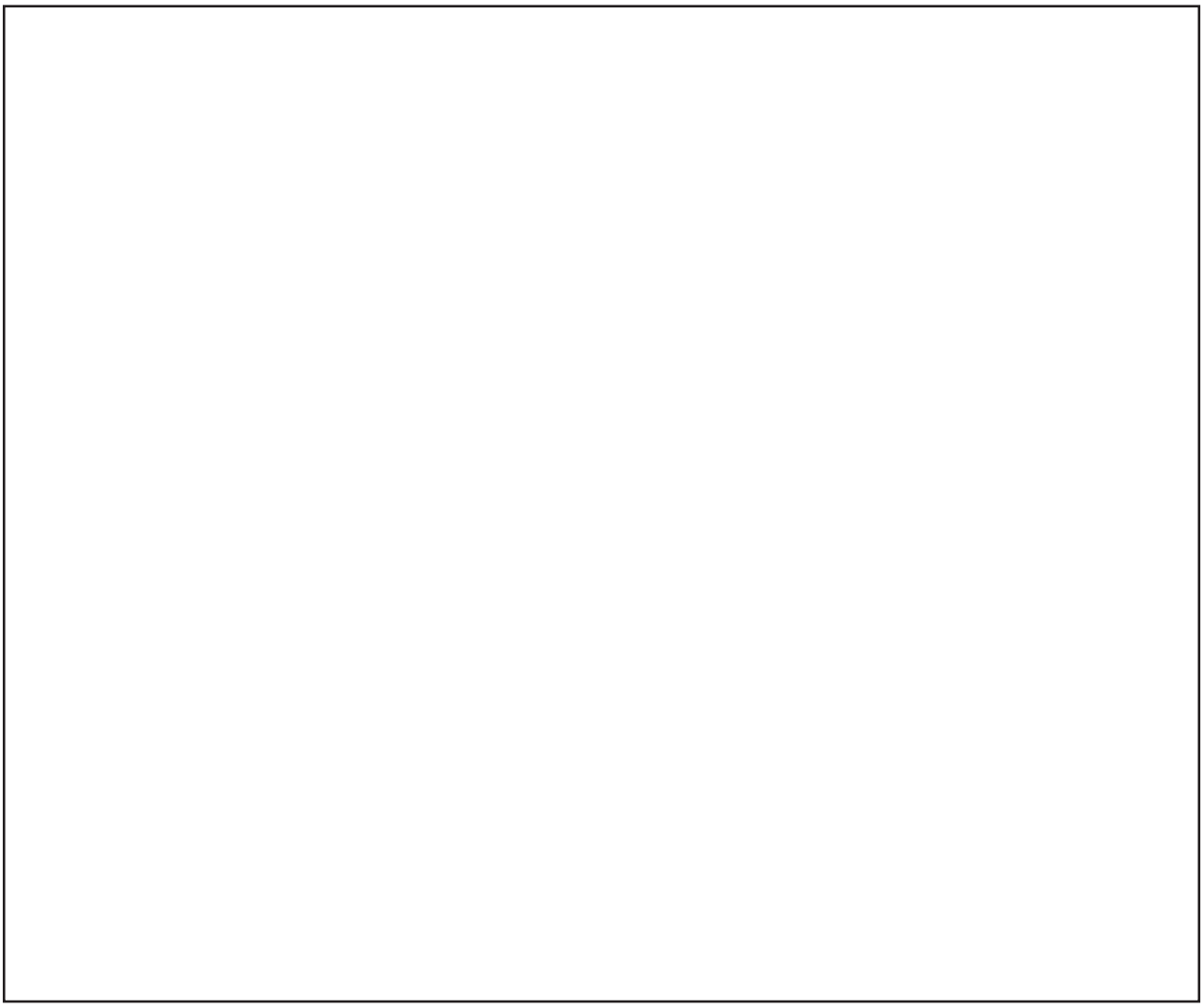
Service Instructions
074979 Rev. B
September 2014

GH Bettis Disassembly and Reassembly

For Models HD521-S and HD721-S Double-Acting Series Hydraulic Actuators



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Section 1: Introduction

1. This service procedure is offered as a guide to enable general maintenance to be performed on GH Bettis HD521-S, HD521 M3-S, HD521 M3HW-S, HD721-S, HD721 M3-S and HD721 M3HW-S hydraulic actuators.

