Safety Manual for Fisher™ Digital Isolation™ DSV1000 SIS Solution with Single SIL

Purpose

This safety manual provides information necessary to design, install, verify and maintain a Safety Instrumented Function (SIF) utilizing the Fisher Digital Isolation DSV1000 SIS Solution.

WARNING

This instruction manual supplement is not intended to be used as a stand-alone document. It must be used in conjunction with the applicable product instruction manuals and quick start guides listed in the related literature section.

Failure to use this instruction manual supplement in conjunction with the applicable product instruction manuals and quick start guides could result in personal injury or property damage. If you have any questions regarding these instructions or need assistance in obtaining any of these documents, contact your Emerson sales office.

Introduction

This manual provides necessary requirements for meeting the IEC 61508 or IEC 61511 functional safety standards.

Figure 1. Fisher Digital Isolation DSV1000 SIS Solution

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DIGITAL ISOLATION DSV1000 SIS SOLUTION WITH FIELDVUE™ DVC6200 SIS

Terms and Abbreviations

Safety: Freedom from unacceptable risk of harm.

Functional Safety: The ability of a system to carry out the actions necessary to achieve or to maintain a defined safe state for the equipment / machinery / plant / apparatus under control of the system.

Basic Safety: The equipment must be designed and manufactured such that it protects against risk of injury to persons by electrical shock and other hazards and against resulting fire and explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition.

Safety Assessment: The investigation to arrive at a judgment - based on the facts - of the safety achieved by safety-related systems.

Fail-Safe State: State where valve actuator is deenergized and spring is extended.

Fail Safe: Failure that causes the valve to go to the defined fail-safe state without a demand from the process.

Fail Dangerous: Failure that does not respond to a demand from the process (i.e. being unable to go to the defined fail-safe state).

Fail Dangerous Undetected: Failure that is dangerous and that is not being diagnosed by automatic stroke testing.

Fail Dangerous Detected: Failure that is dangerous but is detected by automatic stroke testing.

Fail Annunciation Undetected: Failure that does not cause a false trip or prevent the safety function but does cause loss of an automatic diagnostic and is not detected by another diagnostic.

Fail Annunciation Detected: Failure that does not cause a false trip or prevent the safety function but does cause loss of an automatic diagnostic or false diagnostic indication.

Fail No Effect: Failure of a component that is part of the safety function but that has no effect on the safety function.

Low demand mode: Mode, where the frequency of demands for operation made on a safety-related system is no greater than twice the proof test frequency.

Type A Element: “Non-complex” element (using discrete components). More details can be found in IEC 61508-2, para 7.4.4.1.2.

Type B Element: “Complex” element (using complex components such as micro controllers or programmable logic). More details can be found in IEC 61508-2, para 7.4.4.1.3.

λ: Failure rate.

λ_{DD}: Dangerous detected failure rate.

λ_{DU}: Dangerous undetected failure rate.

λ_{SD}: Safe detected failure rate.

λ_{SU}: Safe undetected failure rate.

β: Beta factor for common cause effects of failure.

Acronyms

DETT: De-energize To Trip.

ESD: Emergency Shut Down.

ETT: Energize To Trip.

FE: Final Element.

FIT: Failure In Time (1 x 10^{-9} failures per hour).

FMEDA: Failure Modes, Effects and Diagnostic Analysis.

HART: Highway Addressable Remote Transducer, open protocol for digital isolation.

HFT: Hardware Fault Tolerance.

PFD: Probability of Failure on Demand.

PFD_{AVG}: Average Probability of Failure on Demand.

PST: Full Valve Stroke Test.

PVST: Partial Valve Stroke Test.

SFF: Safe Failure Fraction, the fraction of the overall failure rate of a device that results in either a safe fault or a diagnosed unsafe fault.

SIF: Safety Instrumented Function, a set of equipment intended to reduce the risk due to a specific hazard (a safety loop).

SIL: Safety Integrity Level, discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions to be allocated to the E/E/PE safety-related systems where Safety Integrity Level 4 has the highest level of safety integrity and Safety Integrity Level 1 has the lowest.

SIS: Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).

SOV: Solenoid Valve.

