TopWorx™ D-ESD: Partial Stroke & Emergency Shutdown

Installation, Operation & Maintenance Manual

EMERSON™

Credible Solutions

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EMERSON™

ESD Theory of Operation:

The purpose of the TopWorx™ Emergency Shut-Down (ESD) model is to partially stroke a valve that maintains a full open or full closed position for an extended period of time while offering an ESD function. A partial stroke test (PST) verifies functionality of critical valves that must be in their fail position during an emergency. Increasing the frequency of partial stroke testing (i.e. reducing the proof test interval) improves the SIL (Safety Integrity Level) that the system can achieve through a reduction in the PFD avg (Average Probability of Failure On Demand). These partial stroke tests can be performed without shutting down or disrupting the process. In an emergency, the ESD function overrides partial stroke testing and the valve moves to its fail position.

This ESD unit incorporates a sensor communication module (SCM-ESD) to perform the partial stroke test, verify its status, and output that status back to the user. In combination with the SCM, the ESD unit uses either the optional TopWorx™ pilot and spool valve or a customersupplied solenoid valve to drive the actuator during both normal operation and partial stroke testing. A TopWorx™ GO™ Switch is included for partial stroke confirmation and two (2) limit switches built into the SCM confirm open and close position.

Once the unit is installed, the SCM-ESD must be calibrated for that specific valve, actuator, and solenoid exhaust settings. During calibration, the unit records the time to partially stroke the valve. All future PST times are compared to this original value for determining the test status. To pass a PST, the time must be within +/-20%, 30%, or 40% of the stored calibration value. This PST time tolerance can be changed prior to calibration.

The partial stroke test is initiated via an optional partial stroke test button with a lockable cover, the calibration button on the top of the SCM, or a simulated closed dry contact from the PLC or DCS. Upon issuing a PST command, the SMC-ESD begins a timer while switching a relay to de-energize the pilot/ solenoid. The valve moves from its normal position toward its fail position until the GO™ Switch is made. Once made, the SCM energizes the pilot/solenoid and the valve moves to its normal position while outputting the PST status.

Option ES: SCM

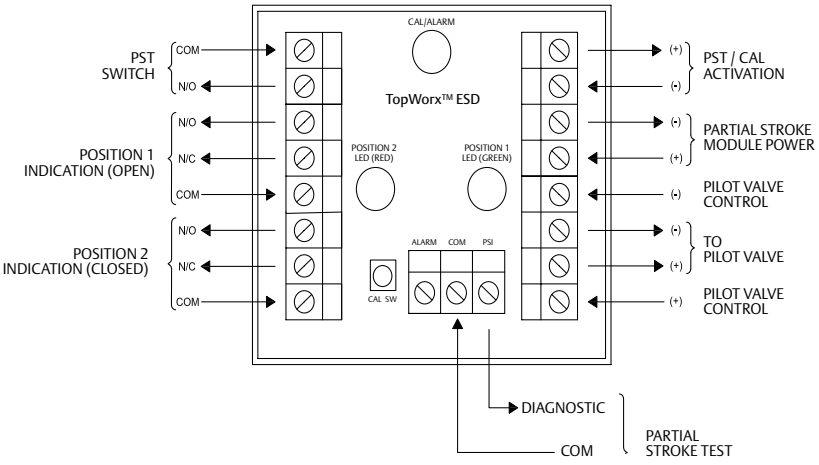


Figure 1: Input/Output Diagram

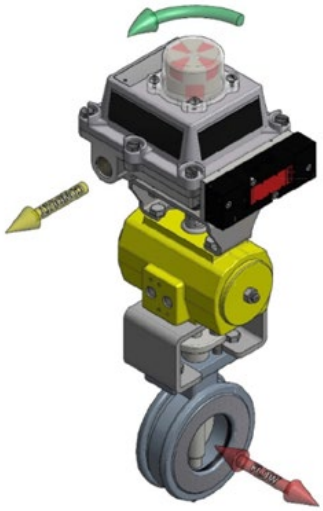
Electrical Ratings	
	Current/Voltage
Open/Closed Indication	0.25A@24VDC w/5V drop 0.25A@120VAC w/5V drop
Dry Contact Rating	Minimum Current Through Switch Contacts: 5 mA
Module Voltage	18-28VDC
Module Current	50mA (MAX)
Pilot Current (Standard)	20mA
PST Feedback Relays	800mA@24VDC MAX 250mA@125VAC MAX
Solenoid Pilot/SOV Maximum PowerRating	800mA@24VDC MAX 250mA@125VAC MAX

Installation on Actuator
Orientations, Normal and Reverse Acting

Normal acting is full clockwise when the process valve is closed and counterclockwise when the process valve is open.
Reverse acting is full clockwise when the process valve is open and counterclockwise when the process valve is closed.

90° indicator dome assemblies are designed to accommodate any mounting arrangement and can be adjusted up to 9° off axis if needed.
45° indicator dome assemblies can only accommodate *normal acting* applications that are *mounted parallel ±9°*.
Consult your local distributor or factory representative for 45° reverse acting or *mounted perpendicular* applications.

The image to the left shows a TopWorx™ unit *mounted parallel* to the process valve in the closed position. The green arrow at the top shows the "*normal acting*" direction of travel to open the valve. This is the standard orientation and unless otherwise specified, your unit will be factory set to operate in this fashion.



The image to the right shows a TopWorx™ *mounted perpendicular* to the process valve in the closed position. The green arrow at the top shows the "*normal acting*" direction of travel to open the valve.

Mounting

TopWorx™ has numerous mounting bracket kits, both rotary and linear, available to meet your specific application. Consult your local distributor or factory representative for ordering information. The illustration below shows a direct NAMUR mount on a quarter turn valve. Refer to your mounting kit documentation for specific mounting instructions.

Storage

Until conduit, conduit covers, and any applicable spool valve port connections are properly installed, the TopWorx™ unit will not support its IP/NEMA rating as the unit ships with temporary covers. Ensure that it is stored in a dry environment with a relative humidity range between 10%-95% and a temperature ranging from -40°F (-40°C) to 160°F (71°C). Once properly installed, the temperature range listed on the nameplate will supersede this storage temperature range.

Mounting Assembly

Installation Notes

Use caution not to allow undue axial (thrust) load on the shaft.

1. Cycle the valve a couple of times prior to final tightening of the mounting kit hardware. This allows the shaft to self-center in the pinion slot, or coupler. Refer to the *dimensions and materials section* of this document for appropriate tightening torque. Please refer to the Proof Testing section for proper safety function setup.

2. Always use sound mechanical practices when applying torque to any hardware or making pneumatic connections. Refer to the Integrated Pneumatic Control Valves section for detailed information.

3. This product comes shipped with conduit covers in an effort to protect the internal components from debris during shipment and handling. **It is the responsibility of the receiving and/or installing personnel to provide appropriate permanent sealing devices to prevent the intrusion of debris or moisture when stored or installed outdoors.**

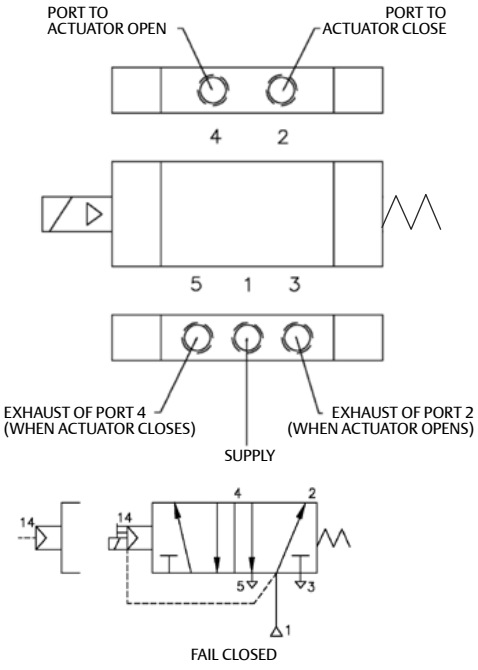
4. **It is the responsibility of the installer, or end user, to install this product in accordance with the National Electrical Code (NFPA 70) or any other national or regional code defining proper practices.**

Pneumatic Hookup Procedures

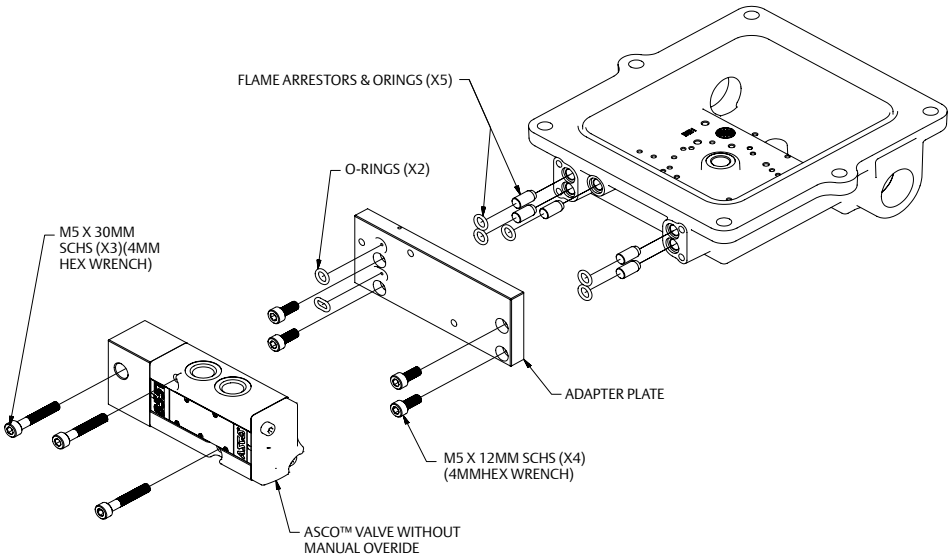
Prior to connecting the supply air to the spool valve, flush the system to remove any debris or contaminates. Galvanized pipe can easily flake and contaminate the system and therefore is not recommended. A 40 micron point of use filter at every device is recommended.

