

BETTIS

SERVICE INSTRUCTIONS

FOR MODELS

G01 THROUGH G10

SPRING RETURN

PNEUMATIC ACTUATORS

WITH M11 HYDRAULIC OVERRIDE

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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 G01XXX-SR, G2XXX-SR, G3XXX-SR, G4XXX-SR, G5XXX-SR, G7XXX-SR, G8XXX-SR, and G10XXX-SR Spring Return Series Single Pneumatic Power Module Actuators with M11 or M11-S hydraulic override module.

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

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

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

1.1.4 Remove all piping and mounted accessories that will interfere with the module(s) that are to be worked on.

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

1.1.6 Numbers in parentheses, () indicate the bubble number (reference number) used on the Bettis Assembly Drawing and Actuator Parts List.

1.1.7 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 the top of the actuator.

1.1.8 Actuator Module weights are listed in Section 6 Table 6.2.

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

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

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

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

1.2 **DEFINITIONS**

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

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

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

1.3 **GENERAL SAFETY INFORMATION** Products supplied by Bettis, in its "as shipped" condition, are intrinsically safe if the instructions contained within this Service Instruction are strictly adhered to and executed by well-trained, equipped, prepared and competent personnel.

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 for G2-SR-M11 through G5-SR-M11 model actuators with one Pneumatic Power Module and one Spring Module with M11 Hydraulic Override Module use part number 121410.

1.4.2 Assembly Drawing for G7-SR-M11 through G10-SR-M11 model actuators with one Pneumatic Power Module and one Spring Module with M11 Hydraulic Override Module use part number 121411.

1.4.3 M11 Manual Hydraulic Override System operating instructions part number 126858 with M11 assembly drawing part number 126567.

1.4.4 M11-S Manual Hydraulic Override System operating instructions part number 121960 with M11-S assembly drawing part number 121107.

1.5 SERVICE SUPPORT ITEMS

1.5.1 Bettis Module Service Kits.

1.5.2 For rod extension retainer nut tool part number, refer to the following table. NOTE: These tools are required only when extension rod assembly (1-50) or (9-50) is removed or when a new extension rod assembly is installed.

ACTUATOR MODEL	BETTIS PART NUMBER		ACTUATOR MODEL	BETTIS PART NUMBER
G01	None required		G5/G7	117369
G2	123616		G8/G10	117368
G3/G4	117370			

1.5.3 Commercial leak testing solution.

1.5.4 Non-hardening thread sealant.

1.6 LUBRICATION AND FLUID REQUIREMENTS

NOTE: Lubricants and Fluids, other than 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. 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 Module Service Kit in tubes or cans and they are marked ESL-4,5 & 10 lubricant.

1.6.2 M11 Manual Hydraulic Override System Fluid Requirements: Temperature service (-35°F to +350°F) use Dexron Automatic Transmission Fluid.

1.7 GENERAL TOOL INFORMATION

1.7.1 Tools: All tools/Hexagons are American Standard inch. Large adjustable wrench, two (2) large screwdrivers, Allen wrench set, set of open/box-end wrenches, rubber or leather mallet, torque wrench (up to 1200 foot pounds / 1627 N-m), breaker bar, small drift punch and a drive socket set. For recommended tool and wrench sizes refer to Section 6, Tables 6.3 through 6.10

SECTION 2 - ACTUATOR DISASSEMBLY

2.1 GENERAL DISASSEMBLY

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

2.1.1 Section 2 - Actuator Disassembly is written to either completely disassemble the entire actuator or can be used to disassemble individual Modules as needed (Pneumatic Power Module or Drive module).

WARNING: **DO NOT REMOVE SPRING MODULE WHILE SPRING IS COMPRESSED**

2.1.2 When the Spring Module is to be removed it should be removed from the Drive Module prior to the Pneumatic Power Module removal or disassembly.

2.1.3 The Pneumatic Power Module can be disassembled while still attached to the Drive Module or the Pneumatic Power Module can be removed from the Drive Module and disassembled separate to the actuator (refer to Section 5 - Module Removal And Installation).

2.1.4 To ensure correct re-assembly; that is, with Pneumatic Power Module or Spring Module on same end of Drive Module as was, mark or tag right (or left) and mark mating surfaces.

2.1.5 For Spring Module removal and installation refer to Section 5 steps 5.3 and 5.4.

NOTE: Use a means of capturing the hydraulic fluid that will be lost during the removal or disassembly of the override power module. Use a bucket, tub, and large container, ECT.

2.2 PNEUMATIC POWER MODULE DISASSEMBLY

NOTE: Review Section 2 steps 2.1.1 through 2.1.5 General Disassembly before proceeding with Pneumatic Power Module Disassembly.

WARNING: If not already removed disconnect all operating pressure from actuator power cylinders.

WARNING: The Spring Cartridge must be checked to verify that the spring(s) are in their extended position before the Pneumatic Power Module is disassembled from the Drive Module (refer to Section 5.3 steps 5.3.7 through 5.3.9).

2.2.1 Mark and record location of the ports on outer end cap (3-80) and inner end cap (3-10).

- 2.2.2 If actuator is equipped with a power module mounted extended stop (ES) then rotate the ES until clear of the piston rod (3-40).
- 2.2.3 Remove breather assembly (12) from outer end cap (3-80).
- 2.2.4 Refer to assembly drawing sheet 2 Detail "E". Remove two socket cap screws (3-130), with lockwasher (3-140), from outer end cap (3-80).
- 2.2.5 Remove two tie bar hex nuts (3-90) from outboard side of outer end cap (3-80).
- 2.2.6 The fit between cylinder (3-70) and outer end cap (3-80) is very tight. Break end cap free by tapping with a breaker bar on lip provided on the end cap. Remove outer end cap (3-80) from cylinder (3-70).

CAUTION: Do not damage o-ring groove when removing end cap from cylinder.

NOTE: When removing cylinder (3-70) off of piston (3-30), tilt the cylinder 15° to 30° degrees with respect to actuator centerline.

- 2.2.7 Remove cylinder (3-70) from inner end cap (3-10).

CAUTION: Do not use pipe wrench to remove tie bars.

2.2.8 TIE BAR REMOVAL:

- 2.2.8.1 Remove G01, G2 and G3 tie bars (3-20) as follows:

NOTE: G01, G2 and G3 models have flats on outboard end of tie bars (3-20) for wrench placement.

- 2.2.8.1.1 Unscrew tie bars (3-20) from inner end cap (3-10). Pull the tie bars out of the inner end cap far enough to expose the o-ring seals (4-80).

- 2.2.8.1.2 Remove o-ring seals (4-80) from the inboard end of tie bars (3-20).

- 2.2.8.1.3 Remove tie bars (3-20) by pulling the tie bars out and through piston (3-30).

- 2.2.8.2 Remove G4 through G10 tie bars (3-20) as follows:

NOTE: 1. G4 models have flats on outboard end of tie bars (3-20) for wrench placement.

- 2. G5 through G10 models have a female square on the out board end of tie bars (3-20) for wrench placement.

- 2.2.8.2.1 Unscrew and remove tie bars (3-20) from inner end cap (3-10) and piston (3-30).

2.2.9 Remove piston as follows: (On early G2 and G3 models equipped with outboard and inboard tie bar nuts skip this step and go to step 2.2.10).

2.2.9.1 Refer to assembly drawing page 2 of 2 Detail "D". Remove two split ring halves (3-50) and one retainer ring (3-60) from outboard side of piston (3-30).

NOTE: Piston (3-30) acts as the retainer for inboard split ring halves (3-50). When removing the piston be careful to not lose inboard split ring halves (3-50).

2.2.9.2 Remove piston (3-30) and two split ring halves (3-50) from piston rod (3-40).

NOTE: Steps 2.2.10 is used only on early G2 and G3 models equipped with outboard and inboard tie bar nuts.

2.2.10 Remove early model G2 and G3 pistons as follows:

2.2.10.1 Refer to assembly drawing page 2 of 2 Detail "D". Remove two split ring halves (3-50) and one retainer ring (3-60) from inboard side of piston (3-30).

NOTE: Piston (3-30) acts as the retainer for outboard split ring halves (3-50).

2.2.10.2 Slide piston (3-30) toward the inner end cap (3-10) until the out board split ring halves are exposed enough for removal. Remove outboard split ring halves from piston rod (3-40).

2.2.10.3 Remove piston (3-30) and two split ring halves (3-50) from piston rod (3-40).

2.2.11 Remove o-ring seal (4-70) from piston rod (3-40).

2.2.12 Remove hex cap screws (3-100) with lockwashers (3-110) from housing (1-10).

2.2.13 Remove inner end cap (3-10) off of piston rod (3-40).

NOTE: On early model G2 and G3 actuators remove two hex nuts (3-90) from housing (1-10). These two nuts will be loose after tie bars (3-20) are removed in step 2.2.8.1 and will be located in the area where the piston rod passes through the housing (1-10).

NOTE: The piston rod (3-40) removal as outlined in step 2.2.14 is only required when the piston rod is being replaced or when the Drive Module is to be disassembled.

2.2.14 Unscrew and remove piston rod (3-40) from drive module.

2.3 **DRIVE MODULE DISASSEMBLY**

NOTE: Review Section 2 steps 2.1.1 through 2.1.5 General Disassembly before proceeding with Drive Module Disassembly.

2.3.1 If not already removed remove piston rod (3-40) from drive module.

2.3.2 Mark stop screws (1-180) left and right. The setting of stop screws (1-180) should be checked and setting recorded before stop screws are loosened or removed. NOTE: Stop screws will be removed later in this procedure.

NOTE: For steps 2.3.3 through 2.3.10 refer to assembly drawing sheet 2 Section A-A and Detail "F".

2.3.3 Before removing position indicator (1-220), record or mark it's position. Remove position indicator (1-220).

NOTE: Step 2.3.4 is used only on G01, G2 and G3 Drive Modules. Drive Modules G4 through G10 will skip step 2.3.4 and continue with step 2.3.5.

2.3.4 Remove one vent check assembly (13) from top of housing cover (1-20).

2.3.5 Unscrew and remove hex cap screws (1-160) with lockwashers (1-170) from yoke cover (1-150).

2.3.6 Remove yoke cover (1-150) from housing cover (1-20).

2.3.7 Mark and record the orientation of the position indicator assembly (1-140) in relation to the top of yoke (1-70).

2.3.8 Remove position indicator assembly (1-140) from top of yoke (1-70).

2.3.9 Remove spring pin (1-100) from top of yoke (1-70).

2.3.10 Remove hex cap screws (1-110), with lockwashers (1-115) from housing cover (1-20).

NOTE: Steps 2.3.11 and 2.3.12 are used only on G7, G8 and G10 Drive Modules. Drive Modules G01, G2, G3, G4 and G5 will skip steps 2.3.11 and 2.3.12 and continue with step 2.3.13.

2.3.11 Remove hex cap screws (1-120), with lockwashers (1-115), from housing cover (1-20).

2.3.12 Using hex cap screws (1-110), install into holes vacated by hex cap screws (1-120). Use these hex cap screws to jack the housing cover up for removal. Alternately rotate the hex cap screws clockwise until housing cover (1-20) is clear of housing (1-10).

NOTE: G01, G2, G3 and G4 model housing cover will have cast tabs for placing prying tools to aid in cover removal.

2.3.13 Remove housing cover (1-20) from housing (1-10).

NOTE: Groove pins (1-130) will remain in housing cover (1-20) when housing cover is removed from housing (1-10). Groove pins (1-130) should not be removed from housing cover (1-20) unless they are damaged and require new replacements.

2.3.14 Refer to assembly drawing page 2 of 2 Detail "B". Remove guide bar (1-90) from housing (1-10).

- 2.3.15 Remove top yoke pin thrust bearing (2-10) from top of yoke pin (1-80).
 - 2.3.16 Rotate the arms of yoke (1-70) to the center position of housing (1-10).
 - 2.3.17 Remove yoke (1-70) with yoke pin (1-80), guide block (1-30), two yoke/guide block bushings (2-30) by lifting yoke up and out of the housing (1-10).
 - 2.3.18 Remove bottom yoke pin thrust bearing (2-10) from inside bottom of housing (1-10).
 - 2.3.19 Remove yoke pin (1-80) by inserting 3/8"-16 UNC screw into top of the yoke pin and pull straight up and out.
 - 2.3.20 Remove guide block (1-30) from between the arms of yoke (1-70).
 - 2.3.21 Remove yoke/guide block bushing (2-30) from the top of guide block (1-30).
 - 2.3.22 Remove yoke/guide block bushing (2-30) from the top of the lower yoke arm of yoke (1-70).
- NOTE: G01 model actuators skip steps 2.3.23 through 2.3.25 and continue disassembly at step 2.3.26.
- 2.3.23 Refer to assembly drawing page 2 of 2 Detail "B". Use Bettis tool part numbers 117368 (G8/G10), 117369 (G5/G7), 117370 (G3/G4) or 123616 (G2) and remove retention retainer nut assemblies (1-60) and (9-60) from guide block (1-30).
 - 2.3.24 Remove rod extension assemblies (1-50) and (9-50) from guide block (1-30).
- NOTE: Spherical washers (1-40) and (9-40) will be removed from guide block (1-30) when the extension rod assemblies are removed.
- 2.3.25 Remove the remaining spherical washers (1-40) and (9-40) from guide block (1-30).
 - 2.3.26 Unscrew and remove two stop screw nuts (1-190) from stop screws (1-180).
 - 2.3.27 Unscrew and remove two stop screws (1-180) from front of housing (1-10).
 - 2.3.28 Housing (1-10) vent check assembly removal as follows:
 - 2.3.28.1 G01, G2 and G3 housing (1-10) unscrew and remove one vent check assembly (13) from the front of housing (1-10).
 - 2.3.28.2 G4 through G10 housing (1-10) unscrew and remove two vent check assembly's (13) from the front of housing (1-10).

2.3.29 The following items do not need to be removed from their assembled locations unless being replaced by new items: Two guide bar bearings, two yoke bearings (2-40), yoke pin bearing), yoke pin thrust bearing (2-10) and spring pin (1-100).

2.4 G01 THROUGH G5 M11 HYDRAULIC OVERRIDE CYLINDER DISASSEMBLY

NOTE: For M11 hydraulic override cylinder removal from spring cartridge refer to Section 5 step 5.1.

2.4.1 Unscrew hydraulic ram cover (7-10) from hydraulic override end cap (7-70).

2.4.2 Remove hydraulic ram (7-20) from hydraulic ram cover (7-10).

2.5 G7 THROUGH G10 M11 HYDRAULIC OVERRIDE CYLINDER DISASSEMBLY

NOTE: For M11 hydraulic override cylinder removal from spring cartridge refer to Section 5 step 5.1.

2.5.1 Unscrew and remove hex cap screws (7-80) with lockwashers (7-90) from outer end cap (7-70).

2.5.2 Remove outer end cap (7-70) from hydraulic cylinder assembly (7-10).

2.5.3 Remove piston rod (7-20) from hydraulic cylinder assembly (7-10).

2.5.4 Refer to assembly drawing sheet 1 Detail "G". Remove two split ring halves (7-30) and one retainer ring (7-40) from one side of piston (7-50).

2.5.5 Refer to assembly drawing sheet 1 Detail "G". Remove two split ring halves (7-30) and one retainer ring (7-40) from the other side of piston (7-50).

2.5.6 Remove piston (7-50) from piston rod (7-20).

2.5.7 Remove vent tube (7-60) from the hydraulic cylinder assembly.

2.5.8 Pipe plug (7-110) does not require removal for routine service.

2.5.9 Pipe plug (7-120) does not require removal for routine service.

SECTION 3 - ACTUATOR REASSEMBLY

3.1 GENERAL REASSEMBLY

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

3.1.1 Remove and discard all old 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, tie bars 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 should be replaced with new parts.

3.1.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of lubricant, before installing into seal grooves.

NOTE: The parts and seals used in the actuator will be assembled using lubricant as identified in Section 1 step 1.6.1.

3.1.5 For Spring Module Installation refer to Section 5 step 5.4.

3.2 DRIVE MODULE REASSEMBLY

NOTE: Review section 3.1 General Reassembly before proceeding with Drive Module Reassembly.

NOTE: Refer to assembly drawing page 2 of 2 Detail "B" for section drawing of guide block.

3.2.1 If guide bar bearings is being replaced install new bearings into guide block (1-30).

NOTE: The guide bar bearing must be press fit into guide block guide bar bore with the seam located $45 \pm 5^\circ$ degrees of the top or bottom centerline as shown in section A-A.

NOTE: G01 model actuators skip steps 3.2.2 through 3.2.13 and continue reassembly at step 3.2.14.

3.2.2 Lubricate guide block (1-30), two spherical washers (1-40), and one extension rod assembly (1-50).

3.2.3 Install one spherical washer (1-40) into the side of guide block (1-30). NOTE: The spherical side of washer (1-40) will be facing to the outside of guide block (1-30).

- 3.2.4 Install second spherical washer (1-40) over threaded end of extension rod assembly (1-50). NOTE: The spherical side of the washer will go on the extension rod assembly facing the head of the extension rod assembly.
- 3.2.5 Install extension rod assembly (1-50) into guide block (1-30) and up against the first spherical washer (1-40).
- 3.2.6 Install extension retainer nut (1-60) over extension rod assembly (1-50) and screw into guide block (1-30).
- 3.2.7 Tighten extension retainer nut assembly (1-60) until extension rod assembly (1-50) can not move. Back off the extension retainer nut assembly (1-60) just enough to allow for extension rod assembly (1-50) to move freely.

NOTE: Steps 3.2.8 through 3.2.13 are to be completed when the actuator is equipped with a Spring Module. If the actuator is Double Acting then skip steps 3.2.8 through 3.2.13 and continue actuator reassembly starting with step 3.2.14.

- 3.2.8 Lubricate guide block (1-30), two spherical washers (9-40) and one extension rod assembly (9-50).
- 3.2.9 Install one spherical washer (9-40) into the side of guide block (1-30). NOTE: The spherical side of washer (9-40) will be facing to the outside of guide block (1-30).
- 3.2.10 Install second spherical washer (9-40) over threaded end of extension rod assembly (9-50). NOTE: The spherical side of the washer will go on the extension rod assembly facing the head of the extension rod assembly.
- 3.2.11 Install extension rod assembly (9-50) into guide block (1-30) and up against the first spherical washer (9-40).
- 3.2.12 Install extension retainer nut (9-60) over extension rod assembly (9-50) and screw into guide block (1-30).
- 3.2.13 Tighten extension retainer nut assembly (9-60) until extension rod assembly (9-50) can not move. Back off the extension retainer nut assembly (9-60) just enough to allow for extension rod assembly (9-50) to move freely.

NOTE: Consult Waller Texas Bettis Service Coordinator for "yoke bearing, yoke pin bearing or yoke/guide block bushing installation information.

- 3.2.14 If the two yoke bearings (2-40) are being replaced, install new bearing into housing cover (1-20) and housing (1-10).

NOTE: The yoke bearing (2-40) must be press fit into housing (1-10) and housing cover (1-20). Install the yoke bearings with the bearing seam located $45^{\circ} \pm 5^{\circ}$ degrees from the yoke arm slot when yoke (1-70) is rotated to its full clockwise position.

