GH BETTIS

SERVICE INSTRUCTIONS

DISASSEMBLY & REASSEMBLY

FOR MODEL

FQ1020X-2SR

SUB SEA

HYDRAULIC ACTUATORS

PART NUMBER: 074961

REVISION: "A"

RELEASE DATE: November, 1991

1.0 INTRODUCTION

1.1 This service procedure is offered as a guide to enable general maintenance to be performed on GH Bettis FQ1020X-2SR Subsea hydraulic actuator. When the model number has a "-S" as a suffix then the actuator is special and may have some differences that are not included in this procedure.

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

1.3 This procedure is written with the understanding that the actuator has been removed from the valve.

COMPLETE ACTUATOR REFURBISHMENT REQUIRES THAT THE ACTUATOR BE DISMOUNTED FROM THE VALVE

2.0 SUPPORT ITEMS AND TOOLS

2.1 **Support Items** - Seal/Service Kit, commercial non-corrosive leak testing solution, anti-seize, non-hardening thread sealant Loctite-PST 567, Loctite 242, and Master Gasket.

2.2 **General Tools**: All tools are American Standard inch. Extra Large (24 inch) adjustable wrench, two large standard slot screwdrivers, l/2" drive socket set, 3/4" drive socket set, torque wrench (up to 1000 foot pounds), 24 oz. ball peen hammer, pry bar, putty knife, and rubber or leather mallet.

3.0 REFERENCE GH-BETTIS MATERIALS

3.1 Assembly drawing part number 107224.

3.2 Dimensional drawing part number 107225.

4.0 GENERAL

4.1. Numbers in parentheses ( ), indicate the bubble number (reference number) used on GH Bettis assembly drawing and actuator parts list.

4.2 Complete actuator refurbishment requires that the control package, along with all piping, be removed from the actuator.

4.3 The actuator is symmetrical about the valve centerlines and it is understood that maintenance performed on one side of the housing is also to be done to the other side.

4.4 Some components of this actuator are very heavy and will require a means of assistance.

4.5 When Normal Operating Pressure (NOP) is referenced, normal plant pressure, if it does not exceed Maximum Operating Pressure (MOP), is sufficient.

4.6 **Lubrication Requirements:** Kronaplate 100 lubricant (ESL-5). This lubricant is furnished in the GH Bettis Service/Seal Kit.

4.7 **Fluid Requirements:** Per Sales Order

5.0 GENERAL DISASSEMBLY

WARNING: **Prior to starting any work on this actuator all hydraulic pressure must be removed, and the springs must be in the relaxed state.**

5.1 Remove all four stop screw nuts (2-110). Measure the exposed length of the stop screws and record each.

5.2 The spring cartridge "pre-load" must be removed before the actuator is disassembled. Remove the spring cartridge "pre-load" as follows: Apply NOP to both inner end cap pressure inlet ports. Unscrew and remove the two stop screws located on the sub assembly spring cartridge. Remove the pressure from the pressure inlet ports. Note that SR stop screws are shorter than the cylinder stop screws (2-100).

5.3 Arrange the actuator so that the bleeder valves (2-130) on the actuator cylinder are facing upward. **CAUTION: Open the bleed valve (2-130) to release any pressure that could be trapped.** Remove the cylinder drain plugs (2-140) and drain the hydraulic fluid.

5.4 Unscrew the spring cartridge pull rod from the guide block (1-50). The pull rod can be rotated for removal by going thru the spring cartridge stop screw hole with a 3/4 inch square drive extension.

5.5 The spring cartridge is very heavy and must be supported with equipment capable of holding very heavy loads.

5.6 Unscrew the four hex head screws (3-20) from adapter plate (3-80), and remove the adapter plate.

5.7 Loosen spring cartridge tie bar hex head nuts one turn.

5.8 Unscrew the spring cartridge tie bars from the housing (1-10). Flats are provided on the outboard end of the tie bars for wrench placement. Pull the cartridge (3-10) away from and off of the housing (1-10).

5.9 To keep from inadvertently pulling the tie bars back into the spring cartridge use 1-3/8 inch 12 UNF hex nuts and screw them on to the spring cartridge tie bars. Place the spring cartridge to one side.