Related Literature

Hardware Documents:

Bulletins:

Fisher Digital Isolation Solutions Selection Guide (D104340X012)
Fisher DSV1000 Product Bulletin (D104724X012)
Bettis Product Selection Guide (BRO-02-04-0208-EN-CS)
Fisher DVC6200 SIS Product Bulletin (D103555X012)
Fisher LCP200 Product Bulletin (D104313X012)
ASCO™ Selection Chart (00066GB-2019)
VBL Product Bulletin (D103393X012)
2625 Product Bulletin (D200071X012)
SS-263 Product Bulletin (D103592X012)

Quick Start Guides:

Fisher DVC6200 Series Quick Start Guide (D103556X012)
TopWorx™ D-Series Quick Start Guide (ES-02390-1)

Instruction Manuals:

Fisher DSV1000 Instruction Manual (D104727X012)
G Series Instruction Manual (124840E)
CBB Spring Return Series Instruction Manual (VA001-196-31)
CBA-300 Spring Return Series Instruction Manual (VCPDS-13402-EN)
Fisher DVC6200 SIS Instruction Manual (D103557X012)
Fisher LCP200 Instruction Manual (D104296X012)
TopWorx D-Series Instruction Manual (ES-01857-1)
ASCO Installation and Maintenance Sheets (ASCO.com)
VBL Instruction Manual (D103317X012)
2625 Instruction Manual (D100348X012)
SS-263 Instruction Manual (D103542X012)

Safety Manuals:

Fisher DSV1000 Safety Manual (D104728X012)
Bettis™ Safety Manual (VAWCO2991)
Fisher DVC6200 SIS Safety Manual (D103601X012)
ASCO Safety Manual (I&M No V 9629)
Fisher VBL Safety Manual (D103857X012)
Fisher 2625 Safety Manual (D103541X012)
Fisher SS-263 Safety Manual (D103985X012)

FMEDA:

Fisher Digital Isolation DSV1000 SIS Solution FMEDA (available upon request)

Guidelines/References:

- Safety Integrity Level Selection – Systematic Methods Including Layer of Protection Analysis, ISBN 1-55617-777-1, ISA
- Control System Safety Evaluation and Reliability, 2nd Edition, ISBN 1-55617-638-8, ISA
- Safety Instrumented Systems Verification, Practical Probabilistic Calculations, ISBN 1-55617-909-9, ISA

Reference Standards

Functional Safety

- IEC 61508: 2010 Functional safety of electrical/electronic/ programmable electronic safety-related systems
- ANSI/ISA 84.00.01-2004 (IEC 61511 Mod.) Functional Safety – Safety Instrumented Systems for the Process Industry Sector

Product Description

The Fisher Digital Isolation DSV1000 SIS Solution is a pre-designed and complete Final Element (FE), comprised of:

- Full Bore Trunnion Mounted Ball Valve
- Scotch Yoke Spring Return Actuator
- Accessory/Pneumatic Control Package

The Fisher Digital Isolation DSV1000 SIS Solution is operated by pneumatic pressure and supplied with different accessory packages, pre-configured for reliable fail-safe operation.

Table 1. Accessory Packages

Accessory Package	Product
1	DVC6200 SIS Digital Valve Controller + Filter/Regulator
2a	SOV in series with DVC6200 + Filter/Regulator (1oo2)
2b	SOV in series with DVC6200 + Filter/Regulator (1oo1 SOV, DVC6200 SIS for PST only)
3	DVC6200 SIS Digital Valve Controller + Volume Booster + Filter Regulator
4 and 6	SOV + Filter/Regulator (with or without non-safety fcn switchbox)
5	TopWorx D-ESD Controller + Filter/Regulator
7a	FIELDVUE DVC6200 SIS + SOV + Volume Booster + Filter/Regulator (1oo2 SOV, DVC6200 SIS)
7b	FIELDVUE DVC6200 SIS + SOV + Volume Booster + Filter/Regulator (1oo1 SOV, DVC6200 SIS for PST only)
8	FIELDVUE DVC6200 SIS (PST only) + 1oo2 SOV + Volume Booster + Filter/Regulator
9	DVC6200 SIS High Cv Digital Valve Controller + Filter/Regulator

The different accessory packages use a single acting, spring return actuator to take the FE to the safe state, when called upon by the Safety Instrumented System (SIS).

