

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODELS

HD521-SR-M7, HD721-SR-M7,

AND HD731-SR-M7

SPRING RETURN SERIES

PNEUMATIC

ACTUATORS WITH M7 HYDRAULIC

CONTROL PACKAGE

PART NUMBER: SE-022

REVISION: "B"

RELEASE DATE: July, 1994

REPLACES: Service-022 Rev. "A"

1.0 INTRODUCTION

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis HDHD521-SR-M7, HD721-SR-M7 and HD731-SR-M7 series pneumatic actuators. When the model number has "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.

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

WARNING: For the protection of personnel working on Bettis actuators, this procedure should be reviewed and implemented for safe disassembly and reassembly. Close attention should be noted to the WARNINGS, CAUTIONS and NOTES contained in this procedure.

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

1.3 DEFINITIONS:

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

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

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

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

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

1.6 This procedure does not include M7 Disassembly and Reassembly Instructions. Bettis does not recommend periodic maintenance for the M4 itself. The M7 needs only to be serviced when it malfunctions. Complete M7 refurbishment should be done by Bettis.

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

2.0 SUPPORT ITEMS AND TOOLS

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

- 2.2 Tools - All tools are American Standard inch. Two each medium standard screwdriver, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and a torque wrench (up to 2,000 in. lbs.). For recommended tool list refer to page 13.

3.0 **BETTIS REFERENCE BETTIS MATERIALS**

- 3.1 Assembly Drawing 036469 for failing close (CW) actuators.
 3.2 Assembly Drawing 040907 for failing open (CCW) actuators.
 3.3 Exploded Detail Drawing 063362 for HD521-SR-M7 and HD721-SR-M7 actuators.
 3.4 Exploded Detail Drawing 063361 for HD731-SR-M7 actuators.

4.0 **GENERAL**

- 4.1 Numbers in parentheses, () indicate the bubble number (reference number) used on the Bettis Assembly Drawing, Exploded Detail Drawing, and actuator parts lists.
- 4.2 This procedure is written using the stop screw side of the housing (1-10) as a reference and this side will be considered the front side of the actuator. The housing cover (1-20) will be considered the top of the actuator.
- 4.3 To help in correct re-assembly; that is, with spring on same end of housing as was, mark or tag mating surfaces. Record the location of the inlet ports on the cylinder adapter (2-30) and (2-140).
- 4.4 When removing seals from seal grooves, use a small screwdriver with sharp corners rounded off or a commercial seal removing tool.
- 4.5 Use a non-hardening thread sealant on all pipe threads. CAUTION: Apply the thread sealant per the manufacture's instructions.
- 4.6 Refer to the following chart for the approximate actuator weights.

ACTUATOR MODEL	APPROXIMATE WEIGHT (LBS) **						
	SR40	SR60	SR80	SR100	SR125	SR150	SR200
521-SRXX-M7	153	157	158	169	171	174	184
721-SRXX-M7	223	230	235	236	259	261	276
731-SRXX-M7	298	331	340				

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

- 4.7 Disassembly of actuator should be done in a clean area on a work bench when possible.
- 4.8 LUBRICATION REQUIREMENTS: Lubricants, other than those listed in steps 4.8.1 and 4.8.2, should not be used without prior written approval of Bettis Product Engineering.
- 4.8.1 Standard and high temperature service (-20° F to +350° F) use Bettis ESL-5, Kronaplate 100 lubricant. ESL-5 is contained in the Bettis Service/Seal Kit.
- 4.8.2 Low temperature service (-50° F to +150° F) use Kronaplate 50 lubricant. This lubricant is not contained in the Low Temperature Service/Seal Kit.