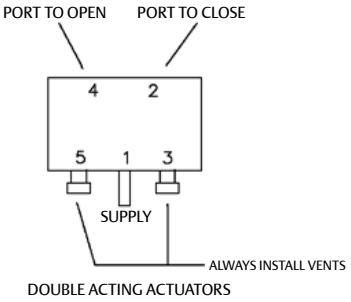
4-Way Spool Valves

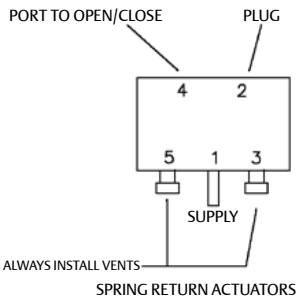
The TopWorx™ spool valve is a 5 port, 4-way valve driven by an internally mounted pilot. The spool valve supply port and work ports are marked as follows:



Spool Valve Assembly







Highly Recommended

TopWorx™ highly recommends Locktite 567 brand thread sealant. Do not use a hard setting pipe compound. If Teflon thread seal tape is used, start the wrap on the second thread from the leading thread of the fitting. This will prevent tape shreds from contaminating the spool valve seals.

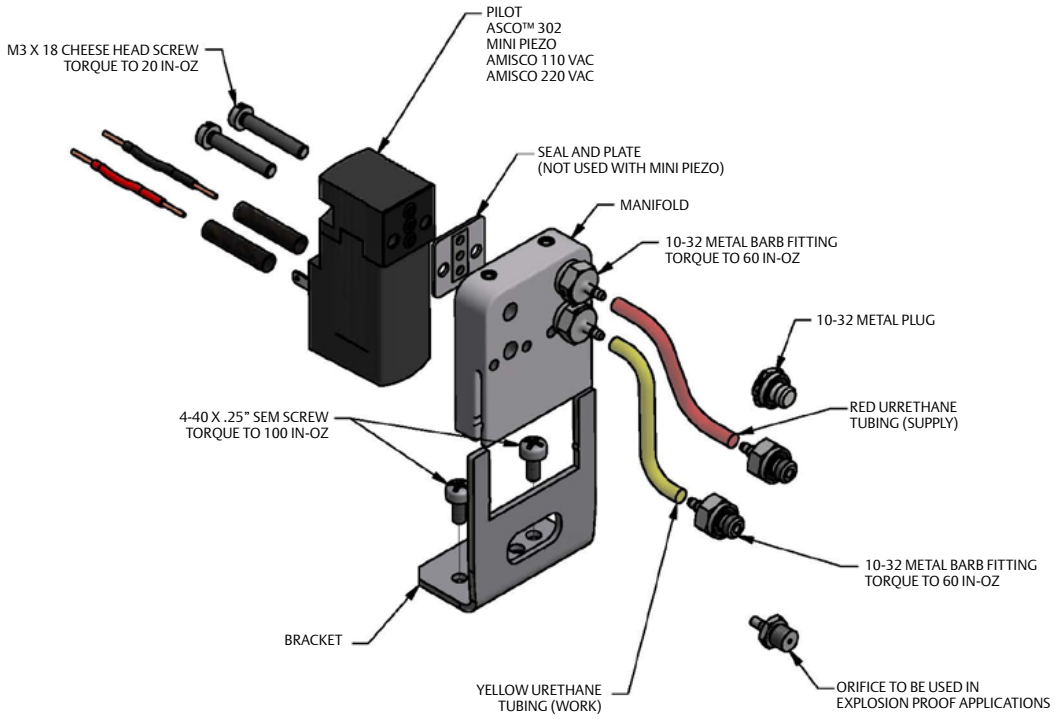
Breathers (AL-M31) should be installed in the exhaust ports to keep debris from falling into the spool valve and damaging the seals. This must be addressed prior to installation, or storage.

VALVE SPECIFICATION	
ITEM	PERFORMANCE
Media	Air
Media temperature	Min: -40°C (-40°F); Max: 60°C (140°F)
Operational ambient temperature	Min: -40°C (-40°F); Max: 60°C (140°F)
Inlet/system pressure	Min: 45 PSI (3.1 bar); Max: 150 PSI (10.3 bar)
Operational pressure differential	Min: 45 PSI (3.1 bar); Max: 150 PSI (10.3 bar)
Safe working pressure	150 PSI (10.3 bar)
Flow / Cv (Kv)	Cv = 0.86 (Kv = 0.74)
Body port connections	1/4" NPT
Allowable leakage	External: 2 sccm Internal: 10 cc/min max for -15°C to 60°C. 3300 cc/min max for -40°C to -15°C
Optimal design life	500,000 cycles
Material in contact with fluid	Body: Aluminium (black anodized) and Stainless Steel 316L Internal: Stainless Steel, LT, nitrile, PTFE, Acetal

* *Refer to the wiring diagram on the inside lid of your product to determine actual pin out location*

Spool Valves and Pilots

SINGLE PILOT ASSEMBLY



ESD CONVENTIONAL INSTRUCTION AND OPERATION—Fail Closed Valves

Operation: Before operation, the ESD must be calibrated (see Calibration below). After calibration, a Partial Stroke Test (PST) may be performed (see Partial Stroke Test below). The partial stroke time tolerance range can be selected as 20%, 30% or 40% (see Partial Stroke Time Tolerance Range Selection below). A single switch (on board and external) is used to perform the calibration, the partial stroke test and the tolerance range selection. These operations can be initiated from the control room with no need to shut down the entire plant. Nonvolatile memory stores the calibration value and the selected tolerance range value allowing for retention, even in the event of loss of power. The LED, both onboard and in the control room, flashes unique visual indicators to signal pass/fail of tests and possible maintenance issues (please see ESD Conventional Flow Chart and Message Table for ESD Conventional for more details).

*Note that the following instructions assume the valve is FAIL CLOSED and the direction of travel from CLOSED to OPEN is CCW.

Fail Closed

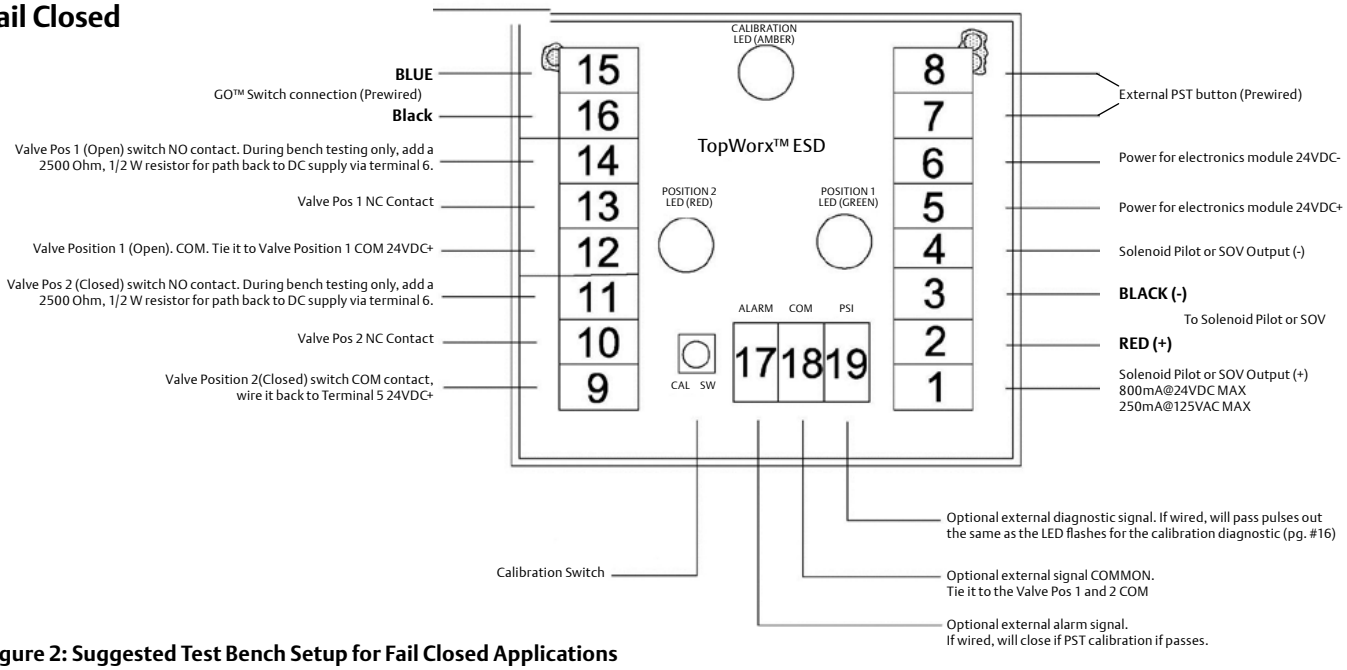


Figure 2: Suggested Test Bench Setup for Fail Closed Applications

Wiring Connections:

