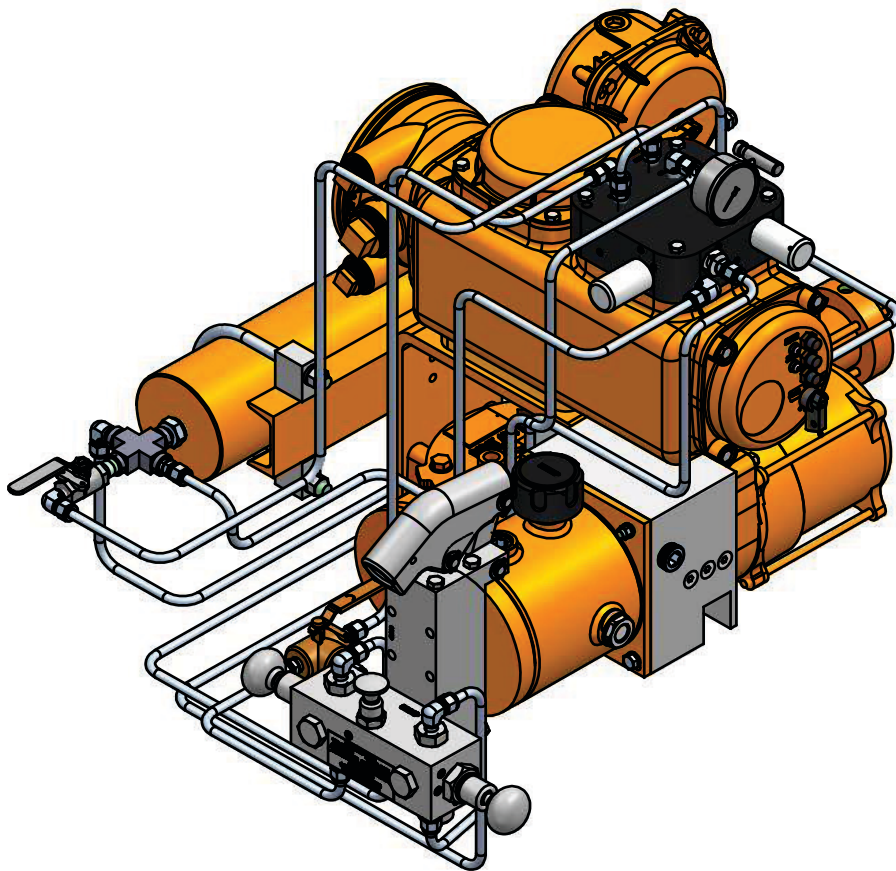


Bettis™ EHO (Electro-Hydraulic Operated)

Double-Acting Actuator



This page intentionally left blank

Table of Contents

Section 1: Introduction

1.1	Scope.....	1
1.2	General Information.....	1
1.3	Safety Information.....	2
1.4	Abbreviation Definitions.....	3

Section 2: Installation

2.1	Preparation.....	4
2.2	Valve Preparation.....	5
2.3	Actuator Preparation.....	5
2.4	Lifting the EHO Actuator.....	6
2.5	Installing the EHO Actuator on the Valve.....	11
2.6	Setting the Stroke Limit Stops.....	12
2.7	Hydraulic Fluid.....	12
2.8	Accumulator (Optional).....	13

Section 3: Electrical Connections

3.1	Remove Separate Terminal Chamber (STC) Cover.....	18
3.2	Sealing Cable/Conduit Entries.....	19
3.3	Recommended Terminal Connections.....	19
3.4	Separate Terminal Chamber (STC) Connections.....	20
3.5	Replace Terminal Chamber Cover.....	20
3.6	External Earth/Ground Connections.....	20
3.7	Discrete Controlled Inputs Connection.....	21

Section 4: Set-up/Start-up Procedure

4.1	Preparation.....	22
4.2	Initial Check of the Unit.....	23
4.3	Initial Connections.....	23
4.4	Handpump.....	24
4.5	Hydraulic Test.....	28
4.6	Check Rotation.....	28
4.7	Limit Switch Adjustment.....	29
4.8	Function Test.....	32
4.9	Other Options.....	34

Section 5: Operation

5.1	Hydraulic Power System.....	35
5.2	Reservoir.....	35
5.3	Main Components.....	35
5.4	Functional Description	39

Section 6: Pushbutton Module (PBM)

6.1	Selector Knob and Control Pushbuttons.....	42
-----	--	----

Section 7: Troubleshooting

	Troubleshooting	43
--	-----------------------	----

Section 8: Hazardous Area Classification and SIL Certification

	Hazardous Area Classification and SIL Certification.....	44
--	--	----

Section 9: Weights and Dimensions

9.1	EHO Standard Double-Acting.....	45
-----	---------------------------------	----

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 double-acting 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, also solar panels are available for areas without electrical power. 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.

1.2.2 Product Attribute

- Easy installation – Bettis™ EHO actuator is a totally self-contained system and designed for compactness and adaptable to new or existing valves.
- Bettis™ G-Series hydraulic double-acting or spring-return fail-safe actuator
- Shafer™ hydraulic control technology
- EIM™ electronics and communication technology
- Multiple input power options with either AC or DC
- Local lockable Remote/Local/Offline switch
- Local open/close/stop switch
- Partial stroke test
- Fast speed of operation to Fail-safe position if required
- Emergency shutdown – independent safety circuits and solenoid valve
- Dual sealed Separate Terminal Chamber, allows installation wiring to be performed or fuses to be replaced without exposing control components to hostile environmental conditions.

- Control enclosure is made of low-copper aluminum alloy, powder-coated, salt resistant also rated for IP68 ingress protection.
- Hydraulic handpump manual override
- Accumulators (optional)
- Solar power (optional)
- Operating pressures up to 3000 psi with standard components
- Easy control over actuator stroking speeds – The stroking speed is controlled through adjustable hydraulic flow control valves. This enables field personnel to easily adjust actuator stroking speed to comply with field requirements.

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 gasses, 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 System Electrical Diagram 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 Philips 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 is 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 2.4.4.

- 2.3.2 Check that all mounting materials such as fasteners, adapters, 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 4.4 Handpump Operation).

2.4 Lifting the EHO Actuator

NOTE:

All Bettis EHO G-Series Considerations

When handling any EHO G-Series, 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.

NOTE:

Do not use hydraulic tubing and electrical cable for lifting.

⚠ CAUTION

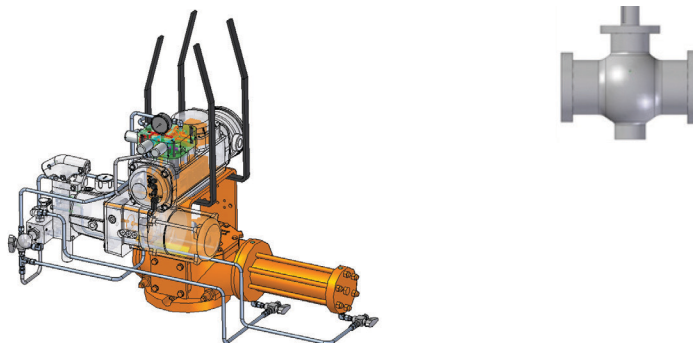
Be sure to use appropriately rated crane/hoist and straps/chains to raise and lower the actuator.

