

BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY AND REASSEMBLY

FOR MODELS

HD521-M11, HD721-M11 AND HD731-M11

DOUBLE ACTING SERIES

PNEUMATIC ACTUATORS

WITH HYDRAULIC

CONTROL PACKAGE

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1.0 **INTRODUCTION**

- 1.1 This service procedure is offered as a guide to enable general maintenance to be performed on Bettis HD521-M11, HD721-M11 and HD731-M11 Double Acting Series Pneumatic Actuators with M11 Hydraulic Control Package.

NOTE: When the model number has a "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.

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 customers representative and an authorized Bettis representative.

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

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

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

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

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 Kit, commercial leak testing solution, and non-hardening thread sealant.

2.2 Tools - All tools are American Standard inch. Two each medium standard screwdrivers, small standard screwdriver with corners rounded, putty knife, rubber or leather mallet and torque wrench (up to 2,000 inch pounds). Refer to the following table for recommended tool style and size.

HD-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"	Ferry 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)	Power Cylinder	Chain Wrench (1)
4-10	1	(2)	(2)	Override Cylinder MX	Chain Wrench (1)
(1) No alternate style tool recommended.					
(2) Bettis recommends a short handled Chain Wrench with a 40" inch chain.					

3.0 **BETTIS REFERENCE MATERIALS**

3.1 Assembly drawing part number 049679.

3.2 Exploded Detail Drawing part number 063359 * for models HD521-MX and HD721-MX.

3.3 Exploded Detail Drawing part number 063357 * for model HD731-MX.

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

4.0 GENERAL DETAILS

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

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

- 4.7 Disassembly of actuator should be done in a clean area on a workbench when possible.
- 4.8 Some HD series actuator models are heavy and will require a means of assistance. For actuator approximate weight refer to the following chart.

ACTUATOR MODEL (2)	APPROXIMATE WEIGHT (LBS) (1)	ACTUATOR MODEL (2)	APPROXIMATE WEIGHT (LBS) (1)
HD521-M11	135	HD731-M11	245
HD721-M11	162		
NOTES:			
(1)	Weights listed for each actuator model is for bare actuators without accessories or valve mounting brackets.		
(2)	Includes actuator models that have a -10 or -11 suffix at the end of the model number.		

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

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

5.0 LUBRICATION REQUIREMENTS

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

NOTE: Lubricants other than those listed in step 5.2 and 5.3 should not be used without prior written approval of Bettis Product Engineering.

- 5.2 **GREASE REQUIREMENTS:** All temperature service (-50°F to +200°F) or (-45.5°C to +93.3°C) use Bettis ESL-5 lubricant contained in the Bettis Standard Temperature Service/Seal Kit.

- 5.3 **FLUID REQUIREMENTS:** For use in the M11 Hydraulic Control Package (8) and the hydraulic control package cylinder assembly M11 (3-20). Fluids other than those listed in steps 5.3.1, 5.3.2, and 5.3.3 should not be used without prior written approval of Bettis Product Engineering.

5.3.1 Standard Temperature Service (-20°F to +200°F) or (-28.9°C to +93.3°C) use Dexron Automatic Transmission Fluid.

5.3.2 High Temperature Service (0°F to +350°F) or (-17°C to 176.6°C) use Dexron Automatic Transmission Fluid.

5.3.3 Low Temperature Service (-40°F to +150°F) or (-40°C to +65.6°C) use Exxon Univis J13 Hydraulic Fluid.

6.0 GENERAL DISASSEMBLY

- 6.1 If not already removed disconnect all operating pressure from pneumatic cylinder (3-10).
- 6.2 Mark stop screws (1-60) left and right. Measure and record the exposed length of right and left stop screws (1-60). The stop screws will be removed later in this procedure.
- 6.3 Record the locations of the pressure ports in the cylinder adapters (2-30) and (2-150).
- 6.4 Remove socket cap screws (1-120) from position indicator (1-110), yoke weather cover (6-110) and remove position indicator/yoke weather cover.
- 6.5 Remove snubber valve (1-120) from top of housing (1-10).
- 6.6 Drain the hydraulic fluid from hydraulic control cylinder (3-20) by removing the pipe plugs (2-120) and then removing the cylinder drainpipe plugs (2-130).
- 6.7 Remove all piping (plumbing) from the actuator and the M11 Hydraulic Control Package.
- 6.8 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.

