

**Table C.1 — International Standards dealing with  $MTTF_D$  or  $B_{10D}$  for components**

	Basic and well-tried safety principles according to ISO 13849-2:2012	Relevant standards	Typical values: $MTTF_D$ (years) $B_{10D}$ (cycles)
mechanical components	Table A.1 and Table A.2	—	$MTTF_D = 150$
hydraulic components with $n_{op} \geq 1\,000\,000$ cycles per year <sup>a</sup>	Table C.1 and Table C.2	ISO 4413	$MTTF_D = 150$
hydraulic components with 1 000 000 cycles per year $> n_{op} \geq 500\,000$ cycles per year <sup>a</sup>	Table C.1 and Table C.2	ISO 4413	$MTTF_D = 300$
hydraulic components with 500 000 cycles per year $> n_{op} \geq 250\,000$ cycles per year <sup>a</sup>	Table C.1 and Table C.2	ISO 4413	$MTTF_D = 600$
hydraulic components with $n_{op} < 250\,000$ cycles per year <sup>a</sup>	Table C.1 and Table C.2	ISO 4413	$MTTF_D = 1\,200$
pneumatic components	Table B.1 and Table B.2	ISO 4414	$B_{10D} = 20\,000\,000^c$
relays and contactor relays with small load	Table D.1 and Table D.2	IEC 61810-3 IEC 60947 series	$B_{10D} = 20\,000\,000$
relays and contactor relays with nominal load	Table D.1 and Table D.2	IEC 61810-3 IEC 60947 series	$B_{10D} = 400\,000$
proximity switches with small load	Table D.1 and Table D.2	IEC 60947 series ISO 14119	$B_{10D} = 20\,000\,000$
proximity switches with nominal load	Table D.1 and Table D.2	IEC 60947 series ISO 14119	$B_{10D} = 400\,000$
contactors with small load <sup>d</sup>	Table D.1 and Table D.2	IEC 60947 series	$B_{10D} = 20\,000\,000$
contactors with nominal load <sup>d</sup>	Table D.1 and Table D.2	IEC 60947 series	$B_{10D} = 1\,300\,000$

NOTE 1 For the definition and use of  $B_{10D}$ , see C.4.

NOTE 2  $B_{10D}$  is estimated as two times  $B_{10}$  (50 % dangerous failure) if no other information (e.g. product standard) is available.

NOTE 3 Emergency stop devices according to IEC 60947-5-5 and ISO 13850 and enabling switches according to IEC 60947-5-8 can be estimated as a category 1 or category 3/4 subsystem depending on the number of electrical output contacts and on the fault detection in the subsequent subsystem. Each contact element (including the mechanical actuation) can be considered as one channel with a respective  $B_{10D}$  value. For enabling switches according to IEC 60947-5-8 this implies the opening function by pushing through or by releasing. In some cases, it is possible that the machine builder can apply fault exclusion according to ISO 13849-2:2012, Table D.8, considering the specific application and environmental conditions of the device.

NOTE 4 Reduction of switching cycles can lead to an increasing probability of sticking of the switching elements in spool valves (see ISO 4413).

NOTE 5 The  $MTTF_D$  for mechanical components refers exclusively to mechanically moving components/parts (not to housing).

<sup>a</sup>  $B_{10D}$  calculation for hydraulic components is not permitted as a reverse calculation from standard  $MTTF_D$  values.

<sup>b</sup> If fault exclusion for direct opening action is possible.

<sup>c</sup> In general, this value can be assumed for most pneumatic components. However, depending on the application and type, e.g. shut-off valve, this value can be significantly lower.

<sup>d</sup> “Nominal load” or “small load” should take into account safety principles described in ISO 13849-2:2012, such as over-dimensioning of the rated current value. “Small load” means, for example, 20 %.

**Table C.1 (continued)**

	<b>Basic and well-tried safety principles according to ISO 13849-2:2012</b>	<b>Relevant standards</b>	<b>Typical values: MTTF<sub>D</sub> (years) B<sub>10D</sub> (cycles)</b>
position switches <sup>b</sup>	Table D.1 and Table D.2	IEC 60947 series ISO 14119	B <sub>10D</sub> = 20 000 000
position switches (with separate actuator, guard-locking) <sup>b</sup>	Table D.1 and Table D.2	IEC 60947 series ISO 14119	B <sub>10D</sub> = 2 000 000
emergency stop devices <sup>b</sup>	Table D.1 and Table D.2	IEC 60947 series ISO 13850	B <sub>10D</sub> = 100 000
push buttons (e.g. enabling switches) <sup>b</sup>	Table D.1 and Table D.2	IEC 60947 series	B <sub>10D</sub> = 100 000

NOTE 1 For the definition and use of B<sub>10D</sub>, see C.4.

NOTE 2 B<sub>10D</sub> is estimated as two times B<sub>10</sub> (50 % dangerous failure) if no other information (e.g. product standard) is available.

NOTE 3 Emergency stop devices according to IEC 60947-5-5 and ISO 13850 and enabling switches according to IEC 60947-5-8 can be estimated as a category 1 or category 3/4 subsystem depending on the number of electrical output contacts and on the fault detection in the subsequent subsystem. Each contact element (including the mechanical actuation) can be considered as one channel with a respective B<sub>10D</sub> value. For enabling switches according to IEC 60947-5-8 this implies the opening function by pushing through or by releasing. In some cases, it is possible that the machine builder can apply fault exclusion according to ISO 13849-2:2012, Table D.8, considering the specific application and environmental conditions of the device.

NOTE 4 Reduction of switching cycles can lead to an increasing probability of sticking of the switching elements in spool valves (see ISO 4413).

NOTE 5 The MTTF<sub>D</sub> for mechanical components refers exclusively to mechanically moving components/parts (not to housing).

<sup>a</sup> B<sub>10D</sub> calculation for hydraulic components is not permitted as a reverse calculation from standard MTTF<sub>D</sub> values.

<sup>b</sup> If fault exclusion for direct opening action is possible.

<sup>c</sup> In general, this value can be assumed for most pneumatic components. However, depending on the application and type, e.g. shut-off valve, this value can be significantly lower.

<sup>d</sup> “Nominal load” or “small load” should take into account safety principles described in ISO 13849-2:2012, such as over-dimensioning of the rated current value. “Small load” means, for example, 20 %.