2. SAFETY STATEMENT: Products supplied by GH Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by a well-trained, equipped, prepared and competent technician.

⚠ WARNING:

FOR THE PROTECTION OF PERSONNEL WORKING ON GH BETTIS ACTUATORS, THIS PROCEDURE SHOULD BE REVIEWED AND IMPLEMENTED FOR SAFE DISASSEMBLY AND REASSEMBLY. CLOSE ATTENTION SHOULD BE NOTED TO THE WARNINGS, CAUTIONS AND NOTES CONTAINED IN THIS PROCEDURE.

3. DEFINITIONS:

⚠ WARNING:

If not observed, user incurs a high risk of severe damage to actuator and/or fatal injury to personnel.

⚠ CAUTION:

If not observed, user may incur damage to actuator and/or injury to personnel.

NOTE:

Advisory and information comments provided to assist maintenance personnel to carry out maintenance procedures.

NOTE:

This product is only intended for use in large-scale fixed installations excluded from the scope of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2).

4. BASIC SERVICE INFORMATION: COMPLETE ACTUATOR REFURBISHMENT REQUIRES THE ACTUATOR BE DISMOUNTED FROM THE VALVE OR DEVICE IT IS OPERATING.

5. The maximum recommended service interval for this actuator series is five years. Storage time is counted as part of the service interval.

6. This procedure is applicable with the understanding that all electrical power and hydraulic pressure has been removed from the actuator. Also, it is understood that the actuator has been removed from the valve as well as all piping and accessories that are mounted on the actuator have been removed.

Section 2: Support Items and Tools

2.1 Support Items

Service/Seal Kit, razor-sharp cutting instrument, commercial leak testing solution, and non-hardening thread sealant.

2.2 Tools

All tools are American Standard inch. General Tools - two each medium standard screwdriver, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet, torque wrench (up to 2,000 inch-pounds).
Refer to Table 1 for recommended tool styles and size.

Section 3: Reference GH Bettis Materials

Assembly Drawing **036251** for pneumatic actuators (see Appendix section).
This drawing is not for hydraulic service and will not show some items that is in the hydraulic series actuators. It is a "good go by" assembly drawing only.

Section 4: General Details

1. This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.

2. Numbers in parentheses ( ), indicate the bubble number (reference number) used on the GH Bettis Assembly Drawing, Exploded Detail Drawing, and actuator parts lists.

3. This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front of the actuator and the housing cover (1-20) as the top of the actuator.

4. To ensure correct reassembly; that is, with cylinder on same end of housing as was, mark or tag right or left and mark mating surfaces.

5. When removing seals from seal grooves, use a commercial seal removing tool or a small screwdriver with sharp corners rounded off.

6. Use a non-hardening thread sealant on all pipe threads.

NOTE:
Apply the thread sealant per the manufacturer's instructions.

7. Disassembly of actuator should be done in a clean area on a work bench when possible.

8. LUBRICATION REQUIREMENTS:

   a. Standard and high-temperature service (-20°F to +350°F) use Kronaplate 100. This lubricant is provided in the GH Bettis Service/Seal Kit.

   b. Low-temperature service (-50°F to +150°F) use Kronaplate 50. This lubricant needs to be purchased from distributors of Kronaplate. For distributors of Kronaplate lubricant in your area, call 800-428-7802.

9. FLUID REQUIREMENTS:

   a. Standard and high-temperature service (-20°F to +350°F) use Dexron II or Shell Tellus T-32 Automatic Transmission Fluid.

   b. Low-temperature service (-50°F to +150°F) use Exxon Univis J13 or HVI 13 Hydraulic Fluid.