The safe state of the accessory package is reached de-energizing either the Solenoid valves (SOV) or the FIELDVUE DVC6200 SIS valve controller.

Detailed information of the functionality and diagnostic can be found under Configurations/Accessory Packages and Test and diagnostics of Final Element.

Designing a SIF Using DSV1000 SIS Solution

When using the Digital Isolation DSV1000 SIS Solution in a safety instrumented system, the following items must be reviewed and considered:

- Safety Function
- Environmental Limits
- Design Verification
- SIL Capability

Safety Function

De-energize to Trip Application: A DETT configuration moves the valve assembly to the safe state on loss of air, power, or control signal or when a shut-down command is issued.

Energize to Trip Application: An ETT configuration (a less common application) moves the valve assembly to the safe state when a shut-down command is issued.

Environmental limits

The designer of a SIF must check that the product is rated for use within the expected environmental limits. Refer to the applicable component instruction manuals and product bulletin for ambient temperature, humidity, electromagnetic compatibility, and vibration limitations.

Application limits

The materials of construction are specified in the product bulletins. A range of materials are available for various applications. The serial card will indicate what the materials of construction are for a specific final element assembly. It is especially important that the designer check for material compatibility considering on-site chemical contaminants and air supply conditions. If the assembly is used outside of the application limits or with incompatible materials, the reliability data provided becomes invalid.

Design Verification

A detailed FMEDA report is available from Emerson. This report details all failure rates and failure modes as well as the expected lifetime.

The achieved SIL of an entire SIF design must be verified by the designer via a calculation of PFD_{AVG} considering architecture, 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 HFT requirements.

The system's response time is dependent on the entire final element subsystem. The user must verify the system response time is less than the process safety time for each final element.

The valve actuation means must be of a type that automatically moves the valve to the safe state when the controls system achieves the safe state. Valve stroke timing under these conditions may also need to be considered as part of the SIS design.

The failure rate data listed the FMEDA report is only valid for the useful lifetime of the final element. The failure rates will increase after this time period. Reliability calculations based on the data listed in the FMEDA report for mission times beyond the useful lifetime may yield results that are too optimistic, i.e. the calculated Safety Integrity Level will not be achieved.

SIL Capability

Systematic Integrity

Figure 2. exida SIL 3 Capable

The product has met manufacturer design process requirements of SIL 3. These are intended to achieve sufficient integrity against systematic errors of design by the manufacturer. A SIF designed with this product must not be used at a SIL level higher than stated without “prior use” justification by the end user or diverse technology redundancy in the design.

Random Integrity

The SIL limit imposed by the Architectural Constraints must be met for each element. The Digital Isolation TOV SIS Solution meets *exida* criteria for Route 2_H.

Safety Parameters

For detailed failure rate information refer to the Failure Modes, Effects, and Diagnostic Analysis Report.

Connection of the Fisher Digital Isolation DSV1000 SIS Solution to the SIS Logic solver

The final element assembly is connected to the safety rated logic solver which is actively performing the Safety Function as well as any automatic diagnostics designed to diagnose potentially dangerous failures within the final element components (i.e. Partial Valve Stroke Test).

General Requirements

Refer to the Fisher Digital Isolation DSV1000 Instruction Manual (D104727X012) for mounting information. Refer to the relevant component instruction manual for wiring configurations, mounting, and tools needed.

The system's response time shall be less than process safety time. The final control element subsystem needs to be sized properly to assure that the response time is less than the required process safety time.

All SIS components must be operational before process start-up.

The user shall verify that the assembly is suitable for use in safety applications.

Personnel performing maintenance and testing on assembly shall be competent to do so. Results from the proof tests shall be recorded and reviewed periodically.

The useful life of the assembly is discussed in the Failure Modes, Effects, and Diagnostic Analysis Report.

Installation and Commissioning

Installation

⚠ WARNING

To ensure safe and proper functioning of equipment, users of this document must carefully read all instructions, warnings, and cautions in each applicable instruction manual.

The Fisher Digital Isolation DSV1000 SIS Solution must be installed per standard practices outlined in the instruction manual.

