

Technical update

Functional safety data for electromechanical control and sensor components

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Users of BS EN 62061 and BS EN ISO 13849-1 standards require reliability data from manufacturers for components.

These values are necessary to verify the Safety Integrity Level (SIL) or the Performance Level (PL) of the safety related control function for machinery.

To answer these requirements for electromechanical input & output devices used in safety related electrical control systems we make available the normal B10* values and the percentage of dangerous failures**. B10 component data combined with the specific data of the application (defined by user) allow the calculation of the safety integrity level (SIL) or the performance level (PL) of the safety related control function concerned.

You can use B10 data, together with your knowledge of the hourly switching rate of these components in your machine, to calculate the failure rate λ_e and hence either the PFH_D or MTTFd of the component as per BS EN 62061 and BS EN ISO 13849-1.

Method of calculation of failure rate using B10

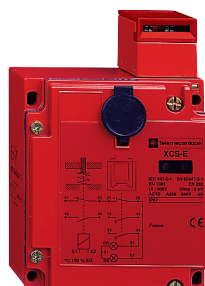
$$\text{Failure rate } \lambda_e = \frac{(0.1 \times C)}{B10} \times \% \text{ dangerous failure fraction}$$

Where C = hourly switching rate of the component

The PFH_D or MTTFd will also depend upon the category or architecture in which the component is being used. This is explained in the annexes of BS EN 62061 and BS EN ISO 13849-1. Some worked examples are to be found on pages 47-55 of our Safe Machinery Handbook (reference SE6534)

Electromechanical components often used in safety systems include:

Limit switches, non-contact magnetic switches, tongue or key operated guardswitches, solenoid interlocks (powered guards), emergency stop pushbuttons, rope pull switches, and contactors (especially those with mirror contacts).



The following values apply to high or continuous demand mode of operations used in machinery applications



Electrical components ***	Control Sensors Osiswitch Actuators TeSys D contactors	Normal (cycles) B10	% ** Dangerous Failures	B10d (=B10 figure divided by % age dangerous failures)
Emergency stop push-button 22 mm XB4 & XB5 (mushroom head)		300,000	20%	1,500,000
Emergency stop trip wire switches XY2C		10,000	20%	50,000
Pushbutton 22 mm XB4 & XB5		5,000,000		5,000,000
Limit switches with plunger or roller lever head XC		10,000,000	20%	50,000,000
Safety limit switches with key (guard switches) XCS		1,000,000	20%	5,000,000
Solenoid guardswitches with key (electromagnetic guard switches) XCS		1,000,000	20%	5,000,000
Safety limit switches with rotary opening head XCS		1,000,000	20%	5,000,000
Safety coded magnetic switches XCS DMC/DMP/DMR		10,000,000	20%	50,000,000
Contactors with mirror contact auxiliaries (AC3 nominal load break/make) TeSys		1,000,000	73%	1,369,863
Contactors with mirror contact auxiliaries (light load make/break) TeSys		10,000,000	50%	20,000,000

Note:

* B10 is the expected time or the number of operation cycles at which 10 % of the tested population will have failed. Do not confuse with B10d which applies only to the dangerous failures of the considered component. B10 value is given for a lifetime of 10 years.

** Corresponds to the relationship of dangerous failures (the contact does not open) divided by the totality of the failures (total)

*** All electromechanical components above except the contactors have direct opening action / IEC 60947-5-1 Annex K).

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