- 3.2.15 If the two yoke pin thrust bearings (2-10) are being replaced install new bearing into housing cover (1-20) and housing (1-10).

3.2.16 Lubricate two yoke/guide block bushings (2-30) and install onto top and bottom sides of guide block (1-30).

NOTE: The guide block (1-30) should be already pre-assembled with extension rod assembly and associated parts assembled in the guide block.

3.2.17 Install guide block (1-30), with yoke/guide block bushings (2-30), between arms of yoke (1-70).

3.2.18 Install o-ring seal (2-50) into inner diameter o-ring groove in the bottom of housing (1-10).

3.2.19 Coat the bearing surfaces of the yoke (1-70) with lubricant and install into housing (1-10).

3.2.20 Align hole in guide block (1-30) with the matching holes in the two yoke/guide block bushings (2-30) and the slots in the arms of yoke (1-70).

NOTE: The yoke pin can be held in place by installing a screw into the .375-16UNC tapped hole in the upper end of yoke pin (1-80).

3.2.21 Install yoke pin (1-80) by inserting into the upper yoke arm, upper yoke/guide block bushing, guide block, lower yoke/guide block bushing, lower yoke arm and resting on lower yoke pin thrust bearing (2-10).

3.2.22 Install guide bar (1-90) into either side of housing (1-10) by inserting through the housing, through guide block and then insert the guide bar into the other side of housing (1-10).

3.2.23 Refer to assembly drawing page 2 of 2 Section A-A. Install spring pin (1-100) into the top of yoke (1-70).

3.2.24 Install position indicator assembly (1-140) onto the top of yoke (1-70) and over spring pin (1-100). NOTE: Refer to Section 2 step 2.3.7 for correct installation position.

3.2.25 Install o-ring (2-50) into housing cover (1-20).

3.2.26 Install housing cover o-ring (2-60) into housing cover (1-20).

3.2.27 Install the housing cover (1-20), being careful not to damage o-ring seals (2-50) and (2-60).

3.2.28 Place lockwashers (1-115) onto hex cap screws (1-110).

NOTE: On G7 through G10 model actuators apply thread adhesive, Loctite 242, to threads of hex cap screws (1-110). Reference assembly drawing note number 9.

3.2.29 Install hex cap screws (1-110) with lockwashers (1-115) through housing cover (1-20) and into housing (1-10). NOTE: Leave hex cap screws (1-110) finger tight - do not tighten.

3.2.30 NOTE: Do this step only if groove pins (1-130) have been pulled or if the pins are being replaced. Drive groove pins (1-130) through housing cover (1-20) and into housing (1-10). The groove pins should be flush with the cover.

- 3.2.31 Torque tighten hex cap screws (1-110) until a final lubricated torque, as listed in the following table, has been achieved.

HOUSING COVER SCREW QUANTITY AND TORQUE TABLE							
MODEL	QTY	TORQUE (±5 % Percent)		MODEL	QTY	TORQUE (±5 % Percent)	
		FT-lb	N-m			FT-lb	N-m
G01	4	40	54	G5	8	100	136
G2	6	40	54	G7	8	100	136
G3	8	40	54	G8	12	100	136
G4	8	40	54	G10	16	100	136

NOTE: Complete step 3.2.32 on G5, through G10 model actuators. For G01 through G4 model actuators skip step 3.2.32 and proceed to step 3.2.33.

- 3.2.32 On G5 through G10 models

3.2.32.1 Place lockwashers (1-115) onto hex cap screws (1-120).

NOTE: Hex cap screws (1-120) are only used as "hole" fillers and to protect threads from environment.

3.2.32.2 Install and tighten hex cap screws (1-120) with lockwashers (1-115).

- 3.2.33 Install thrust bearing (2-110) onto position indicator (1-140).

- 3.2.34 Install o-ring seal (2-100) onto position indicator (1-140).

- 3.2.35 Install upper bearing (2-120) into yoke cover (1-150).

- 3.2.36 Install rod wiper (2-80) into yoke cover (1-150).

- 3.2.37 Install o-ring seal (2-70) into yoke cover (1-150).

- 3.2.38 Install yoke cover (1-150) onto housing cover (1-20) and over position indicator assembly (1-140). NOTE: During yoke cover installation be careful not to damage o-ring seal (2-70) and rod wiper (2-80).

- 3.2.39 Place lockwashers (1-170) onto hex cap screws (1-160).

- 3.2.40 Install and tighten hex cap screws (1-160) with lockwashers through yoke cover (1-150) and into housing cover (1-20).

- 3.2.41 Vent check assembly installation as follows:

3.2.41.1 G01, G2 and G3 housing (1-10) using pipe sealant install one vent check assembly (13) into the front of housing (1-10).

3.2.41.2 G2 and G3 housing (1-10) using pipe sealant install one vent check assembly (13) into the top area of housing cover (1-20).

3.2.41.3 G4 through G10 housing (1-10) using pipe sealant install two vent check assemblies (13) into the front of housing (1-10).

3.2.42 NOTE: Refer to Section 2 step 2.3.3 for correct position indicator placement. Install position indicator (1-220) over the exposed shaft of position indicator assembly (1-140).

3.2.43 Install stop screw nuts (1-190) onto stop screws (1-180).

3.2.44 Install o-ring (2-90) onto stop screws (1-180).

3.2.45 Install two stop screws (1-180) into two stop screw holes on the front of housing (1-10).

3.2.46 Adjust both stop screws (1-180) back to settings recorded earlier in Section 2 at step 2.3.2.

3.2.47 Tighten both stop screw nuts (1-190) securely.

3.3 **PNEUMATIC POWER MODULE REASSEMBLY**

- NOTES:
1. For early model G2 and G3 actuators with double nuts on the power module use section 3.4 for reassembly.
 2. Refer to Section 2 step 2.1.4 for the correct installation location for piston rod (3-40).
 3. THE ACTUATOR MUST BE IN THE APPROPRIATE OVERTRAVEL POSITION. Confirm over-travel position by observing the guide block (1-30) is against the inner wall of housing (1-10).

3.3.1 Lubricate piston rod (3-40) and insert through the side of housing (1-10).

3.3.1.1 G2 thru G10 screw piston rod (3-40) onto extension rod assembly (1-50).

3.3.1.2 G01 only screw piston rod (3-40) onto guide block (1-30).

3.3.2 Torque tighten piston rod (3-40) to the lubricated torque as listed in the following table.

PISTON ROD TORQUE INFORMATION					
HOUSING MODEL	TORQUE (±5 % Percent)		HOUSING MODEL	TORQUE (±5 % Percent)	
	FT-lb	N-m		FT-lb	N-m
G01	90	122	G5	240	325
G2	90	122	G7	240	325
G3	90	122	G8	240	325
G4	240	325	G10	240	325

- 3.3.3 Refer to assembly drawing page 2 of 2 Detail "C". Install one rod wiper (4-10) into inner end cap (3-10).
- 3.3.4 Install one rod bushing (4-20) into inner end cap (3-10).
- 3.3.5 Coat one Polypak seal (4-30) with lubricant and install, lip first, into inner end cap (3-10).

CAUTION: Install the Polypak seal with energizer ring facing outboard side (away from housing).

- 3.3.6 Install one o-ring seal (4-90) into seal groove located on the inboard face of inner end cap (3-10).
- 3.3.7 Install inner end cap (3-10) on to housing (1-10). NOTE: The pressure inlet port should be positioned in the same position as recorded in section 2.2 step 2.2.1.
- 3.3.8 Place lockwashers (3-110) onto hex cap screws (3-100).
- 3.3.9 Install hex cap screws (3-100), with lockwashers, through housing (1-10) and into inner end cap (3-10).
- 3.3.10 Refer to assembly drawing page 2 of 2 Detail "D". Install one o-ring seal (4-70) into the seal groove in piston rod (3-40).
- 3.3.11 Apply lubricant to two sets of rod T-seal components (4-50).

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

- 3.3.11.1 Install two sets of rod T-seals (4-50) into the internal diameter seal grooves of piston (3-30).
- 3.3.11.2 Install a back-up ring on each side of the T-seal.
- 3.3.11.3 When installing the back-up rings, do not align the skive-cuts.
- 3.3.11.4 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.
- 3.3.12 Install two split ring halves (3-50) into the inner most groove in piston rod (3-40) and retain by installing the recessed area of piston (3-30) onto the piston rod and over the two split ring halves (3-50).
- 3.3.13 Install two split ring halves (3-50) into the piston rod, in front of the piston installed in the previous step, and retain with retainer ring (3-60).
- 3.3.14 Install one o-ring seal (4-40) onto the outer diameter seal groove of inner end cap (3-10).
- 3.3.15 Coat one D-ring seal (4-60) with lubricant and install into the piston external seal groove. NOTE: The flat side of the D-ring seal go down into the seal groove.

- 3.3.16 Coat two tie bars (3-20) with lubricant and install by carefully pushing tie bars through piston (3-30) and rod T-seal (4-50).
- 3.3.17 Screw tie bars (3-20) into inner end cap (3-10) and tighten until the threads bottom out.
- 3.3.18 Refer to assembly drawing page 2 of 2 Detail "E". Coat two o-ring seals (4-80) with lubricant and install into outer end cap (3-80).
- 3.3.19 Apply lubricant to one o-ring seal (4-40) and install into the outer diameter o-ring groove of outer end cap (3-80).
- 3.3.20 Apply lubricant to the bore of cylinder (3-70).
- 3.3.21 Install lubricated cylinder (3-70) over piston (3-30) and onto inner end cap (3-10). When installing the cylinder over the piston seal tilt cylinder 15° to 30° degrees to piston rod.

CAUTION: If needed, when installing the cylinder, hammer on the end of the cylinder only with a non metallic object.

- 3.3.22 Install outer end cap (3-80) over tie bars (3-20) and into cylinder (3-70). NOTE: The pressure inlet port should be positioned in the same position as recorded in section 2.2 step 2.2.1.
- 3.3.23 Install tie bar nuts (3-90) onto tie bars (3-20). Torque tighten tie bar nuts, alternately in 100 foot pound / N-m increments, until a final lubricated torque, as listed in the following table, has been achieved.

TIE BAR NUTS					
HOUSING MODEL	TORQUE (±5 %)		HOUSING MODEL	TORQUE (±5 %)	
	FT-lb	N-m		FT-lb	N-m
G01	120	163	G5	400	542
G2	120	163	G7	500	678
G3	150	203	G8	500	678
G4	150	203	G10	1200	1627

- 3.3.24 Install lockwashers (3-140) onto socket cap screws (3-130)).
- 3.3.25 Install and tighten socket cap screws (3-130), with lockwashers (3-140), into outer end cap (3-80).
- 3.3.26 If removed, using pipe dope, install pipe plug (3-120) into outer end cap (3-80).
- 3.3.27 Apply sufficient pneumatic pressure to outer end cap (3-80) pressure inlet port to move the piston to its full inboard position(next to inner end cap).
- 3.3.28 Remove pneumatic pressure from outer end cap (3-80).

3.3.29 Install breather assembly (12) in outer end cap (3-80).

NOTE: Individual actuators may not have reducer bushing (14) depending on port and breather size.

3.4 G2 AND G3 EARLY MODEL PNEUMATIC POWER MODULE REASSEMBLY

- NOTES:
1. Early G2 and G3 pneumatic power modules were equipped with tie bars that had nuts on both ends of the tie bars (3-20) – double nuts.
 2. Refer to Section 2 step 2.1.4 for the correct installation location for piston rod (3-40).
 3. THE ACTUATOR MUST BE IN THE APPROPRIATE OVERTRAVEL POSITION. Confirm over-travel position by observing the guide block (1-30) is against the inner wall of housing (1-10).

3.4.1 Refer to assembly drawing page 2 of 2 Detail "C". Install one rod wiper (4-10) into inner end cap (3-10).

3.4.2 Install one rod bushing (4-20) into inner end cap (3-10).

3.4.3 Coat one Polypak seal (4-30) with lubricant and install, lip first, into inner end cap (3-10).

CAUTION: Install the Polypak seal with energizer ring facing outboard side of inner end cap (3-10).

3.4.4 Install piston rod (3-40) through inner end cap (3-10). NOTE: The piston rod end with retainer grooves to be on the outboard side of inner end cap (3-10).

3.4.5 Apply lubricant to two sets of rod T-seal components (4-50).

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

3.4.5.1 Install two sets of rod T-seals (4-50) into the internal diameter seal grooves of piston (3-30).

3.4.5.2 Install a back-up ring on each side of the T-seal.

3.4.5.3 When installing the back-up rings, do not align the skive-cuts.

3.4.5.4 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.

3.4.6 Coat one D-ring seal (4-60) with lubricant and install into the piston external seal groove. NOTE: The flat side of the D-ring seal goes down into the seal groove.

3.4.7 Install piston (3-30) onto piston rod (3-40). NOTE: The cast rib side of the piston is to be facing away from the outboard side of inner end cap (3-10) or position piston (3-30) on the piston rod so that the retainer grooves are on the out board side of the piston.

- 3.4.8 Refer to assembly drawing page 2 of 2 Detail "D". Install o-ring seal (4-70) into the seal groove in the outboard end of piston rod (3-40).
- 3.4.9 Install two split ring halves (3-50) into the outer most groove in piston rod (3-40) and retain by installing the recessed area of piston (3-30) over the two split halves (3-50).
- 3.4.10 Install two split ring halves (3-50) into the piston rod, in back of the piston and retain with retainer ring (3-60).
- 3.4.11 Coat two tie bars (3-20) with lubricant and install by carefully pushing tie bars through piston (3-30) and rod T-seal (4-50).
- 3.4.12 Install two tie bar o-ring seals (4-80) onto the inboard end of tie bars (3-20) and into the o-ring grooves provided.
- 3.4.13 Insert the tie bars through inner end cap (3-10) and screw hex nuts (3-90) onto inboard end of the tie bars. NOTE: Screw the tie bars through the hex nuts (3-90) until one complete thread is exposed.
- 3.4.14 Refer to assembly drawing page 2 of 2 Detail "E". Install two tie bar o-ring seals (4-80) onto the outboard end of tie bars (3-20) and into the o-ring grooves provided.
- 3.4.15 Apply lubricant to one o-ring seal (4-40) and install into the outer diameter o-ring groove of outer end cap (3-80).
- 3.4.16 Apply lubricant to the bore of cylinder (3-70).
- 3.4.17 Install lubricated cylinder (3-70) over piston (3-30) and onto inner end cap (3-10). When installing the cylinder over the piston seal tilt cylinder 15° to 30° degrees to piston rod.

CAUTION: If needed, when installing the cylinder, hammer on the end of the cylinder only with a non metallic object.

- 3.4.18 Install outer end cap (3-80) over tie bars (3-20) and into cylinder (3-70). NOTE: The pressure inlet port should be positioned in the same position as recorded in section 2.2 step 2.2.1.
- 3.4.19 Install tie bar nuts (3-90) onto tie bars (3-20). Torque tighten tie bar nuts, alternately in 100 foot pound increments, until a final lubricated torque, as listed in the following table, has been achieved.

TIE BAR NUTS					
HOUSING MODEL	TORQUE (±5 %)		HOUSING MODEL	TORQUE (±5 %)	
	FT-lb	N-m		FT-lb	N-m
G2	120	163	G3	150	203

- 3.4.20 Install lockwashers (3-140) onto socket cap screws (3-130).

3.4.21 Install and tighten socket cap screws (3-130), with lockwashers (3-140), into outer end cap (3-80).

3.4.22 Install Pneumatic Power Module per Section 5 steps 5.4.

3.5 G01 THROUGH G5 M11 HYDRAULIC OVERRIDE CYLINDER REASSEMBLY

NOTE: Review Section 3.1 General Reassembly before proceeding with G01 through G5 M11 Hydraulic Override Cylinder Reassembly.

3.5.1 Install ram bushing (8-20) into hydraulic ram cover (7-10).

3.5.2 Install Polypak seal (8-30) into hydraulic ram cover (7-10). NOTE: The lip of Polypak seal (8-30) are to face toward the hydraulic override end cap when installed in the hydraulic ram cover.

3.5.3 Install rod wiper (8-10) into hydraulic ram cover (7-10).

3.5.4 Install hydraulic ram (7-20) into hydraulic ram cover (7-10). NOTE: When installing the hydraulic ram (7-20) push it through the hydraulic ram cover until the ram is at least flush with the outboard ram cover.

3.5.5 Install o-ring seal (8-35) into inner diameter seal groove located at the outboard end of the threads in the hydraulic override end cap (7-70).

3.5.6 Install hydraulic ram cover (7-10) into the hydraulic override end cap (7-70) by screwing the ram cover into the end cap until the ram cover bottoms out into the end cap.

NOTE: For M11 hydraulic override cylinder installations refer to Section 5 step 5.2.

3.6 G7 THROUGH G10 M11 HYDRAULIC OVERRIDE CYLINDER REASSEMBLY

NOTE: Review Section 3 step 3.1 General Reassembly before proceeding with G7 through G10 M11 Hydraulic Override Cylinder Reassembly.

3.6.1 Install Polypak seal (8-30) into hydraulic cylinder assembly (7-10). NOTE: The lip of Polypak seal (8-30) will face toward the hydraulic override end cap when installed in the hydraulic cylinder assembly.

3.6.2 Install rod bushing (8-20) into hydraulic cylinder assembly (7-10).

3.6.3 Install rod wiper (8-10) into hydraulic cylinder assembly (7-10).

3.6.4 Install two split ring halves (7-30) into the inner most groove in piston rod (7-20) and retain by installing retainer ring (7-40) onto the split ring halves.

3.6.5 Apply hydraulic fluid to o-ring seal (8-50) and install it into the seal groove located between the two split ring grooves on the piston rod (7-20).

3.6.6 Install the piston (7-50) onto the piston rod (7-20) and up against the split rings install in step 3.5.4.

- 3.6.7 Install two split ring halves (7-30) into the outboard groove in piston rod (7-20) and retain by installing retainer ring (7-40) onto the split ring halves.
- 3.6.8 Install Polypak seal (8-60) into outer diameter seal groove of piston (7-50). NOTE: The lip of Polypak seal (8-60) will face toward the hydraulic override outer end cap (7-70) when installed in the hydraulic cylinder assembly.
- 3.6.9 Install piston bearing (8-40) into outer diameter bearing groove of piston (7-50).
- 3.6.10 Install o-ring seal (8-80) into inner diameter seal groove located in the piston (7-50).
- 3.6.11 Use pipe dope on the threads install pipe plug (7-110) into the vent tube hole in the inboard end of the hydraulic cylinder assembly (7-10).
- 3.6.12 Install vent tube (7-60) into the hydraulic cylinder assembly inboard end.
- 3.6.13 Install the assembled piston rod (7-20) with piston (7-50) into the open end of the hydraulic cylinder assembly and install the piston over the vent tube (7-60).
- 3.6.14 Install o-ring seal (8-90) into the vent tube port located in the outer end cap (7-70).
- 3.6.15 Install o-ring seal (8-70) into the o-ring groove located on the inner diameter of the hydraulic cylinder assembly flange opening.
- 3.6.16 Install the outer end cap (7-70) assembled piston rod (7-20) with piston (7-50) onto the open end of the hydraulic cylinder assembly and over the vent tube (7-60).
- 3.6.17 Install lockwashers (7-90) onto hex cap screws (7-80).
- 3.6.18 Install and tighten hex cap screws (7-80), with lockwashers (7-90) through outer end cap (7-70) and into hydraulic cylinder assembly.

