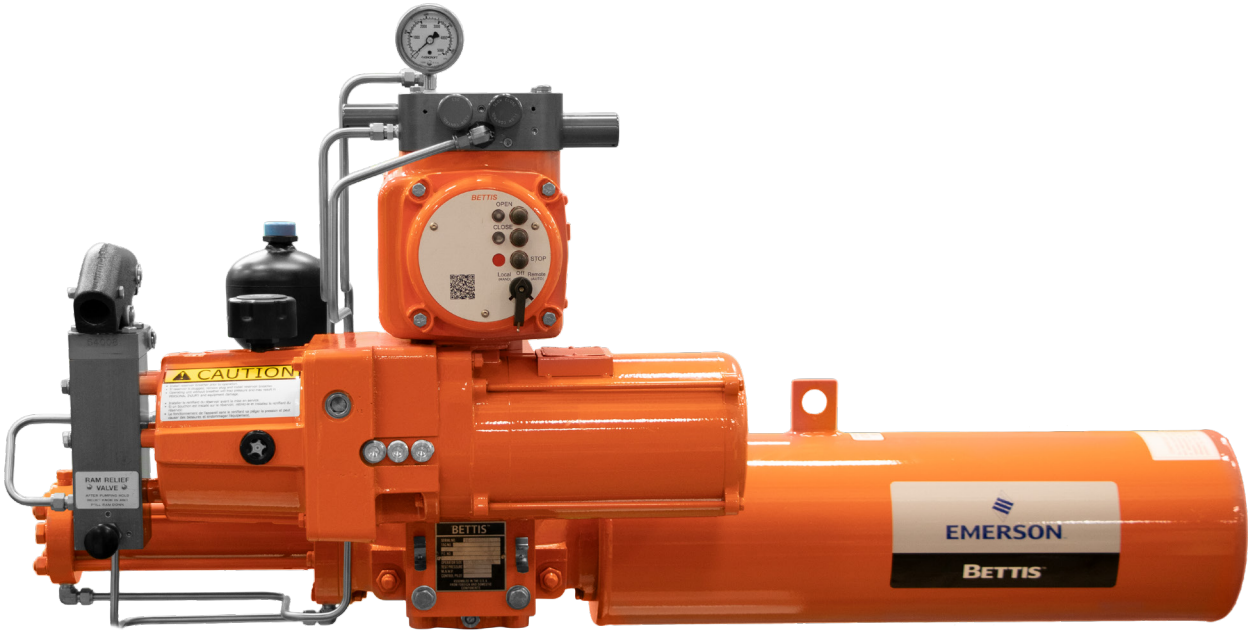
Installation, Operation and Maintenance Manual
VA001-507-32 Rev. 1
December 2022

Bettis™ EHO (Electro-Hydraulic Operated)

Spring-Return Actuator



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Section 1: Introduction

1.1 Scope

This manual is offered as a guide to be used along with locally approved and safe practices to install, operate, service and maintain the Bettis EHO Actuator. Carefully follow the instructions in this manual and make sure you install the actuator correctly and according to your requirements.

1.2 General Information

1.2.1 Overview

The Bettis EHO is a self-contained, quarter-turn, valve actuator that combines proven technologies from Emerson's Actuation Technologies. The actuator has been designed for critical shutdown applications where reliability is crucial. The EHO utilizes a dependable spring-return actuator for the fail-safe stroke combined with an integral hydraulic power pack and electronic control module.

The EHO accepts a wide range of single-phase, three-phase or DC power sources. A hydraulic handpump can be used to stroke the actuator during commissioning or in the event of an emergency power loss.

Electronic modules are contained within an explosion proof, IP68 enclosure and all electronic components are isolated from the customer connection terminals.

The EHO provides a compact design with actuator and control components that have been field proven for decades in critical service applications.

1.3 Safety Information

Safety notices in this manual detail precautions the user must take to reduce the risk of personal injury and damage to the equipment. The user must read these instructions in their entirety. Failure to observe these safety notices could result in serious bodily injury, damage to the equipment, void of the warranty. Take special notice of all tags, warning labels and instructions presented on the actuator. These may provide more specific and significant information regarding the actuator than this general manual.

It is the responsibility of the user to ensure proper safety practices are utilized. Always take necessary precautions and use proper protective equipment when dealing with compressed gases, compressed hydraulic fluid, pinch points and electricity.

Safety notices are presented in this manual in three forms (Warning, Caution and Note) as follows:

⚠ WARNING

Alerts user of potential danger; failure to follow the warning notice could result in serious personal injury or death.

⚠ CAUTION

Identifies precautions, the user must take to avoid personal injury or equipment damage.

NOTE:

Highlights information critical to the user's understanding of the Bettis EHO valve actuator installation or operation.

1.4 Abbreviation Definitions

Abbreviations used in this manual and their definitions are listed in the table below:

Table 1. Abbreviation Definitions

Abbreviation	Definition
IOM	Installation Operation Manual
SCH	Self-Contained Hydraulic
ESD	Emergency Shutdown
FS	Fail-Safe
SR	Spring-Return
DA	Double-Acting
MAWP	Maximum Allowable Working Pressure
MOP	Maximum Operating Pressure
STC	Separate Terminal Chamber
PBM	Pushbutton Module
LDM	Local Display Module
RDM	Remote Display Module
CBM	Circuit Breaker Module
PCB	Printed Circuit Board
LS	Limit Switch
PS	Pressure Switch
NC	Normally Closed
NO	Normally Open
CCW	Counterclockwise
CW	Clockwise
OL	Overload
PPE	Personal Protective Equipment
GA	General Arrangement Drawing

Section 2: Installation

2.1 Preparation

2.1.1 Delayed Usage

If for any reason the actuator is not to be installed immediately, Bettis recommends the following procedures. Failure to comply, with recommended procedures, could lead to actuator malfunction and possibly void the warranty. For storage procedures exceeding one year, consult Bettis for further recommendations.

As shipped from the factory, the Bettis EHO actuator is an inherently weatherproof unit, providing that all compartment covers and cable entry plugs remain intact. The actuator should be immediately stored in a clean, dry warehouse, free from vibration and rapid temperature changes, until it can be installed and energized.

If the actuator must be stored outside, store it off of the ground at an elevation sufficient to prevent it from being immersed in water or buried in snow. Check for any unpainted or exposed metal surfaces and make sure they are protected with a coating of grease to prevent any corrosion. Cover the actuator to prevent damage from site debris.

2.1.2 Tools and Materials Required

To complete these procedures, you will need the following documentation for the Bettis EHO Actuator and items indicated in the table below:

- General Arrangement Drawing
- Bill of Material
- Hydraulic System Schematic
- System Wiring Diagram

Table 2. Tools and Material Requirements

Tools and Material Requirements
Primary Power Source for the EHO (check the EHO General Arrangement Drawing for requirements)
Supplemental quantity of hydraulic fluid, if needed (See 2.7, Hydraulic Fluid and EHO specification, for required fluid type)
Nitrogen Source (if an Accumulator is supplied with the EHO)
Hand Tools: complete complement of open end (SAE and metric) wrenches, screw drivers (Phillips and Flat blade) and a set of hex wrenches
Chains and lifting straps that are inspected and certified for the weight of the EHO Actuator (check shipping weights)
Sealant for all cable and conduit entries (approvable by the National Electric Code or your country standard and applicable local codes)

2.2 Valve Preparation

2.2.1 Remove Valve Gearing if so equipped.

2.2.2 If valve is equipped with stops, remove valve stem extension housing. Examine the valve stops to ensure no foreign material is present that would restrict normal travel of the valve. Some valves are equipped with inspection ports in the valve housing for ease in examining the stops.

2.2.3 Check alignment of stem key slot to the position of the valve. Normally with the valve in the open position, the key slot is in line with the run of the pipeline. With the valve in the closed position, the key slot should be 90° to the run of the valve.

2.2.4 The EHO Actuator may be mounted to the valve at any time regardless of whether or not the valve is under pressure.

2.3 Actuator Preparation

2.3.1 Once the EHO Actuator is uncrated and cleaned for installation, check to ensure there will be no interference with piping or other structure when the actuator is properly mounted to the valve.

NOTE:

At this point, check to see that when the actuator is mounted to the valve and in its final orientation, the outboard end of the power cylinder positioned below the Hydraulic Reservoir Breather. If this is not possible, contact Bettis for further instructions on piping to elevate the breather. See Vertical Mounted Actuator, step 2.4.4.

2.3.2 Check that all mounting materials such as fasteners, adaptors, brackets etc. are on hand and ready for use.

2.3.3 Check the actuator and valve to see that they are in the same relative position, that is either open or closed. If the actuator has to be moved, use the handpump provided. For handpump operation, remove the plug in the reservoir and install the breather (refer to Section 4.4, Handpump).

2.3.4 All spring-return EHO Actuators are supplied with a small accumulator for protection from thermal-expansion of the hydraulic fluid. This accumulator will be tagged and may need pre-charged prior to operation. Check the tag prior to operation.

NOTE:

Failure to pre-charge the accummulator may cause the actuator not to function properly.

⚠ CAUTION

Be aware, while preparing to and lifting the actuator, the Thermal Compensating Accumulator contains high-pressure nitrogen. Use care not to damage the accumulator or its attachments.

2.4 Lifting the EHO Actuator

NOTE:

All Bettis EHO G-Series or E-Series Considerations

When handling any EHO, G-Series or E-Series actuator, be aware of tubing, accessories, handpump, accumulators, pushbutton module, and control enclosures. Straps and chains can become entangled and cause damage to these components. Never use chains on the spring cartridge as it may warp and cause the actuator not to function correctly or may cause personal injury. Do not use hydraulic tubing and electrical cable for lifting.