10. It is a good practice to operate the actuator with the pressure used by the customer to operate the actuator during normal operation, before starting the general disassembly of the actuator. Notate and record any abnormal symptoms such as jerky or erratic operation.

⚠ CAUTION: DO NOT EXCEED PRESSURE RATING

Pressure is not to exceed the maximum operating pressure rating listed on the name tag.

Section 5: General Disassembly

1. Actuators equipped with M3HW jackscrew overrides with handwheel option, remove hex nuts (8-30), lock washers (8-20), and handwheels (8-10).

2. Open the bleed valves.

3. Remove the pipe plug (2-110) and drain the hydraulic fluid from the cylinder adapter (2-30) and cylinder (3).

4. Measure the exposed length of the right and left stop screws (1-60) and record each before loosening.

5. Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.

6. Remove snubber (1-130) from housing (1-10).

Section 6: Rod Cover Disassembly

1. Unscrew and remove the four rod cover ferry head screws (2-100) and gasket seals (6-80).

2. Remove the rod cover (2-60), taking care not to disengage the grooved bushing (2 -50).

3. For actuators equipped with M3 or M3HW jackscrew override, the following steps will be used for disassembly of the M3 from the rod cover (2-60). Unless the M3 is to be removed for replacement, the M3 need not be disassembled from the rod cover:

    a. With the rod cover (2-60) on a work bench, lubricate jackscrew assembly threads with lubricant.

    b. Using a 3/16-inch pin punch, drive out and remove the spirol pin from the slotted nut located on the outboard end of the M3 assembly.

    c. Remove the slotted nut from the M3 assembly.

    d. Loosen and remove the seal nut.

    e. Screw the M3 assembly into the rod cover (2-60) until it is disengaged from the rod cover.

    f. Remove M3 assembly from the open end of rod cover (2-60).

Section 7: Power Cylinder Removal

1. Secure the chain wrench around the cylinder (3) as close to the welded end cap as possible. Using a mallet, break the cylinder (3) loose and then remove by rotating in a counterclockwise direction.

⚠ CAUTION: PROTECT CYLINDER THREADS

When setting the cylinder (3) aside, care should be taken to protect the chamfered edge and cylinder threads.

2. Unscrew and remove standard hex lock nut (2-70) from piston rod (2-10).

3. Remove the piston (2-20).

4. Unscrew and remove the four cylinder adapter ferry head screws (2-90) and seal gaskets (6-80).

5. Remove the cylinder adapter (2-30), taking care not to scratch the piston rod (2-10) or disengage the rod bushings (2-40) and (2-50).

Section 8: Housing Group Disassembly

1. Remove cover screws (1-30) and seal gaskets (6-100).
2. Remove the housing cover (1-20).
3. Rotate the yoke arms to the center position.
4. Remove the upper yoke roller (1-50).
5. Lift out and remove yoke pin (1-40).
6. Holding rod bushings (2-40) and (2-50) in place, pull the piston rod (2-10) out through the rod bushings.
7. Lift out the yoke (1-140) from the housing cavity.
8. Remove the lower yoke roller (1-50).
9. Remove cylinder adapter rod bushing (2-40) and the grooved rod cover rod bushing (2-50) from housing (1-10).
10. Remove the stop screws (1-60), jam nuts (1-70), and gasket seals (6-90).

NOTE:
Be sure to identify stop screws left and right.

11. It is not necessary to remove housing pipe plug, cylinder adapter pipe plug (2-110) and bleed valves.
12. For actuators equipped with M3 or M3HW jackscrew override, the following steps will be used for disassembly of the M3 from the cylinder (3):

NOTE:
Unless the M3 is to be removed for replacement, the M3 need not be disassembled from the cylinder.

a. With the cylinder (3) on a work bench, lubricate M3 assembly threads with lubricant.
b. Using a 3/16-inch pin punch, drive out and remove the spirol pin from the slotted nut located on the outboard end of the M3 assembly.
c. Remove the slotted nut from the M3 assembly.
d. Loosen and remove the seal nut.
e. Screw the M3 assembly into the cylinder (3) until it is disengaged from the cylinder (3).
f. Remove the M3 assembly from the open end of the cylinder (3).

