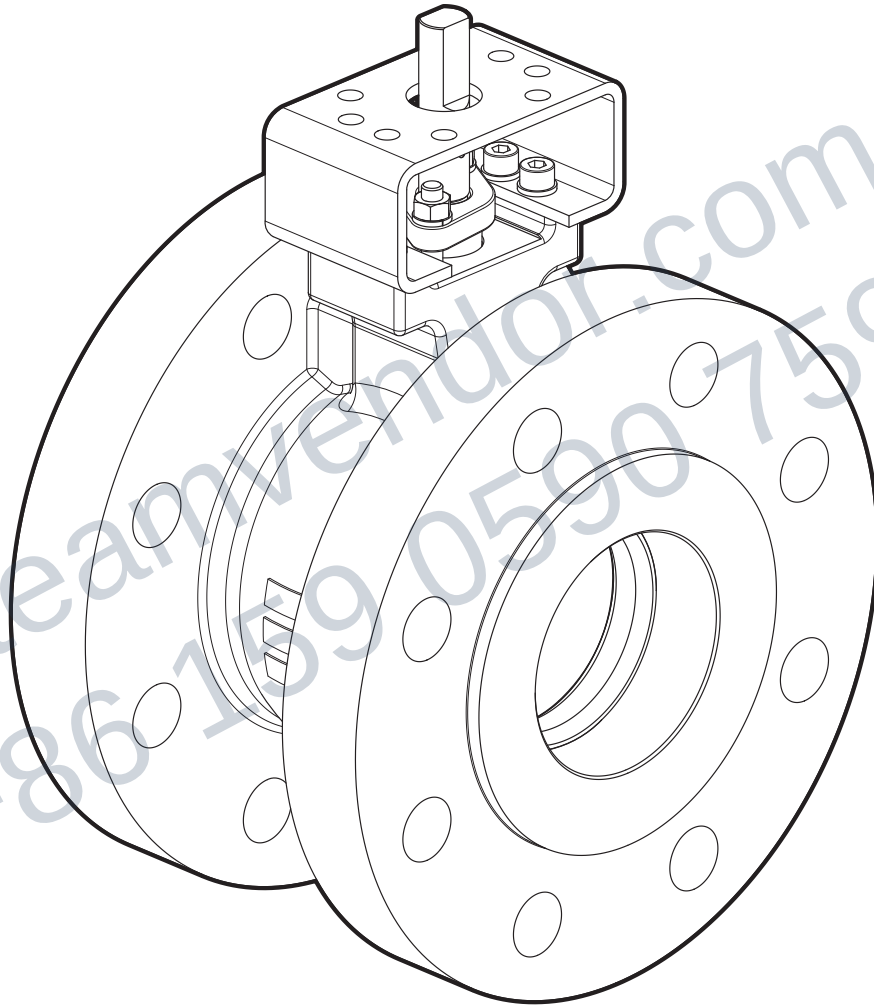

SERIES 19/19L
SEGMENTED BALL VALVES
FUNCTIONAL SAFETY MANUAL

Per IEC 61508 and IEC 61511 Standards



Bray[®]

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1.0 INTRODUCTION

This Safety Manual provides information necessary to design, install, verify and maintain a Safety Instrumented Function (SIF) utilizing the Bray S19/19L Segmented Ball Valves. This manual provides necessary requirements for meeting the IEC 61508 or IEC 61511 functional safety standards.

1.1 ACRONYMS

FMEDA - Failure Modes, Effects and Diagnostic Analysis

HFT - Hardware Fault Tolerance

PFD_{AVG} - Average Probability of Failure on Demand

SFF - Safe Failure Fraction

SIF - Safety Instrumented Function

SIL - Safety Integrity Level

SIS - Safety Instrumented System

1.2 PRODUCT SUPPORT

Product support can be obtained from:

Bray Controls Inc.
13333 Westland East Blvd.
Houston, TX 77041 - USA.
Phone: 281-894-5454
bray.com

1.3 RELATED LITERATURE

Hardware Documents:

1. Sales Data Sheet for Bray S19/19L Segmented Ball Valves.
2. Installation, Operation and Maintenance Instructions for Bray S19/19L Segmented Ball Valves.
3. Technical Sales Manual for Bray S19/19L Segmented Ball Valves.

