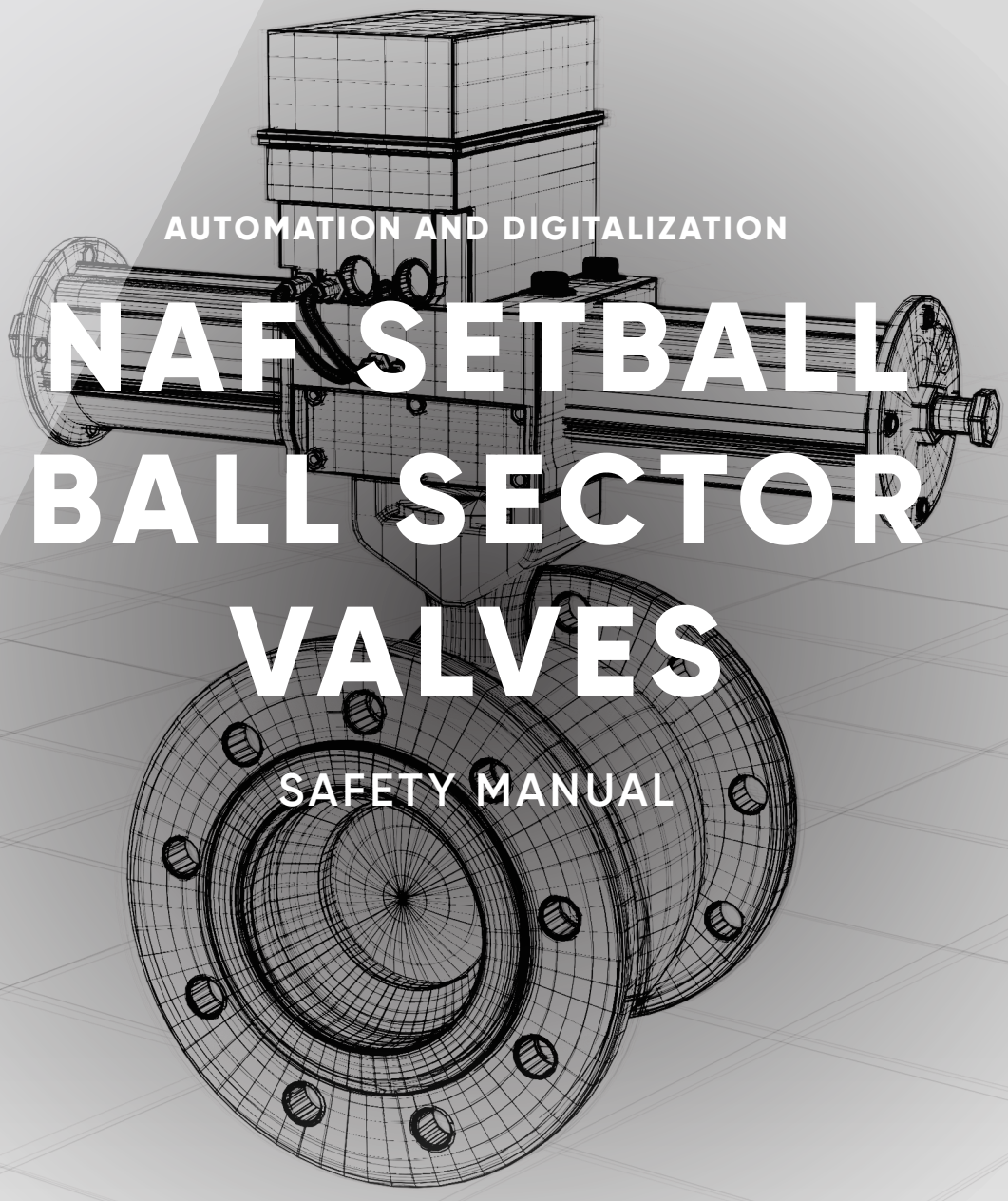
AUTOMATION AND DIGITALIZATION

NAF SETBALL BALL SECTOR VALVES

SAFETY MANUAL



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1 Introduction

1.1 SCOPE AND PURPOSE OF THE SAFETY MANUAL

This safety manual provides the information necessary to design, install, verify and maintain a Safety Instrumented Function (SIF) utilizing the Setball Ball Valve. This manual provides necessary requirements to enable the integration of the Setball Ball Valve when showing compliance with the IEC 61508 or IEC 61511 functional safety standards.
This Safety Manual indicates all assumptions that have been made on the usage of the Setball Ball Valve. If these assump- tions cannot be met by the application, the SIL capability of the Setball Ball Valve may be adversely affected.

