

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODELS

HD521 AND HD721

DOUBLE ACTING SERIES

PNEUMATIC ACTUATORS

PART NUMBER: SE-024

REVISION: "A"

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REPLACES: Service-024 (SE-024, Dated 8/87)

1.0 INTRODUCTION

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis HD521, HD521-M3, HD521-M3HW, HD721, HD721-M3 and HD721-M3HW Double Acting Series Pneumatic Actuators. When the model number has "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.

1.2 Refer to Information Notes, Section 17, for product improvement changes and other revisions to this series of HD actuators.

1.3 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.

1.4 **SAFETY STATEMENT:** Products supplied by 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 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.

WARNING: This procedure should not supersede or replace any customers plant safety or work procedures. If a conflict arises between this procedure and the customers procedures the differences should be resolved in writing between an authorized customers representative and a authorized Bettis representative.

1.5 **BASIC SERVICE INFORMATION:** Complete actuator refurbishment requires the actuator be dismantled from the valve or device it is operating.

1.6 Normal recommended service interval for this actuator series is five years to maximum total life cycle.

NOTE: Storage time is counted as part of the service interval.

1.7 This procedure is applicable with the understanding that all electrical power and pneumatic 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.

2.0 SUPPORT ITEMS AND TOOLS

- 2.1 Support Items - Service/Seal Kit, commercial leak testing solution, and non-hardening thread sealant.
- 2.2 Tools - All tools are American Standard inch. Two each medium standard screwdrivers, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and a torque wrench (up to 2,000 inch pounds). Refer to page 17 for recommended tool style and size.

3.0 BETTIS REFERENCE MATERIALS

- 3.1 Assembly Drawing Part Number 036251.
- 3.2 Exploded Detail Drawing part number 063358* for models HD521 and HD721.
- 3.3 Exploded Detail Drawing part number 068128* for models HD521-M3/HW and HD721-M3/HW.

* Exploded Detail Drawings are included in the standard Bettis Service/Seal Kit.

4.0 GENERAL

- 4.1 This procedure should only be implemented by a technically competent technician who should take care to observe good workmanship practices.
- 4.2 Numbers in parentheses, () indicate the bubble number (item reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawing, and Actuator Parts List.
- 4.3 This procedure is written using the stop screw side of housing (1-10) as a reference and this side will be considered the front of the actuator. Housing cover (1-20) will be considered as the top of the actuator.
- 4.4 To help in correct re-assembly all mating parts should be marked or tagged for ease of reassembly, i.e. cylinder to cylinder adapter, cylinder adapter to housing, and right and left stop adjustment screws, ect.
- 4.5 When removing seals from seal grooves, use a commercial seal removing tool or a small standard screwdriver with sharp corners rounded off.
- 4.6 Use a non-hardening thread sealant on all pipe threads.

CAUTION: Apply thread sealant per the manufacture's instructions.

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

- 4.8 Some HD series actuator models are heavy and will require a means of assistance. For actuator approximate weight refer to the following chart.

ACTUATOR MODEL	APPROXIMATE WEIGHT (LBS) (3)	ACTUATOR MODEL	APPROXIMATE WEIGHT (LBS) (3)
HD521	79	HD721	100
HD521-M3	89	HD721-M3	110
HD521-M3HW	99	HD721-M3HW	120
(3) Weights listed for each model are for bare actuators without valve mounting brackets and accessories.			

- 4.9 LUBRICATION REQUIREMENTS: For use in all areas of the actuator. Lubricants, other than those listed in steps 4.9.1, 4.9.2, and 4.9.3 should not be used without prior written approval of Bettis Product Engineering.

- 4.9.1 Standard temperature service (-20°F to +200°F) use Bettis ESL-5 lubricant contained in the Bettis Standard Temperature Service/Seal Kit.
- 4.9.2 High temperature service (0°F to +350°F) use Bettis ESL-5 lubricant contained in the Bettis High Temperature Service/Seal Kit.
- 4.9.3 Low temperature service (-40°F to +150°F) use ESL-4 lubricant contained in the Bettis Low Temperature Service Kit.

CAUTION: Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator's name tag.