1. Terminals 1 and 4: External power source for switching the solenoid valve. Type and voltage level must match type of solenoid selected. Typical is 24VDC.
2. Terminals 2 and 3: Output to solenoid pilot or SOV.
3. Terminals 5 and 6: Power for electronics module. 5 MUST be +24VDC and 6 MUST be –24VDC.You can jumper the power from terminals 1 and 4 ifthe Solenoid is rated for 24VDC where a separate 24VDC supply is not available.
4. Terminals 7 and 8: Connection to external calibration and partial stroke test button (if installed). Can be used to remotely trigger PST and Calibration from aDCS.
5. Terminals 9 and 11: Switch common and normally open connections for valve position 2 limit switch. Typically connected to DCS for limit switch sensing. Forbench calibration or use in applications where alternate means of sensing valve position are used, these 2 terminals must still be provided withsource and return. The source and return for the electronics module power can be used, but a 2500 Ohm, 1/2W resistor MUST be installed betweenterminals 6 and 11 to prevent damage to the limit switch contacts from excess current.
6. Terminals 10 & 13: N/C side of Position 1 and 2 limit switch. Make sure current through switch is limited below maximum rating. If the system this unit is implemented on is monitoring the N/C side of the switches, a 2500 ohm, 1/2W resistor will need to wired between terminals 10 and 6, as well terminal 13 and 6 for visual indication. If the system is monitoring the N/O side, neither of these terminals are used.
7. Terminals 12 and 14: Switch common and normally open connections 1 limit switch. Typically connected to DCS for limit switch sensing. For benchcalibration or use in applications where alternate means of sensing valve position are used, these 2 terminals must still be provided with source andreturn. The source and return for the electronics module power can be used, but a 2500 Ohm, 1/2W resistor MUST be installed between terminals 6and 14 to prevent damage to the limit switch contacts from excess current.
8. Terminals 15 and 16: Prewired to the GO™ Switch. Do not change these connections.
9. Terminals 17, 18 and 19: External PST status signals:
   A. Terminal 17: PST status signal. In combination with terminal 18, it forms a dry contact that closes if the PST passes.
   B. Terminal 18: 24VDC source terminal for diagnostics and status output signal. Wire this to DCS 24VDC output.
   C. Terminal 19: PST diagnostic signal. When wired to a DCS DC I/O input, will deliver a pulse train after PST completes to report any diagnostic information.

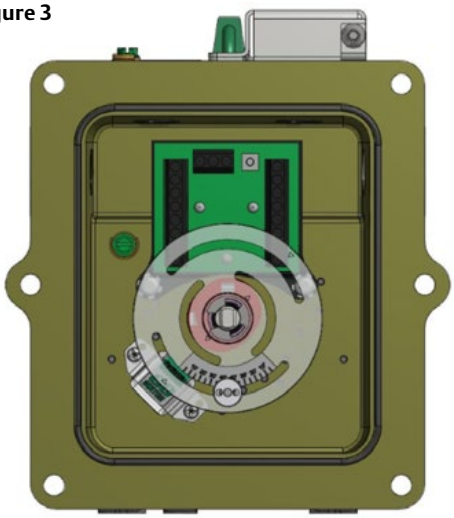
Partial Stroke Time Tolerance Range Selection:

1. The default partial stroke time tolerance range is set to 20%. This value can be selected as 20%, 30% or 40% anytime.The value will be recorded in the EEPROM (memory) of the micro controller.
2. Press and hold the push button for ten to fifteen seconds to set the partial stroke time tolerance range to 20%.If the value is saved to memory successfully, the LED and diagnostic relay will flash message code 5-1.
3. Press and hold the push button for within fifteen to twenty seconds to set the partial stroke time tolerance range to 30%.If the value is saved to memory successfully, the LED and diagnostic relay will flash message code 5-2.
4. Press and hold the push button for more than twenty seconds to set the partial stroke time tolerance range to 40%.If the value is saved to memory successfully, the LED and diagnostic relay will flash message code 5-3.
5. If there is a writing value to memory failure, the LED and diagnostic relay will flash message code 6-6. The Pass/Fail relay willbe turned OFF.

Hardware Configuration:

1. Ensure that the valve is in the OPEN position (the green position 1 LED should be illuminated.)
2. Refer to Fig. 3 which shows the correct orientation of the GO™ Switch target and sensor camsfor FAIL CLOSED valves.
3. If the unit conforms to this configuration, you may proceed to calibration. If not, completeHardware Configuration steps 4-7.
4. Lift the target wheel and rotate it such that the magnet is counterclockwise from the GO™ Switch.
5. Loosen and slide the magnet in the target wheel so as to position it approximately one inch from theedge of the GO™ Switch. Tighten to 20 in-oz.
6. Lift up on the upper cam and rotate it such that it is squarely aligned to the front of the electronicsmodule. The green light on the module should come on.
7. Press down on the lower cam and rotate it such that it is 90º counter clockwise from the electronics module.

Figure 3



Calibration:

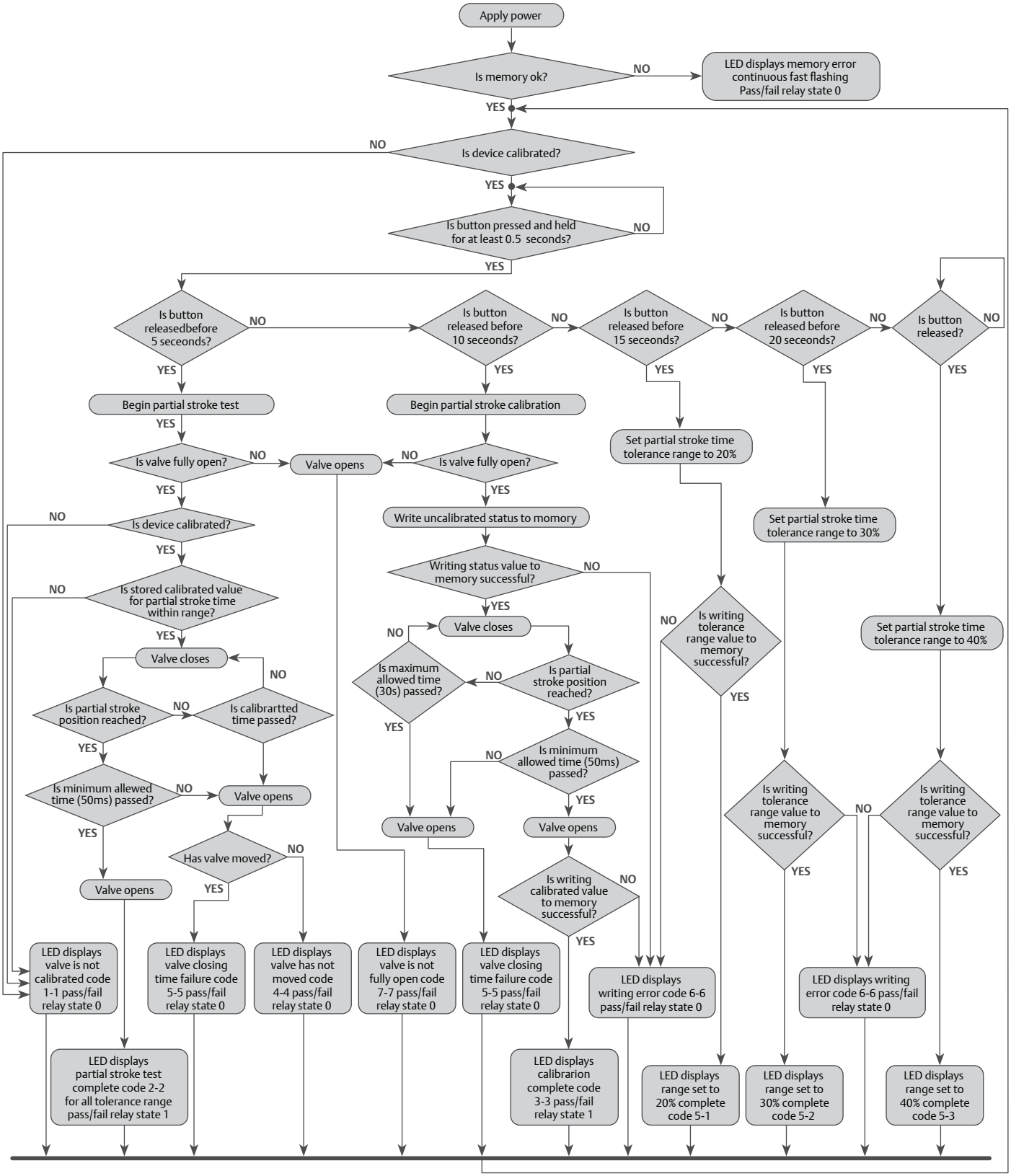
1. Before performing calibration, make certain the valve is fully open (the green position 1 LED should be illuminated,) and the target button is set to the properpartial position.
   *__NOTE: If the valve is not fully open, the test will abort and the LED and diagnostic relay will flash message code 7- 7 indicating thatthe valve is not fully open. The Pass/Fail relay will be turned OFF.__
2. Press and hold the calibration button on board for five to ten seconds.
3. The activation relay will be turned ON to initiate valve closing.
4. The valve will move until the GO™ Switch detects the partial stroke position.
5. The GO™ Switch will send feedback indicating that the predetermined position is reached.
6. The time required to move the valve from the “fully open position” to the “partially open position” is the partial stroke time of the valve. The acceptable timeranges are from fifty milliseconds to thirty seconds. This “partial stroke calibration time” will be recorded in the EEPROM (memory) of the micro controller.EEPROM will retain the value until your next calibration.
7. If the calibration is successful, the Pass/Fail relay will be turned ON and both the LED and diagnostic relay will flash message code 3-3.
8. After the LED flashes code for three cycles, both the LED and diagnostic relay will be steady, signifying that the calibration is complete. Reset of the flashingLED and the diagnostic relay may be performed at anytime while the LED is flashing by pressing the calibration button.

