

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODELS

HD521 AND HD721

DOUBLE ACTING SERIES

PNEUMATIC ACTUATORS

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SECTION 1 - INTRODUCTION

1.1 GENERAL SERVICE INFORMATION

1.1.1 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 Series Double Acting Pneumatic Actuators (includes actuator models that have a -10 or -11 suffix at the end of the model number).

NOTE: 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.

1.1.2 Normal recommended service interval for this actuator series is five years.

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

1.1.3 This procedure is applicable with the understanding that all electrical power and pneumatic pressure has been removed from the actuator.

1.1.4 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.

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

1.1.6 Numbers in parentheses, () indicate the bubble number (reference number) used on the Bettis assembly drawing, exploded detail drawings and actuator parts list.

1.1.7 This procedure is written using the following Actuator references:

1.1.7.1 Stop screw side of housing (1-10) will be considered the front of the actuator.

1.1.7.2 Housing cover (1-20) will be the top of the actuator.

1.1.8 Some HD series actuator models are heavy and will require a means of assistance. For actuator approximate weight refer to Section 4 table 4.1.

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

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

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

1.1.11 Bettis recommends that disassembly of the actuator should be done in a clean area on a workbench.

1.2 **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.

M3: Jackscrew or jackscrew assembly.

1.3 **GENERAL SAFETY INFORMATION**

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 customer's plant safety or work procedures. If a conflict arises between this procedure and the customer's procedures the differences should be resolved in writing between an authorized customers representative and an authorized Bettis representative.

1.4 **BETTIS REFERENCE MATERIALS**

1.4.1 Assembly Drawing Part Number 036251.

1.4.2 Exploded Detail Drawing part number 063358* for models HD521 and HD721.

1.4.3 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 Kit.

1.5 **SUPPORT ITEMS AND TOOLS**

1.5.1 Support Items - Service Kit, commercial leak testing solution, and non-hardening thread sealant.

NOTE: Bettis standard Service kit has all seals and gaskets to fit HD521 or HD721 models manufactured since the early 1970's (can not be used for Basic or "A" model HD's).

- 1.5.2 Tools - All tools / Hexagons are American Standard inch (Imperial). 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 / 226 N-m). Refer to Section 4 table 4.2 for recommended tool style and size.

1.6 LUBRICATION REQUIREMENTS

- 1.6.1 The actuator should be re-lubricated at the beginning of each service interval using the following recommended lubricant.

NOTE: Lubricants, other than listed in step 1.6.2 should not be used without prior written approval of Bettis Product Engineering.

- 1.6.2. All temperature services (-50°F to +350°F)/(-45.5°C to 176.6°C) use Bettis ESL-5 lubricant. ESL-5 lubricant is contained in the Bettis Service Kit in tubes and the tube is marked ESL-4,5 & 10 lubricant.

SECTION 2 – ACTUATOR DISASSEMBLY

2.1 GENERAL DISASSEMBLY

NOTE: Review Section 1 General Service Information prior to starting Section 2.

WARNING: It is possible, that the actuator may contain a dangerous gas and/or liquids. Ensure that all proper measures have been taken to prevent exposure or release of these types of contaminants before commencing any work.

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

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

- 2.1.2 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. Note and record any abnormal symptoms such as jerky or erratic operation.

- 2.1.3 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, etc.

- 2.1.4 If not already removed disconnect all operating pressure from pneumatic cylinder (3) or cylinder assembly M3 (3-10).

2.1.5 Actuators equipped with -M3HW jackscrew with handwheel option, remove hex nut (8-30), lock washer (8-20), and handwheel (8-10).

2.1.6 Mark or record the following:

2.1.6.1 Mark stop screws (1-60) left and right.

2.1.6.2 Measure and record the exposed length of the right and left stop screws (1-60).

NOTE: The stop screws will be removed later in this procedure.

2.1.6.3 Record the location of the pressure ports in the cylinder adapter (2-30).

2.2 PRESSURE CYLINDER REMOVAL

NOTE: Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with Pressure Cylinder Disassembly.

2.2.1 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.

