



## **Annex to certificate**

Project:

Mechanically actuated valves, direct operated solenoid valves,  
pneumatically operated valves and pilot operated solenoid valves

Customer:

HAFNER Pneumatika Kft.  
Halászi  
Hungary

Contract Number: Q15/11-126-C

Report No.: Q15/11-126-C R004

Version V2, Revision R0, January 2020

Peter Söderblom



## Table of Contents

1	Purpose and Scope .....	3
2	Variants .....	3
2.1	Failure rates .....	17
3	Status of the Document .....	20
3.1	Liability .....	20
3.2	Releases .....	20
3.3	Future Enhancements .....	20
3.4	Release Signatures .....	20

## 1 Purpose and Scope

This document lists the versions of the assessed valves together with their respective failure rates. Normally these are registered on the certificate itself but as this assessment was performed for so many variants, the numbers are maintained in this annex instead.

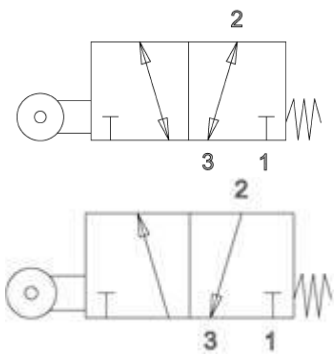
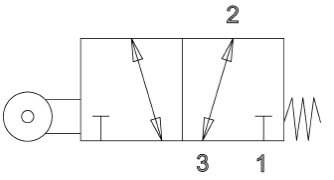
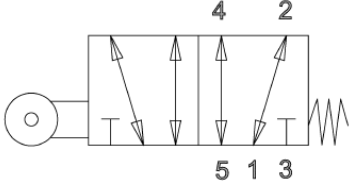
## 2 Variants

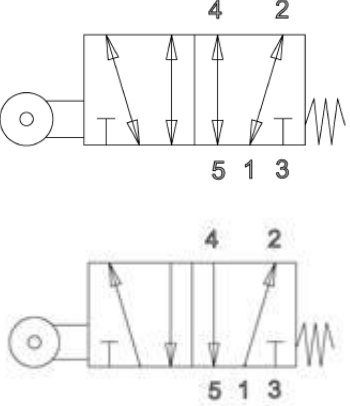
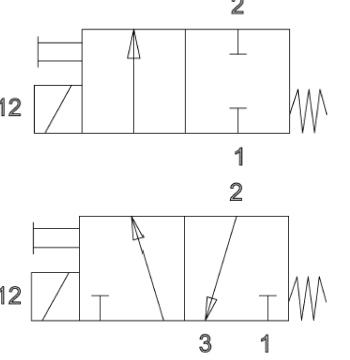
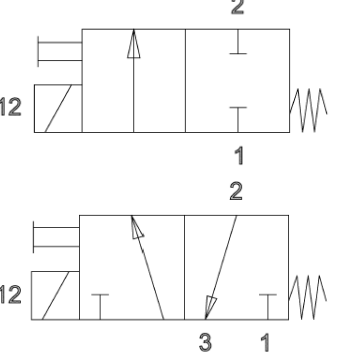
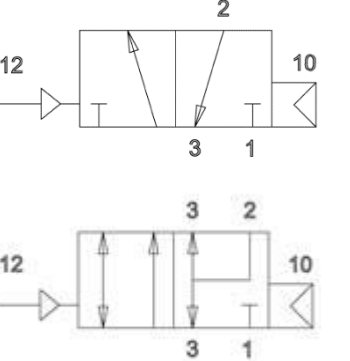
The mechanically actuated valves, direct operated solenoid valves, pneumatically operated valves and pilot operated solenoid valves can be considered to be part of a Type A element with a hardware fault tolerance of 0.

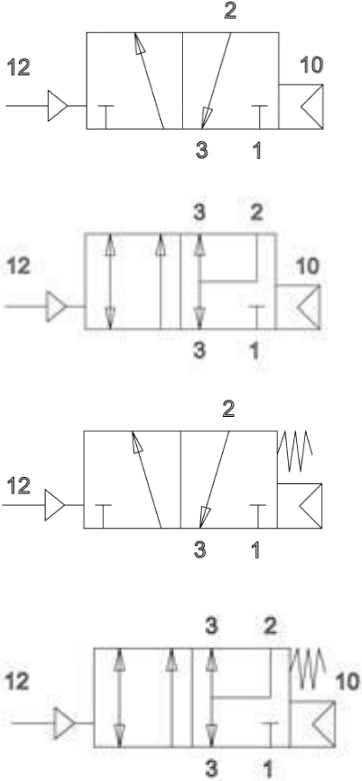
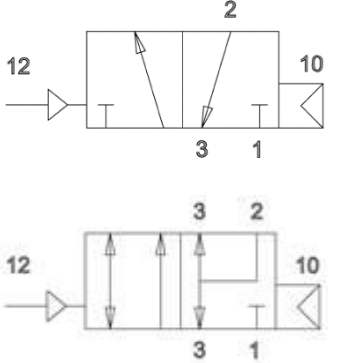
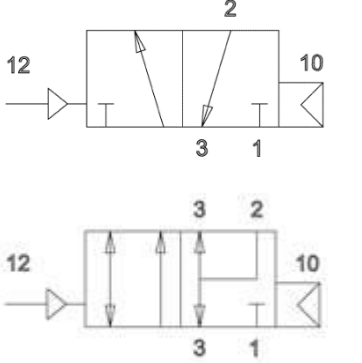
Table 1 gives an overview of the different variants that belong to the considered mechanically actuated valves, direct operated solenoid valves, pneumatically operated valves and pilot operated solenoid valves.