- 4.9 FLUID REQUIREMENTS: For use in the M4 Hydraulic Control Package (8) and the hydraulic control package cylinder assembly M4 (3-20). The following listed fluids are recommended fluids only and does not limit the use of other hydraulic fluids compatible with supplied seals and coatings.
- 4.9.1 Standard and high temperature service (-20° F to +350° F) use Dexron II Automatic Transmission Fluid.
- 4.9.2 Low temperature service (-50° F to +150° F) use Exxon Univis J13 Hydraulic Fluid.
- 4.10 It is a good practice to operate the actuator with 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, before starting the general disassembly of the actuator. Notate and record any abnormal symptoms such as jerky or erratic operation. NOTE: Pressure is not to exceed the maximum operating pressure rating listed on the name tag.
- 4.11 Refer to information notes at the end of this procedure for product improvement changes and other changes to this series of HD actuators.

5.0 GENERAL DISASSEMBLY

- 5.1 Make sure that the M7 control package "block/by-pass valve", located on the right-hand side of the control package, is fully open.
- 5.2 If not already removed disconnect all operating pressure from actuator power cylinder (4-10), allowing the spring to stroke. The spring will rotate the yoke to the fail position.
- 5.3 Drain the hydraulic fluid from the hydraulic cylinder (3) using the pipe plugs (2-130) and bleed valves (2-120).
- 5.4 Remove all piping (plumbing) from the actuator and the M7 Hydraulic Control Package.
- 5.5 If the M7 package is remote mounted then disregard the rest of this step. Disassemble the M7 Hydraulic Control Package/bracket by removing the hex nuts and lockwashers from the u-bolts. Remove the entire package from the hydraulic cylinder (3).
- 5.6 Remove breather (4-20) from end of spring cylinder assembly (4-10).
- 5.7 Measure the exposed length of the right and left stop screws (1-60) and record each before loosening.
- 5.8 Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 5.9 Remove snubber (1-130) from housing (1-10).

6.0 SPRING CYLINDER REMOVAL

- 6.1 When the spring cylinder is installed on the actuator the spring is under compression. DO NOT remove the spring cylinder until the actuator has the "pre-load" removed.

- 6.2 Remove spring cylinder stop screw "pre-load" as follows: Apply nominal operating pressure to the pressure inlet port located in the cylinder adapter (2-30). Locate the stop screw (1-60) that is on the opposite side of the housing from the spring cylinder (4-10). Loosen jam nut (1-70). Unscrew and remove stop screw (1-60). Remove pressure from the pressure inlet port.
- 6.3 Secure the chain wrench around the spring cylinder (4-10) as close to the welded end cap as possible. Using a mallet, break the cylinder loose and then remove the cylinder by rotating in a counter clockwise direction. When setting the spring cylinder (4-10) aside, care should be taken to protect the chamfered edge and cylinder threads. Due to the weight and the nature of a pre-loaded assembly, caution should be exercised when handling the spring cartridge (5). The spring cartridge (5) is unattached and is only contained by the spring cylinder (4-10).

WARNING: Under no circumstances should the spring cartridge (5) be cut apart, as the spring is pre-loaded and the spring cartridge welded together.

- 6.4 Unscrew and remove hex lock nut (2-70) from piston rod (2-10).
- 6.5 Remove the piston (2-20).

7.0 HYDRAULIC CONTROL CYLINDER DISASSEMBLY

- 7.1 Secure the chain wrench around the cylinder (3) as close to the welded end cap as possible. Using the mallet, break the cylinder loose and then remove the cylinder by rotating in a counter clockwise direction. When setting the cylinder aside, care should be taken to protect the chamfered edge and cylinder threads.
- 7.2 Unscrew and remove hex lock nut (2-70) from the piston rod.
- 7.3 Remove the piston (2-20).
- 7.4 Unscrew and remove the four cylinder adapter ferry screws (2-90) and gasket seals (6-80) from the cylinder adapter (2-140).
- 7.5 Remove the cylinder adapter (2-140), taking care not to scratch the piston rod (2-10) or disengage the rod bushing (2-40).
- 7.6 On the spring cylinder (4-10) side of the actuator, unscrew and remove the four cylinder adapter ferry screws (2-90) and gasket seals (6-80) from cylinder adapter (2-30).
- 7.7 Remove the cylinder adapter (2-30), taking care not to scratch the piston rod (2-10) or disengage the rod bushing (2-40).

