

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODELS

HDXX1-SR-M11

SPRING RETURN SERIES PNEUMATIC

ACTUATORS WITH MANUAL HYDRAULIC

OVERRIDE PACKAGE

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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-SR-M11, HD721-SR-M11 and HD731-SR-M11 Spring Return Series Pneumatic Actuators with -H override cylinder. NOTE: Actuator models may not have a M11 override but may have a -H Hydraulic Override Cylinder without an -M11 Override System.

NOTE: When actuator model number has "-S" as a suffix then 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, allowing the spring to stroke and rotate the actuator to its fail position.

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 (item reference number) used on the Bettis Assembly Drawing and actuator parts lists.

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 groove, use a commercial seal removing tool or a small standard screwdriver with the sharp edges rounded off.

CAUTION: Apply 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.

1.1.12 This procedure does not include M11 Disassembly and Reassembly Instructions. Bettis does not recommend periodic maintenance for the M11 itself. The Manual Hydraulic Override needs only to be serviced when it malfunctions.

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.

1.3 **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 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 customer's representative and an authorized Bettis representative.

1.4 **BETTIS REFERENCE MATERIALS**

1.4.1 Assembly drawing part numbers 137653.

1.5 **SUPPORT ITEMS AND TOOLS**

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

1.5.2 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). For recommended tool and wrench sizes refer to Section 4 step 4.2.

1.6 LUBRICATION AND FLUID REQUIREMENTS

NOTE: Lubricants and Hydraulic fluids other than those listed in step 1.6.1 and 1.6.2 should not be used without prior written approval of Bettis Product Engineering.

1.6.1 GREASE REQUIREMENTS: 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 or cans and they are marked ESL-4, 5 & 10 lubricant.

1.6.2 FLUID REQUIREMENTS: M11 Manual Hydraulic Override System - All temperature service (-50°F to +350°F)/(10°C to 176.6°C) use Dexron Automatic Transmission Fluid.

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.

WARNING: DO NOT REMOVE SPRING CYLINDER WHILE SPRING IS COMPRESSED

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. with spring cartridge on same end of housing as was, 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 the actuator cylinder assembly (4-10), allowing the spring to stroke. The spring will rotate the yoke to the fail position.

2.1.5 Use a means of capturing the hydraulic fluid that will be lost during the removal or disassembly of the Hydraulic Override or -H Hydraulic Override Cylinder. Use a bucket, tub, and large container, etc.

2.1.6 Mark or record the following:

2.1.6.1 Mark the 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 cylinder adapters (2-30) and (2-140).

2.2 **SPRING CYLINDER DISASSEMBLY**

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

WARNING: When cylinder assembly (4-10) is installed on the actuator, spring cartridge (5) is under compression. Do not remove cylinder assembly (4-10) until actuator has the "pre-load" removed.

2.2.1 Remove stop screw "pre-load" as follows:

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

2.2.1.1 Apply sufficient pneumatic pressure to the pressure inlet port, located in cylinder adapter (2-30), to move the actuator load off of stop screw (1-60).

2.2.1.2 On the front side of housing (1-10) loosen two jam nuts (1-70).

2.2.1.3 On the front side of housing (1-10) unscrew and remove two stop screws (1-60).

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

2.2.2 Remove breather (4-20) from the outboard end of cylinder assembly (4-10).

CAUTION: Due to the weight and nature of a spring cartridge pre-loaded assembly, caution should be exercised when handling spring cartridge (5). The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).

2.2.3 Secure the chain wrench around the cylinder assembly (4-10) as close to the welded end cap as possible. Using a mallet on the handle of the chain wrench, break the cylinder loose from the cylinder adapter (2-30) sufficiently so it can be removed.

WARNING: Do not tilt the open end of cylinder assembly (4-10) down. The spring cartridge (5) is unattached and is only contained by cylinder assembly (4-10).

2.2.4 Remove cylinder assembly (4-10) from cylinder adapter (2-30) by rotating in a counter clockwise direction.

NOTE: When removing and setting cylinder assembly (4-10) aside, care should be taken to protect the chamfered edge and cylinder threads.