Partial Stroke Test:

1. Before performing the Partial Stroke Test (PST), make certain the valve is fully open.
   *__NOTE: If the valve is not fully open, the test will abort and the LED and diagnostic relay will flash message code 7-7 indicating that the valve isnot fully open. The Pass/Fail relay will be turned OFF.__
2. If using the onboard module calibration button, press the button and hold it for more than half a second and less than five seconds. If using the optional external PST button, push firmly once.
3. The activation relay will be turned ON to initiate valve closing.
4. The valve will move until the GO™ Switch detects the partial stroke position.
5. The time required to move the valve to the partial stroke position will be compared against the “partial stroke calibration time” value stored in EEPROM (memory). The acceptable time ranges from “(1-tolerance range value) x partial stroke calibration time” to”(1+tolerance range value) x partial stroke calibration time”. *For example*, if the partial stroke calibration time is 6 seconds and the tolerance range value is 20%, the acceptable PST time ranges are from 4.8 to 7.2 seconds.
6. If the time required for moving the valve to the Partial Stroke position is outside the acceptable range of the “partial stroke calibration time”, the test will beaborted, indicating valve failure. The Pass/Fail relay will remain OFF and both the LED and diagnostic relay will flash message code 5-5 if the valve has moved. If the valve has not moved, the Pass/Fail relay will remain OFF and both the LED and diagnostic relay will flash code 4-4.
   __CAUTION: Beforerecalibration, make sure any failure codes are addressed (see table pg.#16).__
7. If the time required is within the acceptable range, the Pass/Fail relay will be turned ON and both the LED and Diagnostic Relay will flash message code 2-2 .
8. After the LED flashes code for three times, both the LED and diagnostic relay will be steady, signifying that the Partial Stroke Test is complete.

*__Note: Partial Stroke Time Tolerance Range Selection, Calibration or Partial Stroke Test cannot be performed when the LED is flashing. Before rerunning the test, please wait for the LED to become steady or clear it by pressing the button.__

ESD Calibration/PST Flow Chart—Fail Closed Valves



ESD CONVENTIONAL INSTRUCTION AND OPERATION—Fail Open Valves

Operation:
For operation, the ESD must be calibrated (see Calibration below). After calibration, a partial stroke test may be performed (see Partial Stroke Test below). The partial stroke time tolerance range can be selected as 20%, 30% or 40% (see Partial Stroke Time Tolerance Range Selection below). A single switch (on board and external) is used to perform the calibration, the partial stroke test and the tolerance range selection. These operations can be initiated from the control room with no need to shut down the entire plant. Nonvolatile memory stores the calibration value and the selected tolerance range value allowing for retention, even in the event of loss of power. The LED, both onboard and in the control room, flashes unique visual indicators to signal pass/fail of tests and possible maintenancei ssues (please see **ESD Conventional Flow Chart and Message Table for ESD Conventional** on pg.#15 for more details).

***Note that the following instructions assume the valve is FAIL OPEN and the direction of travel from CLOSED to OPEN is CCW.**

Fail Open

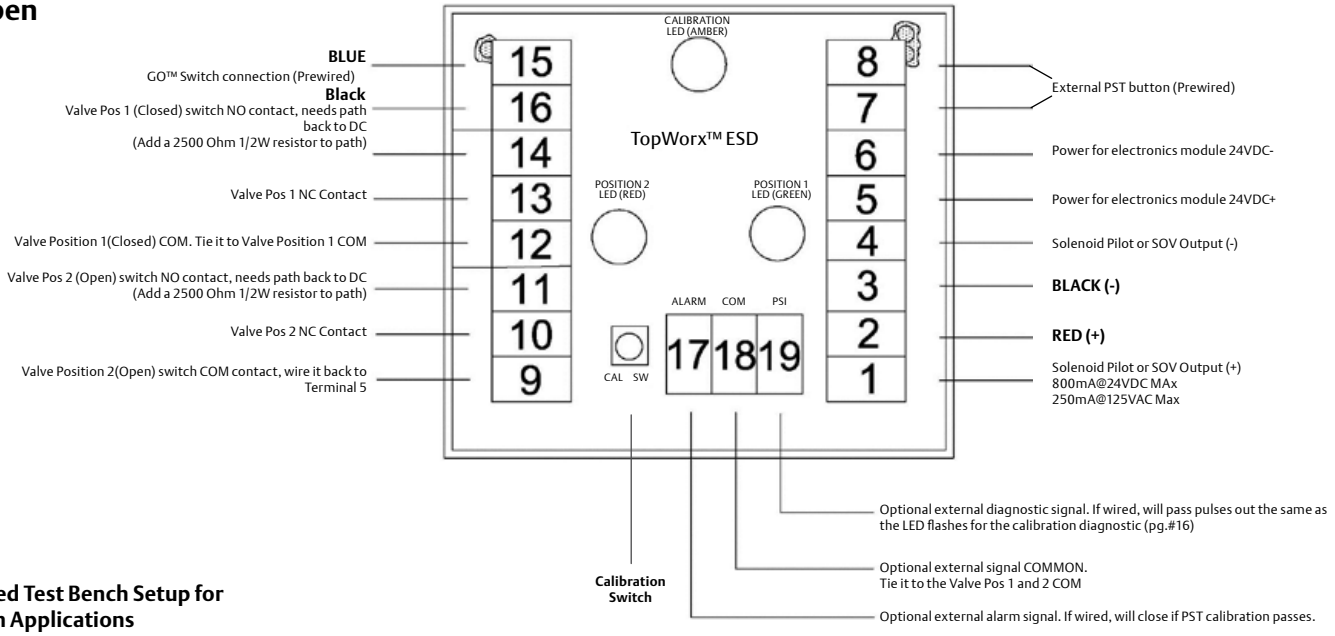


Figure 4:
Suggested Test Bench Setup for Fail Open Applications

Wiring Connections:

1. Terminals 1 and 4: External power source for switching the solenoid valve. Type and voltage level must match type of solenoid selected. Typical is 24VDC.
2. Terminals 2 and 3: Output to solenoid pilot or SOV.
3. Terminals 5 and 6: Power for electronics module. 5 MUST be +24VDC and 6 MUST be –24VDC.**You can jumper the power from terminals 1 and 4 if the Solenoid is rated for 24VDC where a separate 24VDC supply is not available.**
4. Terminals 7 and 8: Connection to external calibration and partial stroke test button (if installed). Can be used to remotely trigger PST and Calibration from a DCS.
5. Terminals 9 and 11: Switch common and normally open connections for valve position 2 limit switch. Typically connected to DCS for limit switch sensing. **For bench calibration or use in applications where alternate means of sensing valve position are used, these 2 terminals must still be provided with source and return. The source and return for the electronics module power can be used, but a 2500 Ohm, 1/2W resistor MUST be installed between terminals 6 and 11 to prevent damage to the limit switch contacts from excess current.**
6. Terminals 10 & 13: **N/C side of Position 1 and 2 limit switch. Make sure current through switch is limited below maximum rating. If the system this unit is implemented on is monitoring the N/C side of the switches, a 2500 ohm, 1/2W resistor will need to wired between terminals 10 and 6, as well terminal 13 and 6 for visual indication. If the system is monitoring the N/O side, neither of these terminals are used.**
7. Terminals 12 and 14: Switch common and normally open connections 1 limit switch. Typically connected to DCS for limit switch sensing. **For bench calibration or use in applications where alternate means of sensing valve position are used, these 2 terminals must still be provided with source and return. The source and return for the electronics module power can be used, but a 2500 Ohm, 1/2W resistor MUST be installed between terminals 6 and 14 to prevent damage to the limit switch contacts from excess current.**
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   B. Terminal 18: 24VDC source terminal for diagnostics and status output signal. Wire this to DCS 24VDC output.
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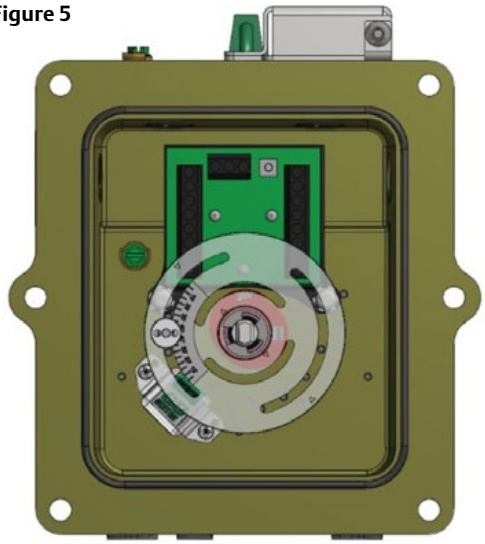
Partial Stroke Time Tolerance Range Selection:

1. The default partial stroke time tolerance range is set to 20%. This value can be selected as 20%, 30% or 40% anytime.The value will be recorded in the EEPROM (memory) of the micro controller.
2. Press and hold the push button for ten to fifteen seconds to set the partial stroke time tolerance range to 20%.If the value is saved to memory successfully, the LED and diagnostic relay will flash message code 5-1.
3. Press and hold the push button for within fifteen to twenty seconds to set the partial stroke time tolerance range to 30%.If the value is saved to memory successfully, the LED and diagnostic relay will flash message code 5-2.
4. Press and hold the push button for more than twenty seconds to set the partial stroke time tolerance range to 40%. If the value is saved tomemory successfully, the LED and diagnostic relay will flash message code 5-3.
5. If there is a writing value to memory failure, the LED and diagnostic relay will flash message code 6-6. The Pass/Fail relay will be turned OFF.