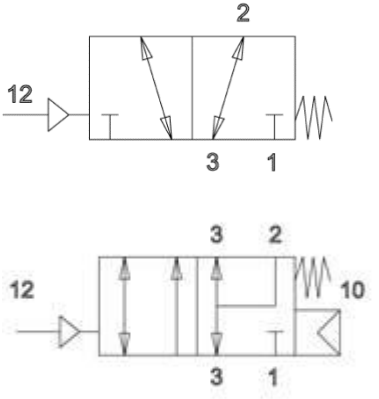
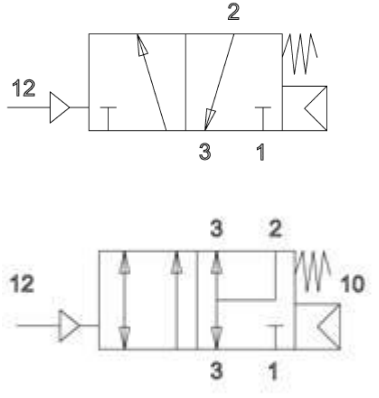
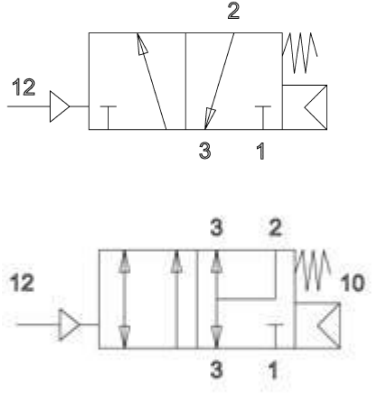
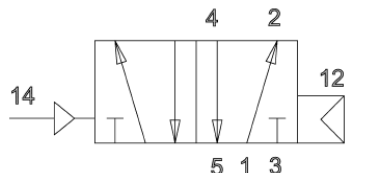
For safety applications only the described variants in Table 1 of the mechanically actuated valves, direct operated solenoid valves, pneumatically operated valves and pilot operated solenoid valves working as DTT (De-energize To Trip) devices have been considered.

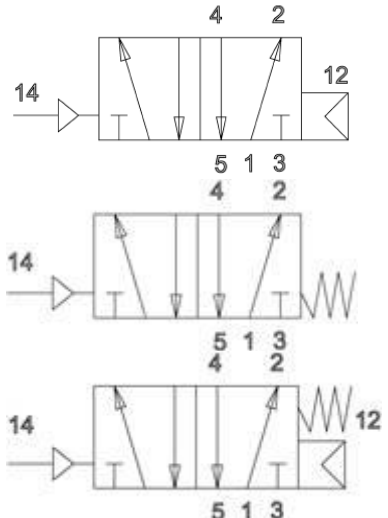
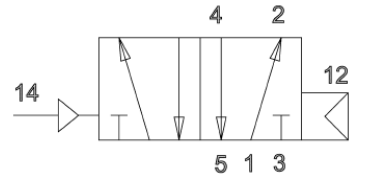
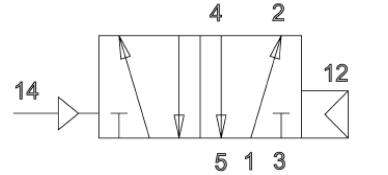
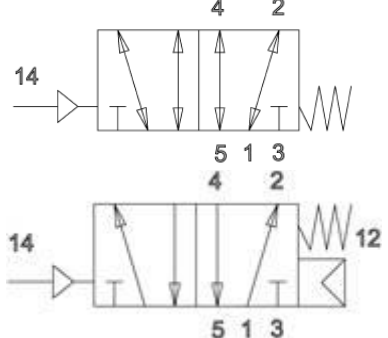
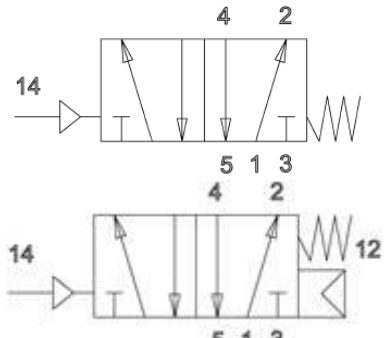
**Table 1: Variants overview**

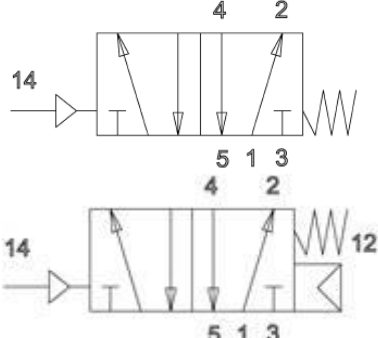
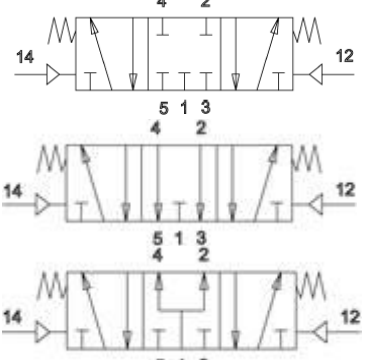
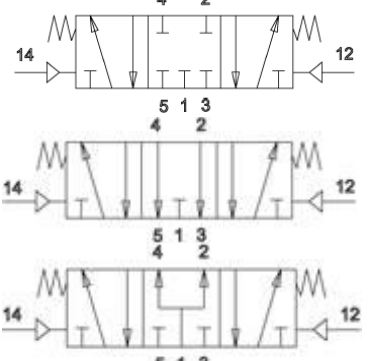
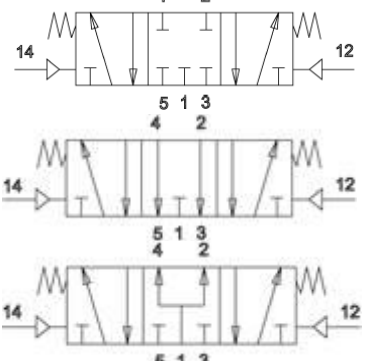
	Name	Description	Pneumatic diagram
[V1]	BR 311 ...	Mechanically actuated 3/2-way roller lever valves	
[V2]	BR 311 ... VES	Mechanically actuated stainless steel 3/2-way roller lever valves	
[V3]	BR 511 ...	Mechanically actuated 5/2-way roller lever valves	

