BS EN 13243:2015

BSI Standards Publication

Safety requirements for cableway installations designed to carry persons — Electrical equipment other than for drive systems

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National foreword

This British Standard is the UK implementation of EN 13243:2015. It supersedes BS EN 13243:2004 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MCE/20, Aerial ropeways.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Sicherheitsanforderungen an Seilbahnen für den Personenverkehr - Elektrische Einrichtungen, ohne Antriebe

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Foreword

This document (EN 13243:2015) has been prepared by Technical Committee CEN/TC 242 “Safety requirements for passenger transportation by rope”, the secretariat of which is held by AFNOR.

This European Standard shall maintain the status of a National Standard, either with the publication of an identical text or by recognition up to July 2015, and any opposing National Standards shall be withdrawn by July 2015.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document is intended to replace EN 13243:2004.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive 2000/9/EC.

For the relationship with EU Directive 2000/9/EC, see informative Annex ZA, which is an integral part of this document.

With respect to EN 13243:2004, the following significant amendments have been made:

– In section 1, additions have been added with respect to worker protection and the transported persons.

– In section 1, the reference to relevant publications, e.g. EN 61508 (all parts) has been added for complex electronics and embedded software.

– In section 3, terms and definitions have been removed because the reference to EN 1907 is sufficient.

– In 4.1.3, the process to determine the requirements for electrical equipment has been added by means of a schematic representation of the process for risk reduction.

– In 4.2.2, the risk categories have been revised with regard to the current principles.

– The content and structure of 4.2.3 have been adjusted to the new reference system of the EN ISO 13849 1 standard due to the withdrawal of EN 954 1 by the end of 2011. The requirements of the requirement classes have been revised accordingly.

– In 4.2.3.14, Table 1 has been added on the basis of EN ISO 13849 1.

– In 4.2.3.15, Table 2 has been added on the basis of EN ISO 13849 1.

– In 4.3, the requirements for safety-related application software have been added with the presentation of the development process of the software (V diagram).

– In 6.4, reference has been made to the reference standard EN ISO 13850, with respect to the requirements of emergency stop devices.

– In 8.2.2, the requirement for test devices has been defined more precisely.

– In Annex A, the definitions of the risk categories have been updated and parameters P1 and P2 have been added with respect to the possibility of avoiding hazardous situations.

– In Annex B, the assignment of performance levels as specified in EN ISO 13849 1 and the safety integrity level (SIL) as specified in EN 61508 (all parts) to requirement classes is shown in a table.

- In the old Annex C, the examples for assigning the requirement classes have been removed.
- In Annex C, the table for indicating devices has been updated.
- In the old Annex D, Deviation A of Italy has been removed.
- In Annex D, the table with examples of the level of fault detection (FG) has been added.
- Old Annex ZA has been updated.
- The bibliography has been updated.

This document forms part of the standards programme approved by the CEN/TC 242 . This programme includes the following standards:

- EN 1907 — *Terminology;*
- EN 12929 (all parts)— *General requirements;*
- EN 12930 — *Calculations;*
- EN 12927 (all parts) — *Ropes;*
- EN 1908 — *Tensioning devices;*
- EN 13223 — *Drive systems and other mechanical equipment;*
- EN 13796 (all parts) — *Carriers;*
- EN 13243 — *Electrical equipment other than for drive systems;*
- EN 13107 — *Civil engineering works;*
- EN 1709 — *Precommissioning inspection, maintenance and operational checks;*
- EN 1909 — *Recovery and evacuation*
- EN 12397 — *Operation;*
- EN 12408 — *Quality assurance;*

This series of standards forms a complete set with regard to the design, production, erection, maintenance and operation of any cableway installation designed to carry persons.

In respect of ski-tows, the drafting of this standard has been guided by the works of the International Organisation for Transportation by Rope (OITAF).

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Belgium, Bulgaria, Denmark, Germany, the former Yugoslav Republic of Macedonia, Estonia, Finland, France, Greece, Ireland, Iceland, Italy, Croatia, Latvia, Lithuania, Luxemburg, Malta, the Netherlands, Norway, Austria, Poland, Portugal, Romania, Sweden, Switzerland, Slovakia, Slovenia, Spain, Czech Republic, Turkey, Hungary, United Kingdom and Cyprus.

1 Scope

This European standard specifies safety requirements for electrical devices (including application software, apart for those in drive systems) on cableway installations designed to carry persons. This standard is applicable to the various types of cableway installations and takes into account their environment. It does not apply to complex electronics and embedded software.

For complex electronics and embedded software, reference is made to the relevant publications e.g. EN 61508 (all parts).

Electromagnetic compatibility (EMC) is not covered in this standard; cableways and their components should comply with general requirements for EMC.

For electrical devices which are part of drive systems, the requirements of those sections listed in the scope of EN 13223 as relating to drive systems should be observed.

This standard contains requirements for the prevention of accidents and protection of workers without prejudice to the application of national regulations. National regulations of a legal nature in regards to building or regulations or that are designed to protect particular groups of people, remain unaffected.

It does not apply to cableway installations for the transportation of goods by rope or to lifts.

2 Normative references

The following references, in whole or in part, are normatively referenced in this standard and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the reference document (including any amendments) applies.

