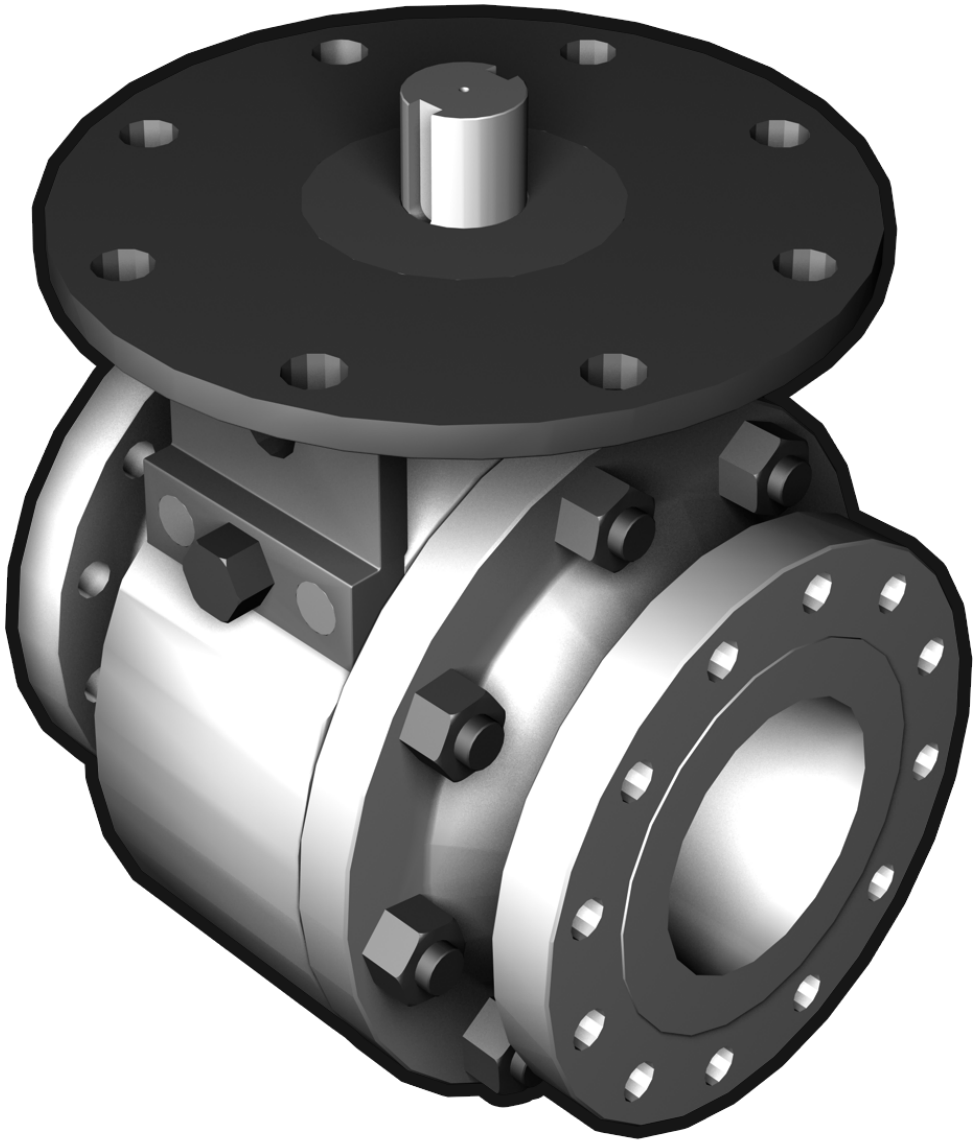
SIL Safety Manual

MOGAS C-Series Floating Ball Valve



MOGAS® SEVERE SERVICE BALL VALVES

SIL Safety Manual

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Contents

Introduction 3

Scope and Purpose of the Safety Manual....3

Skill Level Required....3

Terms, Abbreviations, and Acronyms....3

Product Support & Service 4

Related Documents....4

Reference Standards....4

MOGAS C-Series Floating Ball Valve Description....5

Designing a SIF using the MOGAS C-Series Floating Ball Valve....6

Safety Function 6

Environmental Limits 6

Application Limits 6

Design Verification 6

SIL Capability 6

– Systematic Integrity....6

– Random Integrity....6

– Safety Parameters 7

Implementation of MOGAS C-Series Floating Ball Valve in a SIS....7

General Requirements 7

Installation & Commissioning....8

Installation....8

Physical Location and Placement....8

Pneumatic Connections....8

Operation & Maintenance....9

Proof Test Requirement 9

Repair and Replacement....9

Useful Life 9

Notification of Failures....9

MOGAS® SEVERE SERVICE BALL VALVES

Introduction

Scope and Purpose of the Safety Manual

This safety manual provides the information necessary to design, verify, and maintain a Safety Instrumented Function utilizing the MOGAS C-Series Floating Ball Valve per IEC 61508 or IEC 61511 functional safety standards.