2.2.5 Carefully remove spring cartridge (5) from cylinder assembly (4-10) by slightly tilting open end of cylinder down.

WARNING: Spring cartridge (5) is not field repairable. Under no circumstances should spring cartridge (5) be disassembled, as the spring assembly is pre-loaded.

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

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

2.3 HYDRAULIC OVERRIDE CYLINDER DISASSEMBLY

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

2.3.1 Drain the hydraulic fluid from the hydraulic cylinder using the pipe plugs (2-130) located in cylinder adapter (2-140) and the outboard end of cylinder assembly (3-10)..

2.3.2 Remove all piping (plumbing) from the actuator and the M11 Hydraulic Control Package.

2.3.3 If the M11 package is remote mounted then disregard the rest of this step. If the M11 is mounted on the actuator then remove the M11 control package from the actuator.

2.3.4 Secure the chain wrench around the cylinder assembly (3-10) as close to the welded end cap as possible. Using a mallet on the chain wrench handle, break the cylinder loose from the cylinder adapter (2-140) sufficiently so it can be removed.

NOTE: When removing and setting cylinder assembly (3-10) aside, care should be taken to protect the chamfered edge and cylinder threads.

2.3.5 Remove cylinder assembly (3-10) from cylinder adapter (2-140) by rotating in a counter clockwise direction.

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

2.3.7 Remove the piston (2-20) from piston rod (2-10).

NOTE: Identify cylinder adapter (2-140) location and record it's inlet port locations.

2.3.8 Unscrew and remove the four 12-point cap screws (2-90) and gasket seals (6-80) from the cylinder adapter (2-140).

2.3.9 Remove the cylinder adapter (2-140), taking care not to scratch the piston rod (2-10) or disengage the rod bushing (2-40).

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

2.3.10 On spring cylinder side of the actuator, unscrew and remove four 12 point cap screws (2-90) and gasket seals (6-80) from cylinder adapter (2-30).

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

2.4 HOUSING DISASSEMBLY

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

2.4.1 Remove snubber (1-130) from top of housing (1-10).

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

2.4.3 Remove hex cap screws (1-30) from housing cover (1-20).

2.4.4 Remove housing cover (1-20) from 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.

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

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

2.4.7 Remove yoke pin (1-40) from the slot in the upper arm of yoke (1-140).

2.4.8 Holding rod bushings (2-40) in place, pull piston rod (2-10) out through rod bushings.

2.4.9 Remove both rod bushings (2-40) from each end of housing (1-10).

2.4.10 Remove yoke (1-140) from the cavity of 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.

2.4.11 Remove lower yoke roller (1-50) from bottom area of housing cavity.

2.4.12 If the housing has a pipe plug (1-100) it is not necessary to remove it from housing (1-10).

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: Parts and seals used in the actuator housing assembly and pneumatic cylinder with spring cartridge will be assembled using lubricant as identified in Section 1.6 step 1.6.1

NOTE: Parts and seals used in the cylinder assembly (3-10) will be assembled using the hydraulic fluid as identified in Section 1.6 step 1.6.2.

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 step 1.6.1

3.2.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10).

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

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

- 3.2.3 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).
- 3.2.4 Lubricate yoke (1-140) with a generous amount of lubricant to all bearing surfaces and the slot in the upper and lower arms.
- NOTE: The wide arm of yoke (1-140) should be installed toward the top of housing (1-10).
- 3.2.5 Install yoke (1-140) into the bore located in the bottom area of housing (1-10).
- 3.2.6 Coat two rod bushings (2-40) with lubricant and install one into each end of housing (1-10).
- 3.2.7 Coat one yoke roller (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.
- 3.2.8 Apply lubricant to piston rod (2-10) and install through both bushings (2-40) in housing (1-10).
- 3.2.9 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).
- 3.2.10 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).
- 3.2.11 Apply lubricant to the yoke bore and seal groove of housing cover (1-20).
- 3.2.12 Coat o-ring seal (6-20) with lubricant and install into the seal groove in the yoke bore area of housing cover (1-20).
- 3.2.13 Install cover gasket (6-60) onto top area of housing (1-10).
- 3.2.14 Install housing cover (1-20) over cover gasket (6-60) and onto top area of housing (1-10).
- 3.2.15 Install four gasket seals onto four hex cap screws (1-30) as follows:
- 3.2.15.1 HD722 install gasket seals (6-100) on to hex cap screws (1-30).
- 3.2.15.2 HD732 install gasket seals (6-80) on to hex cap screws (1-30).
- 3.2.16 Install four hex cap screws (1-30) with gasket seals through housing cover (1-20) and into housing (1-10) and tighten.

