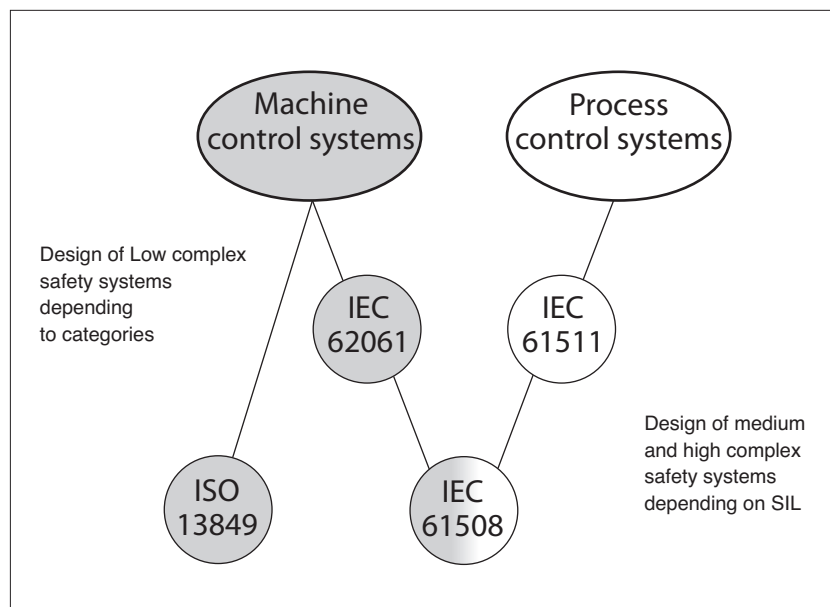


Functional safety, - MTTFd reliability data

according to EN ISO 13849-1/2



The new European Machine Directive 2006/42/EC imposes to fulfill additional safety requirements to all machines or systems delivered into the European market. The approach to define the compliance with above safety requirements refers to different standards according to the product classification:

- Machine control systems refer to the European harmonized standard EN ISO 13849. The safety requirements are evaluated according to reliability calculation procedures performed on any single component of the safety system. In the specific case of hydraulic components MTTFd (mean time to dangerous failure) is applied. MTTFd is a reliability parameter determined by statistical approach, which value is defined by the EN ISO 13849 = 150 years if all safety principle, as those listed in section 1 are fulfilled by the analyzed component.
- Process control systems follow different standards and their components related to safety are classified according to SIL (Safety Integrity Level).

In the following sections are reported the criteria for MTTFd determination and the values for each Atos component suitable to be used in safety related controls.

1 DETERMINATION of MTTFd values according to EN ISO 13849-1/2

The evaluation of MTTFd values for the devices listed in sections 3, 4, 5, 7 has been accomplished according to the basic and well-tried safety principles suggested in the standard EN ISO 13849-1/2 .

Furthermore an FMEDA calculation has been carried out using failure data taken from recognized international database.

A list of MTTFd values for many valves are available in the following pages.

If the components design fulfills requirements of the above principles, the MTTFd of the device can be evaluated equal to 150 years, that it means to perform a Performance Level equal to "c" for the architecture corresponding to category 1.

Each type of devices sections 3 to 7 can be classified as follows, according to EN ISO 13849-1/2:

- category 1
- single channel (the component performs a single function)
- high MTTFd
- Diagnostic Coverage: not applicable
- CCF (Common Cause Failure): applicable only to categories > 1
- maximum obtainable Performance Level is "c"
- Service life = 20 years (according to EN ISO 13849-1 is the maximum period of using)

The above described classification is valid if the following characteristics of the hydraulic valves are respected:

- The spool returns in rest position in case of valve's de-energization;
- The spool must keep the rest position when the valve is de-energized;
- The spool must ensure a sufficient overlapping in rest position;

2 GENERAL NOTES

- The reliability values listed in the following sections 3 to 7 are guaranteed if the operating conditions described in each component's technical table are respected

The manufacturer who has to design a machine or a system with specific safety requirements, has to consider the following important notes:

• Low complex safety systems designed according to EN ISO 13849

The manufacturer must define the Performance Level (PL) according to the risk analysis. This reliability characteristics is obtainable starting from MTTFd values of each hydraulic components used in the equipment.

