# A41 Valve - OBS Valve  cover page

## Contents



## Introduction

The product covered in this document is no longer in production. This document, which includes the latest published version of the instruction manual, is made available to provide updates of newer safety procedures. Be sure to follow the safety procedures in this supplement as well as the specific instructions in the included instruction manual.

Part numbers in the included instruction manual should not be relied on to order replacement parts. For replacement parts, contact your Emerson sales office.

For more than 20 years, Fisher products have been manufactured with asbestos-free components. The included manual might mention asbestos containing parts. Since 1988, any gasket or packing which may have contained some asbestos, has been replaced by a suitable non-asbestos material. Replacement parts in other materials are available from your sales office.

## Safety Instructions

Please read these safety warnings, cautions, and instructions carefully before using the product.

These instructions cannot cover every installation and situation. Do not install, operate, or maintain this product without being fully trained and qualified in valve, actuator and accessory installation, operation and maintenance. **To avoid personal injury or property damage it is important to carefully read, understand, and follow all of the contents of this manual, including all safety cautions and warnings.** If you have any questions about these instructions, contact your Emerson sales office before proceeding.

# Specifications

This product was intended for a specific range of service conditions--pressure, pressure drop, process and ambient temperature, temperature variations, process fluid, and possibly other specifications. **Do not expose the product to service conditions or variables other than those for which the product was intended.** If you are not sure what these conditions or variables are, contact your Emerson sales office for assistance. Provide the product serial number and all other pertinent information that you have available.

# Inspection and Maintenance Schedules

All products must be inspected periodically and maintained as needed. The schedule for inspection can only be determined based on the severity of your service conditions. Your installation might also be subject to inspection schedules set by applicable governmental codes and regulations, industry standards, company standards, or plant standards.

In order to avoid increasing dust explosion risk, periodically clean dust deposits from all equipment.

When equipment is installed in a hazardous area location (potentially explosive atmosphere), prevent sparks by proper tool selection and avoiding other types of impact energy. Control Valve surface temperature is dependent upon process operating conditions.

**⚠ WARNING**

**Control valve surface temperature is dependent upon process operating conditions. Personal injury or property damage, caused by fire or explosion, can result if the valve body surface temperature exceeds the acceptable temperature for the hazardous area classification. To avoid an increase of instrumentation and/or accessory surface temperature due to process operating conditions, ensure adequate ventilation, shielding, or insulation of control valve components installed in a potentially hazardous or explosive atmosphere.**

# Parts Ordering

Whenever ordering parts for older products, always specify the serial number of the product and provide all other pertinent information that you can, such as product size, part material, age of the product, and general service conditions. If you have modified the product since it was originally purchased, include that information with your request.

**⚠ WARNING**

**Use only genuine Fisher replacement parts. Components that are not supplied by Emerson Automation Solutions should not, under any circumstances, be used in any Fisher product, because they may void your warranty, might adversely affect the performance of the product, and could cause personal injury and property damage.**

# Installation

## ⚠ WARNING

- **Personal injury or equipment damage caused by sudden release of pressure or bursting of parts may result if the valve assembly is installed where service conditions could exceed the limits given in the applicable product literature, the limits on the appropriate nameplates, or the mating pipe flange rating. Use pressure-relieving devices as required by government or relevant industry codes and good engineering practices. If you cannot determine the ratings and limits for this product, contact your Emerson sales office before proceeding.**
- **To avoid personal injury, always wear protective gloves, clothing, and eyewear when performing any installation operations.**
- **If hoisting the valve, use a nylon sling to protect the surfaces. Carefully position the sling to prevent damage to the actuator tubing and any accessories. Also, take care to prevent people from being injured in case the hoist or rigging might slip. Be sure to use adequately sized hoists and chains or slings to handle the valve.**
- **Personal injury could result from packing leakage. Valve packing was tightened before shipment; however, the packing might require some readjustment to meet specific service conditions.**
- **Many rotary shaft valves are not necessarily grounded to the pipeline when installed in a flammable, hazardous, oxygen service, or explosive atmospheres. An explosion is possible, due to the discharge of static electricity from the valve components. To avoid personal injury or property damage, make sure that the valve is grounded to the pipeline before placing the control valve assembly into service. Use and maintain alternate shaft-to-body bonding, such as a shaft-to-body bonding strap assembly.**
- **Rotary shaft valves are designed and intended for installation between flanges. Personal injury or property damage may result from improper installation. To avoid personal injury or property damage caused by the sudden release of pressure or bursting of parts, do not use or install rotary shaft valves (including single lug constructions) for dead-end service.**
- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**
- **If installing into an existing application, also refer to the WARNING in the Maintenance section.**
- **When ordered, the valve configuration and construction materials were selected to meet particular pressure, temperature, pressure drop, and controlled fluid conditions. Responsibility for the safety of process media and compatibility of valve materials with process media rests solely with the purchaser and end-user. To avoid possible personal injury and because some valve/trim material combinations are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Emerson sales office.**