Hardware Configuration:

1. Ensure that the valve is in the CLOSED position (the green position 1 LED should be illuminated).
2. Refer to Fig. 5 which shows the correct orientation of the GO™ Switch target and sensor cams for FAILOPEN valves.
3. If the unit conforms to this configuration, you may proceed to calibration. If not, complete HardwareConfiguration steps 4-7.
4. Lift the target wheel and rotate it such that the magnet is counterclockwise from the GO™ Switch.
5. Loosen and slide the magnet in the target wheel so as to position it approximately one inch from the edgeof the GO™ Switch. Tighten to 20in-oz.
6. Lift up on the upper cam and rotate it such that it is squarely aligned to the front of the electronicsmodule. The green light on the module should come on.
7. Press down on the lower cam and rotate it such that it is 90º counter clockwise from the electronics module.

Figure 5



Calibration:

1. Before performing calibration, make certain the valve is fully closed (the green position 1 LED should be illuminated,) and the target button is set to the properpartial position.
   ***NOTE: If the valve is not fully closed, the test will abort and the LED and diagnostic relay will flash message code 7-7 indicating that the valve is not fully closed. The Pass/Fail relay will be turned OFF.**
2. Press and hold the calibration button on board for five to ten seconds.
3. The activation relay will be turned ON to initiate valve closing.
4. The valve will move until the GO™ Switch detects the partial stroke position.
5. The GO™ Switch will send feedback indicating that the predetermined position is reached.
6. The time required to move the valve from the “fully closed position” to the “partially closed position” is the partial stroke time of the valve. The acceptable timeranges are from fifty milliseconds to thirty seconds. This “partial stroke calibration time” will be recorded in the EEPROM (memory) of the micro controller.EEPROM will retain the value until your next calibration.
7. If the calibration is successful, the Pass/Fail relay will be turned ON and both the LED and diagnostic relay will flash message code 3-3.
8. After the LED flashes code for three times, both the LED and diagnostic relay will be steady, signifying that the calibration is complete. Reset of the flashingLED and the diagnostic relay may be performed at anytime while the LED is flashing by pressing the calibration button.

Partial Stroke Test:

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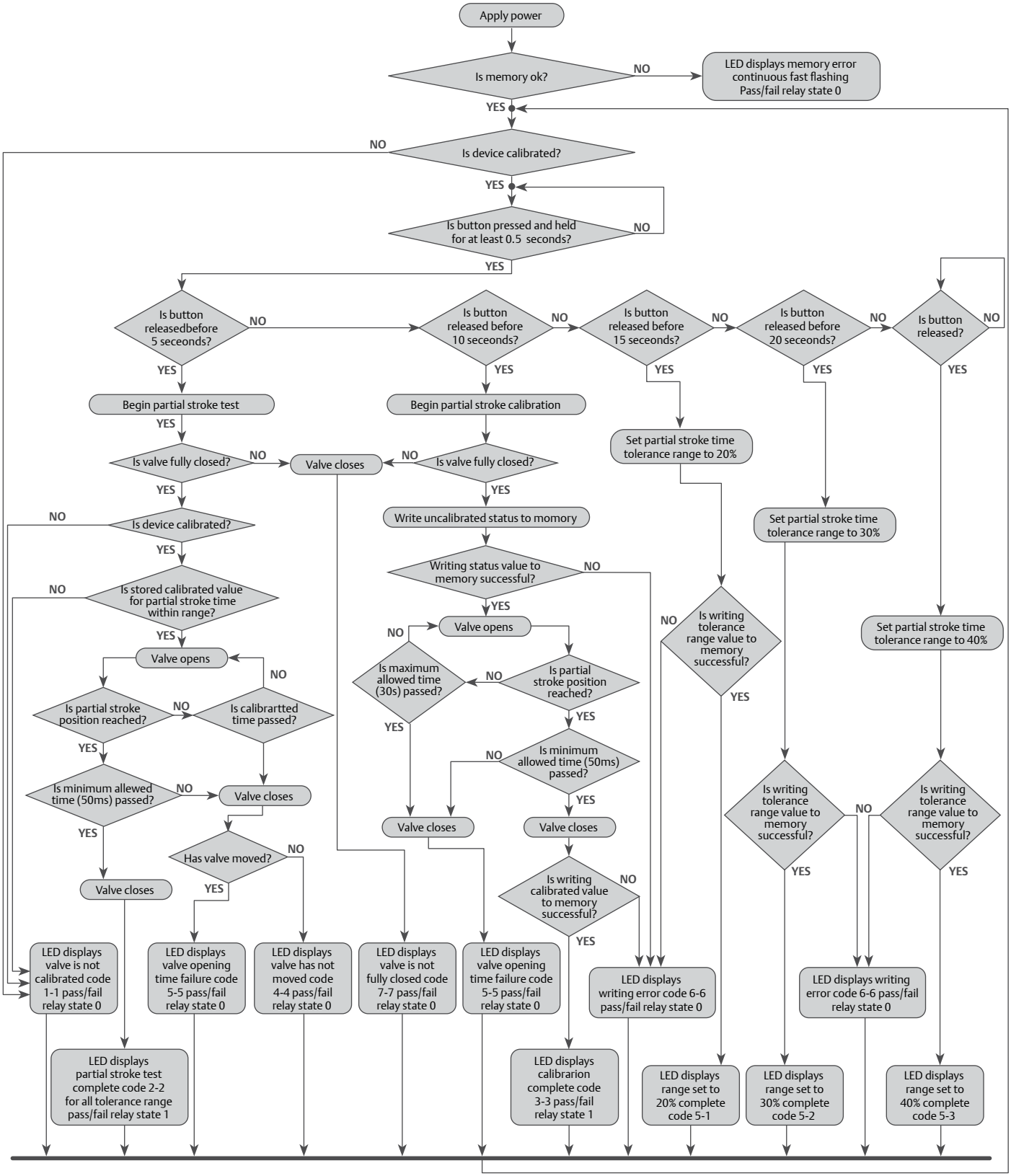
6. If the time required for moving the valve to the Partial Stroke position is outside the acceptable range of the “partial stroke calibration time”, the test will beaborted, indicating valve failure. The Pass/Fail relay will remain OFF and both the LED and diagnostic relay will flash message code 5-5 if the valve has moved. If the valve has not moved, the Pass/Fail relay will remain OFF and both the LED and diagnostic relay will flash code 4-4.
   __CAUTION: Beforerecalibration, make sure any failure codes are addressed (see table pg.#16).__
7. If the time required is within the acceptable range, the Pass/Fail relay will be turned ON and both the LED and Diagnostic Relay will flash message code 2-2 .
8. After the LED flashes code for three times, both the LED and diagnostic relay will be steady, signifying that the Partial Stroke Test is complete.

*__Note: Partial Stroke Time Tolerance Range Selection, Calibration or Partial Stroke Test cannot be performed when the LED is flashing. Before rerunning the test, please wait for the LED to become steady or clear it by pressing the button.__

ESD Calibration/PST Flow Chart—Fail Closed Valves



Message Table for ESD Conventional

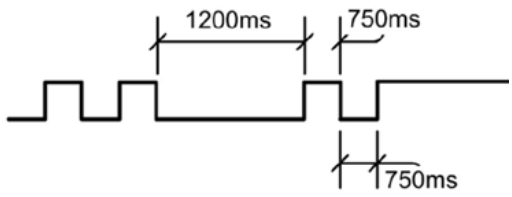
LED Status Flash Code	Diagnostic Relay Message	Problem Cause / Solution
Solid ON	Unit operating correctly	No action required
1 - 1	Device not calibrated	Need to perform the calibration procedure before the partial stroke test
2 - 2	Partial stroke test passed within tolerance range	No action required
3 - 3	Calibration completed	No action required
4 - 4	Valve has not moved during partial stroke test	Possible causes include: 1) The valve is stuck 2) The shaft is broken
5 - 1	Partial stroke time tolerance range is set to 20%	No action required
5 - 2	Partial stroke time tolerance range is set to 30%	No action required
5 - 3	Partial stroke time tolerance range is set to 40%	No action required
5 - 5	Partial stroke test failed	The valve did not reach the partial stroke position within the allotted time. Possible causes include: 1) The valve is stuck or sluggish 2) The GO™ Switch target for the partial stroke position is set incorrectly 3) The shaft is broken
6 - 6	Module memory error	Contact factory
7 - 7	Valve is not fully at the required open or closed position	Unit cannot calibrate or run a partial stroke test without the valve starting in the required open or closed position. Check the following: 1) Air supply to actuator 2) Solenoid is powered 3) Cam setting for fail open or fail closed valves as required
Continuous fast flashing	Hardware failure	Contact factory

Electrical Ratings	
	Current/Voltage
Open/Closed Indication	0.25A@24VDC w/5V drop 0.25A@120VAC w/5V drop
Dry Contact Rating	Minimum Current Through Switch Contacts: 5 mA
Module Voltage	18-28VDC
Module Current	50mA (MAX)
Pilot Current (Standard)	20mA
PST Feedback Relays	800mA@24VDC MAX 250mA@125VAC MAX
Solenoid Pilot/SOV Maximum PowerRating	800mA@24VDC MAX 250mA@125VAC MAX

Diagnostic Relay and Pass/Fail Relay Outputs:

The diagnostic relay outputs the status flash code as shown in the Message Table Above.

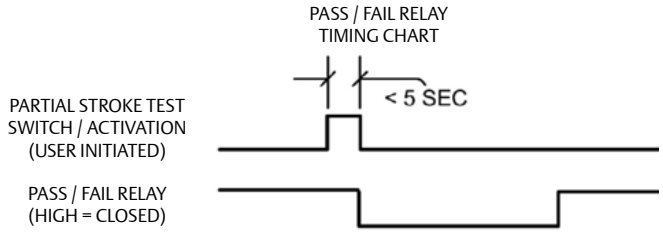
DIAGNOSTIC RELAY
TIMING CHART
EXAMPLE OF A 2-2 RESPONSE



The Pulse Train will repeat 3 times. In order to use this diagnostic relay output, control logic should count the number of positive transitions in order to get the message number. Clear the count register in the logic when you see a logic low (open) for more than one second. The Pulse Train can be reset anytime by activating the Calibration Switch or the PST/Calibration Activation Input.