Skill Level Required

System design, installation, and verification shall be carried out by competent personnel as defined by IEC 61508.

Terms, Abbreviations, and Acronyms

Basic Safety	Freedom from unacceptable risk of harm.
BPCS	Basic Process Control System - A System which responds to input signals from the process, associated equipment, and/or an operator and generates output signals causing the process and its associated equipment to operate in the desired way. The BPCS cannot perform any safety instrumented functions rated with a SIL > 1 unless it meets proven in use requirements.
Fail Dangerous	Failure that does not respond to a demand from the process.
Fail Detected	Failure that is detected as part of a PVST.
Fail No Effect	Failure of a component that is part of the safety function that has no effect on the safety function.
Fail Safe	A characteristic of a particular device which causes that device to move to a safe state when it loses electrical or pneumatic energy.
Fail Undetected	Failure that is not detected as part of a PVST.
FMEDA	Failure Modes, Effects and Diagnostics Analysis
FS	Functional Safety - Freedom from unacceptable risk achieved through the safety lifecycle.
HFT	Hardware Fault Tolerance
Low Demand	Mode of operation where the frequency of demands for operation made on a safety related system is no greater than twice the proof test frequency.
PFD_{AVG}	Average Probability of Failure on Demand

PVST	Partial Valve Stroke Test
SFF	Safe Failure Fraction – fraction of the overall random failure rate of a device that results in a safe fault or a diagnosed unsafe fault.
SIF	Safety Instrumented Function – A set of equipment with a calculated SIL intended to reduce the risk due to a specific hazard. A MOGAS Ball Valve has 3 SIF's: Close on Demand, Open on Demand, and Close on Demand with Tight Shout-Off.
SIL	Safety Integrity Level – A quantitative target for measuring the level of performance needed for safety function to achieve a tolerable risk for a process hazard.
SIS	Safety Integrated System – Instrumented system used to implement one or more SIFs.
Useful Life	The estimated life span of an instrument in a FS application. For MOGAS Ball Valves, the useful Life is typically related to the Performance Guarantee supplied with the valve.

Product Support & Service

All Servicing for MOGAS C-Series Floating Ball Valves shall be conducted by a MOGAS Industries repair facility in order to satisfy the Functional Safety requirements of MOGAS' SIL certification. Please refer to the contact information at the end of this document for more information.

Related Documents

- MOGAS C-Series IOM
- MOGAS C-Series SIL Certification – *MOG 1610021 C001*
- MOGAS C-Series SIL Assessment Report – *MOG 16-10-021 R003*
- MOGAS C-Series FMEDA – *MOG 16-10-021 R001*

NOTE: The above stated documents can be located at https://www.mogas.com/en-us/resources/media-centre.

Reference Standards

IEC 61508 – Functional Safety of Electrical / Electronic / Programmable Electronic Safety-Related Systems.

ANSI/ISA 84.00.01-2004 (IEC 61511) Functional Safety – Safety Instrumented Systems for the Process Industry Sector.

MOGAS C-Series Floating Ball Valve Description

1 Floating ball design

- Rotating ball does not displace volume or solids
- Straight-through bore path protects sealing surfaces

2 Pressure-energized sealing

- Seat springs maintain constant sealing contact between ball and seats
- Allows for thermal expansion of trim
- Metal seats wipe sealing surface of ball clean during operation

3 Wide seat sealing surface

- Matched ball and seat sets provide total sealing contact for reliable isolation
- Greater sealing contact area withstands minor scratches or abrasions

4 Independent replaceable seats

- Minimizes maintenance and repair costs

5 Blowout-proof stem design

- One piece design meets industry safety standards
- Withstands severe service torques and maximum working pressures

6 Dual-guided stem design

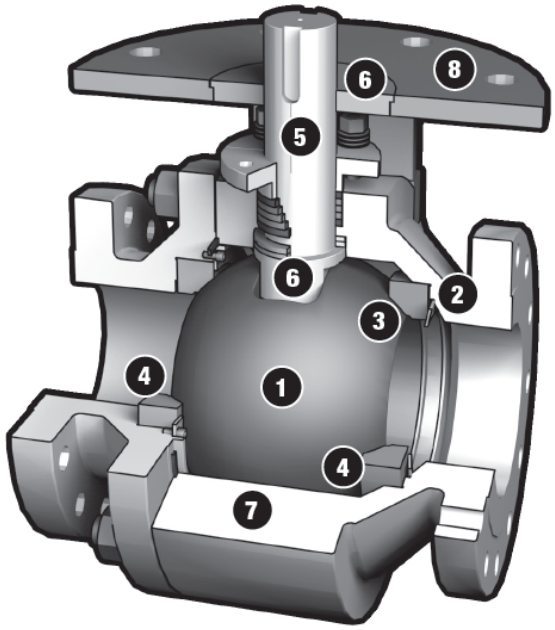
- Pressure-energized inner stem seals serve as thrust bearing and lower stem guide
- Valve stem bushing serves as upper stem guide
- Eliminates lateral movement of valve stem
- Prevents media migration
- Prevents stem packing leaks and risk of fugitive emissions