NOTE: For M11 hydraulic override cylinder installations refer to Section 5 step 5.2.

3.7 **ACTUATOR TESTING**

- 3.7.1 Leakage Test - All areas where leakage to atmosphere may occur are to be checked, using a commercial leak testing solution.

CAUTION: Pressure applied to the actuator is not to exceed the maximum operating pressure rating listed on the actuator name tag. Test the actuator using a properly adjusted self relieving regulator, with gauge.

- 3.7.2 Cycle the actuator five times at the nominal operating pressure (NOP) as listed on the actuator's name tag or the customers normal actuator supply pressure. If excessive leakage across the pistons is noted, generally a bubble which breaks three seconds or less after starting to form, cycle the actuator five times as this will allow the seals to seek their proper service condition.

NOTE: If excessive leakage across the piston remains, the actuator must be disassembled and the cause of leakage must be determined and corrected.

- 3.7.3 Apply NOP pressure to the pressure port in inner end cap (3-10) and allow the actuator to stabilize.
- 3.7.4 Apply a commercial leak testing solution to the following areas:
 - 3.7.4.1 Joint between inner end cap (3-10) and cylinder (3-70). This checks cylinder to inner end cap o-ring seal.
 - 3.7.4.2 The port hole in the outer end cap (3-80). This checks the piston D-seal to cylinder (3-70), o-ring seal (4-70), and rod T seal (4-50).
 - 3.7.4.3 The vent check port hole in housing. This checks Polypak seal (4-30) that seals piston rod (3-40) to inner end cap (3-10).
 - 3.7.4.6 Remove pressure from the pressure inlet port.
- 3.7.5 If an actuator was disassembled and repaired, the above leakage test must be performed again.

SECTION 4 - FIELD CONVERSIONS

4.1 FAIL MODE REVERSAL (CW TO CCW, OR CCW TO CW)

- 4.1.1 Remove Spring Module per Section 5.3.
- 4.1.2 Remove Pneumatic Power Module per Section 5.5.
- 4.1.3 Re-install the Spring Module onto the opposite end of housing (1-10) as it was previously located per Section 5.4.
- 4.1.4 Re-install the Override Cylinder Assembly into Spring Module per Section 5.2.

4.2 CONVERTING DOUBLE ACTING ACTUATOR TO SPRING RETURN WITH OVERRIDE CYLINDER ASSEMBLY

- 4.2.1 Remove Blind End Cap per steps 4.2.1.1 and 4.2.1.2.
 - 4.2.1.1 Remove hex cap screws (5-20), with spring lockwashers (5-30), from blind end cap (5-10).
 - 4.2.1.2 Remove blind end cap (5-10) from end of housing (1-10).
- 4.2.2 If Pneumatic Power Module needs to be relocated due to fail mode requirements (fail counter-clockwise) use Section 5.5 for removal and Section 5.6 for installation.

- 4.2.3 Install Powr Swivl Module per Section 5.8.
- 4.2.4 Install the Spring Module onto the end of housing (1-10) per Section 5.4.
- 4.2.5 Install the Override Cylinder Assembly into Spring Module per Section 5.2.

SECTION 5 - MODULE REMOVAL AND INSTALLATION

5.1 M11 OVERRIDE CYLINDER REMOVAL

- 5.1.1 Shut off and exhaust the operating media from both sides of the actuator's power cylinder.
- 5.1.2 Place the M11 pump control knob (20-320) in the Auto position. NOTE: Control knob (20-320) is located in front and at the bottom of the M11 pump manifold (20-10).

NOTE: Using a means of capturing the hydraulic fluid that will be lost during the following steps. Use a bucket, tub, and large container, ECT.

- 5.1.3 Remove all the piping from the M11 override cylinder end cap (7-70).
- 5.1.4 M11 Hydraulic override cylinder removal: For models G01 through G5 use step 5.1.5 and for G7 through G10 use step 5.1.6..

WARNING: Confirm that the M11 pump control knob is in the auto position prior to completing step 5.1.5. DO NOT STAND DIRECTLY IN FRONT OF THE M11 OVERRIDE CYLINDER WHEN COMPLETING STEP 5.1.5 - STAND TO ONE SIDE OR THE OTHER.

- 5.1.5 G01 through G5 M11 override cylinder removal.
 - 5.1.5.1 Unscrew and remove hex cap screws (7-80) with lockwashers (7-90) from override cylinder end cap (7-70).
 - 5.1.5.2 Remove override cylinder assembly from spring cartridge assembly (5-10).
- 5.1.6 G7 through G10 M11 override cylinder removal.

CAUTION: Do not remove hex cap screws (7-80) from M11 override cylinder at this time. If hex cap screws (7-80) are removed at this time it is possible that hydraulic fluid will be dumped inside the spring cartridge.

- 5.1.6.1 Unscrew and remove hex cap screws (7-100) with lockwashers (7-90) from override cylinder end cap (7-70). NOTE: To identify hex cap screws (7-100) from hex cap screws (7-80), hex cap screws (7-100) will be located to the left and right of SR cartridge top dead center and will then be counted as every other hex cap screw. To verify correct hex cap screws check the following table for screw length.

ACTUATOR MODEL	ITEM 7-80 LENGTH		ITEM 7-100 LENGTH	
	Inches	mm	Inches	mm
G7	2	50.8	2.75	69.85
G8	3	76.2	4.5	114.3
G10	3.5	88.9	5.0	127

- 5.1.6.2 Remove override cylinder assembly from spring cartridge assembly (5-10).

5.2 **M11 OVERRIDE CYLINDER INSTALLATION**

- 5.2.1 Install o-ring seal (6-10) into the o-ring groove in the outboard end of spring cartridge assembly (5-10).
- 5.2.2 M11 Hydraulic override cylinder installation: For models G01 through G5 use step 5.2.3 and for G7 through G10 use step 5.2.4..
- 5.2.3 G01 through G5 M11 override cylinder installation.
- 5.2.3.1 Insert M11 hydraulic override cylinder assembly through spring cartridge outer end.
- 5.2.3.2 Install lockwashers (7-90) on to hex cap screws (7-80).
- 5.2.3.3 Install hex cap screws (7-80) with lockwashers (7-90) through hydraulic override end cap (7-70) and into outer end of spring cartridge (5-10).
- 5.2.4 G7 through G10 M11 override cylinder installation.
- 5.2.4.1 Insert M11 hydraulic override cylinder assembly into spring cartridge outer end.
- 5.2.4.2 Install lockwashers (7-90) on to eight hex cap screws (7-100).
- 5.2.4.3 Install hex cap screws (7-100) with lockwashers (7-90) through hydraulic override end cap (7-70) and into outer end of spring cartridge (5-10).
- 5.2.5 Torque tighten hex cap screws (7-100) and (7-80), alternately until a final lubricated torque, as listed in the following table, has been achieved.

M11 OVERRIDE CYLINDER END CAP TO SR CARTRIDGE SCREW TORQUE					
TABLE					
HOUSING MODEL	TORQUE ± 5 % Percent		HOUSING MODEL	TORQUE ± 5 % Percent	
	Ft-lb	N-m		Ft-lb	N-m
G01	16	21.68	G5	40	54.2
G2	16	21.68	G7	80	108.4
G3	16	21.68	G8	130	176.15
G4	40	54.2	G10	190	257.45

5.2.6 Using pipe dope on threads re-install all piping between hydraulic override cylinder assembly and the M11 pump.

5.2.7 FLUID FILLING INSTRUCTIONS FOR M11 & M11-S HYDRAULIC OVERRIDE SYSTEMS:

5.2.7.1 To fluid fill M11 Manual Hydraulic Override System refer to instructions part number 126858.

5.2.7.2 To fluid fill M11-S Manual Hydraulic Override System refer to instructions part number 121960.

5.3 SPRING MODULE REMOVAL

WARNING: The spring cartridge must be checked to verify that the spring(s) are in their extended position before the spring cartridge is removed from the actuator.

NOTES:

1. When the Spring Module is to be removed it should be removed from the drive Module prior to the Pneumatic Power Module removal or disassembly.
2. Review Section 2.1 General Disassembly before proceeding with Spring Module Disassembly.
3. The setting of stop screws (1-180) should be checked and setting recorded before stop screws are loosened or removed.

5.3.1 Shut off and exhaust the operating media from both sides of the actuator's power cylinder.

5.3.2 The M11 override cylinder must be removed prior to spring module removal: Proceed to section 5.1 and complete all steps 5.1.1 through 5.1.6 and then continue with step 5.3.3

5.3.3 Apply pneumatic pressure to inner end cap (2-40) port "A" to compress the spring enough to move the yoke off the stop screw on the spring module side of the drive module.

5.3.4 Loosen the stop screw nut (1-190) located on the stop screw that is closest to or next to Spring Module.

5.3.5 Unscrew stop screw (1-180) that is closest to or next to Spring Module (unscrew or back out until the load is removed from the stop screw).

5.3.6 Remove pneumatic pressure from pressure inlet port of inner end cap (3-10).

CAUTION: Due to the weight and size of spring cartridge assembly (5-10), heavy duty support equipment will be required when removing spring cartridge assembly from the actuator housing. Refer to section 6 for spring cartridge module weights.

5.3.7 The spring cartridge "pre-load" must be removed before spring cartridge assembly (5-10) is removed from housing (1-10). Refer to steps 5.3.4 through 5.3.6 for spring cartridge "pre-load" removal.

5.3.8 Remove breather assembly (12) from outer end cap (3-80) port "B".

CAUTION: The maximum pressure to be applied in step 5.3.9 is 25 PSIG.

5.3.9 Apply pneumatic pressure, not to exceed the maximum as indicated in the above "CAUTION", to the pressure inlet port "B" of outer end cap (3-80) to move the spring cartridge tension rod hex nut out of it's cast hex seat.

NOTE: If pneumatic pressure is not available to apply to the pressure inlet port "B" located in outer end cap (3-80) then remove pipe plug (3-120) or if equipped with an extended stop (ES) remove the ES. Using a long rod go through the outer end cap pipe plug or ES vacant port hole and push on the piston rod so as to move the spring cartridge tension rod hex nut out of it's cast hex seat.

5.3.10 Unscrew the spring cartridge tension rod from the Drive Module. The tension rod can be rotated for removal by going through the open end of spring cartridge assembly with a square male drive extension.

5.3.11 Remove hex cap screws (5-20) with lockwashers (5-30) from housing (1-10).

5.3.12 Remove spring cartridge assembly (5-10) from actuator housing (1-10).

WARNING: Under no circumstances should the spring cartridge assembly (5-10) be cut apart, as the spring is pre-loaded and the spring cartridge is a weld assembly.

5.4 SPRING MODULE INSTALLATION

CAUTION: Due to the weight and size of Spring Module, heavy duty support equipment will be required when installing spring cartridge module to the actuator housing. For the approximate weight of the spring cartridge refer to Section 6.

WARNING ACTUATOR MUST BE IN THE APPROPRIATE OVERTRAVEL POSITION (see detail "A" on warning tag attached to Spring Module access hole cover or to Bettis drawing part number 123650). Confirm overtravel position by observing the guide block (1-30) is against the inner wall of housing (1-10).

NOTE: The setting of stop screws (1-180) should be checked and setting recorded before stop screws are loosened or removed.

- 5.4.1 On stop screw (1-180), that is located on the same side of the housing as spring cartridge (5-10), loosen stop screw nut (1-190).
- 5.4.2 Unscrew or back out stop screw (1-180) to achieve overtravel as illustrated in detail "A" on warning tag attached to Spring Module cover plate or to Bettis drawing part number 123650.
- 5.4.3 Install o-ring seal (6-20) into the o-ring groove in the inboard end of spring cartridge assembly (5-10).
- 5.4.4 Using lifting equipment move Spring Module up to housing (1-10) and align spring cartridge tension rod with extension rod assembly (9-50).

WARNING: COMPLETE STEP 5.4.5 TO AVOID SEVER INJURY TO PERSONNEL OR INCUR MAJOR DAMAGE TO THE ACTUATOR.

5.4.5 SPRING CARTRIDGE TENSION ROD TO ROD EXTENSION INSTALLATION AS FOLLOWS:

- 5.4.5.1 Using a male square drive extension, go through the open end of Spring Module (5-10) and rotate the tension rod nut until initial thread engagement is achieved.

NOTE: Confirm initial thread engagement of rod extension (9-50) to tension rod.

- 5.4.5.2 After confirming initial thread engagement rotate tension rod into extension rod assembly (9-50) per the following table.

WARNING: After initial thread engagement the tension rod must be rotated clockwise the minimum number of turns listed in the following table.									
ACTUATOR MODEL	TORQUE UNITS	G01	G2	G3	G4	G5	G7	G8	G10
MINIMUM NO TURNS	N/A	N/A	10	10	10	13	14	20	25

WARNING: When screwing tension rod into extension rod assembly (9-50) make certain that the tension rod and extension rod assembly threads do not cross-thread.

- 5.4.6 Torque tighten the spring cartridge tension rod as listed in the following table.

SPRING CARTRIDGE TENSION ROD TORQUE TABLE					
HOUSING MODEL	TORQUE (± 5 % Percent)		HOUSING MODEL	TORQUE (± 5 % Percent)	
	Lbs. Ft	N.m		Lbs. Ft	N.m
G01	50	68	G5	240	325
G2	90	122	G7	240	325
G3	90	122	G8	240	325
G4	240	325	G10	240	325

- 5.4.7 Install lock washers (5-30) onto hex cap screws (5-20).

- 5.4.8 Install hex cap screws (5-20) with lockwashers (5-30) through housing (1-10) and into spring cartridge assembly (5-10) and tighten.
- 5.4.9 Install o-ring seal (6-10) into the o-ring groove in the outboard end of spring cartridge assembly (5-10).
- 5.4.10 M11 Hydraulic override cylinder installation: For models G2 through G5 use step 5.4.11 and for G7 through G10 use step 5.4.12..
- 5.4.11 G2 through G5 M11 override cylinder installation.
- 5.4.11.1 Insert M11 hydraulic override cylinder assembly into spring cartridge outer end.
- 5.4.11.2 Install lockwashers (7-90) on to eight hex cap screws (7-80).
- 5.4.11.3 Install eight hex cap screws (7-80) with lockwashers (7-90) through end cap (7-70) and into outer end of spring cartridge (5-10).
- 5.4.12 G7 through G10 M11 override cylinder installation.
- 5.4.12.1 Insert M11 hydraulic override cylinder assembly into spring cartridge outer end.
- 5.4.12.2 Install lockwashers (7-80) on to eight hex cap screws (7-100).
- 5.4.12.3 Install eight hex cap screws (7-100) with lockwashers (7-90) through end cap (7-70) and into outer end of spring cartridge (5-10).
- 5.4.13 Torque tighten hex cap screws (7-100) and (7-80), alternately until a final lubricated torque, as listed in the following table, has been achieved.

M11 OVERRIDE CYLINDER END CAP TO SR CARTRIDGE SCREW TORQUE TABLE					
HOUSING MODEL	TORQUE ± 5 % Percent		HOUSING MODEL	TORQUE ± 5 % Percent	
	Ft-lb	N-m		Ft-lb	N-m
G01	16	21.68	G5	40	54.2
G2	16	21.68	G7	80	108.4
G3	16	21.68	G8	130	176.15
G4	40	54.2	G10	190	257.45

- 5.4.14 Using pipe dope on threads re-install all piping between hydraulic override cylinder assembly and the M11 pump.
- 5.4.15 FLUID FILLING INSTRUCTIONS FOR M11 & M11-S HYDRAULIC OVERRIDE SYSTEMS:
- 5.4.15.1 To fluid fill M11 Manual Hydraulic Override System refer to instructions part number 126858.

5.4.15.2 To fluid fill M11-S Manual Hydraulic Override System refer to instructions part number 121960.

5.4.16 If removed install stop screw nuts (1-190) onto stop screws (1-180).

5.4.17 If removed install o-ring (2-90) onto stop screws (1-180).

5.4.18 If removed install two stop screws (1-180) into two stop screw holes on the front of housing (1-10).

5.4.19 Adjust both stop screws (1-180) back to settings recorded earlier in Section 5.

5.4.20 Tighten both stop screw nuts (1-190) securely.

5.5 PNEUMATIC POWER MODULE REMOVAL

CAUTION: Due to the weight and size of power module, heavy duty support equipment will be required when removing power module from the actuator housing. Refer to section 6 for Pneumatic Power Module weights.

5.5.1 Remove pipe plug (3-120) from outer end cap (3-80).

5.5.2 Remove hex cap screws (3-100) with lockwashers (3-110) from housing (1-10).

5.5.3 Using a male square drive extension, go through outer end cap (3-80) and unscrew piston rod (3-40) from extension rod assembly (1-50).

NOTE: When removing power module from housing (1-10) be careful not to loose o-ring seal (4-90).

5.5.4 Remove power module from actuator housing (1-10).

5.6 PNEUMATIC POWER MODULE INSTALLATION

NOTE: Re-install the power module onto the opposite side of housing (1-10) as it was previously located.

5.6.1 Check to verify that o-ring seal (4-90) is properly seated in its seal groove located on the housing side of inner end cap (3-10).

NOTE: G2 and G3 models confirm that the two inboard hex nuts (3-90) flats are aligned to fit into the slot located in the end of housing (1-10).

5.6.2 Using lifting equipment move the power module up to housing (1-10) and align piston rod (3-40) with extension rod assembly (1-50).

5.6.3 Using a male square drive extension, go through outer end cap (3-80) and screw piston rod (3-40) into extension rod assembly (1-50).

CAUTION: When screwing piston rod into extension rod assembly (1-50) make certain that the piston rod and extension rod assembly threads do not cross-thread.

- 5.6.4 Torque tighten piston rod (3-40) as follows:
 - 5.6.4.1 G2 and G3 torque to 90 foot pounds lubricated.
 - 5.6.4.2 G4 and G10 torque to 240 foot pounds lubricated.
- 5.6.5 Install lock washers (3-110) onto hex cap screws (3-100).
- 5.6.6 Install and tighten hex cap screws (3-100) with lockwashers (3-110) through housing (1-10) and screw into inner end cap (3-10).
- 5.6.7 Using pipe dope, install pipe plug (3-120) into outer end cap (3-80).

5.7 POWR SWIVL REMOVAL

- 5.7.1 Push the guide block to the side of housing (1-10) that will expose the extension rod assembly (1-50). NOTE: The guide block can be moved by inserting a long non metallic rod through the hole where the blind end cap was removed and pushing on the guide block.
- 5.7.2 Refer to assembly drawing sheet 2 Detail "B". Use Bettis tool part number as listed in chart in section 1 step 1.5.2 to remove retainer nut assembly (1-60) from the guide block (1-30).

CAUTION: When removing rod extension assembly from guide block be careful not to drop one of the spherical washers inside the housing.

- 5.7.3 Remove rod extension assembly (1-50) from guide block (1-30).