Pass/Fail Relay:

The Pass/Fail Relay indicates whether the PST passed or failed. In this example the relay is closed (high) from the last successful Partial Stroke Test.



When the Partial stroke test button is pressed for less than 5 seconds the test begins and the Pass/Fail Relay opens (low). The Pass/Fail Relay closes again once the unit passes a Partial Stroke Test.

Hardware Fault Tolerance: HFT = 0
Device Type: Type A
Systematic Capability: SC3 - SIL3 Capable
Useful Life: 10 years

The proof test procedure should verify the ESD valve controller allows the ESD valve to function 100% on command, and that any failures related to the valve, actuator or partial stroke test function are revealed. The partial stroke test should be preformed monthly.

Special Conditions of Safe Use (All installations)

Clean only with a damp cloth to prevent possibility of electrostatic discharge.

For Explosion Proof installations, the internal ground connection shall be used and the external ground connection, if supplied in addition, is supplemental bonding allowed where local authorities permit, or is required.

When installing with a third party listed nipplemount solenoid, it is the responsibility of the installer to provide fittings, and apparatus, suitable for the area classification in accordance with the National Electrical Code.

All cable entry devices or conduit stopping boxes shall be certified in type of explosion protection ‘d’, suitable for the conditions of use and correctly installed.

The IIC enclosures are excluded from use in Carbon disulphide atmospheres.

The air pressure to the valve block, when fitted, shall not exceed 7 bar.

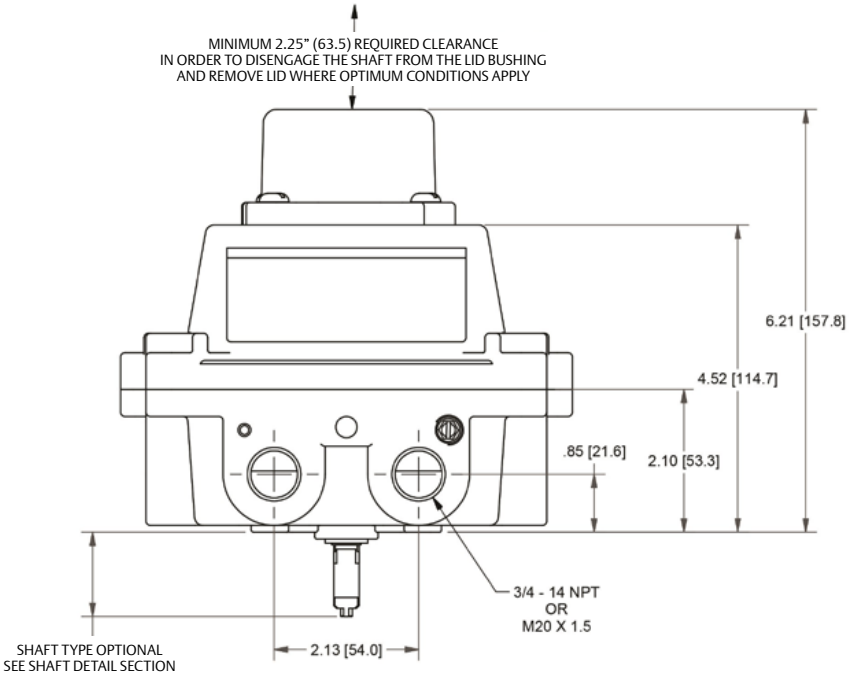
Preventative Maintenance

TopWorx™ are designed to operate for one million cycles without servicing. Call the factory when you are approaching this milestone for a preventative maintenance kit and instructions.

Personal preforming maintenance and testing on the product shall be competent to do so.

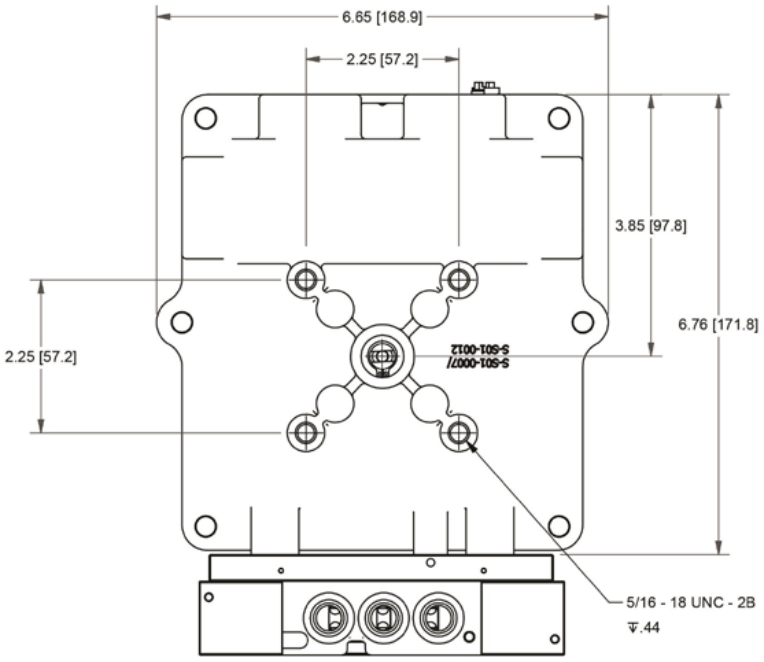
Dimensions and Materials: TopWorx™ DXP

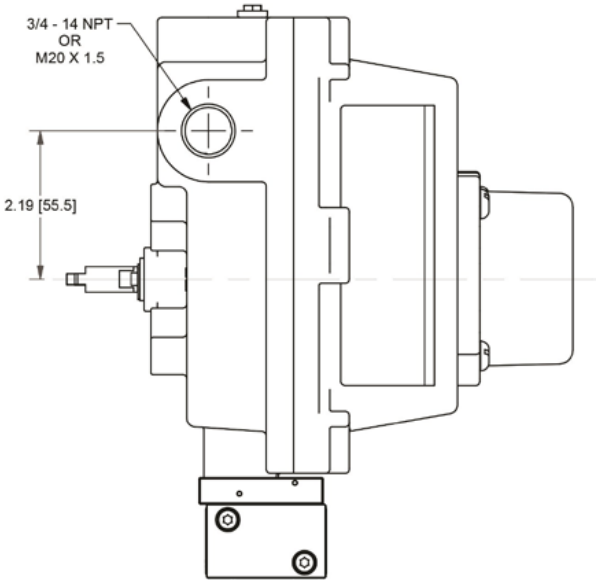
Cast aluminum bracket is recommended for installation with SS 8553 valve in vibrating environment.



MATERIALS OF CONSTRUCTION	
Enclosure	Cast A360 aluminum with dichromate conversion coating inside & out, epoxy coated exterior rated for 250 hrs. salt spray per ASTM B117
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	Oilite Bronze
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna, & Silicone

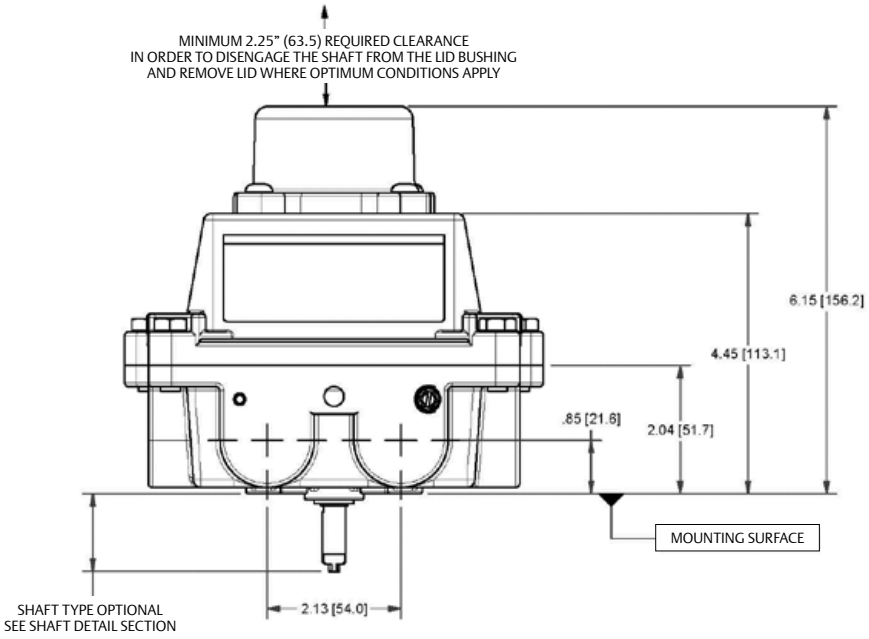
Fastener Torque Specifications	
Enclosure Housing Bolts	8 ft.-lbs [10.8 N·m] +/-10%
Indicator Dome Screws	320 in-oz. [2.3 N·m] +/-10%
Bottom Mounting Holes	10 ft.-lbs [13.6 N·m] +/-10%