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

5.10 Unscrew the hex cap screws (1-290) to remove the adapter plate (3-80).

6.0 **DISASSEMBLY**

6.1 Unscrew and remove the socket cap screws (2-180) from the outer end cap (2-30). Unscrew and remove the hex nut (2-120) from the outboard end of cylinder. Break the outer end cap free by tapping with a rubber or leather mallet on the end cap. Remove the outer end cap from cylinder (2-10).

6.2 Unscrew and remove the two upper tie bars (2-40) from the inner end cap (2-20). Flats on the outboard end are provided for wrench placement. Remove the cylinder (2-10) from the inner end cap. When sliding the cylinder off of the piston (2-60) tilt the cylinder 15^0 to 30^0 degrees. Unscrew and remove the other two tie bars from the inner end cap.

6.3 Remove retaining ring (2-90) and split ring set (2-70) from the piston rod (2-50). Slide the piston (2-60) off of the piston rod. Note: The split rings under the piston are not held together with a retainer ring, and they will fall off when the piston is removed. Remove the second split ring set from the piston rod.

6.4 Loosen the socket set screw (1-380) to remove the position indicator (1-350) from the position indicator drive (1-300).

6.5 Unscrew and remove the hex cap screws (1-330) from the position indicator cover (1-320). Remove position indicator cover (1-320).

6.6 Unscrew and remove the hex cap screws (1-310), then remove the position indicator drive (1-300).

6.7 Unscrew and remove the hex cap screws (1-40) from the housing cover (1-20). Note: Do not remove the raised hex cap screws (1-250). (See Next Step)

6.8 Unscrew and remove the raised hex cap screws (1-250). Remove the hex nuts (1-260) from the hex cap screws. Thread the hex cap screws, less the hex nuts, back into the housing cover (1-20). When the hex cap screw comes into contact with the housing (1-10) then alternately turn each screw one full turn each until the housing cover is lifted off of the housing and the dowel pins (1-30) are clear of the housing cover. Now remove the housing cover (1-20) from the housing.

6.9 Unscrew and remove socket cap screws (1-140) with lock washers (1-145) from the sliding block (1-120). Then remove yoke pin retainer (1-130) & the yoke pin (1-110).

CAUTION: **The actuator contains very large moving parts keep hands clear when moving the yoke.**

6.10 Pushing on the yoke arms (1-90), move the guide block (1-50) to a position on the guide bar (1-60) that will allow access to the hole in the top of the guide block.

6.11 Using a punch or round tool that will fit through the hole in guide block (1-50) and into the hole in the rod extension (1-210), unscrew the piston rod (2-50) from the rod extension. Flats on the inboard end of the piston rod are provided for wrench placement.

6.12 Remove the piston rod (2-50) by pulling it out through the housing (1-10) and inner end cap (2-20).

6.13 Unscrew and remove the hex cap screws (1-290) from inside the housing (1-10), now remove the inner end cap (2-20).

6.14 Remove the retaining ring (2-150) from the inner end cap (2-20).

6.15 Remove the rod bushing (2-80) from the inner end cap (2-20).

6.16 Unscrew the four hex cap screws (1-80) and remove the guide bar cover (1-70).

6.17 Holding on to the guide block (1-50), remove the guide bar (1-60) by pulling it out through the cylinder side of the housing. Remove the guide block (1-50).

6.18 Unscrew and remove the socket cap screws (1-230) from the rod extension flange (1-220) and remove the rod extension flange from the guide block (1-50). Remove the rod extension (1-210) and spherical washer (1-240). Inspect for excessive wear or damage.

6.19 Remove the sliding blocks (1-120).

6.20 Remove the yoke (1-90) by lifting out of the housing (1-10).

6.21 Unscrew and remove hex cap screws (1-160) in the yoke bushing retainers (1-150). Remove the retainers and the yoke bushing (1-100).

6.22 It is not necessary or recommended that the spring cartridge (3-10) be remove during routine maintenance.

7.0 **GENERAL REASSEMBLY**

7.1 Remove and discard all old seals and gaskets, taking care not to scratch or damage seal grooves.

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

7.3 All parts should be thoroughly inspected. Particular attention should be directed to threads, sealing surfaces and areas that will be subjected to sliding motion. Sealing surfaces must be free of deep scratches, pitting, corrosion and blistering or flaking coating.

7.4 Coat all moving parts with lubricant. Coat all seals with lubricant, before installing into grooves. Use Kronaplate 100 lubricant in the housing and customer specified hydraulic fluid in the cylinder.