8.0 HOUSING GROUP DISASSEMBLY

- 8.1 Remove cover screws (1-30) and seal gaskets.
- 8.2 Remove the housing cover (1-20).
- 8.3 Rotate the yoke arms (1-140) to the center position.

- 8.4 Remove the upper yoke roller (1-50).
- 8.5 Lift out and remove the yoke pin (1-40).
- 8.6 Holding rod bushings (2-40) in place, pull piston rod (2-10) out through rod bushings (2-40).
- 8.7 Remove both rod bushings (2-40) from housing (1-10).
- 8.8 Lift out the yoke (1-140) from the housing cavity.
- 8.9 Remove the lower yoke roller (1-50).
- 8.10 Unscrew and remove the remaining stop screw (1-60), jam nut (1-70), and gasket seal (6-90). Be sure to identify this stop screw.
- 8.11 It is not necessary to remove housing pipe plug (1-100) or cylinder adapter pipe plug (2-110).
- 8.12 Using putty knife, remove cover gasket (6-60) and cylinder adapter gaskets (6-70).

9.0 GENERAL RE-ASSEMBLY

- 9.1 Remove and discard all old seals and gaskets, taking care not to scratch or damage seal grooves.
- 9.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.
- 9.3 All parts should be thoroughly inspected. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. Sealing surfaces must be free of deep scratches, pitting, corrosion and blistering or flaking coating.
- 9.4 Before installing coat all surfaces of actuators moving parts with lubricant.
- 9.5 Coat all seals with lubricant, before installing into grooves, also both sides of gaskets.
- 9.6 Low Temperature or trim -11 T-Seal Set installation - The T-seal is composed of one rubber seal and two split skive-cut back-up rings.
 - 9.6.1 Install the T-seal into the seal groove.
 - 9.6.2 Install a back-up ring on each side of the T-seal.
 - 9.6.3 When installing the back-up rings, do not align the skive-cuts.
 - 9.6.4 If the back-up rings are too long and the rings overlap beyond the skive-cuts, then the rings must be trimmed with a razor sharp instrument.

10.0 CENTER HOUSING GROUP RE-ASSEMBLY

- 10.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10).
- 10.2 Install one of the yoke o-ring seals (6-20) into the groove in the housing bore (1-10).

- 10.3 Apply lubricant to the yoke bore and the raised ribs in the bottom of the housing. Arrange the housing so that the yoke bore is nearest to you.
- 10.4 Apply a generous amount of lubricant to the slots in the upper and lower yoke arms and coat the bearing surfaces of the yoke (1-140).
- 10.5 Install the yoke (1-140) into the housing (1-10). The wide yoke arm should be installed toward the top of the housing.
- 10.6 Coat the piston rod bushings (2-40) with lubricant and install into both sides of the housing.
- 10.7 Coat one of the yoke rollers (1-50) with lubricant and place into the lower yoke arm slot nearest the cylindrical portion of the yoke.
- 10.8 Apply a light coat of lubricant to the piston rod (2-10) and install thru the bushings in the housing.
- 10.9 Coat the yoke pin (1-40) with lubricant and install thru the piston rod (2-10) into the lower yoke roller (1-50).
- 10.10 Coat the remaining yoke roller (1-50) with lubricant and install over the yoke pin and into the slot in the upper yoke arm.
- 10.11 Install the remaining yoke o-ring seal (6-20) into the housing cover (1-20).
- 10.12 Coat the yoke bore in the cover (1-20) with lubricant.
- 10.13 Install the cover gasket (6-60) onto the housing.
- 10.14 Install the housing cover (1-20) onto the housing (1-10) and retain with the four cover screws (1-30) with gasket seals (6-80). NOTE: For 521/721 actuators, gasket seals will be item number (6-100).