	Name	Description	Pneumatic diagram
[V4]	BR 511 ... VES	Mechanically actuated stainless steel 5/2-way roller lever valves	
[V5]	M... 211 ... / M... 211 ... Ex ... M... 311 ... / M... 311 ... Ex ... / M... 311 ... TT / M... 311 ... TT Ex ...	Direct actuated in-line 2/2-way or 3/2-way solenoid valves	
[V6]	M... 211 ... VES / M... 211 ... VES Ex ... M... 311 ... VES / M... 311 ... VES TT / M... 311 ... VES Ex ... / M... 311 ... VES TT Ex ...	Direct actuated in-line 2/2-way or 3/2-way stainless steel solenoid valves	
[V7]	P... 310 ... / P... 310 ... Ex ...	Pneumatically actuated 3/2-way in-line valves	

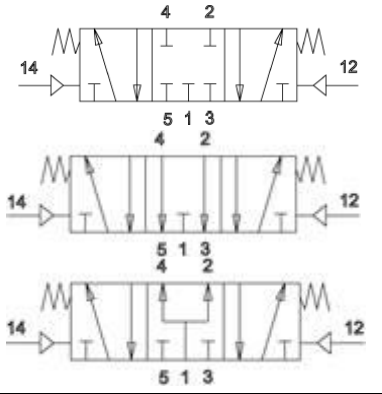
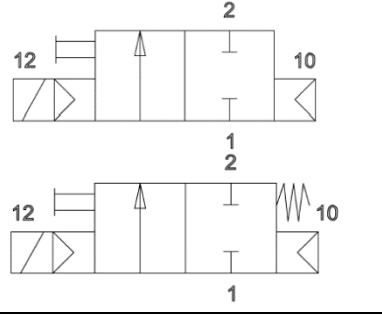
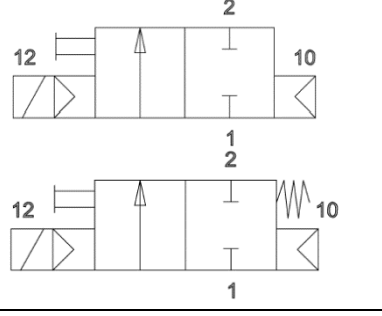
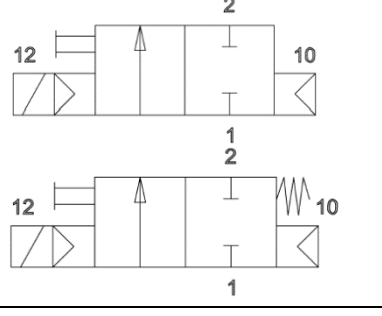
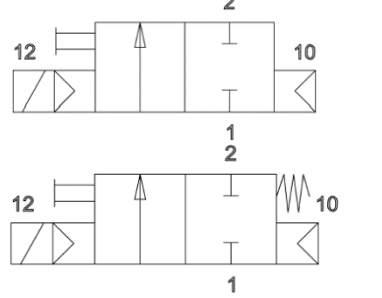
	Name	Description	Pneumatic diagram
[V8]	P... 310 ... VES / P... 310 ... VES Ex ... P... 311 ... VES / P... 311 ... VES Ex ...	Pneumatically actuated 3/2-way in-line stainless steel valves without and with mechanical spring	
[V9] [V9b]	P... 310 ... TT P... 310 ... TT Ex ... P... 310... TT AIR/ P... 310... TT AIR Ex	Low temperature pneumatically actuated 3/2-way valves	
[V10]	P... 310 ... VES TT / P... 310 ... VES TT Ex ...	Low temperature pneumatically actuated 3/2-way stainless steel valves	

