

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODELS

HD522, HD722 AND HD732

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, HD522, HD522-M3, HD522-M3HW, HD722, HD722-M3, HD722-M3HW, HD732, HD732-M3, and HD732-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 036278..

1.4.2 Exploded Detail Drawing 063353 for HD522 and HD722 actuators.

1.4.3 Exploded Detail Drawing 068111 for HD722-M3 and HD722-M3HW actuators.

1.4.4 Exploded Detail Drawing 063356 for HD732 actuators.

1.4.5 Exploded Detail Drawing 068112 for HD732-M3 and HD732-M3HW actuators.

* Exploded Detail drawings contained in 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 HD522, HD722 or HD732 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 DISASSEMBLY

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

NOTE: The following steps may be performed on one cylinder and then on the other cylinder or simultaneously on both cylinders.

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 (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 piston hex lock nut (2-70) from piston rod (2-10).

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

NOTE: Identify each cylinder adapter (2-30) left or right and record their inlet port locations.

2.2.5 Unscrew and remove the four ferry screws (2-90) and gasket seals (6-80) from the cylinder adapter (2-30). Refer to Section 4.3, step 4.3.6 for information when ferry cap screws are not used in this location.

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

2.2.7 For actuators equipped with M3 or M3HW assembly, it is not necessary to disassemble the M3 Jackscrew from cylinder (3-10). If the M3 stud or nut seal (3-30) needs replacement then refer to Section 2.4 for cylinder assembly M3 disassembly.

2.3 HOUSING DISASSEMBLY

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

- 2.3.1 Remove the snubber (1-130) from top of housing (1-10).
 - 2.3.2 Remove socket cap screws (1-120) from position indicator (1-110). Refer to Section 4 step 4.3.3 for information early model actuators and the use of a weather cover.
 - 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 hex cap screws (1-30) with seal gaskets from housing cover (1-20).
 - 2.3.5 Remove housing cover (1-20) from the top of housing (1-10).
- NOTE: Housing cover has a tight fit and will 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 in the cavity of housing (1-10).
 - 2.3.7 Remove the upper yoke roller (1-50) from yoke pin (1-40).
 - 2.3.8 Remove yoke pin (1-40) from yoke arms of yoke (1-140).
 - 2.3.9 Holding rod bushings (2-40) in place, remove piston rod (2-10) out through the rod bushings (2-40).
 - 2.3.10 Remove both rod bushings (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 Remove stop screws (1-60), jam nuts (1-70), and gasket seals (6-90). Be sure to identify the stop screws left and right.
- 2.3.14 It is not necessary to remove pipe plugs (2-110) from cylinder adapters (2-30).

2.4 JACKSCREW DISASSEMBLY FROM CYLINDER ASSEMBLY M3

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

- 2.4.1 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured after December 1990 (current M3 design).
 - 2.4.1.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.4.1.2 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).
 - 2.4.1.3 Remove the slotted nut from jackscrew assembly (3-20).
 - 2.4.1.4 Loosen and rotate seal nut (3-30) off of jackscrew assembly (3-20).
 - 2.4.1.5 Rotate jackscrew assembly (3-20) into cylinder (3-10) until it is disengaged from the cylinder end cap.
 - 2.4.1.6 Remove jackscrew assembly (3-20) from the open end of cylinder (3-10).
- 2.4.2 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured March 1982 through December 1990.
 - 2.4.2.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.4.2.2 Loosen and rotate seal nut (3-30) all the way back to the welded nut.
 - 2.4.2.3 Rotate jackscrew assembly (3-20) into cylinder (3-10) until the pin and washer are exposed.
 - 2.4.2.4 Using a 3/16 inch pin punch, drive out and remove the pin.
 - 2.4.2.5 Remove the washer.
 - 2.4.2.6 Rotate jackscrew assembly (3-20) out and remove from the cylinder.
 - 2.4.2.7 Remove seal nut (3-30) from the M3 jackscrew stud.
- 2.4.3 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured July 1978 through February 1982.
 - 2.4.3.1 With cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.4.3.2 Loosen and rotate seal nut (3-30) all the way back to the welded nut.
 - 2.4.3.3 Rotate jackscrew assembly (3-20) into cylinder (3-10) until the retaining screw is exposed.
 - 2.4.3.4 Remove the retaining screw from the M3.
 - 2.4.3.5 Rotate the jackscrew assembly (3-20) out and remove from the cylinder.