## CAUTION

- **When ordered, the valve configuration and construction materials are generally selected to meet particular pressure, temperature, pressure drop and controlled fluid conditions. Since some body/trim material combinations are limited in their pressure drop and temperature ranges, do not apply any other conditions to the valve without first contacting your Emerson sales office.**
- **Ensure that the valve and adjacent pipelines are free of foreign material that could damage the valve seating surfaces.**

# Maintenance

## ⚠ WARNING

**Avoid personal injury or property damage from sudden release of process pressure or bursting of parts. Before performing any maintenance operations:**

- **Always wear protective gloves, clothing, and eyewear.**
- **Disconnect any operating lines providing air pressure, electric power, or a control signal to the actuator. Be sure the actuator cannot suddenly open or close the valve.**
- **Use bypass valves or completely shut off the process to isolate the valve from process pressure.**
- **Do not remove the actuator while the valve is pressurized.**
- **Relieve process pressure from both sides of the valve. Drain the process media from both sides of the valve.**
- **Vent the pneumatic actuator loading pressure and relieve any actuator spring pre-compression.**
- **Use lock-out procedures to be sure that the above measures stay in effect while you work on the equipment.**
- **The valve packing box might contain process fluids that are pressurized, *even when the valve has been removed from the pipeline*. Process fluids might spray out under pressure when removing the packing hardware or packing rings, or when loosening the packing box pipe plug. Cautiously remove parts so that fluid escapes slowly and safely.**
- **Many valve parts that are moving can injure you by pinching, cutting, or shearing. To help prevent such injury, stay clear of any moving part.**
- **Never apply pressure to a partially assembled valve.**
- **To avoid personal injury or property damage caused by uncontrolled movement of a valve bonnet, loosen the bonnet by following these instructions: Do not remove a stuck bonnet by pulling on it with equipment that can stretch or store energy in any other manner. The sudden release of stored energy can cause uncontrolled movement of the bonnet. Loosen bonnet nuts approximately 3 mm (0.125 inch). Then loosen the body-to-bonnet gasketed joint by either rocking the bonnet or prying between the bonnet and body. Work the prying tool around the bonnet until the bonnet loosens. If no fluid leaks from the joint, proceed with bonnet removal.**
- **As you remove parts, such as valve shafts, other parts, such as disks can fall from the valve body or suddenly move to another position in the valve. To avoid injury from falling or moving parts, be sure to support parts and be sure they are in a stable position as you disassemble the valve.**
- **Personal injury could result from packing leakage. Do not scratch the drive shaft or packing box wall while removing packing parts.**
- **Check with your process or safety engineer for any additional measures that must be taken to protect against process media.**



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# Safety manual for Fisher™ A41 Valve

## Purpose

This safety manual provides information necessary to design, install, verify and maintain a Safety Instrumented Function (SIF) utilizing the Fisher A41 valve.

**⚠ WARNING**

**This instruction manual supplement is not intended to be used as a stand-alone document. It must be used in conjunction with the following manual: Fisher A41 High Performance Butterfly Valve Instruction Manual (D500211X012)**
**Failure to use this instruction manual supplement in conjunction with the above referenced manual 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 or Local Business Partner.**

## Introduction

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

Figure 1. Fisher A41 Valve


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# 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 damage 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 de-energized 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.