11.0 HYDRAULIC CONTROL CYLINDER RE-ASSEMBLY

CAUTION: Do not use the ESL-5 lubricant in this cylinder. Use hydraulic fluid ONLY on all moving parts and seals in the Hydraulic Control cylinder.

- 11.1 Coat piston rod seal (6-30) with hydraulic fluid and install, lip first, into the cylinder adapter (2-30). The energizer ring of rod seal (6-30) must face the cylinder adapter, piston side.
- 11.2 Install one cylinder adapter gasket (6-70) over the piston rod bushing on the right side of the housing for clockwise actuators or on the left side of the housing for counterclockwise actuators.
- 11.3 Install the cylinder adapter (2-140) over the end of the piston rod and retain with the cylinder adapter ferry screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter so that it is in the same position as recorded in step 4.3. Care should be taken at this point not to scratch the piston rod when installing the cylinder adapter.
- 11.4 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port that it was removed from.

- 11.5 Install the cylinder adapter o-ring seal (6-40) into the cylinder adapter (2-140) in the groove at the inner end of the threads.
- 11.6 Install the piston o-ring seal (6-50) onto the piston rod (2-10).
- 11.7 PISTON SEAL INSTALLATION:
- 11.7.1 Standard and High Temp Actuators: Install the piston cup seals (6-10) into the piston (2-20) seal grooves. The lip of the seals should point outward or away from each other.
- 11.7.2 Low Temp Actuators: The low temp piston seal is a T seal and is a bi-directional seal. Being a bi-directional seal only one is required and it can be installed in either piston seal groove.
- 11.7.2.1 Apply lubricant to piston T-seal (6-10). Seal is composed of rubber seal and two back-up rings. The rings serve as anti-extrusion back-ups.
- 11.7.2.2 Install T-seal (6-10) into piston seal groove.
- 11.7.2.3 Install backup ring on each side of T-seal.
- 11.8 Install the piston (2-20) onto the piston rod and retain with hex lock nut (2-70). One side of the piston has a raised boss in the center that has a counter-bore to accept an o-ring. This side should be installed against the shoulder of the piston rod. Teflon insert of hex lock nut (2-70) should rest up against piston. Torque hex nut (2-70) to 146 foot pounds.
- 11.9 Apply a coating of hydraulic fluid to the cylinder threads and the entire bore of cylinder (3).
- 11.11 Install the cylinder (3) over the piston, screwing into the cylinder adapter. Tighten with a chain wrench. Exercise caution to prevent pinching of the piston cup seal lip during installation. It is necessary to depress the seal lip while working the cylinder over it.

12.0 SPRING CYLINDER RE-ASSEMBLY

- 12.1 Install the remaining cylinder adapter gasket (6-70) over the piston rod.
- 12.2 Install the remaining piston rod seal (6-30), lip first, into the cylinder adapter (2-30). The energizer ring of rod seal must face the cylinder adapter (piston side).
- 12.3 Install the cylinder adapter (2-30) over the piston rod and retain with the cylinder adapter ferry head screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter so that it is in the same position as recorded in step 4.3. Care should be taken at this point not to scratch the piston rod when installing the cylinder adapter.
- 12.4 If removed, install pipe plug (2-110) into the cylinder adapter (2-30) pressure port.
- 12.5 Install the remaining cylinder adapter o-ring seal (6-40) into the cylinder adapter in the groove at the inner end of the threads.
- 12.6 Install the remaining piston o-ring seal (6-50) onto the piston rod (2-10).