EN 1709, *Safety requirements for cableway installations designed to carry persons — Precommissioning inspection, maintenance, operational inspection and checks*

EN 1907, *Safety requirements for cableway installations designed to carry persons — Terminology*

EN 1908, *Safety requirements for cableway installations designed to carry persons — Tensioning devices*

EN 1909, *Safety requirements for cableway installations designed to carry persons — Recovery and evacuation*

EN 12397, *Safety requirements for cableway installations designed to carry persons — Operation*

EN 12408, *Safety requirements for cableway installations designed to carry persons — Quality control*

EN 12927 (all parts), *Safety requirements for cableway installations designed to carry persons — Ropes*

EN 12929 (all parts), *Safety requirements for cableway installations designed to carry persons — General requirements* EN 12930, *Safety requirements for cableway installations designed to carry persons — Calculations*

EN 13107, *Safety requirements for cableway installations designed to carry persons — Civil engineering works*

EN 13223, *Safety requirements for cableway installations designed to carry persons — Drive systems and other mechanical equipment*

EN 13796 (all parts), *Safety requirements for cableway installations designed to carry persons — Carriers* EN 50110 (all parts), *Operation of electrical installations* EN 50272-2, *Safety requirements for secondary batteries and battery installations – Part 2: Stationary batteries*

EN 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1)*

EN 62305 (all parts), *Protection against lightning (IEC 62305, all parts)*

EN ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100)*

EN ISO 13849-2, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation (ISO 13849-2)*

EN ISO 13850, *Safety of machinery — Emergency stop — Principles for design (ISO 13850)*

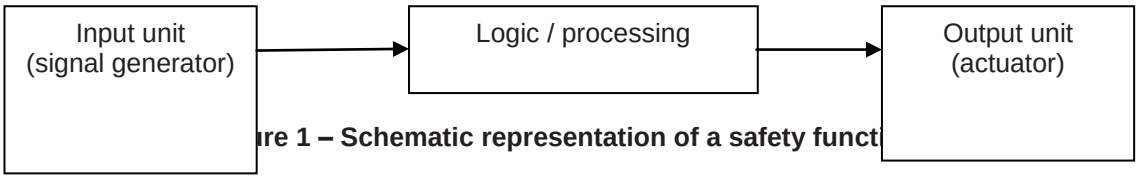
3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1907 and the following apply.

3.1 Basic principles, general

3.1.1
safety function
all the procedures that identify the occurrence of certain conditions or operations that together make up a hazardous situation.

Note 1 to entry: These procedures initiate processes that reduce the risks involved particularly by stopping the installation. A safety function starts with an assessment of the conditions and physical parameters (input unit) in the cableway and ends with the initiation of the process (output unit) or completion of the procedure initiated.



ure 1 – Schematic representation of a safety funct

3.1.2
electrical safety device
all the components used to implement all the operations of a safety function.

Note 1 to entry: Electrical safety devices may be of Type A or Type B (see 4.2.3.1)

3.1.3
remote monitoring installation
signalling installation
installation used to transmit commands and information between the cableway stations or between stations and carriers

3.1.4
suspension of safety functions
process or state whereby safety functions or parts of safety functions are put out of operation by deliberate switching

3.1.5
fault exclusion
exclusion of a theoretically possible fault as a result of special measures

3.1.6
fault tolerance time
time period during which a process can be impaired by erroneous control signals without a dangerous state occurring

3.2 Electrical circuits

3.2.1
break circuit
circuit that normally carries current continuously

Note 1 to entry: The desired function is initiated by interrupting the current flow.

3.2.2
normally open circuit
circuit in which no current normally flows.

Note 1 to entry: The desired function is initiated by generating the current flow.

3.2.3
safety circuits
electrical circuits on which safety functions and emergency stop devices act directly, or which monitor and compare physical parameters relevant to safety (e.g. set point value/actual value monitoring, deceleration monitoring)

Note 1 to entry: They bring the cableway to a stop or prevent an unwanted start-up,

3.2.4
line safety circuits
safety circuits operated directly by the safety functions and emergency stop devices on the line

Note 1 to entry: They are also used for monitoring various ropes and cables for failure, contact with each other and earthing.

3.2.5
control circuits
circuits used for operational control, regulation and to protect the main circuits

3.2.6
main circuits
circuits that supply the drive devices and auxiliary drives with electrical power

3.3 Electric cables

3.3.1
derailment detector line
cable on which the line support structure switches act

3.3.2
telephone line
cable used for the internal telephone system for connecting the stations and intermediate stopping points

3.3.3
line cable
cable that transmits command and information signals (cable position, loudspeakers, wind warning etc.) between the line and the stations

4 General requirements

4.1 Application of this Standard

4.1.1 The requirements of this standard apply to all cableway installations together with those of EN 1709, EN 1908, EN 1909, EN 12927 (all parts), EN 12929 (all parts), EN 12930, EN 12397, EN 12408, EN 13223, EN 13107 and EN 13796 (all parts).

4.1.2 EN 60204-1 shall be applied where this standard does not contain different requirements. EN 60204-1 shall not be applied to the sections relating to control functions, safety interlocks, control functions in the case of faults, electronic components and technical documentation.

4.1.3 Process for establishing the requirements for the electrical devices:

4.1.3.1 General:

The safety analysis of the installation shall provide requirements for eliminating the hazard or for reducing the risk that is associated with the hazard, by means of safety functions.

The necessary safety level of the safety function and its specification shall be established by the manufacturer or its authorized representative for the subsystem from which the hazard for the overall system has originated.

NOTE The required level of safety should be established in requirement classes 1 to 4, in accordance with Annex A.

4.1.3.2 Contribution towards reducing the risk by means of the control, monitoring and safety devices (e.g. electrical subsystem):

The verification process for proving that the required level of safety has been reached with regard to the hardware and software is described in Subclauses 4.2 and 4.3.

4.1.3.3 Validation:

The validation of the safety function shall be carried out the first time on a complete installation by the manufacturer or its authorized representative that specified the safety function.