⚠ CAUTION

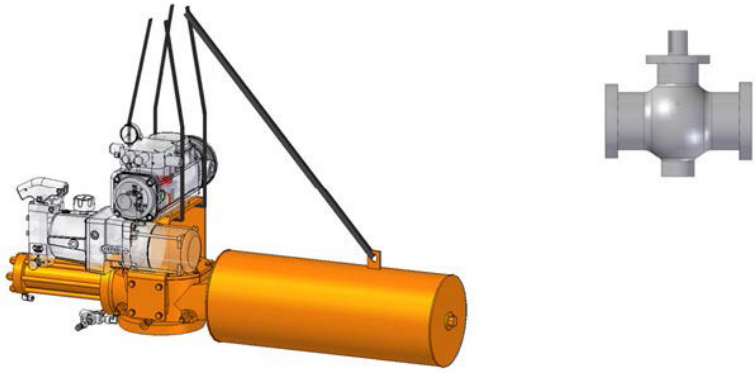
Be sure to use appropriately rated crane/hoist and straps/chains to raise and lower the actuator.

2.4.1 G01X – G2 and All E-Series Actuators

2.4.1.1 Horizontal Pipeline Vertical Stem

The small G-Series and all E-Series actuators mounting on a horizontal pipeline with a vertical valve stem should be supported under the "C" bracket and a two-point attachment for balance. A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported at the "C" bracket, not the stabilization tab. See Figure 1.

Figure 1 G01 – G2 and all E-Series Actuators with Horizontal Pipeline and Vertical Stem



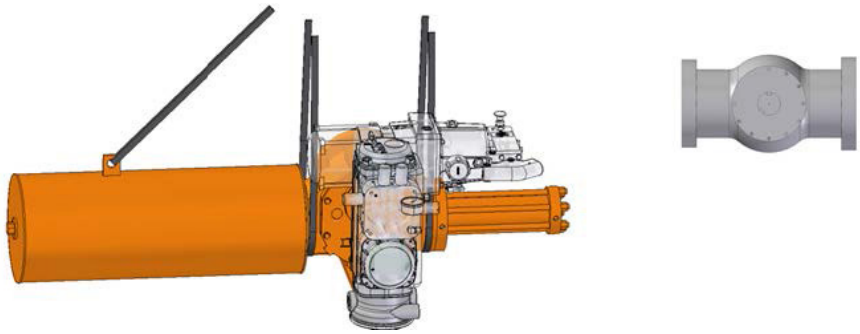
⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

2.4.1.2 Horizontal Pipeline Horizontal Stem

The small G-Series and all E-Series actuators mounting on a horizontal pipeline with a horizontal valve stem should be supported on the ends of the drive module. A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported at the drive module, not the stabilization tab. See Figure 2.

Figure 2 G01 – G3 and all E-Series Actuators with Horizontal Pipeline and Horizontal Stem

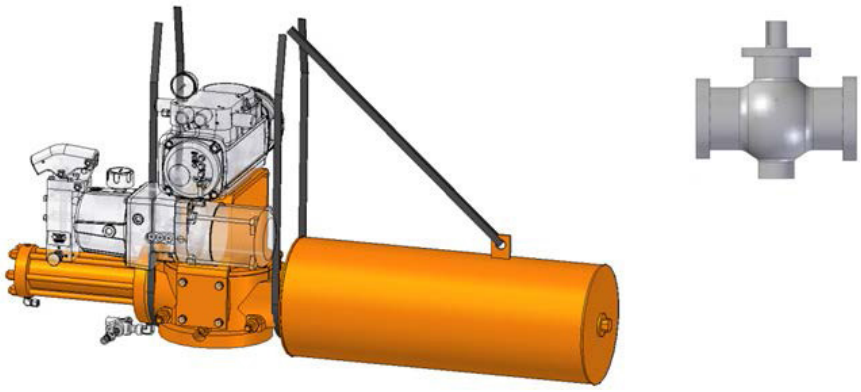


2.4.2 G3-Series Actuators

2.4.2.1 Horizontal Pipeline Vertical Stem

The G3-Series actuator mounting on a horizontal pipeline with a vertical valve stem should be supported at the ends of the drive module. A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported at the drive module, not the stabilization tab. See Figure 3.

Figure 3 G3 with a Horizontal Pipeline and Vertical Stem



⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

2.4.2.2 Horizontal Pipeline Vertical Stem

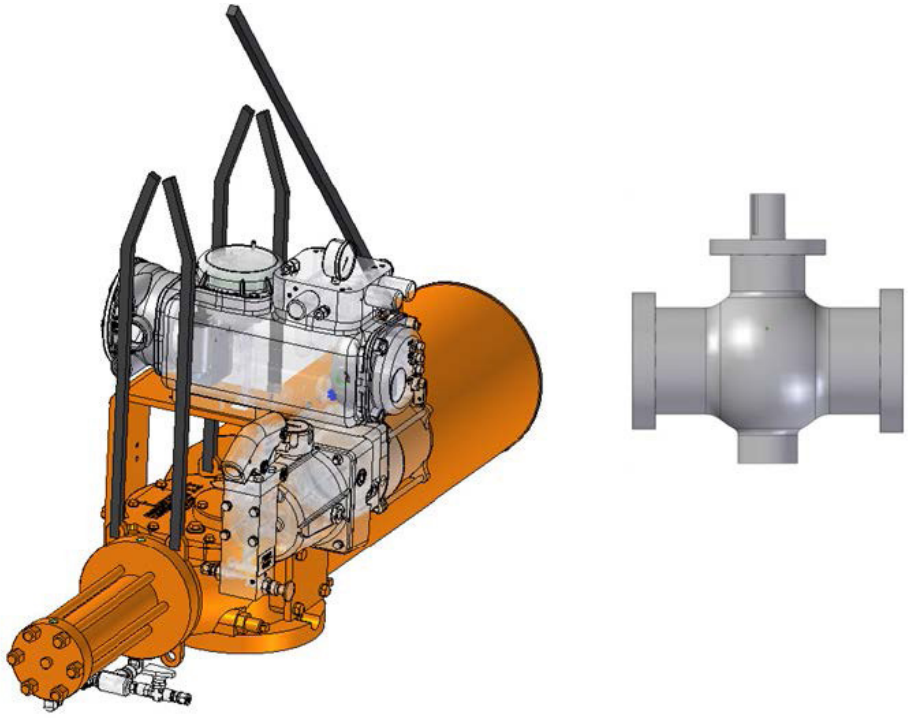
The G3-Series actuator mounting on a horizontal pipeline with a horizontal valve stem should be supported on the ends of the drive module. A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported at the drive module, not the stabilization tab. Be sure to use appropriately rated crane/hoist and straps/chains to raise and lower the actuator. See Figure 2 in the previous page.

2.4.3 G4 – G7 Series Actuators

2.4.3.1 Horizontal Pipeline Vertical Stem

The G4 – G7 Series actuators mounting on a horizontal pipeline with a vertical valve stem should be supported using the lift lugs attached to the drive module. A strap may be attached to the stabilization tab on spring module to balance the unit while lifting. The weight of the actuator must be supported by the lugs at drive module, not the stabilization tab. See Figure 4.

Figure 4 G4 – G7 with a Horizontal Pipeline and Vertical Stem



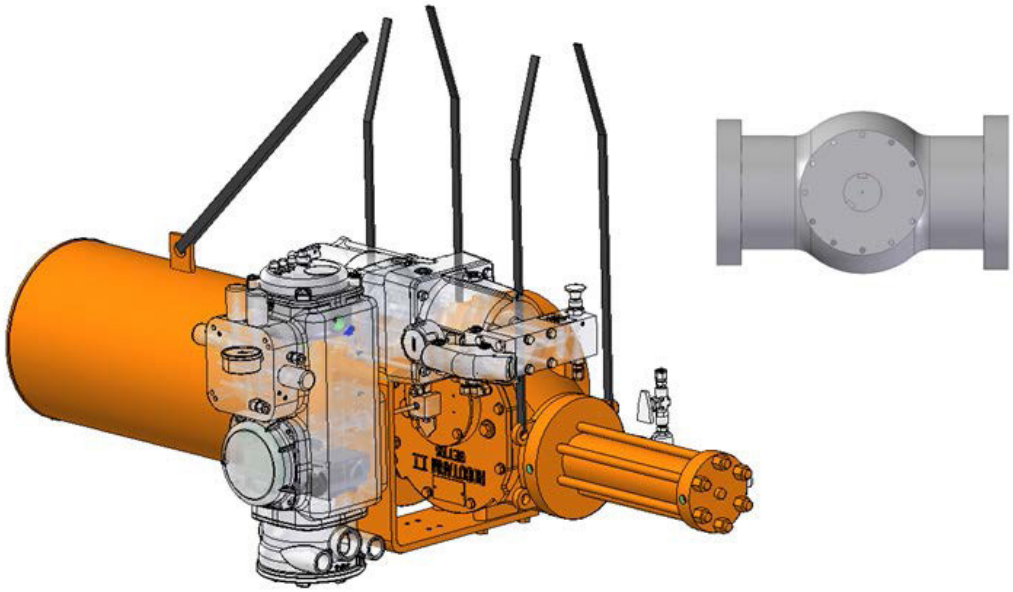
⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

2.4.3.2 Horizontal Pipeline Horizontal Stem

The G4 – G7 Series actuators mounting on a horizontal pipeline with a vertical valve stem should be supported using the lift lugs attached to the drive module. A strap may be attached to the stabilization tab on spring module to balance the unit while lifting. The weight of the actuator must be supported by the lugs at drive module, not the stabilization tab. See Figure 5.

