

ISO 13849-1:2015-12 (E)

Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design

Contents		Page
Foreword		v
Introduction		vi
1	Scope	1
2	Normative references	1
3	Terms, definitions, symbols and abbreviated terms	2
3.1	Terms and definitions	2
3.2	Symbols and abbreviated terms	7
4	Design considerations	9
4.1	Safety objectives in design	9
4.2	Strategy for risk reduction	11
4.2.1	General	11
4.2.2	Contribution to the risk reduction by the control system	11
4.3	Determination of required performance level (PLr)	13
4.4	Design of SRP/CS	14
4.5	Evaluation of the achieved performance level PL and relationship with SIL	15
4.5.1	Performance level PL	15
4.5.2	Mean time to dangerous failure of each channel (MTTFD)	16
4.5.3	Diagnostic coverage (DC)	17
4.5.4	Simplified procedure for estimating the quantifiable aspects of PL	17
4.5.5	Description of the output part of the SRP/CS by category	19
4.6	Software safety requirements	20
4.6.1	General	20
4.6.2	Safety-related embedded software (SRESW)	21
4.6.3	Safety-related application software (SRASW)	22
4.6.4	Software-based parameterization	24
4.7	Verification that achieved PL meets PLr	25
4.8	Ergonomic aspects of design	26
5	Safety functions	26
5.1	Specification of safety functions	26
5.2	Details of safety functions	28
5.2.1	Safety-related stop function	28
5.2.2	Manual reset function	29
5.2.3	Start/restart function	29
5.2.4	Local control function	30
5.2.5	Muting function	30
5.2.6	Response time	30
5.2.7	Safety-related parameters	30
5.2.8	Fluctuations, loss and restoration of power sources	30
6	Categories and their relation to MTTFD of each channel, DCavg and CCF	31
6.1	General	31
6.2	Specifications of categories	31
6.2.1	General	31
6.2.2	Designated architectures	32
6.2.3	Category B	32

6.2.4	Category 1	33
6.2.5	Category 2	34
6.2.6	Category 3	35
6.2.7	Category 4	36
6.3	Combination of SRP/CS to achieve overall PL	38
7	Fault consideration, fault exclusion	40
7.1	General	40
7.2	Fault consideration	40
7.3	Fault exclusion	40
8	Validation	40
9	Maintenance	40
10	Technical documentation	41
11	Information for use	41
Annex A (informative)	Determination of required performance level (PLr)	43
Annex B (informative)	Block method and safety-related block diagram	47
Annex C (informative)	Calculating or evaluating MTTFD values for single components	49
Annex D (informative)	Simplified method for estimating MTTFD for each channel	56
Annex E (informative)	Estimates for diagnostic coverage (DC) for functions and modules	58
Annex F (informative)	Estimates for common cause failure (CCF)	61
Annex G (informative)	Systematic failure	63
Annex H (informative)	Example of combination of several safety-related parts of the control system	66
Annex I (informative)	Examples	69
Annex J (informative)	Software	76
Annex K (informative)	Numerical representation of Figure 5	79
Bibliography	84