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



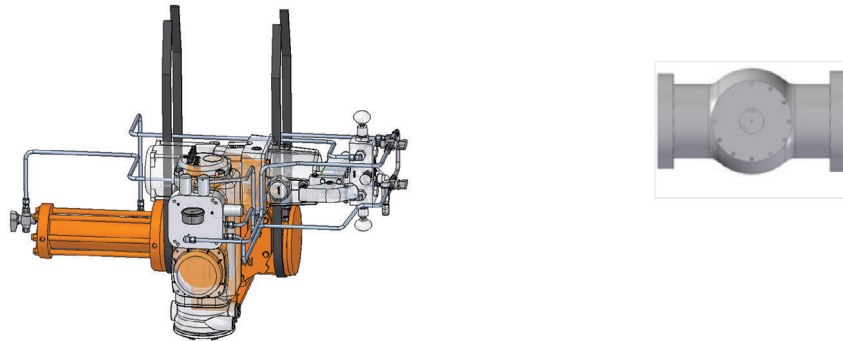
⚠ CAUTION

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

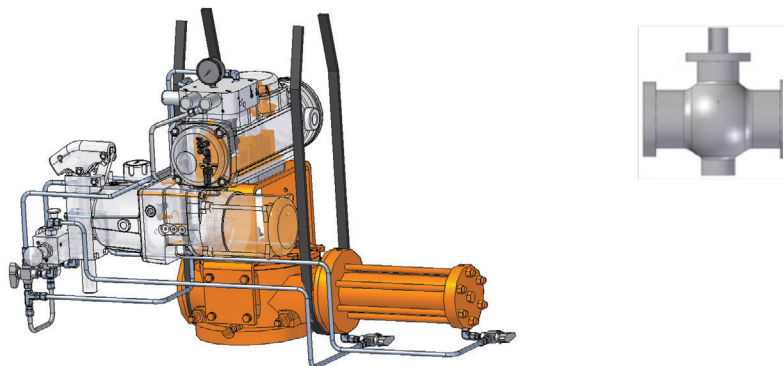


2.4.2 G3-Series Actuators

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 2 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.

2.4.2.3 Horizontal Pipeline Vertical Stem

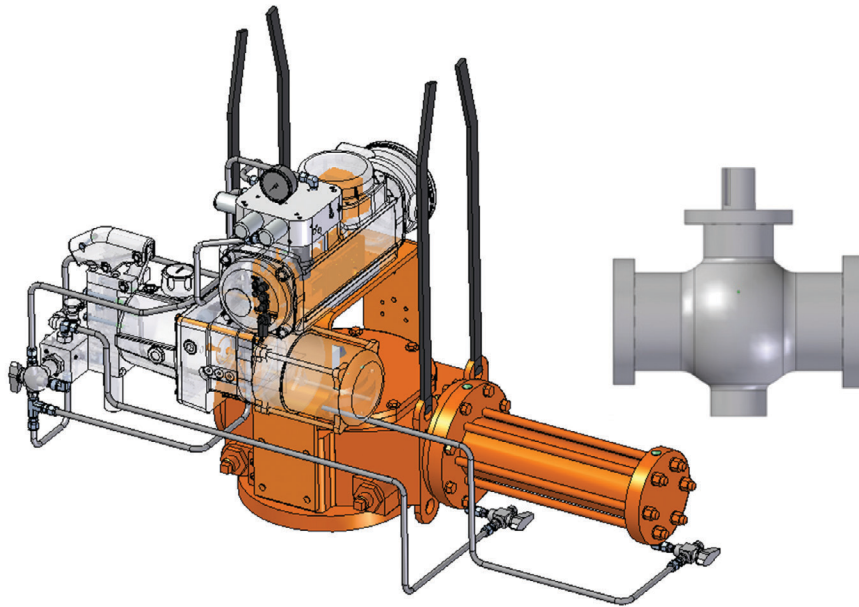
The G3-Series actuator mounting on a horizontal pipeline with a horizontal valve stem should be supported on the ends of the drive module. A strap may be attached to the stabilization tab on the spring module to balance the unit while lifting. The weight of the actuator must be supported at the drive 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 above.

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



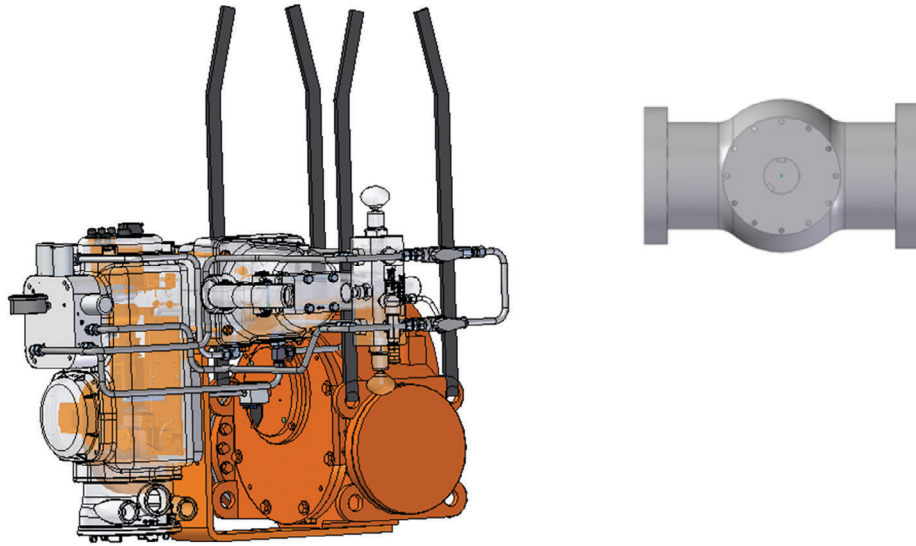
⚠ CAUTION

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



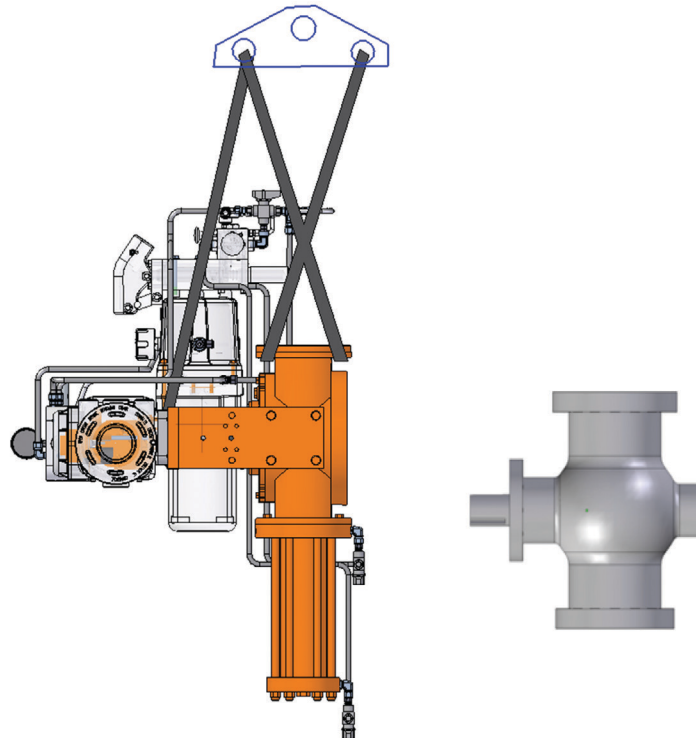
⚠ CAUTION

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 an 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 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 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 adapter (bracket) bottoms out on the valve bonnet.

NOTE:

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

- 2.5.10** Use the required fasteners to firmly attach the adapter 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-Series 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 closed position before attempting to turn the adjusting screw (refer to 4.4, Handpump Operation).

CAUTION

Always use the handpump to move the actuator off the stop before attempting to turn the adjusting screw.

- 2.6.5 With the closed 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 pump the actuator off the full stroke position.

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 by engineering 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 Unavis™ 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 (except for Thermal Compensating Accumulator, see 2.3.4).

NOTE:

When using this procedure, refer to the Bettis EHO Actuator General Arrangement drawing and Hydraulic Schematic for the unit being worked on. (Schematic below is for illustration 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.

2.8.2 Accumulator Pre-charge

- a. Locate Isolation Valve (F) (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 (F) 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 (D) is turned fully counterclockwise.
- d. Slowly open Isolation Valve (Accumulator drain) (E) and drain all the fluid back to the reservoir.
- e. Connect a nitrogen supply to the Customer Nitrogen Fill Connection at Isolation Valve (F).
- f. Open the Isolation Valve (F) (Nitrogen Blow Down and Fill) and charge the Accumulator, to the pre-charge pressure as specified by the Pressure versus Temperature Graph on the General Arrangement Drawing.

NOTE:

For temperatures, which do not appear on the graph, the formula to calculate the pre-charge pressure shown on the General Arrangement Picture Assembly should be used.

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 Pressure versus Temperature graph.