- 12.7 Install the remaining piston (2-20) onto the piston rod and retain with hex lock nut (2-70). One side of the piston has a raised boss in the center that is counter bored to accept an "O" ring. This side should be installed against the shoulder of the piston rod. Teflon insert of lock nut (2-70) should rest up against piston. Torque the piston rod hex nut (2-70) to approximately 1,750 in. lbs. or 146 foot pounds.
- 12.8 PISTON SEAL INSTALLATION:
- 12.8.1 Standard and High Temp Actuators: Coat the remaining piston U-cup seal (6-10) with lubricant and install into the innermost piston groove. The lip of the seal should point outward toward the side of the piston.
- 12.8.2 Low Temp Actuators: The low temp piston seal is a T seal and is a bi-directional seal. Being a bi-directional seal only one is required and it can be installed in either piston seal groove.
- 12.8.2.1 Apply lubricant to piston T-seal (6-10). Seal is composed of rubber seal and two back-up rings. The rings serve as anti-extrusion back-ups.
- 12.8.2.2 Install T-seal (6-10) into piston seal groove.
- 12.8.2.3 Install backup ring on each side of T-seal.
- 12.9 Push the piston in towards the housing as far as it will go.
- 12.10 Coat the cylinder threads and the entire cylinder (4-10) bore with lubricant.
- 12.11 Coat the outside of the spring with lubricant and insert the spring cartridge assembly (5) into the spring cylinder (4-10). 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.
- 12.12 Install the spring cylinder (4-10), containing the spring cartridge, over the piston and screw into the cylinder adapter (2-30). Tighten with a chain wrench.
- 12.13 POSITION INDICATOR INSTALLATION:
- 12.13.1 For spring to close actuators (clockwise), rotate the yoke to the full clockwise (CW) position. Position the yoke weather cover (6-110) and position indicator (1-110) on the yoke (1-140) with the pointer pointing to the piston rod and perpendicular to the cylinder assemblies.
- 12.13.2 For spring to open actuators (counterclockwise), rotate the yoke to full counterclockwise (CCW) position. Position the yoke weather cover (6-110) and position indicator (1-110) on the yoke with the pointer to the cylinder (3) and parallel to the piston rod (2-10).
- 12.13.3 Install and tighten yoke position indicator/yoke weather cover screws (1-120). These screws will need to be rechecked for tightness after the actuator has been cycled and tested.
- 12.14 Install stop screws (1-60), stop screw gasket seals (6-90) and stop screw jam nuts (1-70).

- 12.15 Install the drain pipe plugs (2-130) and bleed valves (2-120) into the Hydraulic Control cylinder.

13.0 ACTUATOR TESTING

- 13.1 All areas, where leakage to atmosphere may occur, are to be checked using a leak testing solution.
- 13.2 All leak testing will use the nominal operating pressure (NOP) as listed on the actuator name tag. 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.
- 13.3 Before testing for leaks, alternately apply and release NOP pressure 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 working attitude.
- 13.4 Apply NOP pressure to the pressure inlet port in the SR cylinder adapter (2-30).
- 13.5 Apply leak testing solution to the following areas:
- 13.5.1 The breather port hole in the end of the SR cylinder (4-10), checks the piston to cylinder wall and piston to piston rod seals.
 - 13.5.2 The threaded joint between the SR cylinder (4-10) and cylinder adapter (2-30), checks the cylinder to cylinder adapter o-ring seal.
 - 13.5.3 The joint between the cylinder adapter and the housing.
 - 13.5.4 The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.
- 13.6 Remove pressure from the pressure inlet port on cylinder adapter (2-30).
- 13.7 Apply NOP pressure to the inlet port in the cylinder adapter (2-140).
- 13.8 Apply leak testing solution to the following areas:
- 13.8.1 The inlet port in the outboard end of cylinder (3), checks piston to cylinder and piston to piston rod seals.
 - 13.8.2 The threaded joint between the cylinder (3) and cylinder adapter (2-140), checks the cylinder to cylinder adapter o-ring seal.
 - 13.8.3 The joint between the cylinder adapter and the housing.
 - 13.8.4 The snubber port hole located in the housing, checks the cylinder adapter to piston rod seal.
- 13.9 Remove pressure from the pressure inlet port on cylinder adapter (2-140).
- 13.10 Apply NOP pressure to the inlet port in the cylinder (3).

