

Certificate of Conformity to IEC 61508 Safety Integrity Level (SIL) 3 in Terms of Random Hardware Performance Requirements and Systematic Capability

Functional Safety of Safety-Related Programmable Electronic Systems

The **Bettis RGS-Q series of Emerson Automation Solutions quarter turn actuators for use as part of a valve assembly sub-system** has been assessed and is considered capable for use in a Low Demand Safety Function up to SIL 3.

The assessment was based on the assumptions, data provided, and recommendations given in:

- ESC Ltd report C119_SV001 rev.4;
- Renewal Letter from QTRCO Inc., signed by Ed Holtgraver, CTO, dated 22nd January 2021.

The system was assessed against the following failure mode:

- Failure to generate required torque to operate connected valve.

The element assessed includes the following variants:

- Spring Return, Double Piston, up to 4 Springs;
- Spring Return, Double Piston, up to 2 Springs;
- Spring Return, Single Piston, up to 2 Springs;
- Spring Return, SD Model;
- Double Acting, Double Piston;
- Double Acting, Single Piston.

The assessment was carried out to determine compliance with IEC 61508 with regards to:

- Random Hardware Failures (Predicted Probability of Failure on Demand (PFD) was based on a 1-year proof test and a monthly Partial Stroke Test (PST));
- Architectural Constraints;
- Systematic capability (element regarded as proven in use).

Model no.	Type	Config.	Achieved PFD	Achieved SIL (PFD)	Achieved SIL (Architecture)	Systematic Capability	Overall Achieved SIL	
RGS-Q Series RGS/RGD-Series (with XRC PST)	Double Acting Actuator	1001	4.8E-03	1	1	3	1	
		1002	3.4E-04	2	2	3	2	
	Spring Return Actuator (2 Springs)	1001	8.9E-04	2	2	3	2	
		1002	5.9E-05	3	3	3	3	
	Spring Return Actuator (4 Springs)	1001	1.4E-03	2	2	3	2	
		1002	9.1E-05	3	3	3	3	
	Spring Return Actuator (SD Model)	1001	8.0E-04	2	2	3	2	
		1002	5.3E-05	3	3	3	3	
			1001	6.1E-04	2	2	3	2

Model no.	Type	Config.	Achieved PFD	Achieved SIL (PFD)	Achieved SIL (Architecture)	Systematic Capability	Overall Achieved SIL
	Spring Return Actuator (single piston)	1oo2	4.0E-05	3	3	3	3
	Double Acting Actuator (single piston)	1oo1	3.4E-03	1	1	3	1
		1oo2	2.4E-04	2	2	3	2
RGS-Q Series (RGS/RGD-Series) (with PSTD)	Double Acting Actuator	1oo1	2.7E-03	1	2	3	1
		1oo2	1.9E-04	3	3	3	3
	Spring Return Actuator (2 Springs)	1oo1	6.6E-04	2	2	3	2
		1oo2	4.3E-05	3	3	3	3
	Spring Return Actuator (4 Springs)	1oo1	9.1E-04	2	2	3	2
		1oo2	6.0E-05	3	3	3	3
	Spring Return Actuator (SD Model)	1oo1	5.3E-04	2	2	3	2
		1oo2	3.5E-05	3	3	3	3
	Spring Return Actuator (single piston)	1oo1	5.0E-04	2	2	3	2
		1oo2	3.3E-05	3	3	3	3
	Double Acting Actuator (single piston)	1oo1	1.9E-03	2	2	3	2
		1oo2	1.2E-04	3	3	3	3
RGS-Q Series RGS/RGD-Series) (without PSTD)	Double Acting Actuator	1oo1	6.3E-03	1	1	3	1
		1oo2	4.6E-04	2	2	3	2
	Spring Return Actuator (2 Springs)	1oo1	1.1E-03	2	2	3	2
		1oo2	7.3E-05	3	3	3	3
	Spring Return Actuator (4 Springs)	1oo1	1.6E-03	2	2	3	2
		1oo2	1.1E-04	3	3	3	3
	Spring Return Actuator (SD Model)	1oo1	9.8E-04	2	2	3	2
		1oo2	6.5E-05	3	3	3	3
	Spring Return Actuator (single piston)	1oo1	8.7E-04	2	2	3	2
		1oo2	5.7E-05	3	3	3	3
	Double Acting Actuator (single piston)	1oo1	4.5E-03	1	1	3	1
		1oo2	3.2E-04	2	2	3	2