Section 9: General Reassembly

1. Remove and discard all old seals and gaskets, taking care not to scratch or damage the seal grooves.

2. All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

3. All parts should be thoroughly inspected. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. Sealing surfaces must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

4. Before installing, coat all surfaces of actuators moving parts with lubricant.

5. Coat all seals with lubricant, before installing into grooves.

6. Low-Temperature or Trim -11 T-Seal Set installation - The T-Seal is composed of one rubber seal and two split skive-cut back-up rings.

    a. Install the T-Seal into the seal groove.

    b. Install a back-up ring on each side of the T-Seal.

    c. When installing the back-up rings, do not align the skive-cuts.

    d. 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.

Section 10: Housing Reassembly

NOTE:
Use the lubricant as indicated in Section 4, Step 8, for housing reassembly.

1. If removed, install a pipe plug (2-110) into the drain port of the housing (1-10).
2. Install one of the yoke O-ring seals (6-20) into groove in the housing bore.
3. Apply lubricant to the yoke bore in the body and arrange the body so that the yoke bore is nearest to you. Lubricate the raised ribs in the bottom of the housing.
4. Apply a generous amount of lubricant to the slots in the upper and lower yoke arms of yoke (1-140).
5. Coat the bearing surfaces of the yoke (1-140) with lubricant and install into the body. The wide yoke arm should be installed toward the top of the housing.
6. Coat the piston rod bushing (2-40) with hydraulic fluid. Install into the right side of the housing (1-10).
7. Coat the grooved rod cover bushing (2-50) with lubricant. Install into left side of the housing (1-10).
8. Coat one of the yoke rollers (1-50) with lubricant and place into the lower yoke arm slot nearest yoke trunnion.
9. Apply lubricant to the piston rod (2-10) and install into the housing through the rod bushings. The threaded end of the piston rod (2-10) should be on the right side of the housing (1-10).
10. Coat the yoke pin (1-40) with lubricant and install through the piston rod (2-10) into the lower yoke roller (1-50).
11. Coat the remaining yoke roller (1-50) with lubricant and install over the yoke pin and into the slot in the upper yoke arm.
12. Install the remaining yoke seal (6-20) into the housing cover (1-20).
13. Coat the yoke bore in the cover (1-20) with lubricant.
14. Install the cover gasket (6-60) onto the housing.
15. Install the housing cover (1-20) and the four cover screws (1-30) with gasket seals (6 -100) onto the housing (1-10).

Section 11: Power Cylinder Reassembly

NOTE:
Use the fluid as indicated in Section 4, Step 9, for power cylinder reassembly.

1. M3 equipped actuators use Step 1 (A through H) to start reassembly. If non M3 equipped, start reassembly at Step 2. If the M3 jackscrew was removed from the cylinder (3), then, preassemble the M3 using the following procedure:

    a. Apply a light coating of lubricant to the threads of M3 assembly.

    b. Insert the M3 assembly through the open end of the cylinder (3). Screw the M3 into the cylinder end cap until the end of the M3 protrudes out of the cylinder end cap.

    c. Turn the M3 until the retainer comes into contact with the inside of the cylinder end cap.

    d. Install seal nut onto the M3 assembly. Turn the seal nut until it is up against the cylinder end cap.

    e. Screw the slotted nut onto the outboard end of the M3 stud with the slot facing toward the cylinder end cap. Turn the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.

⚠ CAUTION: ALIGN SLOT AND CROSS DRILLED HOLE

When aligning the slot and the cross drilled hole, make certain that the back of the slot is at least one thread from being aligned with the hole.

    f. Insert the spirol pin through the slotted nut and through the M3 stud making sure that equal amounts of the spirol pin is exposed on both sides of the slotted nut and the M3 stud.

    g. Turn seal nut until fully tight against the cylinder end cap.

    h. If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.