Figure 5 G4 – G7 with a Horizontal Pipeline and Horizontal Stem



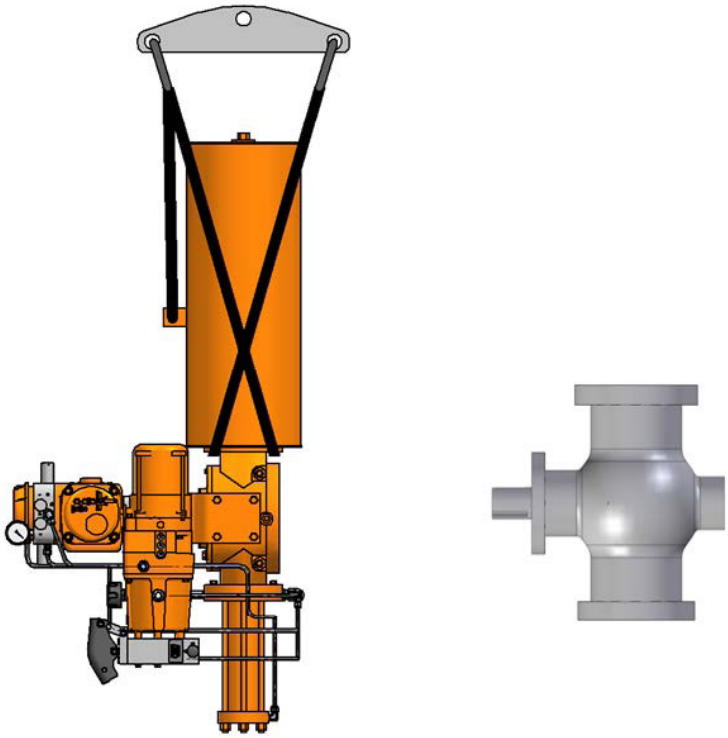
⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

2.4.4 Mounting the Actuator in a Vertical Orientation on a Horizontal Stem

When mounting a Bettis EHO Actuator in a vertical orientation, the spring module must be positioned up. The actuator may be supported by using two straps in the configuration shown in Figure 6. A third strap or small chain may be attached to the stabilization tab on spring module to balance the unit while lifting. The weight of the actuator must be supported by the straps running over the spring module and under the drive module flange.

Figure 6 Vertical Actuator Lift



⚠ CAUTION

Never lift the actuator with a valve attached. Always handle actuator/valve assemblies by attaching lifting equipment to the valve only.

NOTE:

When a vertical EHO Actuator is mounted to the valve and in its final orientation, the spring module must be up and outboard end of the power cylinder positioned below the Hydraulic Reservoir Breather. If not possible, contact Bettis for further instructions on piping to elevate the breather.

2.5 Installing the EHO Actuator on the Valve

The actuator will be bolt-mounted directly to a bracket or adaptor that will be bolted securely to the mounting flange top works of the valve.

2.5.1 Check to see that the dimensions of the bracket or adaptor are suitable for use with the valve mounting flange and stem.

2.5.2 Check valve direction of rotation and the actuator direction of rotation to see if they match (for example: CW = close, CCW = open).

2.5.3 Check to see the actuator and valve are in the same relative position (see step 2.3.3).

2.5.4 Check all mounting surfaces, they must be clean and free of debris to permit proper fit up.

2.5.5 Prior to mounting, grease the coupling bore and the bore of the actuator.

NOTE:

Do not apply grease to the mounting flange surfaces on the valve or the adaptor.

2.5.6 Install the stem key and grease it (keys may be held in place with tape).

2.5.7 Install the coupling onto the stem and stem key.

2.5.8 Install the coupling key and grease it.

2.5.9 Carefully align the coupling and key, to the bore and keyway in the actuator, and slide the actuator onto the coupling until the adaptor (bracket) bottoms out on the valve bonnet.

NOTE:

Ensure the adaptor seats out on the valve bonnet, without interference, before installing fasteners.

2.5.10 Use the required fasteners to firmly attach the adaptor to the valve bonnet. Tighten the fasteners to their manufacturer's recommended maximum torque (dry or lubricated).

2.6 Setting the Stroke Limit Stops

2.6.1 The Bettis G or E-Series Actuator is provided with bi-directional travel stops allowing 80° to 100° total travel (+/- 5° adjustment at each end of the 90° stroke).

2.6.2 Actuators are shipped from the factory with the travel stops adjusted for approximately 90° 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.

2.6.3 When the valve has internal stops, the actuator stops must be set so that the load is applied to them, not the valve stops.

2.6.4 If adjustment is required, use the handpump to move the actuator off the stop at the Fail-safe Position before attempting to turn the adjusting screw (refer to Section 4.4, Handpump).

⚠ CAUTION

Do not adjust actuator's stop at the Fail-Safe Position, with the spring force against the stop. Always use the handpump to move the actuator off the stop before attempting to turn the adjusting screw.

2.6.5 With the Fail-Safe Position stop set, use the handpump to move the actuator to the other end of the stroke and check the stop position. If adjustment is required, slowly open Manual Bypass Valve (Lockable) (19) just enough to allow the actuator to spring-return off the stop before adjusting.

2.7 Hydraulic Fluid

Bettis Electro-Hydraulic Operated actuators are shipped with the reservoir filled to operation level. Before commissioning and periodically afterwards, check to see the fluid level is correct. The oil fill cap is provided with a dipstick marked with a green and a red mark. When the optional accumulator is drained of fluid and the actuator is at Fail-Safe Position, the oil should be at the green mark. The reservoir also has a sight gauge for the purpose of seeing fluid is present. Should fluid need to be added or replaced, use only factory approved hydraulic fluid.

This specification covers hydraulic fluids which are approved for use in Bettis Electro-Hydraulic Operated actuator in a temperature range from -40 °F to 140 °F (-40 °C to 60 °C).

2.7.1 Approved Fluids

- Standard Fluid [use with -20 °F to 140 °F (-29 °C to 60 °C) applications]
  - ConocoPhillips Megaflow™ AW HVI Hydraulic Oil 22
  - Shell Tellus S2 V 22
  - Mobil DTE 10 Excel™ 22
- Low Temperature Fluid [use with -40 °F to 140 °F (-40 °C to 60 °C) applications]
  - Mobil Univis™ HVI 13

Although other brands of fluid matching the same specifications may be used, to maintain the warranty and ensure trouble free operation, always check with the factory before substituting any other fluid.

2.8 Accumulator (Optional)

2.8.1 Introduction

The Bettis EHO Actuator may be equipped with an accumulator to enable manual operation of the actuator if there is a loss of electrical power. Accumulators always have the nitrogen pressure drained for shipping.

When using this procedure, refer to the Bettis EHO Actuator General Arrangement drawing and Hydraulic Schematic for the unit being worked on, (schematics shown in this document are for illustration purposes only).

⚠ WARNING

This unit contains high-pressure hydraulic fluid and nitrogen gas. Exercise caution when performing any type of maintenance. Wear proper safety attire and required personal protective equipment, including safety glasses.

Megaflow™ is a mark owned by ConocoPhillips Company.
Mobil DTE 10 Excel™ and Mobil Univis™ are marks owned by Exxon Mobil Corporation.

2.8.2 Accumulator Pre-charge

a. Locate Isolation Valve (25) (Nitrogen Blow Down and Fill) for the Customer Nitrogen Fill Connection, called out on the General Arrangement Drawing and Hydraulic Schematic (see illustration below).

b. Close the Isolation Valve (25) (Nitrogen Blow Down and Fill) and remove the pipe plug from the adaptor.

NOTE:

The adaptor is tapped with a 1/4-NPTF thread.

c. Ensure 3-way Isolation Valve (22) is turned fully counterclockwise.

d. Slowly open Isolation Valve (Accumulator drain) (24) and drain all the fluid back to the reservoir.

e. Connect a nitrogen supply to the Customer Nitrogen Fill Connection at Isolation Valve (25) (Nitrogen Blow Down and Fill).

f. Open the Isolation Valve (25) (Nitrogen Blow Down and Fill) and charge the accumulator, to the pre-charge pressure as specified by the job specific General Arrangement Drawing.

NOTE:

Recheck the pre-charge pressure after a time interval sufficient to insure the nitrogen pressure is equal to the ambient temperature (a minimum of 4 hours). Adjust the pre-charge pressure as required to conform to the value in the GA table.

g. After the nitrogen filling is complete, close the Isolation Valve (25) (Nitrogen Blow Down and Fill).

h. Disconnect the nitrogen supply and remove the female pipe adaptor from Isolation Valve (25) (Nitrogen Blow Down and Fill).

i. Install the straight thread plug and O-ring, shipped as an accessory, into Isolation Valve (25) (Nitrogen Blow Down and Fill).

NOTE:

The straight thread plug must be installed, after filling is complete, to prevent accidental leakage of nitrogen from Isolation Valve (25).

j. Close Isolation Valve (24).