2.2.2 Remove cylinder (3) or cylinder assembly M3 (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.

2.2.3 Unscrew and remove light hex Lok nut (2-70) from piston rod (2-10).

2.2.4 Remove piston (2-20) from piston rod (2-10).

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

2.2.5 Unscrew and remove four ferry cap screws (2-90) with gasket seals (6-80) from cylinder adapter (2-30). Refer to Section 4.3, step 4.3.9, for information when ferry cap screws are not used in this location.

2.2.6 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).

2.2.7 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 2.5 for cylinder assembly M3 disassembly.

2.3 HOUSING DISASSEMBLY

2.3.1 Remove snubber valve (1-130) from the top of housing (1-10).

2.3.2 Removed socket cap screws (1-120) from position indicator (1-110).

2.3.3 Remove position indicator (1-110) and yoke weather cover (6-110) from the top of yoke (1-140).

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

2.3.5 Remove housing cover (1-20) from the top 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.

2.3.6 Rotate the arms of yoke (1-140) to the center position of housing (1-10).

2.3.7 Remove upper yoke roller (1-50) from yoke pin (1-40).

2.3.8 Remove yoke pin (1-40) from slot in the arms of yoke (1-140).

2.3.9 Holding rod bushing (2-40) in place, remove pull piston rod (2-10) out through rod bushing (2-40).

2.3.10 Remove rod bushing (2-40) from housing (1-10).

2.3.11 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.

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

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

2.3.14 It is not necessary to remove pipe plug (2-110) from cylinder adapter (2-30).

2.4 ROD COVER DISASSEMBLY

2.4.1 Unscrew and remove four ferry cap screws (2-100) with gasket seals (6-80). Refer to Section 4.3, step 4.3.9, for information when ferry cap screw is not used in this location.

2.4.2 Remove rod cover (2-60)

2.4.3 On HD521 and HD721 remove grooved bushing (2-50) from housing (1-10).

2.4.4 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 2.6 for rod cover M3 disassembly.

2.5 CYLINDER ASSEMBLY M3 JACKSCREW DISASSEMBLY

NOTE: Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with M3 jackscrew disassembly.

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 2.5 for a M3 jackscrew description that is installed on the actuator being disassembled.

- 2.5.1 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured after December 1990 (current M3 design).
 - 2.5.1.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.5.1.2 Using a small pin punch, drive out and remove the roll pin from the slotted nut located on outboard end of M3 jackscrew assembly (3-20).
 - 2.5.1.3 Remove the slotted nut from jackscrew assembly (3-20).
 - 2.5.1.4 Loosen and rotate seal nut (3-30) off of jackscrew assembly (3-20).
 - 2.5.1.5 Rotate jackscrew assembly (3-20) into cylinder (3-10) until it is disengaged from the cylinder end cap.
 - 2.5.1.6 Remove jackscrew assembly (3-20) from the open end of cylinder (3-10).
- 2.5.2 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured March 1982 through December 1990.
 - 2.5.2.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.5.2.2 Loosen and rotate seal nut (3-30) all the way back to the welded nut.
 - 2.5.2.3 Rotate jackscrew assembly (3-20) into cylinder (3-10) until the pin and washer are exposed.
 - 2.5.2.4 Using a small pin punch, drive out and remove the pin.
 - 2.5.2.5 Remove the washer.
 - 2.5.2.6 Rotate jackscrew assembly (3-20) out and remove from cylinder.
 - 2.5.2.7 Remove seal nut (3-30) from the M3 jackscrew stud.
- 2.5.3 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured July 1978 through February 1982.
 - 2.5.3.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.5.3.2 Loosen and rotate seal nut (3-30) all the way back to the welded nut.
 - 2.5.3.3 Rotate jackscrew assembly (3-20) into cylinder (3-10) until the retaining screw is exposed.