- 13.11 Apply leak testing solution to the following areas:
- 13.12 The inlet port in the cylinder adapter (2-140), checks piston to cylinder and piston to piston rod seals.
- 13.13 Remove pressure from the inlet port in the outboard end of cylinder (3).
- 13.14 If an actuator was disassembled and repaired, the above leakage test must be performed again.

14.0 M7 SYSTEM SERVICE

- 14.1 Refilling of the M7 Hydraulic Control System and actuator cylinder is best accomplished using a pressure pump. If a pressure pump is not available go to step 14.12 for the manual field service refilling procedure.
- 14.2 Allow the actuator to fully stroke to its fail position.
- 14.3 Remove the breather from the reservoir.
- 14.4 Attach the pump discharge line to reservoir breather port.
- 14.5 Open the two bleed valves located at each end of the hydraulic cylinders.
- 14.6 Open the M7 block/by-pass valve.
- 14.7 Slowly pump hydraulic fluid into the reservoir. Approximately 3 to 5 psi will be required. As the fluid passes through the M7 control module into the cylinder, air will be displaced.
- 14.8 Close each bleed valve when the air has been displaced and hydraulic fluid appears.
- 14.9 Remove the pressure pump.
- 14.10 With the actuator in its "fail" position; add fluid to the reservoir so that its level is within approximately 1-1/2" inches of full.
- 14.11 Install the breather.
- 14.12 Refilling the M7 control system during field service often must be done without the use of a pressure pump. Proceed as follows:
- 14.13 On hydraulic cylinder on which M7 override is mounted, the piston must be stroked toward outboard side of the actuator (actuator natural position for spring return actuators).
- 14.14 Fill hydraulic cylinder(s) with fluid by removing bleed valves at the top of cylinder.
- 14.15 Fill the reservoir. Maintain at least 1-1/2" inches of fluid within the reservoir at all times.
- 14.16 Close the by-pass valve.
- 14.17 Close both speed control valves.

- 14.18 Open outboard end cylinder bleed valve.
- 14.19 Operate hand pump slowly. Keep handle up for about 4 to 5 seconds before each pressure stroke. This allows time for the pump cylinder to fill in order that full displacement of the pup is utilized. (NOTE: If the pump fails to deliver fluid, open the by-pass valve, rapidly operate the pump 15 to 20 times, close the by-pass valve and continue filling sequence).
- 14.20 Close the outboard end cylinder bleed valve when fluid appears.
- 14.21 Open the inboard end cylinder bleed valve.
- 14.22 Operate the hand pump to fully stroke the actuator. Refill reservoir as required.
- 14.23 Open by-pass valve.
- 14.24 Slightly open the outboard cylinder (right hand) speed control. As the actuator strokes, fluid will be displaced from the greater volume of the outboard cylinder into the lesser volume of the inboard cylinder. Fluid will begin flowing from the inboard end cylinder bleed valve.
- 14.25 Close the inboard end cylinder bleed valve when fluid appears. NOTE: If the actuator completes its stroke and fluid does not appear at the inboard end cylinder bleed valve, omit procedure step 14.24 and proceed as follows:
- 14.26 Close the outboard cylinder (right hand) speed control valve.
- 14.27 Close the by-pass valve.
- 14.28 Open inboard end cylinder bleed.
- 14.29 Operate hand pump as described to cycle actuator.
- 14.30 Close inboard end cylinder bleed valve when fluid appears. Stop operation of pump. (If fluid does not appear, repeat steps 14.20 through 14.24)
- 14.31 Open by-pass valve. Fully open inboard cylinder speed control.
- 14.32 Slowly open outboard speed control.
- 14.33 Allow the actuator to complete its stroke to "fail" position. Add fluid to reservoir so that level is within approximately 1-1/2" inches of full. Install breather. Connect power supply lines and cycle the actuator using available power media. Adjust and lock speed controls. Actuator is in normal service.
- 14.34 POWER OPERATION CHECK.
 - 14.34.1 Fully open the M7 block/by-pass valve, located on the right hand side of the M7 block.
 - 14.34.2 Apply NOP pressure to the power cylinder and cycle the actuator. The actuator should be able to complete a full closed to open stroke in power operation.