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

5.0 GENERAL DISASSEMBLY

- 5.1 If not already removed disconnect all operating pressure from pneumatic cylinder (3) or (3-10).
- 5.2 Actuators equipped with -M3HW jackscrew with handwheel option, remove hex nut (8-30), lock washer (8-20), and handwheel (8-10). Refer to Section 17, step 17.8, for information on non removable handwheel.
- 5.3 Mark stop screws (1-60) left and right. Measure and record exposed length of right and left stop screws (1-60). The stop screws will be removed later in this procedure.
- 5.4 Record the location of the pressure ports in cylinder adapter (2-30).
- 5.5 Removed socket cap screws (1-120) from position indicator (1-110).
- 5.6 Remove position indicator (1-110) and yoke weather cover (6-110) from the top of housing (1-10). Refer to Section 17, step 17.3, for information concerning early model actuators and the use of a weather cover.
- 5.7 Remove snubber valve (1-130) from housing (1-10).

6.0 PRESSURE CYLINDER REMOVAL

- 6.1 Secure the chain wrench around cylinder (3) or (3-10) as close to the welded end cap as possible. Using a mallet, break the cylinder loose sufficiently so it can be removed.
- 6.2 Remove cylinder (3) or (3-10) from cylinder adapter (2-30) by rotating in a counter clockwise direction.

CAUTION: When removing and setting cylinder (3) or (3-10) aside, care should be taken to protect the cylinder's chamfered edge and external threads.

- 6.3 Unscrew and remove light hex Lok nut (2-70) from piston rod (2-10).
- 6.4 Remove piston (2-20) from piston rod (2-10).

NOTE: Identify cylinder adapter (2-30) location and record it's inlet port locations.

- 6.5 Unscrew and remove four ferry cap screws (2-90) with gasket seals (6-80) from cylinder adapter (2-30). Refer to Section 17, step 17.9, for information when ferry cap screw are not used in this location.
- 6.6 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).
- 6.7 For actuators equipped with M3 or M3HW assembly, it is not necessary to disassemble the M3 Jackscrew from cylinder assembly -M3 (3-10). If the M3 stud or nut seal (3-30) needs replacement then refer to section 15, M3 jackscrew disassembly.

7.0 ROD COVER DISASSEMBLY

- 7.1 Unscrew and remove four ferry cap screws (2-100) with gasket seals (6-80). Refer to Section 17, step 17.9, for information when ferry cap screw are not used in this location.
- 7.2 Remove rod cover (2-60), taking care not to disengage the grooved bushing (2-50).
- 7.3 For actuators equipped with M3 or M3HW jackscrew assembly, it is not necessary to disassemble the M3 Jackscrew from rod cover (2-60). If the M3 stud or nut seal (2-130) needs replacement then refer to section 15, M3 jackscrew disassembly.

8.0 HOUSING GROUP DISASSEMBLY

- 8.1 Remove four hex cap screws (1-30) and seal gaskets (6-100) from housing cover (1-20).
- 8.2 Remove housing cover (1-20) from housing (1-10).

NOTE: The housing cover has a tight fit and may require the use of two pry bars or screw drivers to assist in removal.

- 8.3 Rotate the arms of yoke (1-140) to the center position of housing (1-10).
- 8.4 Remove upper yoke roller (1-50) from yoke pin (1-40).
- 8.5 Remove yoke pin (1-40) from slot in the arms of yoke (1-140).
- 8.6 Holding rod bushing (2-40) in place, pull piston rod (2-10) out through rod bushing (2-40).
- 8.7 Remove rod bushing (2-40) and grooved rod bushing (2-50) from housing (1-10).

8.8 Remove yoke (1-140) from housing (1-10).

CAUTION: The yoke/housing bearing area must be lubricated and inspected to extend service life and prevent degradation of torque output. This can only be accomplished by removing the yoke from the housing which requires removing the actuator from the device it is mounted on.

8.9 Remove lower yoke roller (1-50) from the cavity of housing (1-10).

8.10 Unscrew and remove stop screws (1-60), jam nuts (1-70), and gasket seals (6-90).

8.11 It is not necessary to remove pipe plug (1-100) from housing (1-10) or pipe plug (2-110) from cylinder adapter (2-30).