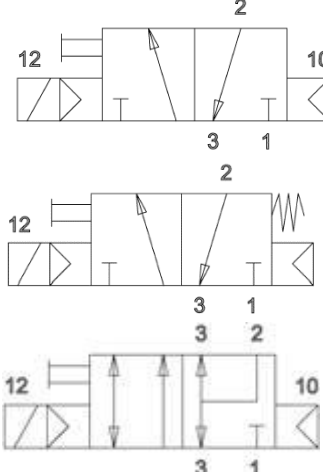
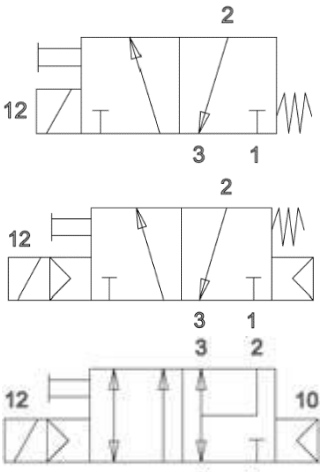
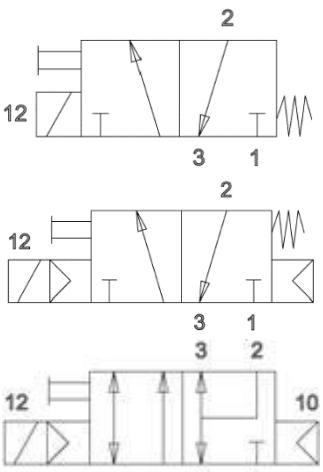
	Name	Description	Pneumatic diagram
[V11]	P... 311 ... / P... 311 ... Ex ...	Pneumatically actuated 3/2-way in-line valves with mechanical spring	
[V12]	P... 311 ... TT / P... 311 ... TT Ex ... P... 311... TT AIR/ P... 311... TT AIR Ex	Low temperature pneumatically actuated 3/2-way valves with mechanical spring	
[V13]	P... 311 ... VES TT / P... 311 ... VES TT Ex ...	Low temperature pneumatically actuated 3/2-way stainless steel valves with mechanical spring	
[V14]	P... 510 ... / P... 510 ... Ex ...	Pneumatically actuated 5/2-way in-line valves	

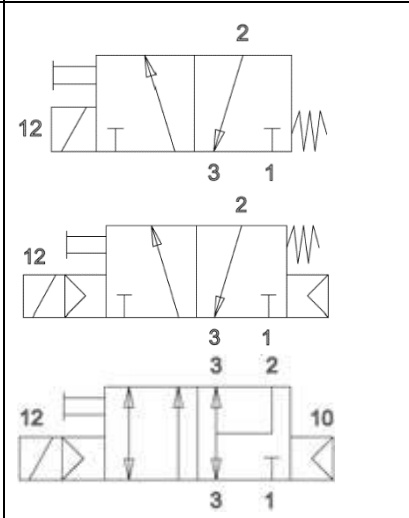
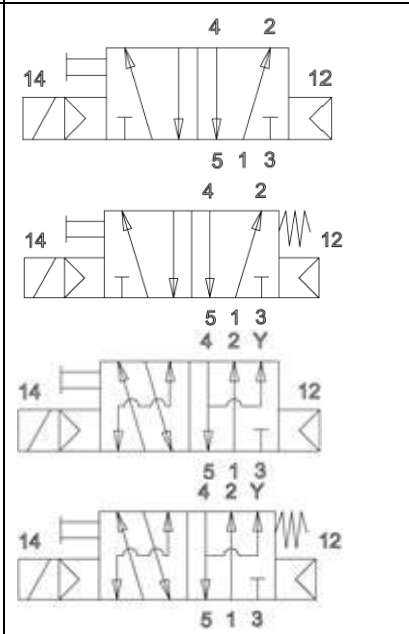
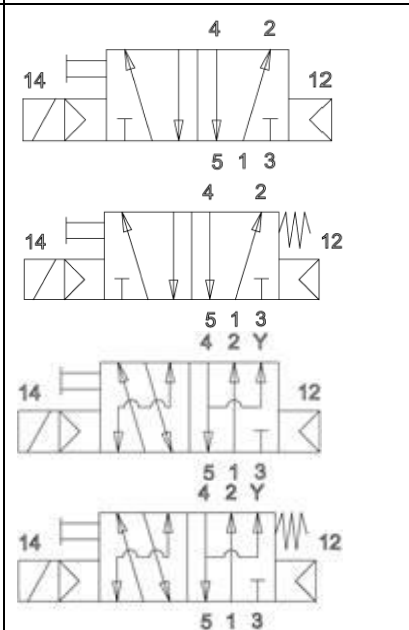
	Name	Description	Pneumatic diagram
[V15]	P... 510 ... VES / P... 510 ... VES Ex ... P... 511 ... VES / P... 511 ... VES Ex ...	Pneumatically actuated 5/2-way in-line stainless steel valves	
[V16]	P... 510 ... TT / P... 510 ... TT Ex ... P... 510... TT AIR/ P... 510... TT AIR Ex	Low temperature pneumatically actuated 5/2-way valves	
[V17]	P... 510 ... VES TT / P... 510 ... VES TT Ex ...	Low temperature pneumatically actuated 5/2-way stainless steel valves	
[V18]	P... 511 ... / P... 511 ... Ex ...	Pneumatically actuated 5/2-way in-line valves with mechanical spring	
[V19]	P... 511 ... TT / P... 511 ... TT Ex ... P... 511... TT AIR/ P... 511... TT AIR Ex	Low temperature pneumatically actuated 5/2-way valves with mechanical spring	