- a. After the nitrogen filling is complete, close the Isolation Valve (F) (Nitrogen Blow Down and Fill).
 - b. Disconnect the nitrogen supply and remove the female pipe adaptor from Isolation Valve (F).
 - c. Install the straight thread plug and O-ring, shipped as an accessory, into Isolation Valve (F).
-

NOTE:

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

- d. Close Isolation Valve (24).

Figure 7 Typical EHO Optional Accumulator System

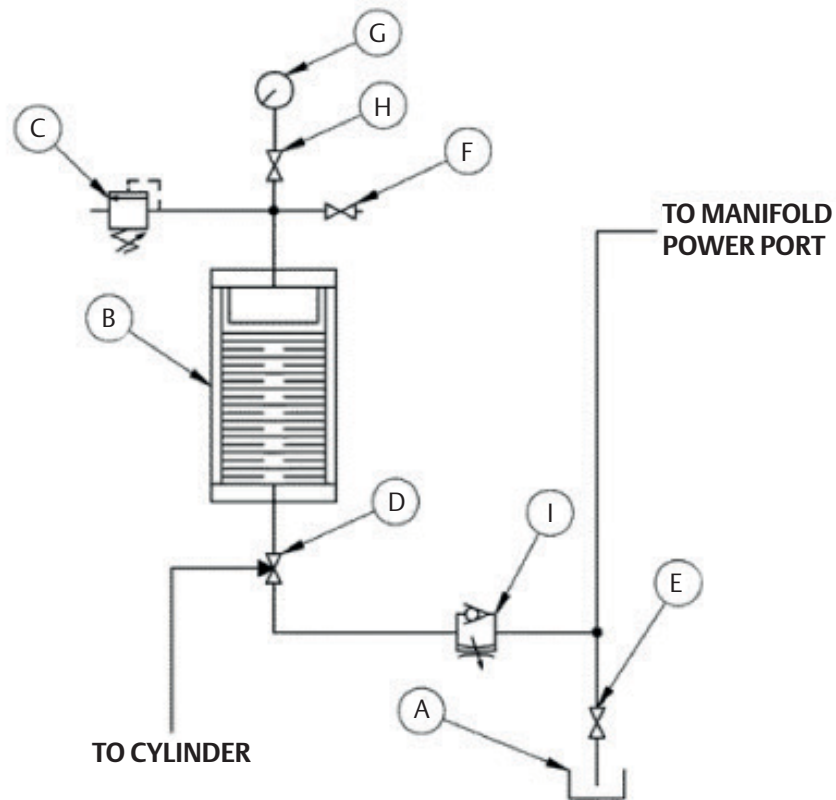


Table 3. Typical EHO Optional Accumulator System

Part Number	Part Name
A	Reservoirs
B	Accumulator
C	Nitrogen Relief Valve
D	3-way Isolation Valve
E	Isolation Valve (Accumulator Drain)
F	Isolation Valve (Nitrogen Blow Down and Fill)
G	Nitrogen Pressure Gauge
H	Nitrogen Gauge Isolation Valve
I	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 (D) is turned fully counterclockwise.
- c. Slowly open Isolation Valve (Accumulator drain) (E) and drain all the fluid back to the reservoir.
- d. Read the pressure at the nitrogen pressure gauge (G) and compare it to the Oil/Temperature Chart 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 on the GA Oil/Temperature Chart. See 2.8.2, Accumulator Pre-charge, if the pre-charge is high relieve pressure to equal the GA Oil/Temperature Chart.
- 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.

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.

2.8.4 Nitrogen Pre-charge Maintenance Record

Serial Number: _____

Tag Number: _____

Date	Initial Pre-charge	GA Chart 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 a maximum of 1/2 inch (12mm).

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

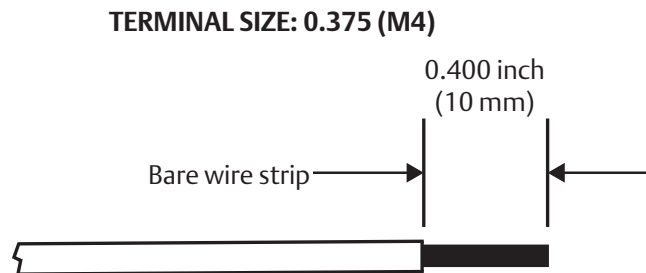
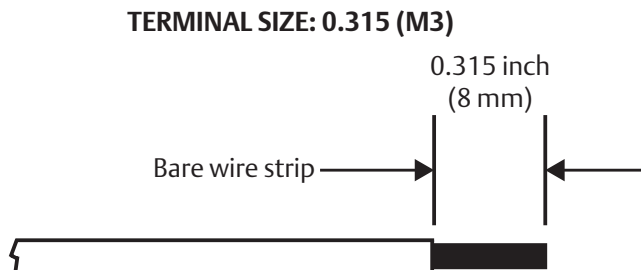


Figure 11 Control Terminal Connection Length of Bare Wire Strip



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 Wiring Diagram).
- 3.4.2 Use the barrier strip clamp screws to connect the control wiring (refer to the job specific Wiring Diagram).
- 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.

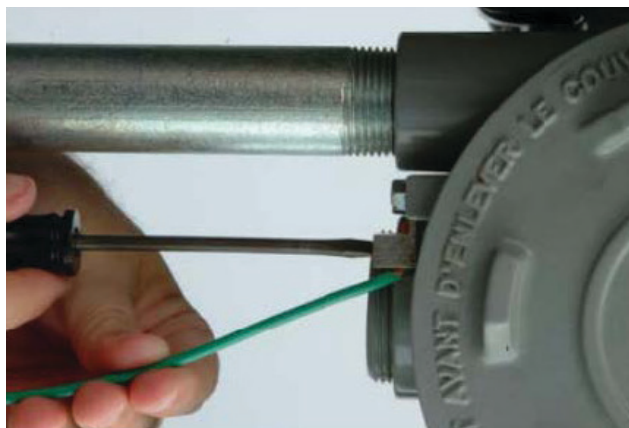
3.6 External Earth/Ground Connections

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. Connect the power for these discrete inputs as detailed in Figures 13 and 14. See Section 3.3, Electrical Connections, for general electrical connection requirements.

Figure 13 Control Input Wiring – Internal Power Supply

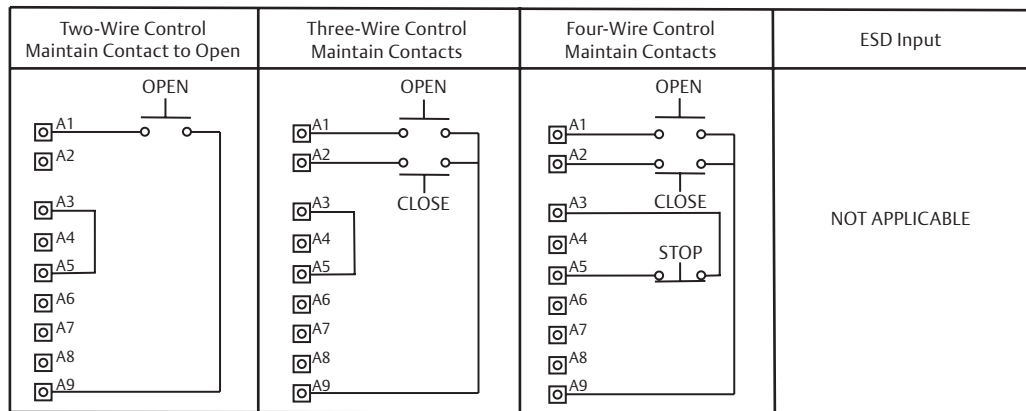
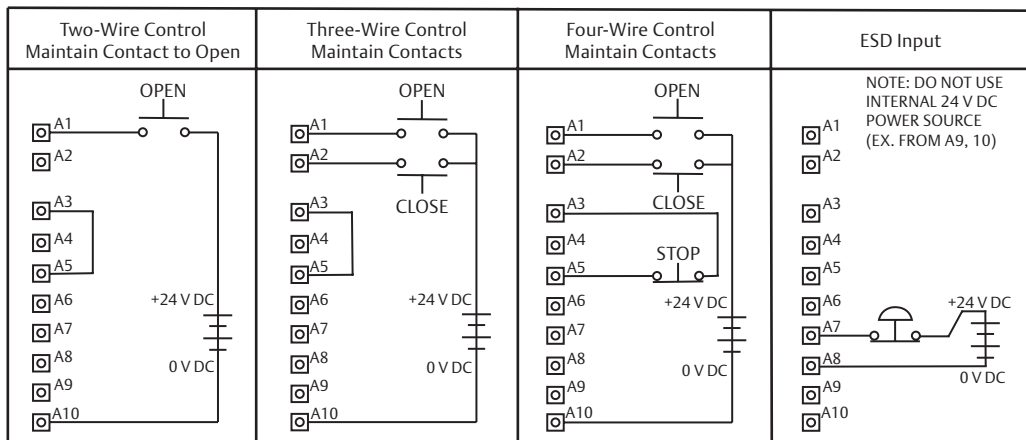


Figure 14 Control Input Wiring – External Power Supply 24 V DC



Section 4: Set-up/Start-up Procedure

In addition to this set-up/start-up procedure, the following 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.