9.0 GENERAL RE-ASSEMBLY

CAUTION: Only new seals, that are still within the seals expectant shelf life, should be install back into actuator being refurbished.

9.1 Remove and discard all seals and gaskets.

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

9.3 All parts should be thoroughly inspected for excessive wear, stress cracking, galling and pitting. Attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding or rotating motion. Sealing surfaces of the cylinder and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

CAUTION: Actuator parts that reflect any of the above listed characteristics must be replaced with new parts.

9.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of lubricant, before installing into seal grooves.

NOTE: The parts and seals used in the actuator housing assembly and power cylinder will be assembled using lubricant as identified in step 4.9.

9.5 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.

9.5.1 Install the T-seal into the seal groove.

9.5.2 Install a back-up ring on each side of the T-seal.

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

9.5.4 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.

9.6 The torque requirements for critical fasteners are specified at the appropriate step of the assembly procedure.

10.0 HOUSING RE-ASSEMBLY

- 10.1 If removed, install pipe plug (1-100) into the drain port of housing (1-10).
 - 10.2 Apply lubricant to the yoke bore in housing (1-10) and the raised ribs in bottom of housing (1-10).
 - 10.3 Install one o-ring seal (6-20) into seal groove in the housing bore. Refer to section 17, step 17.1, for "B" model yoke o-ring information.
 - 10.4 Lubricate yoke (1-140) with a generous amount of lubricant to all bearing surfaces and slots in the upper and lower arms.
 - 10.5 Install yoke (1-140) into the cavity of housing (1-10).
- NOTE: The wide yoke arm should be installed toward the top of housing (1-10).
- 10.6 Coat one yoke roller (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke (1-140).
 - 10.7 Apply a coat of lubricant to rod bushing (2-40), grooved rod bushing (2-50) and piston rod (2-10).
 - 10.8 Install rod bushing (2-40) on to piston rod (2-10).
- NOTE: Standard constructed actuators will have the threaded end of piston rod (2-10) and rod bushing (2-40) will be on the right side of housing (1-10).
- 10.9 Install piston rod (2-10), with rod bushing (2-40) into housing (1-10).
 - 10.10 Slide rod bushing (2-40) along piston rod (2-10) and into side of housing (1-10).
 - 10.11 Install grooved rod bushing (2-50) over exposed piston rod (2-10) and into the left side of housing (1-10).
 - 10.12 Coat yoke pin (1-40) with lubricant and install through piston rod (2-10) into lower yoke roller (1-50).
 - 10.13 Coat remaining yoke roller (1-50) with lubricant and install over yoke pin (1-40) and into the slot in the upper yoke arm of yoke (1-140).
 - 10.14 Install jam nuts (1-70) and gasket seals (6-90) onto stop screws (1-60). Refer to section 17, step 17.4, for information concerning early model actuator stop screw gasket seals.
 - 10.15 Install stop screws (1-60), with gasket seals (6-90) and stop screw jam nuts (1-70), into housing (1-10).
 - 10.16 Coat the yoke bore in housing cover (1-20) with lubricant.
 - 10.17 Coat remaining o-ring seal (6-20) with lubricant and install into housing cover (1-20). Refer to section 17, step 17.1, for information concerning HD "B" series yoke o-rings.
 - 10.18 Install cover gasket (6-60) onto housing (1-10).
 - 10.19 Install housing cover (1-20) onto housing (1-10).
 - 10.20 Install four gasket seals (6-100) onto hex cap hex screws (1-30). Refer to section 17, step 17.5, for information when gasket seals have not been in prior use for this location.

10.21 Install four hex cap screws (1-30), with gasket seals (6-100), through housing cover (1-20) and into housing (1-10).

10.22 Torque tighten hex cap screws (1-30) to 18 foot pounds ± 5 % lubricated.

11.0 PRESSURE CYLINDER RE-ASSEMBLY

11.1 If the actuator cylinder is equipped with a M3 or M3HW assembly and it was removed then reassemble per appropriate steps in section 16.

11.2 Coat rod seal (6-30) with lubricant and install, lip first, into cylinder adapter (2-30). Refer to section 17, step 17.2, for information pertaining to different rod seal configurations.

CAUTION: Energizer ring (O-ring) of rod seal (6-30) must face into cylinder adapter (2-30) or when cylinder is installed on the actuator the rod seal o-ring will be facing towards piston (2-20).

