



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 **QTRCO Inc. Q-Series 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 with regard to random failure rates and systematic capability.

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 James Howard, Engineering Manager, dated 20th February 2019.

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
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
			1001	1.4E-03	2	2	3

Model no.	Type	Config.	Achieved PFD	Achieved SIL (PFD)	Achieved SIL (Architecture)	Systematic Capability	Overall Achieved SIL
	Spring Return Actuator (4 Springs)	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
	Spring Return Actuator (single piston)	1001	6.1E-04	2	2	3	2
		1002	4.0E-05	3	3	3	3
	Double Acting Actuator (single piston)	1001	3.4E-03	1	1	3	1
1002		2.4E-04	2	2	3	2	
Q-Series (RGS/RGD -Series) (with PSTD)	Double Acting Actuator	1001	2.7E-03	1	2	3	1
		1002	1.9E-04	3	3	3	3
	Spring Return Actuator (2 Springs)	1001	6.6E-04	2	2	3	2
		1002	4.3E-05	3	3	3	3
	Spring Return Actuator (4 Springs)	1001	9.1E-04	2	2	3	2
		1002	6.0E-05	3	3	3	3
	Spring Return Actuator (SD Model)	1001	5.3E-04	2	2	3	2
		1002	3.5E-05	3	3	3	3
	Spring Return Actuator (single piston)	1001	5.0E-04	2	2	3	2
		1002	3.3E-05	3	3	3	3
	Double Acting Actuator (single piston)	1001	1.9E-03	2	2	3	2
		1002	1.2E-04	3	3	3	3
Q-Series (RGS/RGD -Series) (without PSTD)	Double Acting Actuator	1001	6.3E-03	1	1	3	1
		1002	4.6E-04	2	2	3	2
	Spring Return Actuator (2 Springs)	1001	1.1E-03	2	2	3	2
		1002	7.3E-05	3	3	3	3
	Spring Return Actuator (4 Springs)	1001	1.6E-03	2	2	3	2
		1002	1.1E-04	3	3	3	3
	Spring Return Actuator (SD Model)	1001	9.8E-04	2	2	3	2
		1002	6.5E-05	3	3	3	3
	Spring Return Actuator (single piston)	1001	8.7E-04	2	2	3	2
		1002	5.7E-05	3	3	3	3
	Double Acting Actuator (single piston)	1001	4.5E-03	1	1	3	1
		1002	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 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
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
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
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).



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