3.3 HYDRAULIC OVERRIDE CYLINDER REASSEMBLY

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

CAUTION: Do not use ESL-4, 5 & 10 lubricant in this cylinder. Use hydraulic fluid, as identified in Section 1.6 step 1.6.2, on all moving parts and seals in the Hydraulic Control cylinder.

NOTE: HD actuators use a Polypak rod seal to seal the cylinders from the center housing (1-10). The dimensional stack of the rod seal and the rod bushing is less than the rod seal cavity. This dimensional difference does not affect the ability of the Polypak seal to provide sealing in this application.

3.3.1 Coat rod seal (6-30) with hydraulic fluid and install, lip first, into cylinder adapter (2-140).

CAUTION: Energizer ring (O-ring) of rod seal (6-30) must face into cylinder adapter (2-140) or when cylinder is installed on the actuator the rod seal o-ring will be facing towards piston (2-20).

3.3.2 Install cylinder adapter gasket (6-70) as follows:

3.3.2.1 Onto the right side of housing (1-10) for fail clockwise actuators.

3.3.2.2 Onto the left side of housing (1-10) for fail counter clockwise actuators.

3.3.3 Install gasket seals (6-80) onto 12 point cap screws (2-90).

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

3.3.4 Install cylinder adapter (2-140) over the end of piston rod (2-10) as follows:

NOTE: Arrange cylinder adapter (2-140) 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.

3.3.4.1 Onto the left end of housing (1-10) for fail clockwise actuators.

3.3.4.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.

3.3.5 Install and tighten 12 point cap screws (2-90) with gasket seals (6-80) through cylinder adapter (2-140) and into housing (1-10).

3.3.6 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in Section 2 step 2.1.6.3.

3.3.7 Coat o-ring seal (6-40) with hydraulic fluid and install into cylinder adapter (2-140). NOTE: Install the o-ring seal into the groove at inner end of the cylinder adapter inner diameter threads.

3.3.8 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).

- 3.3.9 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 3.3.8. 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).

- 3.3.10 Install hex lock nut (2-70) onto piston rod (2-10).

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

3.3.12 Piston Seal Installation

3.3.12.1 Standard and High Temperature actuators:

3.3.12.1.1 Coat piston outer diameter seal grooves with hydraulic fluid.

3.3.12.1.2 Coat two u-cup seals (6-10) with hydraulic fluid.

3.3.12.1.3 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.

3.3.12.1.4 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.

3.3.12.2 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.

3.3.12.2.1 Coat piston outer diameter seal grooves with hydraulic fluid.

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

3.3.12.2.3 Install T-seal into piston outboard seal groove.

3.3.12.2.4 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.

- 3.3.13 Apply a coating of hydraulic fluid to the cylinder outer diameter threads and the entire bore of cylinder assembly (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.

3.3.14 Install cylinder assembly (3-10) over piston (2-20). Rotate the cylinder clockwise and screw into the cylinder adapter (2-140).

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

3.3.15 Using a chain wrench tighten cylinder assembly (3-10) into cylinder adapter (2-140).

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.

3.4 SPRING CYLINDER REASSEMBLY

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

NOTE: The parts and seals used in the actuator Spring Cylinder will be assembled using lubricant as identified in Section 1.6 step 1.6.1.

NOTE: HD actuators use a Polypak rod seal to seal the cylinders from the center housing (1-10). The dimensional stack of the rod seal and the rod bushing is less than the rod seal cavity. This dimensional difference does not affect the ability of the Polypak seal to provide sealing in this application.

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

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).

3.4.2 Install cylinder adapter gasket (6-70) as follows:

3.4.2.1 Onto the left side of housing (1-10) for fail clockwise actuators.

3.4.2.2 Onto the right side of housing (1-10) for fail counter clockwise actuators.

3.4.3 Install gasket seals (6-80) onto 12 point cap screws (2-90).

CAUTION: Care should be taken not to scratch the piston rod (2-10) when installing the cylinder adapter (2-30).