- 2.5.3.4 Remove the retaining screw from the M3.
- 2.5.3.5 Rotate the jackscrew assembly (3-20) out and remove.
- 2.5.3.6 Remove seal nut (3-30) from the M3 jackscrew stud.
- 2.5.4 Disassembly of the M3 assembly from cylinder (3-10) - For actuators manufactured prior to July 1978.
 - 2.5.4.1 With the cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.5.4.2 Loosen seal nut (3-30).
 - 2.5.4.3 Rotate the jackscrew assembly (3-20) out and remove.
 - 2.5.4.4 Remove seal nut (3-30) from the M3 jackscrew stud.

2.6 ROD COVER M3 JACKSCREW DISASSEMBLY

NOTE: Review all of Section 2 steps 2.1.1 through 2.1.6 General Disassembly before proceeding with 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 2.6 for a M3 description that is installed on the actuator being disassembled.

- 2.6.1 Disassembly of the M3 assembly from the rod cover (2-60) - For actuators manufactured after December 1990 (current M3 design).
 - 2.6.1.1 With the rod cover (2-60) on a workbench, lubricate M3 assembly (2-120) threads with lubricant.
 - 2.6.1.2 Using a small pin punch, drive out and remove the spiral pin from the slotted nut located on the outboard end of the M3 assembly (2-120).
 - 2.6.1.3 Remove the slotted nut from the M3 assembly (2-120).
 - 2.6.1.4 Loosen and rotate seal nut (2-130) off of the M3 assembly (2-120).
 - 2.6.1.5 Rotate the M3 assembly (2-120) into rod cover (2-60) until it is disengaged from the rod cover.
 - 2.6.1.6 Remove the M3 assembly (2-120) from the open end of the rod cover (2-60).
- 2.6.2 Disassembly of the M3 assembly from the rod cover (2-69) - For actuators manufactured March 1982 through December 1990.
 - 2.6.2.1 With the rod cover (2-60) on a workbench, lubricate M3 assembly (2-120) threads with lubricant.

- 2.6.2.2 Loosen and rotate nut seal (2-130) all the way back to the welded nut.
- 2.6.2.3 Rotate the M3 assembly (2-120) into rod cover (2-60) until the pin and washer are exposed.
- 2.6.2.4 Using a small pin punch, drive out and remove the pin.
- 2.6.2.5 Remove the washer.
- 2.6.2.6 Rotate the M3 assembly (2-120) out and remove.
- 2.6.2.7 Remove seal nut (2-130) from the M3 stud.
- 2.6.3 Disassembly of the M3 assembly from the rod cover (2-60) - For actuators manufactured July 1978 through February 1982.
 - 2.6.3.1 With the rod cover (2-60) on a workbench, lubricate M3 assembly (2-120) threads with lubricant.
 - 2.6.3.2 Loosen and rotate seal nut (2-130) all the way back to the welded nut.
 - 2.6.3.3 Rotate the M3 assembly (2-120) into rod cover (2-60) until the retaining screw is exposed.
 - 2.6.3.4 Remove the retaining screw from the M3.
 - 2.6.3.5 Rotate the M3 assembly (2-120) out and remove.
 - 2.6.3.6 Remove seal nut (2-130) from the M3 stud.
- 2.6.4 Disassembly of the M3 assembly from the rod cover (2-60) - For actuators manufactured prior to July 1978.
 - 2.6.4.1 With the rod cover (2-60) on a workbench, lubricate M3 assembly (2-120) threads with lubricant.
 - 2.6.4.2 Loosen nut seal (2-130).
 - 2.6.4.3 Rotate the M3 assembly (2-120) out and remove.
 - 2.6.4.4 Remove seal nut (2-130) from the M3 stud.

SECTION 3 – ACTUATOR REASSEMBLY

3.1 GENERAL REASSEMBLY

NOTE: Review Section 1 General Service Information prior to starting Section 3.

CAUTION: Only new seals, which are still within the seal's expectant shelf life, should be install into actuator being refurbished.

3.1.1 Remove and discard all seals and gaskets.

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

3.1.3 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.

3.1.4 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 Section 1.6.

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

3.2 HOUSING REASSEMBLY

NOTE: Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with housing reassembly.