7.0 PNEUMATIC CYLINDER DISASSEMBLY

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

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

- 7.3 Unscrew and remove piston hex Lok nut (2-70) from piston rod (2-10).
- 7.4 Remove piston (2-20) from piston rod (2-10).
- 7.5 Unscrew and remove four ferry cap screws (2-90) with gasket seals (6-80) from cylinder adapter (2-30).
- 7.6 Remove cylinder adapter (2-30), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).

8.0 HYDRAULIC OVERRIDE CYLINDER DISASSEMBLY

- 8.1 Secure a chain wrench around cylinder (3-20) as close to the welded end cap as possible. Using a mallet, break the cylinder loose sufficiently so it can be removed.
- 8.2 Remove cylinder (3-20) from cylinder adapter (2-150) by rotating in a counter clockwise direction.

CAUTION: When removing and setting cylinder (3-20) aside, care should be taken to protect the chamfered edge and cylinder threads.

- 8.3 Unscrew and remove piston hex Lok nut (2-70) from piston rod (2-10).
- 8.4 Remove piston (2-20) from piston rod (2-10).
- 8.5 Unscrew and remove four ferry screws (2-90) with gasket seals (6-80) from cylinder adapter (2-150).
- 8.6 Remove cylinder adapter (2-150), taking care not to scratch piston rod (2-10) or disengage rod bushing (2-40).

9.0 HOUSING DISASSEMBLY

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

- 9.1 Remove cover screw (1-30) and gasket seals (6-80) or (6-100). On HD731 models the gasket seals will be item (6-80) and on HD521/HD721 models the gasket seals will be item (6-100).
- 9.2 Remove housing cover (1-20) from housing (1-10).
- 9.3 Rotate the arms of yoke (1-140) to the center position in the cavity of housing (1-10).
- 9.4 Remove the upper yoke roller (1-50) from yoke pin (1-40).
- 9.5 Remove yoke pin (1-40) from yoke arms of yoke (1-140).
- 9.6 Holding rod bushings (2-40) in place, pull piston rod (2-10) out through rod bushings (2-40).
- 9.7 Remove both rod bushings (2-40) from housing (1-10).
- 9.8 Remove yoke (1-140) from housing (1-10).

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

- 9.9 Remove lower yoke roller (1-50) from bottom area of housing cavity.
- 9.10 Remove stop screws (1-60), jam nuts (1-70), and gasket seals (6-90). Be sure to identify the stop screws left and right.
- 9.11 It is not necessary to remove pipe plug (1-100) from housing (1-10) or pipe plugs (2-110) from cylinder adapters (2-30).

10.0 GENERAL REASSEMBLY

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

- 10.1 Taking care not to scratch or damage seal grooves, remove and discard all seals and gaskets.
- 10.2 All parts should be cleaned to remove all dirt and other foreign material prior to inspection.

- 10.3 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.

- 10.4 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 (1-10) and the pneumatic cylinder assembly (3-10) will be assembled using lubricant as identified in Section 5 step 5.2. The parts and seals used in the cylinder assembly (3-20) and the hydraulic control package cylinder (8) will be assembled using the hydraulic fluid identified in Section 5 step 5.3.

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

11.0 HOUSING REASSEMBLY

CAUTION: Use the lubricants as referenced in Section 5 step 5.2 on all moving parts and seals in the housing assembly.

- 11.1 If removed, install a pipe plug (1-100) into the drain port of the housing (1-10).
- 11.2 In the bottom area of housing (1-10) apply lubricant to the yoke bore and the cast raised ribs. Arrange the housing so that the yoke bore is nearest to you.
- 11.3 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).
- 11.4 Lubricate the 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).

- 11.5 Install yoke (1-140) into the bore located in the bottom area of housing (1-10).
- 11.6 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.
- 11.7 Coat two rod bushings (2-40) with lubricant and install one into each side of housing (1-10)..
- 11.8 Apply a light coat of lubricant to the piston rod (2-10) and install through both bushings (2-40) in housing (1-10).
- 11.9 Coat the yoke pin (1-40) with lubricant and install through the piston rod (2-10) into the lower yoke roller (1-50).

