Safety functions according to DIN EN ISO 13849-1

Type	EC type test certificate	PL	Kat.	$MTTF_d$ [years]	DC_{avg} [%]	
Industrial door (signal transmission and switching devices)						
INTRA 50	E6592 and [4]	e	3	121	95	[1]
InTra6 2	E6934 and [4]	d	2	254	94	[1]
InTra6 3	E6935 and [4]	e	3	247	95	[1]
RFGate 2	E6945 and [4]	c	2	28.8	76	[1]
RFGate 3	E7161 and [4]	d	3	46	77	[1]
EsGate 2	E6937 and [4]	d	2	123	94	[2]
EsGate 3	E6936 and [4]	e	3	73	95	[2]
Machine safety (switching devices)						
ESA25, ESP25	[4]	d	2	109	93	[2]
ESR25 (MUS1)	[4]	d	2	155	60	[2]
ESR26 (MUS2)	[4]	d	2	81	60	[2]
EsMatix 3	[4]	e	3	100	90	[2]
ESD3	[4]	e	3	94	97	[2]

Type	EC type test certificate	PL	Kat.	$MTTF_d$ [years]	DC_{avg} [%]	
Pedestrian door (revolving, sliding, swing door)						
PrimeTec A, PrimeScan A	4420512403013-001[7]	d	2	253	86	[8]
PrimeTec A, PrimeScan A	4420512403013-001[7]	d	3	281	91	[9]
PrimeTec B, PrimeScan B	4420512403013-002[7]	d	2	253	86	[8]
PrimeTec B, PrimeScan B	4420512403013-003[7]	d	2	253	86	[10]
US beam, UniScan	4420512413806-001[7]	d	2	153	99	[8]

Type				$MTTF_d$ [years]	B_{10d} [x 10^6]	
Safety edges, safety mats						
ELE	-	-	-	3)	5	
ESM	-	-	-	3)	6	
Loop detectors						
ProLoop2				73	7	[6]
ProLoop lite				73	7	[6]

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Type	$MTTF_d$ with safety edge [1] [years]	$MTTF_d$ with safety mat [5] [years]
Industrial door (signal transmission and switching devices)		
INTRA 50	107	-
InTra6 2	200	-
InTra6 3	167	-
RFGate 2	28	-
EsGate 2	266	-
EsGate 3	217	-
Machine safety (switching devices)		
ESA25, ESP25	721	132
ESR25 (MUS1)	693	131
ESR26 (MUS2)	422	68
EsMatix 3	386	72
ESD3	322	70
ESR31 / 32	414	97

1) Door application assumed parameters: d_{op} = 365d/a, h_{op} = 24h/d, t_{cycle} = 3'600s (n_{op} = 8'760/a)
2) Machine application assumed parameters: dop = 365d/a, hop = 24h/d, tcycle = 60s (nop = 525'600/a)
3) MTTFd = level and value depending application (see calculation model page 3)
4) In combination with safety edges, certified according to EN12978
5) Assumed parameters: dop = 250d/a, hop = 16h/d, tcycle = 60s (nop = 280'000/a)
6) Assumed parameters: dop = 365d/a, hop = 24h/d, tcycle = 30s
7) EC type-examination certificate tested according to DIN EN ISO 13849-1 and EN61508
8) Safety function presensce detection tested according DIN18650 and EN16005
9) Safety function motion in escape routes DIN18650 and EN16005
10) Safety function presensce detection tested according to EN16005

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Calculation signal transmission and switching units

Products in accordance with DIN EN ISO 13849-1

How to determine the $MTTF_d$ of a sensor

$$MTTF_d = \frac{B_{10d}}{0{,}1 \times n_{op}}$$

Example 1: **Safety edge** on a sliding gate with 2 actuations a day during 365 days a year.
n_{op} = 2 actuations/day × 365 days = 730 actuations a year
$MTTF_d = B_{10d} / (0{,}1 \times n_{op})$ = 5'000'000 / (0,1 × 730) = 68'493 years → „high“

Example 2: **Safety mat** installed in processing centre with 30-s tact, 2 shifts during 250 days a year.
n_{op} = 60 actuations/h × 16 h/day × 250 days = 240'000 actuations a year
$MTTF_d = B_{10d} / (0{,}1 \times n_{op})$ = 6'000'000 / (0,1 × 240'000) = 250 years → „high“

How to determine the overall-MTTFd (simplified description!)

$$\frac{1}{MTTF_d} = \frac{1}{MTTF_{d\ Sensor}} + \frac{1}{MTTF_{d\ Signal\ transmission}}$$

Example 3: **Safety edge** connected to signal transmission InTra6 2.
$MTTF_{d\ Sensor}$ = 68'493 years
$MTTF_{d\ Signal\ transmission}$ = 254 years
→ $MTTF_d$ = 253 years → „high“

Note: This calculation is highly simplified. The various $MTTF_d$-values could be based on different actuations per year (n_{op}). Furthermore, the connection between sensor and switching device is not considered.

Glossary

B_{10d}	Number of switching cycles, of which 10 % of specimens failed during a lifetime test (for electromechanical components)
DC_{avg}	Average diagnostics coverage, probability-based measure of the effectiveness of the diagnosis. It expresses the ratio between detected dangerous failures and the total number of hazardous errors (errors weighted with $MTTF_d$-value)
$MTTF_d$	Meantime to a dangerous failure
n_{op}	Actuations per year
h_{op}	Average operating time in hours per day
d_{op}	Average operating time in days per year
t_{cycle}	Average time between the start of two successive cycles of the component in seconds per cycle
PL	Performance level; value of the safety level. Stands for the quality of risk-reducing measures, respectively specifies the ability of safety-related parts of a control system, to perform a safety function under foreseeable conditions.

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