

## Notes on Sistema Project Files



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This document is only suitable for persons with sufficient expertise for machine safety based on ISO 12100, ISO 13849, IEC 61508, IEC 62061 and IEC 61511. In addition, the following qualifications are required in the project team:

- Specialist in pneumatics
- Specialist in electrical engineering
- Specialist for the programming of control systems and safety switching devices

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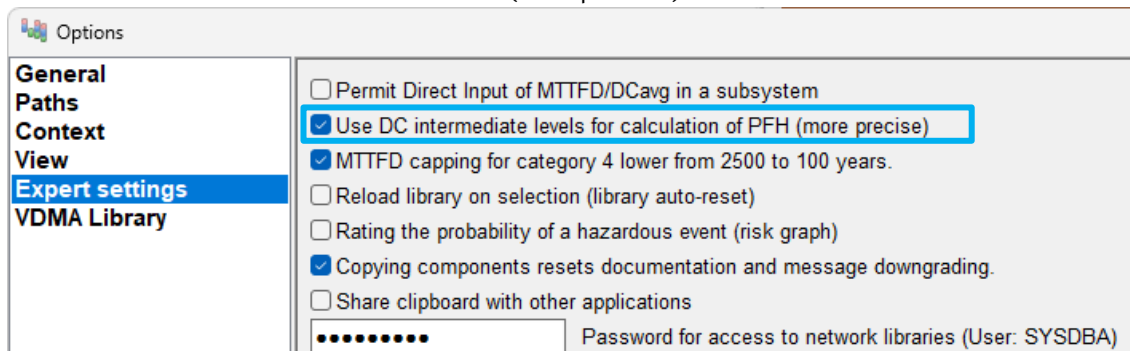
# 1 General

## 1.1 Objectives of this Document

- In this document, the assumptions made in the project files of the “Safety Application Notes ISO 13849” are specified and explained.
- For the application of the Sistema project files, certain options in Sistema have to be applied. These options are given.

## 1.2 General Notes

- In the Sistema project files, only the subsystem “Inputs” or “Outputs” are evaluated. The missing subsystems for a complete safety function always must be added by the user.
- The information in the Sistema project file is always related to the circuit of the associated Safety Application Note.
- In order for the status “green” to be output for the Sistema project, all required specifications are selected for the subsystem, e.g. tabs PL, Category, MTTFD, DCavg and CCF. These must be checked for the application and adjusted if necessary.
- The Sistema project files require that in the menu Edit / Options under Expert Settings, the setting “Use DC intermediate levels for calculation of PFH (more precise)” is set.



- The version of SISTEMA is specified in the project file name, e.g.,

 100419 Sistema Project - V3.0.4 - EN.ssm

## 2 Assumptions for Way Valves

For directional control valves the values  $B_{10}$ , RDF and  $n_{op}$  are applied. The following default values are included in the projects:

| Value                                  | Source                                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $B_{10} = 10,000,000$<br>cycles        | ISO 13849-1, Table C.1,<br>value for pneumatic<br>components <sup>1</sup> | Number of cycles until 10 % of the components fail dangerously (for components with mechanical wear)<br><b>Notes</b><br>Always check whether this $B_{10}$ value corresponds to the $B_{10}$ value of the valve in the specific application. The information is available in the Data Sheet Product Reliability.                                                                                                                                                                                                                             |
| RDF = 50 %                             | ISO 13849-1, table C.1,<br>note 1                                         | RDF is the ratio of dangerous failures, i.e. the proportion of the total failure rate of the directional control valve that can lead to a dangerous failure.<br>To estimate the $B_{10D}$ value from the $B_{10}$ value, assume RDF=50% according to ISO 13849-1, Table C.1, Note 1.                                                                                                                                                                                                                                                         |
| $n_{op} = 525,600$<br>$n_{op} = 1,095$ |                                                                           | Average number of annual actuations<br>For the number of actuation cycles, $n_{op}=525,600$ is assumed for a working valve (one actuation cycle per minute, 24 hours a day, 365 days a year).<br>For the number of requests for the safety function, a $n_{op}=1,095$ is assumed (one actuation every 8 hours, 3 shifts a day, 365 days a year).<br><b>Notes</b><br>It must always be checked whether these assumptions of the annual actuations correspond to the intended application and are to be adapted to the real conditions of use. |

### Notes

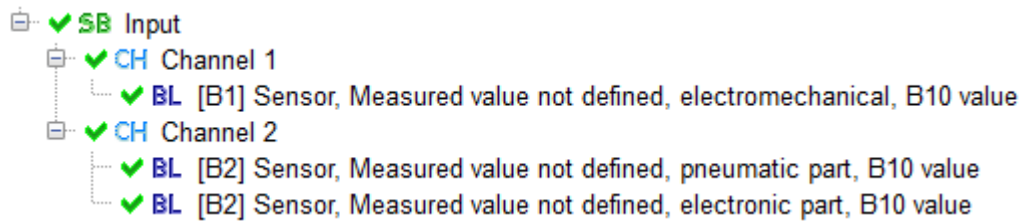
- For certain way valves, a different value may be indicated if a  $B_{10}$  value of 10,000,000 cycles is not reached.
- If the valve(s) is/are located on a valve terminal, the output subsystem must be adapted according to the specifications in document ➔ [100394 Safe electrical switch-off of valve terminals](#).

