



FUNCTIONAL SAFETY CERTIFICATE

This is to certify that the

ST Solenoid Valve Series

manufactured by

BiS Valves Limited

Wimborne, Dorset
United Kingdom

have been assessed by CSA Group Testing UK Ltd with reference to the CASS methodologies and found to meet the requirements of

IEC 61508:2010, Parts (1-7) Routes 2_H Systematic Capability (SC3)

as an element suitable for use in safety related systems performing safety functions up to and including

**Sil 2 capable with HFT=0 (1oo1)*
Sil 3 capable with HFT=1 (1oo2)***

when used in accordance with the scope and conditions of this certificate.

* This certificate does not waive the need for further functional safety verification to establish the achieved Safety Integrity Level (SIL) of the safety related system

A handwritten signature in black ink, appearing to read 'J. Lynskey'.

Certification Decision:

James Lynskey

Initial Certification : 2024-08-22
This certificate issued : 2024-09-30
Renewal date : 2029-08-22

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Product description and scope of certification

The BiS Series ST Solenoid Valves are a series of direct acting spring return solenoid valves. The family is split into 3 model groups, Low-pressure topside, high pressure topside and high-pressure subsea. The low-pressure models (up to 50 bar) use a balanced poppet and seat design and can have 2,3, or 5 ports. High pressure models (up to 1035 bar) use a ball and seat design to seal and have either 2 or 3 ports.

All topside valves can be configured with the following reset options: automatic reset (Standard), Manual Override (MO), Manual Reset (MOMR) and Latching (LT). Due to practicality reasons the subsea models are only available with automatic reset functionality.

"Subsea versions are also available and have options for seawater pressure compensation.

Note: the SIF designer is responsible for determining if the Latching and/or Override functions are suitable for the application. The end user qualified personnel are responsible for determining if it is safe to manually Latch/Unlatch or Override the Valves position.

The entire ST* family are available in a range of voltages and wattages as well as single and dual coil options. Port sizes range from 1/8" up to 1/2" and can be offered in a range of thread forms or manifold mounting options.

Dual Coil versions have been included in this assessment. They have two Coils wired internally in parallel with only one coil connection available to the user. Thus for DTT operation if one coil fails open, the other coil prevents a false trip (DTT 2oo2). Both coils are energized during normal operation. For ETT operation, if one coil has failed, the other coil is capable of changing the Solenoid's state by itself (ETT 1oo2). Dual Coil versions are not intended to provide the ability to control the device from different control signals.

The specific BiS ST Solenoid Valve Series covered in this report have been analyzed in the FMEDA for use in these Safety Function applications (and listed in Table 1):



Figure 1: Typical ST Solenoid Valve.

Element Safety Function

The safety function of the certified equipment is:

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

Certified Data in support of use in safety functions

The assessment has been carried out with reference to the *Conformity Assessment of Safety-related Systems (CASS)* methodology using the Route 2H approach.

Based on the document submitted by BiS Valves Limited the Failure Mode and Effect Analysis (FMEA) of the ST Solenoid Valves. CSA has verified the documents as evidence of conformity to IEC 61508-2:2010 in respect of 'hardware safety integrity'. The results in Table 1 summarize BiS ST Solenoid Valves failure rates with various configurations.

Table 1: Summary of assessment for BiS ST Solenoid Valves.

