

G01 through G13 Series Hydraulic Actuators

With Power Module Tie Bar Construction

Disassembly and Reassembly



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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 G01X0X, G2X0X, G3X0X, G4X0X, G5X0X, G7X0X, G8X0X, G10X0X and G13X0X double-acting and spring-return Series actuators with one single hydraulic power module utilizing tie bar construction. This procedure can also be used on Bettis GXX20X double-acting Series Twin Power Module Hydraulic actuators.
- 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 hydraulic pressure have 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 6.1.
- 1.1.9** When removing seals from seal grooves, use a commercial seal removing tool or a small screwdriver with sharp corners rounded off.
- 1.1.10** Use a non-hardening thread sealant on all pipe threads.

⚠ CAUTION: FOLLOW MANUFACTURER'S INSTRUCTIONS

Apply the thread sealant per the manufacturer's instructions.

- 1.1.11** Emerson recommends that disassembly of the actuator modules should be done in a clean area on a work bench.

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.

NOTE:

This product is only intended for use in large-scale fixed installations excluded from the scope of Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS 2).

1.3 General Safety Information

- 1.3.1 Products supplied by Emerson, 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: READ WARNING MESSAGES CAREFULLY

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: FOLLOW PLANT SAFETY PROCEDURES

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 Emerson representative.

1.4 Bettis Reference Materials

- 1.4.1 Assembly Drawing for G01 through G13 Double-Acting One Power Module Hydraulic Series actuators use part number 116423.
- 1.4.2 Assembly Drawing for G01 through G13 Double-Acting Twin Power Module Hydraulic Series actuators use part number 115676.
- 1.4.3 Assembly Drawing for G01 through G13 Spring-Return One Power Module Hydraulic Series actuators use part number 115941.

1.5 Service Support Items

- 1.5.1 Bettis Module Service Kits
- 1.5.2 For rod extension retainer nut tool, 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;

Table 1. Actuator Model and Part Number

MODEL	BETTIS PART NUMBER	MODEL	BETTIS PART NUMBER
G01	None required	G5/G7	117369
G2	123616	44	117368
G3/G4	117370	50	122849

- 1.5.3 Non hardening thread sealant

1.6 Lubrication Requirements

NOTE:

Lubricants, other than listed in step 1.6.1, should not be used without prior written approval Emerson 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 and 10 lubricant.

1.7 Fluid Requirements

- 1.7.1** For use in the hydraulic power cylinder. The following listed fluids are recommended fluids only and does not limit the use of other hydraulic fluids compatible with supplied seals and coatings.
- 1.7.1.1 Standard temperature service (-20°F to +350°F)/(-28.9°C to +176.6°C) use Shell Tellus S2 V Grade 32 automatic transmission fluid or an Emerson approved fluid.
 - 1.7.1.2 High temperature service (0°F to +350°F)/(-17°C to +176.6°C) use Shell Tellus S2 V Grade 32 automatic transmission fluid or an Emerson approved fluid.
 - 1.7.1.3 Low temperature service (-50°F to +150°F)/(-45.6°C to 65.6°C) use Mobil Univis HVI 13 hydraulic fluid or an Emerson approved fluid.

1.8 General Tool Information

- 1.8.1** 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 1600 foot pounds/1269 N-m), breaker bar, and a drive socket set. For recommended tool and wrench sizes refer to Section 6 Tables 6.2 through 6.10.

1.9 Actuator Storage

For applications where the actuator is not put into immediate service it is recommended that the actuator be cycled with at least once per month. Indoor storage, if available, is recommended for all actuators. Care should be taken to plug all open ports on actuator and controls to keep out foreign particles and moisture. Also, actuators should not be stored in an atmosphere harmful to resilient seals. For extended storage, contact the Emerson factory.

1.10 Actuator Installation

- 1.10.1** Since there are many valve and actuator combinations, it is not practical to include detailed instructions for each type. Mountings are designed to be as simple as possible to keep guess work out of installation.
- 1.10.2** Actuators are shipped from the factory with the travel stops adjusted for approximately ninety degree rotation. Generally it is necessary to make slight travel stop adjustments once the actuator is installed on the valve. Refer to the valve manufacturer's recommendations for specific requirements. When the valve has internal stops, the actuator should be adjusted at the same points.

NOTE:

The actual "stopping" should be done by the actuator. If the valve does not have internal stops, adjust the actuator to the full open position. Using this as a reference point, rotate the valve closed and adjust to the valve manufacturer's specifications for total rotation.

- 1.10.3** Good instrument practices are also recommended. Clean/dry regulated hydraulic pressure is essential for long service life and satisfactory operation. It should be noted that new pneumatic lines often have scale and other debris in them and these lines should be purged of all foreign material.

NOTE:

Scale and debris can damage control valves, solenoids, seals, etc.

1.11 Actuator Start-up

1.11.1 Prestart-up checks

1. Unit has been mounted on valve properly. Gear flange mounting bolts, stem key, set screw(s) installed and secured
2. No tubing damaged or accessories dislodged during shipping or installation
3. Indicated position confirms valve position
4. All switching valves in normal operating position as per schematic / instructions

1.11.2 Check connections:

1. Hydraulic components connected as per schematic enclosed or in service manual supplied
2. Hydraulic supply connected to identified ports
3. Electrical connections terminals are secure
4. Wiring as per enclosed diagram or service manual supplied

- 1.11.3** When actuator is first put into service it should be cycled with regulated pneumatic pressure. This is necessary because the seals have been stationary, causing them to take a "set". Therefore, the actuator should be operated through several cycles, exercising the seals, resulting in a service-ready condition.

1.11.4 The actuator speed of operation is determined by a number of factors including:

1. Power supply line length
2. Power supply line size
3. Power supply line pressure
4. Control valve and fitting orifice size
5. Torque requirements of the valve
6. Size of the actuator
7. Setting of speed controls

8. Hydraulic manual override (where available)

1.11.5 Due to the interaction of these variables it is difficult to specify a "normal" operating time. Faster operating times may be obtained by using one or more of the following:

1. Larger supply lines
2. Larger control valve
3. Higher supply pressure*
4. Quick exhaust valves

*Not to exceed maximum operating pressure of actuator or control components

1.11.6 Slower operating times may be obtained by using flow control valves to meter the exhaust. Excessive exhaust flow metering may cause erratic operation.

1.12 Actuator Operation

1.12.1 Controlled Operation: Controlled operation is accomplished by pressurizing and/or depressurizing the appropriate cylinder inlet(s) of a double-acting or spring-return unit by means of an appropriate control valve.

Do not exceed pressures indicated on actuator nameplate.

1.12.2 Manual Operation: All pressure must be vented or equalized on both sides of the pneumatic piston prior to manual operation.

Section 2: Actuator Disassembly

2.1 General Disassembly

⚠ WARNING: DANGEROUS GAS AND/OR LIQUIDS

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 (hydraulic power module or drive module).
- 2.1.2 When the spring module is to be removed it should be removed from the drive module prior to the hydraulic power module removal or disassembly.
- 2.1.3 The hydraulic power module can be disassembled while still attached to the drive module, or the hydraulic power module can be removed from the drive module and disassembled separate to the actuator (refer to Section 5 - module removal and installation).

NOTE:

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

- 2.1.4 To ensure correct reassembly; that is, with hydraulic power module or spring module on same end of drive module as was marked or tagged right or left and mark mating surfaces.
- 2.1.5 For spring module removal refer to Section 5 step 5.1.

2.2 Hydraulic Power Module Disassembly

NOTE:

1. Review Section 2 steps 2.1.1 through 2.1.5 General Disassembly before proceeding with hydraulic power module disassembly.
2. If the actuator model is a GXX20X Series (two same-size power modules mounted on both sides of the drive module) then do the following steps on both power modules simultaneously or complete one power module and then repeat section 2.2 on the second power module.

⚠ WARNING: DISCONNECT OPERATING PRESSURE

If not already removed disconnect all hydraulic pressure from actuator power cylinders.

⚠ WARNING: ENSURE SPRING IS DECOMPRESSED

If the actuator is spring-return then the spring cartridge must be checked to verify that the spring(s) are in their extended position before the hydraulic power module is disassembled from the drive module (refer to Section 5.1 through step 5.1.6).

- 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 Remove NPT pipe plug or optional SAE O-ring plug (3-120) from outer end cap (3-80).
- 2.2.3 Remove hex nuts (3-90) with lockwashers (3-95), from tie bars (3-20).
- 2.2.4 Remove outer end cap (3-80) from cylinder (3-70) and tie bars (3-20).
- 2.2.5 Unscrew and remove tie bars (3-20) from inner end cap (3-10).
- 2.2.6 Remove cylinder (3-70) from inner end cap (3-10), piston (3-30) and piston rod (3-40).
- 2.2.7 Refer to assembly drawing page 2 of 2 Detail "D". Remove two split ring halves (3-50). and one retainer ring (3-60) from piston rod (3-40).
- 2.2.8 Remove piston (3-30) from piston rod (3-40).
- 2.2.9 Remove O-ring seal (4-70) from piston rod (3-40).
- 2.2.10 Refer to assembly drawing page 2 of 2 Detail "D". Remove two split rings (3-50) and one retainer ring (3-60) from piston rod (3-40).
- 2.2.11 Remove hex cap screws (3-115) with lockwashers (3-110) from inner end cap (3-10).
- 2.2.12 Remove hex nuts (3-105) from hex cap screws (3-100).
- 2.2.13 Remove hex cap screws (3-100) with lockwashers (3-110) from inner end cap (3-10) and housing (1-10).
- 2.2.14 Remove inner end cap (3-10) off of piston rod (3-40).