Figure 7 Typical EHO Optional Accumulator System

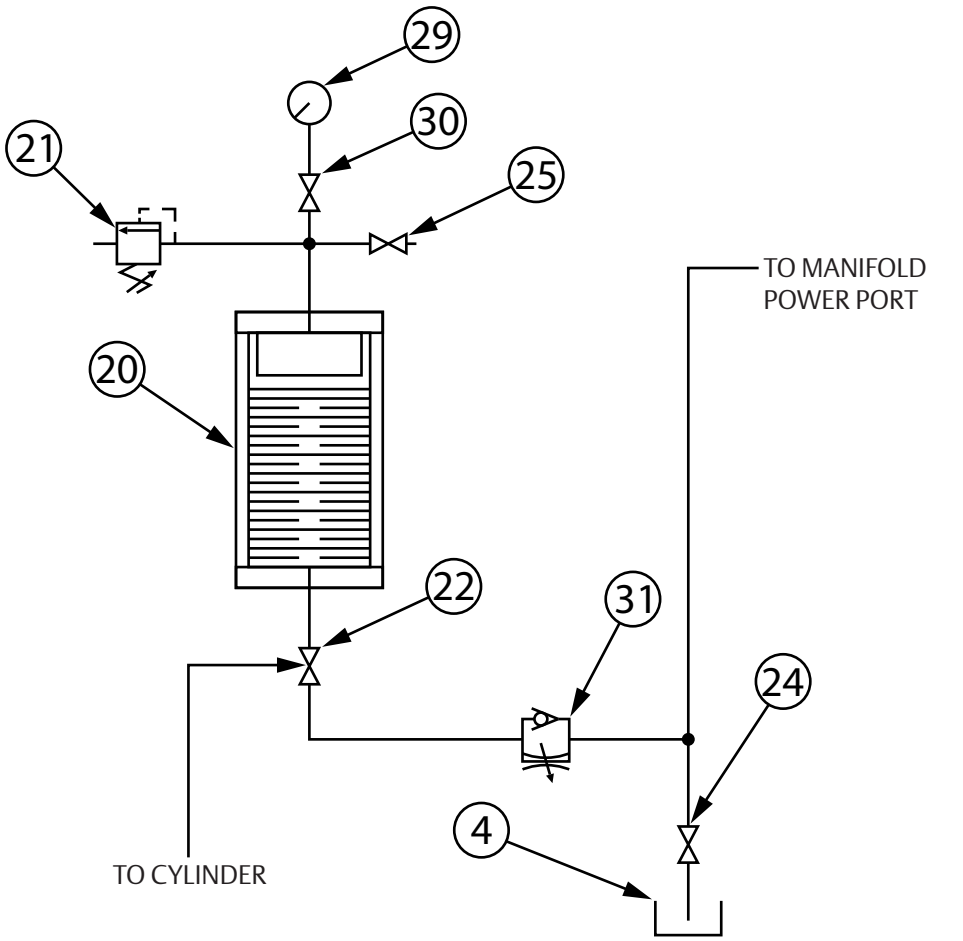


Table 3.

Part Number	Part Name
4.	Reservoir
20.	Accumulator
21.	Nitrogen Relief Valve
22.	3-way Isolation Valve
24.	Isolation Valve (Accumulator Drain)
25.	Isolation Valve (Nitrogen Blow Down and Fill)
29.	Nitrogen Pressure Gauge
30.	Nitrogen Gauge Isolation Valve
31.	Speed Control

2.8.3 Pre-charge Verification

Check the nitrogen pre-charge in the accumulator periodically to ensure the accumulator is at full potential. Follow the steps below and record final readings for reference.

a. Shut off the hydraulic power supply to the accumulator.

b. Ensure 3-way Isolation Valve (22) is turned fully counterclockwise.

c. Slowly open Isolation Valve (Accumulator drain) (24) and drain all the fluid back to the reservoir.

d. Read the pressure at the nitrogen pressure gauge and compare it to the value in the table shown on the General Assembly Drawing for the job being checked.

e. If the pre-charge is low, add nitrogen to increase the pressure to the requirements listed in the GA table. See step 2.8.2 if the pre-charge is high, relieve pressure to equal the value in the GA table.

f. Record information below.

g. With bypass valve closed, reconnect the hydraulic power supply and bring the accumulator back up to full pressure.

h. Check the entire nitrogen circuit for leaks using a liquid leak detector such as Snoop (manufactured by Swagelok). As the unit is self-contained, only a zero leak rate is acceptable. Corrective action must be taken for any leaks found.

2.8.4 Check Thermal Compensating Accumulator

The nitrogen pre-charge should be checked in the Thermal Compensating Accumulator annually. To accomplish this, use a commercially available charging kit and follow the instructions supplied with the kit.

⚠ WARNING

This unit contains high-pressure hydraulic fluid and nitrogen gas. Exercise caution when performing any type of maintenance. Wear proper safety attire and required personal protective equipment, including safety glasses. Ensure the accumulator has been drained of all hydraulic and nitrogen pressure before attempting any repair.

2.8.5 Nitrogen Pre-charge Maintenance Record

Serial Number: _____

Tag Number: _____

Date	Initial Pre-charge	GA Requirement	Final Pre-charge	Nitrogen Leak Test	Signed

Section 3: Electrical Connections

3.1 Remove Separate Terminal Chamber (STC) Cover

⚠ WARNING

Always verify electrical power is disconnected before removing the STC cover.

3.1.1 Remove cover with a strap wrench, drift, or pinch bar by rotating the cover counterclockwise.

Figure 8 Remove STC Cover Turning Counterclockwise

Figure 9 Lay Cover Aside

3.2 Sealing Cable/Conduit Entries

Seal the cable and conduit entries in accordance with the National Electric Code or your country standard and applicable local codes. All conduit entries should be sealed against the site environment. All unused conduit entries must be sealed with threaded metal plugs.

3.3 Recommended Terminal Connections

The Bettis Electro-Hydraulic actuator terminal block connectors are wire binding screw connectors with rising captive plates. Connections can be made one of three ways:

- Strip and connect bare wire
- Strip and install wire ferrule
- Strip and install crimp-on insulated or non-insulated ring or fork-tongue connectors for either M3 control signal terminal block screws or M4 power terminal screws.

3.3.1 Loosen terminal block connectors L1, L2, L3 and GND screws with a common or Phillips head screwdriver.

3.3.2 If bare wire is being used, strip insulation per Figure 10 below.

3.3.3 Insert wire or wire lug under terminal block connector screw clamps and tighten.

Figure 10 Power Terminal Connection Length of Bare Wire Strip

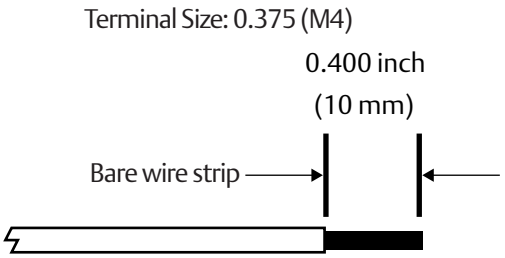
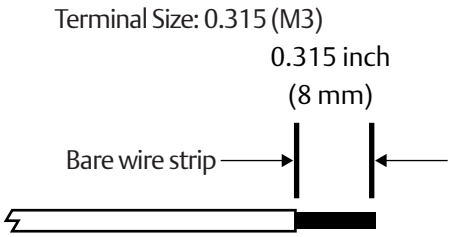


Figure 11 Control Terminal Connection Length of Bare Wire Strip



3.4 Separate Terminal Chamber (STC) Connections

3.4.1 Connect the main power supply cables, including an Earth/Ground (refer to the job specific General Arrangement Drawing).

3.4.2 Use the barrier strip clamp screws to connect the control wiring (refer to the job specific General Arrangement Drawing).

3.4.3 Ensure all connections are hand tight, including any unused terminals.

NOTE:

The main power supply and ground wire connections are screw size M4.
The control connection screw size is M3.

3.5 Replace Terminal Chamber Cover

3.5.1 Clean electrical enclosure threads thoroughly and lightly grease with dielectric grease before closing.

3.5.2 Replace the cover by reversing the order of the steps to remove the cover.

3.6 External Earth/Ground Connections

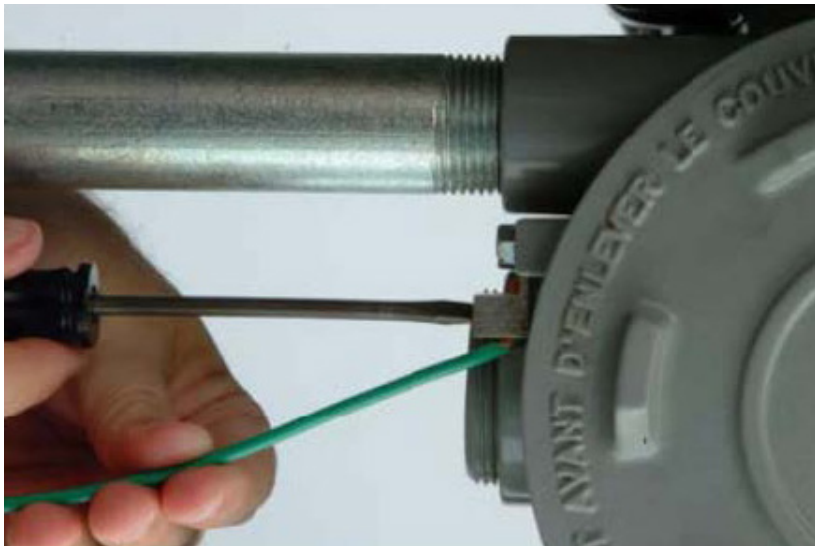
External connection points are provided on the operator for attaching earth/ground in accordance with local electric codes for installation cables.

Connect the external earth/ground connection as follows.

3.6.1 Using a slotted tip screwdriver, back out the 5/16-inch set screw.

3.6.2 Connect 14 AWG or larger earth/ground wire, tighten setscrew.

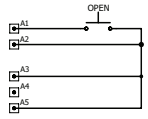
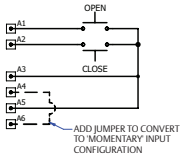
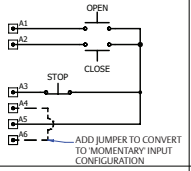
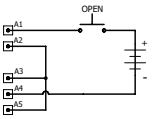
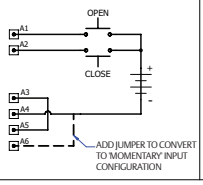
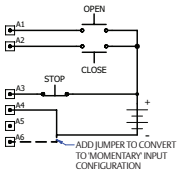
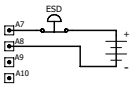
Figure 12 External Earth/Ground Connection



3.7 Discrete Controlled Inputs Connection

The actuator can be controlled by discrete inputs: two-wire control, three-wire control, four-wire valve control. Connections for these discrete inputs may be found on the job specific wiring diagram. Generic connection diagrams for each type of control may be found below in Figure 13. See Section 3.3, Electrical Connections, for general electrical connection requirements.