4.1.3.4 Schematic representation of the process for reducing the risk (e.g. electrical subsystem):

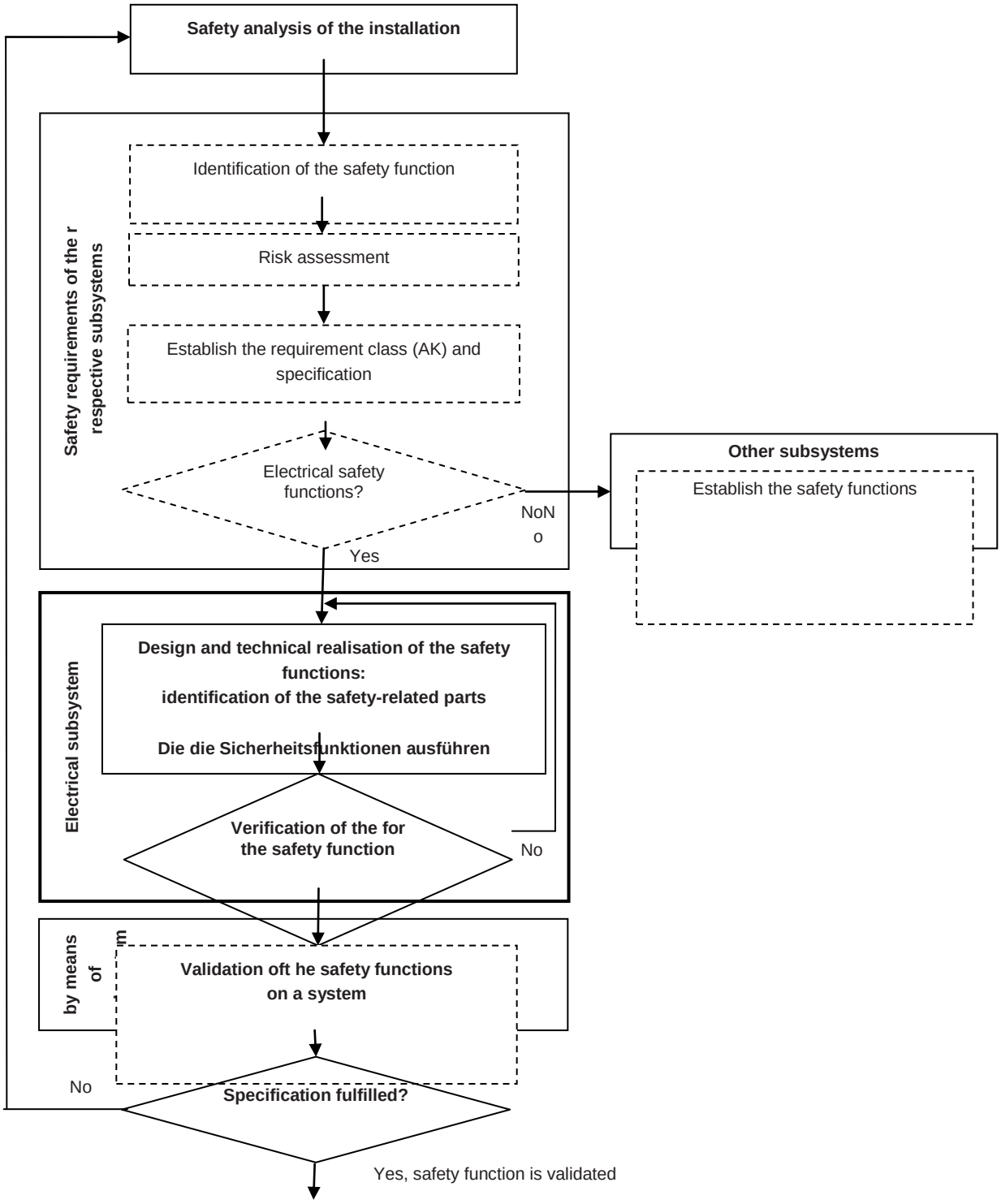


Figure 2 – Overview of the process for reducing the risk

4.2 Safety principles

4.2.1 Hazard scenarios

The safety principles set out in EN 12929-1 shall apply. In addition, the following hazard scenarios and safety measures shall apply within the scope of this standard.

4.2.1.1 The following events may lead to hazardous situations which can be avoided or limited by the safety requirements of this standard:

a) accidental contact of a person with a live metallic component;

b) failure of electrical safety functions;

c) voltage drop or total loss of voltage;

d) occurrence of a short-circuit, earth fault or break;

e) failure of electrical or electronic components;

f) foreseeable external influences, in particular, environmental conditions and electromagnetic fields.

4.2.2 Establishing the requirement classes

4.2.2.1 For each individual safety function, the hazard to persons shall be defined by means of a risk analysis (see also Annex A). A distinction shall be made between the following 3 hazard categories*:*

a) **Hazard category 1:** hazardous situation which cannot cause a personal hazard;

b) **Hazard category 2:** hazardous situation which can cause slight (usually reversible) injury to persons;

c) **Hazard category 3:** hazardous situation which can cause serious (usually irreversible) injury or death to persons.

4.2.2.2 The safety functions shall be allocated to 4 graded requirement classes (in accordance with 4.2.3.4) taking into account the respective hazard category and the probability of avoiding this hazard. The requirement class of a safety function shall be determined as shown in the diagram in Annex A.

4.2.3 Safety measures

The safety measures to be taken to eliminate the hazard scenarios listed under 4.2.1 are the following:

4.2.3.1 division of the components used.

4.2.3.1.1 An electrical safety device is of type A if:

a) the failure behaviour of all components is sufficiently defined; and if

b) the behaviour of the assembly under fault conditions can be completely determined; and if

c) reliable failure rate data from actual experience exist for components or the assembly (proven components). Complex electronic components and assemblies of type B cannot be considered as equivalent.

4.2.3.1.2 An electrical safety device is of type B if it cannot be classified as being of type A.

4.2.3.2 It shall be ensured that, in the event of a hazard to persons, the cableway is automatically put into a safe state according to the hazardous situation.