2. Coat the piston rod seal (6-30) with hydraulic fluid and install, lip first, into the cylinder adapter (2-30).

⚠ CAUTION: PLACE PROPERLY THE ENERGIZER RING

Energizer ring of rod seal must face the cylinder adapter (piston side).

3. Install one cylinder adapter gasket (6-70) onto the right side of the housing.

4. Install the cylinder adapter (2-30) over the piston rod (2-10) and retain with the cylinder adapter ferry screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter (2-30) so that the bleed valve will be at the highest point when the actuator is installed on the valve.

⚠ CAUTION: DO NOT SCRATCH THE PISTON ROD

Care should be taken at this point not to scratch the piston rod when installing the cylinder adapter.

5. If removed, install a pipe plug (2-110) into the cylinder adapter's spare pressure port.

6. Coat the cylinder adapter O-ring seal (6-40) with hydraulic fluid and install in the groove at the inner end of the threads of the cylinder adapter.

7. Coat the piston O-ring seal (6-50) with hydraulic fluid and install onto the piston rod.

8. Install the piston (2-20) onto the piston rod and retain with hex lock nut (2-70). One side of the piston has a raised boss in the center that is counter bored to accept an "O" ring. This side should be installed against the shoulder of the piston rod. Torque the piston hex lock nut (2-70) to approximately 146 foot-pounds.

9. PISTON SEAL INSTALLATION:

   a. Standard and High-Temperature Actuators:
   Coat one piston U-Cup seals (6-10) with hydraulic fluid and install into the innermost piston groove. The lips of the seals should point toward the cylinder adapter.

   b. Low-Temperature Actuators:
   Apply hydraulic fluid to piston T-Seal assembly (6-10) and install into the innermost piston seal groove. Install back-up ring on each side of T-Seal. The T-Seal assembly is composed of a rubber seal and two back-up rings.

10. Push the piston in towards the housing as far as it will go.

11. Coat the cylinder threads and the piston stroke surface of cylinder bore with hydraulic fluid.

12. Install the cylinder (3) over the piston (2-20) and screw into the cylinder adapter (2-30). Tighten with a chain wrench.

13. Rotate the yoke to the full-clockwise (CW) position. Position the yoke weather cover (6-110) and position indicator (1-110) on the yoke (1-140) with the pointer facing the piston rod (2-10) and perpendicular to the cylinder (3) and rod cover (2-60).
Retain with socket cap screw (1-120).

14. Install the stop screws (1-60), gasket seals (6-90) and jam nuts (1-70).

Section 12: Rod Cover Reassembly

NOTE:
Use the lubricant as indicated in Section 4, Step 8, for rod cover reassembly.

1. If the M3 jackscrew was removed from the rod cover, then preassemble the M3 into rod cover (2-60), using the following procedure:

   a. Apply a light coating of lubricant to the threads of M3 assembly.

   b. Insert the M3 assembly through the open end of the rod cover (2-60). Screw the M3 into the rod cover end cap until the end of the assembly protrudes out of the rod cover.

   c. Turn the M3 until the retainer comes into contact with the inside of the rod cover.

   d. Install seal nut onto the M3 assembly. Screw the seal nut until it is up against the rod cover.

   e. Screw the slotted nut onto the outboard end of the jackscrew stud until one of the slots in the nut is aligned with the cross drilled "thru hole" in the stud.

NOTE:
The nut slots will be facing toward the cylinder end cap.

⚠ CAUTION: ALIGN SLOT AND CROSS DRILLED HOLE

When aligning the slot and the cross drilled hole, make certain that the back of the slot is at least one thread from being aligned with the hole.

   f. Insert the spirol pin through the slotted nut and through the M3 stud, making sure that equal amounts of the spirol pin is exposed on both sides of the slotted nut and the M3 stud.

   g. Turn seal nut until fully-tight against the rod cover.

   h. If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.