11.3 Install gasket (6-70) over piston rod (2-10), rod bushing (2-40) and up against housing (1-10).

11.4 Install gasket seals (6-80) onto ferry cap screws (2-100). Refer to section 17, step 17.6, for information pertaining to the past use of lock washers in this location.

11.5 Install cylinder adapter (2-30) over the end of piston rod (2-10).

CAUTION: Care should be taken to not scratch or damage the piston rod when installing the cylinder adapter.

NOTE: Arrange the position of cylinder adapter (2-30) per the identification recorded in section 5 step 5.4.

11.6 Install and tighten four ferry cap screws (2-90), with gasket seals (6-80), through cylinder adapter (2-30) and into housing (1-10). Refer to information note step 17.6 for information when gaskets seals where not used in this location.

11.7 If removed, install a pipe plug (2-110) into cylinder adapter (2-30) pressure port location as recorded in section 5.

11.8 Coat o-ring seal (6-40) with lubricant and install into cylinder adapter (2-30). NOTE: Install the o-ring seal into seal groove at the inner end of the cylinder adapter inner diameter threads.

11.9 Install o-ring seal (6-50) onto piston rod (2-10). NOTE: The o-ring should be installed against the shoulder of the piston rod.

11.10 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that has a seal groove to accept an o-ring. This side should be installed against the shoulder of the piston rod (2-10) and over o-ring seal (6-50).

11.11 Install light hex Lok nut (2-70) onto piston rod (2-10).

CAUTION: When installing light hex Lok nut (2-70) the flat side of the nut should rest up against piston (2-20).

11.12 Torque tighten light hex Lok nut (2-70) to 146 foot pounds lubricated.

11.13 Piston Seal Installation:

11.13.1 Standard and High Temperature actuators:

- 11.13.1.1 Coat two u-cup seals (6-10) with lubricant.
- 11.13.1.2 Install one u-cup seal into the innermost piston seal groove. The lip of the cup seal should point outward toward the outside edge of the piston.
- 11.13.1.3 Install one u-cup seal into the outermost piston seal groove. The lip of the cup seal should point outward toward the outside edge of the piston.

11.13.2 Low Temp Actuators: Refer to T-Seal installation instructions section 9, step 9.5.

- 11.13.2.1 Apply lubricant to one T-seal (6-10). NOTE: T-Seal is composed of rubber seal and two back-up rings.
- 11.13.2.2 Install T-seal set (6-10) into piston outboard seal groove.

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

11.15 Coat the cylinder threads and the entire surface of cylinder bore with lubricant.

11.16 Install lubricated cylinder (3) or (3-10) over piston (2-20).

CAUTION: It is necessary to depress the seal lip while working cylinder over the seal lip. Exercise care to prevent damage to the piston cup seal lip during cylinder installation.

11.17 Rotating the cylinder clockwise, screw cylinder (3) or (3-10) into the cylinder adapter and tighten with the chain wrench.

CAUTION: When using the chain wrench on the cylinder it should be secured as close to the end cap as possible.

11.18 Rotate the yoke to the full clockwise (CW) position. Place yoke weather cover (6-110) and position indicator (1-110) on yoke (1-140) with the pointer facing piston rod (2-10) and perpendicular to cylinder (3) or (3-10) and rod cover (2-60).

11.19 Install and tighten yoke position indicator/yoke weather cover screws (1-120). These screws will need to be rechecked for tightness after the actuator has been cycled and tested.

12.0 ROD COVER RE-ASSEMBLY

12.1 If the actuator was equipped with a M3 or M3HW assembly and was removed from the rod cover then pre-assemble per section 16.

12.2 Install end cap gasket (6-70) onto the left side of housing (1-10).

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

12.4 Install four seal gaskets (6-80) onto ferry cap screws (2-100).

12.5 Install and tighten four ferry cap screws (2-100) with seal gaskets (6-80).

13.0 ACTUATOR TESTING

- 13.1 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. These areas will have zero leakage unless other instructions are given with the area being tested.

CAUTION: Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator name tag.

- 13.2 All leak testing will use 65 psig pneumatic pressure or the pressure used by the customer to operate the actuator during normal operation.