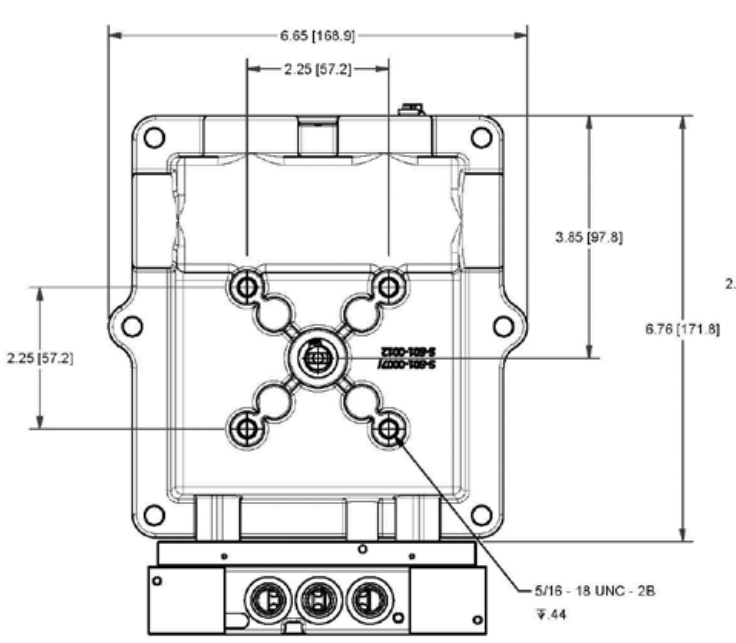
Dimensions and Materials: TopWorx™ DXP - Flameproof Ex d IIC

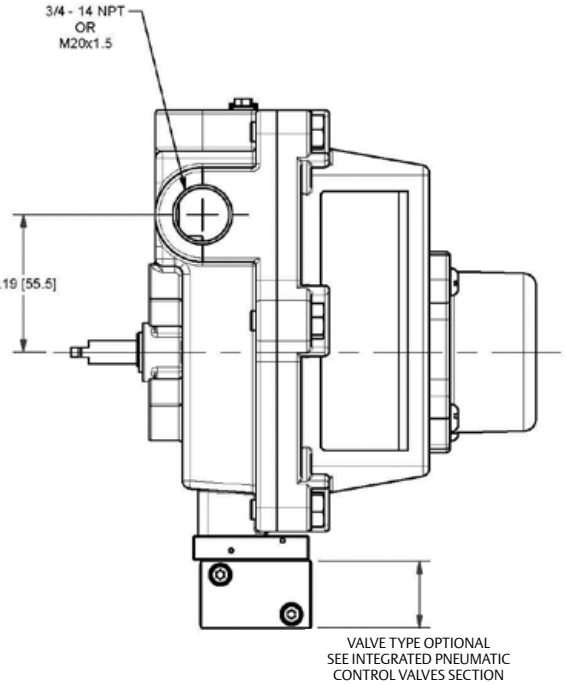
Cast aluminum bracket is recommended for installation with SS 8553 valve in vibrating environment.



MATERIALS OF CONSTRUCTION	
Enclosure	Cast A360 aluminum with dichromate conversion coating inside & out, epoxy coated exterior rated for 250 hrs. salt spray per ASTM B117
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	Oilite Bronze
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna, & Silicone

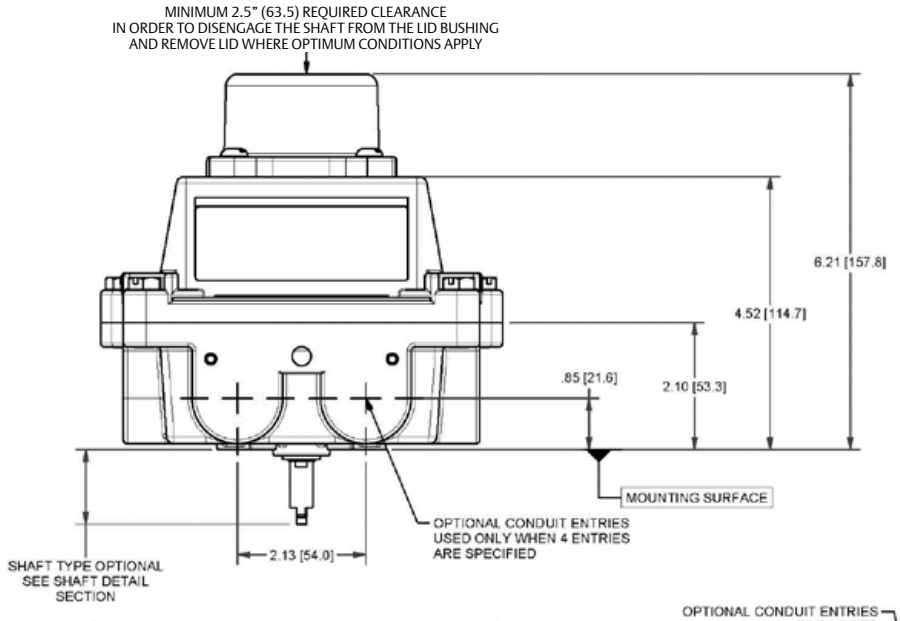
Fastener Torque Specifications	
Enclosure Housing Bolts	8 ft.-lbs [10.8 N·m] +/-10%
Indicator Dome Screws	320 in-oz [2.3 N·m] +/-10%
Bottom Mounting Holes	10 ft-lbs [13.6 N·m] +/-10%





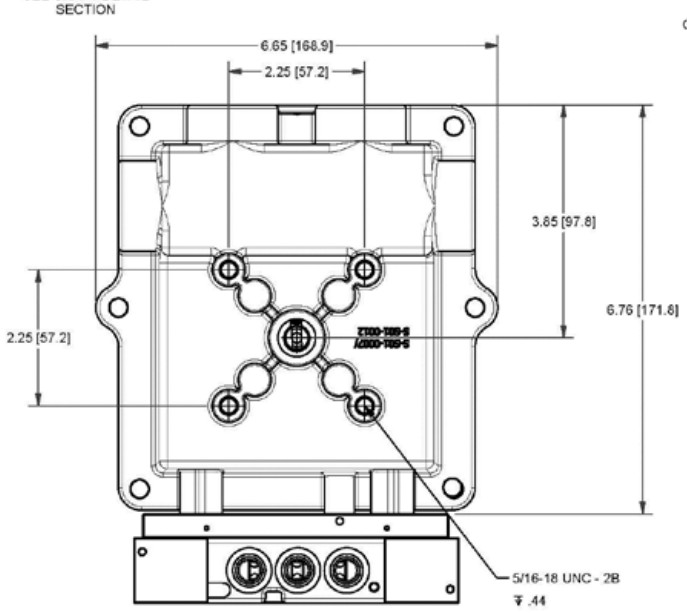
Dimensions and Materials: TopWorx™ DXS

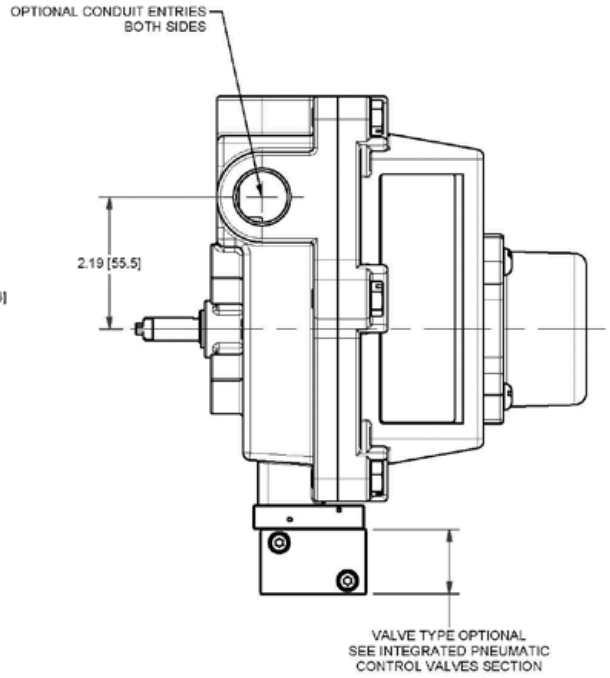
Cast aluminum bracket is recommended for installation with SS 8553 valve in vibrating environment.



MATERIALS OF CONSTRUCTION	
Enclosure	Cast 316 Stainless Steel
Fasteners	304 Stainless Steel standard 316 Stainless Steel optional
Shaft	304 Stainless Steel standard 316 Stainless Steel optional
Shaft Bushing	N/A
Indicator Dome	Polycarbonate, UV F1 rated
Seals	O-ring seals available in: Buna, & Silicone

