Certificate

SIL/PL Capability

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ID 0600000000

No.: V 485.01/15

Product tested	Hydraulic quarter turn and linear actuators	**Certificate holder**	Emerson Process Management Damcos A/S Aederupvej 41 4700 Naestved Denmark
Type designation	Quarter turn actuators: BRC - double acting, BRCF (HT) - single acting Linear actuators: KC - double acting, KF/KFR - single acting		
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010		IEC 61511 Parts 1-3:2004 (in extracts)
Intended application	The actuators are suitable for use in a safety instrumented system up to SIL 2. Under consideration of the minimum required hardware fault tolerance HFT=1 the actuators may be used in a redundant structure up to SIL 3.		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual have to be considered.		

Summary of test results see back side of this certificate.

Valid until 2020-05-20

The issue of this certificate is based upon an examination, whose results are documented in Report No. V 485.01/15 dated 2015-05-20.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

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

Köln, 2015-05-20

Certification Body for FS-Products

Dipl.-Ing. Stephan Häb

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Manufacturer

Emerson Process Management Damcos A/S Aederupvej 41, DK-4700 Naestved

Emerson Process Management Marine Solutions Co., Ltd 530, Sinpyeong-dong Saha-gu Busan, 604-836 Korea

Product tested **Hydraulic Actuators BRC, BRCF (HT), KC, KF(R)**

Device specific values		**BRC, BRCF(HT)**	**KC; KF(R)**
Probability of Dangerous Failure on Demand	PFD_{spec}	2,46 E-04	1,97 E-04
Assumed Test Interval	Ti	1 a	1 a
Confidence Level	1-α	95 %	95 %
Safe Failure Fraction (see note)	SFF	72 %	67 %
Hardware Fault Tolerance	HFT	0	0
Diagnostic Coverage	DC	0 %	0 %
Type of Sub System		Typ A	Typ A
Mode of Operation		Low Demand	Low Demand
Proof Test Coverage	PTC	75 %	85 %
Partial Stroke Test Coverage	PSTC	Not considered	Not considered

Note

The Safe Failure Fraction (SFF) was estimated by an alternative method with a FMEA according to EN 161:2011/A3:2013.

Derived Values for 1oo1-Architecture		**BRC, BRCF(HT)**		**KC; KF(R)**	
Assumed Demands per Year	f_{np}	1 / a		1 / a	
Total Failure Rate	$\lambda_S + \lambda_D$	1,00 E-07 / h	100 FIT	6,82 E-08 / h	68 FIT
Lambda Dangerous Detected	λ_{DD}	0,00 E+00 / h	0 FIT	0,00 E+00 / h	0 FIT
Lambda Dangerous Undetected	λ_{DU}	2,81 E-08 / h	28 FIT	2,25 E-08 / h	22 FIT
Lambda Safe	λ_S	7,23 E-08 / h	72 FIT	4,57 E-08 / h	46 FIT
Mean Time Between Failures	MTBF	9,96 E+06 h	1.137 a	1,47 E+07 h	1.675 a
Mean Time Between Dangerous Failures	$MTBF_D$	3,56 E+07 h	4.060 a	4,45 E+07 h	5.074 a
Average Probability of Failure on Demand	**PFD_{avg}**	**1,23 E-04**		**9,85 E-05**	

Time of Usage

A time of usage of more than 5 years (+ 1.5 years of storage) can only be favored under responsibility of the operator, consideration of specific external conditions (securing of required quality of media, max. temperature, time of impact), and adequate test cycles.

Quality Management

These statements are bound to a proven and verified deployment of safety-related quality management of the manufacturer.