- 11.10 Coat the 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).
- 11.11 Install the remaining yoke o-ring seal (6-20) into the housing cover (1-20).
- 11.12 Coat the yoke bore in the housing cover (1-20) with lubricant.
- 11.13 Install the cover gasket (6-60) onto top area of housing (1-10).
- 11.14 Install housing cover (1-20) over cover gasket (6-60) and onto top area of housing (1-10).
- 11.15 Install four gasket seals onto four hex cap screws (1-30) as follows:
 - 11.15.1 HD521 and HD721 install gasket seals (6-100) on to hex cap screws (1-30).
 - 11.15.2 HD731 install gasket seals (6-80) on to hex cap screws (1-30).
- 11.16 Install four hex cap screws (1-30) with gasket seals through housing cover (1-20) and into housing (1-10).
- 11.17 Torque tighten the four hex cap screws (1-30) as follows:
 - 11.23.1 HD521 and HD721 torque tighten hex cap screw (1-30) to 20 foot pounds ($\pm 5\%$).
 - 11.23.2 HD731 torque tighten the hex cap screw (1-30) to 45 foot pounds ($\pm 5\%$).

12.0 PNEUMATIC CYLINDER REASSEMBLY

CAUTION: Use the lubricants as referenced in Section 5 step 5.2 on all moving parts and seals in the Pneumatic cylinder assembly.

- 12.1 Install the remaining cylinder adapter gasket (6-70) over the exposed piston rod.
- 12.2 Install rod seal (6-30), lip first, into the cylinder adapter (2-30). Refer to Section 17 step 17.1 for rod seal information.

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).

- 12.3 Install cylinder adapter (2-30) over the piston rod and retain with the cylinder adapter ferry cap screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter ports are in the same position as recorded in section 5.
- 12.4 If removed, install pipe plug (2-110) into cylinder adapter (2-30) pressure port.

12.5 Install o-ring seal (6-40) into the groove at the inner end of the threads of cylinder adapter (2-30).

12.6 Install o-ring seal (6-50) onto piston rod (2-10).

12.7 Install piston (2-20) onto piston rod (2-10).

CAUTION: One side of piston (2-20) has a raised boss in the center that is counter bored to accept an "O" ring seal. This side of the piston should be installed against the shoulder of piston rod (2-10).

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

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

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

12.10 Piston Seal Installation:

12.10.1 Standard and High Temperature actuators:

12.10.1.1 Coat outer diameter piston seal grooves of piston (2-20) with lubricant.

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

12.10.1.3 Install one u-cup seal into the innermost piston groove. The lip of the cup seal should point outward toward inboard side of the piston.

12.10.2 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.

12.10.2.1 Coat piston seal grooves with lubricant.

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

12.10.2.3 Install T-seal into piston outboard seal groove.

12.10.2.4 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.

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

12.12 Coat the cylinder threads and the entire cylinder (3-10) bore with lubricant.

- CAUTION:**
1. **When installing the cylinder into the cylinder adapter be careful not to cross the threads.**
 2. **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.**

12.13 Install cylinder assembly (3-10) 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.**

12.14 Using a chain wrench tighten cylinder assembly (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 two 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.

13.0 HYDRAULIC OVERRIDE CYLINDER REASSEMBLY

- CAUTION:** **Use hydraulic fluid ONLY, as referenced in Section 5 step 5.3, on all moving parts and seals in the Hydraulic Control cylinder.**

13.1 Coat rod seal (6-30) with hydraulic fluid and install, lip first, into cylinder adapter (2-30). Refer to Section 17 step 17.1 for rod seal information.

- 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).**

13.2 Install cylinder adapter gasket (6-70) over the piston rod bushing on the left side of housing (1-10).

13.3 Install cylinder adapter (2-150) over the end of the piston rod and retain with cylinder adapter ferry screws (2-90) and gasket seals (6-80). Arrange the cylinder adapter so that the ports are in the same position as recorded in section 5.