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.

4.3.1 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, adapters 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 ((if an Accumulator is supplied with the EHO))

4.2 Initial Check of the Unit

NOTE:

When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

- 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 Isolation Valve (Accumulator drain) (24) is closed ((if applicable)).
- 4.2.5 Ensure Isolation Valve (Nitrogen Blow Down and Fill) (25) is closed ((if applicable)).

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 2-Way Remote Electric without ESD solenoid function

NOTE:

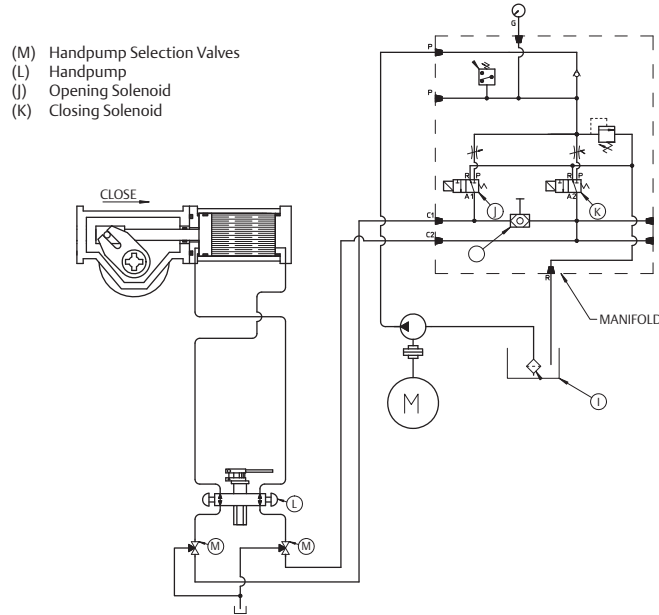
Handpump Isolation Valve (8)

The components referenced below are referencing Schematic 4.4.1. and is for illustration purposes only. When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

- 4.4.1.1 Check the Reservoir (I) to see the hydraulic is at the proper level.
- 4.4.1.2 Rotate downward in the horizontal position both Handpump Selector Valves (M).
- 4.4.1.3 Select and push inward the open or close knob located on the Handpump Selector Manifold (L).
- 4.4.1.4 Use supplied Handpump Handle to discharge hydraulic fluid into the open or close side of the actuator cylinder.
- 4.4.1.5 Continue hand pumping until the actuator completes the open or close stroke and contacts the actuators adjustable end stops.
- 4.4.1.6 Once completion of the hand pumping operation, push the Pump Bypass Valve located on the top of the Handpump Selector Manifold (L) and pull the pump handle downward retracting the pump ram into the pump body.
- 4.4.1.7 Rotate both Handpump Selector Valves back into the upward vertical position.
- 4.4.1.8 Check the Reservoir (I) to see the hydraulic fluid is at the proper level.

4.4.2 2-Way Remote Electric with an ESD solenoid function

Figure 15 2-Way Remote Electric Without an ESD Solenoid Function Schematic

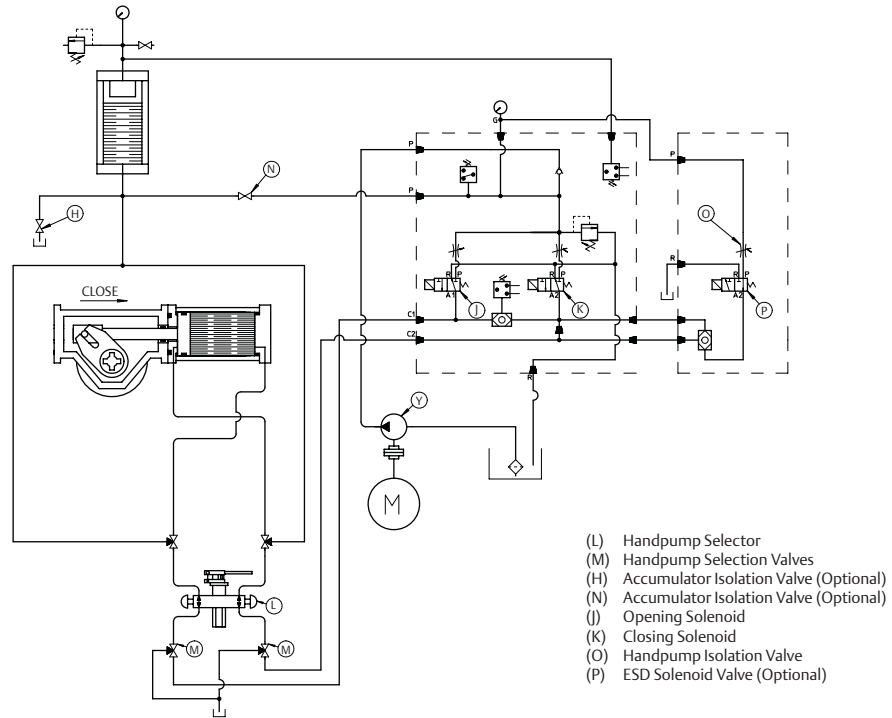


NOTE:

The components referenced below are referencing Schematic 4.4.2. and is for illustration purposes only. When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

- 4.4.2.1 Check the Reservoir (I) to see the hydraulic is at the proper level.
- 4.4.2.2 Close Handpump Isolation Valve (O)
- 4.4.2.3 Rotate downward in the horizontal position both Handpump Selector Valves (M).
- 4.4.2.4 Select and push inward the open or close knob located on the Handpump Selector manifold (L).
- 4.4.2.5 Use supplied Handpump Handle to discharge hydraulic fluid into the open or close side of the actuator cylinder.
- 4.4.2.6 Continue hand pumping until the actuator completes the open or close stroke and contacts the actuators adjustable end stops.
- 4.4.2.7 After completion of the hand pumping operation, push the Pump Bypass Valve located on the top of the Handpump Selector Manifold (L) and pull the pump handle downward retracting the pump ram into the pump body.
- 4.4.2.8 Rotate both Handpump Selector Valves (M) back into the upward vertical position.
- 4.4.2.9 Check the Reservoir (I) to see the hydraulic fluid is at the proper level.
- 4.4.2.10 Once the ESD solenoid signal is re-established, slowly open Handpump Isolation Valve (O).