• Medium and high complex safety systems designed according to EN 62061

The manufacturer must define the Safety Integrity Level (SIL) according to the risk analysis. This characteristics is obtainable starting from Performance Level (PL) defined by EN ISO 13849 and calculated as described in the previous step.

3 MODULAR VALVES (Section D of KT master catalog)

SOLENOID OPERATED VALVES					
Valves type	MTTFd value (years)	Configuration (1)	Spools type (1)	Notes	Technical table
HM, KM, HMP	150	02, 03, 04, 11, 16	-	-	D120
HG, KG		31, 33, 34	Normally closed		D140
JPG-2, JPG-3		11			
HQ, KQ JPQ-2, JPQ-3		12, 13, 14, 22, 23, 24			
HR, KR		02, 03, 04, 11, 16	-		D180
JPR-2, JPR-3		12, 13, 14			

(1): For available coupling between valve type, configuration and spool, see the indicated technical table

4 DIRECTIONAL ON-OFF CONTROLS (Section E of KT master catalog)

SOLENOID OPERATED VALVES					
Valves type	MTTFd value (years)	Configuration (1)	Spools type (1)	Notes	Technical table
DHI DHE DHEP	150	61, 63, 67, 71, 75 (Excepted 70 and 77)	0/2, 1, 1/2, 2, 2/2, 3, 4, 5, 58, 6, 7, 8, 91, 19, 93, 39, 94, 49, 16, 17, 1/9 (Excepted 0, 90, 09)	-	E010 E015 TE030
DKE DKEP		61, 63, 67, 71, 75 (Excepted 70)	0/2, 1, 1/2, 2/2, 2/7, 3, 4, 5, 5/7, 6, 7, 8, 91, 19, 93, 39, 1/3, 1/9 (Excepted 0)		E025 TE030
DLOH, DLOK DLEH, DLEHM		2 way or 3 way	Normally open or Normally closed		E041 E045
DPHI DPHE	75	61, 63, 67, 71, 75 (Excepted 70)	0, 0/2, 1, 1/2, 2, 2/2, 3, 4, 5, 58, 6, 7, 8, 90, 09, 91, 19, 93, 39, 94, 49, 16, 17		E085

SAFETY VALVES					
Valves type	MTTFd value (years)	Configuration (1)	Spools type (1)	Notes	Technical table
DHI-*/F* DHE-*/F	150	61, 63, 67, 71, 75	0/2, 1, 1/2, 2, 2/2, 3, 4, 5, 6, 7, 8, 91, 19, 93, 39, 94, 49, 16, 17, 58, 2/7, 5/7, 6/7, 7/7 (Excepted 0)	Safety valves TÜV certified	EY010
DKE-*/F*		61, 63, 67, 71, 75 (Excepted 70)	0/2, 1, 1/2, 2/2, 3, 4, 5, 6, 7, 8, 91, 19, 93, 39, 2/7, 5/7, 58 (Excepted 0)		
HF-06*/FV		61, 67	1, 3, 4	-	EY050
LIFI		Normally closed	42, 43	Safety valves TÜV certified	EY120
LIDA-*/FV LIDAS-*/FV	Normally closed	43			
LIDAH-*/FV LIDASH-*/FV			75		
DPHI-*/FV DPHE-*/FV	150	Two way		Normally closed (Excepted normally open)	-
JODL			Normally closed	Safety valves TÜV certified	
JODL-*/FV					