NOTE: One spherical washer (1-40) will be removed from guide block (1-30) when extension rod assembly is removed.

- 5.7.4 Remove the remaining spherical washer (1-40) from guide block (1-30).

5.8 POWR SWIVL MODULE INSTALLATION

WARNING: The actuator must be in the appropriate overtravel position. Confirm overtravel position by observing the guide block (1-30) is against the inner wall of housing (1-10).

- 5.8.1 Push the guide block to the required side of the housing (1-10). NOTE: The guide block can be moved by inserting a long rod through either end of the housing and pushing on the guide block.
- 5.8.2 Lubricate two spherical washers (1-40), and one extension rod assembly (1-50).
- 5.8.3 Install one spherical washer (1-40) into the side of guide block (1-30). NOTE: The spherical side of washer (1-40) will be facing to the outside of guide block (1-30).

- 5.8.4 Install second spherical washer (1-40) over threaded end of extension rod assembly (1-50). NOTE: The spherical side of the washer will go on the extension rod assembly facing the head of the extension rod assembly.
- 5.8.5 Install extension rod assembly (1-50) into right of guide block (1-30) and up against the first spherical washer (1-40).
- 5.8.6 Install extension retainer nut assembly (1-60) over extension rod assembly (1-50) and screw into guide block (1-30).
- 5.8.7 Tighten extension retainer nut assembly (1-60) until extension rod assembly (1-50) can not move. Back off the extension retainer nut assembly (1-60) just enough to allow for extension rod assembly (1-50) to move freely.

SECTION 6 - ACTUATOR SUPPORT INFORMATION

6.1 M11 HYDRAULIC OVERRIDE SYSTEM FLUID VOLUME TABLE

ACTUATOR SIZE		G01	G2	G3	G4	G5	G7	G8	G10
APPROX. VOLUME FLUID FOR M11 SYSTEM	Quarts	1.6	1.8	2.0	3.6	10.2	9.7	15.9	27.0
	Liters	1.8	1.7	1.9	3.4	9.6	9.1	15.1	25.6

6.2 MODULE WEIGHTS BY ITEM NUMBER AND ACTUATOR HOUSING SIZE

ITEM NO.		G01 WT.	G2 WT.	G3 WT.	G4 WT.	G5 WT.	G7 WT.	G8 WT.	G10 WT.	MODULE DESCRIPTION
1	Lbs.	83	110	162	280	545	1025	1495	2550	Drive Module
	Kg	38	50	73	127	247	465	678	1157	
3	Lbs.	69	N/A	N/A	N/A	N/A	N/A	N/A	N/A	8" Dia. Power
	Kg	31	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs.	68	80	N/A	N/A	N/A	N/A	N/A	N/A	9" Dia. Power
	Kg	30.5	36	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs.	75	73.5	88	N/A	N/A	N/A	N/A	N/A	10" Dia. Power
	Kg	34	33	40	N/A	N/A	N/A	N/A	N/A	
3	Lbs.	86	86	104	130	N/A	N/A	N/A	N/A	12" Dia. Power
	Kg	39	39	47	59	N/A	N/A	N/A	N/A	
3	Lbs.	96	96	114	145	N/A	N/A	N/A	N/A	14" Dia. Power
	Kg	44	44	51	66	N/A	N/A	N/A	N/A	

6,2 continued next page.

6.2 CONTINUED - MODULE WEIGHTS BY ITEM NUMBER AND ACTUATOR HOUSING SIZE

ITEM NO.		G01 WT.	G2 WT.	G3 WT.	G4 WT.	G5 WT.	G7 WT.	G8 WT.	G10 WT.	MODULE DESCRIPTION
3	Lbs.	N/A	135	145	168	295	N/A	N/A	N/A	16" Dia. Power
	Kg	N/A	61	66	76	134	N/A	N/A	N/A	
3	Lbs.	N/A	N/A	235	260	305	585	N/A	N/A	20" Dia. Power
	Kg	N/A	N/A	107	118	138	265	N/A	N/A	
3	Lbs.	N/A	N/A	N/A	340	410	735	911	N/A	24" Dia. Power
	Kg	N/A	N/A	N/A	154	186	334	413	N/A	
3	Lbs.	N/A	N/A	N/A	505	590	810	1225	1120	28" Dia. Power
	Kg	N/A	N/A	N/A	229	268	367	556	508	
3	Lbs.	N/A	N/A	N/A	N/A	977	1100	1260	1440	32" Dia. Power
	Kg	N/A	N/A	N/A	N/A	443	499	572	653	
3	Lbs.	N/A	N/A	N/A	N/A	1243	1400	1525	1755	36" Dia. Power
	Kg	N/A	N/A	N/A	N/A	564	653	692	796	
3	Lbs.	N/A	N/A	N/A	N/A	N/A	N/A	1975	2205	40" Dia. Power
	Kg	N/A	N/A	N/A	N/A	N/A	N/A	896	1000	
3	Lbs.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	44" Dia. Power
	Kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	48" Dia. Power
	Kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs.	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	52" Dia. Power
	Kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs.	160	225	320	564	975	2740	3545	4975	SR1 Spring
	Kg	73	102	145	256	442	1243	1608	2257	
5	Lbs.	158	215	310	549	980	2630	2345	4515	SR2 Spring
	Kg	72	98	141	249	445	1193	1064	2048	
5	Lbs.	153	215	295	534	925	2410	3085	4095	SR3 Spring
	Kg	153	98	295	534	925	2410	3085	4095	
5	Lbs.	144	200	280	474	860	2210	N/A	3735	SR4 Spring
	Kg	65	91	127	215	390	1002	N/A	1694	
5	Lbs.	N/A	200	N/A	N/A	N/A	N/A	N/A	N/A	SRA5 Spring
	Kg	N/A	91	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs.	N/A	180	N/A	N/A	N/A	N/A	N/A	N/A	SRA6 Spring
	Kg	N/A	82	N/A	N/A	N/A	N/A	N/A	N/A	
7	Lbs.	18	34	47	82	100	181	270	530	M11 SR Override Cyl.
	Kg	8.2	15.3	21.2	36.9	45	81.45	1275	239	
2	Lbs.	35	35	35	45	50	35	45	50	M11 SR Pump / Reservoir
	Kg	14.5	14.5	14.5	20.4	22.7	14.5	20.4	22.7	

6.3 G01 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	4	Hex Cap Screws	Socket
1-160	1/2	4	Hex Cap Screws	Socket
1-180	3/8" Sq.	2	Stop Screws	Open End or Adjustable
1-190	1-15/16"	2	Hex Jam Nuts	Open End or Adjustable
3-20	3/8"	2	Tie Bar (flats)	Open End or Adjustable
3-40	3/8" Sq.	1	Piston Rod	Male Drive
3-90	1-1/8"	2	Standard Hex Nuts	Socket
3-100	9/16"	4	Hex Cap Screws	Socket
3-120	5/8" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	9/16"	4	Hex Cap Screws	Socket
7-80	9/16"	4	Hex Cap Screws	Socket
7-110	1/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
7-120	9/16" Sq.	1	Square Head Pipe Plug	Square Head Pipe Plug
12	1"	1	Breather Assembly	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/8" Sq.	1	Tension rod	Male Drive

6.4 G2 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	6	Hex Cap Screws	Socket
1-160	9/16"	4	Hex Cap Screws	Socket
1-180	3/8" Sq.	2	Stop Screws	Open End or Adjustable
1-190	1-1/8"	2	Hex Jam Nuts	Open End or Adjustable
3-20	3/8"	2	Tie Bar (flats)	Open End or Adjustable
3-40	3/8" Sq.	1	Piston Rod	Male Drive
3-90	1-1/8"	4	Standard Hex Nuts	Socket
3-100	9/16"	4	Hex Cap Screws	Socket
3-120	5/8" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	9/16"	6	Hex Cap Screws	Socket
7-80	9/16"	4	Hex Cap Screws	Socket
7-110	1/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
7-120	1/2" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/8" Sq.	1	Tension rod	Male Drive

6.5 G3 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	8	Hex Cap Screws	Socket
1-160	9/16"	4	Hex Cap Screws	Socket
1-180	1/2" Sq.	2	Stop Screws	Open End or Adjustable
1-190	1-5/16"	2	Hex Jam Nuts	Open End or Adjustable
3-20	1/2"	2	Tie Bar (flats)	Open End or Adjustable
3-40	3/8" Sq.	1	Piston Rod	Male Drive
3-90	1-5/16"	4	Standard Hex Nuts	Socket
3-100	9/16"	6	Hex Cap Screws	Socket
3-120	5/8" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	9/16"	6	Hex Cap Screws	Socket
7-80	9/16"	6	Hex Cap Screws	Socket
7-110	1/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
7-120	1/2" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/8" Sq.	1	Tension rod	Male Drive

6.6 G4 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	8	Hex Cap Screws	Socket
1-160	9/16"	4	Hex Cap Screws	Socket
1-180	3/4" Sq.	2	Stop Screws	Open End or Adjustable
1-190	1-13/16"	2	Hex Jam Nuts	Open End or Adjustable
3-20	5/8"	2	Tie Bar (flats)	Open End or Adjustable
3-40	1/2" Sq.	1	Piston Rod	Male Drive
3-90	1-5/8"	2	Standard Hex Nuts	Socket
3-100	3/4"	6	Hex Cap Screws	Socket
3-120	5/8" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	3/4"	6	Hex Cap Screws	Socket
7-80	3/4"	6	Hex Cap Screws	Socket
7-110	1/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
7-120	1/2" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Tension rod	Male Drive

6.7 G5 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	8	Hex Cap Screws	Socket
1-120	3/4"	4	Hex Cap Screws	Socket
1-160	9/16"	6	Hex Cap Screws	Socket
1-180	7/8" Sq.	2	Stop Screws	Open End or Adjustable
1-190	2-3/8"	2	Heavy Hex Jam Nuts	Open End or Adjustable
3-20	1/2 Sq.	2	Tie Bar (flats)	Open End or Adjustable
3-40	1/2 Sq.	1	Piston Rod	Male Drive
3-90	2"	2	Standard Hex Nuts	Socket
3-100	3/4"	8	Hex Cap Screws	Socket
3-120	1-1/8" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	3/4"	8	Hex Cap Screws	Socket
7-80	3/4"	8	Hex Cap Screws	Socket
7-110	1/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
7-120	1/2" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Tension rod	Male Drive

6.8 G7 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	8	Hex Cap Screws	Socket
1-120	3/4"	4	Hex Cap Screws	Socket
1-160	9/16"	8	Hex Cap Screws	Socket
1-180	1"	2	Stop Screws	Open End or Adjustable
3-20	3/4" Sq.	2	Tie Bar (female square)	Open End or Adjustable
3-40	3/4" Sq.	1	Piston Rod	Male Drive
3-90	2-3/8"	2	Standard Hex Nuts	Socket
3-100	15/16"	8	Hex Cap Screws	Socket
3-120	1-1/8" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	15/16"	8	Hex Cap Screws	Socket
7-80	15/16"	8	Hex Cap Screws	Socket
7-100	15/16"	8	Hex Cap Screws	Socket
7-110	9/16"	1	Flush Socket Head Pipe Plug	Allen
7-130	9/32" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Tension rod	Male Drive

6.9 G8 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	12	Hex Cap Screws	Socket
1-120	3/4"	4	Hex Cap Screws	Socket
1-160	9/16"	8	Hex Cap Screws	Socket
1-180	1-1/4"	2	Stop Screws	Open End or Adjustable
3-20	3/4" Sq.	2	Tie Bar (female square)	Open End or Adjustable
3-40	3/4" Sq.	1	Piston Rod	Male Drive
3-90	2-3/4"	2	Standard Hex Nuts	Socket
3-100	1-1/8"	8	Hex Cap Screws	Socket
3-120	1-5/16" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	1-1/8"	8	Hex Cap Screws	Socket
7-80	1-1/8"	8	Hex Cap Screws	Socket
7-100	1-1/8"	8	Hex Cap Screws	Socket
7-110	9/16"	1	Flush Socket Head Pipe Plug	Allen
7-130	9/32" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Tension rod	Male Drive

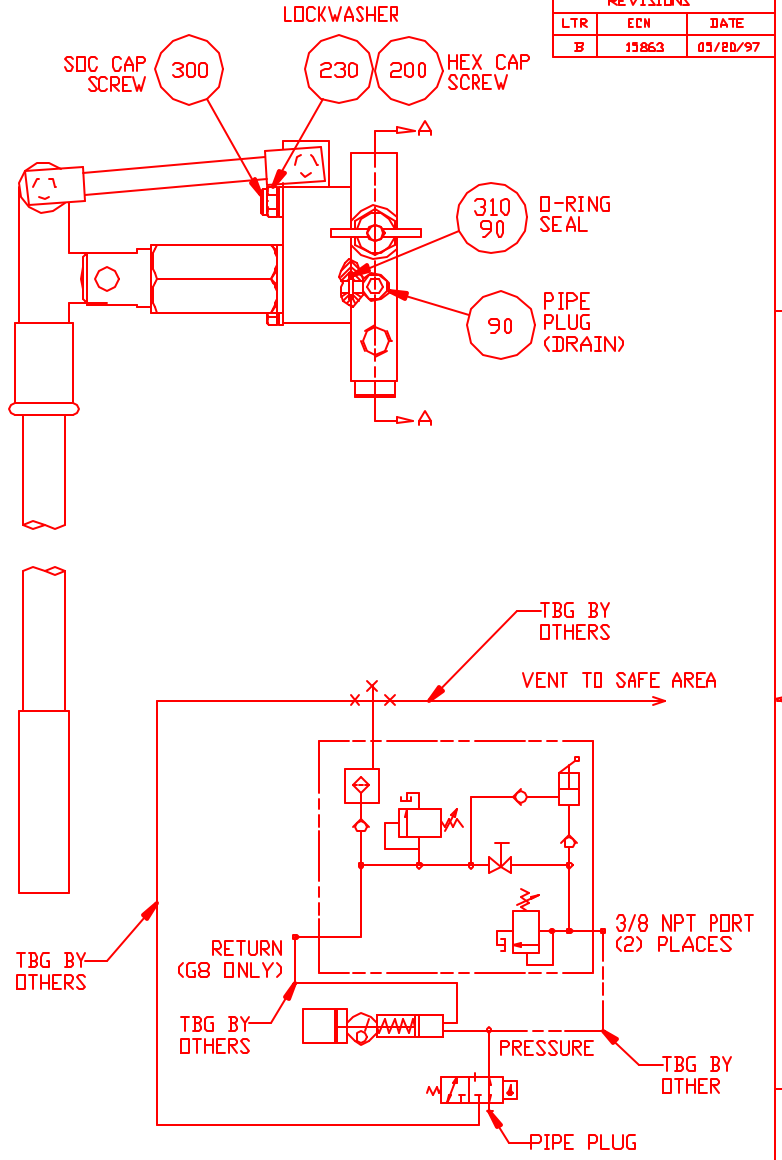
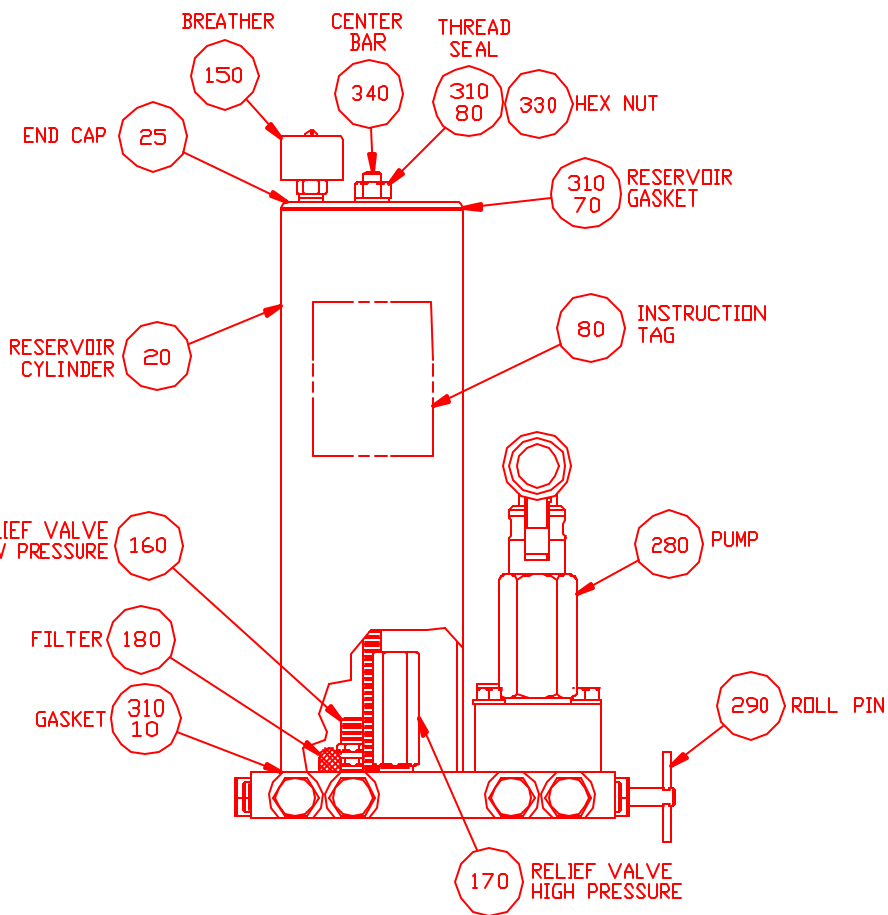
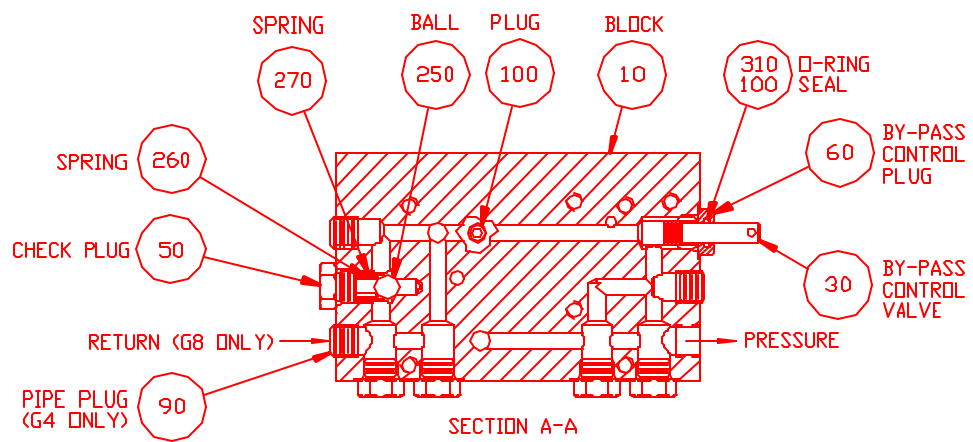
6.10 G10 TOOL STYLE AND WRENCH SIZE

ITEM NO.	WRENCH SIZE	ITEM QTY	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	16	Hex Cap Screws	Socket
1-120	3/4"	4	Hex Cap Screws	Socket
1-160	9/16"	8	Hex Cap Screws	Socket
1-180	1-1/2"	2	Stop Screws	Open End or Adjustable
3-20	3/4" Sq.	2	Tie Bar (female square)	Open End or Adjustable
3-40	3/4" Sq.	1	Piston Rod	Male Drive
3-90	3-1/2"	2	Standard Hex Nuts	Socket
3-100	1-5/16"	8	Hex Cap Screws	Socket
3-120	1-5/16" Sq.	1	Pipe Plug	Open End or Adjustable
3-130	3/16"	2	Socket Cap Screws	Allen
5-20	1-1/8"	8	Hex Cap Screws	Socket
7-80	1-5/16"	8	Hex Cap Screws	Socket
7-100	1-5/16"	8	Hex Cap Screws	Socket
7-110	9/16"	1	Flush Socket Head Pipe Plug	Allen
7-130	9/32" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
12	1"	1	Breather Assembly	Open End
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Tension rod	Male Drive

ECN	DATE	REV		BY *	DATE
Released	December 2001	A	COMPILED	B. Cornelius	17 December 2001
			CHECKED	B. Cornelius	17 December 2001
			APPROVED	R. Smith	17 December 2001

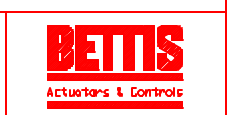
* Signatures on file Bettis, Waller, Texas

REVISIONS		
LTR	EEN	DATE
B	13863	05/20/97



DRAWN BY: EDINSON	DATE 07/11/96
CHECKED BY: ROONEY	DATE 07/19/96
APPROVED BY: MAN	DATE 07/19/96

TITLE:
REMOTE MOUNT
ASSEMBLY DWG
M1S - S
G4/G8
FOR FIRE SAFE



THIS DOCUMENT AND THE DATA DISCLOSED HEREIN OR HEREVITH IS NOT TO BE REPRODUCED, USED OR DISCLOSED IN WHOLE OR IN PART TO ANYONE WITHOUT THE PERMISSION OF BETTIS.