13.4 If removed, install a pipe plug (2-110) into the cylinder adapter pressure port that it was removed from.

13.5 Install o-ring seal (6-40) into cylinder adapter (2-150) in the groove at the inner end of the threads.

- 13.6 Install o-ring seal (6-50) onto piston rod (2-10).
- 13.7 Piston Seal Installation:
- 13.7.1 Standard and High Temperature actuators:
- 13.7.1.1 Coat outer diameter piston seal grooves of piston (2-20) with lubricant.
- 13.7.1.2 Coat two u-cup seals (6-10) with lubricant.
- 13.7.1.3 Install the two 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.
- 13.7.2 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.
- 13.7.2.1 Coat piston seal grooves with lubricant.
- 13.7.2.2 Apply lubricant to one T-seal (6-10). T-Seal is composed of one rubber seal and two skive-cut back-up rings.
- 13.7.2.3 Install T-seal into piston outboard seal groove.
- 13.7.2.4 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
- 13.8 Install 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.
- 13.9 Torque tighten hex nut (2-70) to 146 foot pounds lubricated.
- 13.10 Apply a coating of hydraulic fluid to the cylinder threads and the entire bore of cylinder assembly -M11 (3-20).
- CAUTION:**
- 1. When installing the cylinder into the cylinder adapter be careful not to cross the threads.**
 - 2. 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.**
- 13.11 Install cylinder assembly (3-20) 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.**

13.12 Using a chain wrench tighten cylinder assembly (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 twice. 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.

13.13 Install two pipe plugs (2-130) into cylinder adapter (2-150) and two pipe plugs into cylinder assembly (2-150) ports.

13.14 Install jam nuts (1-70) onto stop screws (1-60).

13.15 Install gasket seals (6-90) onto stop screws (1-60) and up against back side of hex jam nuts (1-70).

13.16 Install stop screws (1-60) with gasket seals (6-90) and hex jam nuts (1-70) into the front housing (1-10).

13.17 Adjust both stop screws (1-60) back to the settings recorded in section 6.

13.18 Tighten both stop screw hex jam nuts (1-70) securely, while holding stop screws (1-60) in place.

13.19 Install yoke weather cover (6-110) on top of yoke (1-140).

13.20 With the yoke rotated to the full clockwise (CW) position. Install position indicator (1-110) on top of yoke (1-140) with the pointer pointing to the piston rod and perpendicular to the cylinder assemblies.

13.21 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.

14.0 ACTUATOR TESTING

14.1 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.

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

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

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

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

14.4 Apply 65 psig pneumatic pressure to the pressure inlet port in 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.

14.5 Apply leak testing solution to the following areas:

14.5.1 Form a leak testing solution bubble over the inlet port hole in the outboard end of cylinder (3-10). Checks the piston to cylinder wall and piston to piston rod seal.

14.5.2 The threaded joint between cylinder (3-10) and cylinder adapter (2-30). Checks the cylinder to cylinder adapter o-ring seal.

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

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

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

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

14.8 Form a leak testing solution bubble over the inlet port in cylinder adapter (2-30). Checks piston to cylinder and piston to piston rod seal.

- 14.9 Remove pressure from the inlet port in the outboard end of cylinder (3-10).
- 14.10 Apply 65 psig pneumatic pressure to the inlet port in cylinder adapter (2-150).
- 14.11 Apply leak testing solution to the following areas:
 - 14.11.1 Form a leak testing solution bubble over the inlet port in the outboard end of cylinder assembly (3-20). Checks piston to cylinder wall and piston to piston rod seals.
 - 14.11.2 The threaded joint between cylinder assembly (3-20) and cylinder adapter (2-150). Checks the cylinder to cylinder adapter o-ring seal.
 - 14.11.3 The joint between cylinder adapter (2-150) and housing (1-10).
 - 14.11.4 The snubber port hole located in top of housing (1-10). Checks the cylinder adapter to piston rod seal.
- 14.12 Remove pressure from the pressure inlet port on cylinder adapter (2-150).
- 14.13 Apply 65 psig pneumatic pressure to the outboard inlet port in cylinder assembly (3-20).
- 14.14 Form a leak testing solution bubble over the inlet port in cylinder adapter (2-150). Checks piston to cylinder and piston to piston rod seal.
- 14.15 Remove pressure from the inlet port in outboard end of cylinder assembly (3-20).

