

Certificate



No.: 968/V 1168.00/21


Product tested	3/2 Solenoid Valve Redundant Supply & Exhaust Assemblies	Certificate holder	MAC Valves Europe Inc. Rue Marie Curie 12 4431 Loncin Belgium
Type designation	52, 54 and 67 series		
Codes and standards	IEC 61508 Parts 1-2 and 4-7:2010	EN ISO 13849-1:2015	
Intended application	Safety function: Achieving the safe position by built-in spring / by solenoid / by external pilot The valves are suitable for use in a safety instrumented system up to SIL 2 (low demand mode). Under consideration of the minimum required hardware fault tolerance HFT = 1 the valves may be used in a redundant architecture up to SIL 3. The valves are also suitable for operation in safety related systems according EN ISO 13849-1 with a Performance Level of up to PL d. If the valves are used in a redundant configuration (HFT = 1) the system is usable in a safety related system up to PL e according EN ISO 13849-1. A sufficient diagnostics has to be implemented. Constraints of the calculated MTTF _D according to the frequency of demand have to be considered.		
Specific requirements	The instructions of the associated Installation, Operating and Safety Manual shall be considered.		
Summary of test results see back side of this certificate.			
Valid until 2026-01-28			

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/V 1168.00/21 dated 2021-01-28.
This certificate is valid only for products which are identical with the product tested.

TÜV Rheinland Industrie Service GmbH
Bereich Automation
Funktionale Sicherheit

Köln, 2021-01-28

Certificate Body Safety & Security for Automation & Grid


Dipl.-Ing. (FH) Wolf Rückwart

Holder: MAC Valves Europe Inc.
 Rue Marie Curie 12
 4431 Loncin
 Belgium

Product tested: Solenoid Valves of Types
52, 65 and 67
 as Redundant Supply and Exhaust Assemblies

Results of Assessment

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

Type 52:	λ_D	Safe position by built-in spring		Safe position by solenoid	
Dangerous Failure Rate		8.50 E-08 / h	85 FIT	2.59 E-07 / h	259 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	3.78 E-04		1.15 E-03	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	3.80 E-05		1.17 E-04	

Type 54:	λ_D	Safe position by solenoid	
Dangerous Failure Rate		2.79 E-07 / h	279 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	1.24 E-03	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	1.26 E-04	

Type 67:	λ_D	Safe position by built-in spring		Safe position by solenoid		Safe position by external pilot	
Dangerous Failure Rate		1.14 E-07 / h	114 FIT	2.90 E-07 / h	290 FIT	1.38 E-07 / h	138 FIT
Average Probability of Failure on Demand 1oo1	$PFD_{avg}(T_1)$	5.08 E-04		1.29 E-03		6.14 E-04	
Average Probability of Failure on Demand 1oo2	$PFD_{avg}(T_1)$	5.10 E-05		1.31 E-04		6.18 E-05	

Assumptions for the calculations above: DC = 0 %, $T_1 = 1$ year, MRT = 72 h, $\beta_{1oo2} = 10$ %

High demand mode (HDM)		Type 52	Type 54	Type 67
B_{10D}	[-]	10,500,000	10,500,000	5,500,000
$MTTF_D (1oo1)$	[a]	12,470	12,470	6,752
Average Probability of Failure per Hour PFH_{1oo1}	[1/h]	9.15 E-09	9.15 E-09	1.69 E-08
$MTTF_D (1oo2)$	[a]	124,623	124,623	67,547
Average Probability of Failure per Hour PFH_{1oo2}	[1/h]	9.16 E-10	9.16 E-10	1.69 E-09

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 failure rates for high demand mode are the result of an endurance test under critical temperatures. 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.