SALES ORDER:

THIRD ANGLE PROJECTION
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PART No. 121107	
SCALE NTS	DWG. SIZE C
SHEET 1 OF 2	REV.

4

3

2

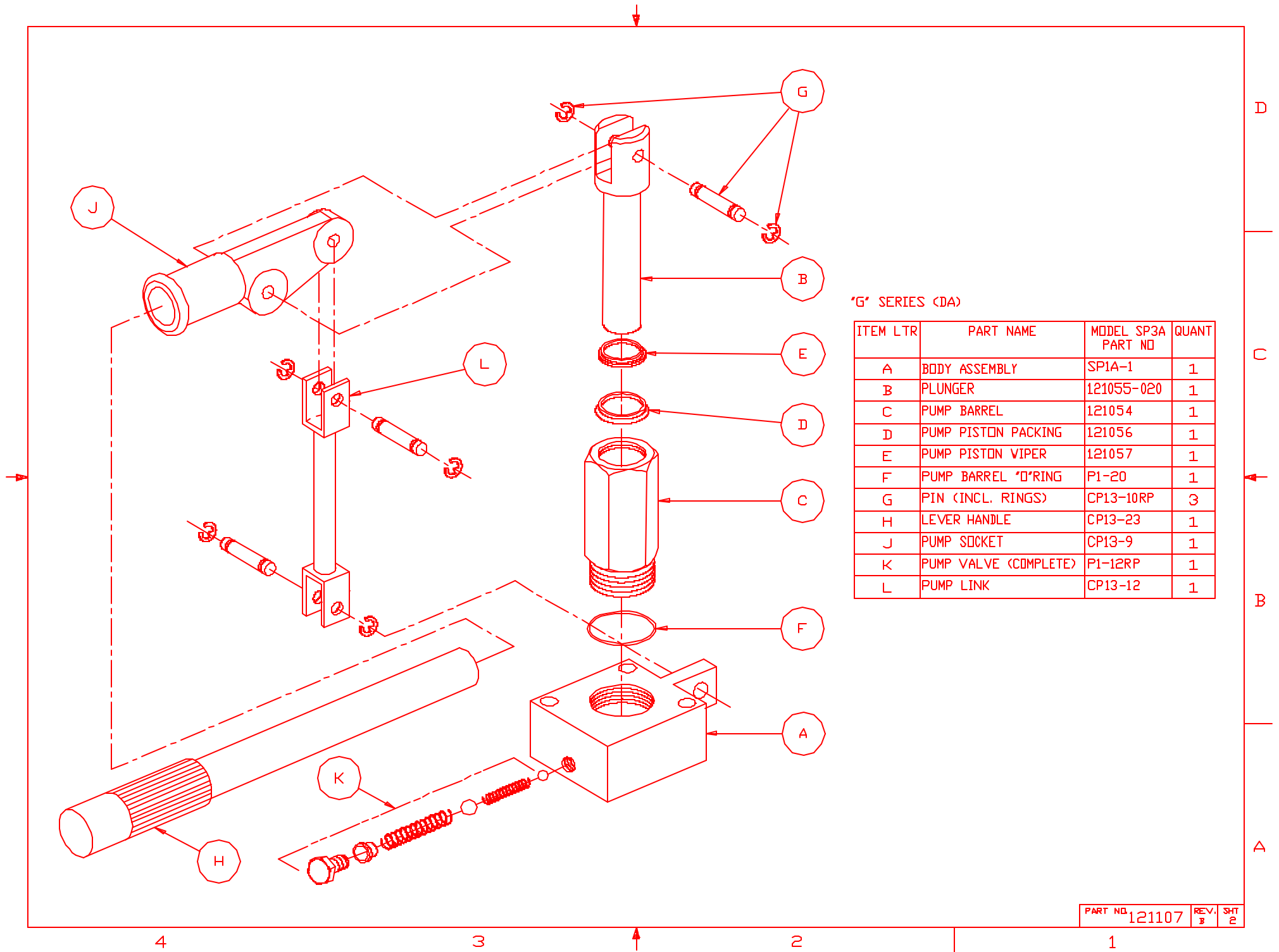
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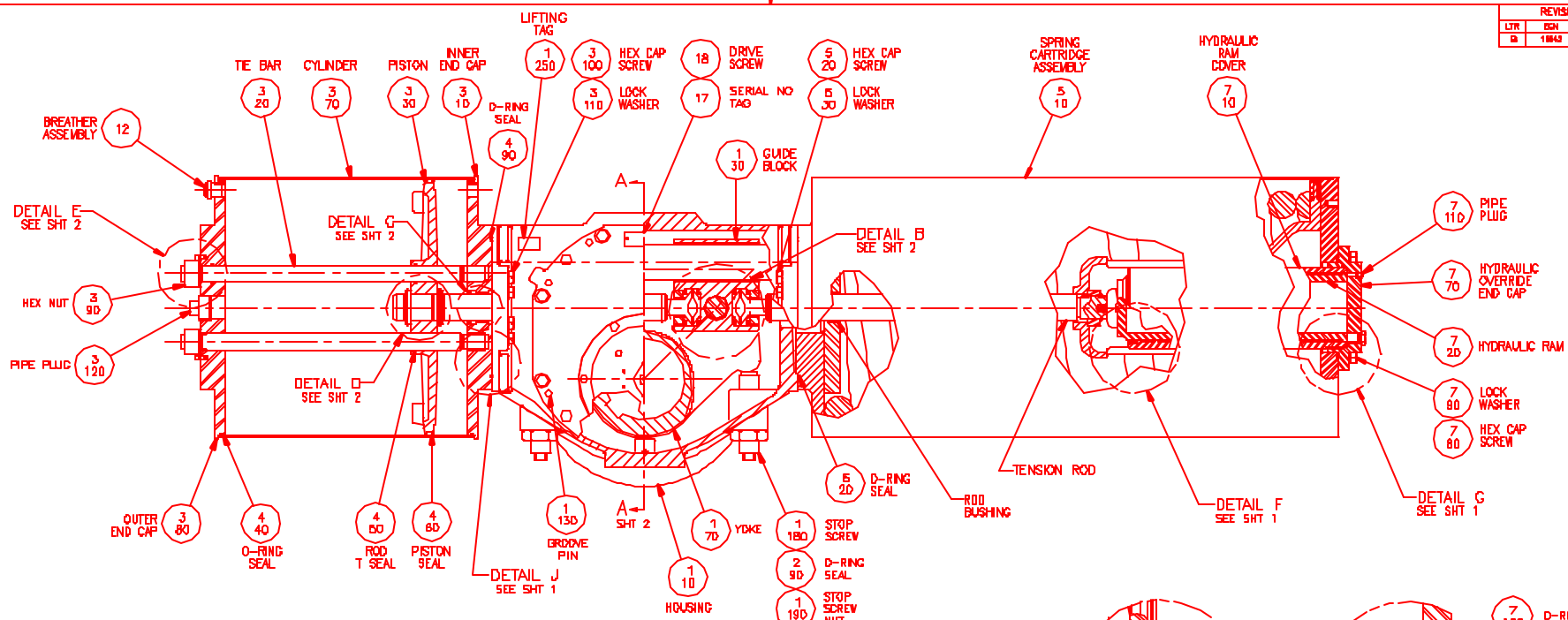
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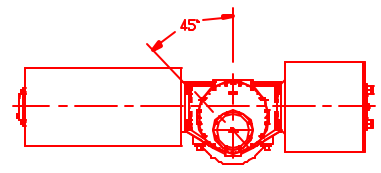
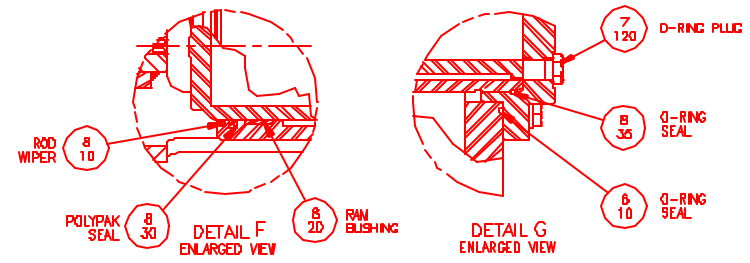
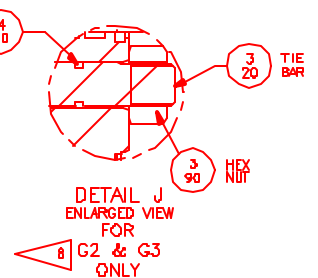
'G' SERIES (DA)

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A	BODY ASSEMBLY	SP1A-1	1
B	PLUNGER	121055-020	1
C	PUMP BARREL	121054	1
D	PUMP PISTON PACKING	121056	1
E	PUMP PISTON VIPER	121057	1
F	PUMP BARREL 'O'RING	P1-20	1
G	PIN (INCL. RINGS)	CP13-10RP	3
H	LEVER HANDLE	CP13-23	1
J	PUMP SOCKET	CP13-9	1
K	PUMP VALVE (COMPLETE)	P1-12RP	1
L	PUMP LINK	CP13-12	1

REVISIONS		
LTR	EGN	DATE
18	1804	10/23/98

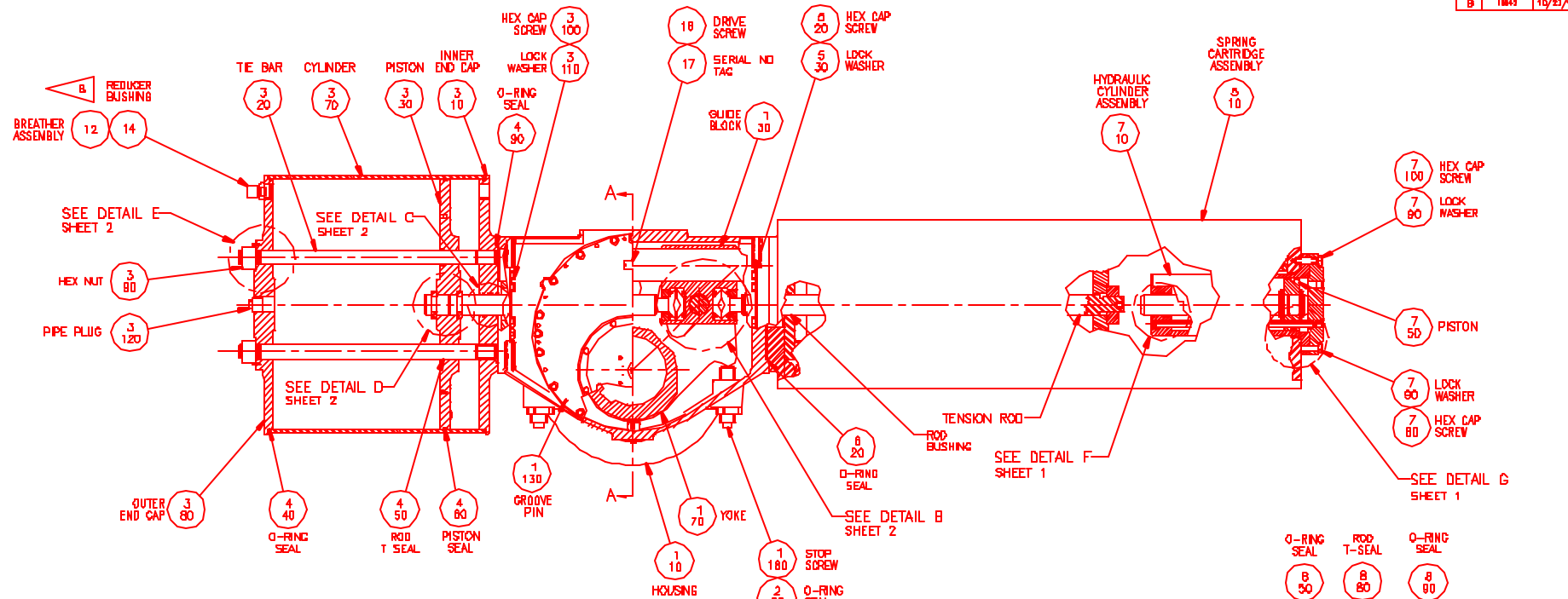


- 8 EARLY RELEASE MODELS OF G2 & G3 ACTUATORS USED TIE BARS THAT EXTENDED THRU THE CYLINDER INNER END CAP AND WERE SECURED BY A HEX NUT (ITEM 3-90) SEALS WERE ALSO ON THE TIE BARS
 - 7 INSPECT PER ES-6.
 - 6 TO REMOVE HSG COVER (1-20), REMOVE ALL HEX CAP SCREWS FROM HSG COVER INSTALL HEX CAP SCREW 1-110 INTO HOLES TAPPED THRU HSG COVER ONLY. TIGHTEN UNTIL HSG COVER IS LOOSE. THIS PROCEDURE DOES NOT APPLY TO G4 ACTUATORS. HEX CAP SCREW 1-120 NOT USED ON G4 ACTUATORS. LOCKWASHER 1-115 NOT USED ON G4 ACTUATORS, USE LOCKWASHER 1-170
 - 5 TIGHTEN THE EXTENSION RETAINER NUT ASSY (1-80) UNTIL THE EXTENSION ROD ASSY (1-80) CAN NOT MOVE, THEN BACK OFF THE EXTENSION RETAINER NUT ASSY (1-80) JUST ENOUGH TO ALLOW FOR THE EXTENSION ROD ASSY (1-80) TO MOVE FREELY
 - 4 YOKE BEARING (2-40) MUST BE PRESS FIT INTO THE HSG (1-10) AND HSG COVER (1-20) WITH THE SEAM LOCATED 45°±0° COW FROM THE YOKE (1-70) SLOT WHEN AT FULL CLOCKWISE ROTATION. NOTE, SOME HAND FITTING MAY BE REQUIRED AT THE SEAM FOR ASSEMBLY.
 - 3 GUIDE BAR BEARINGS (2-20) MUST BE PRESS FIT INTO THE GUIDE BLOCK (1-30) GUIDE BAR BORE WITH THE SEAM LOCATED WITHIN ±5° AS SHOWN IN SECTION A-A.
 - 2 APPLY LUBRICANT (500) TO ALL MOVING PARTS AND FASTENERS
 - 1. ALL PARTS TO BE CLEANED TO REMOVE ALL DIRT AND FOREIGN MATTER PRIOR TO ASSEMBLY.
- NOTES:

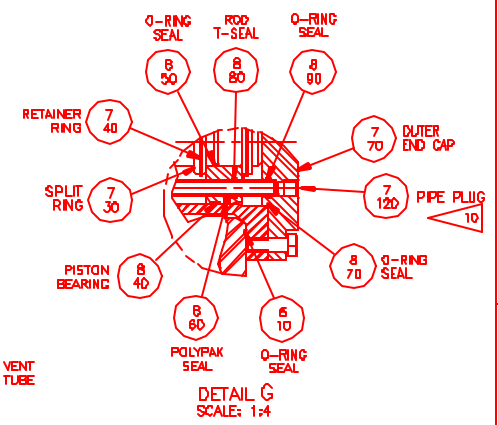
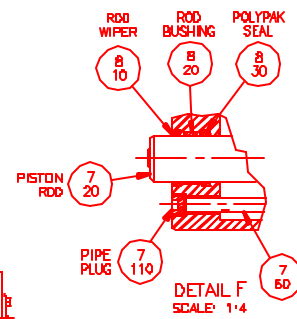
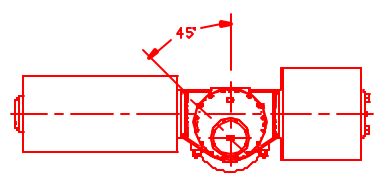