CAUTION: Test the actuator using a properly adjusted self relieving regulator, with gauge.

- 13.3 Before testing for leaks, alternately apply and release 65 psig pneumatic pressure to each side of the pistons to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their proper service condition.

- 13.4 Apply 65 psig pneumatic pressure to the pressure inlet port in cylinder adapter (2-30).

- 13.5 Apply leak testing solution to the following areas:

13.5.1 Form a leak testing solution bubble over the inlet port hole in the outboard end of cylinder (3) or (3-10). If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected. Checks the piston to cylinder wall and piston to piston rod seals.

13.5.2 The threaded joint between cylinder (3) or (3-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.

13.5.3 The joint between cylinder adapter (2-30) and housing (1-10).

13.5.4 The snubber port hole located in top of housing (1-10), checks the cylinder adapter to piston rod seal.

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

- 13.7 Apply 65 psig pneumatic pressure to the inlet port in outboard end of cylinder (3) or (3-10).

- 13.8 Form a leak testing solution bubble over the inlet port in cylinder adapter (2-30). If excessive leakage is noted, generally a bubble which breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected. Checks piston to cylinder and piston to piston rod seals.

- 13.9 Remove pressure from the inlet port in the outboard end of cylinder (3) or (3-10).

14.0 RETURN TO SERVICE

- 14.1 Replace the software components of snubber (1-130) and then install the snubber into the top of housing (1-10).

- 14.2 Adjust both stop screws (1-60) back to settings recorded in step 5.3 under General Disassembly.

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

- 14.4 For actuators equipped with M3 jackscrew and require an optional handwheel, M3HW, install the handwheel using the following procedure:
- 14.4.1 Place handwheel (8-10) onto the nut. The handwheel hub has a cast hexagon hole that fits over the nut.
 - 14.4.2 Place lock washer (8-20) onto M3 up against handwheel hub.
 - 14.4.3 Place hex nut (8-30) onto M3 and thread up against lock washer, tighten until lock washer is flat.
- 14.5 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.
- 14.6 The actuator should now be ready to return to service.

15.0 M3 JACKSCREW DISASSEMBLY

NOTE: If the age of the actuator is unknown or if the M3 has been replaced at some unknown point in time, then review all of section 15 for a M3 description that is installed on the actuator being disassembled.

- 15.1 Disassembly of M3 jackscrews manufactured after December, 1990.
- 15.1.1 With the rod cover (2-60) on a work bench, lubricate M3 assembly (2-120) threads with lubricant.
 - 15.1.2 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 (2-120).
 - 15.1.3 Remove the slotted nut from the M3 assembly (2-120).
 - 15.1.4 Loosen and thread seal nut (2-130) off of the M3 assembly (2-120).
 - 15.1.5 Thread the M3 assembly (2-120) into the rod cover (2-60) until it is disengaged from the rod cover.
 - 15.1.6 Remove the M3 assembly (2-120) from the open end of the rod cover (2-60).
 - 15.1.7 With the cylinder assembly -M3 (3-10) on a work bench, lubricate M3 assembly (3-20) threads with lubricant.
 - 15.1.8 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 (3-20).
 - 15.1.9 Remove the slotted nut from the M3 assembly (3-20).
 - 15.1.11 Loosen and thread seal nut (3-30) off of the M3 assembly (3-20).
 - 15.1.12 Thread the M3 assembly (3-20) into the cylinder assembly -M3 (3-10) until it is disengaged from the cylinder.
 - 15.1.13 Remove the M3 assembly (3-20) from the open end of the cylinder (3-10).
- 15.2 Disassembly of M3 jackscrews manufactured March, 1982 through December, 1990.