The environment must be checked to verify that environmental conditions do not exceed the ratings.

- Verify that nameplate markings of all the equipment being installed are suitable for the hazardous location (if required).
- Verify appropriate connections to the logic solver are made by referring to the instruction and safety manual of the logic solver.
- Calibration should be done in accordance with the appropriate instruction manual for all diagnostic devices.

Operation and Maintenance

Proof Testing

Periodic testing is required by SIS standards and should be carried out by qualified personnel. Results of periodic inspections and tests should be recorded and reviewed periodically.

The objective of proof testing is to detect failures within the device that are not detected by any automatic diagnostics of the system. Of main concern are undetected failures that prevent the SIF from performing its intended safety function.

The frequency of proof testing, or the proof test interval, is to be determined in reliability calculations for the SIF for which a device is applied. The proof tests must be performed at least as frequently as specified in the calculation in order to maintain the required safety integrity of the SIF.

The proof test shall be carried out by competent and qualified personnel, trained to carry out operations on SIS.

Refer to the relevant sections below for the components of the assembly as well as the relevant Safety and Instruction Manuals.

⚠ WARNING

To avoid personal injury or property damage, any time the SIF needs to be disabled, such as to perform a proof test or to take corrective action, appropriate measures must be taken to ensure the safety of the process.

Note

To ensure corrective action, continuous improvement, and accurate reliability prediction, the user must also work with their local Emerson service representative to see that all failures are reported.

DSV1000 Valve

Full Stroke Test

No specific tools are required for proof testing. Individual who will perform the proof test is expected to be trained in valve maintenance.

The proof test procedure for a full stroke of the device can be summarized as follows:

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. Interrupt or change the signal/supply to the actuator to force the actuator and the valve to perform a full stroke to the Fail-Safe position and confirm that the Safe State is achieved and within the correct time. In case of safety function to close check for valve seat tightness to verify that the valve (and not only the actuator) has reached the closed position; additionally, if tightness is a safety-related performance it is necessary to measure the seat leakage rate. In case of safety function to open check that the process flow rate is compatible with the fully open position of the valve.
3. Restore the supply/signal to the actuator and confirm that the normal operating state is achieved.
4. Inspect the valve and the final element components for any leaks, visible damage, or contamination.
5. Record the test results and any failures in your company's SIF inspection database.
6. Remove the bypass and restore normal operation.

The proof test procedure may be integrated by more specific instructions from the safety manuals of the actuator and/or positioner manufacturer.

Partial Stroke Test

The basic Partial Stroke test procedure can be summarized as follows:

1. Bypass the safety function and take appropriate action to avoid a false trip.
2. Interrupt or change the signal/supply to the actuator to force the actuator and the valve to perform a partial stroke (15 to 25 degrees) toward the Fail-Safe position and confirm that the expected position is achieved. In case of safety function to close with internal tightness it is not possible to verify the valve seat tightness.
3. Restore the supply/signal to the actuator and confirm that the normal operating state is achieved.
4. Inspect the valve and the final element components for any leaks, visible damage, or contamination.
5. Record the test results and any failures in your company's SIF inspection database.
6. Remove the bypass and restore normal operation.

The partial stroke test procedure may be integrated by more specific instructions from the actuator and/or positioner manufacturer.

CBB, CBA-300, and G-Series Actuator

No specific tools are required for proof testing. Individual who will perform the proof test is expected to be trained in actuator maintenance.

Proof test procedures for the valve also apply to the actuator. Refer to the DSV1000 Valve section for test procedures.

DVC6200 SIS

Full Stroke Test

As part of the test, the capability of the SIF to achieve the defined safe state must be verified. The proof test interval must be established for the SIF based on the failure rates of all the elements within the function and the risk reduction requirements. The proof test interval has to be at least two times more frequent than the demand rate. This determination is a critical part of the design of the SIS. A proof test will detect 77% (ETT) to 79% (DETT) of dangerous undetected failures not detected by the DVC6200 SIS automatic diagnostics. A proof test includes the following steps:

1. Read the digital valve controller alert record using a HART communicating device such as an Emerson Field Communicator, ValveLink™ software or a DD or DTM based host. Any active alert messages must be investigated and resolved.
2. Bypass the final control element or take appropriate action to avoid a false trip.
3. If used, bypass the safety function of the position monitor or take appropriate action to avoid a false trip.
4. If applying "with PVST" failure rates, verify that the Instrument Mode is In Service, End Point Pressure Control (EPPC) is enabled, and that the instrument Protection is set to "Config & Calib."
5. Trip the DVC6200 SIS to its safe state by either de-energization (for DETT) or energization (for ETT).
6. Observe that the actuator and valve move to its safe state within the required safety time through an instrument independent means (visual or other).
7. If used, observe that the position transmitter reports the actual valve position to within 5% accuracy throughout the range of travel as required by the application through an instrument-independent means (visual or other).
8. If used, observe that the limit switch is open through an instrument-independent means (visual or other).

9. Restore the DVC6200 SIS to its normal state by either energization (for DETT) or de-energization (for ETT).
10. Observe that the actuator and valve return to its normal state through an instrument-independent means (visual or other).
11. If applying “with PVST” failure rates, ensure that EPPC is operational by noting that output pressure from the instrument goes to the Pressure Set Point after the Pressure Saturation Time has elapsed (default 45 seconds).
12. If used, observe that the position transmitter reports the actual valve position to within 5% accuracy throughout the range of travel as required by the application through an instrument-independent means (visual or other).
13. If used, observe that the limit switch is closed through an instrument-independent means (visual or other).
14. Check air filters to ensure they are clean and operating properly.
15. Inspect the unit for any loose screws or other incorrect mechanical condition.
16. Record the test results and any failures in your company’s SIF inspection database.
17. Remove the bypass and restore normal operation.

Partial Stroke Test

Partial stroke tests are designed to provide Diagnostic Coverage for many of the failure modes of the final control element without affecting the process under control. To take credit for the “with PVST” failure rates, the user must ensure that partial stroke tests are performed at least 10 times more frequently than the expected demand rate. A partial stroke test can be configured to be initiated by the following means:

1. Schedule a partial stroke test to occur automatically on a time schedule (requires configuration).
2. Press the “test” button on the LCP100/LCP200.
3. Short the “aux” terminals on the DVC6200 SIS for 3 to 10 seconds (requires configuration).
4. Initiate a partial stroke test using an Emerson Field Communicator, ValveLink software, or a DD or DTM based host.

Should alarms, alerts, or failures be detected during operation, maintenance or periodic inspection and test, record the alarms, alerts, or failures, and immediately take corrective action. The diagnostics detection time for all failures including the PVST is determined by the PVST interval which is configured by the user.

To ensure corrective action, continuous improvement, and accurate reliability prediction, the user must also work with their local Emerson service representative to see that all failures are reported.

TopWorx

Full Stroke Test

The suggested proof test consists of a full stroke of the valve and actuator. Refer to the DSV1000 Valve section for test procedures.

Partial Stroke Test

Fail Closed Valves

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 is not fully open. The Pass/Fail relay will be turned OFF.

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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 be aborted, 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 di- agnostic relay will flash code 4-4.
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 re-running the test, wait for the LED to become steady or clear it by pressing the button.

Fail Open Valves

1. Before performing the Partial Stroke Test, 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 is not 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 be aborted, 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.
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 re-running the test, wait for the LED to become steady or clear it by pressing the button.

ASCO

Proof Test without Automatic Testing

The objective of proof testing is to detect failures within an ASCO Solenoid that are not detected by any automatic diagnostics of the system. Of main concern are undetected failures that prevent the safety instrumented function from performing its intended function.

The frequency of proof testing, or the proof test interval, is to be determined in reliability calculations for the safety instrumented functions for which an ASCO Solenoid is applied. The proof tests must be performed more frequently than or as frequently as specified in the calculation in order to maintain the required safety integrity of the safety instrumented function.

The following proof test is recommended. Any failures that are detected and that compromise functional safety should be reported to ASCO.