NOTE: The parts and seals used in the actuator housing (1-10) will be assembled using lubricant as identified in Section 1.6

3.2.1 Apply lubricant to the yoke bore in housing (1-10) and the raised ribs in bottom of housing (1-10).

3.2.2 Install one o-ring seal (6-20) into seal groove in the housing bore. Refer to Section 4.3, step 4.3.1, for "B" model yoke o-ring information.

NOTE: The Bettis Service Kit will contain two sets of o-ring seals for item (6-20). One set will fit the current model HD Series actuators while the larger outer diameter o-ring seal set will fit the early model HD Series actuators.

3.2.3 Lubricate yoke (1-140) with a generous amount of lubricant to all bearing surfaces and slots in the upper and lower arms.

3.2.4 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).

3.2.5 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).

3.2.6 Apply a coat of lubricant to rod bushing (2-40), grooved rod bushing (2-50) and piston rod (2-10).

3.2.7 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).

3.2.8 Install piston rod (2-10), with rod bushing (2-40) into housing (1-10).

3.2.9 Slide rod bushing (2-40) along piston rod (2-10) and into side of housing (1-10).

3.2.10 Install grooved rod bushing (2-50) over exposed piston rod (2-10) and into the left side of housing (1-10).

3.2.11 Coat yoke pin (1-40) with lubricant and install through piston rod (2-10) into lower yoke roller (1-50).

3.2.12 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).

3.2.13 Install jam nuts (1-70) and gasket seals (6-90) onto stop screws (1-60). Refer to Section 4.3, step 4.3.4, for information concerning early model actuator stop screw gasket seals.

3.2.14 Install stop screws (1-60), with gasket seals (6-90) and stop screw jam nuts (1-70), into housing (1-10).

3.2.15 Coat the yoke bore in housing cover (1-20) with lubricant.

3.2.16 Coat remaining o-ring seal (6-20) with lubricant and install into housing cover (1-20). Refer to Section 4.3, step 4.3.1, for information concerning HD "B" series yoke o-rings.

3.2.17 Install cover gasket (6-60) onto housing (1-10).

3.2.18 Install housing cover (1-20) onto housing (1-10).

3.2.19 Install four gasket seals (6-100) onto hex cap hex screws (1-30). Refer to Section 4.3, step 4.3.5, for information when gasket seals have not been in prior use for this location.

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

3.3 PRESSURE CYLINDER REASSEMBLY

NOTE: Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with pressure cylinder reassembly.

NOTE: The parts and seals used in the actuator cylinder assembly (3) or (3-10) will be assembled using lubricant as identified in Section 1.6.

3.3.1 If the actuator cylinder is equipped with a M3 or M3HW assembly and it was removed then reassemble cylinder assembly M3 (3-10) per appropriate steps in Section 3.5.

3.3.2 Coat rod seal (6-30) with lubricant and install, lip first, into cylinder adapter (2-30). Refer to Section 4.3, step 4.3.2, 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).

3.3.3 Install cylinder adapter gasket (6-70) onto the right end of housing (1-10) for standard construction actuators.

3.3.4 Install four gasket seals (6-80) onto four ferry cap screws (2-90). Refer to Section 4.3, step 4.3.6, for information pertaining to the past use of lock washers in this location.

CAUTION: Care should be taken to not scratch or damage the piston rod when installing the cylinder adapter (2-30).

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

NOTE: Arrange cylinder adapter (2-30) with the pressure inlet port in the same position as recorded in Section 2 step 2.1.6.3. The location of the port may be different on your actuator depending on customer, plumbing, and accessory requirements.

3.3.6 Install and tighten four ferry cap screws (2-90), with gasket seals (6-80), through cylinder adapter (2-30) and into housing (1-10).

3.3.7 If removed, install a pipe plug (2-110) into cylinder adapter (2-30) pressure port location as recorded in Section 2 step 2.1.6.

3.3.8 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.

3.3.9 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 (2-10).

3.3.10 Install piston (2-20) onto piston rod (2-10). NOTE: One side of piston (2-20) has a raised boss in the center that is counter bored to accept the o-ring installed in step 3.3.9. The counter bore side of the piston should be installed against the shoulder of piston rod (2-10) and over o-ring seal (6-50).