# Acronyms

**FMEDA:** Failure Modes, Effects and Diagnostic Analysis

**HFT:** Hardware Fault Tolerance

**MOC:** Management of Change. These are specific procedures often done when performing any work activities in compliance with government regulatory authorities.

**$PFD_{AVG}$:** Average Probability of Failure on Demand

**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).

## Related Literature

Hardware Documents:

Fisher A41 Valve Instruction Manual

*Instruction Manual:*
A41: D500211X012

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: 2000 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 A41 valve features an eccentrically mounted disc with a soft or stainless steel seal ring. Soft seals provide excellent sealing capabilities in both flow directions. The metal seal ring provides excellent shutoff against pressure applied in the recommended flow direction for both liquid and gas applications. The NOVEX and Phoenix III metal seals are available for demanding applications requiring excellent shutoff capabilities. The double D shaft combines with a variety of power and manual actuators to form a reliable, high-performance valve suitable for many power applications requiring tight shutoff. It is typically used with other interface components (valve actuator and positioner or solenoid valve) to provide a final element subsystem for a Safety Instrumented Function (SIF).

# Designing a SIF Using Fisher A41 Valves

## Safety Function

When the valve's actuator is de-energized, the actuator and valve shall move to its fail-safe position. Depending on which configuration is specified fail–closed or fail-open, the actuator will rotate the valve disk to close off the flow path through the valve body or open the flow path through the valve body.

The A41 valve is intended to be part of final element subsystem as defined per IEC 61508 and the achieved SIL level of the designed function must be verified by the designer.

## Pressure, Temperature, and Environmental limits

The designer of a SIF must check that the product is rated for use within the expected environmental limits. Refer to the A41 valve product bulletin for environmental limits.

## Application limits

The materials of construction of A41 valves are specified in the product bulletin. A range of materials are available for various applications. The serial card will indicate what the materials of construction are for a given valve. It is especially important that the designer check for material compatibility considering on-site chemical contaminants and environmental conditions. If the A41 valve is used outside of the application limits or with incompatible materials, the reliability data provided becomes invalid.

## Diagnostic Response Time

The A41 valve does not perform any automatic diagnostic functions by itself and therefore has no diagnostic response times of its own. However, automatic diagnostics of the final control subsystem may be performed such as Partial Valve Stroke Testing (PVST). This typically will exercise the valve over a small percentage of its normal travel without adversely affecting the flow through the valve. If any failures of this PVST are automatically detected and annunciated, the diagnostic response time will be the PVST interval time. The PVST must be performed 10 times more often than an expected demand in order for credit to be given for this test. Typically this test could be performed monthly or weekly.

## Design Verification

A detailed Failure Mode, Effects, and Diagnostics Analysis (FMEDA) report is available from Emerson. This report details all failure rates and failure modes as well as the expected lifetime.

The achieved Safety Integrity Level (SIL) of an entire Safety Instrumented Function (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 hardware fault tolerance (HFT) requirements.

When using A41 valves in a redundant configuration, a common cause factor of at least 5% should be included in the Safety Integrity calculations. This value is dependent on the level of common cause training and maintenance in use at the end user's facility.

The failure rate data listed the FMEDA report is only valid for the useful lifetime of A41 valves. 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 IEC 61508 Safety Integrity Level 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 without “prior use” justification by the end user or diverse technology redundancy in the design.

## Random Integrity

A41 valves are classified as a Type A device according to IEC 61508, having a hardware fault tolerance of 0. The complete final element subsystem, with a Fisher butterfly valve as the final control element, will need to be evaluated to determine the Safe Failure Fraction of the subsystem. If the SFF for the entire final element subsystem is between 60% and 90%, a design can meet SIL 2 @ HFT=0.

## Safety Parameters

For detailed failure rate information refer to the Failure Modes, Effects and Diagnostic Analysis Report for the A41 valve.

# Connection of the Fisher A41 Valve to the SIS Logic-solver

The final element subsystem (consisting of a positioner, actuator, and A41 valve) 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 A41 valve , actuator and any other final element components, (i.e. Partial Valve Stroke Test).