Models considered in the certification transfer

Valve Types		Design And Application				
2/3AS*-ST*- Or 2/2AS*-ST*-	Opt 1 & Opt 2	Series ST Solenoid with 3/2 (or 2/2) Pneumatic or Hydraulic Valve, De-energize To Trip (DTT), Including MO/MR and Latching options.				
	Opt 3 & Opt 4	Series ST Solenoid with 3/2 (or 2/2) Pneumatic or Hydraulic Valve, Energize To Trip (ETT),				
2/5AS*-ST*-	DTT	5/2 Pneumatic or Hydraulic Valve, Solenoid Actuator De-energize to trip (DTT), including MO/MR and Latching options.				
	ETT	5/2 Pneumatic or Hydraulic Valve, Solenoid Actuator Energize to trip (ETT)				
2/*DS01*-ST*- Or 2/*DS01*-STSW*	Opt 1 & Opt 2	Series ST Solenoid with 3/2 (or 2/2) Hydraulic Valve, De-energize To Trip (DTT), MO/MR and latching options only included for topside models.				
	Opt 3 & Opt 4	Series ST Solenoid with 3/2 (or 2/2) Hydraulic Valve, De-energize To Trip (ETT),				
Valve Type and Application		SD	SU	DD	DU	PFD
2/*AS*-ST*- Or 2/2AS*-ST*-	DTT Opt 1	0	4.21E-07	0	1.05E-07	4.61E-04
	DTT Opt 2	0	3.54E-07	0	1.92E-07	8.42E-04
	ETT Opt 3	0	2.30E-08	0	2.98E-07	1.31E-03
	ETT Opt 4	0	1.05E-07	0	2.32E-07	1.02E-03
2/5AS*-ST*-	DTT	0	3.80E-07	0	1.55E-07	6.80E-04
	ETT	0	6.60E-08	0	2.66E-07	1.17E-03
2/*DS01*-ST*- Or 2/*DS01*- STSW*	DTT Opt 1	0	3.73E-07	0	1.17E-07	5.13E-04
	DTT Opt 2	0	3.47E-07	0	1.96E-07	8.60E-04
	ETT Opt 3	0	3.30E-08	0	2.59E-07	1.14E-03
	ETT Opt 4	0	9.90E-08	0	2.37E-07	1.04E-03

**Note. As per Route 2H clause 7.4.4.3.1 of IEC61508-2; a hardware fault tolerance of 1 for a specified safety function for SIL 3 unless the conditions in clause 7.4.4.3.2 are met, must apply. Clause 7.4.4.3.2 indicates that the hardware fault tolerance can be reduced if the sum of all dangerous failures does not exceed 1% of the target failure measure. This requires for the PFD value to be <1.00E-05, therefore in failing to meet this requirement of the BiS ST Solenoid Valves are limited to SIL 2 with HFT=0, however SIL 3 with HFT=1 is achievable.



Note 1: The failure data:

- 1) The PFD_{AVG} figure shown is for illustration only assuming a proof test interval of 8760 hours and MTTR of 8 hours. Refer to IEC 61508-6 for guidance on PFD_{AVG} calculations from the failure data.
- 2) The verified failure rates used in the safe failure fraction and diagnostic coverage do not include (λ no parts or no effect) failures in the calculation.

The failure data above is supported by the base information given in Table 2 below.

Table 2: Base information for the BiS ST Solenoid Valves.

1	Product identification:	<i>BiS ST Solenoid Valves</i>
2	Functional specification:	<i>The ST Solenoid Valve will move to the designed safe position per the actuator design within the specified safety time.</i>
3-5	Random hardware failure rates:	<i>Refer to table 1 of this certificate.</i>
6	Environment limits:	<i>Operating temperature: 0 to +70 °C.</i>
7	Lifetime/replacement limits:	<i>25 years</i>
8	Proof Test requirements:	<i>Refer to safety manual - I.0100.00.0383.1</i>
9	Maintenance requirements:	<i>Refer to safety manual - I.0100.00.0383.1</i>
10	Diagnostic coverage:	<i>0% diagnostic coverage.</i>
11	Diagnostic test interval:	<i>Refer to safety manual - I.0100.00.0383.1</i>
12	Repair constraints:	<i>Refer to safety manual - I.0100.00.0383.1</i>
13	Safe Failure Fraction:	<i>See Report R80214013B</i>
14	Hardware fault tolerance (HFT):	<i>See Table 1 above</i>
15	Highest SIL (architecture/type A/B):	<i>Type A, SIL 3.</i>
16	Systematic failure constraints:	<i>The hardware safety integrity assessment was based on a proof test interval of 1 year. Refer to safety manual - I.0100.00.0383.1</i>
17	Evidence of similar conditions in previous use:	<i>Not applicable.</i>
18	Evidence supporting the application under different conditions of use:	<i>Not applicable.</i>
19	Evidence of period of operational use:	<i>Not applicable.</i>
20	Statement of restrictions on functionality:	<i>See Report R80214013B</i>
21	Systematic capability (SC1, SC2, SC3)	<i>See Report R80214013B</i>
22	Systematic fault avoidance measures:	<i>See Report R80214013B</i>
23	Systematic fault tolerance measures:	<i>See Report R80214013B</i>
24	Validation records:	<i>See Report R80214013B</i>

Management of functional safety

The assessment has demonstrated that the product is supported by an appropriate functional safety management system that meets the relevant requirements of IEC 61508-1:2010 clause 6, see report R80214013B.