NOTE:

The piston rod (3-40) removal as outlined in step 2.2.15 is only required when the piston rod is being replaced or when the drive module is to be disassembled.

- 2.2.15 Unscrew and remove piston rod (3-40) from the 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.

NOTE:

If the actuator is equipped with submerged stop screws with stop screw covers (1-195) then proceed to and complete steps 2.3.2.1 and 2.3.2.2 prior to doing step 2.3.2.

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.

2.3.2.1 Hold stop screw cover (1-195) in place and remove pipe plug (1-260).

2.3.2.2 Hold submerged stop screw (1-180) in place and remove stop screw cover (1-195).

NOTE:

For steps 2.3.3 through 2.3.10 refer to assembly drawing page 2 of 2 Section A A and Detail "E".

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

NOTE:

Step 2.3.4 is used only on G01, G2 and G3 drive modules. Drive modules for G4 through G13 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) or with lockwashers (1-170), 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 screw clockwise until housing cover (1-20) is clear of housing (1-10).
-

NOTE:

G01, G2, G3 and G4 model housing cover (1-20) 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), extension rod assembly (1-50) and extension rod assembly (9-50), 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 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), 122849 (G13) or 123616 (G2) and remove retention retainer nut assemblies (1-60) from guide block (1-30). On spring-return actuators also remove retention retainer nut assemblies (9-60).
- 2.3.24** Remove rod extension assembly (1-50) from guide block (1-30). On spring-return actuators also remove rod extension assembly (9-50).
-

NOTE:

One spherical washer (1-40) will be removed from guide block (1-30) when extension rod assembly is removed. On spring-return actuators also one spherical washer (9-40) will be removed from guide block (1-30).

- 2.3.25** Remove the remaining spherical washer (1-40) from guide block (1-30).
On spring-return actuators also remove the remaining spherical washer (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 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 G13 housing (1-10) unscrew and remove two vent check assemblies (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 Blind End Cap Module Disassembly

- 2.4.1** Remove hex cap screws (5-20) with spring lockwashers (5-30), from blind end cap (5-10).
- 2.4.2** Remove blind end cap (5-10) from end of housing (1-10).

Section 3: Actuator Reassembly

3.1 General Reassembly

⚠ CAUTION: ONLY USE NEW SEALS

Only new seals, that are still within the seals expectant shelf life, should be installed into 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 and piston rod must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

⚠ CAUTION: REPLACE WORN PARTS

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 housing module will be assembled using lubricant as identified in Section 1 step 1.6.1. The parts and seals used in the actuator cylinder module will be assembled using lubricant as identified in Section 1 step 1.7.1.

- 3.1.5 For Spring Module Installation refer to Section 5 step 5.2.

3.2 Drive Module Disassembly

NOTE:

Review section 3.1 General Reassembly before proceeding with drive module reassembly.

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

- 3.2.1 If guide bar bearings (2-20) is being replaced install new bearings into guide block (1-30).

NOTE:

The guide bar bearing (2-20) must be press fit into guide block guide bar bore with the seam located $\pm 5^\circ$ of the top or bottom centerline as shown in Section A-A.

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) cannot 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 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) cannot 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 Houston 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 $45^\circ \pm 5^\circ$ 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) while 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 G13 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.
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.

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

Table 2. Housing Cover Screw Quantity and Torque

Model	Qty	TORQUE ($\pm 5\%$)		Model	Qty	TORQUE ($\pm 5\%$)	
		Lbf-ft.	N-m			Lbf-ft.	N-m
G01	4	40	54	G7	8	100	136
G2	6	40	54	G8	12	100	136
G3	8	40	54	G10	16	100	136
G4	8	40	54	G13	20	340	461
G5	8	100	136				

NOTE:

Complete step 3.2.32 on G5, through G13 model actuators. For G01 through G4 model actuators skip step 3.2.32 and proceed to step 3.2.33.

- 3.2.31** On G5 through G13 models

3.2.31.1 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.

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

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

3.2.33 Install O-ring seal (2-100) onto position indicator (1-140).

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

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

3.2.36 Install O-ring seal (2-70) into yoke cover (1-150).

3.2.37 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).

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

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

3.2.40 Vent check assembly installation as follows:

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

- 3.2.40.2 G2 and G3 housing (1-10) using pipe sealant install one vent check assembly (13) into the top area of housing cover (1-20).
- 3.2.40.3 G4 through G13 housing (1-10) using pipe sealant install two vent check assemblies (13) into the front of housing (1-10).

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).

- 3.2.41 Install stop screw nuts (1-190) onto stop screws (1-180).
- 3.2.42 Install O-ring (2-90) onto stop screws (1-180).
- 3.2.43 Install two stop screws (1-180) into two stop screw holes on the front of housing (1-10).
- 3.2.44 Adjust both stop screws (1-180) back to settings recorded earlier in Section 2 at step 2.3.2.
- 3.2.45 Tighten both stop screw nuts (1-190) securely.

3.3 Hydraulic Power Module Reassembly

NOTE:

Review Section 3.1 General Reassembly before proceeding with Hydraulic Power Module Reassembly.

In Section 3.3 where the step indicates to "lubricate, coat or apply fluid", use hydraulic fluid for lubricating the part being installed.

- 3.3.1 Lubricate piston rod (3-40) with fluid.
- 3.3.2 Install O-ring seal (4-70) into the seal groove in piston rod (3-40).
- 3.3.3 Install two split ring halves (3-50) into the inner most groove in piston rod (3-40) and retain with one retainer ring (3-60).
- 3.3.4 Install piston (3-30) onto piston rod (3-40) and up against split rings install as indicated in step 3.3.3.
- 3.3.5 Install two split ring halves (3-50) into the outer most groove in piston rod (3-40) and retain with one retainer ring (3-60).
- 3.3.6 Apply fluid to the bore of cylinder (3-70).
- 3.3.7 Coat one piston bearing (4-45) with fluid and install into the piston external seal groove.
- 3.3.8 Install piston (3-30), with piston rod (3-40), into cylinder (3-70) and leave the inner most piston seal groove outside of the cylinder.
- 3.3.9 Coat one piston seal (4-60) with fluid and install into the piston external seal groove.

⚠ CAUTION: CORRECTLY INSTALL PISTON SEAL

Install the piston seal with energizer ring facing outside edge of piston (3-30).

- 3.3.10** Push the piston through the cylinder (3-70) until the outboard piston seal groove is exposed.

NOTE:

To move the piston (3-30) through the bore of cylinder (3-70) this may require mechanical assistance.

- 3.3.11** Coat one piston seal (4-60) with fluid and install into the piston external seal groove.

⚠ CAUTION: CORRECTLY INSTALL PISTON SEAL

Install the piston seal with energizer ring facing outside edge of piston (3-30).

- 3.3.12** Refer to assembly drawing page 2 of 2 Detail "C". Coat Polypak seal (4-30) with hydraulic fluid and install lip first, into inner end cap (3-10).

⚠ CAUTION: CORRECTLY INSTALL POLYPAK SEAL

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

- 3.3.13** Install rod bushing (4-20) into inner end cap (3-10).

- 3.3.14** Install rod wiper (4-10) into inner end cap (3-10).

- 3.3.15** Install one O-ring seal (4-90) into inboard face of inner end cap (3-10).

- 3.3.16** Install inner end cap (3-10) onto piston rod (3-40).

- 3.3.17** Install two tie bars (3-20) into inner end cap (3-10).

NOTE:

The tie bars should be installed across from each other.

- 3.3.18** Install one O-ring seal (4-40) into inboard face of outer end cap (3-80).

- 3.3.19** Install outer end cap (3-80) into open end of cylinder (3-70).

NOTE:

The pressure inlet ports of the inner and outer end caps should be positioned in the same position as recorded in Section 2 step 2.2.1.

- 3.3.20** Install the remaining tie bars (3-20) through outer end cap (3-80) and into inner end cap (3-10). Screw all tie bars (3-20) into inner end cap until dimension "A" (as shown on assembly drawing page 1 of 2) is achieved.

- 3.3.21** Install lockwashers (3-95) onto tie bars (3-20) and up against outer end cap (3-80).

- 3.3.22** Install hex nuts (3-90) onto tie bars (3-20) and up against lockwashers (3-95).

- 3.3.23** Torque tighten hex nuts (3-90) until a final lubricated torque, as listed in the following table, has been achieved.

Table 3. Tie Bar Nuts (3-90) Torque Table

Model	Quantity	Torque ($\pm 5\%$)		Model	Quantity	Torque ($\pm 5\%$)	
G01	4	40	54	G7	8	100	136
G2	6	40	54	G8	12	100	136
G3	8	40	54	G10	16	100	136
G4	8	40	54	G13	20	340	461
G5	8	100	136				

3.3.24 Torque tighten piston rod (3-40) per the chart in Section 5.4 step 5.4.4.

3.3.25 If the power module is reassembled off the actuator then refer to Section 5 step 5.4 for hydraulic power module installation instructions.

3.4 Blind End Cap Module Reassembly

3.4.1 Install O-ring seal (6-10) into the O-ring groove in blind end cap (5-10).

3.4.2 Install lockwashers (5-30) onto hex cap screws (5-20).

3.4.3 Install blind end cap (5-10) onto end of housing (1-10).

3.4.4 Install and tighten hex cap screws (5-20) with lockwashers (5-30) through housing (1-10) and into blind end cap (5-10).