## General Requirements

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. The A41 valve will move to its safe state in less than the required SIF's safety time (a typical value is 3 seconds) under the specified conditions.

All SIS components including the A41 valve must be operational before process start-up.

The user shall verify that the A41 valve is suitable for use in safety applications.

Personnel performing maintenance and testing on the A41 valve shall be competent to do so.

Results from the proof tests shall be recorded and reviewed periodically.

The useful life of the A41 valve is discussed in the Failure Modes, Effects, and Diagnostic Analysis Report for the Fisher A41 valve.

# Installation and Commissioning

## Installation

The Fisher A41 valve must be installed per standard practices outlined in the appropriate instruction manual.

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

The A41 valve must be accessible for physical inspection.

## Physical Location and Placement

The Fisher A41 valve shall be accessible with sufficient room for the actuator, pneumatic connections, any other components of the final control element. Provisions shall be made to allow for manual proof testing.

Pneumatic piping to the actuator shall be kept as short and straight as possible to minimize the airflow restrictions and potential clogging. Long or kinked pneumatic tubes may also increase the valve closure time.

The A41 valve shall be mounted in a low vibration environment. If excessive vibration can be expected special precautions shall be taken to ensure the integrity of pneumatic connectors or the vibration should be reduced using appropriate damping mounts.

# Operation and Maintenance

## Suggested Proof Test

The objective of proof testing is to detect failures within the A41 valve that is 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 A41 valves are 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 proof test shown in table 1 is recommended. The results of the proof test should be recorded and any failures that are detected and that compromise functional safety should be reported to Emerson. The suggested proof test consists of a full stroke of the A41 valve.

The person(s) performing the proof test of A41 valves should be trained in SIS operations, including bypass procedures, valve maintenance and company Management of Change procedures. No special tools are required.

Table 1. Recommended Full Stroke Proof Test

| Step | Action |
|---|---|
| 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 valve to perform a full stroke to the Fail-Safe state and confirm that the Safe State was achieved and within the correct time. |
| 3 | Restore the supply/signal to the actuator and confirm that the normal operating state was achieved. |
| 4 | Inspect the A41 valve and the other final control 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. |

## Repair and replacement

Repair procedures in the appropriate valve instruction manual must be followed.

## Manufacturer Notification

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

# Appendix A

## Sample Startup Checklist

This appendix provides a Sample Start-up Checklist for Fisher A41 valves. A start-up checklist will provide guidance during the final control elements employment.

# Start-Up Checklist

The following checklist may be used as a guide to employ A41 valves in a safety critical SIF compliant to IEC61508.

| # | Activity | Result | Verified | |
|---|---|---|---|---|
| | | | By | Date |
| | **Design** | | | |
| | Target Safety Integrity Level and $PFD_{AVG}$ determined | | | |
| | Correct valve mode chosen (Fail-closed, Fail-open) | | | |
| | Design decision documented | | | |
| | Pneumatic compatibility and suitability verified | | | |
| | SIS logic solver requirements for valve tests defined and documented | | | |
| | Routing of pneumatic connections determined | | | |
| | SIS logic solver requirements for partial stroke tests defined and documented | | | |
| | Design formally reviewed and suitability formally assessed | | | |
| | **Implementation** | | | |
| | Physical location appropriate | | | |
| | Pneumatic connections appropriate and according to applicable codes | | | |
| | SIS logic solver valve actuation test implemented | | | |
| | Maintenance instructions for proof test released | | | |
| | Verification and test plan released | | | |
| | Implementation formally reviewed and suitability formally assessed | | | |
| | **Verification and Testing** | | | |
| | Electrical connections verified and tested | | | |
| | Pneumatic connection verified and tested | | | |
| | SIS logic solver valve actuation test verified | | | |
| | Safety loop function verified | | | |
| | Safety loop timing measured | | | |
| | Bypass function tested | | | |
| | Verification and test results formally reviewed and suitability formally assessed | | | |
| | **Maintenance** | | | |
| | Tubing blockage / partial blockage tested | | | |
| | Safety loop function tested | | | |



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