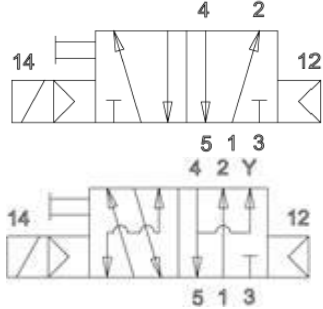
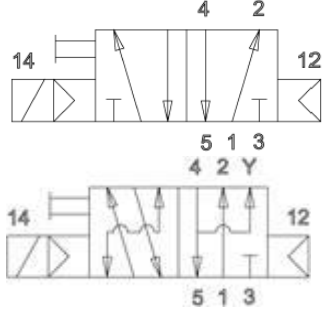
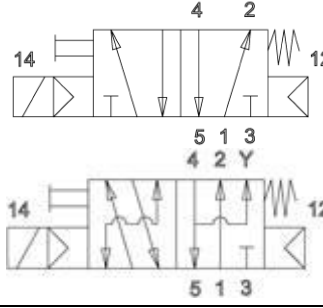
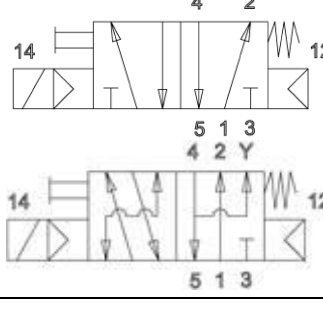
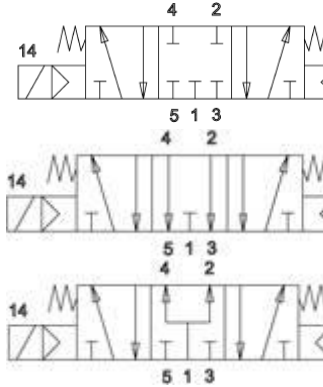
	Name	Description	Pneumatic diagram
[V20]	P... 511 ... VES TT / P... 511 ... VES TT Ex ...	Low temperature pneumatically actuated 5/2-way stainless steel valves with mechanical spring	
[V21]	P... 53_ ... / P... 53_ ... Ex ...	Pneumatically actuated 5/3-way in-line valves with mechanical spring	
[V22]	P... 53_ ... VES P... 53_ ... VES Ex ...	Pneumatically actuated 5/3-way in-line stainless steel valves with mechanical spring	
[V23] [V23b]	P... 53_ ... TT / P... 53_ ... TT Ex ... P... 53_ ... TT AIR/ P... 53_ ... TT AIR Ex	Low temperature pneumatically actuated 5/3-way valves with mechanical spring	

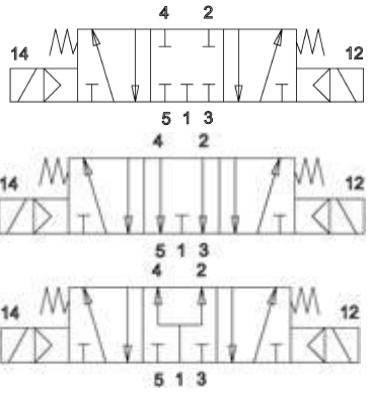
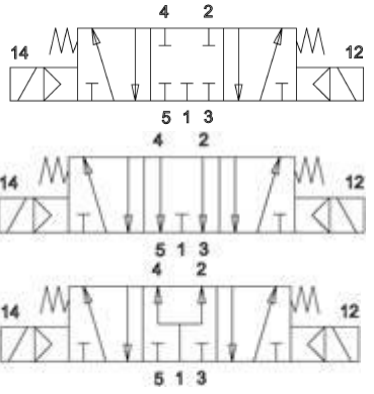
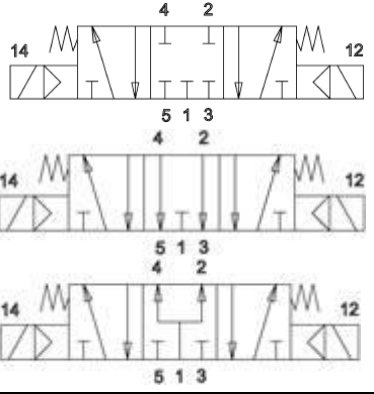
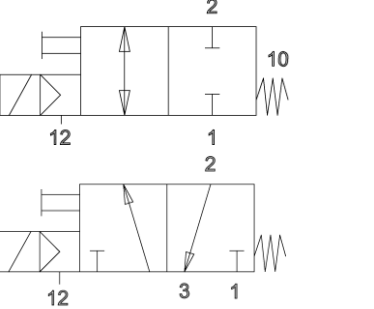


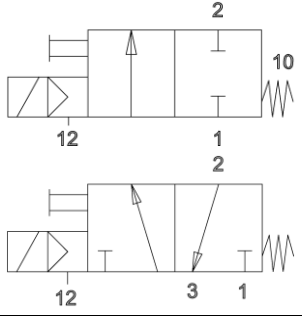
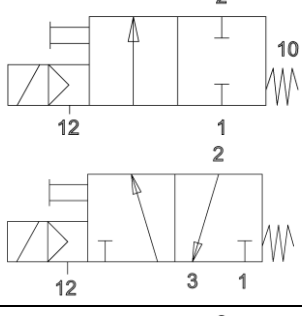
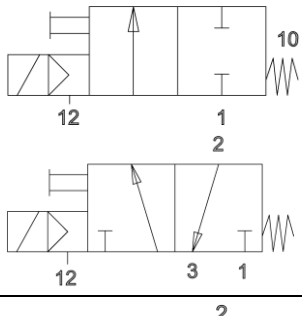
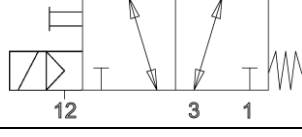
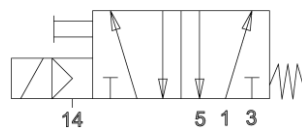
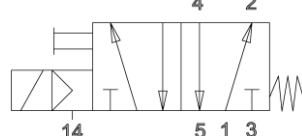
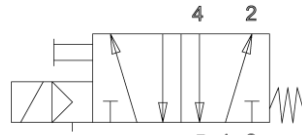
	Name	Description	Pneumatic diagram
[V24]	P... 53_ ... VES TT / P... 53_ ... VES TT Ex ...	Low temperature pneumatically actuated 5/3-way stainless steel valves with mechanical spring	
[V25]	M... 210 ... / M... 210 ... Ex ... M... 211 ... / M... 211 ... Ex ...	Pilot operated 2/2-way in-line solenoid valves	
[V26]	M... 210 ... VES / M... 210 ... VES Ex ... M... 211 ... VES / M... 211 ... VES Ex ...	Pilot operated 2/2-way in-line stainless steel solenoid valves	
[V27]	M... 210 ... TT / M... 210 ... TT Ex ... M... 211 ... TT / M... 211 ... TT Ex ...	Low temperature pilot operated 2/2-way in-line solenoid valves	
[V28]	M... 210 ... VES TT / M... 210 ... VES TT Ex ... M... 211 ... VES TT / M... 211 ... VES TT Ex ...	Low temperature pilot operated 2/2-way in-line stainless steel solenoid valves	