1.2 SKILL LEVEL REQUIRED

System design, installation and commissioning, and repair and maintenance shall be carried out by suitably qualified personnel.

1.3 TERMS, ABBREVIATIONS AND ACRONYMS

Basic Safety	Freedom from unacceptable risk of harm.
Size range	Basic Process Control System - a system which responds to input signals from the process, its associated equipment, other programmable systems and/or an operator and generates output signals causing the process and its associated equipment to operate in the desired manner but which does not perform any safety instrumented functions with a claimed SIL ≥ 1.
Fail-safe State	State where solenoid valve is de-energized and spring is extended.
Fail Annunciation Detected	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.
Valve design	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 Dangerous	Wafer design
Fail Dangerous Detected	Failure that is dangerous but is detected as part of partial valve stroke testing.
Fail Dangerous Undetected	Failure that is dangerous and that is not detected as part of partial valve stroke testing.
Fail No Effect	Failure of a component that is part of the safety function but that has no effect on the safety func- tion.
Fail Safe	Failure that causes the valve to go to the defined fail-safe state without a demand from the pro- cess.
FMEDA	Failure Modes, Effects and Diagnostics Analysis.
Functional safety	Part of the overall safety relating to the process and the BPCS which depends on the correct func- tioning of the SIS and other protection layers.
HFT	Hardware Fault Tolerance.
Low demand	Mode of operation, where the frequency of demands for operation made on a safety-related sys- tem is no greater than twice the proof test frequency.
MOC	Management Of Change - specific procedures often done when performing any work activities in compliance with government regulatory authorities.

PFDAVG	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 either a safe failure or a detected dangerous failure
SIF	Safety Instrumented Function - safety function with a specified SIL which is necessary to achieve functional safety. Typically a set of equipment intended to reduce the risk due to a specified hazard (a safety loop).
SIL	Safety Integrity Level - discrete level (one out of four) for specifying the safety integrity requirements of the safety instrumented functions to be allocated to the safety instrumented systems. SIL 4 has the highest level of safety integrity; SIL 1 has the lowest.
SIS	Safety Instrumented System - instrumented system used to implement on or more safety instru- mented functions. An SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).

1.4 PRODUCT SUPPORT & SERVICE

Please refer to the contact information on the back cover of this document.

1.5 RELATED DOCUMENTS

Hardware documents:

Fk 41.51GB, Setball Ball Valve Datasheet
Fi 41.51GB, Setball Maintenance and installation

instructions Guidelines/References:
FMEDA report - NAF 14/05-134 R002

1.6 REFERENCE STANDARDS

IEC 61508-2: 2010, Functional Safety of Electrical/ Electronic/Programmable Electronic Safety-Related Systems
IEC 60654-1:1993-02, second edition, Industrial-process measurement and control equipment – Operating conditions –
Part 1: Clima- tic condition.

2 Setball Ball Valve Description

The NAF Setball Ball Valve series consists of a single piece body housing and a V-port ball sector. The ball sector has top and bottom bearings for low operating torque, so that low-torque actuators can be used. The standard Stellite seat can easily be converted to PTFE after turning the ball sector by 180 degrees, without the need to dismantle the valve
The NAF Setball Ball Valve is supplied as standard in stainless steel and is also available in other materials, such as, CG8M, Titanium, etc. The valves are available in sizes from DN25 to DN500 (1 inch to 20 inch) in PN10 to PN40 and ANSI pressure classes 150-300. Flanged versions are available over the full size range and wafer versions up to DN 200.

3 Designing a SIF Using the Setball Ball Valve

3.1 SAFETY FUNCTION

The safety function for the valve and the additional components in the subsystem is to move the valve to the safe position (which can be either open or closed as required by the application) within the specified safety time when the system is tripped.

3.2 ENVIRONMENTAL LIMITS

The designer of the SIF must check that the product is rated for use within the expected environmental limits, maximum working pres- sure and temperature. Refer to the Setball Ball Valve datasheet for this information.

3.3 APPLICATION LIMITS

The materials of construction of a Setball Ball Valve are specified in the NAF AB Setball Ball Valve datasheet. It is especially important that the designer of the SIF checks for material compatibility considering on-site chemical contaminants and air/hydraulic (as appropriate)

supply conditions. If the Setball Ball Valve is used outside the application limits or with incompatible materials, the reliability data and predicted SIL capability becomes invalid.

3.4 DESIGN VERIFICATION

A detailed Failure Modes, Effects and Diagnostics Analysis (FMEDA) report is available from NAF AB for this product. This report details all failure rates and failure modes as well as expected lifetime of the product.