- 15.2.1 With the rod cover (2-60) on a work bench, lubricate M3 assembly (2-120) threads with lubricant.
- 15.2.2 Loosen and thread nut seal (2-130) all the way back to the welded nut.
- 15.2.3 Thread the M3 assembly (2-120) into the rod cover (2-60) until the pin and washer are exposed.
- 15.2.4 Using a 3/16 inch pin punch, drive out and remove the pin.
- 15.2.5 Remove the washer.
- 15.2.6 Thread the M3 assembly (2-120) out and remove.
- 15.2.7 Remove seal nut (2-130) from the M3 stud.
- 15.2.8 With the cylinder assembly -M3 (3-10) on a work bench, lubricate M3 assembly (3-20) threads with lubricant.
- 15.2.9 Loosen and thread nut seal (3-30) all the way back to the welded nut.
- 15.2.10 Thread the M3 assembly (3-20) into the cylinder assembly -M3 (30) until the pin and washer are exposed.
- 15.2.11 Using a 3/16 inch pin punch, drive out and remove the pin.
- 15.2.12 Remove the washer.
- 15.2.13 Thread the M3 assembly (3-20) out and remove.
- 15.2.14 Remove seal nut (3-30) from the M3 stud.
- 15.3 Disassembly of M3 jackscrews manufactured July, 1978 through February 1982.
 - 15.3.1 With the rod cover (2-60) on a work bench, lubricate M3 assembly (2-120) threads with lubricant.
 - 15.3.2 Loosen and thread seal nut (2-130) all the way back to the welded nut.
 - 15.3.3 Thread the M3 assembly (2-120) into the rod cover (2-60) until the retaining screw is exposed.
 - 15.3.4 Remove the retaining screw from the M3.
 - 15.3.5 Thread the M3 assembly (2-120) out and remove.
 - 15.3.6 Remove seal nut (2-130) from the M3 stud.
 - 15.3.7 With the cylinder assembly -M3 (3-10) on a work bench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 15.3.8 Loosen and thread seal nut (3-30) all the way back to the welded nut.

- 15.3.9 Thread the M3 assembly (3-20) into the cylinder assembly -M3 (3-10) until the retaining screw is exposed.
- 15.3.10 Remove the retaining screw from the M3.
- 15.3.11 Thread the M3 assembly (3-20) out and remove.
- 15.3.12 Remove seal nut (3-30) from the M3 stud.
- 15.4 Disassembly of M3 jackscrews manufactured before July, 1978.
 - 15.4.1 With the rod cover (2-60) on a work bench, lubricate M3 assembly (2-120) threads with lubricant.
 - 15.4.2 Loosen nut seal (2-130).
 - 15.4.3 Thread the M3 assembly (2-120) out and remove.
 - 15.4.4 Remove seal nut (2-130) from the M3 stud.
 - 15.4.5 With the cylinder assembly -M3 (3-10) on a work bench, lubricate M3 assembly (3-20) threads with lubricant.
 - 15.4.6 Loosen nut seal (3-30).
 - 15.4.7 Thread the M3 assembly (3-20) out and remove.
 - 15.4.4 Remove seal nut (3-30) from the M3 stud.

16.0 **M3 JACKSCREW REASSEMBLY**

NOTE: If the age of the actuator is unknown or if the M3 jackscrew has been replaced at some unknown point in time, then review all of section 16 for a M3 jackscrew description that is installed on the actuator being reassembled.

- 16.1 Reassembly of M3 jackscrew manufactured after December, 1990.
 - 16.1.1 Apply a light coating of lubricant to the threads of M3 assembly (2-120).
 - 16.1.2 Insert the M3 assembly (2-120) through the open end of the rod cover (2-60). Thread the M3 into the rod cover end cap until the end of the assembly protrudes out of the rod cover.
 - 16.1.3 Turn the M3 until the retaining washer/nut comes into contact with the inside of the rod cover.
 - 16.1.4 Install seal nut (3-30) onto the M3 assembly (2-120). Thread the seal nut until it is up against the rod cover.
 - 16.1.5 Thread the slotted nut onto the outboard end of the M3 stud with the slot facing toward the rod cover. Thread the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.

CAUTION: 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.

- 16.1.6 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.
- 16.1.7 Turn seal nut until fully tight against the rod cover.
- 16.1.8 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.
- 16.1.9 Apply a light coating of lubricant to the threads of M3 assembly (3-20).
- 16.1.10 Insert the M3 assembly (3-20) through the open end of the cylinder (3-10). Thread the M3 into the cylinder end cap until the end of the assembly protrudes out of the cylinder.
- 16.1.11 Turn the M3 until the retaining washer/nut comes into contact with the inside of the cylinder (3-10).
- 16.1.12 Install seal nut (3-30) onto the M3 assembly (3-20). Thread the seal nut until it is up against the cylinder (3-10).
- 16.1.13 Thread the slotted nut onto the outboard end of the M3 stud with the slot facing toward the cylinder (3-10) end cap. Thread the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.