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

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

3.3.12 Torque tighten light hex Lok nut (2-70) to 146 foot pounds / 198 N-m ± 5 % lubricated.

3.3.13 Piston Seal Installation:

3.3.13.1 Standard and High Temperature actuators:

3.3.13.1.1 Coat two u-cup seals (6-10) with lubricant.

3.3.13.1.2 Install one u-cup seal (6-10) into the innermost piston seal groove. The lip of the cup seal should point outward toward the outside edge of the piston.

3.3.13.1.3 Install one u-cup seal (6-10) into the outermost piston seal groove. The lip of the cup seal should point outward toward the outside edge of the piston.

3.3.13.2 Low Temperature or trim -11 T-Seal Set installation as follows:

NOTE: The low temperature T-seal is composed of one rubber seal and two split skive-cut back-up rings.

3.3.13.2.1 Coat piston outer diameter seal grooves with lubricant.

3.3.13.2.2 Apply lubricant to one T-seal (6-10). T-Seal is composed of one rubber seal and two skive-cut back-up rings.

3.3.13.2.3 Install T-seal into piston outboard seal groove.

3.3.13.2.4 Install a back-up ring on each side of the T-seal. NOTE: When installing the back-up rings, do not align the skive-cuts.

NOTE: 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.

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

3.3.15 Apply a coating of lubricant to the cylinder outer diameter threads and the entire bore of cylinder (3-10).

3.3.16 Install cylinder (3) or (3-10) over piston (2-20). Rotate the cylinder clockwise and screw into the cylinder adapter.

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

3.3.17 Using a chain wrench tighten cylinder (3) or (3-10) into cylinder adapter (2-30).

NOTE: While the chain wrench is still positioned on the cylinder and after the cylinder is tight, take a mallet and rap (hit) the chain wrench handle a couple of times. This will seat the cylinder assembly into the o-ring seal located in the cylinder adapter. Repeat this step if during testing the area between the cylinder assembly and the cylinder adapter is leaking pressure at an unacceptable rate.

3.3.18 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).

3.3.19 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.

3.4 ROD COVER REASSEMBLY

3.4.1 If the actuator was equipped with a M3 or M3HW assembly and was removed from the rod cover then pre-assemble per section 3.5.

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

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

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

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

3.5 M3 JACKSCREW REASSEMBLY TO ROD COVER AND CYLINDER ASSEMBLY

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 15 for a M3 jackscrew description that is installed on the actuator being reassembled.

3.5.1 Reassembly of M3 jackscrews for actuators manufactured after December, 1990 (current M3 design).

3.5.1.1 Rod Cover M3 Reassembly.

3.5.1.1.1 Apply a light coating of lubricant to the threads of M3 assembly (2-120).

3.5.1.1.2 Insert the M3 assembly (2-120) through the open end of the rod cover (2-60). Rotate the M3 into the rod cover end cap until the end of the assembly protrudes out of the rod cover.

3.5.1.1.3 Rotate the M3 until the retaining washer/nut comes into contact with the inside of the rod cover.

3.5.1.1.4 Install seal nut (3-30) onto the M3 assembly (2-120). Rotate the seal nut until it is up against the rod cover.

3.5.1.1.5 Rotate the slotted nut onto the outboard end of the M3 stud with the slot facing toward the rod cover. Rotate 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.

3.5.1.1.6 Insert the roll 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.

3.5.1.1.7 Rotate seal nut until fully tight against the rod cover.

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

3.5.1.2 Cylinder Assembly M3 Reassembly.

3.5.1.2.1 Apply a light coating of lubricant to the threads of M3 assembly (3-20).

3.5.1.2.2 Insert the M3 assembly (3-20) through the open end of the cylinder (3-10). Rotate the M3 into the cylinder end cap until the end of the assembly protrudes out of the cylinder.

3.5.1.2.3 Rotate the M3 until the retaining washer/nut comes into contact with the inside of the cylinder (3-10).

3.5.1.2.4 Install seal nut (3-30) onto the M3 assembly (3-20). Rotate the seal nut until it is up against the cylinder (3-10).

