move counter-clockwise. Adjust inboard bleed valve to remove air from system.
- 14.4 With bleed valves closed, stroke actuator full 90<sup>0</sup>, cw and ccw, using M4 override.

#### **15.0 RETURN TO SERVICE**

- 15.1 If removed, install the snubber valve (1-190).
- 15.2 Install the position indicator (1-170) and the yoke weather cover (3-140) with the socket cap screws (1-180). With the actuator rotated clockwise the position indicator will be pointing away and perpendicular to the piston rod (2-170).
- 15.3 Re-install the actuator to the valve.
- 15.4 Re-install all piping and accessories that were removed.
- 15.5 Adjust the stop screws (1-60) back to the settings recorded in step 5.3 under General Disassembly.