CAUTION: **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.**

- 16.1.14 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.
 - 16.1.15 Turn seal nut until fully tight against the cylinder (3-10).
 - 16.1.16 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.
- 16.2 Reassembly of M3 jackscrews manufactured March, 1982 through December, 1990.
- 16.2.1 If removed, install seal nut (2-130) onto jackscrew assembly (2-120) with the insert side facing away from the retaining nut.
 - 16.2.2 Thread the seal nut until it is up against the retaining nut.
 - 16.2.3 Apply a generous coating of lubricant to the M3 threads.
 - 16.2.4 Thread the jackscrew assembly (2-120) into the rod cover end cap. Turn the jackscrew until the end of the assembly protrudes out of the open end of the rod cover.
 - 16.2.5 Install a washer and pin onto the turndown end of the M3.
 - 16.2.6 Turn the jackscrew until the washer just comes into contact with the rod cover end cap.
 - 16.2.7 Turn seal nut until fully tight against the rod cover.
 - 16.2.8 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.

- 16.2.9 If removed, install seal nut (3-30) onto M3 assembly (3-20) with the insert side facing away from the retaining nut.
 - 16.2.10 Thread the seal nut until it is up against the retaining nut.
 - 16.2.11 Apply a generous coating of lubricant to the M3 threads.
 - 16.2.12 Thread the M3 assembly (3-20) into the cylinder (3-10) end cap. Turn the M3 until the end of the assembly protrudes out of the open end of the cylinder.
 - 16.2.13 Install a washer and pin onto the turndown end of the M3.
 - 16.2.14 Turn the M3 until the washer just comes into contact with the cylinder (3-10) end cap.
 - 16.2.15 Turn seal nut until fully tight against the cylinder (3-10) end cap.
 - 16.2.16 If desirable, wipe away excess lubricant on M3 after operation. If preferred, the lubricant may be left on M3 to provide additional corrosion protection.
- 16.3 Reassembly of M3 jackscrews manufactured July, 1978 through February, 1982.
- 16.3.1 If removed, install seal nut (2-130) onto M3 assembly (2-120) with the insert side facing away from the retaining nut.
 - 16.3.2 Thread the seal nut until it is up against the retaining nut.
 - 16.3.3 Apply a generous coating of lubricant to the M3 threads.
 - 16.3.4 Thread the M3 assembly (2-120) into the rod cover end cap. Turn the M3 until the end of the assembly protrudes out of the open end of the rod cover.
 - 16.3.5 To retain the M3 in the rod cover thread a hex head cap screw into the threaded hole in the turndown area of the M3 stud.
 - 16.3.6 Turn the M3 until the retaining screw just comes into contact with the rod cover end cap.
 - 16.3.7 Turn seal nut until fully tight against the rod cover.
 - 16.3.8 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.
 - 16.3.9 If removed, install seal nut (3-30) onto M3 assembly (3-20) with the insert side facing away from the retaining nut.
 - 16.3.10 Thread the seal nut until it is up against the retaining nut.
 - 16.3.11 Apply a generous coating of lubricant to the M3 threads.
 - 16.3.12 Thread the M3 assembly (3-20) into the cylinder end cap. Turn the M3 until the end of the assembly protrudes out of the open end of the cylinder.
 - 16.3.13 To retain the M3 in the cylinder thread a hex head cap screw into the threaded hole in the turndown area of the M3 stud.