7.5 Apply stainless steel pipe sealant, Loctite 567-7, to threads as marked on the assembly drawing as note number 4.

7.6 Apply sealant, Loctite-242, to external threads as marked on the assembly drawing as note number 3.

7.7 Apply Master Gasket to seal to all external joints as marked on the assembly drawing as note number 2.

7.8 Apply anti-seize to all stainless threads.

8.0 **HOUSING REASSEMBLY**

8.1 Apply lubricant to o-ring seals (4-10) and install onto the outside, and o-ring seals (4-20) to the inside of the yoke bushings (1-100). Install the yoke bushings into the housing (1-10) and the cover (1-20). Retain the yoke bushing with the yoke bushing retainers (1-150), hex cap screws (1-160) and lockwashers (1-170).

8.2 Lubricate the yoke (1-90) and then install into the housing (1-10). Note: The top is easily determined by the indicator mounting holes.

8.3 Install one of the sliding blocks (1-120) into the bottom yoke arm and one in the top yoke arm. Install the guide block (1-50) in between the yoke arms. Install the yoke pin (1-110) into and through the sliding blocks and the guide block. Retain the yoke pin with the yoke pin retainer (1-130), the lockwasher (1-145) and socket cap screw (1-140).

8.4 Install the guide bar (1-60) into the side of the housing (1-10) through the guide block (1-50) and into the other side of the housing.

8.5 Install the guide bar cover o-ring (4-80). Install guide bar cover (1-70), retain with the hex cap screws (1-80) and the gasket seals (4-60).

8.6 Thread the pull rod into the guide block (1-50) and torque to 300 foot pounds.

8.7 Install the o-rings (5-30) seals into the inner end cap (2-20). Install the poly-pak seals (5-60) into the rod bushing(2-80). Install the rod bushing into the inner end cap and retain with the retainer ring (2-150).

8.8 Install the end cap o-ring (5-100). Install the inner end cap (2-20) and retain with hex cap screws (1-290), and flat washers (1-370).

8.9 Install the spherical washers (1-240) and the rod extension (1-210) into the guide block (1-50). Install the rod extension flange (1-220) and retain with the socket cap screws (1-230). Torque the socket cap screws to 200 foot pounds.

8.10 Install the piston rod (2-50) through the inner end cap (2-20) and thread into the rod extension (1-210).

8.11 Remove the twelve hex cap screws (1-250) from the cover (1-20). Install the hex nuts (1-260) onto the hex cap screws and install the hex cap screws with the hex nuts back into the cover. The twelve hex cap screws should not be threaded into the cover far enough to contact the housing (1-10), but should be flush with the bottom of the cover.

8.12 Apply a 1/8" bead of master gasket to the housing (1-10) around the cover gasket surface, circling the bolt holes. Install the cover gasket (4-140), apply master gasket the same as above. Install the cover (1-20) onto the housing. Align the cover dowel pins (1-30) with the dowel pin holes in the housing. Using a leather or rubber mallet tap down the cover onto the housing.

8.13 Install the hex cap screws (1-40) with the gasket seals (4-30) thru the cover (1-20) and into the housing (1-10).

8.14 Install the position indicator drive (1-300), retain with the hex cap screws (1-310) and lockwashers (1-315).

8.15 Install the wear ring (4-100), the o-ring seal (4-90), and the rod wiper (4-150) into the position indicator cover (1-320). Install the outer o-ring seal (4-130) into the position indicator cover, apply master gasket per assembly drawing. Install the position indicator cover (1-320), retain with the hex cap screws (1-330), and the gasket seals (4-30).

9.0 **POWER CYLINDER REASSEMBLY**

9.1 Install the o-ring seal (5-40) onto the inner end cap (2-20).

9.2 Install the o-ring seal (5-20) onto the piston rod (2-50).

9.3 Install the two halves of the split rings (2-70) into the inner most groove in the piston rod (2-50).

9.4 Install the piston (2-60) onto the piston rod (2-50) and over the split rings (2-70). Install the second set of split rings and retain with retaining ring (2-90).

9.5 Install the piston seals (5-50), along with the back up rings (5-90) on the back or flat side of the piston seals, and the piston wear rings (5-80) onto the piston (2-60).