2. Coat the remaining end cap gasket (6-70) with lubricant and install onto the right side of the housing (1-10).

3. Install the rod cover (2-60) over the exposed piston rod end (2-10).

4. Install and tighten the four rod cover screws (2-100) and seal gaskets (6-80).

Section 13: Actuator Testing

1. All areas, where leakage to atmosphere may occur, are to be checked using a leak testing solution.

2. All leak testing will use 65 psi operating pressure. If excessive leakage across the piston is noted, generally a bubble which breaks three seconds or less after starting to form, the unit must be disassembled and the cause of leakage must be determined and corrected.

3. Before testing for leaks, alternately apply and release 65 psi pressure to each side of the piston to stroke the actuator. Repeat this cycle approximately five times. This will allow the new seals to seek their proper service ready condition.

4. Apply 65 psi pressure to the pressure inlet port located in the cylinder adapter (2- 30).

5. Apply leak testing solution to the following areas:

    a. The inlet port hole in the end of the cylinder (3), checks the piston to cylinder wall and piston to piston rod seals.

    b. The threaded joint between the cylinder (3) and cylinder adapter (2-30), checks the cylinder to cylinder adapter O-ring seal.

    c. The joint between the cylinder adapter and the housing.

    d. The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.

    e. Remove pressure from pressure inlet port located in the cylinder adapter (2-30).

6. Apply 65 psi pressure to the pressure inlet port located in the cylinder end cap .

7. Apply leak testing solution to the inlet port hole in the cylinder adapter (2-30), checks the piston to cylinder wall.

8. Remove pressure from pressure inlet port located in the cylinder end cap.

9. If an actuator was disassembled and repaired, the above leakage test must be performed again.

Section 14: Return to Service

1. Replace the software components of the snubber (1-130) and then install the snubber into the housing.

2. Adjust both stop screws (1-60) back to settings recorded in Section 5 under General Disassembly.

3. Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).

4. For actuators equipped with M3 jackscrew assembly and require an optional handwheel, M3HW, install the handwheel using the following procedure:

   a. Place the handwheels (8-10) onto the pinned nuts. The handwheel hub has a cast hexagon hole that fits over the nut.

   b. Place lock washers (8-20) onto M3 up against handwheel hub.

   c. Place hex nuts (8-30) onto M3 and thread up against lock washer, torque to 250 foot-pounds.

5. After the actuator is reinstalled on the device it is to operate, all accessories, including solenoid valves, positioners, pressure switches, and others, should be hooked up and tested for proper operation and replaced, if found defective.

Table 1. Tool Style and Wrench Sizes

Item No.	Wrench Size	Description	Recommended Wrench Style
1-30	9/16"	Cover screws	Socket
1-60	7/16"	Stop screw	Open end or adjustable
1-70	15/16"	Stop screw nut	Open end or adjustable
1-100	7/16"	Housing drain plug	Open end or adjustable
1-120	3/16"	Weather cover screws	Allen
1-130	7/8"	Snubber	Deep socket
2-70	1-1/4"	Piston/piston rod nut	Socket
2-90	7/16"	Cylinder adapter screws	12 point socket
2-100	7/16"	Rod cover screws	12 point socket
2-110	7/16"	Cylinder adapter port plug	Allen
2-130	1-11/16"	M3 nut seal	Open end or adjustable
2-150	3/16"	Spiral pin	Pin punch
3-20	----	Cylinder	Chain wrench
8-30	1-11/16"	Jam nut	Open end or adjustable

(1) No alternate style recommended.