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THE INFORMATION ON THIS DRAWING IS NOT TO BE REPRODUCED, USED OR DISCLOSED IN WHOLE OR IN PART TO ANYONE WITHOUT THE PERMISSION OF GEA-BENTLEY	PART NO.: 121410	SCALE: N/A DWG. SIZE: D SHEET: 1 of 2 REV:
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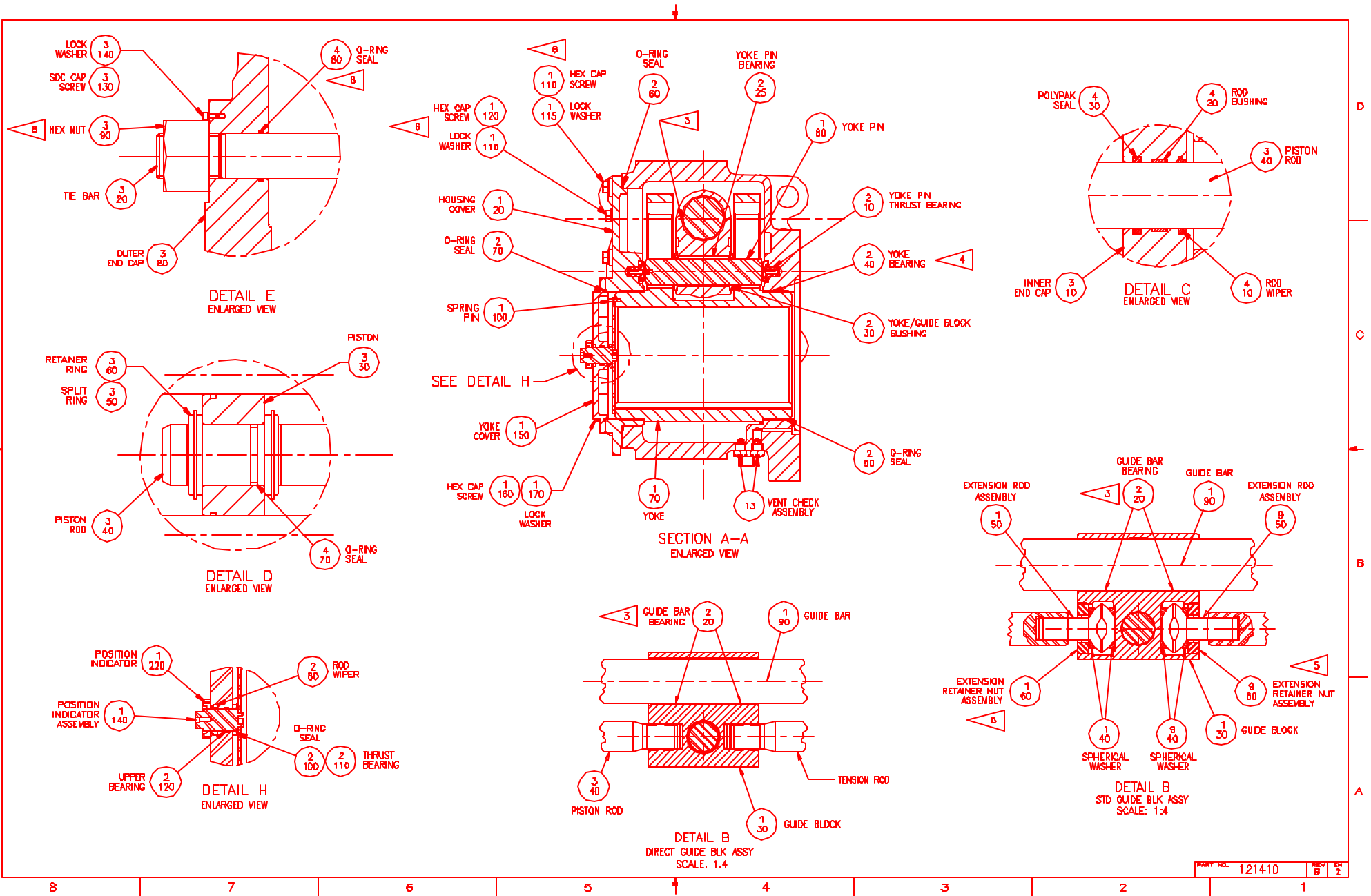
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ITR	EGN	DATE
B	18842	10/23/08

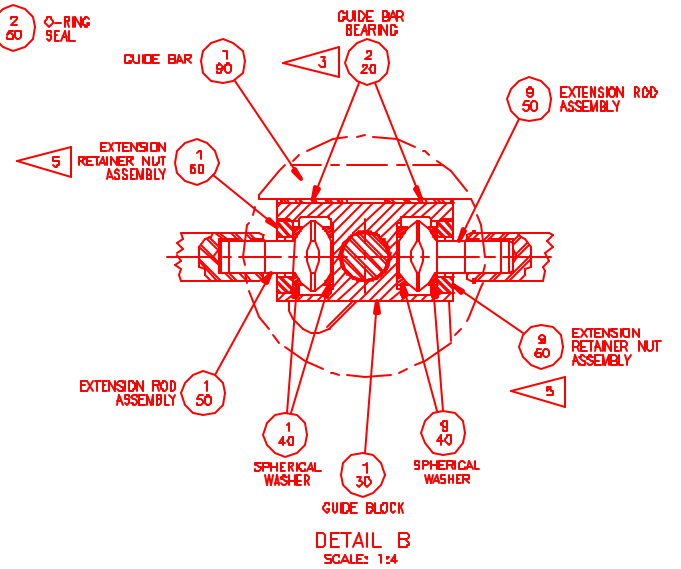
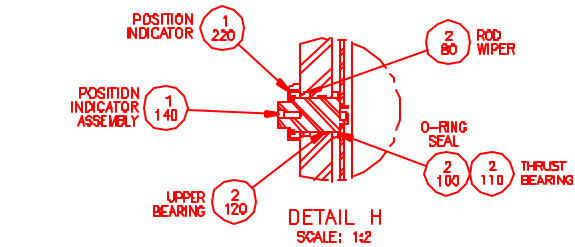
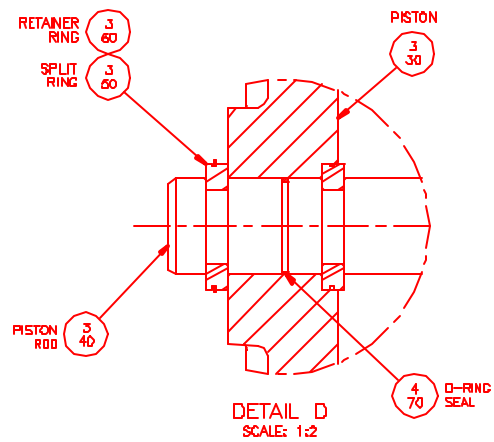
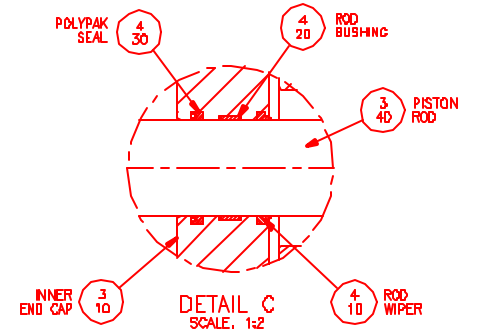
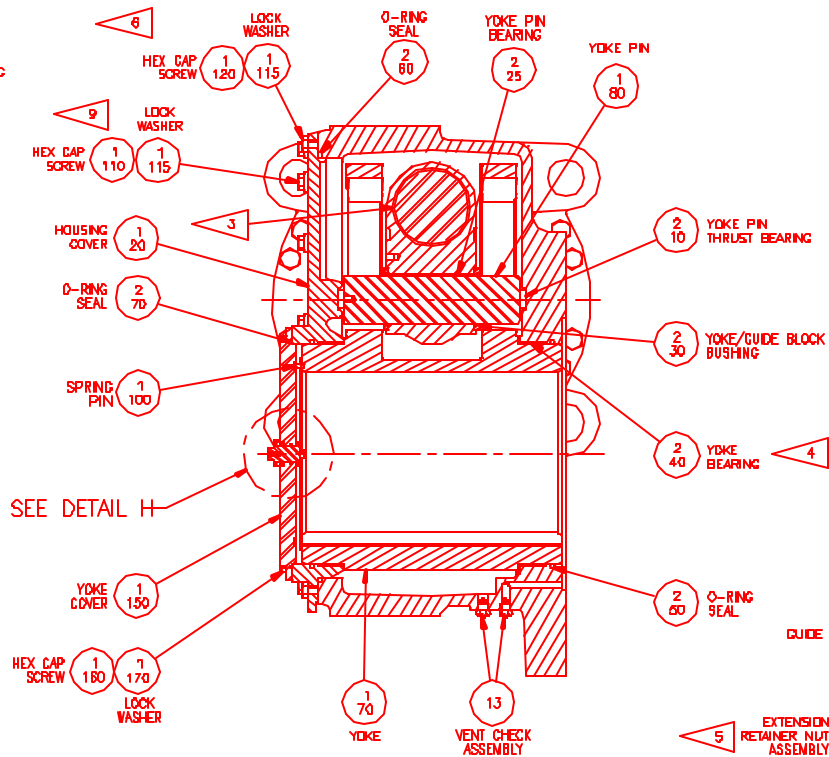
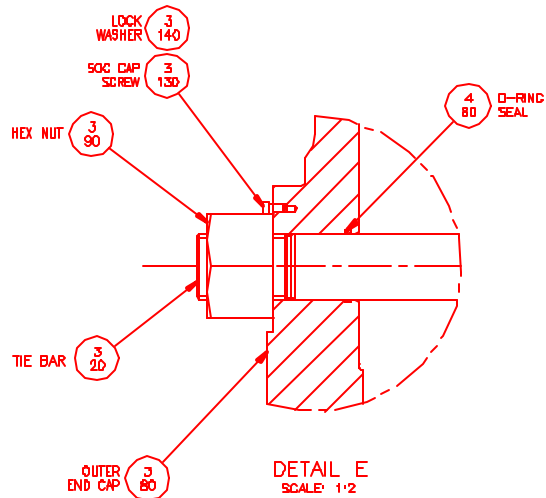


- 10 PIPE PLUG (7-120) FOR SHIPPING ONLY
 - 9 APPLY THREAD ADHESIVE (2-130) TO HSG COVER SCREWS ON G7, G8, G10 AND G13 ACTUATORS.
 - 8 REDUCER BUSHING NOT REQUIRED ON ALL MODELS.
 - 7. INSPECT PER ES-6.
 - 6 TO REMOVE HSG COVER (1-20), REMOVE ALL HEX CAP SCREWS FROM HSG COVER. INSTALL HEX CAP SCREW 1-110 (IN THE PLACE OF HEX CAP SCREW 1-120) INTO HOLES TAPPED THRU HSG COVER ONLY. TIGHTEN UNTIL HSG COVER IS LOOSE.
 - 5 TIGHTEN THE EXTENSION RETAINER NUT ASSY (1-80) UNTIL THE EXTENSION ROD ASSY (1-80) CAN NOT MOVE, THEN BACK OFF THE EXTENSION RETAINER NUT ASSY (1-80) JUST ENOUGH TO ALLOW FOR THE EXTENSION ROD ASSY (1-80) TO MOVE FREELY
 - 4 YOKE BEARING (2-40) MUST BE PRESS FIT INTO THE HSG (1-10) AND HSG COVER (1-20) WITH THE SEAM LOCATED 45±0° CCW FROM THE YOKE (1-70) SLOT WHEN AT FULL CLOCKWISE ROTATION. NOTE, SOME HAND FITTING MAY BE REQUIRED AT THE SEAM FOR ASSEMBLY.
 - 3 GUIDE BAR BEARINGS (2-20) MUST BE PRESS FIT INTO THE GUIDE BLOCK (1-30) GUIDE BAR BORE WITH THE SEAM LOCATED WITHIN ±5° AS SHOWN IN SECTION A-A.
- 2 APPLY LUBRICANT (800) TO ALL MOVING PARTS AND FASTENERS
1. ALL PARTS TO BE CLEANED TO REMOVE ALL DIRT AND FOREIGN MATTER PRIOR TO ASSEMBLY. NOTES:

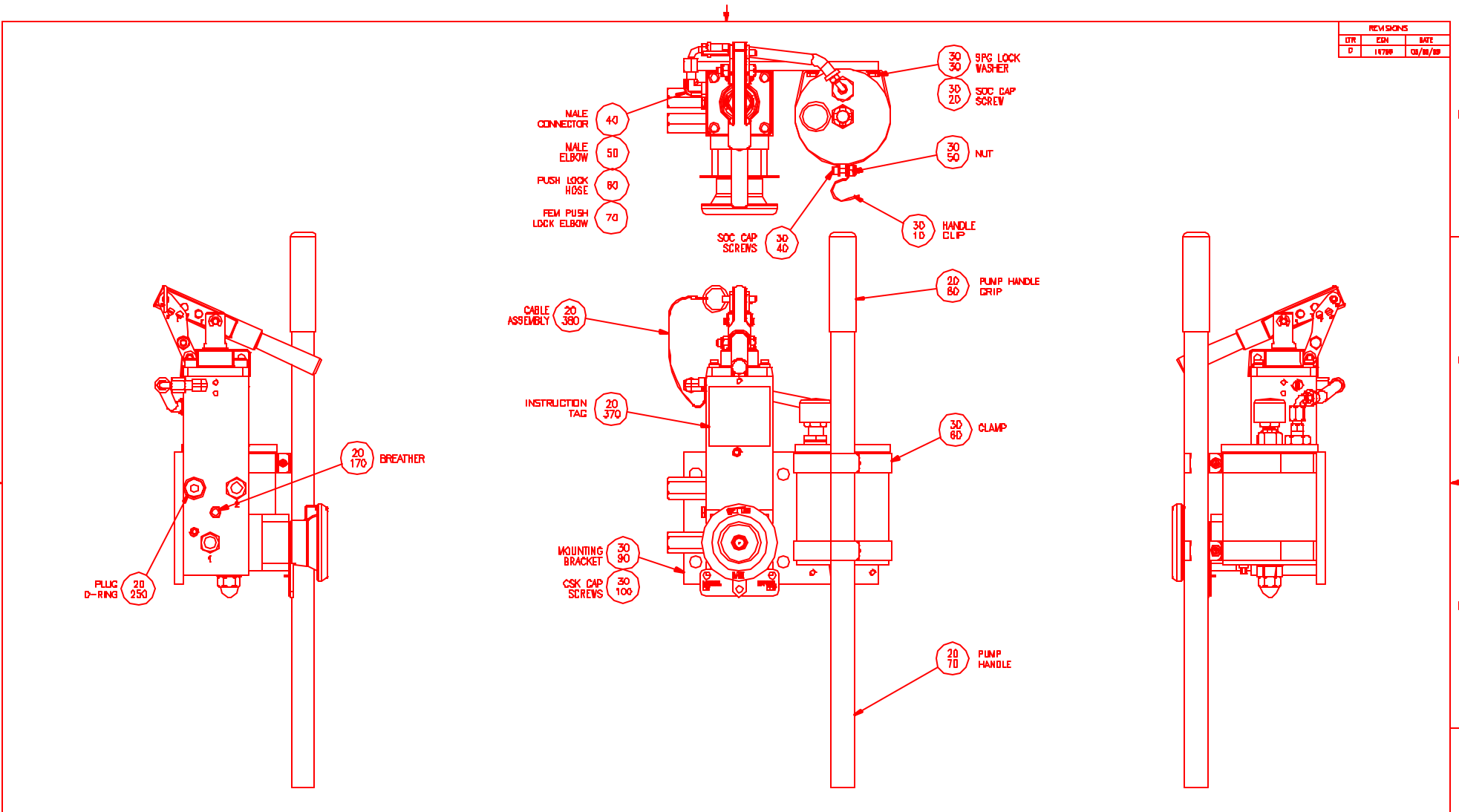


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PART NO: 121411		SCALE: NPS DWG. SIZE: D SHEET: 1 of 2	





REV'SIONS		
QTR	EGN	DATE
D	14788	02/06/08



- MALE CONNECTOR 40
- MALE ELBOW 50
- PUSH LOCK HOSE 80
- FEM PUSH LOCK ELBOW 70

- 30 30 SPS LOCK WASHER
- 30 2D SOC CAP SCREW
- 30 50 NUT

- SOC CAP SCREWS 30 40
- 30 1D HANDLE CLIP

- CABLE ASSEMBLY 20 380

- 20 60 PUMP HANDLE DRIP

- INSTRUCTION TAG 20 370

- 30 60 CLAMP

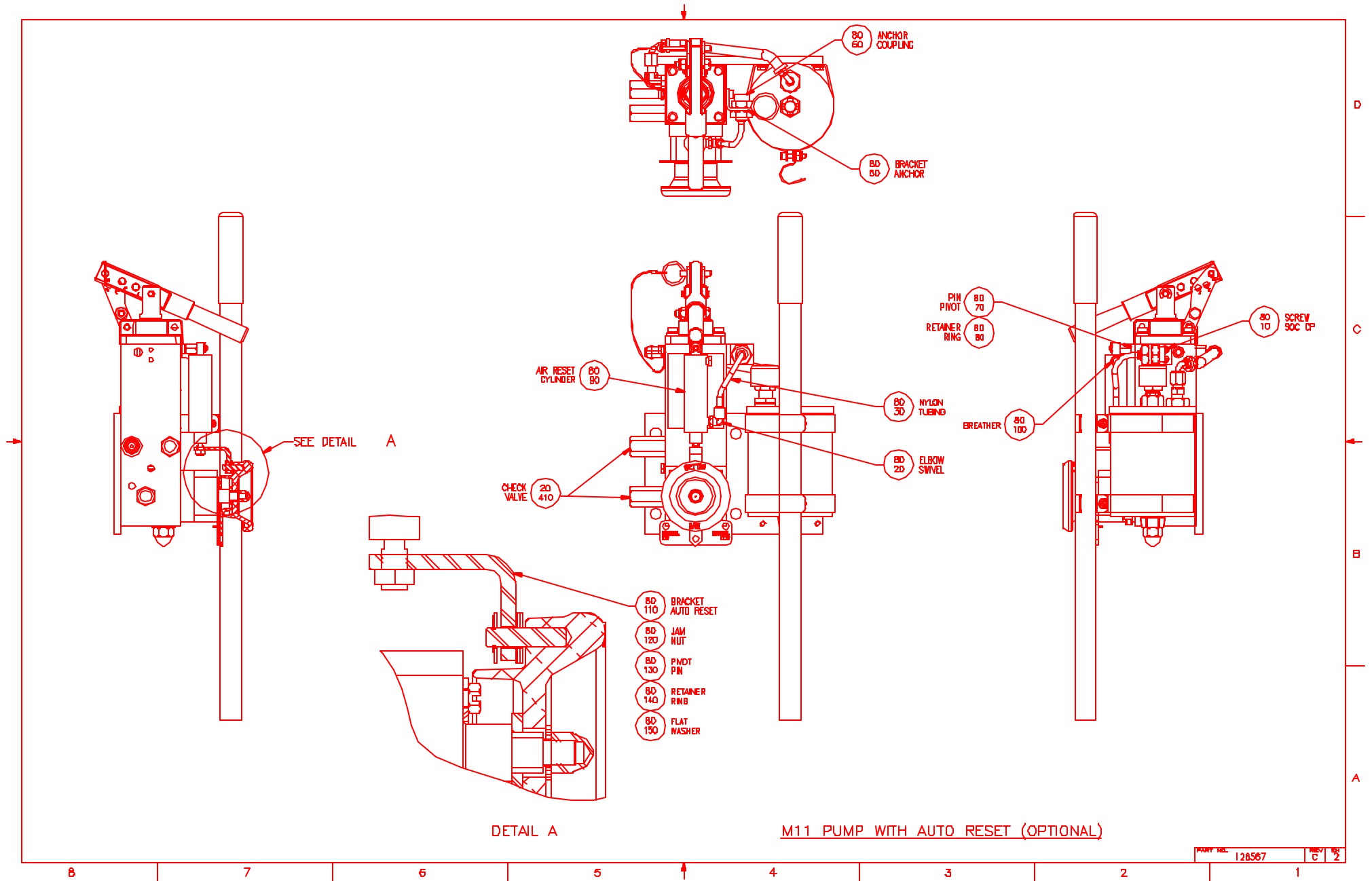
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- CSK CAP SCREWS 30 100