3.5.1.2.5 Rotate the slotted nut onto the outboard end of the M3 stud with the slot facing toward the cylinder (3-10) end cap. Rotate 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.

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

3.5.1.2.7 Rotate seal nut until fully tight against the cylinder (3-10).

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

3.5.2 Reassembly of M3 Jackscrew to rod cover (2-60) manufactured March 1982 through December 1990 (current M3 design).

3.5.2.1 If removed, install seal nut (2-130) onto the inboard end of jackscrew assembly (2-120) with the insert side facing away from the retaining nut.

3.5.2.2 Rotate seal nut (2-130) until it is up against the retaining nut.

3.5.2.3 Apply a generous coating of lubricant to jackscrew assembly threads.

3.5.2.4 Rotate jackscrew assembly (2-120) into the outer end of rod cover (2-60). Rotate jackscrew assembly (2-120) until the end of the jackscrew assembly protrudes out of the open end of rod cover (2-60).

3.5.2.5 Install a flat washer and spirol pin onto the turndown end of jackscrew assembly (2-120).

3.5.2.6 Rotate jackscrew assembly (2-120) until the flat washer just comes into contact with the end cap of rod cover (2-60).

3.5.2.7 Rotate seal nut (2-130) until fully tight against rod cover (2-60).

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

3.5.3 Reassembly of M3 Jackscrews to rod cover (2-60) manufactured July 1978 through February 1982.

3.5.3.1 If removed, install seal nut (2-130) onto jackscrew assembly (2-120) with the insert side facing away from the retaining nut.

3.5.3.2 Rotate seal nut (2-130) until it is up against the retaining nut.

3.5.3.3 Apply a generous coating of lubricant to the threads of jackscrew assembly (2-120).

3.5.3.4 Rotate jackscrew assembly (2-120) into the end cap of rod cover (2-60) until the end of the jackscrew assembly protrudes out of the open end of rod cover (2-60).

3.5.3.5 To retain jackscrew assembly (2-120) in rod cover (2-60) install hex cap screw into the threaded hole in the turndown area of the jackscrew assembly (2-120).

3.5.3.6 Rotate jackscrew assembly (2-120) until the retaining screw just comes into contact with the end cap of rod cover (2-60).

3.5.3.7 Rotate seal nut (2-130) until fully tight against rod cover (2-60).

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

3.5.4 Reassembly of M3 jackscrew to rod cover (2-60) manufactured prior to July 1978.

3.5.4.1 If removed, install seal nut (2-130) onto jackscrew assembly (2-120) with the insert side facing away from the retaining nut.

3.5.4.2 Rotate seal nut (2-130) until it is up against the retaining nut.

3.5.4.3 Apply a generous coating of lubricant to the threads of jackscrew assembly (2-120).

3.5.4.4 Rotate jackscrew assembly (2-120) into the end cap of rod cover (2-60). Rotate jackscrew assembly (2-120) until the end of the jackscrew assembly protrudes just out of the end cap of rod cover (2-60).

3.5.4.5 Rotate seal nut (2-130) until fully tight against end cap of rod cover (2-60).

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

3.6 **ACTUATOR TESTING**

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

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

3.6.2 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.

3.6.3 Before testing for leaks, alternately apply and release pneumatic pressure, as listed in step 3.6.2, to each side of the piston to stroke the actuator fully. Repeat this cycle approximately five times. This will allow the new seals to seek their proper service condition.

3.6.4 Apply pneumatic pressure, as listed in step 3.6.2, to the pressure inlet port in cylinder adapter (2-30).

3.6.5 Apply leak-testing solution to the following areas:

3.6.5.1 Form a leak testing solution bubble over the inlet porthole 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.

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

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

- 3.6.5.4 The snubber porthole located in top of housing (1-10), checks the cylinder adapter to piston rod seal.
- 3.6.6 Remove pressure from the pressure inlet port in cylinder adapter (2-30).
- 3.6.7 Apply pneumatic pressure, as listed in step 3.6.2, to the inlet port in outboard end of cylinder (3) or (3-10).
- 3.6.8 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.
- 3.6.9 Remove pressure from the inlet port in the outboard end of cylinder (3) or (3-10).