4.2.3.3 Measures to be taken concerning software or hardware to try to prevent accidental or systematic faults from occurring shall be executed corresponding to the applicable requirement classes. In principle, it may be assumed that maintenance will be carried out in accordance with the specifications.

4.2.3.4 Type A safety devices shall meet the following requirements, depending on the applicable requirement class:

a) **Requirement class 1:** electrical devices shall be designed, selected, assembled and installed in accordance with the state of the art so that they can at least adequately withstand the expected operating stresses and external influences;

Recommendation: at least a lower $MTTF_d$ value should be achieved (in accordance with Table 2).

b) **Requirement class 2:** the requirements of requirement class 1 shall be met and well-tried components and well-tried safety principles shall be used. The safety functions of the electrical safety devices of requirement class 2 shall be tested at suitable intervals (automatic or manual tests). The occurrence of a fault may lead to the loss of the safety function between the test intervals;

At least a lower level of fault detection shall be achieved (in accordance with Table 1).

Recommendation: at least a medium $MTTF_d$ value should be achieved for each channel (in accordance with Table 2).

c) **Requirement class 3:** the requirements of requirement class 2 shall be met. Electrical safety devices of requirement class 3 shall be designed so that a single fault in one of these devices does not lead to the loss of the safety functions. The occurrence of a second fault may lead to the loss of the safety function between the test intervals (automatic or manual tests);

At least a medium level of fault detection shall be achieved (in accordance with Table 1).

Recommendation: at least a medium MTTFd value should be achieved for each channel (in accordance with Table 2).

Appropriate measures to counter failures as a result of a combined cause shall be taken.

It is not necessary for all parts to be physically redundant for a safety function of requirement class 3, provided there are redundant means in order to ensure that the fault does not cause the loss of the safety function. In this case, a higher level of fault detection should be achieved.

d) **Requirement class 4:** the requirements of requirement class 3 shall be met. Electrical safety devices of requirement class 4 shall be designed so that a single fault in one of these devices does not lead to the loss of the safety functions and:

1) the single fault, while always possible, is identified at or before the next call for the safety function or else results in putting the cableway into a safe state; or

2) if this is not possible, then a second fault does not lead to the loss of the safety function and results in putting the cableway into a safe state. If automatic or manual tests at periodic intervals in accordance with 4.2.3.10 c) run with a high degree of fault detection, so that the first fault is recognised before another fault occurs, a second fault need not be considered.

A higher level of fault detection shall be achieved (in accordance with Table 1).

Recommendation: at least a higher $MTTF_d$ value should be achieved for each channel (in accordance with Table 2).

Appropriate measures to counter failures as a result of a combined cause shall be taken.

4.2.3.5 Type B safety devices, in addition to meeting the requirements for type A, shall also meet the following requirements:

a)

1) the structure of the safety device, the interaction of components and the way in which the components are connected shall clearly and comprehensibly meet the fundamental safety aims of the respective requirement class or;

2) the approved safety components for the corresponding requirement class, including any software operating system which may be installed, shall be used in accordance with the requirements, observing the conditions noted in the test certificate of a notified body.

b) If application software (according to 4.3) is installed, this shall demonstrably fulfil the fundamental safety aims of the respective requirement class.

4.2.3.6 The term “fault” covers the original fault as well as any subsequent fault resulting from it. In doing so, the first fault and all consequent faults are considered as a single fault.

4.2.3.7 The simultaneous occurrence of two independent accidental faults in the same safety function need not be considered.

4.2.3.8 Exclusion of faults shall only be permissible if appropriately justified, it corresponds to generally accepted technical experience and the probability of occurrence of the fault is known and sufficiently small (verifications analogous to those of EN ISO 13849-2).

4.2.3.9 Safety circuits shall be break circuits or shall demonstrate at least the same level of safety. In the case of line safety circuits, breaks, short-circuits, changes in impedance and earth faults shall not lead to the loss of the safety function or shall result in the cableway being put into a safe state.

4.2.3.10 The following applies to tests on electrical safety devices:

a) all faults which could impair the function of safety devices shall be recognised with the level of fault detection required by the corresponding requirement class. Tests may be carried out manually or automatically, or as a combination of both methods;

b) if tests take place before the start of daily operation or before every start, start-up shall only occur if no fault has been detected during the test. If they take place during travel and a fault is found, the cableway shall be brought to a stop.

NOTE In the case of a test initiated and carried out manually, this may be an operational requirement, as it is not always possible to prevent start-up.

c) The frequency of tests depends on the prescribed requirement class and also the fault tolerance time, the failure rate data and the execution (structure) of the safety-related electrical device.

4.2.3.11 The electrical installations shall be planned, manufactured, assembled and maintained so that:

a) they do not adversely affect the proper, safe use of other electrical installations in a hazardous or unreasonable manner;

b) their proper, safe use is not adversely affected in a hazardous or unreasonable manner by other electrical installations.

4.2.3.12 In principle, electrical devices which are not safety-critical shall correspond at least to requirement class 1.

4.2.3.13 Deviations from the requirement class determined in the risk analysis shall be permissible in the case of recovery and evacuation.

4.2.3.14 Level of fault detection (FG):

The level of fault detection (FG) is a measure of the efficacy of the diagnosis and can be determined as a ratio of the failure rate of the established hazardous failures and the failure rate of the total hazardous failures.

The value for the FG shall be specified in four steps (in accordance with Table 1).

Table 1 – Level of fault detection

Level of fault detection (FG)	
Designation	Area
None	FG < 60 %
Low	60 % ≤ FG < 90 %
Medium	90 % ≤ FG < 99 %
High	99 % ≤ FG
NOTE In the case of electrical safety devices which are made up of several parts, a mean value of the FG shall be used. For examples, in accordance with Annex D.	

4.2.3.15 Average time up until the dangerous failure (MTTFd).

The MTTFd represents the expected value of the average time until the dangerous failure (in accordance with Table 2).