Guidelines/References:

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

1.4 REFERENCE STANDARDS

Functional Safety

1. IEC 61508: 2000 Functional safety of electrical/electronic/programmable electronic safety-related systems
2. ANSI/ISA 84.00.01-2004 (IEC 61511 Mod.) Functional Safety – Safety Instrumented Systems for the Process Industry Sector

2.0 DEVICE DESCRIPTION

The Bray S19/19L Segmented Ball Valves are used in throttling or on-off service. It is offered in Flanged & Flangeless Body style configurations (S19L only in Flanged style) from 1" through 16" (DN25-DN400), with a rating of ANSI CI 150/300/600 (PN20-PN100). Bray S19/19L Segmented Ball Valves are provided with actuator/operator mounting details which conform to ISO 5211 standard

3.0 DESIGNING A SIF USING A MANUFACTURED PRODUCT

3.1 SAFETY FUNCTION

When de-energized, the Bray S19/19L Segmented Ball Valves move to their fail-safe position. Depending on the version specified: Fail - Closed or Fail - Open, the Bray S19/19L Segmented Ball Valves will rotate the valve disc to close off the flow path through the valve body or open the flow path through the valve body. The Bray S19/19L Segmented Ball Valves are 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.

3.2 ENVIRONMENTAL LIMITS

The designer of a SIF must check that the product is rated for use within the expected environmental limits. Refer to the Service data and Material sections of Bray S19/19L Segmented Ball Valves product catalogues for environmental limits.

3.3 APPLICATION LIMITS

The materials of construction of Bray S19/19L Segmented Ball Valves are specified in the respective valve product brochures. It is important that the designer check for material suitability considering on-site conditions and air supply conditions. If any of the Bray S19/19L Segmented Ball Valves are used outside of the application limits or with incompatible materials, the reliability data provided becomes invalid.

3.4 DESIGN VERIFICATION

A detailed Failure Mode, Effects, and Diagnostics Analysis (FMEDA) report is available from Bray Controls. 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 PFDavg 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 the Bray S19/19L Segmented Ball Valves in a redundant configuration, a common cause factor of at least 10% should be included in safety integrity calculations. The failure rate data listed in the FMEDA report is only valid for the useful life time of Bray S19/19L Segmented Ball Valves. The failure rates will increase sometime after this time period. 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 Safety Integrity Level will not be achieved

3.5 SIL Capability

3.5.1 Systematic Integrity

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 the statement without "prior use" justification by end user or diverse technology redundancy in the design.

3.5.2 Random Integrity

Bray S19/19L Segmented Ball Valves are Type A Devices and are just some of the many components that can be used in a final element assembly. The final element assembly consists of many components, i.e. a Bray S19/19L Segmented Ball valve, an actuator or operator, solenoid, quick exhaust valve, etc. and the SIL must be verified for the entire assembly using failure rates from all components. This analysis must account for any hardware fault tolerance and architecture constraints.

3.5.3 Safety Parameters

For detailed failure rate information refer to the Failure Modes, Effects and Diagnostic Analysis Report for the Bray S19/19L Segmented Ball Valves.

3.6 CONNECTION OF THE BRAY S19/19L SEGMENTED BALL VALVES TO THE SIS LOGIC-SOLVER

The Bray S19/19L Segmented Ball Valves are connected to the safety rated logic solver which is actively performing the safety function as well as automatic diagnostics designed to diagnose potentially dangerous failures within the Bray S19/19L Segmented Ball Valves (i.e. partial stroke test).

3.7 GENERAL REQUIREMENTS

The system's response time shall be less than process safety time. The Bray S19/19L Segmented Ball Valves are only part of the final element of a SIS. All elements of the SIF must be chosen to meet the safety response time. All SIS components, including the Bray S19/19L Segmented Ball Valves must be operational before process start-up. User shall verify that each Bray S19/19L Segmented Ball Valve is suitable for use in safety applications. Personnel performing maintenance and testing on Bray S19/19L Segmented Ball Valves shall be competent to do so. Results from the proof tests shall be recorded and reviewed periodically. The useful life of the Bray S19/19L Segmented Ball Valves is discussed in Section 5.4.