14.34.3 Remove the pressure from the power cylinder and the actuator should complete an open to full closed position.

14.35 MANUAL OPERATION CHECK.

14.35.1 Manual operation requires that the block/by-pass valve be fully closed.

14.35.2 Operate the hand pump until the actuator strokes from full closed to open. When the actuator is fully stroked against the travel stops, an increased resistance in pumping effort will be noted. Continued operation of the pump simply circulates fluid through a high pressure relief.

14.35.3 Fully open the block/by-pass valve to reverse the actuator rotation or to return to the full closed position or normal power operation position.

15.0 RETURN TO SERVICE

15.1 Install breather (4-20) in the end of the spring cylinder (4-10).

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

15.3 Adjust both stop screws (1-60) back to settings recorded in section 5.0 General Disassembly.

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

15.5 Re-install any piping and accessories that were removed.

16.0 INFORMATION NOTES:

16.1 HD-SR 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 current polypak seal to provide sealing in this application.

16.2 All asbestos has been eliminated from the gasket material used in Bettis Actuators. The current gasket material used is Non Asbestos Synthetic Fiber.

HD521/HD721-SR-M7 TOOL STYLE AND WRENCH SIZES

ITEM NO.	ITEM QTY.	WRENCH SIZE	LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	9/16"	Cover Screws	Socket
1-60	2	7/16"	Stop Screws	Open End or Adjustable
1-70	2	15/16"	Hex Jam Nut	Open End or Adjustable
1-100	1	7/16"	Pipe Plug	Open End
1-120	4	3/16"	Socket Cap Screws	Allen
1-130	1	7/8"	Snubber Valve	Deep Socket
2-70	1	1-1/4"	Light Hex Lok Nut	Socket
2-90	4	7/16"	Ferry Cap Screws	12 Point Socket (1)
2-110	1	7/16"	Pipe Plug	Open End
3	1	(1)	Hyd Control Cylinder	Chain (2)
4-10	1	(1)	SR Cylinder	Chain (2)
4-20	1	11/16"	Breather	Open End

(1) No alternate style tool recommended.

(2) Bettis recommends a #11 Titan Chain wrench with a 40" chain.

HD731-SR-M7 TOOL STYLE AND WRENCH SIZES

ITEM NO.	ITEM QTY.	WRENCH SIZE	LOCATION	RECOMMENDED WRENCH STYLE
1-30	4	3/4"	Cover Screws	Socket
1-60	2	7/8"	Stop Screws	Open End or Adjustable
1-70	2	1-5/16"	Hex Jam Nut	Open End or Adjustable
1-100	1	7/16"	Pipe Plug	Open End
1-120	4	3/16"	Socket Cap Screws	Allen
1-130	1	7/8"	Snubber Valve	Deep Socket
2-70	1	1-5/8"	Light Hex Lok Nut	Socket
2-90	4	1/2"	Ferry Cap Screws	12 Point Socket (1)
2-110	1	7/16"	Pipe Plug	Open End
3	1	(1)	Hyd Control Cylinder	Chain (2)
4-10	1	(1)	SR Cylinder	Chain (2)
4-20	1	11/16"	Breather	Open End

(1) No alternate style tool recommended.

(2) Bettis recommends a #11 Titan Chain wrench with a 40" chain.