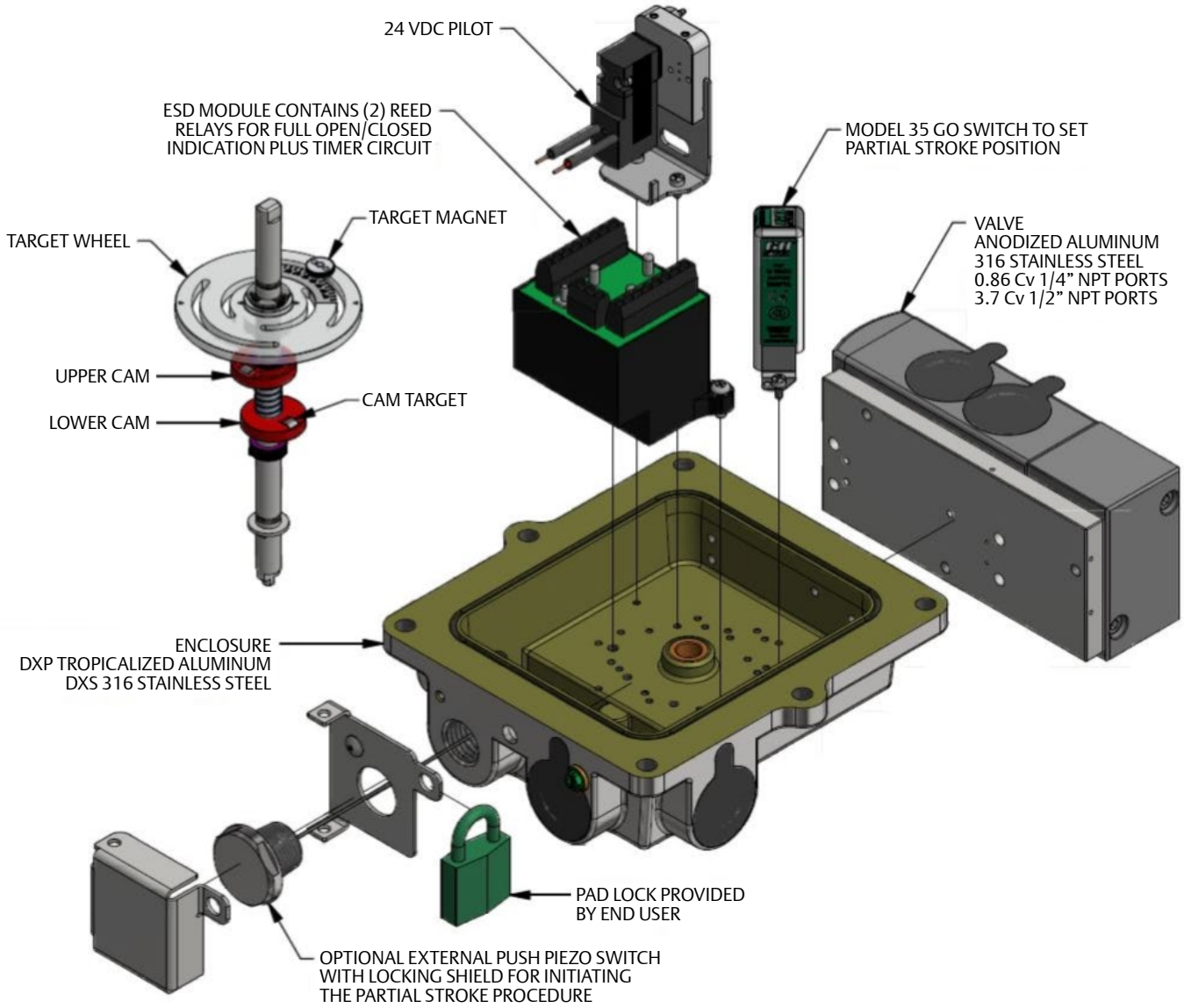
Fastener Torque Specifications	
Enclosure Housing Bolts	8 ft.-lbs [10.8 N·m] +/-10%
Indicator Dome Screws	320 in-oz. [2.3 N·m] +/-10%
Bottom Mounting Holes	10 ft.-lbs [13.6 N·m] +/-10%





Interior and Indicator Assemblies

Interior Assembly



Certifications & Approvals

Ex d IIC T* Gb or Ex d IIB+H2 T* Gb; Ex tb IIC T* Db IECEx SIR 07.0093X / Sira 07ATEX1273X USL/CNL Class I, Div 1, GrCD; Class II, Div 1, GrEFG UL File E125326
EAC RU C-US, M1062.B0027
KOSHA 19-GA4B0-0179X, 19-GA4BO-0180X & 19-GA4BO-0178X
NEPSI GY18.1386X
InMetro UL-BR 18.0096X
PESO P433642

Ex e MB IIC T* Gb; Ex tb IIIC T* Db
IECEx SIR 09.0088X / Sira 09ATEX3209X (DXR)

Ex nA nC IIC T* Gc; Ex tb IIIC T* Dc
USL/CNL Class I, Div 2, GrABCD; Class II, Div 2, GrFG UL
File E125326

USL/CNL General Purpose UL
File E359150

Environmental Ratings: Type 4, 4X; IP 66/67

Conformance to Directives: ATEX 2014/34/EU, EMC 2014/30/EV, LVD 2014/35/EO

*Operating and Ambient temperature ratings vary depending on bus/sensor option(s), reference certificate for specific markings available.

Consult factory for certification questions or to request a custom product.

Certificate / Certificat
Zertifikat / 合格証

EPM 1308108 C001

exida hereby confirms that the:

D-ESD Valve Controller

Topworx, Inc.
Louisville, KY - USA

Has been assessed per the relevant requirements of:

IEC 61508 : 2010 Parts 1-7

and meets requirements providing a level of integrity to:

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type A, Route 2_H Device

PFD_{AVG} and Architecture Constraints must be verified for each application

Safety Function:
The Valve Controller will move the associated actuator and valve to the designed safe position per the final element design within the specified safety time.

Application Restrictions:
The unit must be properly designed into a Safety Instrumented Function per the Safety Manual requirements.

The manufacturer may use the mark:

Revision 3.0 March 31, 2017
Surveillance Audit Due
April 1, 2020

Evaluating Assessor

Certifying Assessor

ANSI Accredited Program
ISO/IEC 17065
PRODUCT CERTIFICATION BODY
#1004

D-ESD Valve Controller

Certificate / Certificat / Zertifikat / 合格証

EPM 1308108 C001

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type A, Route 2_H Device

PFD_{AVG} and Architecture Constraints must be verified for each application

Systematic Capability:

The Product has met manufacturer design process requirements of Safety Integrity Level (SIL) 3. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer.
A Safety Instrumented Function (SIF) designed with this product must not be used at a SIL level higher than stated.

Random Capability:

The SIL limit imposed by the Architectural Constraints must be met for each element. This Device meets *exida* criteria for Route 2_H.

This certificate covers the following Model Designations:

Model Designation	Description
DXP/S-ESXXXXXXXXYX	Integrated Solenoid
DXP/S-ESXXXXXXXXYXZZZZ	Integrated Solenoid

IEC 61508 Failure Rates in FIT[1]

Application	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
Single Acting Actuator	0	284	0	217
Single Acting Actuator w/PVST[2]	281	3	201	16

[1] FIT = 1 failure / 10^9 hours
[2] PVST = Partial Valve Stroke Test

SIL Verification:

The Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) must be verified via a calculation of PFD_{AVG} considering redundant architectures, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and the specific failure rates of all products included in the SIF. Each subsystem must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

The following documents are a mandatory part of certification:

Assessment Report: EPM 13/08-108 R002 V3 R1

Safety Manual: ES-05481-1

80 N Main St
Sellersville, PA 18960

T-061, V2R1

Safe Use

User instructions (in compliance with ATEX 2014/34/EU Directive, Annex II, 1.0.6)

Instructions for safe selection, installation, use, maintenance and repair

1. The equipment may be used in zones 1 or 2.
2. The equipment may be used in the presence of flammable gases and vapors with apparatus groups IIC or IIB or IIA and with temperature classes T3, T4, T5 or T6.
3. The equipment is certified for use in ambient temperatures in the range of -50°C to +60°C and should not be used outside this range. *(NOTE: Ambient temperature range may change according to protection method)*
4. The equipment is to be installed by suitably trained personnel in accordance with the applicable code of practice (typically IEC 60079-14)
5. Under certain extreme circumstances, the plastic cover over the valve position indicator may generate an ignition-capable level of electrostatic charge. Therefore, particularly in the event of an installation in zone 0, the equipment shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge, e.g. wind-blown dust, etc. Additionally the equipment shall only be cleaned with a damp cloth.
6. Periodic inspection of the equipment and system should be performed by suitably trained personnel in accordance with the applicable code of practice (typically IEC 60079-17) to ensure it is maintained in a satisfactory condition.
7. The equipment does not require assembly or dismantling.
8. The equipment is not intended to be repaired by the user. Repair of the equipment is to be carried out by the manufacturer, or their approved agents, in accordance with the applicable code of practice.

Special Conditions of Safe Use (All installations)

Clean only with a damp cloth to prevent possibility of electrostatic discharge.

For Explosion Proof installations, the internal ground connection shall be used and the external ground connection, if supplied in addition, is supplemental bonding allowed where local authorities permit, or is required.

When installing with a third party listed nipple-mount solenoid, it is the responsibility of the installer to provide fittings, and apparatus, suitable for the area classification in accordance with the National Electrical Code.

All cable entry devices or conduit stopping boxes shall be certified according to protection type and suitable for the conditions of use and correctly installed.

The IIC enclosures are excluded from use in carbon disulphide atmospheres.

The air pressure to the valve block, when fitted, shall not exceed 10.0bar.

Special Conditions or Safe Use (Flameproof Installations)

1. The IIC enclosures are excluded from use in carbon disulphide atmospheres.
2. The air pressure to the valve block, when fitted, shall not exceed 10.0 bar.
3. For ambient temperatures above 110ºC, the degrees of ingress protection IP66 and IP67 are not endorsed.
4. The slotted hexagonal head cover screws are not of standard form; they shall only be replaced with identical screws sourced from the equipment manufacturer.
5. The hexagonal head cover screws are to be replaced only with stainless steel 304, grade A2-70 or A4-80 screws to ISO 35061.
6. Periodic inspection of the equipment and system should be performed by suitably trained personnel in accordance with the applicable code of practice (typically IEC 60079-17) to ensure it is maintained in a satisfactory condition.
7. Cover fasteners are to be tightened to a torque valve of 10.85Nm (8 ft./lbs) minimum.

Notes:

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For comprehensive information on our company, capabilities, and products – including model numbers, data sheets, specifications, dimensions, and certifications:

Visit us: **Emerson.com/TOPWORX**
Your local contact: **Emerson.com/contactus**

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ES-00936-1 R19-ENUS | 06-20

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