The achieved Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) design must be verified by the designer via a calculation of PFDAVG considering the architecture, proof test interval, proof test effectiveness, any automatic diagnostics, average repair time and the specific failures rates of all equipment included in the SIF. Each subsystem must be checked to assure compliance with minimum Hardware Fault Tolerance (HFT) requirements. The exida exSILentia™ tool is recommended for this purpose as it contains accurate models for the Setball Ball Valve and its failure rates.

When using the Setball Ball Valve in a redundant configuration, a common cause factor of at least 5% should be included in the safety integrity calculations. The failure rate data listed in the FMEDA report is only valid for the useful lifetime of the Setball Ball Valve.

The failure rates will increase after this useful lifetime period has expired. Reliability calculations based on the data listed in the FMEDA report for mission times beyond the lifetime may yield results that are too optimistic, i.e. the calculated SIL will not be achieved.

3.5 SIL CAPABILITY

3.5.1 SYSTEMATIC INTEGRITY

The Setball Ball Valve 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 higher than the statement without “prior use” justification by the end user, or verification of diverse technology in the design.

3.5.2 RANDOM INTEGRITY

According to IEC 61508 the architectural constraints of an element must be determined. This can be done by following the 1H ap- proach 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 Setball Valve is classified as a device that is part of a Type A element according to IEC 61508, having a hardware fault tolerance of 0.
The Setball 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 at HFT=0 (or SIL 3 @ HFT=1) per Route 2H. If Route 2H is not applicable for the entire final element, the architectural cons- traints will need to be evaluated per Route 1H.
When the final element assembly consists of several components additional to Setball Ball Valve, the SIL must be verified for the entire assembly using the failu- re rates of all components. This analysis must account for architectural constraints by comparing both SFF and HFT with IEC61508-2, Table 2 if following Route 1H.

3.5.3 SAFETY PARAMETERS

For detailed failure rate information refer to the FMEDA report for the Setball Ball Valve.

3.6 CONNECTION OF THE SETBALL BALL VALVE TO THE SIS LOGIC SOLVER

The Setball Valve should be assembled with an actuator and logic solver where all components are safety rated. The safety rated logic solver shall actively perform the safety function as well as automatic diagnostics (if any) designed to diagnose potentially dangerous failures within the Setball Ball Valve, (i.e. partial valve stroke test).

3.7 GENERAL REQUIREMENTS

FThe system and function response time shall be less than the process safety time. The Setball Ball Valve will move to its defined safe state in less than this time with relation to the specific hazard scenario.
All SIS components including the Setball Ball Valve must be operational before process start-up.
The User shall verify that the Setball Ball Valve is suitable for use in safety applications by confirming the Setball Ball Valve nameplate and model number is properly marked.
Personnel performing maintenance and testing on the Setball Ball Valve shall first be assessed as being competent to do so. Results from periodic proof tests and partial valve stroke tests (if any) shall be recorded and periodically reviewed.
The Setball Ball Valve shall not be operated beyond the useful lifetime as listed in paragraph 5.3 without undergoing overhaul or repla- cement.

4 Installation & Commissioning

4.1 INSTALLATION

The Setball Ball Valve must be installed per the standard practices outlined in the Maintenance and Installation Instructions. The environment must be checked to verify that environmental conditions do not exceed the ratings.
The Setball Ball Valve must be accessible for physical inspection.

4.2 PHYSICAL LOCATION AND PLACEMENT

The Setball 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 Setball 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.

4.3 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 also 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 installation manual. The process air capacity shall be sufficient to move the valve within the required time.

5 Operation & Maintenance

5.1 PROOF TEST REQUIREMENT

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 also increase valve closure time.
Only dry instrument air filtered to 50 micron level or better shall be used.

5.2 REPAIR AND REPLACEMENT

Repair procedures outlined in the Maintenance and Installation Instructions must be followed.

5.3 USEFUL LIFE

Based on general field failure data and a low demand mode of operation, a useful life period of approximately 10 to 15 years is expec- ted for the Setball Ball Valve.

For high demand mode applications, the useful lifetime of the mechanical parts is limited by the number of cycles. The useful lifetime of the mechanical parts is > 10,000 full scale cycles or 8 to 10 years, whichever results in the shortest lifetime.

5.4 NOTIFICATION OF FAILURES

In case of malfunction of the system or SIF, the Setball Ball Valve shall be put out of operation and the process shall be kept in a safe state by other measures.
NAF AB must be informed when the Setball Ball Valve is required to be replaced due to failure. The occurred failure shall be docu- mented and reported to ANDRITZ NAF representative or directly to NAF AB using the contact details on the back cover of this safety manual.

CONTACT US!

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