3.4.4 Install cylinder adapter (2-30) over the end of piston rod (2-10) as follows:

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.

3.4.4.1 Onto the left end of housing (1-10) for fail clockwise actuators.

3.4.4.2 Onto the right end of housing (1-10) for fail counter clockwise actuators.

3.4.5 Install 12 point cap screws (2-90) with gasket seals (6-80) through cylinder adapter (2-30), gasket (6-70) and screw into housing (1-10).

3.4.6 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port in the same position as recorded in Section 2 step 2.1.6.3.

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

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

3.4.9 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 3.4.8. 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).

3.4.10 Install hex lock nut (2-70) onto piston rod (2-10).

3.4.11 Torque tighten hex lock nut (2-70) to approximately 146 foot pounds / 198 N-m ± 5 % lubricated.

3.4.12 Piston Seal Installation:

3.4.12.1 Standard and High Temperature actuators:

3.4.12.1.1 Coat piston seal grooves with lubricant.

3.4.12.1.2 Coat one u-cup seal (6-10) with lubricant.

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

3.4.12.2 Low Temp Actuators:

3.4.12.2.1 Coat piston seal grooves with lubricant.

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

3.4.12.2.3 Install T-seal set (6-10) into piston outboard seal groove.

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

3.4.14 Apply a coating of lubricant to the cylinder outer diameter threads and the entire bore of cylinder assembly (4-10).

3.4.15 On the spring cartridge assembly (5) coat the outside of the spring with lubricant and insert spring cartridge assembly (5) into cylinder assembly (4-10).

NOTE: One end of the spring cartridge assembly has a flat face with a deep hole in it, this end should be inserted into the cylinder first.

3.4.16 Install spring cylinder assembly (4-10), containing spring cartridge assembly (5), over piston (2-20). Rotate the cylinder assembly clockwise and screw into cylinder adapter (2-30).

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

3.4.17 Using a chain wrench tighten spring cylinder assembly (4-10) 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.

3.4.18 Position Indicator Installation as follows:

3.4.18.1 For spring to fail clockwise actuators, rotate the yoke to the full clockwise (CW) position. Install yoke weather cover (6-110) and position indicator (1-110) onto yoke (1-140) with the pointer facing piston rod (2-10) and perpendicular to cylinder assembly (4-10) and cylinder assembly (3-10).

3.4.18.2 For spring to fail counter clockwise actuators, rotate yoke (1-140) to full counter clockwise (CCW) position. Install yoke weather cover (6-110) and position indicator (1-110) onto yoke (1-140) with the pointer parallel to cylinder assembly (4-10), cylinder assembly (3-10) and to piston rod (2-10).

3.4.18.3 Install and tighten socket cap screws (1-120) through position indicator (1-110), weather cover (6-110) and into the top of yoke (1-140).

NOTE: Socket cap screws (1-120) will require rechecking for tightness after the actuator has been cycled a few times.

3.4.19 Install gasket seals (6-90) and hex jam nuts (1-70) onto stop screws (1-60).

3.4.20 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.

3.4.21 Adjust both stop screws (1-60) back to settings recorded in Section 2 step 2.1.6.2.

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

3.5 ACTUATOR TESTING

3.5.1 In general all areas, where leakage to atmosphere may occur, are to be checked using a commercial leak testing solution. Generally, a small bubble, which breaks about three seconds after starting to form, is considered acceptable. If excessive leakage is noted, the formed bubble breaks before three seconds, the actuator must be disassembled and the cause of leakage must be determined and corrected.

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

3.5.2 All leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag 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.

3.5.3 Before testing for leaks, alternately apply and release operating pressure, as described in step 3.5.2, to the pressure 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.

3.5.4 Apply operating pressure, as described in step 3.5.2 to the pressure inlet port in the cylinder adapter (2-30).

3.5.5 Apply leak testing solution to the following areas:

3.5.5.1 Breather "port" hole in the outboard end of cylinder assembly (4-10). Checks the piston to cylinder wall and piston to piston rod seal.