3.5 Actuator Testing

3.5.1 Leakage Test: All sources of leakage to atmosphere and across piston are to be checked, using hydraulic pressure.

3.5.2 Cycle the actuator five times at 10% of the operating pressure, as listed on the cylinder name tag under maximum pressure.

NOTE:

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

3.5.3 Apply operating pressure as listed in step 3.5.2 to one side of the piston and allow the actuator to stabilize.

3.5.4 Repeat the above procedure for the opposite side of the piston.

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

3.5.6 Shell pressure test the actuator as follows: Apply 1.5 times the pressure listed on the cylinder name tag to both sides of the piston simultaneously for a period of two (2) minutes.

NOTE:

If any leakage occurs during step 3.5.6 the actuator must be disassembled and the cause of leakage must be determined and corrected.

- 3.5.7** If an actuator was disassembled and repaired, the above testing must be performed again.
- 3.5.8** Shell Pressure Test: Optional pressure test could be performed on the actuator by applying pressure to both sides of the piston simultaneously for a period of two (2) minutes. If any leakage occurs across a static seal, the unit must be disassembled and the cause of leakage determined and corrected.

⚠ WARNING: PED PRESSURE TESTING

The actuator's main pressure bearing parts will be tested in controlled conditions in accordance with the requirement of PED by pressuring both sides of the piston to avoid damage and over torquing of the actuator components. If further future testing in the field is necessary, the factory should be contacted for guidance.

- 3.5.9** After the actuator is installed on the valve all accessories should be hooked up and tested for proper operation and replaced if found defective.

Section 4: Field Conversions

4.1 Fail Mode Reversal (CW to CCW or CCW to CW)

- 4.1.1 Remove spring module per Section 5.1.
- 4.1.2 Remove hydraulic power module per Section 5.3.
- 4.1.3 Reinstall the spring module onto the opposite end of housing (1-10) as it was previously located per Section 5.2.
- 4.1.4 Reinstall the hydraulic power module onto the opposite end of housing (1-10) as it was previously located per Section 5.4.

4.2 Convert Double-Acting Actuator to Spring-Return

- 4.2.1 Remove blind end cap module per Section 2.4.
- 4.2.2 If hydraulic power module needs to be relocated due to fail mode requirements (fail counterclockwise) use Section 5.3 for removal and Section 5.4 for installation.
- 4.2.3 Install Powr Swivl™ module per Section 5.6.
- 4.2.4 Install the spring module onto the end of housing (1-10) per Section 5.2.

4.3 Convert Spring-Return Actuator to Double-Acting

- 4.3.1 Remove the spring cartridge per Section 5.1
- 4.3.2 If hydraulic power module needs to be relocated due to fail mode requirements (fail counterclockwise) use Section 5.3 for removal and Section 5.4 for installation.

NOTE:

Skip step 4.3.3 when working on G01-SR models and continue to step 4.3.4.

- 4.3.3 Remove the spring cartridge Powr Swivl module per Section 5.5.
- 4.3.4 Install the blind end cap module per Section 3.4.

Section 5: Module Removal and Installation

NOTE:

When the spring module is to be removed it should be removed from the drive module prior to the hydraulic power module removal or disassembly.

⚠ WARNING: CHECK FOR COMPRESSED SPRINGS

Do not remove spring module while spring is compressed.

⚠ WARNING: READ ACTUATOR WARNING TAGS

For actuators equipped with a spring cartridge mounted M3 jackscrew or an extended stop (ES) read warning tag wired to the spring cartridge cover plate.

5.1 Spring Module Removal

⚠ WARNING: CHECK FOR COMPRESSED SPRINGS

Do not remove spring module while spring is compressed.

NOTE:

1. Review Section 2.1 general disassembly before proceeding with spring module disassembly.
 2. The setting of stop screws (1-180) should be checked and setting recorded before stop screws are loosened or removed.
 3. For G2-SRF and G3-SRF use step 5.1.1. For G01-SR, G2-SR, G3-SR through G13 skip step 5.1.1 and start at step 5.1.2.
-

- 5.1.1** For G2-SRF and G3-SRF unscrew and remove pipe plug (7-10) from spring cartridge assembly (5-10). Skip steps 5.1.2 and 5.1.3 and start at step 5.1.4.

⚠ WARNING: EXTENDED STOP CONTACTS

If an M3, M3HW jackscrew or extended stop (ES) is mounted in the spring module cover plate (7-10), the M3, M3HW or ES assembly (7-40) should not contact the end of the spring module tension rod.

- 5.1.2** Unscrew hex cap screws (7-20) with lockwashers (7-30) from cover plate (7-10) or if spring module has a ES or M3 SR adapter plate (7-10) remove safety wire from hex cap screws (7-20) and then remove hex cap screws (7-20).
- 5.1.3** Remove cover plate (7-10) from spring cartridge assembly (5-10).

- 5.1.4 Apply hydraulic pressure to the pressure inlet port of inner end cap (3-10) to compress the spring enough to move the yoke off the stop screw on the spring module side of the drive module.
- 5.1.5 Loosen the stop screw nut (1-190) located on the stop screw that is closest to or next to spring module.
- 5.1.6 Unscrew stop screw (1-180) that is closest to or next to spring cartridge module (unscrew or back out until the load is removed from the stop screw).
- 5.1.7 Remove hydraulic pressure from pressure inlet port of inner end cap (3-10).

⚠ CAUTION: USE HEAVY DUTY SUPPORT EQUIPMENT

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.

- 5.1.8 The spring cartridge "pre load" must be removed before spring cartridge (5-10) is removed from housing (1-10). Refer to steps 5.1.4 through 5.1.6 for spring cartridge "pre load" removal.

⚠ CAUTION: DO NOT EXCEED MAXIMUM PRESSURE

The maximum pressure to be applied in step 5.1.9 is 25 PSIG.

- 5.1.9 Apply hydraulic pressure, which should not to exceed the maximum as indicated in the above "CAUTION" to the pressure inlet port of outer end cap (3-80) to move the spring cartridge tension rod hex nut out of its cast hex seat.

NOTE:

If hydraulic pressure is not available to apply to the pressure inlet port of outer end cap (3-80) then remove hex plug (3-120). Using a long rod go through the outer end cap vacant pipe plug port hole and push the piston rod so as to move the spring cartridge tension rod hex nut out of its cast hex seat.

- 5.1.10 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.
- 5.1.11 Remove hex cap screws (5-20) with lockwashers (5-30) from housing (1-10).
- 5.1.12 Remove spring cartridge assembly (5-10) from actuator housing (1-10).

⚠ WARNING: DO NOT CUT SPRING CARTRIDGE ASSY.

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

5.2 Spring Module Installation

⚠ CAUTION: USE HEAVY DUTY SUPPORT EQUIPMENT

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: CHECK CORRECT OVERTRAVEL POSITIONS

ACTUATOR MUST BE IN THE APPROPRIATE OVERTRAVEL POSITION (Refer to detail "A" on warning tag attached to spring module access hole cover or to Bettis drawing part number 130084 for G01 models or part number 123650 for G2 through G13 models). Confirm over-travel 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.

- 5.2.1 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).
- 5.2.2 Unscrew or back out stop screw (1-180) to achieve over travel as illustrated in detail "A" on warning tag attached to spring module cover plate or to Bettis drawing part number 123650.
- 5.2.3 Install O-ring seal (6-20) into the O-ring groove in the inboard end of spring cartridge assembly (5-10).
- 5.2.4 Using lifting equipment move spring module up to housing (1-10) and align spring cartridge tension rod with extension rod assembly (9-50) for G2 through G13 models or G01 models align spring cartridge with tapped hole in guide block (1-30).

⚠ WARNING: COMPLETE STEP 5.2.5

Complete step 5.2.5 to avoid severe injury to personnel or incur major damage to the actuator.

- 5.2.5 Spring cartridge tension rod to rod extension installation as follows:
 - 5.2.5.1 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.

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

⚠ WARNING: OBSERVE MINIMUM NUMBER OF TURNS

After initial thread engagement the tension rod must be rotated clockwise in the minimum number of turns listed in the following table.

Table 4. Rod Rotation

ACTUATOR MODEL G/GC/GH/GHC	G01	G2	G3	G4	G5	G7	G8	G10	G13
MINIMUM NO. TURNS	6	10	10	10	13	14	20	25	31

⚠ WARNING: CORRECTLY SCREW TENSION ROD

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.

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

Table 5. Spring Cartridge Tension Rod Torque Table

HOUSING MODEL G/GC/GH/GHC	TORQUE (±5 % Percent)		HOUSING MODEL G/GC/GH/GHC	TORQUE (±5 % Percent)	
	Lbf-ft.	N-m		Lbf-ft.	N-m
G01	50	68	G7	240	325
G2	90	122	G8	240	325
G3	90	122	G10	240	325
G4	240	325	G13	240	325
G5	240	325			

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

5.2.8 Install hex cap screws (5-20) with lockwashers (5-30) through housing (1-10) and into spring cartridge assembly (5-10) and tighten.

5.2.9 Install O-ring seal (6-10) into the O-ring groove in the outboard end of spring cartridge assembly (5-10).

NOTE:

For G2-SRF and G3-SRF use step 5.2.10. For G01-SR, G2-SR, G3-SR through G13-SR skip step 5.2.10 and start at step 5.2.11.