EX-PROOF VALVES					
Valves type	MTTFd value (years)	Configuration (1)	Spools type (1)	Notes	Technical table
DHA	150	61, 63, 67, 71, 75	0/2, 1, 1/2, 2, 2/2, 3, 4, 5, 6, 7, 8, 91, 19, 93, 39, 94, 49, 16, 17, 58 (Excepted 0, 09, 90)	Ex-proof valves Multicertified Atex, IECEx, EAC or C UL US	see www.atos.com catalog on line section "ex-proof & stainless steel" or KTX ex-proof paper catalog
DLAH DLAHM	150	2A, 2C, 3A, 3C	-		
DHZA, DKZA		51, 53, 71, 73	L14, L1, S2, S3, L3, D3, S5, L5, D5		
DPZA	75		61, 63, 67, 71, 75 (Excepted 70)		
DPHA		0/2, 1, 1/2, 2, 2/2, 3, 4, 5, 6, 7, 8, 91, 19, 93, 39, 94, 49, 16, 17, 58 (Excepted 0, 09, 90)			
DHW	150	61, 63, 71, 75	1, 1/2, 3, 3H	Intrinsically safe certified Atex, IECEx	
DPHW	75	61, 63, 67, 71, 75	1, 1/2, 3, 4, 5, 58, 6, 7, 8, 91, 19, 93, 39, 94, 49, 16, 17		
DLOH-*WO	150	2A, 2C, 3A, 3C	-	Stainless steel Multicertified Atex, IECEx, EAC or C UL US	
DHAX*		61, 63, 71, 75	1, 1/2, 3, 6, 7 (Excepted 0)		
DLAHX* DLAHMX*		3A, 3C	-		
DLPX* DLHPX*					
DLAPX* DLAHPX*					75

(1): For available coupling between valve type, configuration and spool, see the indicated technical table

5 PROPORTIONAL CONTROLS (See section F of KT master catalog)

PRESSURE CONTROLS					
Valves type	MTTFd value (years) (2)	Configuration (1)	Spools type (1)	Notes	Technical table
RZMO-A*, RZMO-R* HZMO-A*	150	010, 030	-	Switch-off the power supply for valves with integral electronics (2)	FS007, FS010 FS065, FS067
RZGO-A*, RZGO-R*		010, 033			FS015, FS020, FS070, FS075
HZGO-A*, KZGO-A*		031, 033			F070
DHZO-A*, DKZOR-A DKZOR-A*, DKZOR-T*		51, 53, 70, 71, 73			L14, L1, S2, S3, L3, D3, S5, L5, D5
DPZO-A*	75	51, 53, 71, 73	S3, D3, S5, L5, D5	Monitor and feedback signal processed by integral electronics must not be used for safety machine relevant function	FS170
DPZO-T*			L3, S3, D3, L5, S5, D5, DL5, Q5, D9, V9, L9		FS172
DPZO-L*			51, 53, 70, 71, 73 (Excepted 60, 70)		L3, S3, D3, L5, S5, D5, DL5, Q5, D9, V9, L9, T5
DLHZO-T* DLKZOR-T*	150	40, 60	L0, L1, V1, L3, V3, L5, T5, L7, T7, V7, D7, DT7		FS180
LIQZO-L* LIQZP-L*	75	2 way 3 way	L4		FS330, FS340

(1): For available coupling between valve type, configuration and spool, see the indicated technical table

(2): For valves with integral electronics, the MTTFd value is evaluated considering the valve's mechanical reliability. For safety function, the power supply to the valve integral electronics must be interrupted by using a switching device with adequate reliability degree.

6 MODULAR COVER (See section H of KT master catalog)

COVER ELEMENTS					
Valves type	MTTF _d value (years)	Configuration (1)	Cartridge type (1) see section 7	Notes	Technical table
LIDA	Not relevant	Check function	Can be coupled to: 32, 33, 42, 43, 52	-	H040
LIDB					
LIDD		Flow control	Can be coupled to: 32, 33, 42, 43		H020
LIDBH	Directional control Piloted by solenoid valve	H030			
LIDEW	Directional control Piloted by a shuttle valve				

(1): For available coupling between valve type, configuration and spool, see the indicated technical table

7 CARTRIDGES (See table H003 and H050 of KT master catalog)

2 WAY CARTRIDGES					
Valves type	MTTF _d value (years)	Area ratio (3)	Poppet / Spool type (3)	Notes	Technical table
SC LI	150	1:1 1:1,1 1:2 1:1,5	31, 32, 33, 42, 43, 52	-	H003
LIDAS		1:1 1:1,6	31, 33, 43		H050
LIDASH	75				

(3): For area ratio of poppet / spool type, see the indicated technical table

The MTTF_d values of valves not included in these above sections, are available on request