3.5.5.2 The threaded joint between cylinder assembly (4-10) and cylinder adapter (2-30) checks the cylinder to cylinder adapter o-ring seal.

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

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

3.5.6 Remove pressure from the pressure inlet port on cylinder adapter (2-30).

CAUTION: DO NOT COMPLETE STEPS 3.5.7 THROUGH 3.5.12 IF THE HYDRAULIC OVERRIDE CYLINDER HAS BEEN FILLED WITH HYDRAULIC FLUID.

- 3.5.7 Apply operating pressure, as described in step 3.5.2, to the inlet port in cylinder adapter (2-140).
- 3.5.8 Apply leak-testing solution to the following areas:
 - 3.5.8.1 Inlet port in the outboard end of cylinder assembly (3-10). Checks piston to cylinder and piston to piston rod seal.
 - 3.5.8.2 The threaded joint between cylinder assembly (3-10) and cylinder adapter (2-140) checks the cylinder to cylinder adapter o-ring seal.
 - 3.5.8.3 The joint between cylinder adapter (2-140) and housing (1-10).
 - 3.5.8.4 The snubber "port hole" located in top of housing (1-10), checks the cylinder adapter to piston rod seal.
- 3.5.9 Remove pressure from the pressure inlet port on cylinder adapter (2-140).
- 3.5.10 Apply operating pressure, as described in step 3.5.2, to the inlet port in cylinder assembly (3-10).
- 3.5.11 Apply leak-testing solution to form a leak testing solution bubble over the inlet port in cylinder adapter (2-140). Checks piston to cylinder and piston to piston rod seals.
- 3.5.12 Remove pressure from the inlet port in the outboard end of cylinder assembly (3-10).
- 3.5.13 If an actuator was disassembled and repaired, the above leakage test must be performed again.
- 3.5.14 Operation test the actuator to verify proper function of the actuator. This test is to be done off of the valve.
 - 3.5.14.1 Adjust the pressure regulator to the pressure as defined in step 3.5.2.
 - 3.5.14.2 Apply the above pressure to the pressure inlet port in the cylinder adapter (2-30). Allow the actuator to stabilize. The actuator should stroke to a full 90° degrees of travel.
- 3.5.15 Remove pressure from the pressure inlet ports.

3.6 M11 HYDRAULIC CONTROL PACKAGE INSTALLATION

Reference Bettis M11 Operating and Maintenance Service Procedure part number 126858 for more information.

NOTE: The M11 unit must be mounted with the reservoir upright.

CAUTION: Do not use Teflon tape to seal hydraulic system threads.

NOTE: Recommend that a non-hardening thread sealant, compatible with petroleum base hydraulic fluid be used in this system.

- 3.6.1 If the M11 was mounted on the actuator then reinstall it on the actuator.
- 3.6.2 Hook up piping from the M11 hydraulic pump to cylinder ports.
- 3.6.3 Use either Refilling Method Number 1 (steps 3.6.4) or Refilling Method Number 2 (steps 3.6.5). NOTE: Method Number 1 is the best, most efficient and the recommended method.
- 3.6.4 **REFILLING METHOD NUMBER 1.** - Refilling of the M11 Manual Hydraulic Override System is best accomplished using a pump motor.

NOTE: If a pump motor is not available go to step 3.6.5 (Method number 2) for the manual field service refilling procedure.

- 3.6.4.1 Remove pipe plugs (2-130) from the actuator hydraulic override cylinder outer and inner end. NOTE: Only remove the pipe plugs located at the highest points, in the vertical plane, of the hydraulic override cylinder.
- 3.6.4.2 Disconnect the pump hose from the reservoir fitting, located close to the reservoir inner end cap, and connect the pump motor to the pump hose.
- 3.6.4.3 Place the M11 pump selector knob in the "Auto" position.

NOTE: The pressure pump should not exceed 10 to 20 psi when force filling the M11 hydraulic system.