- 2.4.3.6 Remove seal nut (3-30) from the M3 jackscrew stud.
- 2.4.4 Disassembly of the M3 assembly from the cylinder (3-10) - For actuators manufactured prior to July 1978.
 - 2.4.4.1 With the cylinder (3-10) on a workbench, lubricate jackscrew assembly (3-20) threads with lubricant.
 - 2.4.4.2 Loosen seal nut (3-30).
 - 2.4.4.3 Rotate the jackscrew assembly (3-20) out and remove from the cylinder.
 - 2.4.4.4 Remove seal nut (3-30) from the M3 jackscrew 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

NOTE: Position housing (1-10) so that the yoke bore is nearest to you.

3.2.1 In the bottom area of housing (1-10) apply lubricant to the cast raised ribs, to the yoke bore and inner diameter seal groove.

3.2.2 Coat one o-ring seal (6-20) with lubricant and install into the seal groove located in the yoke bore in the bottom area of housing (1-10). 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.

NOTE: The wide yoke arm should be installed toward the top of housing (1-10).

3.2.4 Install yoke (1-140) into the cavity of housing (1-10).

3.2.5 Coat two rod bushings (2-40) with lubricant and install one into each end of housing (1-10).

3.2.6 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).

3.2.7 Apply lubricant to piston rod (2-10) and install through both bushings (2-40) in housing (1-10).

3.2.8 Coat yoke pin (1-40) with lubricant and install through the slot in the upper arm of yoke (1-140), through piston rod (2-10) and into lower yoke roller (1-50).

3.2.9 Coat remaining yoke roller (1-50) with lubricant and install over yoke pin (1-40) and into the slot of the upper arm of yoke (1-140).

3.2.10 Apply lubricant to the yoke bore and seal groove of housing cover (1-20).

3.2.11 Coat o-ring seal (6-20) with lubricant and install into the seal groove in the yoke bore area of housing cover (1-20). Refer to Section 4 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.

3.2.12 Install cover gasket (6-60) onto top area of housing (1-10).

3.2.13 Install housing cover (1-20) over cover gasket (6-60) and onto top area of housing (1-10).

3.2.14 Install four gasket seals onto four hex cap screws (1-30) as follows:

NOTE: Refer to Section 4 step 4.3.5 for information when gasket seals have not been in prior use for this location.

3.2.14.1 HD522 and HD722 install gasket seals (6-100) onto hex cap screws (1-30).

3.2.14.2 HD732 install gasket seals (6-80) onto hex cap screws (1-30).

3.2.15 Install four hex cap screws (1-30) with gasket seals through housing cover (1-20) and into housing (1-10) and 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 following steps may be performed on one cylinder and then on the other cylinder or simultaneously on both cylinders.

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 3.4.

3.3.2 Coat the piston rod seal (6-30) with lubricant and install, lip first, into the cylinder adapter (2-30). Refer to Section 4 step 4.3.2 for information pertaining to early model actuator 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 the adapter gasket (6-70) over the piston rod (2-10), rod bushing (2-40) and up against the housing (1-10).

3.3.4 Install four gasket seals (6-80) onto four ferris cap screws (2-90). NOTE: Refer to Section 4 step 4.3.6 for information pertaining to the use of lockwashers in this location.

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

3.3.5 Install the cylinder adapter (2-30) over the end of the 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 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 the cylinder adapter (2-30) pressure port location as recorded in Section 2 step 2.1.6.