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<sup>1</sup> In ISO 13849-1, Table C.1, a  $B_{10D}=20,000,000$  cycles is specified. From this, according to note 1 of this table,  $B_{10}=10,000,000$  cycles was derived.

### 3 Assumptions for Switches and Sensors

For switches, the values  $B_{10}$ , RDF, and  $n_{op}$  are applied. For sensors, an MTTF value may also be provided. If both a  $B_{10}$  value and an MTTF value are specified, both values should normally be taken into account in the Sistema project.



The following default values are included in the projects:

| Value                                  | Source                                                                       | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|----------------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $B_{10} = 10,000,000$<br>cycles        | ISO 13849-1,<br>Table C.1, value<br>for pneumatic<br>components <sup>2</sup> | Number of cycles until 10 % of the components fail dangerously<br>(for components with mechanical wear)<br><b>Notes</b><br>Always check whether this $B_{10}$ value corresponds to the $B_{10}$ value<br>of the sensor in the specific application. The information is<br>available in the Data Sheet Product Reliability.                                                                                                                                                                                                                              |
| RDF = 50 %                             | ISO 13849-1,<br>table C.1, note 1                                            | RDF is the ratio of dangerous failures, i.e. the proportion of the<br>total failure rate of the sensor that can lead to a dangerous failure.<br>To estimate the $B_{10D}$ value from the $B_{10}$ value, assume RDF=50%<br>according to ISO 13849-1, Table C.1, Note 1.                                                                                                                                                                                                                                                                                 |
| $n_{op} = 525,600$<br>$n_{op} = 1,095$ |                                                                              | Average number of annual actuations<br>For the number of actuation cycles, $n_{op}=525,600$ is assumed for a<br>sensor (one actuation cycle per minute, 24 hours a day, 365 days a<br>year).<br>For the number of requests for the safety function, a $n_{op}=1,095$ is<br>assumed (one actuation every 8 hours, 3 shifts a day, 365 days a<br>year).<br><b>Notes</b><br>It must always be checked whether these assumptions of the<br>annual actuations correspond to the intended application and are<br>to be adapted to the real conditions of use. |
| MTTF = 150 a                           |                                                                              | Mean time to failure<br>For the electronic part of sensors, an MTTF value of 150 years is<br>assumed.<br><b>Note</b><br>It must always be verified that these assumptions correspond to<br>the reliability of the electronic part of the component used and to<br>the actual operating conditions.                                                                                                                                                                                                                                                      |

<sup>2</sup> In ISO 13849-1, Table C.1, a  $B_{10D}=20,000,000$  cycles is specified. From this, according to note 1 of this  
table,  $B_{10}=10,000,000$  cycles was derived.

## **4 Used Literature**

### **4.1 Software**

- [1] Sistema, Version 3.0.4 Build 5, standard version: ISO 13849-1:2023, available from Internet:  
<https://www.dguv.de/ifa/praxishilfen/praxishilfen-maschinenschutz/software-sistema/index.jsp?query=webcode+d11223>

### **4.2 Cited Documents from Festo**

- [2] [100394 Safe electrical switch-off of valve terminals](#)

### **4.3 Standards**

- [3] DIN EN ISO 13849-1:2023-12 – Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2023); German version EN ISO 13849-1:2023
- [4] VDMA 24584:2022-06 - Sicherheitsfunktionen geregelter und nicht geregelter (fluid-) mechanischer Systeme.

### **4.4 Legal Regulations**

- [5] Machinery Directive: Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast)
- [6] Machinery Regulation: Regulation (EU) 2023/1230 of the European Parliament and of the Council of 14 June 2023 on machinery and repealing Directive 2006/42/EC of the European Parliament and of the Council and Council Directive 73/361/EEC

## 5 Information about the Document

### 5.1 General Information

|                 |                                |  |
|-----------------|--------------------------------|--|
| Document Number | 100395                         |  |
|                 | Notes on Sistema Project Files |  |

### 5.2 Revision History

| Ver. | Date       | Ed.  | Chapter | Description of Change/Impact    |
|------|------------|------|---------|---------------------------------|
| 1.10 | 2022-06-02 | JKHL | All     | Creation of the document        |
| 1.20 | 03.09.2026 | JKHL | All     | Update Layout, editorial review |
|      |            |      | 3       | Addition chapter for sensors    |
|      |            |      | 1, 4    | Change to new Sistema release   |

### 5.3 Approval/Release of the Document

| Role    | Signature                                                                                                                                                                                                                                                                                                                                                      |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Release | <br><small>Digital signiert von Jürgen Kühnle<br/>DN: cn=Jürgen Kühnle, gn=Jürgen Kühnle, c=DE, Germany, o=Festo SE &amp; Co. KG, ou=SC-OTP<br/>e=juergen.kuehnle@festo.com<br/>Grund: Freigabe dieses Dokuments<br/>Ort: Esslingen<br/>Datum: 2025-09-03 14:55+02:00</small> |

### 5.4 Period of Validity

Document is valid until 2031-09-03 or until one of the documents used or the required relevant base are changed.



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