9.6 Making sure that the bleeder plugs (2-130) are facing up, slide the cylinder (2-10) over piston (2-60) and onto the inner end cap (2-20). Tilt the cylinder approximately 15° to 30° across piston to help in installation. Make certain the piston wear rings (5-80) do not come out of the grooves during installation.

9.7 Install the tie bars (2-40) into the inner end cap (2-20).

9.8 Install the o-ring seal (5-40) onto the outer end cap (2-30).

9.9 Install the outer end cap (2-30) over the tie bars (2-40) and onto the cylinder (2-10). Install the hex nuts (2-120) and torque to 1000 foot pounds. After tightening all four hex nuts, replace all four socket cap screws (2-180).

9.10 Install the o-ring seal (5-70) into the power cylinder stop screw nut (2-110). Install the stop screw nuts over the stop screws.

9.12 Install the drain pipe plugs (2-140) into the bottom or lowest point of the cylinder (2-10).

9.13 If removed, install the bleed valves (2-130). For correct cylinder bleeding, the bleed valve must be located at the highest vertical point of the cylinder (2-10).

10.0 SPRING CARTRIDGE INSTALLATION

10.1 Remove and discard all old seals, taking care not to scratch or damage seal grooves.

10.2 Clean the mounting surface of the adapter plate (3-80), inboard end of spring cartridge (3-10) and spring cartridge side of the housing (1-10) and apply master gasket per assembly drawing.

10.3 Install the o-ring seal (4-80) into the adapter plate (3-80).

10.4 Install the adapter plate (3-80) and retain with socket cap screws (3-20) and lock washers (3-30).

10.5 Remove the tie bar nuts on outboard end of the spring cartridge and install new thread seals (6-10) and countersunk washers (6-20).

10.6 Re-install the tie bar nuts onto the tie bars.

10.7 Install the o-ring seal (6-40) over the tie bars and into the spring cartridge inner end cap o-ring groove.

10.8 If installed remove the safety nuts from the inboard end of the spring cartridge.

10.9 Apply loctite to the pull rod per assemble drawing, note 3.

10.10 Bring the spring cartridge up to the housing and insert the pull rod thru the housing and then thread the pull rod into the yoke pin nut. The pull rod can be rotated by going thru the spring cartridge stop screw hole (in the outboard end of the cartridge) with a 3/4 inch square drive extension. CAUTION: While installing the pull rod do not allow the spring cartridge tie bars to be pushed back into the cartridge. Do not tighten the pull rod.

10.11 Insert the tie bars into the mating holes in the housing (1-10). Screw the tie bars into the housing. Tighten each tie bar until the threads bottom out.

10.12 Use the spring cartridge tie bar nuts to draw the spring cartridge firmly against the adapter plate (3-20). Torque alternately, in 50 ft. lb increments, until a final torque of 350 foot pounds plus or minus 10% has been achieved.

10.13 Install the hex head screws (3-20) and the lock washers (3-30) thru the adapter plate (3-80) and into the spring cartridge end plate. Torque to approximately 50 to 60 ft. lbs.

10.14 Install the stop screws removed from the sub assembly spring cartridge (3-10). Adjust the stop screw back to the setting recorded in step 1 of paragraph 5.0.

10.15 Install the oring (6-30) into the stop screw nut on the sub-assembly spring (3-10) side. Then replace the stop screw nut.

11.0 ACTUATOR TESTING

11.1 **Leakage Test**: All areas, where leakage to atmosphere may occur, are to be checked using hydraulic pressure.

11.2 Cycle the actuator five (5) times at the normal operating pressure. This will allow the seals to seek a service ready condition.

11.3 Apply the normal operating pressure and allow unit to stabilize.

11.4 If there is any notable leakage, the actuator must be disassembled and the cause of leakage must be determined and corrected.

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

11.6 **Optional Shell Test**: This test should be performed if any one of the following items are replaced: tie bar, piston, piston rod, end caps or cylinder. All air should be bled from the cylinder before shell testing.

11.7 Shell test the actuator by applying 1.5 times the maximum allowable working pressure, as marked on actuator name tag, to both sides of the piston simultaneously for a period of two (2) minutes.

11.8 If any leakage occurs, the unit must be disassembled and the cause of leakage must be determined and corrected.

12.0 RETURN TO SERVICE

12.1 Install the position indicator (1-350) onto the position indicator drive (1-300) and retain with socket set screw (1-380).

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

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