7 Forged body & end connections

- Greater wall thickness in critical areas provides longer valve life
- 2- or 3-piece designs

8 Heavy-duty mounting flange

- Machined after attaching to ensure precise stem alignment
- Provides structural support for operator mounting
- Provides visual inspection for confirmation of ball position



Application Specific Options	
Seat designs	• Engineered for maximum performance in application-specific conditions
Live-loaded packing	• Ensures constant packing energization • Prevents stem packing leaks and risk of fugitive emissions
Body Gaskets	• Pressure energized body gasket available to meet industry codes
Materials	• Application-specific materials available, including exotics • Extends valve life
Coatings	• Application-specific coatings provide enhanced erosion and corrosion resistance
Liners and inlays	• Liners and inlays can be applied to the through-bore or wetted surfaces
Purge ports	• Purge ports are available for recommended periodic maintenance
End connections	• Available end connections include flanged, welded, hub/clamp or RTJ

MOGAS® SEVERE SERVICE BALL VALVES

Designing a SIF using the MOGAS C-Series Floating Ball Valve

Safety Function

The safety function for a MOGAS C-Series Floating Ball Valve is to effectively move the valve to the save position (defined by end user application) within the specified safety time upon a trip.

Environmental Limits

The designer of the SIF must verify that the product is rated for use within the expected environmental limits, maximum working pressure and temperature, as well as useful life.

Application Limits

The materials of construction of a MOGAS Ball Valve are specified in the Packing Slip Report or the Order Verification Report (OVR) provided with every order. It is especially important that the SIF designer verify material compatibility considering on-site chemical contaminants and that the supply conditions for air/hydraulic actuation (per application) is sufficient. If the MOGAS Ball Valve is used outside of the application limits defined in the OVR, the reliability data and SIL Capability Assessment becomes invalid.

Design Verification

A detailed FMEDA report is available from MOGAS Industries upon request. This report details all failure rates and failure modes for the C-Series Floating Ball Valve. The achieved SIL of the SIF design must be verified by the designer via a calculation of the PFD_{AVG} considering the architecture, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time, common cause factors, and the specific failure rates of all equipment included in the SIF.

The failure rate data listed in the FMEDA report is only valid over the Useful Life of the MOGAS C-Series Floating Ball Valve which typically correlates to its Performance Guarantee specified for each MOGAS valve. Contact your MOGAS Rep for more details.

SIL Capability

Systematic Integrity

The MOGAS C-Series Floating Ball Valve has met the manufacturer design process requirements of Safety Integrity Level (SIL) 3. These valves are intended to achieve sufficient integrity against systematic errors of design by MOGAS. A SIF designed with this product must not be used at a SIL higher than SIL 3 without “prior use” justification by the end user, or verification of diverse technology in the design.

Random Integrity

According to IEC 61508 the architectural constraints of an element must be determined. This can be done by following the 1H approach according to 7.4.4.2 of IEC 61508 or the 2H approach according to 7.4.4.3 of IEC 61508.

The 1H approach involves calculating the SFF for the entire element.

The 2H approach involves assessment of the reliability data for the entire element according to 7.4.4.3.3 of IEC 61508.

The MOGAS Ball Valve is classified as a device that is part of a “Type A” element according to IEC 61508, having a HFT of 0.

The MOGAS Ball Valve can be classified as a 2H device when the failure rates listed in the FMEDA report are used for the Design Verification Calculations. When 2H data is used for all of the devices in an element, then the element meets the hardware architectural constraints up to SIL 2 @ HFT=0 (or SIL 3 @ HFT=1) depending on the end user application.

When all the devices in an element are not Route 2H applicable, Route 1H must be utilized.

NOTE: More details can be found in the MOGAS C-Series SIL Certification, *MOG 1610021 C001*.

Safety Parameters

For detailed failure rate information, refer to the FMEDA report for the MOGAS C-Series Ball Valve, *MOG 16-10-021 R001*.

Implementation of MOGAS C-Series Floating Ball Valve in a SIS

The MOGAS C-Series Floating Ball Valve can be packaged with a SIL certified actuator & controls that meets the Systematic Capability requirements of the MOGAS Valve if specified by the end user.