1. Bypass the safety PLC or take other appropriate action to avoid a false trip, following company Management of Change (MOC) procedures.
2. Inspect the external parts of the solenoid valve for dirty or clogged ports and other physical damage. Do not attempt disassembly of the valve.
3. De-energize the solenoid coil and observe that the actuator and valve move. Energize the solenoid after a small movement of the valve.
4. Inspect the solenoid for dirt, corrosion or excessive moisture. Clean if necessary and take corrective action to properly clean the air supply. This is done to avoid incipient failures due to dirty air.
5. Record any failures in your company's SIF inspection database. Restore the loop to full operation.
6. Remove the bypass from the safety PLC or otherwise restore normal operation.

The person(s) performing the proof test of an ASCO Solenoid should be trained in SIS operations, including bypass procedures, solenoid maintenance and company Management of Change procedures. No special tools are required.

Proof Test with Automatic Partial Valve Stroke Testing

An automatic partial valve stroke testing scheme that performs a stroke of the solenoid valve and measures valve movement timing will detect most potentially dangerous failure modes. It is recommended that a physical inspection (see step 2 from Proof Test without Automatic Testing above) be performed on a periodic basis with the time interval determined by plant conditions. Maximum inspection interval is 5 years, but an annual inspection is recommended.

VBL, 2625, and SS-263 Volume Boosters

Proof tests are full-stroke tests that are manually initiated. As part of the test, the capability of the SIF to achieve the defined safe state must be verified. The proof test interval must be established for the SIF based on the failure rates of all the elements within the function and the risk reduction requirements. This determination is a critical part of the design of the SIS.

A proof test includes the following steps:

1. Check air filters to ensure they are operating properly.
2. Inspect the unit for any loose screws, contamination or other visible incorrect mechanical condition.
3. Listen for air leaks when equipment is at steady-state.
4. Apply the safe command input to the SIF to force the valve to the Fail-Safe state and verify that this is achieved within the required time.
5. Restore the SIF to normal operation.

Repair and Replacement

Refer to the relevant instruction and operation manuals and for repair and replacement procedures for the components of the assembly.

Manufacturer Notification

Any failures that are detected and that compromise functional safety should be reported to Emerson. Please contact your Emerson sales office.

Appendix A

Startup Checklist

Refer to the relevant instruction and operation manuals and quick start guides for start-up procedures for the components of the assembly.

Fisher DVC6200 Series Quick Start Guide (D103556X012)
TopWorx D-Series Quick Start Guide (ES-02390-1)

Appendix B

Elements Tested with Proof Tests

Table 2. Recommended Full Stroke Proof Test

Accessory Package	Test Type	TESTED ELEMENTS						
		Valve	**Actuator**	**Interface/Bracket**	**DVC**	**SOV**	**D-ESD**	**VB**
1	FVST	X	X	X	X	N/A	N/A	N/A
	PVST	X	X	X	X	N/A	N/A	N/A
2a	FVST	X	X	X	X	X	N/A	N/A
	PVST	X	X	X	X	- - -	N/A	N/A
	SOV	- - -	- - -	- - -	- - -	X	N/A	N/A
2b	FVST	X	X	X	X	- - -	N/A	N/A
	PVST	X	X	X	X	- - -	N/A	N/A
	SOV	- - -	- - -	- - -	- - -	X	N/A	N/A
3	FVST	X	X	X	X	N/A	N/A	X
	PVST	X	X	X	X	N/A	N/A	X
4 and 6	FVST	X	X	X	N/A	X	N/A	N/A
5	FVST	X	X	X	N/A	N/A	X	N/A
	PVST	X	X	X	N/A	N/A	X	N/A
7a	FVST	X	X	X	X	X	N/A	X
	PVST	X	X	X	X	- - -	N/A	X
	SOV	- - -	- - -	- - -	- - -	X	N/A	- - -
7b	FVST	X	X	X	X	X	N/A	X
	PVST	X	X	X	X	- - -	N/A	X
	SOV	- - -	- - -	- - -	- - -	X	N/A	- - -
8	FVST	X	X	X	X	X	N/A	X
	PVST	X	X	X	X	- - -	N/A	X
	SOV	- - -	- - -	- - -	- - -	X	N/A	- - -
9	FVST	X	X	X	X	N/A	N/A	N/A
	PVST	X	X	X	X	N/A	N/A	N/A

X - Element is tested
- - - Element is not tested N/A - Element is not present

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