- 3.6.4.4 Start pumping the hydraulic fluid into the system with the pump motor.
- 3.6.4.5 Stop the pump motor when hydraulic fluid appears at vacant pipe plug ports located in the actuator's hydraulic override cylinder.
- 3.6.4.6 Apply pipe dope to threads of pipe plugs (2-130) and install into vacant pipe plug ports located in the actuator's hydraulic override cylinder and cylinder adapter (2-140).
- 3.6.4.7 Disconnect the pump motor from the M11 pump hose.
- 3.6.4.8 Connect the M11 pump hose to the fitting on the reservoir outer end cap.
- 3.6.4.9 Remove the breather from the top of the reservoir inner end cap.
- 3.6.4.10 Fill reservoir to 1-1/2 inches (40 mm) from top of reservoir end cap. Note: Add fluid to the reservoir through the open port left vacant in step 3.6.4.9.
- 3.6.4.11 Apply pipe dope to breather threads and install breather into port vacated in step 3.6.4.9.

3.6.5 **REFILLING METHOD NUMBER 2.** - Refilling the M11 Manual Hydraulic Override System without using a pump motor.

3.6.5.1 Remove breather (10-160) from the top of the reservoir end cap.

3.6.5.2 Remove the pipe plugs from the actuator hydraulic override cylinder outer and inner end. NOTE: Only remove the pipe plugs located at the highest points, in the vertical plane, of the hydraulic override cylinder.

3.6.5.3 Place the M11 pump selector knob in the "Manual" position.

CAUTION: Never allow the M11 reservoir to be pumped dry of hydraulic fluid.

3.6.5.4 Fill reservoir to 1-1/2 inches (40 mm) from top of reservoir end cap. Note: Add fluid to the reservoir through the open port left vacant in step 3.6.5.1.

3.6.5.5 Start pumping the hydraulic fluid into the system with the M11 pump handle.

3.6.5.6 Stop pumping the M11 pump handle when hydraulic fluid appears at both vacant pipe plug ports located in the actuator's hydraulic override cylinder.

3.6.5.7 Apply pipe dope onto pipe plug threads and install into both vacant pipe plug ports located in the actuator's hydraulic override cylinder.

3.6.5.8 Fill the M11 reservoir 1-1/2 inches (40-mm) from the top of the reservoir.

3.6.5.9 Apply pipe dope to the breather threads and install into the port on top of the reservoir upper end cap.

3.7 RETURN TO SERVICE

3.7.1 Install breather (4-20) in the end of the cylinder assembly (4-10).

3.7.2 If supplied in the service kit, replace the software components of the snubber (1-130) and then install the snubber into the housing.

3.7.3 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.

3.7.4 The actuator should now be ready to return to service.

SECTION 4 – ACTUATOR SUPPORT INFORMATION

4.1 ACTUATOR WEIGHT TABLE

ACTUATOR MODEL (1) (2)	APPROXIMATE WEIGHT (POUNDS) (3)						
	SR40	SR60	SR80	SR100	SR125	SR150	SR200
HD521-SR-M11	153	157	158	169	171	174	184
HD721-SR-M11	223	230	235	236	259	261	276
HD731-SR-M11	298	331	340	N/A	N/A	N/A	N/A

- NOTES:
- (1) Includes both fail clockwise (CW) and fail counter clockwise (CCW) actuator models.
 - (2) Includes actuator models that have a -10 or -11 suffix at the end of the model number.
 - (3) Weights listed for each actuator model are for bare actuators without accessories or valve mounting brackets.

4.2 TOOL TABLE - HD-SR-H (M11) TOOL STYLE AND WRENCH SIZES

ITEM NO.	ITEM QTY.	HD521/721 WRENCH SIZE	HD731 WRENCH SIZE	DESCRIPTION OR LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	9/16"	3/4"	Cover Screws	Socket
1-60	2	3/8"	1/2"	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"	12 Point Cap Screws	12 Point Socket (1)
2-110	2	7/16"	7/16"	Pipe Plug	Open End
2-130	4	9/32"	9/32"	Pipe Plug	Open End
3-10	1	(2)	(2)	Cylinder Assembly	Chain Wrench (1)
4-10	1	(2)	(2)	SR Cylinder Assembly	Chain Wrench (1)

- (1) No alternate style tool recommended.
- (2) Bettis recommends a short handled Chain Wrench with a 40" inch chain.

ECN	DATE	REV	BY *	DATE	
Released	April 2002	A	COMPILED	B. Cornelius	22 April 2002
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			APPROVED		

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