Certificate / Certificat Zertifikat / 合格証

CRE 2101073 P0043 C001

exida hereby confirms that the:

Krombach© TUFSEAT™ Ball Valves KFO / KAO / KSO 11**/12**/51**/52** Floating Ball Valves

Friedrich Krombach GmbH Armaturenwerke - A Crane Co. Company Kreuztal, Germany

Have been assessed per the relevant requirements of:

IEC 61508 : 2010   Parts 1-7

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:

CERTIFIED · IEC 61508 · **FS** · exida · **SIL 3 CAPABLE**

Revision 1.0 July 16, 2021
Surveillance Audit Due
August 31 , 2024

ANAB
ANSI National Accreditation Board
A C C R E D I T E D
ISO/IEC 17065
PRODUCT CERTIFICATION BODY
#1004

_____
Evaluating Assessor

_____
Certifying Assessor

Certificate / Certificat / Zertifikat / 合格証

CRE 2101073 P0043 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

Krombach©
TUFSEAT™ Ball Valves

KFO / KAO / KSO
11/12**/51**/52****

Floating Ball Valves

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*

Floating Ball Valve

Application	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
Full Stroke, Clean Service	0	0	0	414
Tight Shutoff, Clean Service	0	0	0	1154
Open on Trip, Clean Service	0	121	0	294
Full Stroke, Severe Service	0	0	0	737
Tight Shutoff, Severe Service	0	0	0	2213
Open on Trip, Severe Service	0	242	0	495

* FIT = 1 failure / 10^9 hours

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: CRA 21/01-073-C R003 V0 R1

Safety Manual: CPE-KROMBACH TUFSEAT-Safety Manual V1R0

Certificate / Certificat Zertifikat / 合格証

CRE 2101073 P0043 C002

exida hereby confirms that the:

**Krombach© TUFSEAT™ Ball Valves
KFO / KAO / KSO
71**/91**
Trunnion Ball Valves**

**Friedrich Krombach GmbH
Armaturenwerke - A Crane Co. Company
Kreuztal, Germany**

Have been assessed per the relevant requirements of:

IEC 61508 : 2010   Parts 1-7

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.

_____
Evaluating Assessor

_____
Certifying Assessor

The manufacturer
may use the mark:

CERTIFIED · IEC 61508 · SIL 3 CAPABLE · exida · FS

Revision 1.0 July 16, 2021
Surveillance Audit Due
August 31 , 2024

ANAB
ANSI National Accreditation Board
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#1004

Certificate / Certificat / Zertifikat / 合格証

CRE 2101073 P0043 C002

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

Krombach©
TUFSEAT™ Ball Valves

KFO / KAO / KSO
71/91****

Trunnion Ball Valves

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*

Trunnion Ball Valve

Application	λ_{SD}	λ_{SU}	λ_{DD}	λ_{DU}
Full Stroke, Clean Service	0	0	0	504
Tight Shutoff, Clean Service	0	0	0	1261
Open on Trip, Clean Service	0	121	0	383
Full Stroke, Severe Service	0	0	0	832
Tight Shutoff, Severe Service	0	0	0	2342
Open on Trip, Severe Service	0	242	0	590

* FIT = 1 failure / 10^9 hours

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: CRA 21/01-073-C R003 V0 R1

Safety Manual: CPE-KROMBACH TUFSEAT-Safety Manual V1R0

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Sellersville, PA 18960

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