The safety rated logic solver shall actively perform the safety function (specified by the end user) as well as automatic diagnostics (PVST) designed to prevent potentially dangerous failures within the MOGAS Ball Valve.

General Requirements

The system and function response time shall be less than the process safety time. The MOGAS C-Series Floating Ball Valve will move to its defined safe state in less than the process safety time with respect to the specific hazard scenario.

All SIS components including the MOGAS C-Series Floating Ball Valve must be operational before process start-up.

The end user shall verify that the MOGAS C-Series Floating Ball Valve is suitable for use in their safety applications by confirming the valve specifications on the nameplate.

All personnel performing maintenance and testing on the MOGAS C-Series Floating Ball Valve shall first be assessed as being competent to do so.

Results from periodic proof tests and PVSTs shall be recorded and periodically reviewed.

The MOGAS C-Series Floating Ball Valve shall not be operated beyond its Useful Life without undergoing service or repairs by an authorized MOGAS service representative.

Installation & Commissioning

Installation

The MOGAS C-Series Floating Ball Valve must be installed per the standard practices outlined in the IOM Manual (Installation, Operation, and Maintenance Manual) supplied with the valve. See Related Documents for IOM location.

The environmental conditions must be verified such that they do not exceed the ratings detailed on the valve nameplate.

The MOGAS C-Series Floating Ball Valve must be accessible for physical inspection.

Physical Location and Placement

The MOGAS C-Series Floating Ball Valve shall be accessible with sufficient room for pneumatic connections to the actuator and shall allow for manual proof testing to take place.

The MOGAS C-Series Floating Ball Valve shall be mounted in a low vibration environment. If excessive vibration can be expected, then special precautions shall be taken to ensure the integrity of pneumatic connectors or the vibration should be reduced using appropriate damping mounts.

Pneumatic Connections

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

Only dry instrument air filtered to 50 micron level or better shall be used.

The process air pressure shall meet the requirements set forth in the actuator IOM.

The process air capacity shall be sufficient to move the valve within the required process safety time.

Operation & Maintenance

Proof Test Requirement

During operation, a low demand mode SIF must be proof tested. The objective of proof testing is to detect failures within the equipment in the SIS that are not detected by any automatic diagnostics of the system. Of main concern are undetected failures that prevent the SIS from performing its SIF.

Periodic proof tests shall take place at the frequency (or interval) defined by a SIL verification calculation performed by a competent SIS designer. The recommended Proof Test Interval for a MOGAS C-Series Ball Valve is 8760 hours.

The proof tests must be performed more frequently (or as frequently as) specified in the SIL verification calculation in order to maintain the required SIL of the SIF. Results from periodic proof tests and PVSTs shall be recorded and periodically reviewed as applicable.

Repair and Replacement

Repair and Maintenance procedures outlined in the IOM supplied with the MOGAS C-Series Floating Ball Valve must be followed by competent personnel.

In order for MOGAS' SIL Certificate to be upheld, all repair and service requests should be carried out by an authorized MOGAS service representative.

Useful Life

The Useful Life for a MOGAS C-Series Floating Ball Valve is determined per application and typically correlates to the Performance Guarantee of the Ball Valve.

The Useful Life must not be exceeded in order to maintain the SIL certification of the MOGAS C-Series Floating Ball Valve.

> **NOTE:** More information about the MOGAS Performance Guarantee can be found at https://www.mogas.com/en-us/why-mogas/performance-guarantee.

Notification of Failures

In case of malfunction of the system of SIF, the MOGAS Ball Valve shall be put out of operation and the process shall be kept in a safe state by other measures.

MOGAS must be informed when the MOGAS Ball Valve is required to be replaced due to failure. The occurred failure shall be documented and reported to a MOGAS representative using the contact details on the last page of this Safety Manual.

DOCUMENT REVISIONS

Rev	Reason for Revision	Date (MM/DD/YY)	Revised by
A	Initial Release	03/02/17	S. Lakhani

Severe Service

The MOGAS Definition

- Extreme temperatures
- High pressures
- Abrasive particulates
- Acidic products
- Heavy solids build-up
- Critical plant safety
- Large pressure differentials
- Velocity control
- Noise control

MOGAS Industries, Inc.

Headquarters

14204 East Hardy Street
Houston, TX, USA 77039-1405

Phone: +1.281.449.0291
Fax: +1.281.590.3412
E-mail: mogas@mogas.com

Europe

Phone: +44 (0)116.279.3367

China

Phone: +86 (0)10.84549478

Australia

Phone: +61 (0)8.9456.3533

Middle East

Phone: +971 (0)4.889.5667