Figure 13 Generic Control Input Wiring

	Two-Wire Control Maintain Contact to Open	Three-Wire Control Maintain Contacts	Four-Wire Control Maintain Contacts	ESD Control
Internal Power Supply				
External Power Supply 18 - 100 V DC or 20 - 240 V AC				

Section 4: Set-up/Start-up Procedure

In addition to this set-up/start-up procedure, the following actuator specific documentation will be necessary to fulfill all set-up and start-up requirements.

1. General Arrangement drawing
2. Bill of Material
3. Schematic drawing
4. Wiring Diagram drawing

When using these instructions, refer to the schematic diagram, wiring diagram, general arrangement drawings for the Bettis EHO and the certified bills of material provided with your actuator. The diagrams and drawings in this manual are generic and may not match the documentation related to your actuator.

Numbers in **[ ]** correspond to components labeled on the wiring diagram. Numbers in **( )** correspond to components labeled on the schematic diagram. Information in **(( ))** is descriptive.

When the Bettis EHO is delivered to the job site, it has been both pressure and function tested. The oil reservoir was filled to operation level when it shipped from factory.

4.1 Preparation

4.1.1 Safety First

Hydraulic Pressure

⚠ WARNING

Ensure that test personnel and witnesses are properly informed of the hazards involved with high pressures and the proper safety barriers are employed.

Never check for leakage using your fingers or hands. Fluid under high pressure can inject into the skin and cause severe damage or death. Always use an implement such as a piece of paper.

Safety Equipment

⚠ WARNING

All personnel in the testing area must always wear safety glasses.

4.1.2 Material and Equipment for Start-up and Set-up

To complete this procedure, you will also need the following materials and equipment:

Table 4. Required Material and Equipment

Required Material and Equipment
Miscellaneous fittings, adaptors and Hand Tools: complete complement of open end ((SAE and metric)) wrenches, screw drivers Philips and flat blade and a set of hex wrenches
Primary Power Source for the EHO ((check the EHO System Electrical Diagram for requirements))
Supplemental quantity of hydraulic fluid, if needed ((See 2.6, Hydraulic Fluid, and EHO specification for required fluid type))
Nitrogen Source

4.2 Initial Check of the Unit

4.2.1 Check to ensure all hydraulic tube fittings are tight. Vibration during shipment may have loosened connections.

4.2.2 Visually inspect the unit to make sure tubing, hand valves, gauges and other equipment have not been damaged.

4.2.3 Using the schematic drawing, verify that the Flow Control Valves (7) are fully opened ((turn stem completely counterclockwise)).

4.2.4 Ensure Manual Bypass Valve (Lockable) (19) is closed.

4.2.5 Ensure Isolation Valve (Accumulator drain) (24) is closed ((if applicable)).

4.2.6 Ensure Isolation Valve (Nitrogen Blow Down and Fill) (25) is closed ((if applicable)).

4.2.7 Check the nitrogen pre-charge on the thermal compensating accumulator prior to operation. Do not operate without a charge or the bladder may be damaged.

4.3 Initial Connections

Electrical connections should have been made to the STC (Separate Terminal Chamber). If power is not connected, follow the instructions under Section 3, Electrical Connections, before continuing. If an ((optional)) Circuit Breaker Module is provided, ensure it is turned to OFF.

⚠ CAUTION

Before the actuator is stroked, check to see it has been filled with fluid to the proper level. ((See 2.7, Hydraulic Fluid.))

4.4 Handpump

4.4.1 Check the Reservoir (4) to see the hydraulic fluid is at the proper level.

4.4.2 Close Handpump Isolation Valve (8).

NOTE:

Handpump Isolation Valve (8)
Remove the Protective Cap. Loosen the stem retaining nut by turning counterclockwise. Using a 5/32 inch ((4 mm)) hex wrench, turn the stem counterclockwise for open or clockwise for close.

4.4.3 Use the handle supplied with the pump to raise the pump clevis. This will draw hydraulic fluid from the reservoir (4) into the handpump.

4.4.4 Pull the pump handle down to discharge the hydraulic fluid into the cylinder of the Actuator (1). Repeat until you see the handpump is working correctly.

4.4.5 Repeat operating the handle until the actuator has completed its power stroke.

4.4.6 Push Handpump Bypass Valve (16) located on the bottom of the handpump and pull the pump handle down, retracting the pump ram back into the pump body.

4.4.7 Slowly open Manual Bypass Valve (Lockable) (19) to allow the actuator to spring-return to its Fail-Safe Position.

4.4.8 After the actuator has returned to its Fail-Safe Position and pressure has been released, close Manual Bypass Valve (Lockable) (19).

4.4.9 Open the Handpump Isolation Valves (8) to return to automatic operation.

4.4.10 Check Reservoir (4) to see the hydraulic fluid is at the proper level.

NOTE:

Manual Bypass Valve (Lockable) (19) must be closed to enable any mode of operation. Handpump Isolation Valve (8) must be open for normal operation.

4.5 Hydraulic Test

The system has been hydrostatic and function tested at the factory before shipping. This test is to discover if any leaks have developed in the hydraulic fittings during shipment.

4.5.1 Open Handpump Isolation Valve (8) and ensure Manual Bypass Valve (Lockable) (19) is closed.

4.5.2 Using the supplied handle, stroke Handpump (13) four or five times and stop. Allow the unit to remain under pressure for a few minutes and check all fittings for leakage.

4.5.3 If any leakage is found, release the pressure by slowly opening Manual Bypass Valve (Lockable) (19). Repair any leakage and repeat the pressure test from step 4.4.1.

4.5.4 Push Handpump Bypass Valve (16), located on the bottom of the handpump, and pull the pump handle, retracting the pump ram back into the pump body.

4.5.5 Open the Handpump Isolation valves (8). ((See NOTE above.))

4.5.6 Check Reservoir (4) to see the hydraulic fluid is at the proper level.

4.6 Check Rotation

4.6.1 Turn on the electrical supply to the unit. If an ((optional)) Circuit Breaker Module is supplied, turn the Circuit Breaker to ON.

4.6.2 Turn the LOCAL-OFF-REMOTE selector switch to LOCAL.

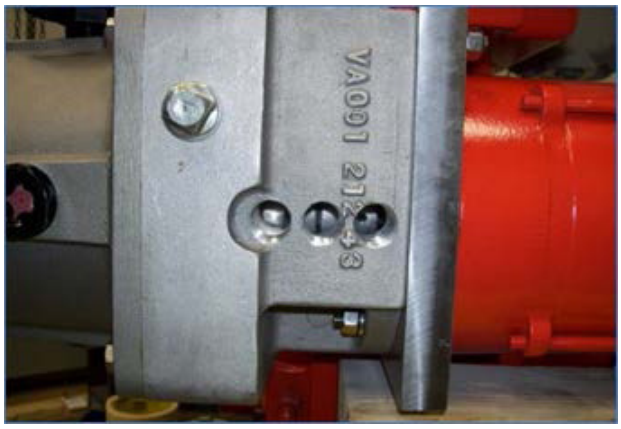
NOTE:

On spring-return units, fail-safe close units OPEN with the power cylinder and spring-return CLOSE. Fail-safe open units CLOSE with the power cylinder and spring-return OPEN.

4.6.3 Ensure Flow Control Valves (7) are adjusted fully counterclockwise for maximum flow.

4.6.4 Open inspection port on side of unit to observe the rotation of the motor/pump shaft.

Figure 14 Inspection Port for Motor Rotation



4.6.5 While observing the inspection port, for motor rotation, push and release the OPEN/CLOSE PUSHBUTTON to power stroke the actuator and immediately push the STOP pushbutton. Verify the motor rotation is consistent with the decal on the on motor tag, looking from the back of the motor.

4.6.6 If needed, correct motor rotation.

NOTE:

If the EHO Actuator is supplied with optional ESD, before operating a motor-powered stroke, a customer supplied ESD signal must be present and Solenoid Valve (17) energized.

4.6.7 Push and release the OPEN/CLOSE PUSHBUTTON to power stroke the actuator. The Electric Motor (2) will start to run driving Hydraulic Pump (3). The Hydraulic Pump (3) draws fluid from Reservoir (4) and pushes it into the Bettis G or E-Series hydraulic cylinder (1). As the actuator strokes, the spring will compress in the spring-return module.

4.6.8 At the end of the power stroke, push the STOP PUSHBUTTON. Slowly open Manual Bypass Valve (Lockable) (19) and allow the actuator to spring-return back to the start position.

4.6.9 Shut off the electrical power going to the unit, if an (optional) Circuit Breaker Module is supplied, turn the Circuit Breaker to OFF.

4.7 Limit Switch Adjustment

4.7.1 To complete limit switch adjustment, the actuator will need to be stroked from a fully closed position to a fully open position several times. In the following instructions, the electric motor is used to power stroke the actuator. If it is not safe or possible to use the electric motor at this time, use the handpump to power stroke the actuator.

4.7.2 The limit switch adjustments are found in a covered compartment in line with the valve stem and on the opposite side of the control box. Remove the limit switch compartment cover by loosening the four corner bolts retaining it. All covers have tapped holes for jackscrews to aid in removing the cover. Use the retaining screws in these holes to lift the cover evenly at each corner. Use caution to not allow the cover to bind during removal.