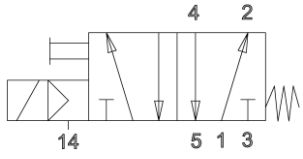
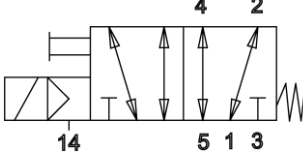
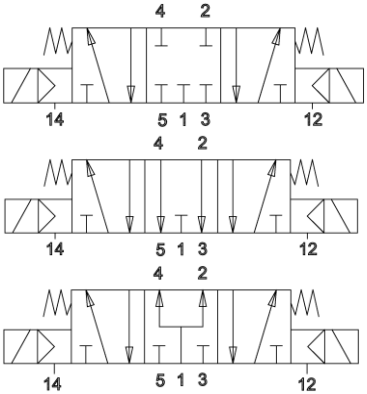
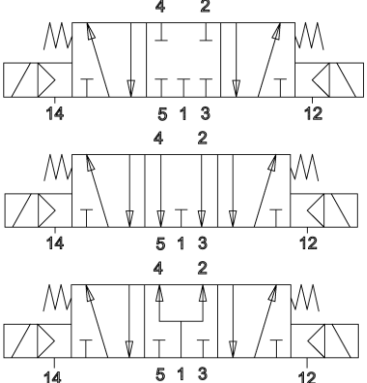
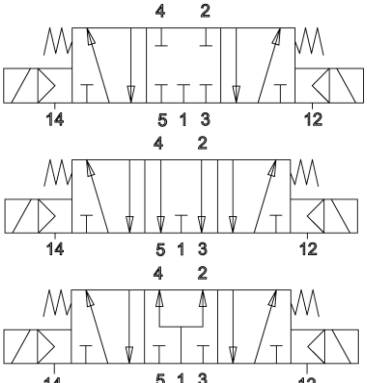
	Name	Description	Pneumatic diagram
[V29]	M... 310 ... / M... 310 ... Ex ... M... 311 ... / M... 311 ... Ex ...	Pilot operated in-line 3/2-way solenoid valves	 <p>The pneumatic diagrams for V29 valves show three configurations. Each diagram features a 3/2-way valve with ports 12, 2, 3, 1, and 10. The top diagram shows a standard 3/2-way valve with a pilot line from port 2 to port 3. The middle diagram shows a similar valve with a spring return. The bottom diagram shows a 3/2-way valve with a pilot line from port 2 to port 3, and a spring return to port 10.</p>
[V30]	M... 310 ... VES / M... 310 ... VES Ex ... M... 311 ... VES / M... 311 ... VES Ex ...	Pilot operated in-line 3/2-way stainless steel solenoid valves	 <p>The pneumatic diagrams for V30 valves are identical in structure to those of V29, showing three configurations of a 3/2-way valve with ports 12, 2, 3, 1, and 10, including pilot lines and spring returns.</p>
[V31] [V31b]	M... 310 ... TT / M... 310 ... TT Ex ... M... 311 ... TT / M... 311 ... TT Ex ... M... 310 ... TT AIR/ M... 310 ... TT AIR Ex M... 311 ... TT AIR/ M... 311 ... TT AIR Ex	Pilot operated low temperature in-line 3/2-way solenoid valves	 <p>The pneumatic diagrams for V31 valves are identical in structure to those of V29 and V30, showing three configurations of a 3/2-way valve with ports 12, 2, 3, 1, and 10, including pilot lines and spring returns.</p>

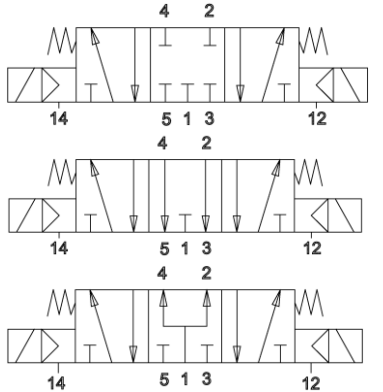
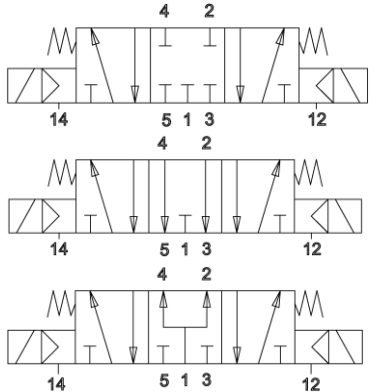
	Name	Description	Pneumatic diagram
[V32]	M... 310 ... VES TT / M... 310 ... VES TT Ex ... M... 311 ... VES TT / M... 311 ... VES TT Ex ...	Pilot operated low temperature in-line 3/2-way stainless steel solenoid valves	 <p>The diagrams show three configurations of a 3/2-way solenoid valve. The first two are standard 3/2-way valves with ports 12, 3, and 1. The third is a pilot-operated version with an additional port 10. Arrows indicate the flow of air through the valve in different states.</p>
[V33]	M... 510 ... / M... 510 ... Ex ... M... 511 ... / M... 511 ... Ex ... M... 350 ... / M... 350 ... Ex ... M... 351 ... / M... 351 ... Ex ...	Pilot operated in-line 5/2-way solenoid valves	 <p>The diagrams show three configurations of a 5/2-way solenoid valve. The first two are standard 5/2-way valves with ports 14, 4, 2, 5, 1, and 3. The third is a pilot-operated version with an additional port 12. Arrows indicate the flow of air through the valve in different states.</p>
[V34]	M... 510 ... VES / M... 510 ... VES Ex ... M... 511 ... VES / M... 511 ... VES Ex ... M... 350 ... VES / M... 350 ... VES Ex ... M... 351 ... VES / M... 351 ... VES Ex ...	Pilot operated in-line 5/2-way stainless steel solenoid valves	 <p>The diagrams show three configurations of a 5/2-way stainless steel solenoid valve, identical in structure to the previous row but with different port numbering (14, 4, 2, 5, 1, 3) and a pilot port 12. Arrows indicate the flow of air through the valve in different states.</p>