3.7 RETURN TO SERVICE

- 3.7.1 Replace the software components of snubber (1-130) and then install the snubber into the top of housing (1-10).
- 3.7.2 Adjust both stop screws (1-60) back to settings recorded in Section 2 step 2.1.6 under General Disassembly.
- 3.7.3 Tighten both jam nuts (1-70) securely, while holding stop screws (1-60).
- 3.7.4 For actuators equipped with M3 jackscrew and require an optional handwheel, M3HW, install the handwheel (8-10) using the following procedure:
 - 3.7.4.1 Place handwheel (8-10) onto the nut. The handwheel hub has a cast hexagon hole that fits over the nut.
 - 3.7.4.2 Place lock washer (8-20) onto M3 up against handwheel hub.
 - 3.7.4.3 Place hex nut (8-30) onto M3 and rotate up against lock washer, tighten until lock washer is flat.
- 3.7.5 Check yoke position indicator/yoke weather cover screws (1-120) for tightness.
- 3.7.6 After actuator is reinstalled on the device it is to operate all accessories should be hooked up, leak tested, and then tested for proper operation and replaced if found defective.
- 3.7.7 The actuator should now be ready to return to service.

SECTION 4 – ACTUATOR SUPPORT INFORMATION

4.1 ACTUATOR WEIGHT TABLE

ACTUATOR MODEL	APPROXIMATE WEIGHT (1)		ACTUATOR MODEL	APPROXIMATE WEIGHT (1)	
	Lbs.	Kg		Lbs.	Kg
HD521	79	35.9	HD721	100	45.4
HD521-M3	89	40.3	HD721-M3	110	49.8
HD521-M3HW	99	44.9	HD721-M3HW	120	54.4

NOTE: (1) Weights listed for each model are for bare actuators without valve mounting brackets and accessories.

4.2 TOOL TABLE

TOOL STYLE AND WRENCH SIZES				
ITEM NO.	ITEM QTY.	WRENCH SIZE (1)	DESCRIPTION OR LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	9/16"	Cover Screws	Socket
1-60	2	3/8"	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 (2)
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 (2)
2-100	4	7/16"	Ferry Cap Screws	12 Point Socket (2)
2-110	1	7/16"	Pipe Plug	Open End
2-130	1	1-13/16"	M3 Seal Nut	Open End or Adjustable
3	1	(3)	Cylinder Assembly	Chain Wrench (2)
3-10	1	(3)	Cylinder Assembly –M3	Chain Wrench (2)
8-30	1	1-13/16"	M3 Seal Nut	Open End or Adjustable

NOTES:

- (1) All tools / Hexagons are American Standard inch (Imperial).
- (2) No alternate style tool recommended.
- (3) Bettis recommends a short handled Chain Wrench with a minimum 40 inch / 101.6 cm chain.

4.3 PRODUCR IMPROVEMENT AND REVISIONS

4.3.1 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.

- 4.3.2 HD-SR actuators manufactured through the late 1970's where originally shipped with a rod seal and an 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.
- 4.3.3 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.
- 4.3.4 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.
- 4.3.5 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.
- 4.3.6 Early model actuators used lock washers on the cylinder adapter retaining screws (2-90). During the early 1970's the lock washers where 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.
- 4.3.7 All asbestos has been eliminated from the gasket material used in Bettis Actuators. The current gasket material used is Non Asbestos Synthetic Fiber.
- 4.3.8 Original style M3 jackscrew with handwheel was a weldment and the handwheel was not removable.
- 4.3.9 Early model actuators used socket cap screws instead of ferry cap screws as cylinder adapter (2-30) and rod cover (2-60) retaining screws.
- 4.3.10 Actuators manufactured after mid year 2000 may not have a pipe plug, item (1-100), in the housing (1-10).

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Released	March 2002	A	COMPILED	B. Cornelius	27 March 2002
			CHECKED	B. Cornelius	27 March 2002
			APPROVED	T. Jeansonne	27 March 2002

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