- 5.2.10** Using pipe sealant on the threads install pipe plug (7-10) in the vacant hole in out board end of spring cartridge assembly (5-10). Skip steps 5.2.11 through 5.2.14 and start at step 5.2.15.
- 5.2.11** Install lockwashers (7-30) onto hex cap screws (7-20).
- 5.2.12** Install the cover plate (7-10) or install M3 adapter plate (7-10) onto the outboard end of spring cartridge assembly (5-10).
- 5.2.13** Install and tighten hex cap screws (7-20) with lockwashers (7-30) through cover plate (7-10) and into spring cartridge assembly (5-10).
- 5.2.14** Torque tighten hex cap screws (7-20) until a final lubricated torque, as listed in the following table, has been achieved.

Table 6. Hex Cap Screws (7-20) Torque Table

HOUSING MODEL G/GC/GH/ GHC	TORQUE (±5 % Percent)		HOUSING MODEL G/GC/GH/ GHC	TORQUE (±5 % Percent)	
	Lbf-ft.	N-m		Lbf-ft.	N-m
G01	30	41	G7	135	183
G2	30	41	G8	240	325
G3	30	41	G10	285	386
G4	65	88	G13	340	461
G5	65	88			

- 5.2.15** On M3, M3HW and ES models install Monel wire (6-130) through each hex cap screw (7-20) per the following steps:

NOTE:

The following steps provides guidelines for wire locking hex cap screws to discourage screw loosening and removal in applications where screw removal could be hazardous.

- 5.2.15.1** Make sure hex cap screws are tightened to their specified torque.
- 5.2.15.2** Using required lengths of 0.31 diameter Monel wire as provided in the Module ordered. When replacing Monel wire use the following table for wire length requirements.

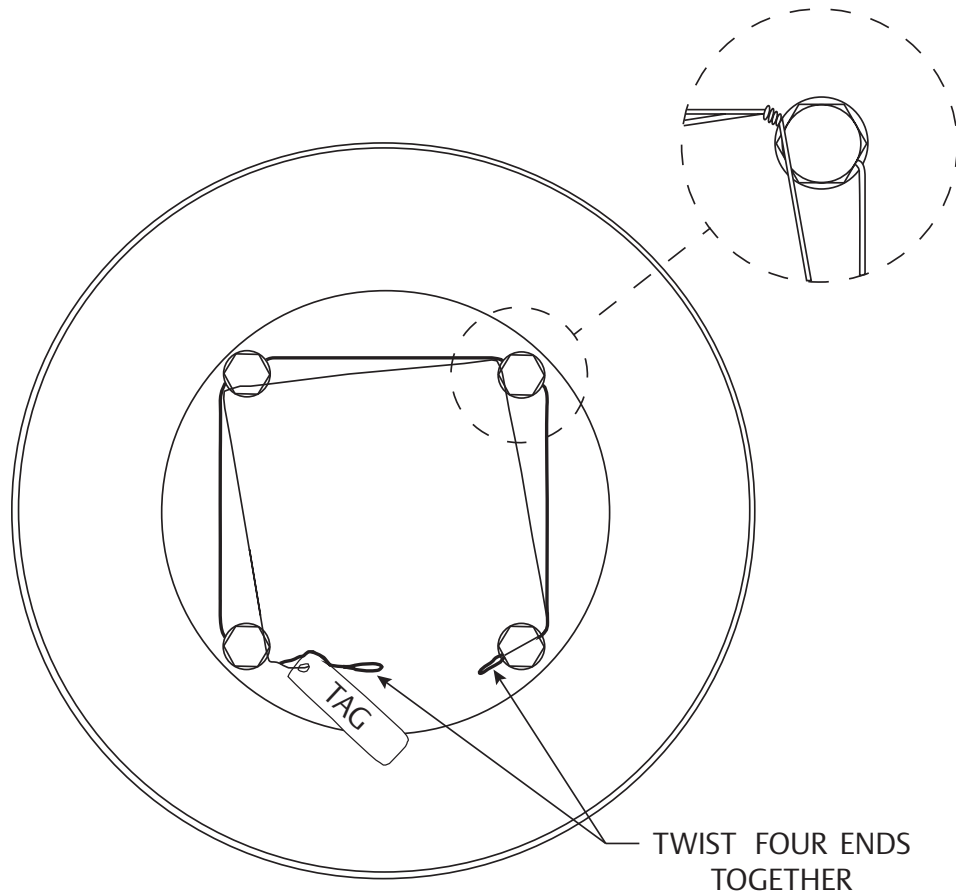
Table 7. Wire Length Requirements

MODEL G/GC/GH/ GHC	LENGTH		MODEL G/GC/GH/ GHC	LENGTH	
	Inch	mm		Inch	mm
G01-SR	36	914.4	G5-SR	66	1676.4
G2-SR	44	1117.6	G7-SR	79	2006.6
G3-SR	48	1219.2	G8-SR	88	2235.2
G4-SR	55	1397.0	G10-SR	110	2794.0

- 5.2.15.3** Twist the end of both wires together and insert one through the drilled hole in the hex cap screw head, pass the second wire over the screw head and twist it three (3) times around the first wire at a location where the first wire exits the screw head.

- 5.2.15.4 Repeat the procedure until the second wire is twist tied to the screw head through wire of the last screw head.
- 5.2.15.5 Attach caution tag and twist tie the wires from the last screw head to the twisted wires of the first screw head. See following for illustration.

Figure 1 Tag Attachment Guide



- 5.2.16 If removed install stop screw nuts (1-190) onto stop screws (1-180).
- 5.2.17 If removed install O-ring (2-90) onto stop screws (1-180).
- 5.2.18 If removed install two stop screws (1-180) into two stop screw holes on the front of housing (1-10).
- 5.2.19 Adjust both stop screws (1-180) back to settings recorded earlier in Section 5.
- 5.2.20 Tighten both stop screw nuts (1-190) securely.

5.3 Hydraulic Power Module Removal

⚠ WARNING: CHECK FOR EXTENDED SPRINGS

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

NOTE:

Review Section 2.1 General Disassembly before proceeding with the hydraulic power module disassembly.

- 5.3.1 Remove O-ring plug (3-120) from outer end cap (3-80).
- 5.3.2 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).

⚠ WARNING: USE APPROPRIATE LIFTING EQUIPMENT

Use suitable lifting equipment to support the cylinder assembly.

- 5.3.3 Remove hex cap screws (3-115) with lockwashers (3-110) from inner end cap (3-10).
- 5.3.4 Remove hex nuts (3-105) from hex cap screws (3-100).
- 5.3.5 Remove hydraulic power module from actuator housing (1-10).

5.4 Hydraulic Power Module Installation

NOTE:

Review section 3.1 General Reassembly before proceeding with hydraulic power module installation.

- 5.4.1 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).
- 5.4.2 Using lifting equipment move the power module up to housing (1-10) and install as follows: Use step 5.4.3 for G01 and step 5.4.4 for G2 through G10 model actuators.
- 5.4.3 G01 Model Actuator:
 - 5.4.3.1 Align piston rod (3-40) with threads in the guide block (1-30).
 - 5.4.3.2 Using a male square drive extension, go through outer end cap (3-80) and screw piston rod (3-40) into guide block (1-30).

⚠ WARNING: CORRECTLY SCREW RODS

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.

- 5.4.4 G2 through G10 model actuators:
 - 5.4.4.1 Align piston rod (3-40) with extension rod assembly (1-50).
 - 5.4.4.2 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).

⚠ WARNING: DO NOT CROSS-THREAD RODS

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.

- 5.4.5 Torque tighten piston rod (3-40) per the following chart.
 - 5.4.5.1 G01 model actuators torque to 50 foot pounds / 68 N-m lubricated
 - 5.4.5.2 G2 and G3 model actuators torque to 90 foot pounds / 122 N-m lubricated
 - 5.4.5.3 G4 through G13 model actuators torque to 240 foot pounds / 325 N-m lubricated
- 5.4.6 Torque tighten piston rod (3-40) per the following chart.
- 5.4.7 Install hex cap screws (3-115) with lockwashers (3-110), through inner end cap (3-10) and screw into housing (1-10).
- 5.4.8 Install lock washers (3-110) onto hex cap screws (3-100).
- 5.4.9 Install hex cap screws (3-100) with lockwashers (3-110), through inner end cap (3-10) and housing (1-10).
- 5.4.10 Install and tighten hex nuts (3-105) onto hex cap screws (3-100).
- 5.4.11 Using pipe dope, install standard NPT pipe plug (3-120) into outer end cap (3-80). If the actuator uses SAE threads install SAE O-ring plug (3-120) into outer end cap (3-80).

5.5 G2 Through G13 POWR SWIVL Module Removal

- 5.5.1 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.

- 5.5.2 Refer to assembly drawing page 2 of 2 Detail "B". Use Bettis tool part number as listed in chart in section 1 step 1.2.1 to remove retainer nut assembly (1-60) from the guide block (1-30).

⚠ CAUTION: DO NOT DROP SPHERICAL WASHERS

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

- 5.5.3 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.

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

5.6

G2 Thru G13 POWR SWIVL Module Installation

⚠ WARNING: CONFIRM OVERTRAVEL POSITION

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

5.6.1 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.

5.6.2 Lubricate two spherical washers (1-40) and one extension rod assembly (1-50).

5.6.3 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 the outside of guide block (1-30).

5.6.4 Install second spherical washer (1-40) over threaded end of extension rod assembly (1-50).

NOTE:

The spherical side of washer (1-40) will be facing to the outside of guide block (1-30).

5.6.5 Install extension rod assembly (1-50) into right of guide block (1-30) and up against the first spherical washer (1-40).