Figure 16 2-Way Remote Electric With an ESD Solenoid Function Schematic



4.4.3 Manual Open or Close with Accumulator Override feature (Optional)

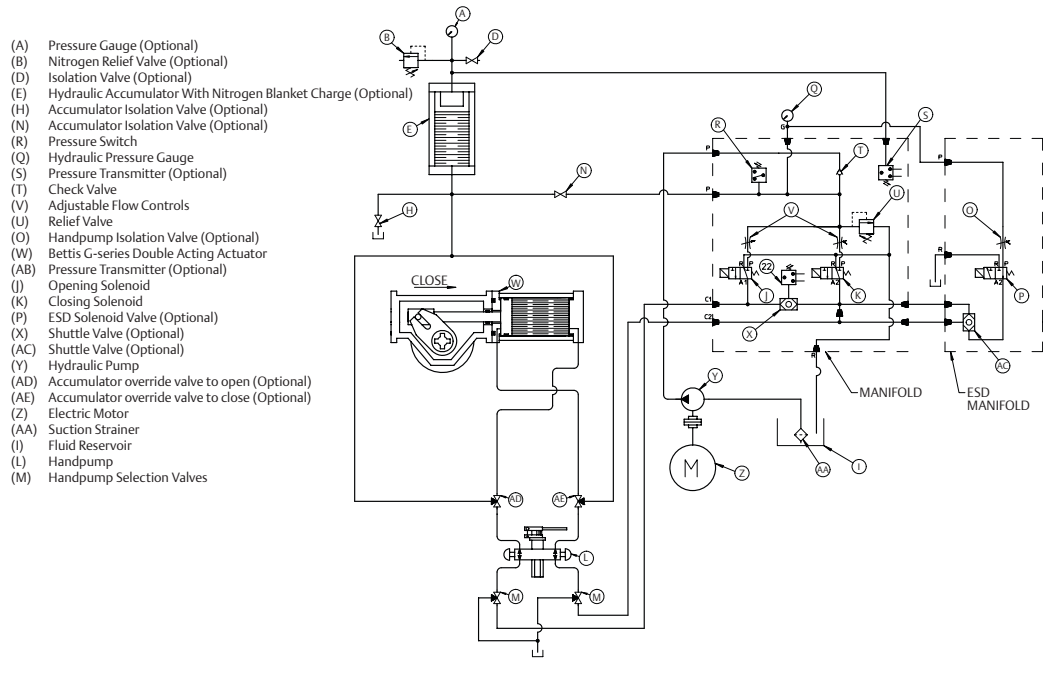
NOTE:

The components referenced below are referencing Schematic 4.4.2. and is for illustration purposes only. When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

4.4.3.1 Select and slowly open the Accumulator override Isolation Valve (AD) for actuator open stroke and (AE) for actuator closing stroke. The Isolation Valve is in the actuator stroking position when rotated downward to the horizontal position.

4.4.3.2 After completion of the Accumulator manual override stroke, return the Isolation Valve (AD) or (AE) to the upward vertical position.

Figure 17 2-Way Remote Electric With Emergency Shutdown Feature Powered by an Electro-hydraulic power unit



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 shipping.

NOTE:

The components referenced below are referencing Schematic 4.4.2. and is for illustration purposes only. When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

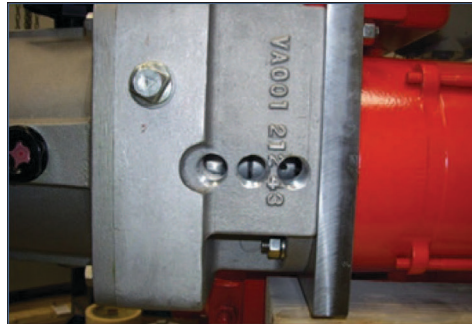
- 4.5.1 Rotate both Handpump Isolation Valves (O) to the downward horizontal position.
- 4.5.2 Select and push inward the open or close knob located on the Handpump Selector Manifold (L).
- 4.5.3 Use supplied Handpump Handle to discharge hydraulic fluid into the open or close side of the actuator cylinder.
- 4.5.4 Once the actuator is fully stroked and makes contact with the actuators adjustable stops, observe if any leakage is detected at any tube fittings or port connections from the Handpump to the Actuators operating ports.
- 4.5.5 Push the Pump Bypass Valve located on the top of the Handpump Selector Manifold (L) and pull the pump handle downward retracting the pump ram into the pump body.
- 4.5.6 Select and push inward the opposite open or close knob located on the Handpump Selector Manifold (L).
- 4.5.7 Repeat steps 4.5.3 thru 4.5.5
- 4.5.8 Rotate both Handpump Selector Valves (M) back into the upward vertical position.

4.6 Check Rotation

NOTE:

When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

- 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.
- 4.6.3 Ensure Flow Control Valves (V) 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 18 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. Motor rotation should be counterclockwise when looking at 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 (P) energized.

- 4.6.7** Push and release the OPEN/CLOSE PUSHBUTTON to Power Stroke the actuator. The Electric Motor (Z) will start to run driving Hydraulic Pump (Y). The Hydraulic Pump (Y) draws fluid from Reservoir (I) and pushes it into the Bettis G-series hydraulic cylinder (W).
- 4.6.8** 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 etc. 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 19 Remove Cover for Limit Switch Chamber



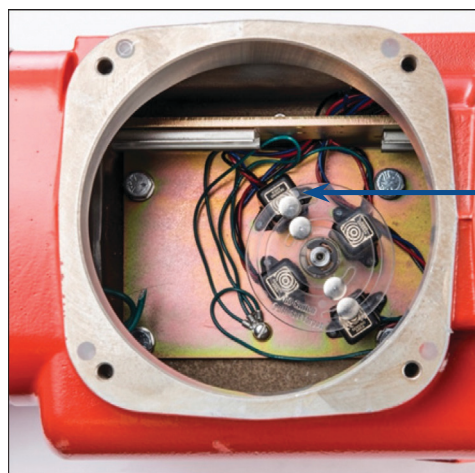
⚠ WARNING

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 Close Limit Switch Adjustment

- 4.7.3.1** The Open and Close Limit Switches, shown in Figure 20, 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 20 View of Limit Switch Targets



Limit Switch #1 Target

NOTE:

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

4.8 Function Test

4.8.1 Double-acting Actuator without an ESD Solenoid Valve

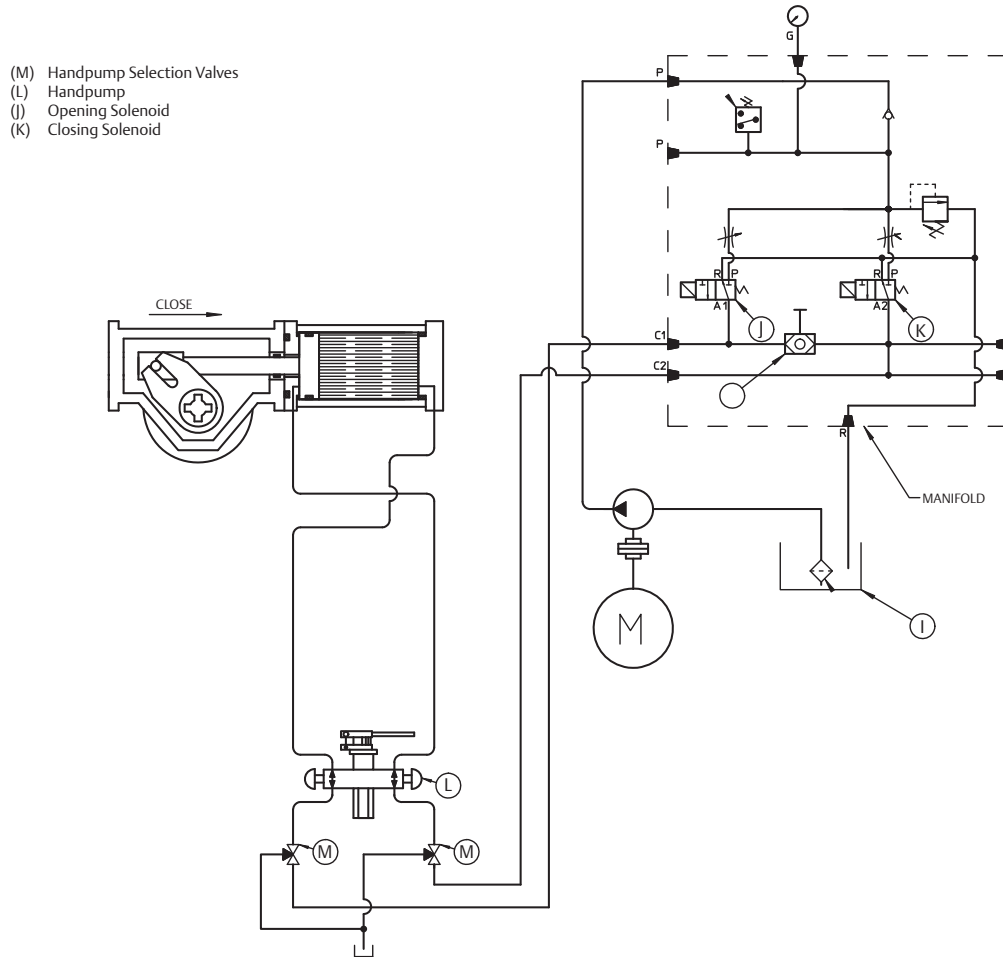
NOTE:

The components referenced below are referencing Schematic 4.8.1. and is for illustration purposes only. When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

- 4.8.1.1 Ensure both Handpump Selector Valves (M) are in the automatic open position.
- 4.8.1.2 Energize the desired solenoid valve (J) to open the actuator or (K) to close the actuator.
- 4.8.1.3 Push and release the OPEN/CLOSE PUSHBUTTON to start the Electric Motor. The Hydraulic Pump Draws Fluid from the Reservoir and discharges fluid thru either the opening solenoid (J) or the closing solenoid (K) which ever one is energized.
- 4.8.1.4 Upon completion of the open or close stroke, the Pressure Switch will reach its set point and stop the Electric Motor.
- 4.8.1.5 Upon completion of the open or close stroke, the Limit Switch(s) can be configured to de-energized the solenoid that is energized. Some field installations can use the customer's control room logic to de-energize the solenoids after the actuator stroke open or close is reached.

4.8.2 Double-acting Actuator with an (Optional) ESD Solenoid Valve and Accumulator

Figure 21 2-Way Remote Electric Without an ESD Solenoid Function Schematic



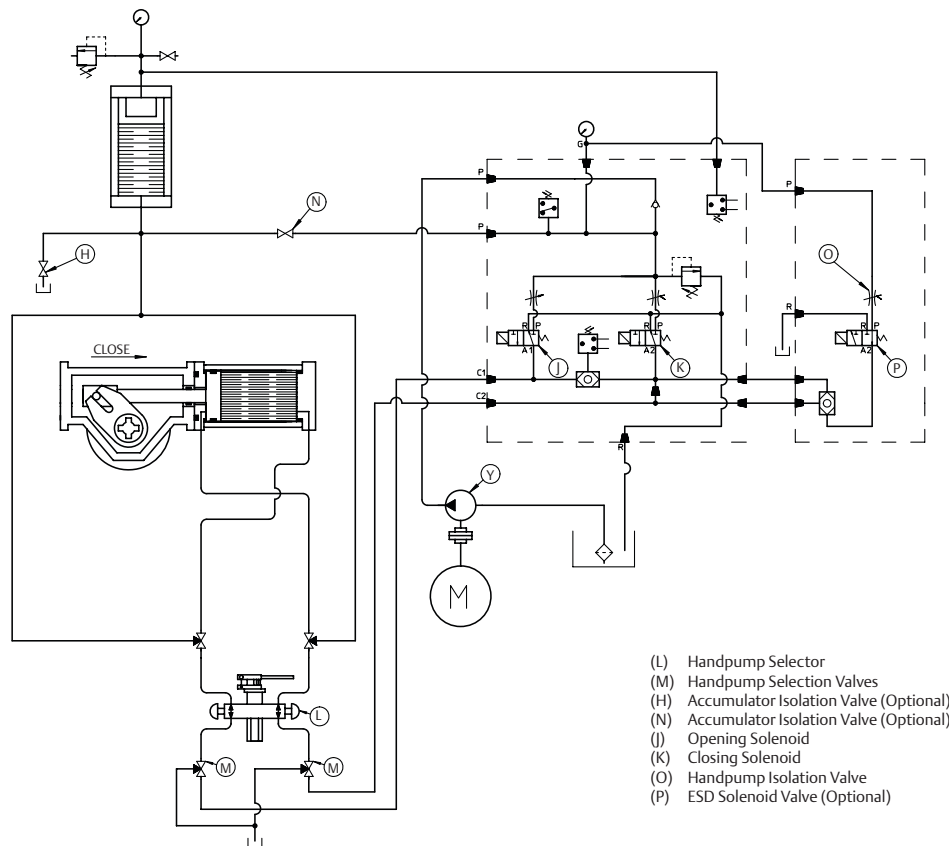
NOTE:

The components referenced below are referencing Schematic 4.8.2. and is for illustration purposes only. When using this procedure refer to the Bettis EHO Actuator General Arrangement Drawing and Hydraulic Schematic for the unit being worked on.

- 4.8.2.1 Ensure both Handpump Selection Valves (M) are in the automatic open position.
- 4.8.2.2 ESD (Emergency Shut Down) Solenoid Valve (P) is constantly energized closed.
- 4.8.2.3 Ensure Isolation Valve (H) is closed and Isolation Valves (N) and (O) are both open.
- 4.8.2.4 Push and release the OPEN/CLOSE PUSHBUTTON to start the Electric Motor. The Hydraulic Pump Draws Fluid from the Reservoir and discharges fluid to the nitrogen pre-charged accumulator.

- 4.8.2.5 Upon completion of the charging of the accumulator, the pressure switch set point will be reached and it will stop the electric motor.
- 4.8.2.6 Energize the desired solenoid valve (J) to open the actuator or (K) to close the actuator.
- 4.8.2.7 Upon completion of the open or close stroke, the Limit Switch(s) can be configured to de-energized the solenoid that is energized. Some field installations can use the customer's control room logic to de-energize the solenoids after the actuator stroke open or close is reached.

Figure 22 2-Way Remote Electric With an ESD Solenoid Function Schematic



- (L) Handpump Selector
- (M) Handpump Selection Valves
- (H) Accumulator Isolation Valve (Optional)
- (N) Accumulator Isolation Valve (Optional)
- (J) Opening Solenoid
- (K) Closing Solenoid
- (O) Handpump Isolation Valve
- (P) ESD Solenoid Valve (Optional)

4.9 Other Options

Other options such as Partial Stroke Test 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.

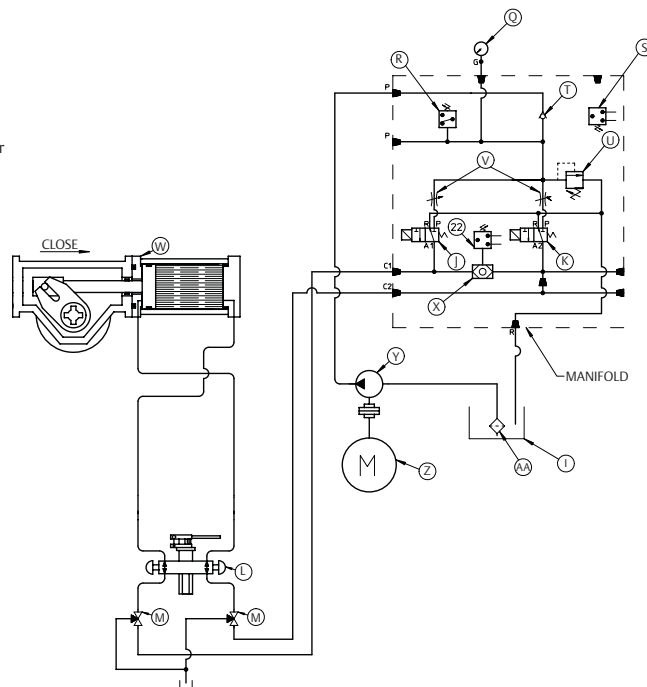
5.2 Reservoir

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 gauge 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

Figure 23 Basic Double-acting

- (Q) Hydraulic Pressure Gauge
- (R) Pressure Switch
- (S) Pressure Transmitter (Optional)
- (T) Check Valve
- (U) Relief Valve
- (V) Adjustable Flow Controls
- (W) Bettis G-series Double Acting Actuator
- (J) Opening Solenoid
- (K) Closing Solenoid
- (X) Shuttle Valve (Optional)
- (Y) Hydraulic Pump
- (Z) Electric Motor
- (AA) Suction Strainer
- (I) Fluid Reservoir
- (L) Handpump
- (M) Handpump Selection Valves