Figure 15 Remove Cover for Limit Switch Chamber

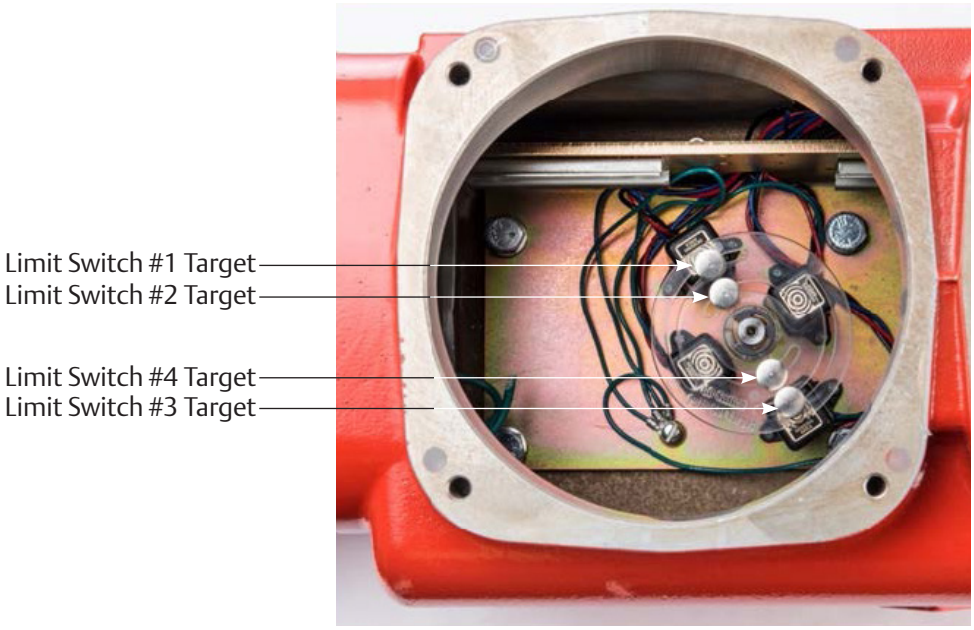
⚠ WARNING

If the actuator is being installed in a hazardous area, use extreme care. This procedure requires the limit switch cover to be open while electrical power is connected to the unit. Follow these steps only when the atmosphere is free of explosive gases.

4.7.3 Fail-Safe Close Limit Switch Adjustment

4.7.3.1 The Open and Close Limit Switches, shown in Figure 16, are operated by targets mounted in a plastic disk that rotates with the actuator stroke. To adjust a Target, push down on it and slide it in a clockwise or counterclockwise direction.

Figure 16 View of Limit Switch Targets



NOTE:
The Switch Targets will be labeled to identify the switch they operate.

4.7.3.2 With the actuator in the Fail-Safe Close Position, rotated fully clockwise, the Target for CLOSE LS-2 will need to be adjusted.

4.7.3.3 Reconnect electrical power to the unit.

4.7.3.4 Push down on the Target for CLOSE LS-2 and move clockwise until it is off of the switch in the clockwise direction. Both the OPEN and the CLOSE lights on the PBM ((Pushbutton Module)) should be illuminated at this point.

4.7.3.5 Now, push down and slide the Target for CLOSE LS-2 counterclockwise until the OPEN light just goes out. It is important to always adjust a Target in the opposing direction of the valve travel to get an accurate setting.

4.7.3.6 With the LOCAL – OFF – REMOTE Switch set to LOCAL, push the OPEN PUSHBUTTON and allow the Actuator to travel to the Open position, rotated fully counterclockwise.

4.7.3.7 Push down and slide Target for OPEN LS-1 counterclockwise until it is off the switch in the counterclockwise direction.

4.7.3.8 Now, push down and slide the Target for OPEN LS-1 clockwise until the CLOSE light just goes out.

4.7.3.9 Push the CLOSE PUSHBUTTON and allow the actuator to rotate clockwise to the fully closed position and check to see CLOSE LS-2 is operated; the OPEN light should go out. Cycle the actuator open and closed a few times checking the setting of CLOSE LS-1 and OPEN LS-2.

4.7.4 Fail-Safe Open Limit Switch Adjustment

4.7.4.1 With the actuator in the Fail-Safe Open Position, rotated fully counterclockwise, the Target for OPEN LS-1 will need to be adjusted.

4.7.4.2 Reconnect electrical power to the unit.

4.7.4.3 Push down on the Target for OPEN LS-1 and move counterclockwise until it is off of the switch in the counterclockwise direction. Both the OPEN and the CLOSE lights on the PBM (Pushbutton Module) should be illuminated at this point.

4.7.4.4 Now, push down and slide the Target for OPEN LS-1 clockwise until the CLOSE light just goes out. It is important to always adjust a Target in the opposing direction of the valve travel to get an accurate setting.

4.7.4.5 With the LOCAL – OFF – REMOTE Switch set to LOCAL, push the CLOSE PUSHBUTTON and allow the Actuator to travel to the Close position, rotated fully clockwise.

4.7.4.6 Push down and slide Target for CLOSE LS-2 counterclockwise until it is off the switch in the clockwise direction.

4.7.4.7 Now, push down and slide the Target for CLOSE LS-1 clockwise until the OPEN light just goes out.

4.7.4.8 Push the OPEN PUSHBUTTON and allow the actuator to rotate counterclockwise to the fully open position and check to see OPEN LS-2 is operated; the CLOSE light should go out. Cycle the actuator open and closed a few times, checking the setting of CLOSE LS-1 and OPEN LS-2.

4.7.5 Four Limit Switch Models

4.7.5.1 If your unit utilizes four switches LS-3 OPEN and LS-4 CLOSE, adjust in the same manner except you will need to use a continuity tester on the terminal strip to detect switch operation. LS-3 is connected to terminals A31, A32 and A33. LS-4 is connected to A35, A36 and A37. Look at these switches on the wiring diagram for exact configuration.

4.8 Function Test

NOTE:
If the EHO Actuator is supplied with optional ESD before operating a motor powered stroke, a customer supplied ESD signal must be present and Solenoid Valve (17) energized.

4.8.1 Ensure the Handpump Isolation Valve (8) is open and check to see Manual Bypass Valve (Lockable) (19) is closed.

4.8.2 Push and release the OPEN/CLOSE PUSHBUTTON to Power Stroke the actuator. The Electric Motor (2) will start to run driving Hydraulic Pump (3). The Hydraulic Pump (3) draws fluid from Reservoir (4) and pushes it into the Bettis G or E-Series hydraulic cylinder (1). As the actuator strokes, the spring will compress in the spring-return module.

4.8.3 At the end of the power stroke, pressure will increase filling the ((optional)) Accumulator. Pressure will increase, with or without the ((optional)) accumulator, till it reaches the setting on pressure switch (23); pressure switch (23) will operate and stop the motor.

4.8.4 Push and release the OPEN/CLOSE PUSHBUTTON. 2-way N.C. Solenoid Valve energizes, venting the fluid in the power cylinder to the reservoir. At the Fail-Safe Position, the OPEN/Close limit switch will operate de-energizing solenoid (6).

4.8.5 Spring-return module will stroke the actuator to the Fail-Safe Position.

4.8.6 Check all hydraulic lines and fittings for leakage, repair as needed.

4.8.7 Press and release the OPEN/CLOSE PUSHBUTTON to power stroke the actuator. The motor (2) will start and pump fluid into Bettis G or E-Series hydraulic cylinder to stroke the actuator. The actuator travels to the fully power stroked position and the pressure switch or limit switch operates stopping the motor.

4.8.8 Push and release the opposing OPEN/CLOSE PUSHBUTTON to spring-return the actuator to the Fail-Safe Position.

4.8.9 Cycle the actuator open and closed a few times to ensure operation.

4.8.10 With the actuator at Fail-Safe Position, press and release the OPEN/CLOSE PUSHBUTTON to power stroke the actuator. The motor (2) will start to pump fluid into Bettis G or E-Series hydraulic cylinder to stroke the actuator.

4.8.11 While the motor is running, push the STOP PUSHBUTTON. The motor and actuator will stop.

4.8.12 Press and release the OPEN/CLOSE PUSHBUTTON to fully power stroke the actuator.

4.8.13 Return the actuator to its original position.

4.8.14 Turn the LOCAL-OFF-REMOTE selector switch to REMOTE.

4.8.15 Press the CLOSE PUSHBUTTON and then press the OPEN PUSHBUTTON. The actuator must remain at rest.

4.8.16 Turn the LOCAL-REMOTE selector switch to LOCAL. Try the CLOSE PUSHBUTTON and OPEN PUSHBUTTON to ensure control returned to the LOCAL Control Mode.

4.9 Other Options

Other options may have been supplied with this order. Refer to supplemental start-up procedures supplied with these options for start-up and test.

The functional test of the Electro-Hydraulic Actuator is now complete.
The Bettis EHO Actuator is now operational and ready for service.

Section 5: Operation

After initial start-up and commissioning procedures have been accomplished, the Bettis EHO Actuator provides a simple self-contained means of operation for a quarter-turn valve. In case of a power failure, the actuator can be operated by the use of the supplied handpump.

5.1 Hydraulic Power System

The Hydraulic System, powered by an electric motor, contains manifold based valves and controls with minimal piping. The system will drive the actuator to the OPEN/CLOSE position as selected by operation personnel.

5.2 Fluid Reservoir

The Bettis self-contained, Electro-Hydraulic Actuator includes a fluid reservoir sized to contain the hydraulic fluid required to operate the actuator cylinder and controls. The standard unit has a sight gage to ensure presence of fluid and a dipstick measure attached to the fill/breather cap to more accurately gauge the quantity of fluid contained.

5.3 Main Components and Options

NOTE:
Item numbers correspond to the Hydraulic Schematic Drawing in this manual. Special features or configurations may have schematic item numbers that do not correspond to the below. Verify the item numbers with the job specific schematic as you follow these instructions.