5.6.6 Install extension retainer nut assembly (1-60) over extension rod assembly (1-50) and screw into guide block (1-30).

5.6.7 Tighten extension retainer nut assembly (1-60) until extension rod assembly (1-50) cannot 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 Module Weight Tables

Table 8. 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.	G13 WT.	DESCRIPTION
1	Lbs	83	110	162	280	545	1025	1495	2550	4625	Drive Module
	Kg	38	50	73	127	247	465	678	1157	2098	
1	Lbs	26	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.5" Dia. Power Module
	Kg	12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
1	Lbs	25	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1.7" Dia. Power Module
	Kg	11.4	13.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs	26	29	43	N/A	N/A	N/A	N/A	N/A	N/A	2.0" Dia. Power Module
	Kg	11.7	13	19.5	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs	27	30	45	N/A	N/A	N/A	N/A	N/A	N/A	2.2" Dia. Power Module
	Kg	12.2	13.6	20.4	N/A	N/A	N/A	N/A	N/A	N/A	
3	Lbs	28	31	48	71	N/A	N/A	N/A	N/A	N/A	2.5" Dia. Power Module
	Kg	12.7	14.1	21.7	32	N/A	N/A	N/A	N/A	N/A	
3	Lbs	29	35	48	84.5	N/A	N/A	N/A	N/A	N/A	3.0" Dia. Power Module
	Kg	13	15.8	21.7	38	N/A	N/A	N/A	N/A	N/A	
3	Lbs	32	38	52	83	160	N/A	N/A	N/A	N/A	3.5" Dia. Power Module
	Kg	14.5	17.2	23.5	37.6	73	N/A	N/A	N/A	N/A	
3	Lbs	N/A	42	57	84	170	287	N/A	N/A	N/A	4.0" Dia. Power Module
	Kg	N/A	19	25.8	38	77	130	N/A	N/A	N/A	
3	Lbs	N/A	N/A	59	86	177.5	301	N/A	N/A	N/A	4.5" Dia. Power Module
	Kg	N/A	N/A	26.7	39	80.5	136	N/A	N/A	N/A	
3	Lbs	N/A	N/A	N/A	92	173	317	411	N/A	N/A	5.0" Dia. Power Module
	Kg	N/A	N/A	N/A	41.7	78	144	186	N/A	N/A	
3	Lbs	N/A	N/A	N/A	106	184	303	475	729	N/A	6.0" Dia. Power Module
	Kg	N/A	N/A	N/A	49	83	137	215	331	N/A	
3	Lbs	N/A	N/A	N/A	N/A	194	331	485	783	N/A	7.0" Dia. Power Module
	Kg	N/A	N/A	N/A	N/A	88	150	220	255	N/A	
3	Lbs	N/A	N/A	N/A	N/A	228	337	459	756	-	8.0" Dia. Power Module
	Kg	N/A	N/A	N/A	N/A	103	153	208	343	-	
3	Lbs	N/A	N/A	N/A	N/A	N/A	394	495	808	-	9.0" Dia. Power Module
	Kg	N/A	N/A	N/A	N/A	N/A	179	225	367	-	
3	Lbs	N/A	N/A	N/A	N/A	N/A	400	501	862	-	10.0" Dia. Power Module
	Kg	N/A	N/A	N/A	N/A	N/A	181	227	400	-	
3	Lbs	N/A	N/A	N/A	N/A	N/A	N/A	599	959	1139	12.0" Dia. Power Module
	Kg	N/A	N/A	N/A	N/A	N/A	N/A	254	435	517	
3	Lbs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1104	-	14.0" Dia. Power Module
	Kg	N/A	N/A	N/A	N/A	N/A	N/A	N/A	501	-	

Table 8 (continued).....

ITEM NO.		G01 WT.	G2 WT.	G3 WT.	G4 WT.	G5 WT.	G7 WT.	G8 WT.	G10 WT.	G13 WT.	DESCRIPTION
3	Lbs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-	16.0" Dia. Power Module
	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	-	18.0" Dia. Power Module
	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	10010	SR1 Spring Module
	Kg	73	102	145	256	442	1243	1608	2257	4541	
5	Lbs	158	215	310	549	980	2630	2345	4515	9275	SR2 Spring Module
	Kg	72	98	141	249	445	1193	1064	2048	4207	
5	Lbs	N/A	200	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRA5 Spring Module
	Kg	N/A	91	N/A	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	N/A	SRA6 Spring Module
	Kg	N/A	82	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs	N/A	220	310	N/A	N/A	N/A	N/A	N/A	N/A	SRF1 Spring Module
	Kg	N/A	100	141	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs	N/A	210	300	N/A	N/A	N/A	N/A	N/A	N/A	SRF2 Spring Module
	Kg	N/A	95	136	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs	N/A	210	285	N/A	N/A	N/A	N/A	N/A	N/A	SRF3 Spring Module
	Kg	N/A	95	129	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs	N/A	195	270	N/A	N/A	N/A	N/A	N/A	N/A	SRF4 Spring Module
	Kg	N/A	88	122	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs	N/A	205	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRF5 Spring Module
	Kg	N/A	93	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
5	Lbs	N/A	185	N/A	N/A	N/A	N/A	N/A	N/A	N/A	SRF6 Spring Module
	Kg	N/A	84	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

6.2 G01 Tool Table

Table 9. G01 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	4	Cover Screws	Socket
1-160	1/2"	4	Yoke Cover Screws	Socket
1-180	3/8" Sq.	2	Stop Screws	Open End or Adjustable
1-190	15/16"	2	Hex Jam Nuts	Open End or Adjustable
3-40	3/8" Sq.	1	Piston Rod	Male Drive
3-90	3/4"	4	Standard Hex Nuts	Socket
3-100	9/16"	4	Hex Cap Screws	Socket
3-105	9/16"	4	Standard Hex Nuts	Socket
3-115	9/16"	4	Hex Cap Screws	Socket
3-120	9/16" Sq.	1	Pipe Plug, Square Head	Open End or Adjustable
3-210	7/16" Sq.	4	Pipe Plug, Square Head	Open End or Adjustable
5-20	9/16"	4	Hex Cap Screws	Socket
7-20	9/16"	4	Hex Cap Screw	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/8"	1	Pull Rod	Male Drive

6.3 G2 Tool Table

Table 10. G2 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	6	Cover Screws	Socket
1-160	9/16"	4	Yoke Cover 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
3-40	3/8" Sq.	1	Piston Rod	Male Drive
3-90	3/4"	4	Standard Hex Nuts	Socket
3-100	9/16"	4	Hex Cap Screws	Socket
3-105	9/16"	4	Standard Hex Nuts	Socket
3-115	9/16"	4	Hex Cap Screws	Socket
3-120	9/16" Sq.	1	Pipe Plug, Square Head	Open End or Adjustable
3-210	7/16" Sq.	4	Pipe Plug, Square Head	Open End or Adjustable
5-20	9/16"	6	Hex Cap Screws	Socket
7-20	9/16"	6	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/8"	1	Pull Rod	Male Drive

6.4 G3 Tool Table

Table 11. G3 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	8	Cover Screws	Socket
1-160	9/16"	4	Yoke Cover 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
3-40	3/8" Sq.	1	Piston Rod	Male Drive
3-90	3/4"	6	Standard Hex Nuts	Socket
3-100	9/16"	4	Hex Cap Screws	Socket
3-105	9/16"	4	Standard Hex Nuts	Socket
3-115	9/16"	4	Hex Cap Screws	Socket
3-120	9/16" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
3-210	7/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	9/16"	6	Hex Cap Screws	Socket
7-20	9/16"	6	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/8"	1	Pull Rod	Male Drive

6.5 G4 Tool Table

Table 12. G4 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	9/16"	8	Cover Screws	Socket
1-160	9/16"	4	Yoke Cover 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
3-40	1/2" Sq.	1	Piston Rod	Male Drive
3-90	15/16"	6	Standard Hex Nuts	Socket
3-100	3/4"	4	Hex Cap Screws	Socket
3-105	3/4"	4	Standard Hex Nuts	Socket
3-115	3/4"	4	Hex Cap Screws	Socket
3-120	5/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
3-210	9/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	3/4"	6	Hex Cap Screws	Socket
7-20	3/4"	6	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Pull Rod	Male Drive

6.6 G5 Tool Table

Table 13. G5 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	8	Cover Screws	Socket
1-120	3/4"	4	Yoke Cover Screws	Socket
1-160	9/16"	6	Hex Cap Screws	Socket
1-180	3/4" Sq.	2	Stop Screws	Open End or Adjustable
1-190	2 3/8"	2	Heavy Hex Jam Nuts	Open End or Adjustable
3-40	1/2" Sq.	1	Piston Rod	Male Drive
3-90	15/16"	6	Hex Nuts	Socket
3-100	3/4"	4	Hex Cap Screws	Socket
3-105	3/4"	4	Standard Hex Nuts	Socket
3-115	3/4"	4	Hex Cap Screws	Socket
3-120	5/8" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
3-210	9/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	3/4"	8	Hex Cap Screws	Socket
7-20	3/4"	8	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Pull Rod	Male Drive