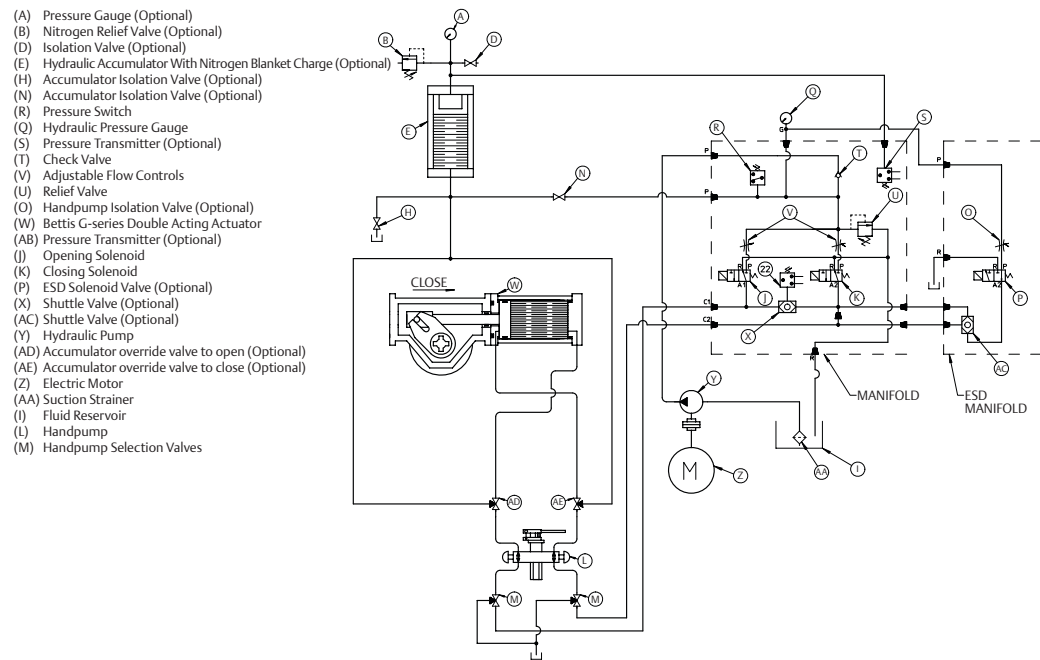


NOTE:

Item numbers correspond to attached schematic drawing 11794-S.

- (W) Bettis G-series Double-acting Actuator
- (Z) Electric Motor
- (Y) Hydraulic Pump
- (I) Fluid Reservoir
- (K) 3-Way Normally Closed Solenoid Valve for closing the actuator
- (J) 3-Way Normally Closed Solenoid Valve for opening the actuator
- (V) Adjustable Flow Controls. There are two flow controls located upstream of the open and close solenoid valve items (J) and (K).
- (AA) Suction Strainer
- (T) Check Valve
- (U) 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.
- (Q) Hydraulic Pressure Gauge
- (R) Pressure Switch
- (L) Handpump: Used to manually stroke the actuator open or closed.
- (M) Handpump Selection Valves: These two valves are engaged to isolate the control system before using the handpump. Note: Both selection valves are engaged at the same time when the handpump is used to open or close the actuator.
- (X) Shuttle Valve; (Optional) Used with an optional pressure transmitter.
- (S) Pressure Transmitter (Optional)

Figure 24 Main Components Double-acting with ESD Solenoid and Accumulator



- (W) Bettis G Double-acting Actuator
- (Z) Electric Motor
- (Y) Hydraulic Pump
- (I) Fluid Reservoir
- (K) 3-Way Normally Closed Solenoid Valve for closing the actuator
- (J) 3-Way Normally Closed Solenoid Valve for opening the actuator
- (V) Adjustable Flow Controls. There are two flow controls located upstream of the open and close solenoid valve items (J) and (K).
- (AA) Suction Strainer
- (T) Check Valve
- (U) 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.

- Q) Hydraulic Pressure Gauge
- (R) Pressure Switch
- (L) Handpump: Used to manually stroke the actuator open or closed.
- (AD) Optional accumulator override 3-way isolation valve to open the actuator.
- (AE) Optional accumulator override 3-way isolation valve to close the actuator.
- (M) Handpump Selection Valves: These two valves are engaged to isolate the control system before using the handpump. Note: Both selection valves are engaged at the same time when the handpump is used to open or close the actuator.
- (X) Shuttle Valve; (Optional) Used with an optional pressure transmitter.
- (P) (Optional) ESD 3-Way Normally Open Solenoid Valve.
- (E) (Optional) Hydraulic Accumulator w/nitrogen blanket charge:
The accumulator is used to stroke the actuator open or close with an additional override feature.
- (B) (Optional) Nitrogen Relief Valve: The relief valve is provided to prevent the nitrogen gas pressure to reach an over pressurization point caused by the pump or excessive thermal expansion.
- (N) (Optional) Accumulator Isolation Valve: Used to isolate the accumulator for repair or maintenance.
- (AB) (Optional) Pressure Transmitter: Used to transmit the pressure required to stroke the valve over time as a diagnostic feature.
- (H) (Optional) Accumulator Isolation Valve: This valve allows the hydraulic pressure to bypass back to the reservoir.
- (D) (Optional) Isolation Valve: Used to blow down or decay the nitrogen pressure from the accumulator for repair or maintenance.
- (A) (Optional) Pressure Gauge: Illustrates the accumulator nitrogen blanket pressure.
- (O) (Optional) Handpump Isolation Valve: This valve isolates the ESD solenoid and must be closed prior to using the handpump for stroking the actuator open or closed.
- (AC) (Optional) Shuttle Valve: This valve allows the actuator to close by either remote electric by energizing the closing solenoid item (K) or by losing the electric signal thru the ESD solenoid item (P).
- (S) (Optional) Pressure Transmitter: Used to transmit the accumulator nitrogen blanket pressure.

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.

5.4.1 Double-Acting Without Accumulator and ESD Solenoid Valve

NOTE:

Refer to Section 10.1 for Hydraulic Schematic 11794-S, however the project specified schematic may be slightly different in the numbering sequence and should be referred to determine the actual options provided.

5.4.1.1 Power Stroke ((Open/Close))

Either one of the two closing or opening solenoids (J) or (K) are energized open and the motor (Z) drives the hydraulic pump (Y) to supply the actuator open or closing port thru the energized solenoid.

5.4.1.2 Manual Handpump Stroke

- a. Open the handpump selection isolation valve (M) to the pump position.
Note: both isolation valves (M) must be engaged whether hand pumping open or close.
- b. Select and push the open or close knob on the handpump (L).
- c. Stroke the handpump (L) until the OPEN/CLOSE stroke is completed.
- d. Push the manual relief valve located on the handpump to retract the pump ram back into the pump body and pull the pump handle down.
- e. Upon completion of the OPEN/CLOSE handpump stroke, return both handpump selection isolation valves back to the automatic position.

5.4.2 Double-Acting with Optional Accumulator and ESD Solenoid Valve Functional Description

NOTE:

Refer to Section 10.2. for Hydraulic schematic 11516-S, however the project specified schematic may be slightly different in the numbering sequence and should be referred to determine the actual options provided.

5.4.2.1 Accumulator Charge

The motor (Z) drives the hydraulic pump (Y) and discharges fluid to the nitrogen blanket pre-charged accumulator (E).

5.4.2.2 Power Stroke ((Open/Close))

Upon completion of the accumulator charging, the pressure switch (R) set point is reached and stops the motor. Either one of the two closing or opening solenoids (J) or (K) are energized open and the accumulator (E) provides hydraulic pressure to flow thru the energized solenoid, either (J) or (K) and the actuator strokes open or closed.

5.4.2.3 ESD Operation ((Optional))

In an ESD application the ESD Solenoid (P) is constantly energized closed. This customer supplied signal is held as long as the signal is present. Upon loss of the signal to the ESD solenoid, the solenoid will de-energize and open allowing hydraulic supply fluid from the accumulator (E) to pass thru the ESD solenoid and to the closing port of the actuator (W).

