



Certificate / Certificat Zertifikat / 合格証

FLO 1606053 C001

exida hereby confirms that the:

Worcester 44/59/459/599 Cryogenic Series Ball Valves

Flowserve Flow Control

Haywards Heath, West Sussex - UK

Has been assessed per the relevant requirements of:

IEC 61508 : 2010 Parts 1-2

and meets requirements providing a level of integrity to:

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type A, Route 2_H Device

**PFH/PFD_{avg} and Architecture Constraints
must be verified for each application**

Safety Function:

The Ball Valve will move to the designed safe position per the actuator design within the specified safety time.

Application Restrictions:

The unit must be properly designed into a Safety Instrumented Function per the Safety Manual requirements.

The manufacturer may use the mark:



Revision 1.3 November 14, 2022
Surveillance Audit Due
October 1, 2025



Evaluating Assessor

Certifying Assessor

FLO 1606053 C001

Systematic Capability: SC 3 (SIL 3 Capable)

Random Capability: Type A, Route 2_H Device

PFH/PFD_{avg} and Architecture Constraints must be verified for each application

Systematic Capability :

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 stated.

Random Capability:

The SIL limit imposed by the Architectural Constraints must be met for each element. This device meets *exida* criteria for Route 2_H.

IEC 61508 Failure Rates in FIT*

Failure rates Worcester C44/59/459/599 Cryogenic Series Ball Valves in Clean Service

Device	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
Full Stroke	0	0	0	499
Tight Shut -Off	0	0	0	1365
Open on Trip	0	146	0	353
Full Stroke with PVST	0	0	181	318
Tight Shut -Off with PV ST	0	0	181	1184
Open on Trip with PVST	146	0	181	172

* FIT = 1 failure / 10⁹ hours

† PVST = Partial Valve Stroke Test of a final element Device

SIL Verification:

The Safety Integrity Level (SIL) of an entire Safety Instrumented Function (SIF) must be verified via a calculation of PFH/PFD_{avg} considering redundant architectures, 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 element must be checked to assure compliance with minimum hardware fault tolerance (HFT) requirements.

The following documents are a mandatory part of certification:

Assessment Report: FLO 13-03-024 R001 V2, R4 (or later)

Safety Manual: FLOSILWOR4459459599-01 Rev 1 (or later)



80 N Main St
Sellersville, PA 18960

Worcester
44/59/459/599
Cryogenic Series Ball
Valves