Table 2 – Average time until the dangerous failure ($MTTF_d$)

$MTTF_d$	
Designation for each channel	Area for each channel
Low	3 years ≤ $MTTF_d$ < 10 years
Medium	10 years ≤ $MTTF_d$ < 30 years
High	30 years ≤ $MTTF_d$ ≤ 100 years
NOTE The restriction of the $MTTF_d$ value of each channel up to a maximum of 100 years refers to the individual channel which executes the safety function.	

4.3 Requirements for safety-critical application software

4.3.1 Software development process

All activities in the life cycle of safety-critical application software shall primarily take into consideration the avoidance of faults which can occur during the software life cycle (see Figure 3). The main objective of the following requirements shall be to maintain legible, understandable, testable and maintainable software.

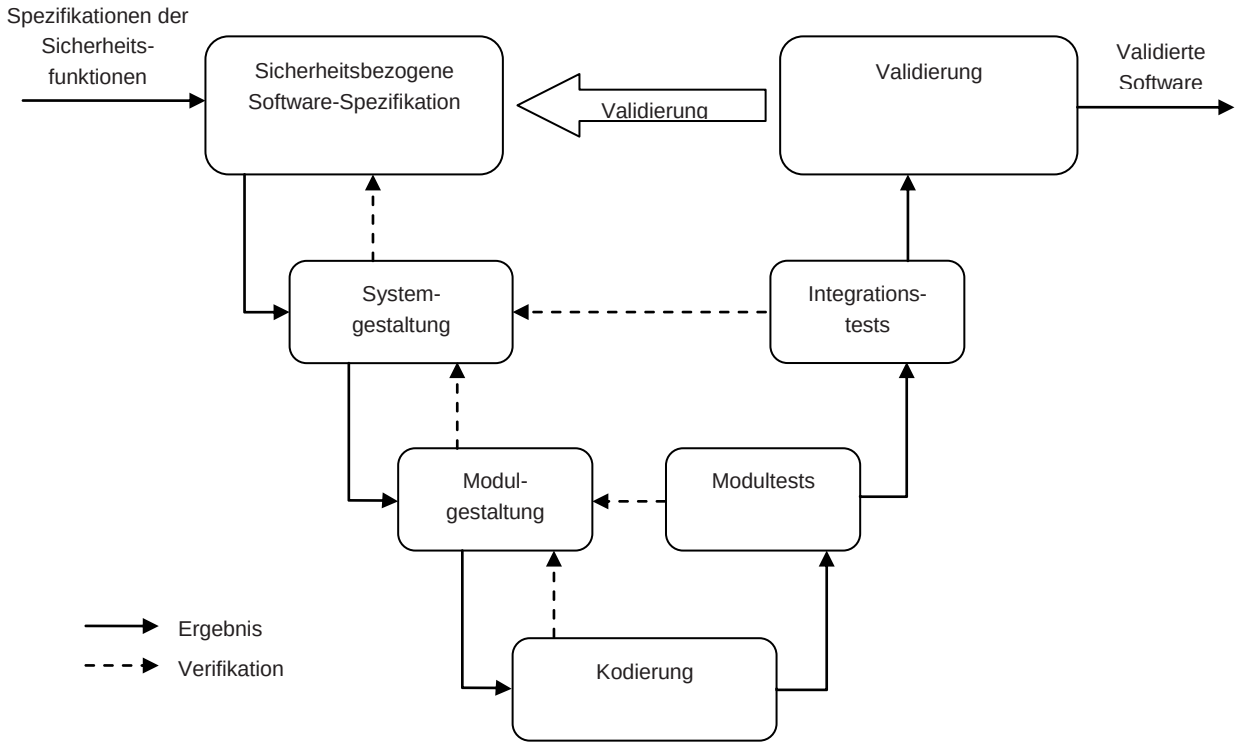


Figure 3 – Simplified V-model of the software life cycle

The following basic measures shall be applied for safety-critical application software (SRASW) for safety functions with an AK 1 to 4:

- development life cycle with verification and validation, in accordance with Figure 3;
- documentation of the specification and design;
- modular and structured programming;
- functional tests;
- suitable development activities after changes.

For SRASW in safety functions with AK 3 - 4, the following additional measures are required.

a) the specification of the safety-critical software shall be checked and each person involved in the life cycle shall be available and the following descriptions included:

   1) safety functions with required AK

   2) performance criteria, e.g. reaction times,

   3) hardware architecture with external signal interfaces and

   4) detection and control of external failures.

b) Choice of tools, libraries, languages:

   the programming tools provided by the hardware manufacturer shall be used to create the safety-critical application software - it shall be preferable to use the safety-critical FB libraries or validated specific FB libraries provided by the tool manufacturer.

c) The software design shall include the following features:

1) semiformal procedure for describing the data and control flow e.g. status diagram or program flow diagram;

2) modular and structured programming, primarily realised by means of the provision of validated safety-critical function block libraries;

3) function blocks with minimised code length;

4) within the function block, the code shall be executed with an input step and an output step;

5) architecture of the model in three stages: inputs ⇨ ⇒ processing ⇨ ⇒ outputs (in accordance with Figure 4);

6) allocation of the safety output to just one program part;

7) use of methods to detect external failures and for defensive programming within the input, processing and output blocks which will bring about a safe state.