	Name	Description	Pneumatic diagram
[V35]	M... 510 ... TT / M... 510 ... TT Ex ... M... 510 ... TT AIR/ M... 510 ... TT AIR Ex M... 350 ... TT / M... 350 ... TT Ex ...	Pilot operated low temperature in-line 5/2-way solenoid valves	
[V36]	M... 510 ... VES TT / M... 510 ... VES TT Ex ... M... 350 ... VES TT / M... 350 ... VES TT Ex ...	Pilot operated low temperature in-line 5/2-way stainless steel solenoid valves	
[V37]  [V37b]	M... 511 ... TT / M... 511 ... TT Ex ... M... 351 ... TT / M... 351 ... TT Ex ... M... 511 ... TT AIR/ M... 511 ... TT AIR Ex	Pilot operated low temperature in-line 5/2-way solenoid valves with mechanical spring	
[V38]	M... 511 ... VES TT / M... 511 ... VES TT Ex ... M... 351 ... VES TT / M... 351 ... VES TT Ex ...	Pilot operated low temperature in-line 5/2-way stainless steel solenoid valves with mechanical spring	
[V39]	M... 53_ ... / M... 53_ ... Ex ...	Pilot operated in-line 5/3-way solenoid valves	

	Name	Description	Pneumatic diagram
[V40]	M... 53_ ... VES / M... 53_ ... VES Ex ...	Pilot operated in-line 5/3-way stainless steel solenoid valves	
[V41] [V41b]	M... 53_ ... TT / M... 53_ ... TT Ex ... M... 53_ ... TT AIR/ M... 53_ ... TT AIR Ex	Pilot operated low temperature in-line 5/3- way solenoid valves	
[V42]	M... 53_ ... VES TT / M... 53_ ... VES TT Ex ...	Pilot operated low temperature in-line 5/3- way stainless steel solenoid valves	
[V43]	ME. 211.../ ME. 211... Ex ME. 311.../ ME. 311... Ex	External pilot feed operated 2/2-way or 3/2 way in-line solenoid valves	

	Name	Description	Pneumatic diagram
[V44]	ME. 211... VES/ ME. 211... VES Ex ME. 311... VES/ ME. 311... VES Ex	External pilot feed operated 2/2-way or 3/2 way in-line stainless steel solenoid valves	
[V45]	ME. 211... TT/ ME. 211... TT Ex ME. 311... TT/ ME. 311... TT Ex/	Low temperature external pilot feed operated 2/2-way or 3/2 way in-line solenoid valves	
[V46]	ME. 211... VES TT/ ME. 211... VES TT Ex ME. 311... VES TT/ ME. 311... VES TT Ex	Low temperature external pilot feed operated 2/2-way or 3/2 way in-line stainless steel solenoid valves	
[V47]	ME. 311... TT AIR/ ME. 311... TT AIR Ex	Low temperature external pilot feed operated 3/2-way in-line solenoid valves	
[V48]	ME. 511.../ ME. 511... Ex	External pilot feed operated 5/2-way in-line solenoid valves	
[V49]	ME. 511... VES/ ME. 511... VES Ex	External pilot feed operated 5/2-way in-line stainless steel solenoid valves	
[V50]	ME. 511... TT/ ME. 511... TT Ex	Low temperature external pilot feed operated 5/2-way in-line solenoid valves	

	Name	Description	Pneumatic diagram
[V51]	ME. 511... VES TT/ ME. 511... VES TT Ex	Low temperature external pilot feed operated 5/3-way in-line stainless steel solenoid valves	
[V52]	ME. 511... TT AIR/ ME. 511... TT AIR Ex	Low temperature external pilot feed operated 5/2-way in-line solenoid valves	
[V53]	ME. 53_.../ ME. 53_... Ex	External pilot feed operated 5/3-way in-line solenoid valves	
[V54]	ME. 53_... VES/ ME. 53_... VES Ex	External pilot feed operated 5/3-way in-line stainless steel solenoid valves	
[V55]	ME. 53_... TT/ ME. 53_... TT Ex	Low temperature external pilot feed operated 5/3-way in-line solenoid valves	

	Name	Description	Pneumatic diagram
[V56]	ME. 53_... VES TT/ ME. 53_... VES TT Ex	Low temperature external pilot feed operated 5/3-way in-line stainless steel solenoid valves	
[V57]	ME. 53_... TT AIR ME. 53_... TT AIR Ex	Low temperature external pilot feed operated 5/3-way in-line solenoid valves	



## 2.1 Failure rates

The table below lists the failure rates in FIT (failures / 10<sup>9</sup> hours) for the variants listed above.