- **(1)** Bettis G or E-Series hydraulic spring-return actuator.
- **(2)** Electric motor.
- **(3)** Hydraulic pump.
- **(4)** Fluid Reservoir.
- **(5)** Open Item.
- **(6)** 2-way Normally Close Solenoid Valve: Energized by the controller when an operator pushes the local CLOSE button or when receiving a remote discrete CLOSE signal.
- **(7)** Flow control valves: There are two flow control valves. One is used to adjust the speed of normal closing stroke, when solenoid valve (6) is energized. The other is used to adjust the stroke speed of ESD shutdown when solenoid (17) de-energizes due to loss of electrical power.
- **(8)** Handpump isolation valve: The handpump isolation valve is used to isolate the solenoid valves when using handpump to OPEN/CLOSE the actuator.
- **(9)** Check valve.

- **(10)** Relief valve: A pressure relief valve is provided to protect the actuator and control system from over-pressurization caused by the pump or thermal expansion of the hydraulic fluid. This valve is factory set, do not adjust.
- **(11)** Hydraulic Pressure gauge: A pressure gauge to indicate the hydraulic system pressure.
- **(12)** Pressure Transmitter: Provides an analog signal for customer remote readout.
- **(13)** Handpump: The hydraulic handpump is used to open the actuator during power loss.
- **(17)** ESD 2-way N.O. solenoid valve: The ESD solenoid valve is constantly energized closed during the normal operation. Upon loss of electric power to solenoid (17), the valve will de-energize allowing the actuator to spring-return to Fail-Safe Position.
- **(19)** Manual bypass valve (lockable): A bypass valve that provides a means to manually stoke the actuator to its Fail-Safe Position.
- **(20)** Hydraulic accumulator (optional): An accumulator will provide hydraulic power to operate the actuator manually in case of power loss.
- **(21)** Nitrogen relief valve (optional): A relief valve to protect the accumulator and system from over pressurization due to thermal expansion. This valve is factory set, do not adjust.
- **(22)** 3-way isolation valve (optional).
- **(23)** Pressure switch: Used for a positive end-of-stroke signal during the power stroke.
- **(24)** Isolation valve (accumulator drain): An isolation valve that can be used to drain off the hydraulic fluid under pressure in the accumulator.
- **(25)** Isolation valve (Nitrogen blow down and fill)
- **(28)** 2-way N.C. solenoid valve for accumulator: Can be used to power stroke the actuator with a remote customer signal.
- **(29)** Nitrogen Pressure Gauge: A pressure gauge to indicate the nitrogen system pressure.
- **(31)** Accumulator Speed Control: Use to control the actuator speed while power stroking utilizing Solenoid (28).

5.4 Functional Description

The following is a functional description of the Bettis Electro-Hydraulic Actuator and a brief explanation of the main components. Throughout this explanation, numbers which appear in **[ ]** correspond to components labeled on the wiring diagram. Numbers in **( )** correspond to components labeled on the schematic diagram. Information in **(( ))** is descriptive.

NOTE:

Refer to the job specific Hydraulic Schematic for the actuator being worked on to determine what options were supplied.

5.4.1 Power Stroke ((OPEN/CLOSE))

During a normal power cycle, the motor (2) drives the hydraulic pump (3). Hydraulic fluid from the pump is forced into the actuator's (1) hydraulic power cylinder and moves the actuator to the OPEN/CLOSE position which compresses the spring in the spring-return module.

5.4.2 Spring-Return Stroke

In an on/off application, the normally close solenoid valve (6) is energized open by the controller. The hydraulic fluid flows back to reservoir (4) from actuator cylinder forced by the spring in the spring-return module. The spring forces the actuator to the Fail-Safe Position.

5.4.3 ESD Operation ((Optional))

In an ESD application, the ESD 2-way normally open solenoid valve (17) is constantly held energized, as long as a customer supplied electrical ESD signal is present. In case of electrical ESD signal loss, ESD solenoid valve (17) will de-energize. Hydraulic fluid will flow from the actuator's hydraulic cylinder, forced by the spring-return module, through speed control (7), through normally open ESD 2-way valve (17) and return to the reservoir (4).

5.4.4 Electric Fail-safe ((Optional))

The EHO Control can be configured to stroke the actuator to Fail-Safe Position upon loss of electrical power.

5.4.5 Accumulator Opening Manual Override ((Optional))

1. Close isolation valve (8) to isolate the Solenoid Valves if Valve (17) is in failed open mode.
2. Turn the handle of isolation valve (22) 180° to the right, the Accumulator will power stroke the actuator to OPEN/CLOSE position.
3. Close isolation valve (22) by turning 180° to the left. The actuator spring-return moves to full OPEN/CLOSE position. Open isolation valve (8).

5.4.6 Manual Handpump Power Stroke

1. Close handpump isolation valve (8).
2. Stroke handpump (13) until the OPEN/CLOSE stroke is complete.
3. Open isolation valve (8) when the handpumping is complete.

NOTE:
If equipped with ESD, Do Not open Isolation Valve (8) before the customer supplied ESD Signal is present.

4. To stroke the actuator to the Fail-Safe Position, if required, slowly open Manual Bypass Valve (Lockable) (19).

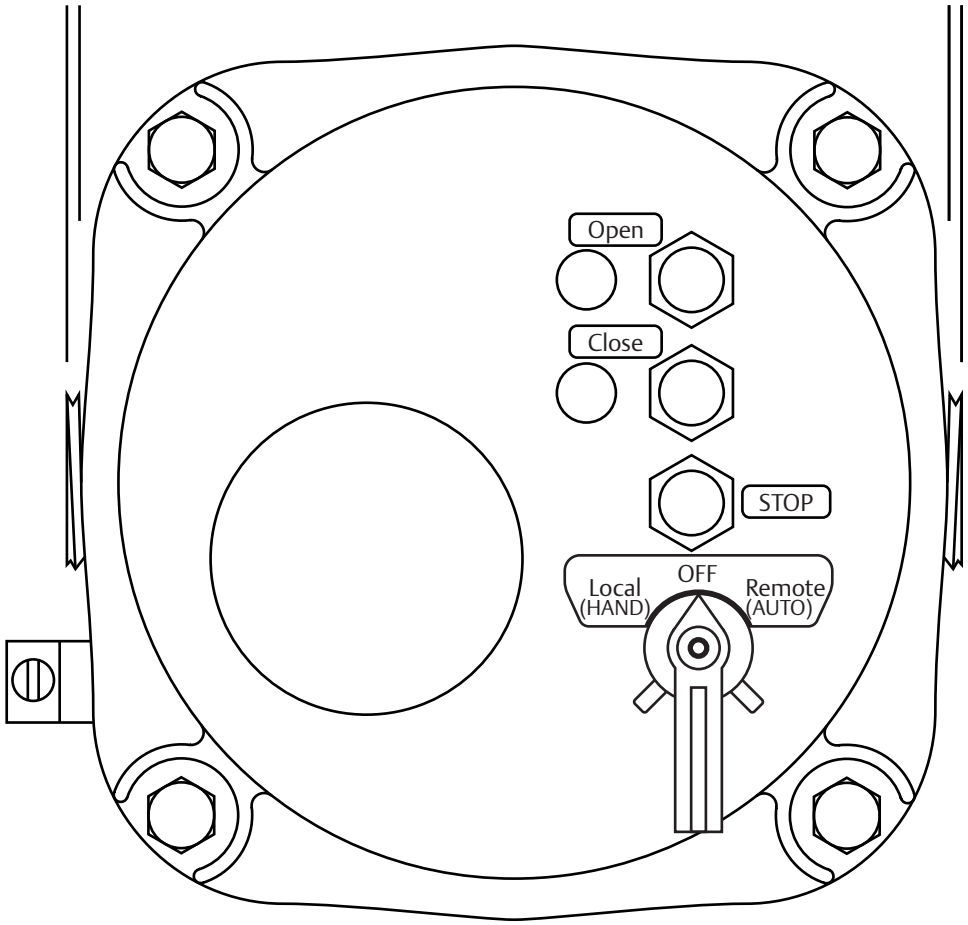
NOTE:
Manual Bypass Valve (Lockable) (19) must be closed to enable any mode of operation. Handpump Isolation Valve (8) must be open for normal operation.

Section 6: Pushbutton Module (PBM)

The Pushbutton Module consists of the following as shown in Figure 17:

- Two Pilot Lights: OPEN and CLOSE
- Three Pushbuttons: OPEN, CLOSE, and STOP
- Local – OFF – Remote Selector Knob

Figure 17 Pushbutton Module (PBM)



The Pushbutton Module is the interface used to setup and operate the actuator and display valve position.

To use the Local Control and Selector Knob, refer to tables in Section 6.1.

6.1 Selector Knob and Control Pushbuttons

The selector knob provides the choice of Local/Off/Remote operation. The control pushbuttons perform normal Open/Stop/Close function in the local control mode.

Table 5. Selector Knob

Selector Knob	Rotate	Local Control Mode Function
OFF (Stop)	Return position	Stop movement: Prevents motor operation
REMOTE (Auto)	Clockwise	Remote control: Allows control from remote location
LOCAL (Hand)	Counterclockwise	Local operation: Allows control from the local control knob

Table 6. Pushbuttons

Pushbutton	Local Control Mode Function
STOP	Stop movement: Prevents motor operation
CLOSE	Actuator moves to close position
OPEN	Actuator moves to open position

Table 7. Pilot Lights

Pilot Lights	Valve Position		
-	Valve Closed	Valve Mid-Stroke	Valve Open
CLOSE	Illuminated	Illuminated	Off
OPEN	Off	Illuminated	Illuminated

Section 7: Troubleshooting

⚠ WARNING

To prevent personal injury, the actuator must be in spring-return, Fail-Safe Position and all hydraulic pressure drained, including an optional accumulator, before opening any tube lines or attempting replacement operations below.

Of all the system components, the actuator itself is least likely to malfunction and require the most time and effort to service.