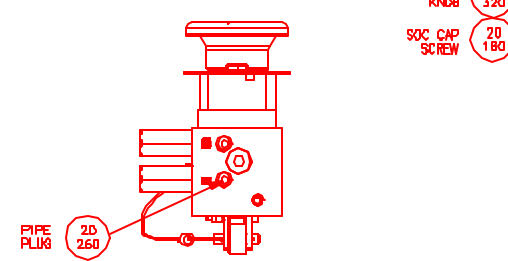
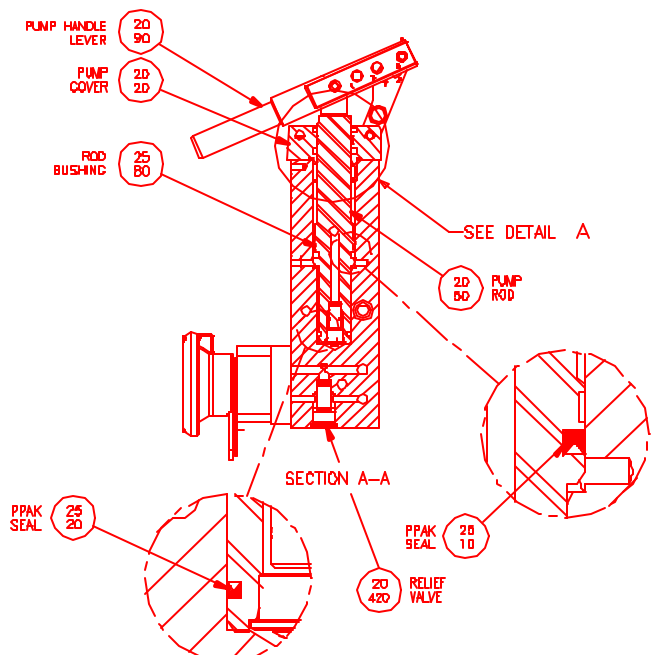
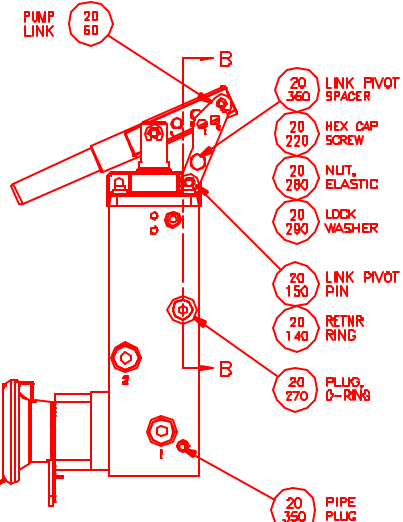
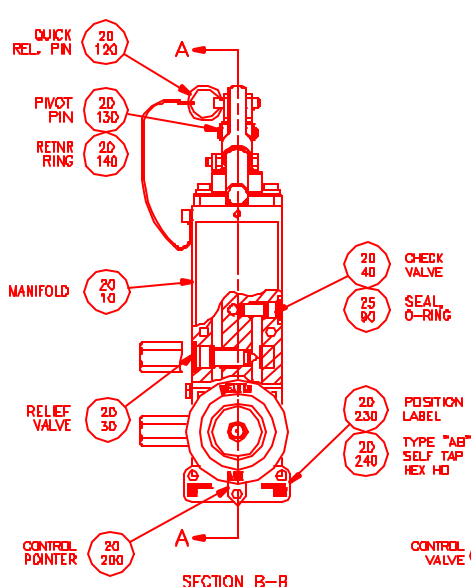
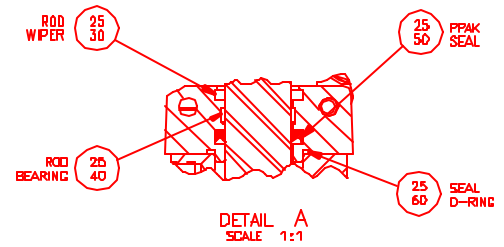
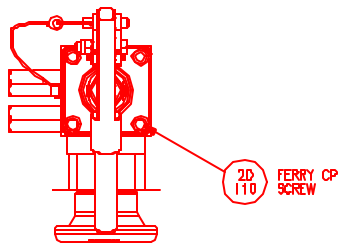
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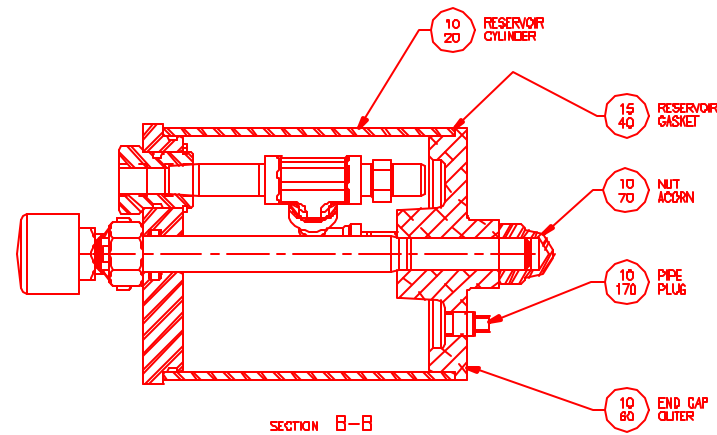
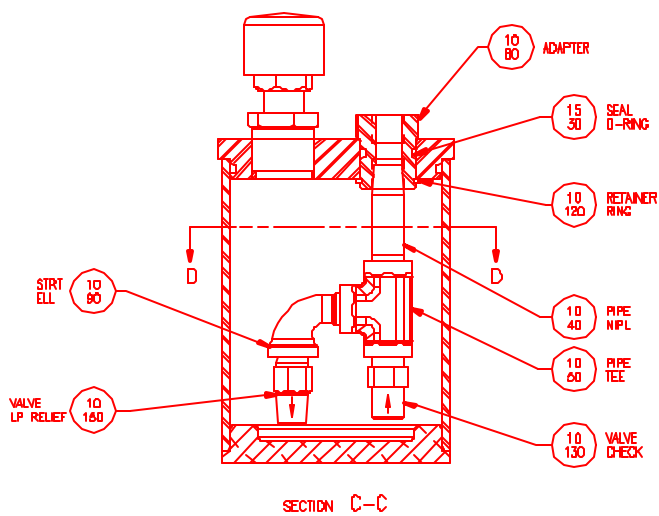
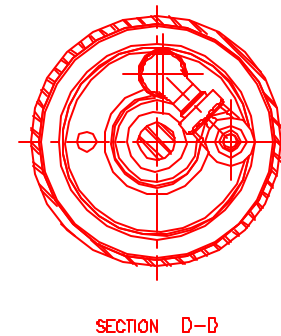
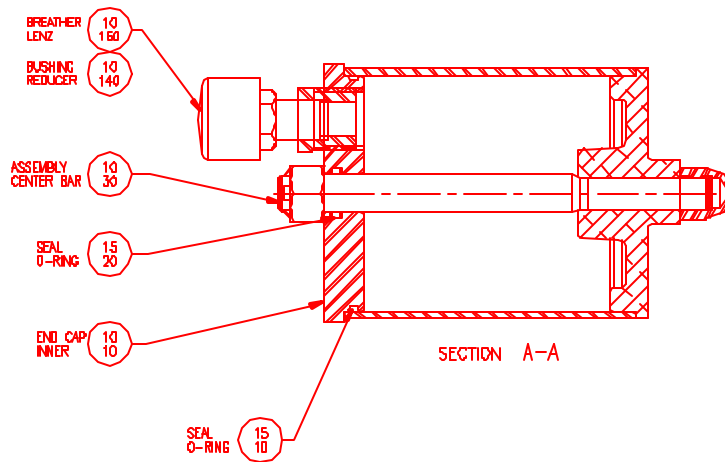
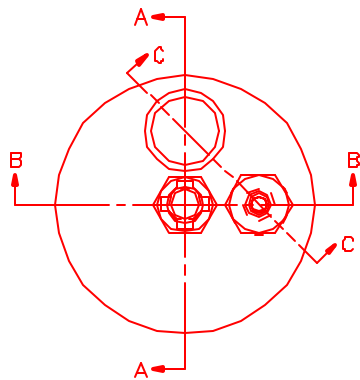
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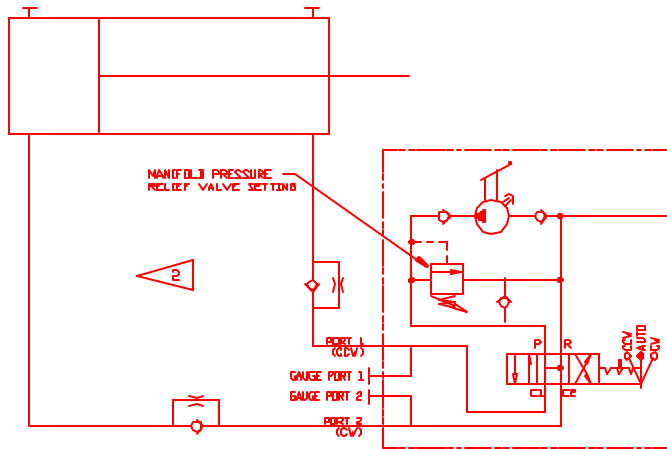
- 20 170 BREATHER

UNLESS OTHERWISE SPECIFIED				DESIGNED BY	DATE	TITLE
GENERAL NOTES 1 DIMENSIONS ARE IN INCHES 2 HONEY BEEBEE ARE DRAWN TO SIZE 3 CHAMFER ANGLES 45° 4 SURFACE FINISH 125 RMS 5 FILLETS .0314 IN. R16 6. NO KEY SEALS BEARING 7 DIMENSIONS IN PARENTHESIS ARE FOR (S-7)				REVISED BY	1/1/06	M11 ASSEMBLY
				APPROVED BY	1 JUL 08	
TOLERANCES DECIMALS IN MM .XX ± .015 .XXX ± .010 .XXX ± .008 ANGULAR ±1° HOLE POSITION ±.127 TO .254				THIS DOCUMENT AND THE DATA IT CONTAINS ARE THE PROPERTY OF HONEYWELL INTERNATIONAL CORPORATION. IT IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS WITHOUT THE WRITTEN PERMISSION OF HONEYWELL INTERNATIONAL CORPORATION.		PART NO. 126567
MATERIAL PER DRAWING FINISH PER ISO DIMENSIONS ARE INCHES APPROX. HEIGHT				IF APPLICABLE, MARK (X) WITH PART NUMBER AND LATEST REVISION. <input type="checkbox"/> SHOWN BROKEN		SCALE 1:2
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				SHEET 1 of 1		REV. C

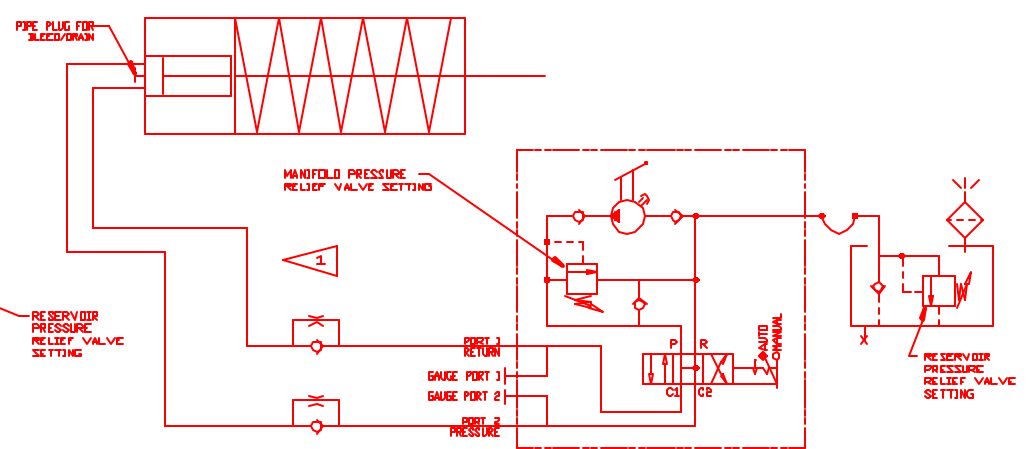




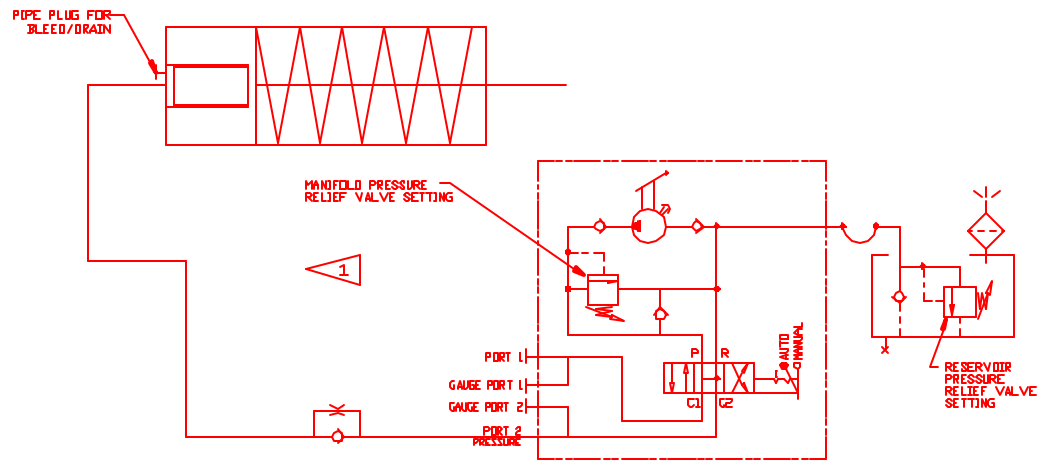




M11 - DA
(ALL DOUBLE ACTING G, T'S, HD'S)



M11 - SR-PSTN
(HD, T'S AND G7-G10)



M11 - SR RAM
(ONLY G2-G5)

ACTUATOR	PRESSURE RELIEF VALVE SETTINGS	
	MANIFOLD	RESERVOIR
HD SR	250 PSI	33
HD DA	350 PSI	33
T DA / TR DA / TRQ DA	1000 PSI	200
T3SR/ T4SR/ T5SR2,3,4&5 T8SR3,4&5/ TRSR/ TRQSR	1500 PSI	200
T5SR1 / TBSR1&2	2000 PSI	200
G SERIES	3000 PSI	200

NOTES:

- 1** OPTIONS:
 > ONE FLOW CONTROL
 > AUTO RESET
 > SUBMERGED TRIM
- 2** OPTIONS:
 > 2 FLOW CONTROL
 > AUTO RESET
 > BYPASS, INCLUDING 2 FLOW CONTROL
 > SUBMERGED TRIM

BETTIS

M11 MANUAL HYDRAULIC

OVERRIDE SYSTEM

OPERATING INSTRUCTIONS

FOR

“HD”, “T”, AND “G” SERIES

PNEUMATIC AND HYDRAULIC

ACTUATORS

PART NUMBER: 126858

REVISION: "F"

RELEASE DATE: 18 September 2007

SECTION 6.0 - MODIFICATIONS

6.1 M11 PUMP HANDLE REORIENTATION

- 6.1.1 Remove the four socket cap screws (20-110) from pump cover (20-20).
- 6.1.2 Lift the pump cover (20-20) up from manifold (20-10) far enough to turn the pump handle to its new location.
- NOTE: Before putting the pump cover back down on the manifold be sure that the pump cover to manifold o-ring is still seated in it's seal groove located in the pump cover.
- 6.1.3 Install the pump cover back down on top of the manifold.
- 6.1.4 Install the four socket cap screws (20-110) through the pump cover and into the manifold.
- 6.1.5 Tighten the socket cap screws (20-110) tight plus a quarter turn.

<u>ECN</u>	<u>DATE</u>	<u>REV</u>		<u>BY *</u>	<u>DATE</u>
19291	26 Oct 06	C	COMPILED	L.Ramirez	18 April 2007
19330	17 Nov 06	D	CHECKED	C. Ross	18 April 2007
19562	18 April 2007	E	APPROVED	D. McGee	18 April 2007

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

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SECTION 1 - INTRODUCTION

1.1 GENERAL M11 SERVICE INFORMATION

1.1.1 M11 is a compact modular hydraulic override system designed for use with Bettis Double Acting and Spring Return Actuators. The system incorporates a piston type hand pump and a fluid reservoir. NOTE: The M11 fluid reservoir is required because of the hydraulic cylinder differential, which is due to the inboard piston rod displacement.

1.1.2 MAINTENANCE:

1.1.2.1 Bettis does not recommend periodic field maintenance for the M11 Manual Hydraulic Override System (pump and reservoir).

1.1.2.2 The only time the M11 Manual Hydraulic Override System should be disassembled is when either the pump or the reservoir fails to perform its manual hydraulic override function

1.1.2.3 When possible the M11 package should be returned to the factory for maintenance.

1.1.3 Numbers in parentheses (), indicate the bubble number (reference number) used on the Bettis Assembly Drawing.

WARNING: Do not use Teflon tape on M11 system threads.

1.1.4 Use a non-hardening thread sealant on all system threads.

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

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

WARNING: For the protection of personnel working on Bettis actuators, this procedure should be reviewed and implemented for safe operation. 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 FLUID REQUIREMENTS

1.4.1 M11 Manual Hydraulic Override System Fluid Requirements: Hydraulic fluids, other than those listed in steps 1.4.1 and 1.4.2, should not be used without prior written approval of Bettis Product Engineering.

1.4.1 Standard and high temperature service (-20°F to +350°F) use Dexron II or Shell Tellus T-32 Automatic Transmission Fluid.

1.4.2 Low temperature service (-50°F to +150°F) Use Exxon Unavis J13 or HVI 13 Hydraulic Fluid.

1.5 BETTIS REFERENCE MATERIALS

1.5.1 Bettis M11 System Assembly drawing part number 127247.

1.5.2 M11 with auto reset module uses additional drawing part number 135978.

SECTION 2 - GENERAL INFORMATION

2.1 ACTUATOR POWER OPERATION

CAUTION: Power operation of the actuator with the M11 control knob in any other position than "AUTO" will cause fluid to overflow at the low pressure relief valve located in the reservoir outer end cap.

2.1.1 Place the M11 control knob (20-320) in the Auto position (middle position). NOTE: The control knob (20-320) is located in front and at the bottom of the M11 pump.

CAUTION: Do not exceed the maximum operating pressure rating of the actuator.

2.1.2 Apply an operating media, of the correct pressure, through a control valve to the actuator's power cylinder.

2.2 ACTUATOR M11 MANUAL HYDRAULIC OPERATION

2.2.1 Shut off and exhaust the operating media from both sides of the actuator's power cylinder.

2.2.2 M11 Manual Hydraulic Operation as follows:

2.2.2.1 Double Acting Actuators - Select actuator rotation desired by placing the control knob (20-320) in the Manual CW or Manual CCW position.

2.2.2.2 Spring Return Actuators - Place the control knob (20-320) in the Manual position.

2.2.3 Operate the M11 pump handle until required valve position is reached.

NOTE: 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 relief valve.

SECTION 3 - M11 SYSTEM FLUID FILLING INSTRUCTIONS

3.1 **DOUBLE ACTING ACTUATOR M11 SYSTEM FLUID FILLING** - 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.

3.1.1 Actuator position as follows:

3.1.1.2 Pneumatic and Hydraulic T series actuators: Apply pneumatic or hydraulic pressure to the inlet port located in the outer end cap of the actuators power cylinder, placing the actuator in the counter clockwise (CCW) position and proceed to step 3.1.2.