3.3.8 Coat the cylinder adapter o-ring seal (6-40) with lubricant and install into the cylinder adapter (2-30). NOTE: Install the o-ring seal into the groove at 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 seal 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 hex lock nut (2-70) the flat side of the nut 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 Temp Actuators:

3.3.13.1.1 Coat piston outer diameter seal grooves with lubricant.

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

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

3.3.13.1.4 Install one u-cup seal (6-10) into outermost piston seal groove. The lip of the cup seal should point outward toward the outside 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) or (3-10).

CAUTION: Exercise caution during cylinder installation to prevent pinching lip of the u-cup seal during installation. It is necessary to depress the seal lip while working the cylinder over it.

3.3.16 Install the cylinder (3) or (3-10) over the 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 welded 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 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).

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.

- 3.3.20 Install gasket seals (6-90) and hex jam nuts (1-70) onto stop screws (1-60).
- 3.3.21 Install stop screws (1-60) with gasket seals (6-90) and hex jam nuts (1-70) into housing (1-10) in the position as recorded in Section 2 step 2.1.6.1.
- 3.3.22 Adjust both stop screws (1-60) back to settings recorded in Section 2 step 2.1.6.2.
- 3.3.23 Tighten both hex jam nuts (1-70) securely, while holding stop screws (1-60).

3.4 **M3 JACKSCREW REASSEMBLY TO PRESSURE CYLINDER**

NOTE: Review Section 3 steps 3.1.1 thru 3.1.5 General Reassembly before proceeding with 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 3.4 for a M3 jackscrew description that is installed on the actuator being reassembled.

- 3.4.1 Reassembly of M3 jackscrew for actuators manufactured after 1990 (current M3 design).
 - 3.4.1.1 Apply a light coating of lubricant to the threads of jackscrew assembly (3-20).
 - 3.4.1.2 Insert the jackscrew assembly (3-20) through the open end of cylinder (3-10). Rotate the jackscrew into the cylinder end cap until the end of the assembly protrudes out of the end cap of the cylinder.
 - 3.4.1.3 Rotate the jackscrew until the M3 retainer comes into contact with the inside of the cylinder end cap.
 - 3.4.1.4 Install seal nut (3-30) onto the jackscrew assembly (3-20). Rotate the seal nut until it is up against the cylinder end cap.

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.**

- 3.4.1.5 Rotate the slotted nut onto the outboard end of the jackscrew stud with the slot facing toward the cylinder end cap. Rotate the nut until one of the slots in the nut is aligned with the cross drilled "through hole" in the stud.
- 3.4.1.6 Insert the roll pin through the slotted nut and through the jackscrew stud making sure that equal amounts of the roll pin is exposed on both sides of the slotted nut and the jackscrew stud.
- 3.4.1.7 Rotate the nut seal until fully tight against end cap.

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

3.4.2 Reassembly of M3 Jackscrew for actuators manufactured 1982 through 1990.

- 3.4.2.1 If removed, install nut seal (3-30) onto jackscrew assembly (3-20) with the insert side facing away from the retaining nut.
- 3.4.2.2 Rotate the nut seal until it is up against the retaining nut.
- 3.4.2.3 Apply a generous coating of lubricant to the M3 threads.
- 3.4.2.4 Rotate the jackscrew assembly (3-20) into the cylinder end cap. Rotate the jackscrew until the end of the assembly protrudes out of the threaded end of the cylinder.
- 3.4.2.5 Install a washer and pin onto the turndown end of the M3.
- 3.4.2.6 Rotate the jackscrew until the washer just comes into contact with the cylinder end cap.
- 3.4.2.7 Rotate nut seal until fully tight against end cap.

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

3.4.3 Reassembly of M3 Jackscrew for actuators manufactured July 1978 through 1981.

- 3.4.3.1 If removed, install nut seal (3-30) onto jackscrew assembly (3-20) with the insert side facing away from the retaining nut.
- 3.4.3.2 Rotate the nut seal until it is up against the retaining nut.
- 3.4.3.3 Apply a generous coating of lubricant to the M3 threads.
- 3.4.3.4 Rotate the jackscrew assembly (3-20) into the cylinder end cap. Rotate the jackscrew until the end of the assembly protrudes out of the threaded end of the cylinder.
- 3.4.3.5 To retain the M3 in the cylinder, screw a hex head cap screw into the threaded hole in the turndown area of the M3 stud.
- 3.4.3.6 Rotate the jackscrew until the retaining screw just comes into contact with the cylinder end cap.
- 3.4.3.7 Rotate nut seal until fully tight against end cap.

