

Safety functions according to EN ISO 13849-1

Type	EC type test certificate	PL	Kat.	MTTF _d [years]	DC _{avg} [%]	
Industrial door (signal transmission and switching devices)						
InTra6 2	E 6934 and ⁴⁾	d	2	254	94	¹⁾
InTra6 3	E 6935 and ⁴⁾	e	3	247	95	¹⁾
RFGate 2	E 6945 and ⁴⁾	c	2	28.8	76	¹⁾
RFGate 3	E 7161 and ⁴⁾	d	3	46	77	¹⁾
EsGate 2	E 6937 and ⁴⁾	d	2	123	94	²⁾
EsGate 3	E 6936 and ⁴⁾	e	3	73	95	²⁾
XRF	E 7239 and ⁴⁾	c	2	98	82	¹⁾
XRF	E 7239 and ⁴⁾	d	3	98	82	¹⁾
Machine safety (switching devices)						
EsMatix 3	E 7142 and ^{4),11)}	e	3	100	90	²⁾
ESD3	E 7259 and ^{4),11)}	e	3	24 (8)	99	²⁾ I=500mA (I=2A)
ESR31C /32	E 7260 and ^{4),11)}	e	3	26 (8)	99	²⁾ I=500mA (I=2A)

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 (Sensors)						
ELE	-	-	-	³⁾	5	
XL	-	-	-	³⁾	5	
ESM	-	-	-	³⁾	6	
Loop detectors						
ProLoop2				73	7	⁶⁾
ProLoop lite				73	7	⁶⁾

Type	MTTF _d with safety edge ¹⁾ [years]	MTTF _d with safety mat ⁵⁾ [years]
Industrial door (signal transmission and switching devices)		
InTra6 2	200	-
InTra6 3	167	-
RFGate 2	28	-
EsGate 2	266	-
EsGate 3	217	-
Machine safety (switching devices)		
EsMatix 3	386	72
ESD3	>100	14
ESR31C / 32	>100	15

- 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: $d_{op} = 365d/a$, $h_{op} = 24h/d$, $t_{cycle} = 60s$ ($n_{op} = 525'600/a$)
- 3) MTTF_d = level and value depending application (see calculation model page 3)
- 4) In combination with safety edges, certified according to EN ISO 13856-2
- 5) Assumed parameters: $d_{op} = 250d/a$, $h_{op} = 16h/d$, $t_{cycle} = 60s$ ($n_{op} = 280'000/a$)
- 6) Assumed parameters: $d_{op} = 365d/a$, $h_{op} = 24h/d$, $t_{cycle} = 30s$
- 7) EC type-examination certificate tested according to DIN EN ISO 13849-1 and EN 61508
- 8) Safety function presense detection tested according DIN 18650 and EN 16005
- 9) Safety function motion in escape routes DIN 18650 and EN 16005
- 10) Safety function presense detection tested according to EN 16005
- 11) In combination with safety mats, certified according to EN ISO 13856-1

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.

$$n_{op} = 2 \text{ actuations/day} \times 365 \text{ days} = 730 \text{ actuations a year}$$

$$MTTF_d = B_{10d} / (0,1 \times n_{op}) = 5'000'000 / (0,1 \times 730) = 68'493 \text{ years} \rightarrow \text{„high“}$$

Example 2: **Safety mat** installed in processing centre with 30-s tact, 2 shifts during 250 days a year.

$$n_{op} = 60 \text{ actuations/h} \times 16 \text{ h/day} \times 250 \text{ days} = 240'000 \text{ actuations a year}$$

$$MTTF_d = B_{10d} / (0,1 \times n_{op}) = 6'000'000 / (0,1 \times 240'000) = 250 \text{ years} \rightarrow \text{„high“}$$

How to determine the overall- $MTTF_d$ (simplified description!)

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

Example 3: **Safety edge** connected to signal transmission InTra6 2.

$$MTTF_{d \text{ Sensor}} = 68'493 \text{ years}$$

$$MTTF_{d \text{ Signal transmission}} = 254 \text{ years}$$

$$\rightarrow MTTF_d = 253 \text{ years} \rightarrow \text{„high“}$$

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.