- 16.3.14 Turn the jackscrew until the retaining screw just comes into contact with the rod cover end cap.
- 16.3.15 Turn seal nut until fully tight against the rod cover.
- 16.3.16 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.
- 16.4 Reassembly of M3 jackscrews manufactured before July, 1978.
- 16.4.1 If removed, install seal nut (2-130) onto M3 assembly (2-120) with the insert side facing away from the retaining nut.
- 16.4.2 Thread the seal nut until it is up against the retaining nut.
- 16.4.3 Apply a generous coating of lubricant to the M3 threads.
- 16.4.4 Thread the M3 assembly (2-120) into the rod cover end cap. Turn the jackscrew until the end of the assembly protrudes just out of the rod cover end cap.
- 16.4.5 Turn seal nut until fully tight against rod cover end.
- 16.4.6 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.
- 16.4.7 If removed, install seal nut (3-30) onto M3 assembly (3-20) with the insert side facing away from the retaining nut.
- 16.4.8 Thread the seal nut until it is up against the retaining nut.
- 16.4.9 Apply a generous coating of lubricant to the M3 threads.
- 16.4.10 Thread the M3 assembly (3-20) into the cylinder assembly -M3 end cap. Turn the M3 until the end of the assembly protrudes just out of the cylinder.
- 16.4.11 Turn seal nut until fully tight against end cap.
- 16.4.12 If desirable, wipe away excess lubricant on M3 after operation. If preferred, lubricant may be left on M3 to provide additional corrosion protection.

17.0 **INFORMATION NOTES:**

- 17.1 On HD-SR series "B" models the yoke o-ring grooves are in the yoke journals. On the HD-SR series "C" and current models the yoke o-ring grooves will be in the housing cover and in the housing.
- 17.2 HD-SR actuators manufactured through the late 1970's where originally shipped with a rod seal and a anti-extrusion seal. This combination is replaced with the current Polypak seal. The dimensional stack of the rod seal and the anti-extrusion seal is greater than the rod seal provided in the current Service/Seal Kit. This dimensional difference does not affect the ability of the current Polypak seal to provide sealing in this application.
- 17.3 Early model actuators may not have a position indicator or a weather cover. These items are product improvements and may be retrofitted to your actuator.

- 17.4 Early model actuators used nylon "Zytel 101" stop screw seal (6-90). The nylon seal is replaced with the wrought copper/Cu alloy gasket seal.
- 17.5 Early model actuators did not use any gasket seal washers (6-100) on the housing cover screws (1-30). The current Service/Seal kits provide wrought copper alloy (ASTM B-152 C11000) gasket seal washers. This change to the product is a product improvement and may be retrofitted to your actuator.
- 17.6 Early model actuators used lock washers on the cylinder adapter retaining screws (2-90). During the early 1970's the lock washers were replaced with wrought copper alloy (ASTM B-152 C11000) gasket seal washers (6-90). The current Service/Seal kits provide these wrought copper alloy washers and Bettis would recommend that they be used in place of the original lock washers.
- 17.7 All asbestos has been eliminated from the gasket material used in Bettis Actuators. The current gasket material used is Non Asbestos Synthetic Fiber.
- 17.8 Original style M3 jackscrew with handwheel was a weldment and the handwheel was not removable.
- 17.9 Early model actuators used socket cap screws instead of ferris cap screws as cylinder adapter (2-30) and rod cover (2-60) retaining screws.

TOOL STYLE AND WRENCH SIZES

ITEM NO.	ITEM QTY.	WRENCH SIZE	LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	9/16"	Cover Screws	Socket
1-60	2	7/16"	Stop Screws	Open End or Adjustable
1-70	2	15/16"	Hex Jam Nut	Open End or Adjustable
1-100	1	7/16"	Pipe Plug	Open End
1-120	4	3/16"	Socket Cap Screws	Allen (1)
1-130	1	7/8"	Snubber Valve	Deep Socket
2-70	1	1-1/4"	Light Hex Lok Nut	Socket
2-90	4	7/16"	Ferry Cap Screws	12 Point Socket (1), (3)
2-100	4	7/16"	Ferry Cap Screws	12 Point Socket (1), (3)
2-110	1	7/16"	Pipe Plug	Open End
2-130	1	1-13/16"	M3 Seal Nut	Open End or Adjustable
3	1	(2)	Cylinder	Chain Wrench (1)
3-10	1	(2)	Cylinder Assembly	Chain Wrench (1)
8-30	1	1-13/16"	M3 Seal Nut	Open End or Adjustable
<p>(1) No alternate style tool recommended.</p> <p>(2) Bettis recommends a short handled Chain Wrench with a 40" inch chain.</p> <p>(3) Early model actuators used socket head cap screws in this location - wrench style will change to Allen.</p>				