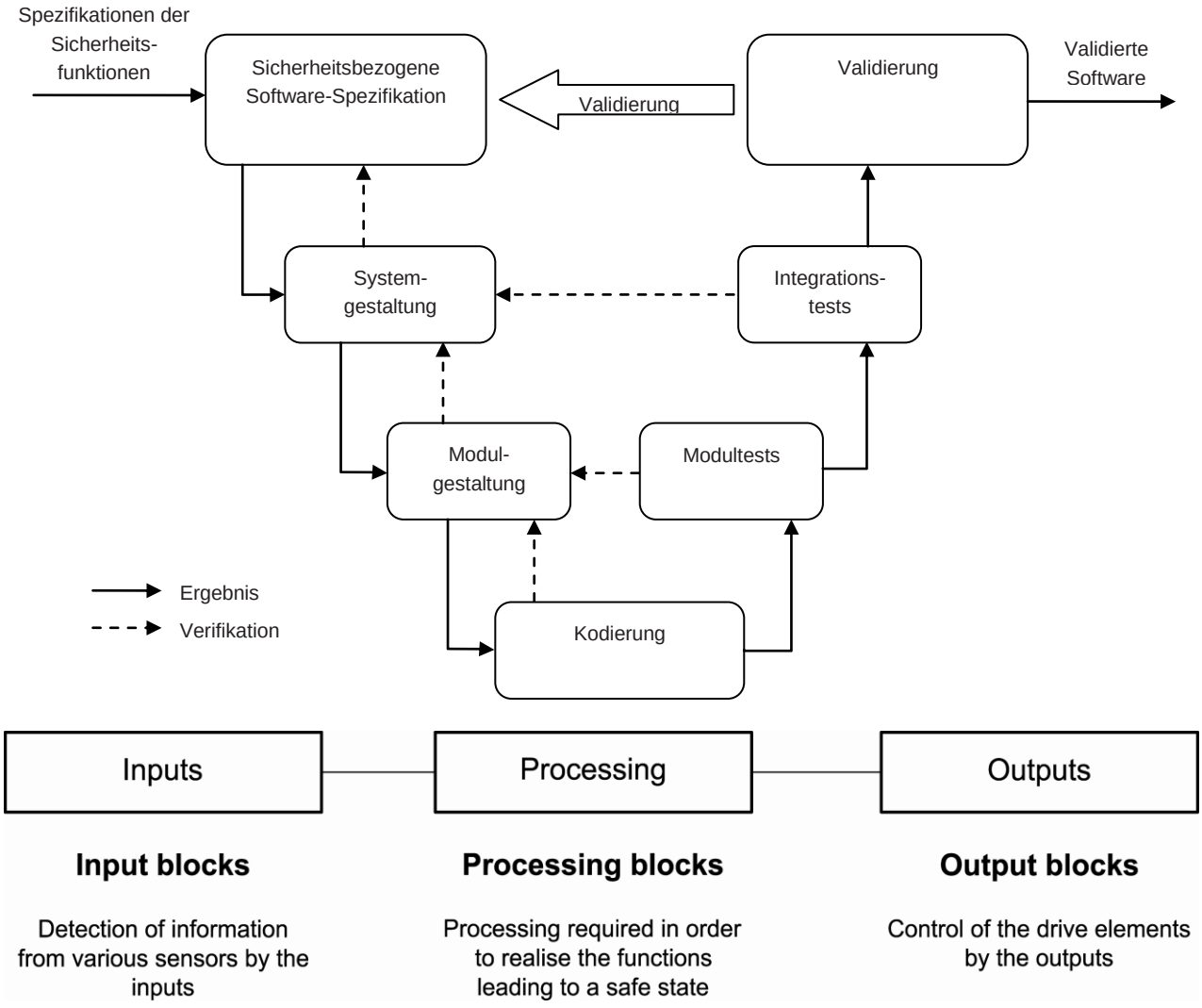


Figure 4 — General architectural model for software

d) Where SRASW and non-safety-critical software are combined in one safety function:

1) SRASW and non-safety-critical software shall be coded in different function blocks with carefully defined data interfaces;

2) there shall be no logical link between non-safety-critical and safety-critical data which could lead to a downgrading of the integrity of the safety-critical signals, e.g. link of a safety-critical and a non-safety-critical signal by means of a logical “OR”, the output of which controls safety-critical signals.

e) Software implementing/coding:

1) the code shall be legible, understandable and testable such that symbolic variables (in the place of explicit hardware addresses) can be applied;

2) justified or accepted programming guidelines shall be used;

3) data integrity and plausibility tests (e.g. area tests) at user level should be implemented;

4) the code shall be tested by means of simulation;

5) the verification should take place by means of control and data flow analysis at AK = 3 and 4.

f) Tests:

1) the appropriate validation procedure is the black box test of the functional behaviour and the performance criteria (e.g. temporal performance criteria);

2) a test case execution based on limit values analyses is recommended;

3) a test plan is recommended and should include test cases with closing conditions and required tools;

4) I/O tests shall ensure that the safety-critical signals in the SRASW are being used correctly.

g) Documentation:

1) all life cycle and change activities shall be documented;

2) the documentation shall be complete, available, legible and understandable;

3) the code documentation within the source text shall contain module heads with a legal body, function and I/O description version of the SRASW and version of the used function block library and sufficient commenting of the networks/instructions and declaration lines.

h) Verification:

A verification shall be performed only for an application-specific code and not for validated library functions.

EXAMPLE Check, inspection, walk-through or other suitable activities.

i) Configuration management:

The introduction of procedures and data back-up is particularly recommended in order to identify and archive all the documents, software modules, results of the verification/validation and tool configuration which relate to a specific SRASW.

j) Changes:

After changes to an SRASW, it is important to conduct an influence analysis to ensure the specification and appropriate life cycle activities shall also take place. Access rights to the changes shall be checked and the change history documented.

4.3.2 Software-based parameterisation

Software-based parameterisation of safety-critical parameters shall be considered a safety-critical aspect of the design that is described in the specification of the software safety requirements. The parameterisation shall be executed using an appropriate software tool. This tool shall have its own designation (name, version etc.), and shall prevent any unauthorized modifications, e.g. by changing a password.