15.0 **M11 HYDRAULIC CONTROL PACKAGE INSTALLATION** - Use either Refilling Method Number 1 (steps 3.1.2) or Refilling Method Number 2 (steps 3.1.3). Method number 1 is the best, most efficient and the recommended method.

- NOTES:
- 1. The M11 must be mounted with reservoir upright..
 - 2. Recommend that a non hardening thread sealant, compatible with petroleum base hydraulic fluid be used in this system.

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

- 15.1.1 Actuator position as follows: Apply pneumatic pressure to the inlet port located in the outer end cap of the actuators power cylinder, placing the actuator in the clockwise (CW) position and proceed to step 15.1.2.
- 15.1.2 **REFILLING METHOD NUMBER 1.** - Refilling of the M11 Manual Hydraulic Override System is best accomplished using a pressure pump.

NOTE: If a pressure pump is not available go to step 15.1.3 (method number 2) for the manual field service refilling procedure.

- 15.1.2.1 Shut off and exhaust the operating media from the actuator's power cylinder.
- 15.1.2.2 Remove pipe plug from the top area on the outer end of the hydraulic override cylinder and the cylinder adapter.
- 15.1.2.3 Disconnect the pump hose from the reservoir fitting, located close to the reservoir upper end cap (10-10), and connect the pump motor to the pump hose.
- NOTE: The M11 pump handle should be in the up position.
- 15.1.2.4 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.
- 15.1.2.5 Start pumping the hydraulic fluid into the system with the pump motor.
- 15.1.2.6 When hydraulic fluid appears at the vacant bleed plug port hole located in the inboard area of the hydraulic override cylinder install pipe plug into the vacant port hole. NOTE: Use pipe dope on the bleed pipe plug.
- 15.1.2.7 When hydraulic fluid appears at the vacant bleed plug port hole located in the outboard area of the hydraulic override cylinder stop the pump motor and install pipe plug into the vacant port hole. NOTE: Use pipe dope on the bleed pipe plug.
- 15.1.2.8 Disconnect the pump motor from the M11 pump hose.
- 15.1.2.9 Connect the M11 pump hose to the fitting on the reservoir outer end cap (10-10).
- 15.1.2.10 Remove the breather (10-160) from the top of the reservoir upper end cap (10-10).
- 15.1.2.11 Fill reservoir to 1-1/2 inches (40 mm) from top of reservoir end cap (10-10).
Note: Add fluid to the reservoir through the open port left vacant in step 15.1.2.10.
- 15.1.2.12 Apply pipe dope to breather (10-160) threads and install into the port in top of the reservoir inner end cap (10-10).
- 15.1.2.13 Return the M11 pump selector knob to the "Auto" position. With the M11 selector knob in the "Auto" position the actuator is ready for service.

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

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

15.1.3.2 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.

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

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

15.1.3.5 Fill reservoir to 1-1/2 inches (40 mm) from top of reservoir end cap (10-10). Note: Add fluid to the reservoir through the open port left vacant in step 15.1.3.1.

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

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

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

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

15.1.3.10 Apply pipe dope to the breather (10-160) threads and install into the port on top of the reservoir upper end cap (10-10).

16.0 RETURN TO SERVICE

16.1 Replace the software components of snubber valve (1-120) and then install into housing (1-10).

16.2 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.

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

17.0 INFORMATION NOTES

- 17.1 HD521-M11, HD721-M11 and HD731-M11 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.

<u>ECN</u>	<u>DATE</u>	<u>REV</u>		<u>BY *</u>	<u>DATE</u>
Released	7 March 2000	A	COMPILED	<u>Bill Cornelius</u>	<u>7 March 2000</u>
			CHECKED	<u>Bill Cornelius</u>	<u>7 March 2000</u>
			APPROVED	<u>Russell Smith</u>	<u>7 March 2000</u>

* Signatures on file Bettis Actuator & Controls, Waller, Texas