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

- 3.4.4 Reassembly of M3 Jackscrew for actuators manufactured before July 1978.
- 3.4.4.1 If removed, install nut seal (3-30) onto jackscrew assembly (3-20) with the insert side facing away from the retaining nut.
 - 3.4.4.2 Rotate the nut seal until it is up against the retaining nut.
 - 3.4.4.3 Apply a generous coating of lubricant to the M3 threads.
 - 3.4.4.4 Rotate the jackscrew assembly (3-20) into the cylinder end cap until the end of the assembly protrudes just out of the cylinder end cap.
 - 3.4.4.5 Rotate nut seal until fully tight against end cap.

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

3.5 ACTUATOR TESTING

- 3.5.1 All areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. 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.
- 3.5.2 Before leak testing may be accomplished, it will be necessary to provide a piping system whereby pressure may be applied simultaneously to all common pressure ports

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

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

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

- 3.5.4 Simultaneously apply pressure, as defined in step 3.5.3, to each side of the pistons to stroke the actuator fully in each direction. Repeat this cycle approximately five times. This will allow the new seals to seek their service condition.
- 3.5.5 Simultaneously apply pressure, as defined in step 3.5.3, to the pressure ports in the end of the right side cylinder (3) or (3-10) and in the left side cylinder adapter (2-30).
- 3.5.6 Apply leak testing solution to the following areas:
- 3.5.6.1 The pressure inlet port in the right side cylinder adapter (2-30), checks piston to cylinder and piston to piston rod seals.
 - 3.5.6.2 The pressure inlet port hole in the end of the left side cylinder, checks the piston to cylinder wall and piston to piston rod seals.

3.5.6.3 The threaded joint between the left side cylinder and left side cylinder adapter (2-30) checks the cylinder to cylinder adapter o-ring seal.

3.5.6.4 The joint between the left cylinder adapter and the housing.

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

3.5.7 Remove pressure from the pressure ports in the end of the right side cylinder (3) or (3-10) and in the left side cylinder adapter (2-30).

3.5.8 Simultaneously apply pressure, as defined in step 3.5.3, to the pressure ports in the end of the left side cylinder (3) or (3-10) and in the right side cylinder adapter (2-30).

NOTE: If excessive leakage is noted, generally a leak testing solution bubble which is formed over the area that is to be checked and this bubble breaks three seconds or less after starting to form, the actuator must be disassembled and the cause of leakage must be determined and corrected.

3.5.9 Apply leak testing solution to the following areas:

3.5.9.1 The pressure inlet port in the left side cylinder adapter (2-30), checks piston to cylinder and piston to piston rod seals.

3.5.9.2 The pressure inlet port hole in the end of the right side cylinder, checks the piston to cylinder wall and piston to piston rod seals.

3.5.9.3 The threaded joint between the right side cylinder and right side cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.

3.5.9.4 The joint between the right side cylinder adapter and the housing.

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

3.5.10 Remove pressure from the pressure ports in the end of the left side cylinder (3) or (3-10) and in the right side cylinder adapter (2-30).