Table 8. Troubleshooting

Symptoms	Possible Reason
EHO does not turn on	1. Ensure voltage is adequate to the unit. 2. Check to see that the electrical power is connected to the correct terminals. 3. Branch circuit fuse blown out.
EHO is on, but motor does not run	1. Ensure the Local/Off/Auto switch is in the proper position. 2. Ensure the field power wiring is an adequate size. 3. Power supply is insufficient. 4. Check to see if thermal overload is tripped.
EHO motor runs, but fails to develop sufficient pressure to open the valve	1. Low fluid level in reservoir. 2. Wrong motor shaft rotation. 3. Manual bypass valve (19) is open. 4. Handpump isolation valve (8) is closed (if optional accumulator is provided). 5. ESD solenoid is not energized because signal power is insufficient. 6. The Relief valve is cracking open. Check to ensure setting set to factory setting.
EHO will not return to the Fail-Safe Position	1. Ensure the Local/Off/Auto switch is in the proper position when initiating the open/close command. 2. Handpump isolation valve (8) is closed; preventing ability to stroke to the Fail-Safe Position.

Should any issue be experienced besides the symptoms noted above, please consult factory.

Important check points for automatic operation of the EHO:

1. Ensure oil level is at the proper level.
2. Ensure bypass valve (19) is closed.
3. Ensure handpump isolation valve (8) is open.
4. Check to see that the ESD (optional) signal power is on.

Section 8: Hazardous Area Classification and SIL Certification

- CSA, Canadian Standard Association Certification Class I, Division I, Groups, C and D. Group B configuration upon request
- FM, Factory Mutual Certification Class I, II, and III, Groups C, D, E, F, G, Division I, T4. Group B configuration upon request
- ATEX Directive EExd IIB T4
- RoHS Directive
  This product is only intended for use in large-scale fixed installation 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)
- IECEx Certificate of Conformity Ex d IIB T4
- SIL II Certification

Section 9: Weights and Dimensions

9.1 EHO Standard Spring-Return

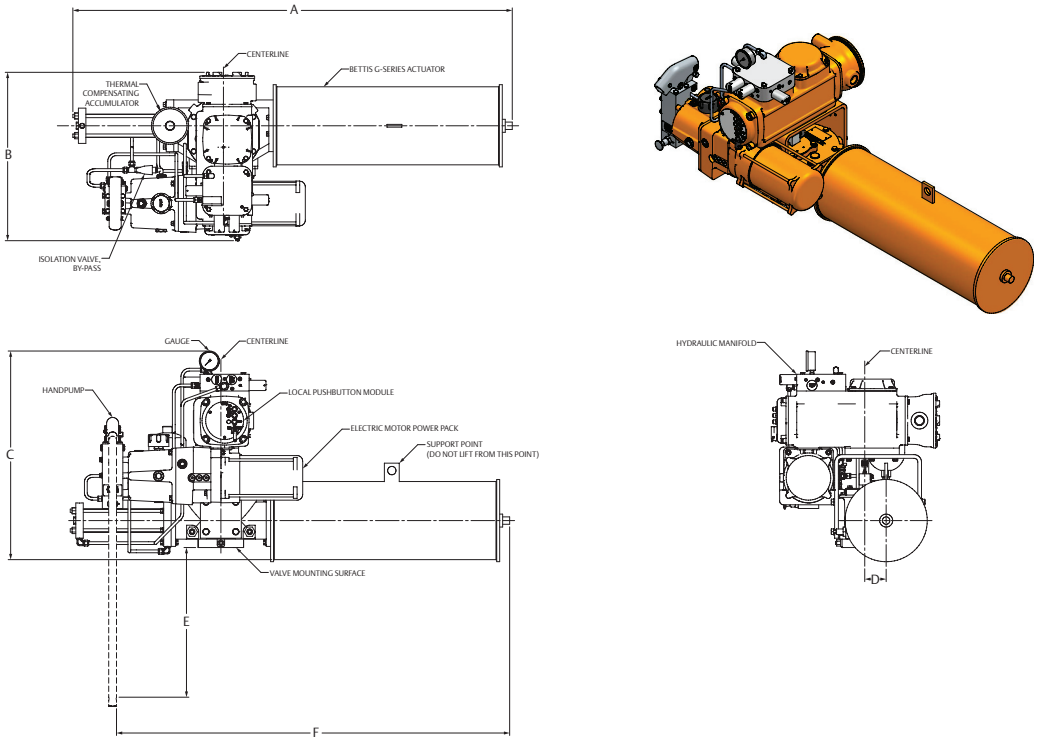


Table 9. Troubleshooting

OUTLINE DIMENSION AND DETAILS														
Actuator	A		B		C		D		E		F		Approximate Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	lb	kg
E35D-SRH100	32.00	81.30	22.6	57.40	28.10	71.40	1.40	3.50	22.8	57.91	25.0	63.50	515	234
E50D-SRH100	48.50	123.20	22.6	57.40	28.10	71.40	2.20	5.60	20.2	51.31	30.0	76.20	565	259
E60D-SRH100	54.00	137.20	22.6	57.40	30.10	76.50	2.40	6.10	18.4	46.74	30.9	78.49	625	284
G01002.0-SR2-CW	54.0	137.16	22.6	57.40	28.1	71.37	2.4	6.10	21.9	55.63	34.4	87.38	669	303
G01002.0-SR4-CW	54.0	137.16	22.6	57.40	28.1	71.37	2.4	6.10	21.9	55.63	34.4	87.38	655	297
G2002.2-SR2-CW	57.8	146.81	22.6	57.40	28.1	71.37	2.9	7.37	21.4	54.36	54.0	137.16	774	351
G2002.2-SR4-CW	57.8	146.81	22.6	57.40	28.1	71.37	2.9	7.37	21.4	54.36	54.0	137.16	759	344
G3002.5-SR4-CW	65.5	166.37	22.6	57.40	32.1	81.53	3.5	8.89	17.9	45.47	57.1	145.03	916	415
G3003.0-SR2-CW	65.5	166.37	22.6	57.40	32.1	81.53	3.5	8.89	17.9	45.47	57.1	145.03	945	429
G4003.0-SR4-CW	76.2	193.55	27.7	70.36	31.7	80.52	4.3	10.92	16.4	41.66	62.6	159.00	1229	557
G4003.5-SR2-CW	76.2	193.55	27.7	70.36	31.7	80.52	4.3	10.92	16.4	41.66	62.6	159.00	1313	596
G5004.5-SR4-CW	89.0	226.06	31.1	78.99	35.9	91.19	5.5	13.97	13.3	33.78	69.3	176.02	1970	894
G5005.0-SR2-CW	89.0	226.06	31.1	78.99	35.9	91.19	5.5	13.97	13.3	33.78	69.3	176.02	2099	952
G7005.0-SR3-CW	105.6	268.22	35.7	90.68	42.4	107.70	6.8	17.27	10.3	26.16	91.8	233.17	3238	1469
G7005.0-SR4-CW	105.6	268.22	35.7	90.68	42.4	107.70	6.8	17.27	10.3	26.16	91.8	233.17	3325	1508
G7006.0-SR4-CW	105.6	268.22	35.7	90.68	42.4	107.70	6.8	17.27	10.3	26.16	91.8	233.17	3312	1502
G8007.0-SR2-CW	139.7	354.84	36.9	93.73	43.1	109.47	8.0	20.32	9.2	23.37	111.2	282.45	5447	2471
G8007.0-SR3-CW	139.7	354.84	36.9	93.73	43.1	109.47	8.0	20.32	9.2	23.37	111.2	282.45	5427	2462
G10009.0-SR4-CW	168.6	428.24	39.4	100.08	45.3	115.06	10.5	154.94	7.2	18.29	127.0	322.58	7497	3401

Note:
Weights and dimensions shown are nominal values, for accurate weights and dimensions always refer to the General Arrangement Drawing for the unit being worked on.

Section 10: Maintenance

10.1 Storage Procedures

The actuator should be immediately stored in a clean, dry warehouse, free from vibration and rapid temperatures changes, until it can be installed and energized.

If the actuator must be stored outside, it should be stored off of the ground at an elevation sufficient to prevent it from being immersed in water or buried in snow, and covered to prevent damage from site debris.

If the actuator is not attached to a valve, the preferred orientation is with the motor and electrical compartment horizontal.

Care should be taken to plug all open ports on the actuator and all controls to keep out foreign contaminates.

10.2 Service Interval

Routine maintenance is generally unnecessary. Normally recommended service interval for Bettis actuators is five years or maximum actuator seal life cycle, whichever occurs first.

NOTE:
Storage time is considered as part of the Service Interval time.

It is recommended that Service Kits be ordered approximately three (3) months prior to scheduled maintenance to assure availability.

10.3 Lubrication Requirements

NOTE:

Lubricant, other than listed below should not be used without prior written approval of Bettis Product Engineering:

- All temperature services -40 °C to 60 °C (-40 °F to 140 °F) use Bettis™ ESL-5 lubricant. ESL-5 lubricant is contained in the Bettis Module Service Kit in tubes and the tube is marked ESL-4, 5 and 10 lubricant.
- Hydraulic fluids, other than those listed below should not be used without prior written approval of Bettis Product Engineering.
- Standard temperature service (-29 °C to 60 °C/-20 °F to 140 °F) use ConocoPhillips Megaflow™ AW HVI 22 Fluid.
- Low temperature service (-40 °C to 60 °C/-40 °F to 140 °F) use Mobil Univis™ HVI 13 Fluid.

10.4 Recommended Annual Inspection

It is recommended the following components and features of the Bettis Smart EHO to be evaluated at least once a year.

- Check hydraulic fluid levels
- Check the pressure gauge
- Check bolts and fittings for tightness
- Check for external oil leaks
- If an accumulator is provided, check the nitrogen blanket
- Check handpump operation functions properly
- If/When possible, perform a function test (See section 4.9 for instructions on how to perform a function test)
- Check the breather on the hydraulic reservoir

Qualified service personnel are available upon request for problems, which our customers do not wish to handle. If the requirement should arise please feel free to contact:

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