Certificate

No.: 968/V 1158.01/20

Product tested	Ball Valves with Pneumatic Turn Actuators	**Certificate holder**	G. Bee GmbH Robert-Bosch-Straße 14 71691 Freiberg a.N. Germany

Type designation Ball Valves: 71MS/71ME, 75, 77, 79S/79E, 87S/87E, 168S/168E, 964

Pneumatic Actuators: DAE / GTE (single acting), DAD / GTD (double acting)

Codes and standards IEC 61508 Parts 1-2 and 4-7:2010

Intended application

Safety function:
Ball valves: Safe closing or opening through auxiliary energy

Pneumatic actuators:
Single acting: Move to the fail-safe position using spring force accumulator / auxiliary stored energy
Double acting: Move to the fail-safe position using pneumatic air / auxiliary energy supply

The products are suitable for use in a safety instrumented system up to SIL 2 (low demand mode) and SIL 1 (high demand mode of operation). Under consideration of the minimum required hardware fault tolerance HFT = 1 the products may be used in a redundant architecture up to SIL 3.

Specific requirements The instructions of the associated Installation and Operating Manual shall be considered.

Summary of test results see back side of this certificate.
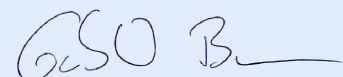
Valid until 2025-04-17

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/V 1158.01/20 dated 2020-06-22.
This certificate is valid only for products which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit
Am Grauen Stein, 51105 Köln

Köln, 2020-06-22

Certification Body Safety & Security for Automation & Grid

Dipl.-Ing. Gebhard Bouwer

TÜVRheinland®
Precisely Right.

Holder: G. Bee GmbH
Robert-Bosch-Straße 14
71691 Freiberg a. N.
Germany

Product tested: Ball valves
Types: 71MS / 71ME, 75, 77, 79S / 79E, 87S / 87E,
168S / 168E, 964

Results of Assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode
Hardware Fault Tolerance	HFT	0
Systematic Capability		**SC 3**

Safe closing through axiliary energy

Dangerous Failure Rate	λ_D	2.02 E-07 / h	**202 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	8.85 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	8.94 E-05	

Safe opening through auxiliary energy

Dangerous Failure Rate	λ_D	1.25 E-07 / h	**125 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	5.48 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	5.51 E-05	

Assumptions for the calculations above: DC = 0 %, T_1 = 1 year, β_{1oo2} = 10 %

Origin of failure rates

The stated failure rates for low demand are the result of an FMEDA with tailored failure rates for the design and manufacturing process.

The stated failure rates for high demand are the result of tests over the whole temperature range. If the conditions vary widely from the test conditions the failure rates might be adjusted.

Furthermore the results have been verified by qualification tests and field-feedback data of the last years (since the last evaluation).

Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing.

The stated failure rates do not release the end-user from collecting and evaluating application-specific reliability data.

Periodic Tests and Maintenance

The given values require periodic tests and maintenance as described in the Safety Manual.

The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.

High demand Mode [see note]		*for complete system (valve, actuator, solenoids)*	
B_{10d}		45,326	
Maximum Demands per Year	n_{op}	400 / a	4,57 E-02 / h
Average Frequency of a dangerous Failure per Hour	**PFH**	**1.01 E-07**	

Note: PFH has to be verified by the end user with the correct demand rate for the certain application.

The resulting PFH shall not be lower than 10 FIT. If the PFH calculation results in a lower value, 10 FIT shall be used for further investigation.

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Holder: G. Bee GmbH
Robert-Bosch-Straße 14
71691 Freiberg a. N.
Germany

Product tested: Pneumatic actuator - single-acting
Type: DAE / GTE

Results of Assessment

Route of Assessment		2_H / 1_S
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode
Hardware Fault Tolerance	HFT	0
Systematic Capability		**SC 3**

Move to the fail-safe position using spring force accumulator / auxiliary stored energy

Dangerous Failure Rate	λ_D	1.87 E-07 / h	**187 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	8.19 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	8.27 E-05	

Assumptions for the calculations above: DC = 0 %, T_1 = 1 year, β_{1oo2} = 10 %

Origin of failure rates

The stated failure rates for low demand are the result of an FMEDA with tailored failure rates for the design and manufacturing process.

The stated failure rates for high demand are the result of tests over the whole temperature range. If the conditions vary widely from the test conditions the failure rates might be adjusted.

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Failure rates include failures that occur at a random point in time and are due to degradation mechanisms such as ageing.

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The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.

High demand Mode [see note]		*for complete system (valve, actuator, solenoids)*	
B_{10d}		45,326	
Maximum Demands per Year	n_{op}	400 / a	4,57 E-02 / h
Average Frequency of a dangerous Failure per Hour	**PFH**	**1.01 E-07**	

Note: PFH has to be verified by the end user with the correct demand rate for the certain application.

The resulting PFH shall not be lower than 10 FIT. If the PFH calculation results in a lower value, 10 FIT shall be used for further investigation.

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Holder: G. Bee GmbH
Robert-Bosch-Straße 14
71691 Freiberg a. N.
Germany

Product tested: Pneumatic actuator - double-acting
Type: DAD / GTD

Results of Assessment

Route of Assessment		$2_H / 1_S$
Type of Sub-system		Type A
Mode of Operation		Low Demand Mode
Hardware Fault Tolerance	HFT	0
Systematic Capability		**SC 3**

Move to the fail-safe position using pneumatic air / auxiliary energy supply

Dangerous Failure Rate	λ_D	3.56 E-07 / h	**356 FIT**
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	1.56 E-03	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	1.59 E-04	

Assumptions for the calculations above: DC = 0 %, T_1 = 1 year, β_{1oo2} = 10 %

Origin of failure rates

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The stated failure rates for high demand are the result of tests over the whole temperature range. If the conditions vary widely from the test conditions the failure rates might be adjusted.

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The operator is responsible for the consideration of specific external conditions (e.g. ensuring of required quality of media, max. temperature, time of impact), and adequate test cycles.

High demand Mode [see note]		*for complete system (valve, actuator, solenoids)*	
B_{10d}		45,326	
Maximum Demands per Year	n_{op}	400 / a	4,57 E-02 / h
Average Frequency of a dangerous Failure per Hour	**PFH**	**1.01 E-07**	

Note: PFH has to be verified by the end user with the correct demand rate for the certain application.

The resulting PFH shall not be lower than 10 FIT. If the PFH calculation results in a lower value, 10 FIT shall be used for further investigation.

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