Identification of certified equipment

The certified equipment and its safe use is defined in the manufacturer's documentation listed in Table 3 below.

Table 3: Certified documents

Document no.	Pages	Rev	Date	Document description
G.0102.00.0448	1	2	28-09-2016	GA Drawing (2/3AS25-STEX-6K)
L.102.00.0446	2	3	08-06-2023	BOM (2/3AS25-STEX-6K)
G.0102.00.0440	1	1	14-04-2016	GA Drawing (2/2AS25-NO-MO-STEX-6K)
L.0102.00.0449	2	5	08-06-2023	BOM (2/2AS25-NO-MO-STEX-6K)
G.0102.00.0386	1	1	10-01-2020	GA Drawing (2/5AS25-STEX-10B (Mk 2))
L.0102.00.0624	2	1	09-01-2020	BOM (2/5AS25-STEX-10B (Mk 2))
G.0199.00.0412	1	4	28-07-2021	GA Drawing (2/3DS01-STEX)
L.0199.00.0413	2	5	26-05-2015	BOM (2/3DS01-STEX)
G.0199.00.0718	1	2	28-07-2021	GA Drawing (2/3DS01-SW-24VDC-1070-10K)
L.0199.00.0717	2	3	24-06-2020	BOM (2/3DS01-SW-24VDC-1070-10K)
G.0102.00.0587	1	2	14-09-2023	GA Drawing (2/3AS25-STEX) (Mk 2)
L.0102.00.0539	3	4	18-11-2022	BOM (2/3AS25-STEX) (Mk 2)

Note: Table 3 shows the base models for the BiS Solenoid Valves Series, the BiS Solenoid Valves derivatives are referred in CSA project file 80214013.

Conditions of Certification

The validity of the certified base data is conditional on the manufacturer complying with the following conditions:

1. The manufacturer shall analyse failure data from returned products on an on-going basis. CSA Certification Service shall be informed in the event of any indication that the actual failure rates are worse than the certified failure rates. (A process to rate the validity of field data should be used. To this end, the manufacturer should co-operate with users to operate a formal field-experience feedback programme).
2. CSA shall be notified in advance (with an impact analysis report) before any modifications to the certified equipment or the functional safety information in the user documentation is carried out. CSA may need to perform a re-assessment if modifications are judged to affect the product's functional safety certified herein.
3. On-going lifecycle activities associated with this product (e.g., modifications, corrective actions, field failure analysis) shall be subject to surveillance by CSA in accordance with 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd Certificates'.

Conditions of Safe Use

The validity of the certified base data in any specific user application is conditional on the user complying with the following conditions:

1. The user shall comply with the requirements given in the manufacturer's user documentation in regard to all relevant functional safety aspects such as application of use, installation, operation, maintenance, proof tests, maximum ratings, environmental conditions, and repair.
2. Selection of this product for use in safety function and the installation, configuration, overall validation, maintenance and repair shall only be carried out by competent personnel, observing all the manufacturer's conditions and recommendations in the user documentation.
3. All information associated with any field failures of this product should be collected under a dependability management process (e.g., IEC 60300-3-2) and reported to the manufacturer.



4. The safety device is to have an independent power supply, it must not share the same power supply as non-safety devices that may cause a fault to the safety device.
5. A proof test interval of 1 year.

General Conditions and Notes

1. This certificate is based upon a functional safety assessment of the product described in CSA Test & Certification Assessment Report R80214013B.
2. If the certified product or system is found not to comply, CSA Group Testing UK Ltd should be notified immediately at the address shown on this certificate.
3. The use of this Certificate and the CSA Certification Mark that can be applied to the product or used in publicity material are subject to the 'Regulations Applicable to the Holders of CSA Group Testing UK Ltd Certificates' and 'Supplementary Regulations Specific to Functional Safety Certification'.
4. This document remains the property of CSA and shall be returned when requested by the issuer.
5. No part of the Functional safety related aspects stated in the instruction manual shall be changed without approval of the certification body.
6. This certificate will remain valid subject to completion of two surveillance audits within the five year certification cycle, and upon receipt of acceptable response to any findings raised during this period. This certificate can be withdrawn if the manufacturer no longer satisfies scheme requirements.



Certificate History

Issue	Date	Report no.	Comment
0	27th September 2024	R80214013B	The release of prime certificate.
1	30th September 2024	R80214013B	Table 3, updated to reflect current document change L.0102.00.0539.4. to L.0102.00.0539