Section 15: Document Revision

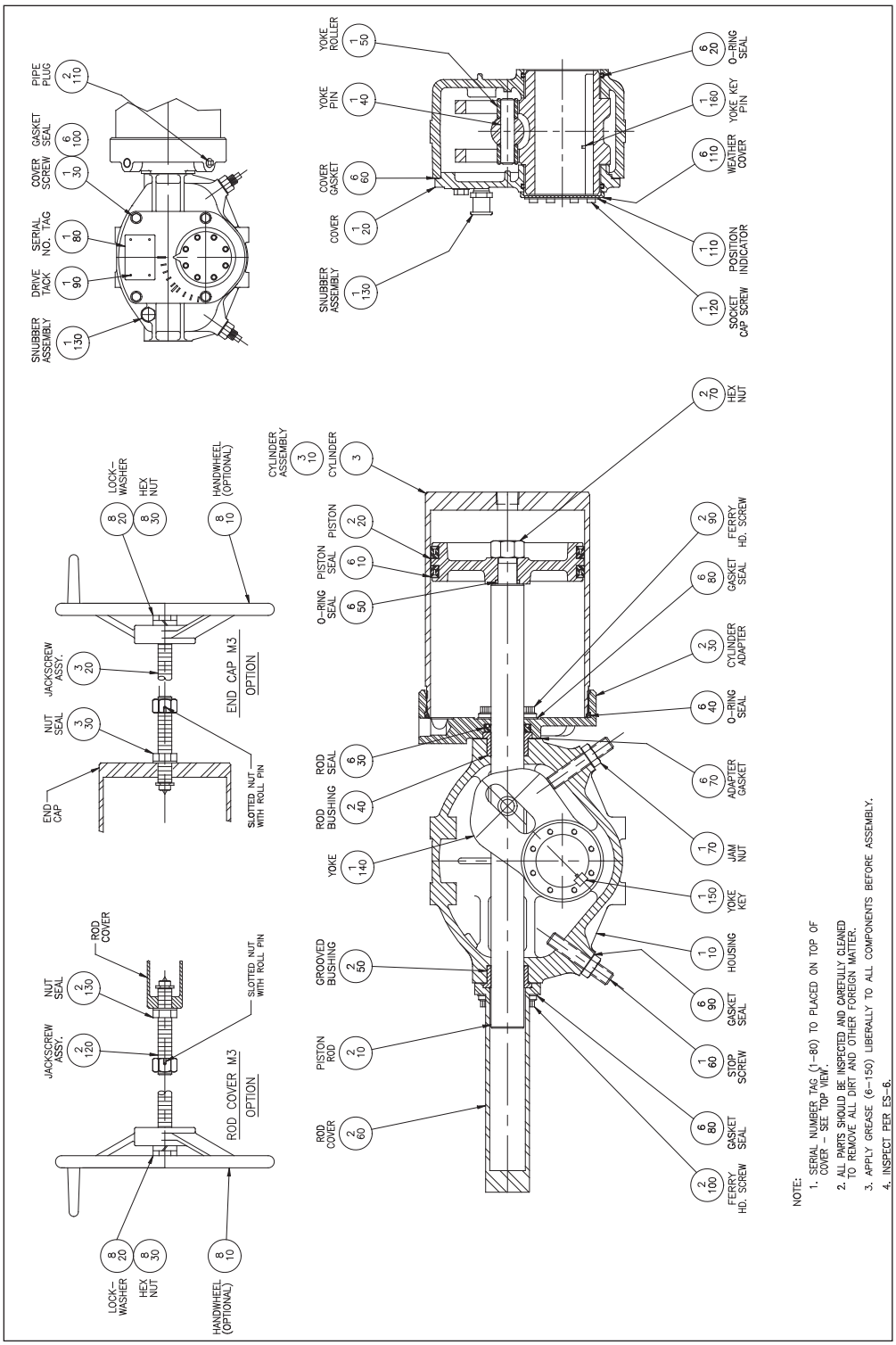
Table 2. Revision Overview

ECN	DATE	REV		BY *	DATE
Released	1 July 1993	A	* COMPILED	Colby	22 June 2006
19110	5 July 2006	B	CHECKED	John R	22 June 2006
			APPROVED	David McGee	1 July 1993

* Signatures on file Waller, Texas

Appendix A: List of Drawings

A.1 Part No. 036251J, Pneumatic Actuator, Assy Dwg.



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