

Reliability coefficients $MTTF_D$ for functional safety according to ISO 13849

$MTTF_D$ values for Compact hydraulics



Contents

Calculation of $MTTF_D$ values according to ISO 13849-1:2015	page 2
Compliance with safety principles, application notes	page 2
Use of Compact hydraulic components in safety-related control system	page 3

Calculation of $MTTF_D$ values according to ISO 13849-1:2015

The reliability coefficients $MTTF_D$ (mean time to dangerous failure) of components are used to calculate the probability of a potentially dangerous failure per hour (PFHD) of a machine or system and to keep this to an acceptable level.

For hydraulic components, the standard ISO 13849-1:2015 stipulates an $MTTF_D$ value of 150 years, assuming that basic and well-tried safety principles are applied. Requirements for components employed in safety-related parts of control systems include:

- ▶ Automatic reset to basic settings in the event of a power failure
- ▶ Reliable maintenance of the basic settings

Hydraulic components which are not compliant with the relevant safety principles are not suitable for application in safety-related parts of control systems.

Bosch Rexroth has carefully tested its products with respect to all relevant basic and well-tried safety principles in accordance with a method recognized by the Institute for Occupational Safety of the German Statutory Accident Insurance Association (IFA).

Compliance with safety principles, application notes

The products for which the corresponding $MTTF_D$ value is specified in the datasheet are suitable for use in safety-related parts of a control system according to ISO 13849-1:2015. Where applicable, these products are compliant with ISO 13849-2:2012, in particular with

- ▶ basic safety principles
- ▶ well-tried safety principles.

Use the following parameters for the product for evaluating and configuring the reliability of the control systems:

$MTTF_D$ = see table on the following pages

TM = 20 years respectively TM = 10 years for electronic components such as sensors and switches (maximum duration of use according to ISO 13849-1:2015)

When using these, please ensure compliance with the following application notes!

Application notes:

The further basic and well-tried safety principles according to ISO 13849-2:2012 which are needed for implementing and operating the products are also to be fulfilled.

- ▶ For the operation and handling of the products, the system specifications stipulated in the data sheet and instruction manual must be observed.
- ▶ Only use the hydraulic fluids specified in the data sheets and maintain the cleanliness of the hydraulic fluid over the entire period of use.
- ▶ Seizures may occur after a prolonged period in which the control elements are not used. Our advice is therefore to regularly switch or actuate the system at reasonable periods.
- ▶ If the product is employed for safety-related structures with higher categories (2 to 4) according to ISO 13849-1:2015, Section 6, take into account the requirements stipulated there (e.g. CCF, DC, PLr, software, system errors).
- ▶ According to ISO 13849-1:2015, the maximum period of use, observing the cleanliness of the hydraulic fluid according to ISO 4406:1999 TM = 20 years respectively 10 years for electronic components. In the interest of preventive maintenance, it is advisable to exchange the components before this maximum period of use has expired.

Use of Compact hydraulic components for safety-related control systems

The safety coefficient $MTTF_D$ is limited to the safety-related parts of the valve as products that have no control function cannot be assigned to functional safety. The valve alone does not fulfill a complete, self-contained safety function.

The control valve may be used as a component part of the safety function "safe volume flow shutoff". The safety function is shown in its initial position. This ensures, among other things, an adequate degree of overlap. Adequate overlap is a proven safety principle. Even in the event of a loss of power, the valve will return automatically to its initial position.

When available the corresponding $MTTF_D$ value is specified in the datasheet.

The valve alone does not fulfill a complete, self-contained safety function.

In order to realize the necessary safety function in the machine, further measures have to be realized by the machine manufacturer (e.g. use of a suitable control unit or sensor).

The machine manufacturer bears the responsibility for the safety of the machine, including the correct design and evaluation of the control systems employed in the safety functions. He is thus responsible for ensuring compliance with normative and statutory requirements in the countries concerned.

System reliability / life cycle costs (TCO)

Because the $MTTF_D$ values only take account of the safety-related parts of a component, these coefficients are not suitable for evaluating the reliability of a system or the life cycle costs (TCO = Total Cost of Ownership).

If necessary, please consult your contact person at Bosch Rexroth.

Formulas

$$MTTF_D = \frac{B10_D}{0.1 \times n_{op}}$$

$$n_{op} = \frac{d_{op} \times h_{op} \times 3600 \text{ s/h}}{t_{cycle}}$$

$MTTF_D$	Mean time to failure dangerous
$B10_D$	Number of cycles until 10% of the units have failed dangerous
n_{op}	Mean number of annual operation cycles
d_{op}	Mean number of operation days per year
h_{op}	Mean number of operation hours per day
t_{cycles}	Cycle time (s/cycle)