6.7 G7 Tool Table

Table 14. G7 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	8	Cover Screws	Socket
1-120	3/4"	4	Yoke Cover Screws	Socket
1-160	9/16"	8	Hex Cap Screws	Socket
1-180	1"	2	Stop Screws	Open End or Adjustable
3-40	3/4" Sq.	1	Piston Rod	Male Drive
3-90	1 1/2"	6	Hex Nuts	Socket
3-100	15/16"	8	Hex Cap Screws	Socket
3-105	15/16"	8	Standard Hex Nuts	Socket
3-115	15/16"	8	Hex Cap Screws	Socket
3-120	15/16"	1	Hex Head Pipe Plug	Open End or Adjustable
3-210	9/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	15/16"	8	Hex Cap Screws	Socket
7-20	15/16"	8	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Pull Rod	Male Drive

6.8 G8 Tool Table

Table 15. G8 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	12	Cover Screws	Socket
1-120	3/4"	4	Yoke Cover Screws	Socket
1-160	9/16"	8	Hex Cap Screws	Socket
1-180	1 1/4"	2	Stop Screws	Open End or Adjustable
3-40	3/4" Sq.	1	Piston Rod	Male Drive
3-90	1 1/2"	8	Hex Nuts	Socket
3-100	1 1/8"	8	Hex Cap Screws	Socket
3-105	1 1/8"	8	Standard Hex Nuts	Socket
3-115	1 1/8"	8	Hex Cap Screws	Socket
3-120	15/16"	1	Hex Head Pipe Plug	Open End or Adjustable
3-210	9/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	1 1/8"	8	Hex Cap Screws	Socket
7-20	1 1/8"	8	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Pull Rod	Male Drive

6.9 G10 Tool Table

Table 16. G10 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	3/4"	16	Cover Screws	Socket
1-120	3/4"	4	Yoke Cover Screws	Socket
1-160	9/16"	8	Hex Cap Screws	Socket
1-180	1 1/2"	2	Stop Screws	Open End or Adjustable
3-40	3/4" Sq.	1	Piston Rod	Male Drive
3-90	1 7/8"	8	Hex Nuts	Socket
3-100	1 1/8"	8	Hex Cap Screws	Socket
3-105	1 1/8"	8	Standard Hex Nuts	Socket
3-115	1 1/8"	8	Hex Cap Screws	Socket
3-120	15/16"	1	Hex Head Pipe Plug	Open End or Adjustable
3-210	9/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	1-5/16"	8	Hex Cap Screws	Socket
7-20	1-5/16"	8	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Pull Rod	Male Drive

6.10 G13 Tool Table

Table 17. G13 Tool Style and Wrench Size

ITEM NO.	WRENCH SIZE	ITEM QTY.	LOCATION OR DESCRIPTION	RECOMMENDED TOOL STYLE
1-110	1 1/8"	20	Cover Screws	Socket
1-120	1 1/8"	4	Yoke Cover Screws	Socket
1-160	9/16"	12	Hex Cap Screws	Socket
1-180	2" Sq.	2	Stop Screws	Open End or Adjustable
3-40	7/8" Sq.	1	Piston Rod	Male Drive
3-90	2-3/16"	8	Hex Nuts	Socket
3-100	1 11/16"	8	Hex Cap Screws	Socket
3-105	1 11/16"	8	Standard Hex Nuts	Socket
3-115	1 11/16"	8	Hex Cap Screws	Socket
3-120	15/16" Sq.	1	Square Head Pipe Plug	Open End or Adjustable
3-210	13/16" Sq.	4	Square Head Pipe Plug	Open End or Adjustable
5-20	1 13/16"	8	Hex Cap Screws	Socket
7-20	1 13/16"	8	Hex Cap Screws	Socket
13	3/4"	2	Vent Check Assembly	Open End
-	3/4"	1	Pull Rod	Male Drive

Section 7: Troubleshooting

7.1 Fault Insertion

In the unlikely event of a fault developing, the following Fault Location Table is provided to assist the service engineer to perform troubleshooting. This table is designed to cover as wide a range of Emerson Bettis actuators as possible. Reference to equipment not supplied should be ignored.

Table 18. Fault Location Table

SYMPTOM	POTENTIAL CAUSES	REMEDY
Erratic movement	Irregular Supply of Operating Medium	Check operating medium for consistent supply pressure and correct as necessary
	Inadequate Lubrication	Dismantle, relubricate and reassemble
	Worn Parts	Dismantle. Visually inspect for significant wear. Actuator replacement may be required
	Defective Valve	Consult the valve OEM's documentation
Short stroke	Incorrectly Set Stops (Valve and/or Actuator)	Check the position of the travel stops and readjust as necessary
	Hardened Grease	Dismantle, remove any hard grease, relubricate and reassemble
	Debris Left in the Cylinder or Housing During Maintenance	Disassemble cylinder assembly to remove debris. Reassemble cylinder assembly as necessary
	Defective Valve	Consult the valve manufacturer's documentation
Apparent lack of torque	Inadequate Supply Pressure	Ensure supply pressure is above the minimum operating pressure of the actuator and that output torque produced at supply pressure exceeds valve torque demand
	Incorrect Speed Control Settings	Adjust speed controls to increase flow
	Exhaust Port Blocked	Remove and clean the exhaust port silencers and replace them
	Pipe Work Blocked, Crushed or Leaking	Examine the pipe work for blockages, crushed pipe or leakage and clear or replace as necessary
	Defective Controls	Examine the controls and refurbish or renew as necessary and refer to component manufacturer's documentation
	Defective Piston Seal	Dismantle the cylinder assembly and remove the defective piston seal and fit new seal and reassemble
	Defective Rod Seal	Dismantle the cylinder assembly and remove the defective rod seal and fit new seal and reassemble
	Defective Housing Seal	Dismantle the housing assembly, remove the defective seal and fit new seal and reassemble
	High Valve Torque or Valve Seized	Consult the valve OEM documentation

7.2 Operational Test

7.2.1 Full Stroke Test

The “Full Stroke Test” (“On-line”) must be performed to satisfy the PFD_{AVG} (average probability of failure on demand) value. The full stroke test frequencies will be defined by the final installer to achieve the defined SIL level.

7.2.1.1 Procedure

7.2.1.1.1 Stroke the actuator/valve assembly two complete open/close cycles with complete closing of the valve.

7.2.1.1.2 Verify if the open/close cycles functioned correctly (e.g., check locally, or automatically via Logic solver, the correct movement of the actuator/valve).

7.2.2 Partial Stroke Test (when requested)

The “Partial Stroke Test” (“On-line”) can be performed to improve the PFD_{AVG} value and to satisfy PFD_{AVG} (average probability of failure on demand) value. A typical partial stroke value is 15% of the stroke and the recommended test interval is about every one to three months.

7.2.2.1 Procedure

7.2.1.1.1 Operate the actuator/valve assembly for No° 1 open/close cycles 15% of the stroke.

7.2.1.1.2 Verify if the partial stroke test functioned correctly (e.g., check locally, or automatically via logic solver, or via the PST system if the correct movement of the actuator/valve was 15% of the stroke).

NOTE:

The above test is only applicable on systems equipped with a partial stroke feature.

Section 8: Removal and Decommissioning

8.1 Removal and Decommissioning

⚠ WARNING: FOLLOW PROPER PROCEDURE

Always follow safe work practices while removing and disassembling the G-Series actuator.

The below basic 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 Emerson/Bettis representative.

⚠ CAUTION: ISOLATE AND POWER OFF ACTUATOR

Make sure actuator is isolated before removing from valve. Turn off the power medium and bleed off all pressure first, including storage tank (if present). Next, bleed off pilot pressure, disconnect: pneumatic pressure supply, pilot tubing and electrical wiring (if equipped).

Before starting the disassembly, a large area should be created around the actuator so to allow any kind of movement.

Separate the parts composing the actuator according to their nature (e.g., metallic, and plastic materials, fluids, etc.) and send them to differentiated waste collection sites, as provided for by the laws and provisions in force.

- 8.1.1** Drain tanks and remove tubing from actuator. Remove accessories (if equipped) and control from actuator.
- 8.1.2** Remove all equipment mounted on top of actuator (limit switches, end of stroke valve, and relevant pneumatic/electric connection, etc.).
- 8.1.3** Remove mounting bolts and check if actuator is ready to be removed from valve.

For complete actuator teardown refer to Section 2 of the manual.

Section 9: Document Revision

Table 19. Revision Overview

ECN	DATE	REVISION	STATUS	BY *	DATE
17787	December 2001	B		B. Cornelius	December 2001
19110	July 2006	C	UPDATED	C. Ross	July 2006
VAWCO2794	October 2015	D	UPDATED	C. Rico	October 2015