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

3.6 RETURN TO SERVICE

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

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

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

- 3.6.4 For actuators equipped with a M3 jackscrew assembly (3-20) and require an optional handwheel, install handwheel (8-10) using the following procedure: Refer to information note step 4.39 for old style M3 handwheel.
- 3.6.4.1 Place the handwheel (8-10) onto jackscrew assembly (3-20) and over the pinned slotted nut. NOTE: The hub of handwheel (8-10) has a cast hexagon hole that fits over the pinned slotted nut.
- 3.6.4.2 Place lockwasher (8-20) onto jackscrew assembly (3-20) up against handwheel hub.
- 3.6.4.3 Install and tighten hex nut (8-30) onto jackscrew assembly (3-20) and screw nut up against lockwasher (8-20).
- 3.6.5 Check yoke position indicator/yoke weather cover screws (1-120) for tightness
- 3.6.6 After actuator is reinstalled on the device it is to operate, all accessories, should be hooked up and tested for proper operation and replaced, if found defective.
- 3.6.7 The actuator is now ready for returning to service.

SECTION 4 – ACTUATOR SUPPORT INFORMATION

4.1 **ACTUATOR WEIGHT TABLE**

ACTUATOR MODEL	APPROXIMATE WEIGHT **		ACTUATOR MODEL	APPROXIMATE WEIGHT **	
	Lbs	Kg		Lbs	Kg
HD522	108	49	HD722-M3HW	145	65
HD522-M3	118	53	HD732	207	93
HD522-M3HW	123	55	HD732-M3	217	98
HD722	125	56	HD732-M3HW	227	103
HD722-M3	135	61			

** Weights listed for each model are for bare actuators without valve mounting brackets and accessories.

4.2 TOOL TABLE

HD-SR/M3/HW TOOL STYLE AND WRENCH SIZES					
ITEM NO.	ITEM QTY.	WRENCH SIZE		DESCRIPTION OR LOCATION	RECOMMENDED WRENCH STYLE
		HD522/722	HD732 WR		
1-30	4	9/16"	3/4"	Cover Screws	Socket
1-60	2	3/8" (4)	1/2" (5)	Stop Screws	Open End or Adjustable
1-70	2	15/16"	1-5/16"	Hex Jam Nut	Open End or Adjustable
1-100	1	7/16"	7/16"	Pipe Plug	Open End
1-120	4	3/16"	3/16"	Socket Cap Screws	Allen (1)
1-130	1	7/8"	7/8"	Snubber Valve	Deep Socket
2-70	2	1-1/4"	1-5/8"	Standard Hex Nut	Socket
2-90	8	7/16"	1/2"	Ferry Cap Screws	12 Point Socket (1) (3)
2-110	1	7/16"	7/16"	Pipe Plug	Open End
3	1	(2)	(2)	Cylinder Assembly	Chain Wrench (1)
3-10	1	(2)	(2)	Cylinder Assembly	Chain Wrench (1)
3-30	1	1-13/16"	1-13/16"	M3 Seal Nut	Open End or Adjustable
8-30	1	1-13/16"	1-13/16"	Heavy Hex Nut	Open End or Adjustable
-	1	1-13/16"	1-13/16"	M3 Slotted Hex Nut	Open End or Adjustable

- (1) No alternate style tool recommended.
- (2) Bettis recommends a short handled Chain Wrench with a 40" inch chain.
- (3) Early models used socket head cap screws - wrench style will change to Allen.
- (4) Actuators manufactured prior to 1980 used square head stop screws - wrench size changes to 1/2" inch Open End or Adjustable.
- (5) Actuators manufactured prior to middle of 1994 used square head stop screws - wrench size changes to 5/8" inch Open End or Adjustable.

4.3 INFORMATION NOTES

- 4.3.1 On HD series "B" models the yoke o-ring grooves are machined into the yoke journals. On the HD series "C" and current models the yoke o-ring grooves are machined into the housing cover and into the housing.
- 4.3.2 HD 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.
- 4.3.3 Early model actuators may not have a position indicator or a weather cover. These items may be added 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 (6-80) or (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.
- 4.3.6 Early model actuators used lockwashers on the cylinder adapter retaining screws (2-90). During the early 1970 the lockwashers 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 lockwashers.
- 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 Old style M3 jackscrew with handwheel was of one piece construction and the handwheel is not removable or replaceable as an option.
- 4.3.9 Actuators manufactured after mid-year 2000 may not have a pipe plug, item (1-100), in the housing (1-10).

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