3.1.1.3 Hydraulic G series actuators: Apply pneumatic or hydraulic pressure to the inlet port located in the outer end cap of the actuators power module (cylinder), placing the actuator in the counter clockwise (CCW) position and proceed to step 3.1.2.

3.1.1.4 Pneumatic G and HD series actuators: Apply pneumatic pressure to the inlet port located in the outer end cap of the actuators power module (cylinder), placing the actuator in the clockwise (CW) position and proceed to step 3.1.2.

3.1.2 **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 3.1.3 (method number 2) for the manual field service refilling procedure.

3.1.2.1 Shut off and exhaust the operating media from the actuator's power cylinder.

3.1.2.2 Remove the bleed plugs from the following locations:

3.1.2.2.1 G Series Actuators remove o-ring plug from the top of the outer and inner end caps.

3.1.2.2.2 T Series Actuators remove pipe plugs from the top area located on the outer and inner end of the hydraulic override cylinder.

3.1.2.2.3 HD Series Actuators remove pipe plug from the top area on the outer end of the hydraulic override cylinder and the cylinder adapter.

3.1.2.3 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.

3.1.2.4 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.

3.1.2.5 Start pumping the hydraulic fluid into the system with the pump motor.

3.1.2.6 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.

3.1.2.7 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.

3.1.2.8 Disconnect the pump motor from the M11 pump hose.

3.1.2.9 Connect the M11 pump hose to the fitting on the reservoir outer end cap (10-10).

3.1.2.10 Remove the breather (10-140) from the top of the reservoir upper end cap (10-10).

3.1.2.11 Fill reservoir to 1-1/2 inches from top of reservoir end cap (10-10). Note: Add fluid to the reservoir through the open port left vacant in step 3.1.2.10.

3.1.2.12 Apply pipe dope to breather (10-140) threads and install into the port in top of the reservoir inner end cap (10-10).

3.1.2.13 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.

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

3.1.3.1 Remove breather (10-140) from the top of the reservoir end cap (10-10).

3.1.2.2 Remove the bleed plugs from the following locations:

NOTE: Only remove the pipe plugs located at the highest points, in the vertical plane, of the hydraulic override cylinder.

3.1.2.2.1 G Series Actuators remove o-ring plug from the top of the outer and inner end caps.

3.1.2.2.2 T Series Actuators remove pipe plugs from the top area located on the outer and inner end of the hydraulic override cylinder.

3.1.2.2.3 HD Series Actuators remove pipe plug from the top area on the outer end of the hydraulic override cylinder and the cylinder adapter.

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

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

3.1.3.4 Fill reservoir to 1-1/2 inches from top of reservoir end cap (10-10). Note: Add fluid to the reservoir through the open port left vacant in step 3.1.3.1.

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

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

3.1.3.7 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.

3.1.3.8 Fill the M11 reservoir 1-1/2 inches from the top of the reservoir.

3.1.3.9 Apply pipe dope to the breather (10-140) threads and install into the port on top of the reservoir upper end cap (10-10).

3.2 SPRING RETURN ACTUATORS M11 SYSTEM FLUID FILLING - Use either Refilling Method Number 1 (steps 3.2.1) or Refilling Method Number 2 (steps 3.2.2). NOTE: Method Number 1 is the best, most efficient and the recommended method.

3.2.1 **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 3.2.2 (Method number 2) for the manual field service refilling procedure.

3.2.1.1 Actuator hydraulic override cylinder pipe plug removal.

3.2.1.1.1 G-Series – Remove one pipe plug from the spring cartridge hydraulic override outer end cap.

3.2.1.1.2 HD and T Series – 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.

3.2.1.2 Disconnect the pump hose from the reservoir fitting, located close to the reservoir inner end cap (10-10), and connect the pump motor to the pump hose.

3.2.1.3 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.

3.2.1.4 Start pumping the hydraulic fluid into the system with the pump motor.

3.2.1.5 Stop the pump motor when hydraulic fluid appears as follows.

3.2.1.5.1 G-Series - At the vacant pipe plug port located in the hydraulic override end cap.

3.2.1.5.2 HD and T-Series - At both vacant pipe plug port located in the actuator's hydraulic override cylinder.

3.2.1.6 Apply pipe dope onto pipe plug threads and install into the vacant pipe plug port as follows.

3.2.1.6.1 G-Series - At the vacant pipe plug port located in the hydraulic override end cap.

3.2.1.6.2 HD and T-Series - At both vacant pipe plug ports located in the actuator's hydraulic override cylinder.

3.2.1.7 Disconnect the pump motor from the M11 pump hose.

3.2.1.8 Connect the M11 pump hose to the fitting on the reservoir outer end cap (10-10).

3.2.1.9 Remove the breather (10-140) from the top of the reservoir inner end cap (10-10)

3.2.1.10 Fill reservoir to 1-1/2 inches from top of reservoir end cap (10-10). Note: Add fluid to the reservoir through the open port left vacant in step 3.2.1.9.

3.2.1.11 Apply pipe dope to breather threads and install breather (10-140) into port vacated in step 3.2.1.9.

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

3.2.2.1 Remove breather (10-140) from the top of the reservoir end cap (10-10).

3.2.2.2 Actuator hydraulic override cylinder pipe plug removal.

3.2.2.2.1 G-Series – Remove one pipe plug from the spring cartridge hydraulic override outer end cap.

3.2.2.2.2 HD and T Series – 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.

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

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

3.2.2.4 Fill reservoir to 1-1/2 inches from top of reservoir end cap (10-10). Note: Add fluid to the reservoir through the open port left vacant in step 3.1.15.

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

3.2.2.6 Stop pumping the M11 pump handle when hydraulic fluid appears as follows.

3.2.2.6.1 G-Series - At the vacant pipe plug port located in the hydraulic override end cap.

3.2.2.6.2 HD and T-Series - At both vacant pipe plug ports located in the actuator's hydraulic override cylinder.

3.2.2.7 Apply pipe dope onto pipe plug threads and install into the vacant pipe plug port as follows.

3.2.2.7.1 G-Series - At the vacant pipe plug port located in the hydraulic override end cap.

3.2.2.7.2 HD and T-Series - At both vacant pipe plug port located in the actuator's hydraulic override cylinder.

3.2.2.8 Fill the M11 reservoir 1-1/2 inches from the top of the reservoir.

3.2.2.9 Apply pipe dope to the breather (10-140) threads and install into the port on top of the reservoir upper end cap (10-10).

SECTION 4 - M11 DISASSEMBLY INSTRUCTIONS

4.1 M11 PRESSURE RELEASE INSTRUCTIONS

NOTE: Shut off and exhaust the operating media from both sides of the actuator's power cylinder.

4.1.1 Place the M11 control knob (20-320) in the Auto position (middle position). NOTE: Control knob (20-320) is located in front and at the bottom of the M11 pump manifold (20-10).

NOTE: Using a means of capturing the hydraulic fluid that will be lost during the following steps. Use a bucket, tub, and large container, etc.

4.1.2 Remove the 1/8" pipe plug (10-100) from the reservoir bottom end cap (10-60).

4.1.3 Place the M11 control knob (20-320) in the Manual position.

4.1.4 Remove all the M11 pump assembly piping; SS Tubing (50) with male connector (40).

NOTE: When removing the pump hose/tube fitting there will be a loss of fluid pressure. G & T Series actuators there is 250 psi pressure and HD Series actuator there is 33 psi pressure.

4.2 M11 RESERVOIR DISASSEMBLY INSTRUCTIONS

NOTE: Review Section 4.1 M11 Pressure Relief Instructions before proceeding with reservoir disassembly.

4.2.1 Remove piping from port located in upper end cap (10-10).

4.2.2 Loosen socket cap screws (30-20) and remove the M11 reservoir from the M11 mounting bracket (30-90).

4.2.3 Remove breather (10-140) from upper end cap (10-10).

4.2.4 Remove acorn nut (10-70) from upper end cap (10-10).

4.2.5 Remove center bar assembly (10-30) from the upper end of the reservoir upper end cap (10-10).

4.2.6 Remove bottom end cap (10-60) from M11 cylinder (10-20) and center bar assembly (10-30).

4.2.7 Remove M11 cylinder (10-20) from upper end cap (10-10).

4.2.8 If required for replacement or maintenance remove low pressure relief valve (10-130) from elbow (10-90).

4.2.9 If required for replacement or maintenance remove check valve (10-120) from pipe tee (10-50).

4.2.10 Remove elbow (10-90), pipe tee (10-50), and pipe nipple (10-40).

4.2.11 Remove Thread Seal (10-80) and washer (10-75) from upper end cap (10-10).

4.3 **M11 PUMP DISASSEMBLY INSTRUCTIONS**

NOTE: Review Section 4.1 M11 Pressure Relief Instructions before proceeding with M11 pump disassembly.

4.3.1 Place the M11 control knob (20-320) in the Auto position (middle position). NOTE: Control knob (20-320) is located in front and at the bottom of the M11 pump manifold (20-10).

NOTE: Using a means of capturing the hydraulic fluid that will be lost during the following steps, i.e. a bucket, tub, large container, etc.

4.3.2 Using a standard 1/4" Allen wrench remove o-ring plug (20-270) from the left side of the manifold (20-10).

4.3.3 Place the M11 control knob (20-320) in the Manual position.

4.3.4 Refer to assembly drawing sheet 2. To remove the check valve (20-40) from the manifold (20-10) move the pump handle to the up position and using a fast motion move pump handle down. Be ready to catch the check valve, as pulling the pump handle down will cause the check valve to come out of the manifold under pressure. There will be further fluid lost when the check valve (20-40) is removed.

4.3.5 Refer to assembly drawing sheet 1. Remove all the M11 pump assembly piping - male connector (40), and Tubing (50).

NOTE: If the M11 pump is equipped with Auto Reset then do steps 4.3.6 and 4.3.7 and refer to Auto Reset drawing 135978. If not equipped with Auto Reset skip steps 4.3.6 and 4.3.7.

4.3.6 Remove male swivel elbow (40-20) from Bimba Cylinder (40-90).

4.3.7 Remove two socket cap screws (40-10) from bracket (40-50) and manifold (20-10).

4.3.8 Refer to assembly drawing sheet 1. Remove the four socket cap screws that retains the mounting bracket (30-90) to actuator housing and remove M11 pump assembly/bracket.

4.3.9 Refer to assembly drawing sheet 1. Remove four countersunk socket flat screws (30-100) that mounts mounting bracket (30-90) to pump manifold (20-10).

- 4.3.10 Remove the M11 pump assembly from the M11 mounting bracket (30-90).
- 4.3.11 Refer to assembly drawing sheet 2. Remove four cap screws (20-110) from pump cover (20-20).
- NOTE: In step 4.3.10 the pump handle lever (20-90), pump rod (20-50), and associated parts will be removed with the pump cover (20-20).
- 4.3.12 Remove pump cover (20-20) from manifold (20-10). NOTE: To remove the pump cover (20-20) pull the pump rod (20-50) up out of the manifold (20-10) using a slight twisting back and forth motion.
- 4.3.13 Remove quick release pin (20-120) from pump handle lever (20-90).
- 4.3.14 Remove retainer ring (20-140) from pivot pin (20-130).
- 4.3.15 Remove pivot pin (20-130) from pump rod (20-50).
- NOTE: If the M11 pump is equipped with Auto Reset then do steps 4.3.16 and 4.3.17 and refer to Auto Reset drawing 135978. If not equipped with Auto Reset skip steps 4.3.16 and 4.3.17.
- 4.3.16 Remove one retainer ring (40-140) from auto reset lower pivot pin (40-130) located on the back side of auto reset bracket (40-110).
- 4.3.17 Remove flat washer(s) (40-150) from auto reset lower pivot pin (40-130) located on the back side of auto reset bracket (40-110).
- 4.3.18 Refer to assembly drawing sheet 2. Remove one socket cap screw (20-180) from the center of the M11 control knob (20-320) and remove the control knob from the control valve (20-190).
- 4.3.19 Remove the self-tapping hex head screws (20-240) from the position label (20-230).
- 4.3.20 Remove position label (20-230) from the control valve (20-190).
- 4.3.21 Remove the screws that retain the control valve (20-190) to the M11 manifold (20-10).
- 4.3.22 Remove the control valve (20-190) from the M11 manifold (20-10).
- 4.3.23 Using a standard 1/4" Allen wrench remove o-ring plug (20-250) from the right side of the M11 manifold (20-10).
- 4.3.24 Remove the relief valve (20-30) from the right side of the M11 manifold (20-10).
- 4.3.25 Using a standard 1/4" Allen wrench remove o-ring plug (20-270) from the bottom end of pump rod (20-50).
- 4.3.26 Remove check valve (20-40) from pump rod (20-50).

SECTION 5 - M11 REASSEMBLE INSTRUCTIONS

5.1 GENERAL REASSEMBLY INSTRUCTIONS

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

5.1.1 Remove and discard all old seals and gaskets.

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

5.1.3 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 manifold (20-10) and pump rod (20-50) must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

CAUTION: Parts that reflect any of the above listed characteristics should be replaced with new parts.

5.1.4 Before installation coat all moving parts with a complete film of lubricant. Coat all seals with a complete film of lubricant, before installing into seal grooves. NOTE: The parts and seals used in the actuator will be assembled using lubricant as identified in section 1 step 1.5.1.

5.2 M11 RESERVOIR REASSEMBLE INSTRUCTIONS

NOTE: Review Section 5.1 General Reassembly Instructions before proceeding with reservoir reassembly.

5.2.1 Refer to the assembly drawing SHEET 3. If disassembled, reassemble the following items;

5.2.2.1 Pipe nipple (10-40), pipe tee (10-50), elbow (10-90), low-pressure relief valve (10-130) and check valve (10-120) into one complete assembly.

- 5.2.2.2 Using pipe dope install the items assembled in step 5.2.2.1 into upper end cap (10-10). NOTE: The pipe nipple (10-40) is installed into the upper end cap (10-10). Position the above assembly such that the assembly will not interfere with the center bar assembly (10-30).
- 5.2.3 Screw bottom end cap (10-60) onto center bar assembly (10-30).
- 5.2.4 Install reservoir o-ring (10-150) over the lip of bottom end cap (10-60).
- 5.2.5 Install cylinder (10-20) over the lip of bottom end cap (10-60).
- 5.2.6 Install reservoir o-ring (10-150) over the lip of upper end cap (10-10) then install entire upper end cap assembly (10-10) over the lubricated center bar assembly (10-30) and into the cylinder (10-20).
- 5.2.7 Install thread seal (10-80) and countersink washer (10-75) onto center bar assembly (10-30).
- 5.2.8 Install and tighten acorn nut (10-70) onto center bar assembly (10-30).
- 5.2.9 Apply sealant to breather (10-140) and install into upper end cap (10-10).
- 5.2.10 Apply sealant to pipe plug (10-100) and install into bottom end cap (10-60).

5.3 M11 PUMP REASSEMBLY INSTRUCTIONS

NOTE: Review section 5.1 General Reassembly before proceeding with M11 pump reassembly.

- 5.3.1 Install o-ring seals onto two o-ring plugs (20-270).
- 5.3.2 Install one check valve (20-40), with o-ring seal into the bottom of pump rod (20-50).
- 5.3.3 Install one o-ring plug (20-270) into the bottom of pump rod (20-50).
- 5.3.4 Install one check valve (20-40), with o-ring seal into the side of manifold block (20-10).

- 5.3.5 Install one o-ring plug (20-270) into the side of manifold block (20-10).
- 5.3.6 Install Polypak seal (25-20) into the lower seal groove located on the pump rod (20-50).
NOTE: Refer to assembly drawing sheet 2 Section A-A for correct orientation for Polypak lips.
- 5.3.7 Install Polypak seal (25-10) into the upper seal groove located on the pump rod (20-50).
NOTE: Refer to assembly drawing page 2 for correct orientation for Polypak lips.
- 5.3.8 Install rod bushing (25-80) into groove located on the pump rod (20-50).
- 5.3.9 Install pump rod (20-50) into pump rod shaft of manifold (20-10).
- 5.3.10 Install rod wiper (25-30) into pump cover (20-20).
- 5.3.11 Install rod bearing (25-40) into pump cover (20-20).
- 5.3.12 Install Polypak seal (25-50) into pump cover (20-20).
- 5.3.13 Install o-ring seal (25-60) into pump cover (20-20).
- 5.3.14 Install pump cover (20-20) onto top of manifold (20-10). NOTE: When installing the manifold cover be careful in keeping the o-ring seal (25-60) in its seal groove.
- 5.3.15 Install four cap screws (20-110) through pump cover (20-20) and into manifold (20-10).
- 5.3.16 If removed install two pump links (20-60). Retain the two pump link to pump cover (20-20) using one link pivot pin ((20-150) and one retainer ring (20-140).
- 5.3.17 Tie the two pump links together using hex cap screw (20-220), two link pivot spacers (20-360), lockwasher (20-185) and elastic nut (20-280).
- 5.3.18 Install pump handle lever (20-90).
- 5.3.19 Retain pump handle to pump rod (20-50) using one pivot pin (20-130) and one retainer ring (20-140).
- 5.3.20 Install quick release pin (20-120) through the two pump links (20-60) and the pump handle lever (20-90). NOTE: The quick release pin can be installed in position 1, 2 or 3. Select position most appropriate for "effort" desired.
- 5.3.21 Install relief valve (20-30) into the right side of the manifold (20-10).
- 5.3.22 Install o-ring plug (20-250) into the right side of the manifold (20-10).
- 5.3.23 Install the control valve (20-190) onto the front of the manifold (20-10).

- 5.3.25 Retain the control valve (20-190) to the manifold by install screws through the control valve body and screwing into the manifold (20-10). Tighten control valve screws to tight plus 1/4 turn.
 - 5.3.26 Install the position label (20-230) onto the control valve. NOTE: The label for spring return actuators will be mounted with the two-position ("AUTO" or "MANUAL") side of the label facing outward. If the actuator is a double acting model then the three-position ("MANUAL CW", "AUTO" and "MANUAL CCW") side of the label will be facing outward.
 - 5.3.27 Retain the position label with one type "AB" self tap hex head screw (20-240).
 - 5.3.28 Install the control pointer (20-200) onto the control valve (20-190).
 - 5.3.29 Install the control knob (20-320) onto the control valve (20-190).
 - 5.3.30 Retain the control knob (20-320) on the control valve (20-190) with one socket cap screw (20-180) & lockwasher (20-185)
 - 5.3.31 Install the manifold (20-10) onto the mounting bracket (30-90) using four countersunk flat socket screws to retain the manifold to the mounting bracket.
 - 5.3.32 Install the M11 package/mounting bracket (30-90) onto the actuator housing mounting pad using four socket cap screws.
- NOTE: If the M11 pump is equipped with Auto Reset then do steps 5.3.33 and 5.3.34 or if non Auto Reset M11 skip steps 5.3.33 and 5.3.34.
- 5.3.33 Install the male swivel elbow to the Bimba Cylinder (40-90).
 - 5.3.34 Install the bracket (40-50) on the reservoir side of the manifold (20-10) and retaining the bracket with two socket cap screws (40-10).
 - 5.3.35 Reinstall any piping that was removed from the M11 package.