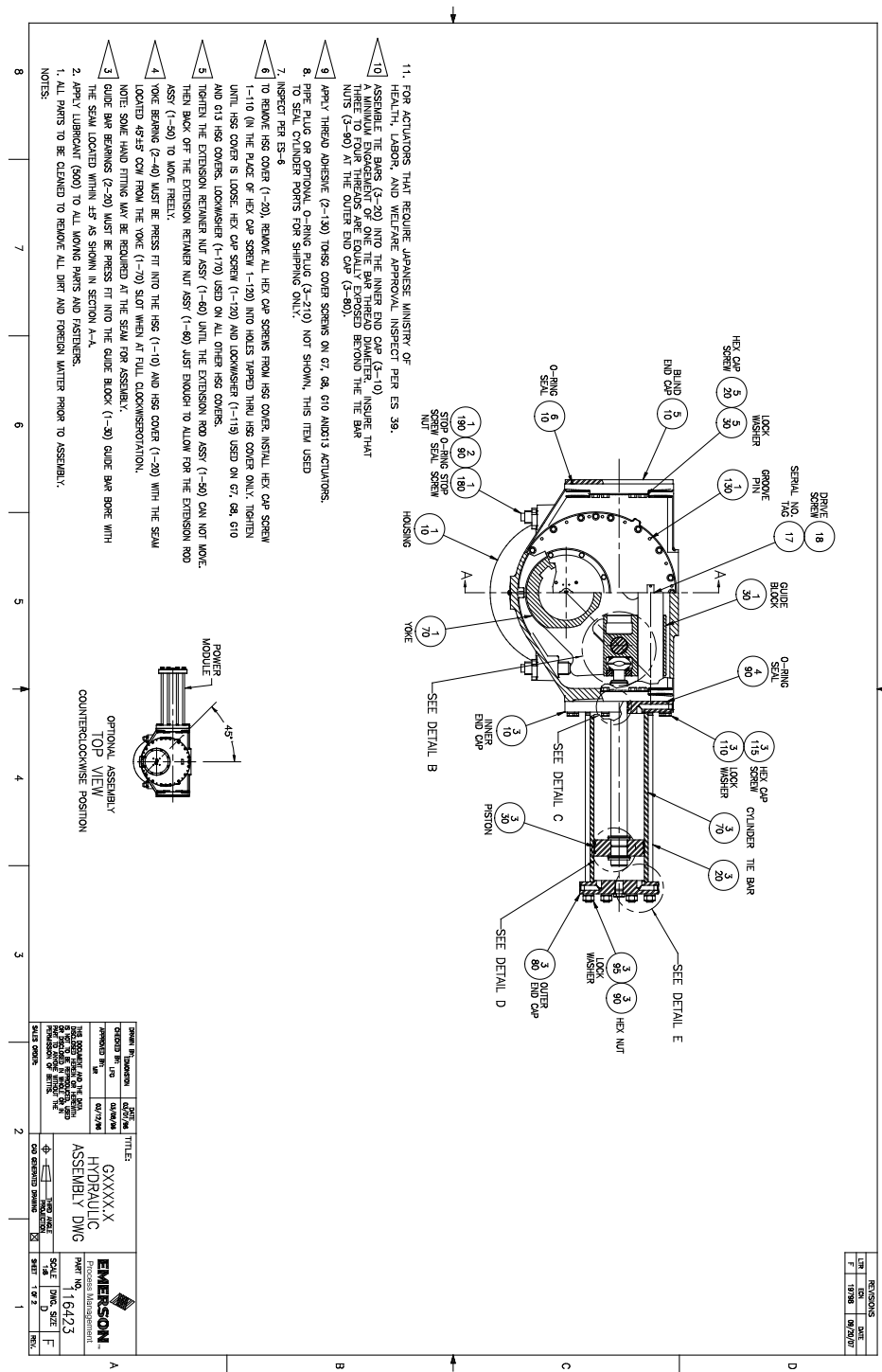
*Signatures on file Emerson, Houston, Texas

Appendix A: List of Tables

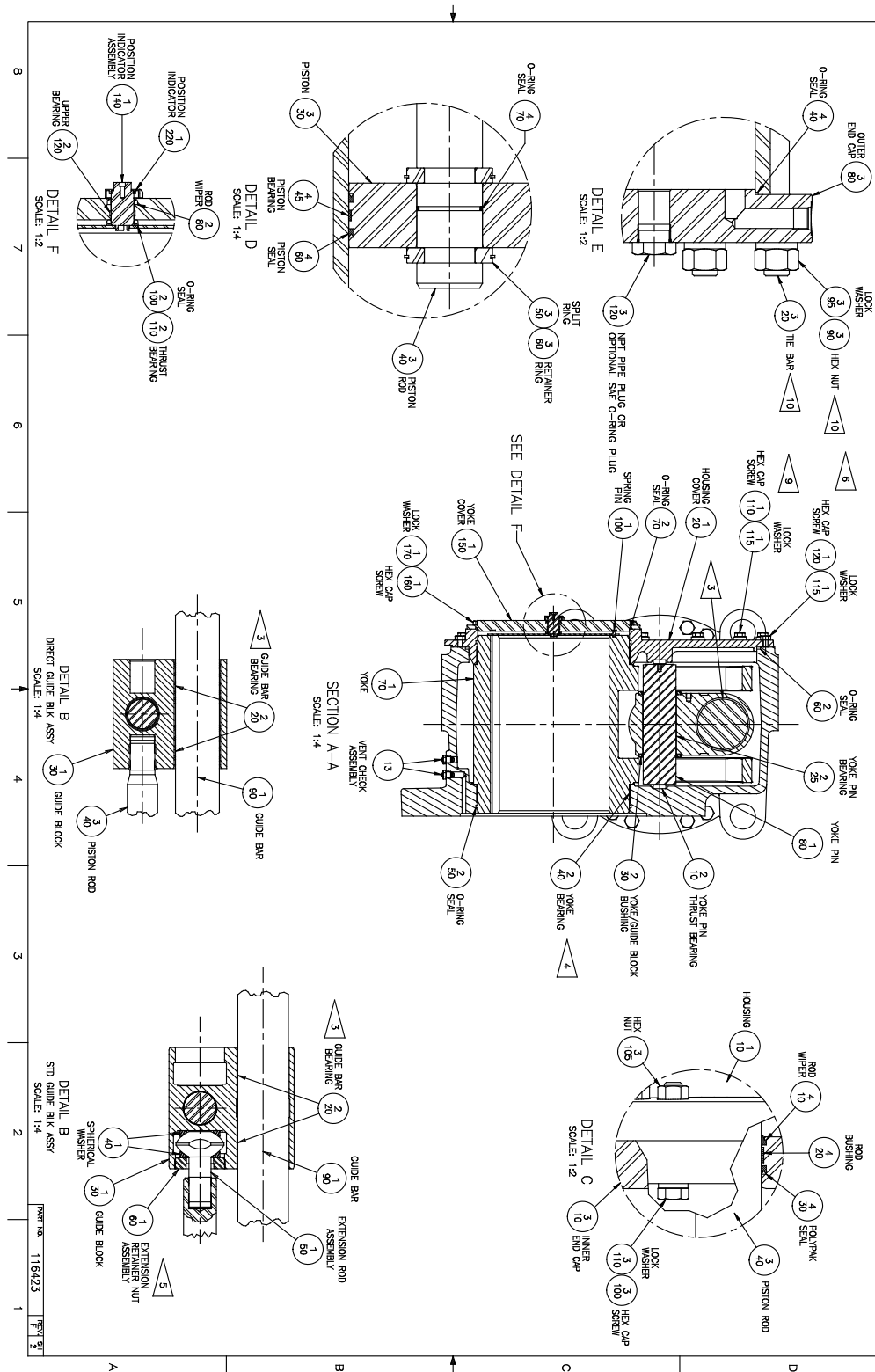
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Appendix B: List of Drawings

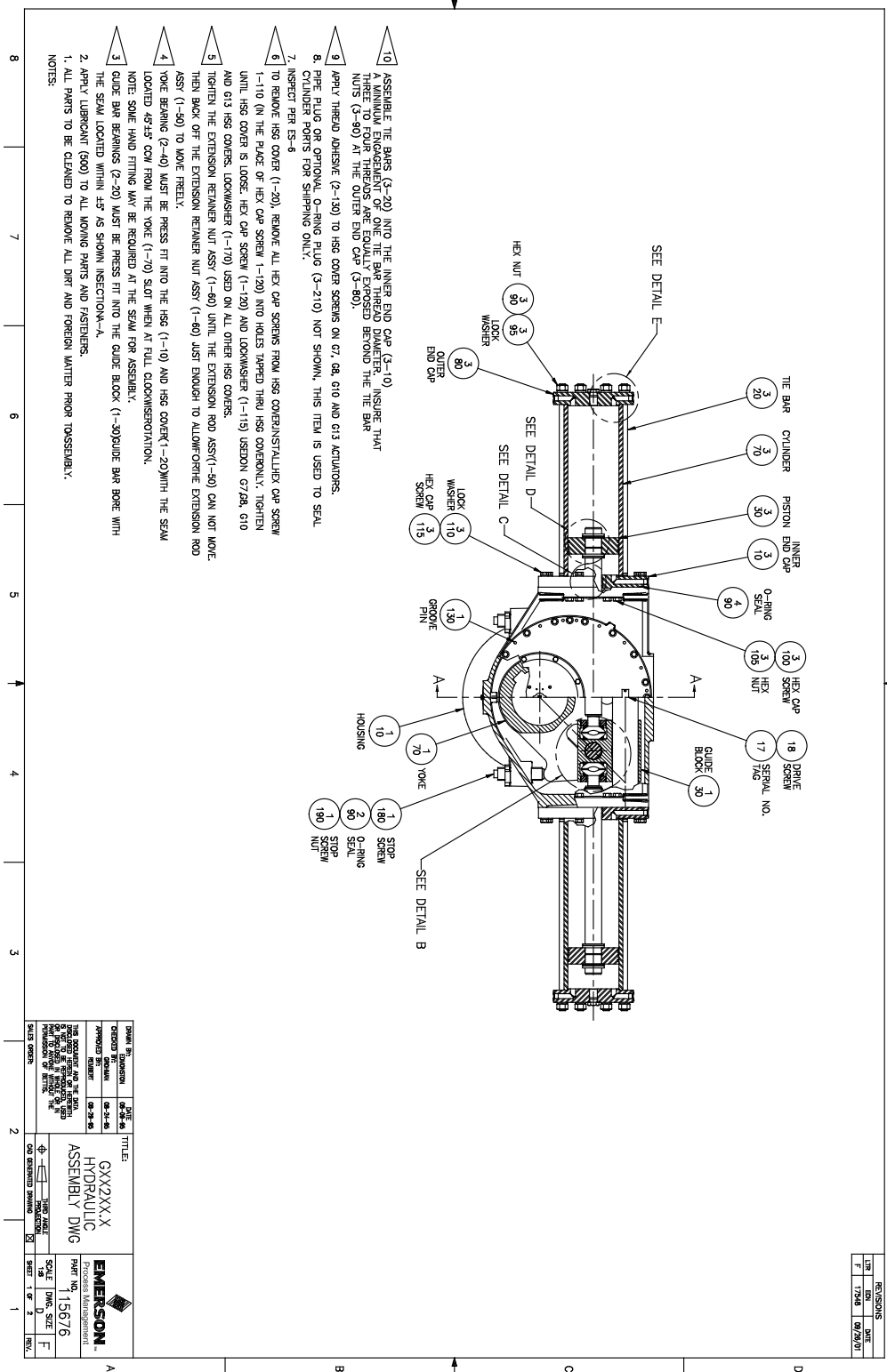
B.1 Part No. 116423, GXXX.X Hydraulic Assembly Drawing, Sheet 1 of 2