5.4.2.4 Manual Handpump Stroke

1. Open the Handpump Selection Isolation Valve (M) to the pump position.

NOTE:

Both Handpump Selection Isolation Valves (M) must be engaged whether hand pumping open or close.

2. Select and push the open or close knob on the Handpump (L).
3. Stroke the handpump until the OPEN/CLOSE stroke is completed.
4. Push the manual relief valve located on the handpump to retract the pump ram back into the pump body and pull the pump handle down.
5. Upon completion of the OPEN/CLOSE handpump stroke, return both handpump selection isolation valves back to the automatic position.

5.4.2.5 Accumulator override Feature ((Optional))

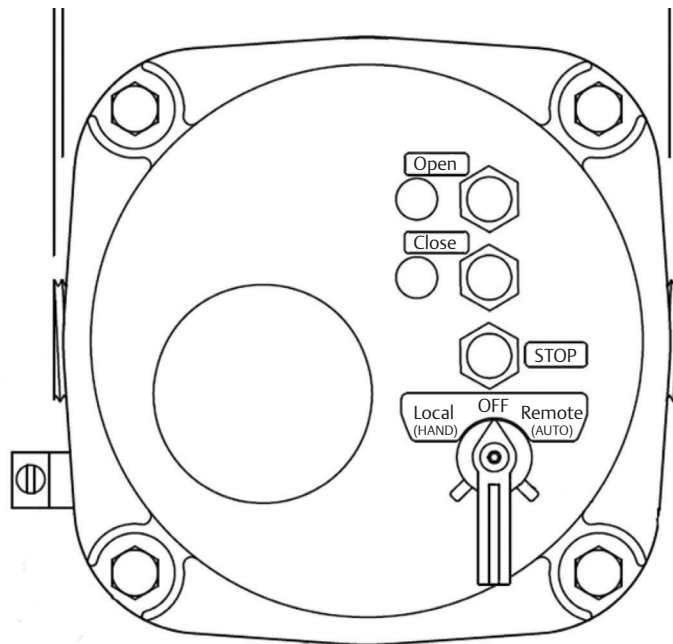
To stroke the actuator OPEN or CLOSED using the accumulator override isolation valves, open valve (AD) to stroke the actuator open, or open (AE) to stroke the actuator closed.

Section 6: Pushbutton Module (PBM)

The Pushbutton Module consists of the following as shown in Figure 25:

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

Figure 25 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 the following tables.

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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Low fluid level in reservoir. 2. Wrong motor shaft rotation. 3. Handpump isolation valve (O) is closed (if optional accumulator is provided). 4. ESD solenoid is not energized because signal power is insufficient. 5. The Relief valve is cracking open. Check to ensure setting set to factory setting.
EHO will not return to the Fail-safe Position	<ol style="list-style-type: none"> 1. Ensure the Local/Off/Auto switch is in the proper position when initiating the open/close command. 2. Handpump isolation valve (O) 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:

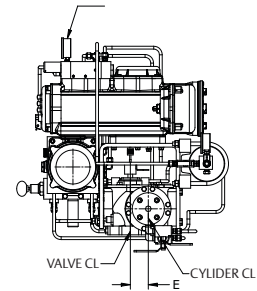
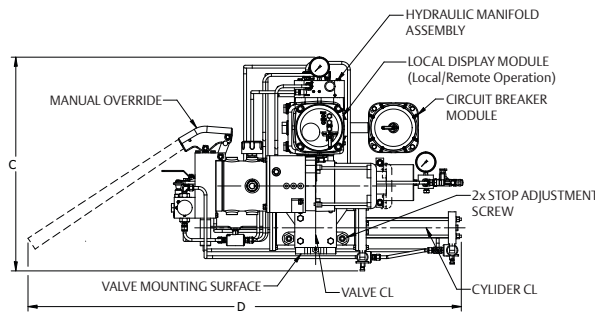
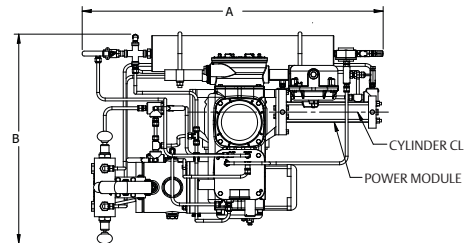
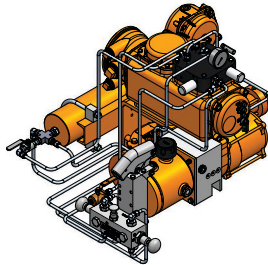
1. Ensure oil level is at the proper level.
2. Ensure handpump isolation valve (O) is open.
3. Check to see that the ESD (optional) signal power is on.

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 Double-Acting



OUTLINE DIMENSION AND DETAILS												
Actuator	A		B		C		D		E		Approximate Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	lb	kg
G01001.5	39.8	1010.9	27.7	703.6	28.3	718.8	57.9	1470.7	2.4	61.0	513	233
G2002.0	40.6	1031.2	28.7	729.0	29.0	736.6	58.3	1480.8	2.9	73.7	546	248
G3004.0	46.8	1188.7	30.1	764.5	32.5	825.5	61.5	1562.1	3.5	88.9	626	284
G4003.0	52.0	1320.8	34.5	876.3	31.9	810.3	66.8	1696.7	4.3	109.2	770	349
G4004.0	53.0	1346.2	35.5	901.7	32.9	835.7	67.8	1722.1	5.3	134.6	783	355
G5004.0	58.3	1480.8	37.4	950.0	34.8	883.9	73.2	1859.3	5.5	139.7	1141	518
G5005.0	59.3	1506.2	38.4	975.4	35.8	909.3	74.2	1884.7	6.5	165.1	1300	590
G7005.0	64.3	1633.2	40.4	1026.2	39.7	1008.4	81.6	2072.6	6.8	172.7	1786	810
G7008.0	65.3	1658.6	41.4	1051.6	40.7	1033.8	82.6	2098.0	7.8	198.1	1829	830
G8008.0	76.5	1943.1	42.7	1085.8	39.5	1003.3	87.5	2222.5	8.0	203.2	2461	1116
G10008.0	93.6	2377.4	46.9	1191.3	43.6	1107.4	99.4	2524.8	10.5	266.7	3754	1703

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.

World Area Configuration Centers (WACC) offer sales support, service, inventory and commissioning to our global customers. Choose the WACC or sales office nearest you:

NORTH & SOUTH AMERICA

19200 Northwest Freeway
Houston TX 77065
USA
T +1 281 477 4100

Av. Hollingsworth
325 Iporanga Sorocaba
SP 18087-105
Brazil
T +55 15 3413 8888

ASIA PACIFIC

No. 9 Gul Road
#01-02 Singapore 629361
T +65 6777 8211

No. 1 Lai Yuan Road
Wuqing Development Area
Tianjin 301700
P. R. China
T +86 22 8212 3300

MIDDLE EAST & AFRICA

P. O. Box 17033
Jebel Ali Free Zone
Dubai
T +971 4 811 8100

P. O. Box 10305
Jubail 31961
Saudi Arabia
T +966 3 340 8650

24 Angus Crescent
Longmeadow Business Estate East
P.O. Box 6908 Greenstone
1616 Modderfontein Extension 5
South Africa
T +27 11 451 3700

EUROPE

Holland Fasor 6
Székesfehérvár 8000
Hungary
T +36 22 53 09 50

Strada Biffi 165
29017 Fiorenzuola d'Arda (PC)
Italy
T +39 0523 944 411

For complete list of sales and manufacturing sites, please visit www.emerson.com/actuationtechnologieslocations or contact us at info.actuationtechnologies@emerson.com

www.emerson.com/bettis

VCIOM-13254-EN ©2021 Emerson. All rights reserved.

The Emerson logo is a trademark and service mark of Emerson Electric Co. Bettis™ is a mark of one of the Emerson family of companies. All other marks are property of their respective owners.

The contents of this publication are presented for information purposes only, and while every effort has been made to ensure their accuracy, they are not to be construed as warranties or guarantees, express or implied, regarding the products or services described herein or their use or applicability. All sales are governed by our terms and conditions, which are available on request. We reserve the right to modify or improve the designs or specifications of our products at any time without notice.

BETTIS™