4.0 INSTALLATION AND COMMISSIONING

4.1 INSTALLATION

The Bray S19/19L Segmented Ball Valves must be installed per standard practices outlined in the Installation, Operation and Maintenance Instructions. The environment must be checked to verify that environmental conditions do not exceed the ratings. The Bray S19/19L Segmented Ball Valves must be accessible for physical inspection.

4.2 PHYSICAL LOCATION AND PLACEMENT

The Bray S19/19L Segmented Ball Valves shall be accessible with sufficient room for pneumatic connections and shall allow manual proof testing. Pneumatic piping to the valve 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 Bray S19/19L Segmented Ball Valves 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 to the valve actuator, or the vibration should be reduced using appropriate damping mounts.

4.3 PNEUMATIC CONNECTIONS

Recommended piping for the inlet and outlet pneumatic connections to the actuator of the Bray S19/19L Segmented Ball Valves is a minimum 1/4" metal or PVC tubing. The length of tubing between the actuator and the control device, such as a solenoid valve, shall be kept as short as possible and free of kinks.

Only dry air filtered to 50 micron or better is recommended. The process air pressure shall meet the requirements set forth in the Installation, Operation and Maintenance Instructions. The process air capacity shall be sufficient to move the valve actuator within the required time

5.0 OPERATION AND MAINTENANCE

5.1 PROOF TEST WITHOUT AUTOMATIC TESTING

The objective of proof testing is to detect failures within the valve 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 a valve 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. The results of the proof test should be recorded and any failures that are detected and that compromise functional safety should be reported to Bray Controls. The suggested proof test consists of a full stroke of the Bray S19/19L Segmented Ball Valves' actuator

Table 1: Recommended Proof Test

STEP	ACTION
1	Bypass the safety function and take appropriate action to avoid a false trip.
2	Send a signal to the final element configuration to perform a full stroke and verify that this is achieved.
3	Inspect the Bray S19/19L Segmented Ball Valves for any visible damage or contamination.
4	Record any failures in your company's SIF inspection database.
5	Remove the bypass and otherwise restore normal operation.

This proof test coverage for Bray S19/19L Segmented Ball Valves are listed in the FMEDA report which is available from Bray Controls. The person(s) performing the proof test of Bray S19/19L Segmented Ball Valves should be trained in SIS operations, including bypass procedures, valve maintenance and company Management of Change procedures

5.2 PROOF TEST WITH AUTOMATIC PARTIAL OPERATIONAL STROKE TESTING

An automatic testing scheme that performs a full stroke of the Bray S19/19L Segmented Ball Valves and measures valve movement timing will detect most potentially dangerous failure modes. It is recommended that a physical inspection (Step 2 from Table 1) be performed on a periodic basis with the time interval determined by plant conditions. A maximum inspection interval of five years is recommended.

5.3 REPAIR AND REPLACEMENT

Repair procedures in the Bray S19/19L Segmented Ball Valves Installation, Operation and Maintenance manuals must be followed.

5.4 USEFUL LIFE

The normal useful life of the Bray S19/19L Segmented Ball Valves in Functional Safety Applications (IEC 61508-2) is 10 to 15 years; however, valve cycle life and valve useful life can be greater or less depending on temperature, flow media (acids, abrasives, total dissolved solids, compatibility of valve trim materials with media), pressure, fluctuation between extreme temperatures, cycle frequency, flow velocity, valve orientation and placement in pipeline with respect to elbows, pumps, etc., and other application conditions.

5.5 MANUFACTURER NOTIFICATION

Any failures that are detected and that compromise functional safety should be reported to Bray Controls. Please contact Bray Controls customer service.

5.6 PRODUCT REGISTRATION

If the product is being used in a safety application and there is a desire to receive notices regarding the product, register the product with Bray Controls Customer Service.

6.0 START-UP CHECKLIST

The following checklist may be used as a guide to employ the Bray S19/19L Segmented Ball Valves in a safety critical SIF compliant to IEC 61508.

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 Bray S19/19L Segmented Ball Valves 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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