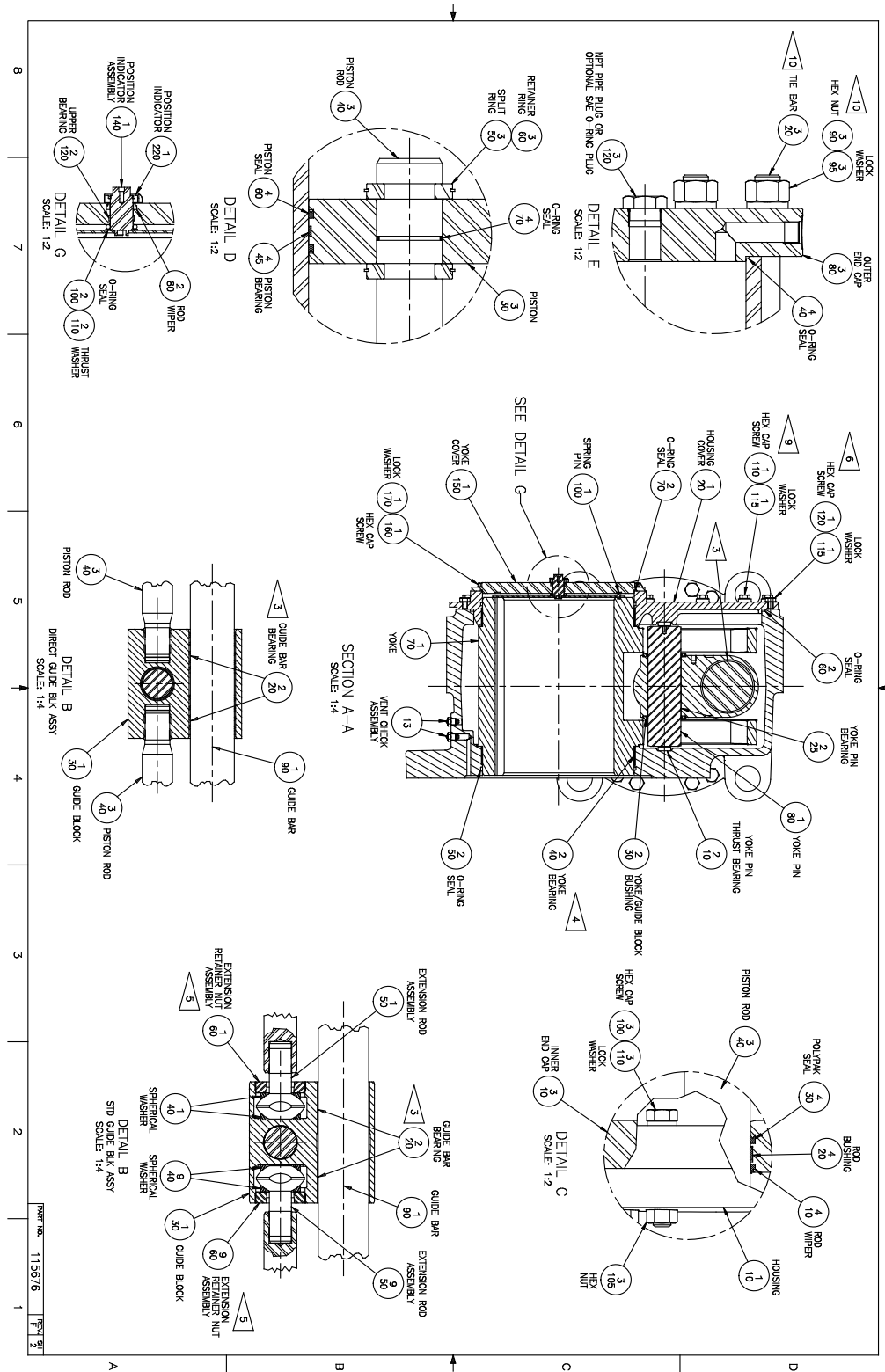
B.2 Part No. 116423, GXXX.X Hydraulic Assembly Drawing, Sheet 2 of 2



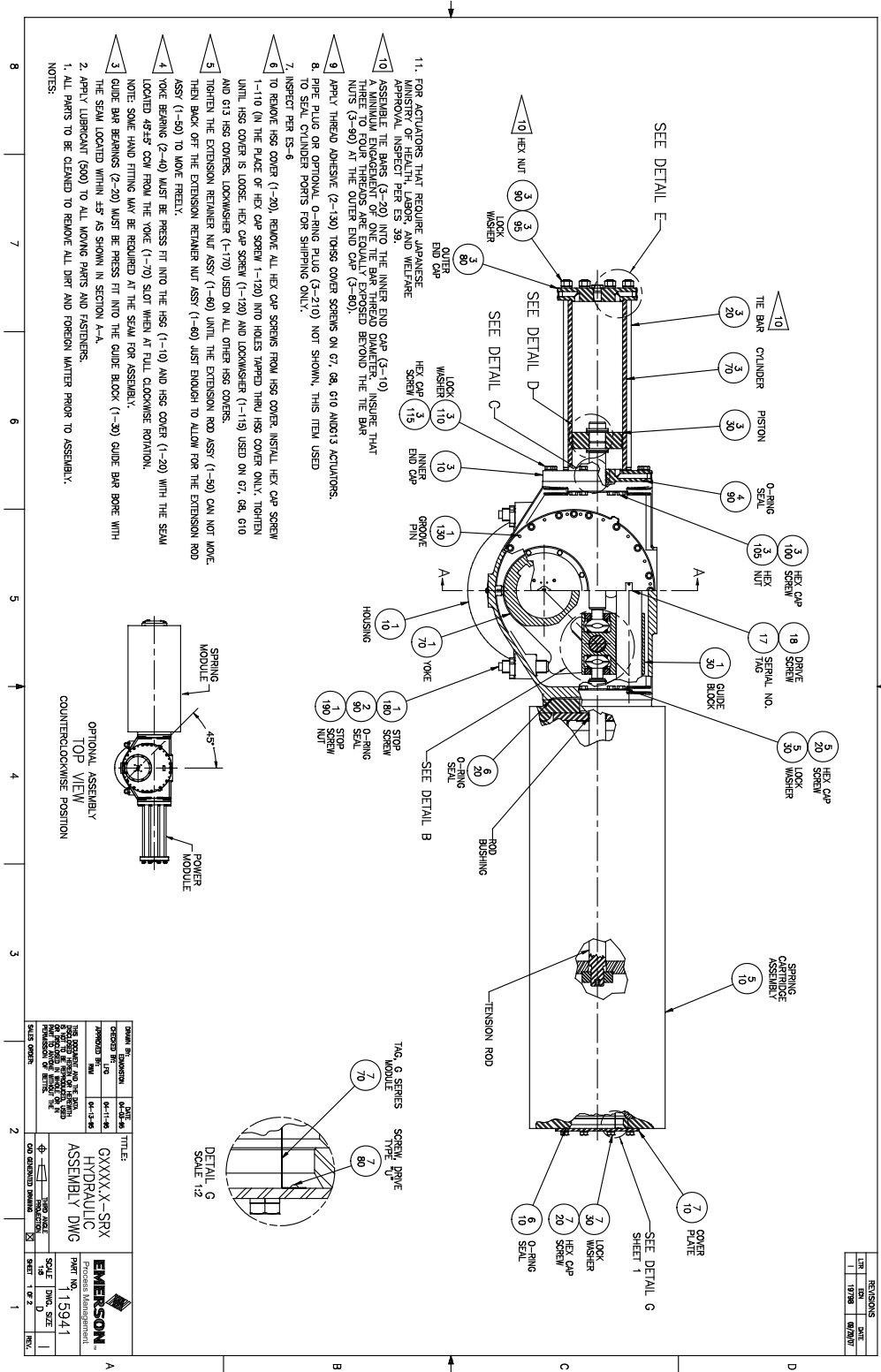
B.3 Part No. 115676, GXX2XX.X Hydraulic Assembly Drawing, Sheet 1 of 2



B.4 Part No. 115676, GXX2XX.X Hydraulic Assembly Drawing, Sheet 2 of 2



B.5 Part No. 115941, GXXXX.X-SRX Hydraulic Assembly Drawing, Sheet 1 of 2



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