Note 1: The sensing, logic solver and reaming final element sub-system have been excluded for the analysis and subsequently 80% of the SIL band has been allocated for their inclusion (e.g. SIL 2 band is modified to $\geq 0.2E-03$ to $< 0.2E-04$).

It must be noted that the above assessment is an example to demonstrate the PFD capability of the RGS-Q series actuator. A full assessment covering the proof test and repair strategy and PFD contribution of other sub-systems must be carried out to justify any PFD and SIL claim for the complete Safety Function.

IEC 61508 failure rates:

Model no.	Type	λ (/hr)	λ_{DU} (/hr)	λ_{DD} (/hr)	λ_S (/hr)	SFF (%)	Device Type
RGS-Q Series (with XRC PST)	Double Acting Actuator	1.4E-06	1.0E-06	4.2E-07	0.0E+00	29%	A
	Spring Return Actuator (2 Springs)	8.3E-07	1.9E-07	5.8E-08	5.8E-07	77%	A
	Spring Return Actuator (4 Springs)	9.4E-07	3.0E-07	6.4E-08	5.8E-07	68%	A
	Spring Return Actuator (SD Model)	8.1E-07	1.8E-07	4.9E-08	5.9E-07	78%	A
	Spring Return Actuator (single piston)	8.6E-07	1.3E-07	7.0E-08	6.6E-07	85%	A
	Double Acting Actuator (single piston)	1.0E-06	7.3E-07	3.0E-07	0.0E+00	29%	A
RGS-Q Series (with PSTD)	Double Acting Actuator	1.4E-06	4.6E-07	9.8E-07	0.0E+00	68%	A
	Spring Return Actuator (2 Springs)	8.3E-07	1.3E-07	1.2E-07	5.8E-07	84%	A
	Spring Return Actuator (4 Springs)	9.4E-07	1.8E-07	1.9E-07	5.8E-07	81%	A
	Spring Return Actuator (SD Model)	8.1E-07	9.9E-08	1.2E-07	5.9E-07	88%	A
	Spring Return Actuator (single piston)	8.6E-07	9.8E-08	1.0E-07	6.6E-07	89%	A
	Double Acting Actuator (single piston)	1.0E-06	3.0E-07	7.4E-07	0.0E+00	71%	A
RGS-Q Series (without PSTD)	Double Acting Actuator	1.4E-06	1.4E-06	0.0E+00	0.0E+00	0%	A
	Spring Return Actuator (2 Springs)	8.3E-07	2.5E-07	0.0E+00	5.8E-07	70%	A
	Spring Return Actuator (4 Springs)	9.4E-07	3.6E-07	0.0E+00	5.8E-07	61%	A
	Spring Return Actuator (SD Model)	8.1E-07	2.2E-07	0.0E+00	5.9E-07	72%	A
	Spring Return Actuator (single piston)	8.6E-07	2.0E-07	0.0E+00	6.6E-07	77%	A
	Double Acting Actuator (single piston)	1.0E-06	1.0E-06	0.0E+00	0.0E+00	0%	A

XRC PST – Automated partial stroke testing using QTRCO XRCISER.

PSTD - Automated partial stroke testing (with or without QTRCO XRCISER) that produces a valve signature (comparing air pressure/torque against valve movement).

IMPORTANT: It should be noted that this assessment does not include confirmation of the response time of the device. For response times (along with any relevant assumptions) reference should be made to the Safety Manual of each device and the total SIF response time **MUST** be compared against the process safety time for the specific application.



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