The integrity of all data used for the parameterisation shall be maintained. This shall be achieved by the use of the following measures:

– inspection of the valid input area;

– control of data corruption prior to data transfer;

– control of the effects of deviations during the process of parameter transfer;

– control of the effects when transferring incomplete parameters; and

– control of the effects of faults and failures in the hardware and software of the tool that is being used for the parameterisation.

The tool that is being used for the parameterisation shall comply with all requirements on the safety component. Alternatively, a special procedure shall be used for adjusting the safety-critical parameters. This procedure shall incorporate the confirmation of input parameters for the safety components, either by

– retransfer of the modified parameter to the parameterisation tool, or

other suitable means to confirm the integrity of the parameter,

as well as by subsequent confirmation, e.g. by a sufficiently trained person and an automatic check by a parameterisation tool.

NOTE 1 this is of particular importance if the parameterisation should be executed using a device that is not specifically intended for the purpose (e.g. personal computer or the like).

The software modules which are used for coding/decoding within the transfer/retransfer process, and the software modules which are used to display safety-critical parameters for the user shall at least apply diversity in terms of their function(s) in order to prevent systematic failures.

The documentation of a software-based parameterisation shall display the data used (e.g. pre-defined parameter sets) and necessary information for identifying the parameters allocated to the safety component, the person(s) who have executed the parameterisation as well as other relevant information, like for example, the date of the parameterisation.

The following verification activities shall be applied for a software-based parameterisation:

– verification of the correct adjustment for each of the safety-critical parameter (minimum, maximum and representative values);

– verification that the safety-critical parameters will be checked for plausibility, e.g. by entering invalid values etc.;

– verification that unauthorised modifications to safety-critical parameters shall be prevented;

– verification that the data/signals of a parameterisation shall be generated and processed such that faults will not induce a loss of the safety function.

NOTE 2 this is of particular importance if the parameterisation should be executed using a device that is not specifically intended for the purpose (e.g. personal computer or the like).

5 Special regulations

5.1 Suspension of safety functions

5.1.1 The suspension of the different safety functions shall only take place individually or in functional groups.

5.1.2 The suspension of safety functions shall only be possible by means of a key switch or an equivalent device.

5.1.3 If safety functions are suspended, the operation shall only be performed from the control console.

5.1.4 Suspension of safety functions shall be indicated visually to the machine operators in an obvious way; the safety functions which are no longer functioning shall be unambiguously recognisable.

5.1.5 Operation in accordance with EN 12397 shall be permissible under exceptional circumstances.

5.1.6 During recovery with bridging, one or more safety functions can be partly or completely suspended.

5.1.7 During recovery, the running speed shall be monitored in accordance with EN 12929-1.

5.2 Lightning protection and earthing

5.2.1 The stations and intermediate stops shall be protected by lightning protection devices in accordance with EN 62305 (all parts). All metallic constructional parts of significant size shall be connected to the earthing system in the station. The applicable national guidelines and standards shall be observed for this.

5.2.2 The occurrence of unacceptable step voltages and contact voltages (for example, caused by high voltage installations) shall be prevented by means of suitable earthing devices and electrical bonding measures.

5.2.3 Ropes which are not electrically isolated shall be earthed in the stations at least.

5.2.4 Cast sleeves between track ropes and tension ropes shall be electrically bridged.

5.2.5 The line support structures shall be earthed, except where otherwise justified (for example, position on rock).

5.2.6 The following shall be protected by means of suitable lightning protection devices:

a) the remote monitoring installation, the remote transmission and reporting devices;

b) if necessary, other electrical equipment.

5.2.7 Static electricity shall not have any dangerous effects on the carriers.

5.2.8 The carriers in funicular railways shall be reliably earthed.

NOTE This can, for example, be achieved by means of earthing brushes on at least two axles per carrier acting on the earthed rails.

5.2.9 During long periods out of operation, a corresponding means of earthing the haul or the towing rope shall be provided; if the ropes are earthed in this way, start-up shall be prevented.

6 Electrical power, equipment

6.1 Main switch

6.1.1 In all operating conditions, it shall be possible to remove the voltage from the electrical installations in the cableway by means of a lockable main switch for each electrical feed.

6.1.2 Electrical circuits used exclusively for auxiliary operations, control systems, safety functions etc. may be connected on the line side of the main switch if:

a) they are isolated from the other circuits;

b) they can be isolated from the supply by special main switches.

6.1.3 Circuits used exclusively for electrical equipment for maintenance shall be:

a) connected on the line side of the main switch;

b) isolated from the other circuits;

c) capable of being isolated from the supply by a special isolating device if they are not part of the actual domestic installation.

6.1.4 Only the electrical installations for the cableway shall be capable of being made voltage-free by means of the main switches (6.1.1 and 6.1.2), not the actual domestic installation

6.1.5 The main switches shall be:

a) capable of being operated mechanically and actuated from the same location;

b) permanently and legibly marked so that it is quite clear which parts of the installation are disconnected.

6.1.6 It shall be possible to switch off the main switch without additional aid, even with the cabinet doors open.

6.1.7 The main switch shall be installed either in a separate cabinet or in a normal switchgear cabinet enclosed on all sides so as to prevent accidental contact. In the first instance, no other terminals or switchgear shall be installed under the same covers.

6.1.8 If the main switch for the main drive is not located in the control room or is not easily accessible from there, it shall be capable of being actuated by remote control from the control room.

6.2 Electrical equipment

6.2.1 Electrical equipment shall be constructed, dimensioned and installed so that it functions correctly and reliably in the expected conditions of use. This applies particularly to the special physical environment and operating conditions.

6.2.2 It shall only be possible to switch control voltages on and off by means of a key switch or a similar piece of equipment.

6.2.3 Operating elements by means of which functions relevant to safety can be switched off or altered shall take the form of key switches or equivalent equipment.

6.2.4 The keys for key switches which perform safety functions shall only be removable in the safe position of these switches.