**Table 2: Failure rates per IEC 61508:2010**

Variant	Profile	exida Profile							
		Failure rates (in FIT)							
		without PST				with PST			
		□SD	□SU	□DD	□DU	□SD	□SU	□DD	□DU
[V1]	3	0	3	0	312	0	3	269	44
[V2]	5	0	3	0	377	0	3	324	53
[V3]	3	0	3	0	452	0	3	392	60
[V4]	5	0	3	0	545	0	3	471	74
[V5]	3	0	75	0	5	0	75	5	0
[V6]	5	0	75	0	7	0	75	7	0
[V7]	3	0	58	0	188	0	58	153	35
[V8]	5	0	70	0	204	0	70	171	33
[V9]	3	0	58	0	158	0	58	135	23
[V9b]	3	0	58	0	208	0	58	166	42
[V10]	5	0	70	0	192	0	70	164	28
[V11]	3	0	55	0	330	0	55	278	52
[V12]	3	0	58	0	218	0	58	191	27
[V13]	5	0	70	0	264	0	70	231	33
[V14]	3	0	58	0	398	0	58	338	60
[V15]	5	0	70	0	420	0	70	371	49
[V16]	3	0	58	0	338	0	58	302	36
[V17]	5	0	70	0	408	0	70	364	44
[V18]	3	0	55	0	470	0	55	401	69
[V19]	3	0	6	0	384	0	6	349	35
[V20]	5	0	7	0	464	0	7	421	43
[V21]	3	0	12	0	454	0	12	395	59
[V22]	5	0	13	0	473	0	13	430	43
[V23]	3	0	12	0	394	0	12	359	35
[V23b]	3	0	96	0	502	0	96	424	78
[V24]	5	0	13	0	475	0	13	432	43
[V25]	3	0	150	0	189	0	150	154	35

Variant	Profile	exida Profile							
		Failure rates (in FIT)							
		without PST				with PST			
		□SD	□SU	□DD	□DU	□SD	□SU	□DD	□DU
[V26]	5	0	159	0	206	0	159	173	33
[V27]	3	0	147	0	159	0	147	136	23
[V28]	5	0	159	0	194	0	159	166	24
[V29]	3	0	150	0	190	0	150	155	35
[V30]	5	0	159	0	207	0	159	174	33
[V31]	3	0	147	0	160	0	147	137	23
[V31b]	3	0	150	0	230	0	150	179	51
[V32]	5	0	159	0	194	0	159	166	28
[V33]	3	0	150	0	400	0	150	340	60
[V34]	5	0	159	0	422	0	159	373	49
[V35]	3	0	347	0	380	0	347	328	52
[V36]	5	0	399	0	459	0	399	395	64
[V37]	3	0	147	0	340	0	147	304	36
[V37b]	3	0	150	0	470	0	150	401	69
[V38]	5	0	159	0	411	0	159	366	45
[V39]	3	0	196	0	457	0	196	397	60
[V40]	5	0	182	0	478	0	182	435	43
[V41]	3	0	180	0	398	0	180	362	36
[V41b]	3	0	280	0	504	0	280	426	78
[V42]	5	0	182	0	480	0	182	436	44
[V43]	3	0	145	0	261	0	145	218	43
[V44]	5	0	159	0	280	0	159	242	38
[V45]	3	0	147	0	221	0	147	194	27
[V46]	5	0	161	0	265	0	161	233	32
[V47]	3	0	145	0	331	0	145	280	51
[V48]	3	0	145	0	401	0	145	341	60
[V49]	5	0	159	0	424	0	159	375	49
[V50]	3	0	127	0	301	0	127	242	59
[V51]	5	0	139	0	361	0	139	291	70
[V52]	3	0	145	0	471	0	145	403	68

Variant	Profile	exida Profile							
		Failure rates (in FIT)							
		without PST				with PST			
		<input type="checkbox"/> SD	<input type="checkbox"/> SU	<input type="checkbox"/> DD	<input type="checkbox"/> DU	<input type="checkbox"/> SD	<input type="checkbox"/> SU	<input type="checkbox"/> DD	<input type="checkbox"/> DU
[V53]	3	0	185	0	458	0	185	397	59
[V54]	5	0	191	0	477	0	191	434	43
[V55]	3	0	188	0	396	0	188	361	35
[V56]	5	0	207	0	475	0	207	433	42
[V57]	3	0	269	0	504	0	269	426	78

### 3 Status of the Document

#### 3.1 Liability

*exida* prepares reports based on methods advocated in International standards. *exida* accepts no liability whatsoever for the use of this annex or for the correctness of the standards on which the general calculation methods are based.

#### 3.2 Releases

Contract Number	Report Number	Revision Notes
Q19/02-018-C	1511-126-C R004 V2, R0	Surveillance audit and new versions added: MEH, TT AIR and MH 311
Q15/11-126-C	1511-126-C R004 V1, R0	Review comments implemented
Q15/11-126-C	1511-126-C R004 V0, R1	Draft; Waiting for review

Author: Peter Söderblom

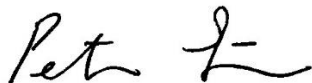
Review: Steven Close

Release status: Released 09-Jan-2020

#### 3.3 Future Enhancements

At request of client.

#### 3.4 Release Signatures



---

Peter Söderblom, Senior Safety Engineer



---

Steven Close, Senior Safety Engineer