6.2.5 Safety-critical electrical equipment shall be kept under lock and key so that unauthorized interventions are prevented.

6.2.6 Switches and pushbuttons on whose reliable functioning the safety of the cableway depends, and their mechanical actuation, shall operate on the principle of positive action. In justified cases, the following may be used instead:

a) monitored duplication of switches not of the positive action type; or

b) contactless controllable switchgear that together with its wiring meets the safety requirements (see 4.2).

6.2.7 Switchgear whose position is checked for safety reasons shall have positive action contacts. If contactless switchgear is used, this requirement shall be met by analogy

For relays with positive action contacts, EN 50205 should be observed.

6.2.8 If exceeding or falling below a preset time has to be prevented for safety reasons, a suitable timing element which meets the safety requirements shall be used.

6.2.9 For batteries that supply safety-critical devices with electric power, it shall be ensured that:

a) they are charged automatically;

b) they are galvanically separated from the supply network, even during the charging process;

c) the charging and discharging current and the voltage shall be indicated by instruments or monitored automatically;

d) a cover shall be provided, at least over the connection terminals;

e) it shall be possible to check the state of charge periodically;

f) they meet the requirements of EN 50272-2.

6.3 Assembly and installation

6.3.1 Electrical equipment shall not be assembled until work which could adversely affect its operability in the relevant rooms, buildings etc. has been completed.

6.3.2 Switchgear cabinets shall be installed in suitable and easily accessible rooms or in the control room.

6.3.3 Electrical equipment for main circuits and their control circuits shall generally be installed in a separate cabinet or cabinet section.

6.3.4 Live parts of electrical equipment for maintenance shall be protected against accidental contact even when the cabinet doors are open.

6.3.5 The relevant national regulations are applicable for protective earthing in the stations. Insulation defects shall not impair safety.

6.3.6 In carriers, the frame shall not be used for carrying current.

6.3.7 At the minimum, spaces important for the operation and maintenance of electrical equipment shall have adequate artificial lighting, and in addition, artificial lighting independent of the normal power supply (emergency lighting) in accordance with national regulations (e.g. portable lamps).

6.4 Maintenance switches (safety switches) and emergency stop buttons

6.4.1 EN 13850 shall be applied for maintenance switches (safety switches) and emergency stop buttons, insofar as this standard does not contain different provisions.

6.4.2 Maintenance switches (safety switches) and emergency stop buttons shall be arranged so as to be readily visible and easily accessible and shall be marked with a label.

6.4.3 The arrangement and design of maintenance switches (safety switches) and emergency stop buttons shall:

a) as far as possible, prevent confusion with other electrical equipment;

b) as far as possible, prevent unintentional operation.

6.4.4 In order to comply with 6.4.3, emergency stop buttons can differ in shape and colour from the requirements of EN ISO 13850 and the Clause concerning operator control devices for the EMERGENCY STOP under EN 60204-1.

6.4.5 Emergency stop buttons shall stay in position after they have been operated and then shall not return automatically to their initial position, unless the safety level is maintained.

6.4.6 Maintenance switches (safety switches) shall stay in position after they have been operated and shall be lockable in the activated position (in accordance with the requirements on safety functions and control devices for drive systems in EN 13223).

6.4.7 Maintenance switches (safety switches) shall be available to the operating personnel at least at the following points:

a) in the machine room;

b) at maintenance areas and work platforms adjacent to moving mechanical devices moved by the drive systems in all stations and intermediate stopping points;

c) at the control points in the carriers;

d) at the control console.

6.4.8 Emergency stop buttons shall be available at least at the following points:

a) at the control console;

b) on the platforms;

c) at intermediate stopping points;

d) in stations;

e) in the control points in carriers;

f) if necessary, in the carriers of reversible aerial ropeways and funicular railways if they are unattended by operating personnel.

6.5 Special installations for line safety circuits

6.5.1 The insulation resistance to earth of the ropes to be monitored (in accordance with 7.1.3 and 7.1.4) shall be at least 10 000 Ohm even in the most unfavourable weather conditions when measured with a 500 V test voltage.

6.5.2 All suitable measures shall be taken to protect the connecting cables for the switches on line support structures against short circuits and earth faults (increased insulation, reinforced mechanical protection etc.). The cables shall be suitable for the local environmental conditions (low temperatures, UV radiation etc.).

6.5.3 If break line support structure switches are used, each line support structure shall be reliably connected electrically to earth. The earth resistance value of the line support structure shall never exceed half the leakage resistance of the line safety circuit for the line support structure switches that leads to disconnection.

If necessary, electrical bonding between the line support structures should be installed.

6.6 Power supply to carriers

6.6.1 The power supplies to the carriers shall be constructed and installed so that hazards to persons are excluded.

6.6.2 The applicable national regulations shall be observed with regard to construction and the protective measures to be taken.

7 Safety functions

7.1 Line safety circuits

7.1.1 Safety functions and emergency stop devices on the line shall act directly on the line safety circuits by interruption or by bringing about a detectable change in the signal. Those in the carriers, in the return stations or in the intermediate stops shall act directly or via safety circuits on line safety circuits.

7.1.2 Breaks, short-circuits and earth faults on the conductors of line safety circuits, contact with other monitored conductors and conductors laid in parallel or in the same cable shall either not impair the operability of the line safety circuits or the cableway shall be put into a safe state.

7.1.3 Ropes whose position shall be monitored (in accordance with, in particular, requirements on protective measures in EN 12929-1), shall be monitored by internal line safety circuits, except those that are monitored exclusively in accordance with 7.3.

7.1.4 Other ropes (for example, warning ropes for aircraft, telephone ropes), whose breakage could lead to a hazard for the cableway, shall be monitored for breakage by line safety circuits.

7.1.5 An emergency stop shall be triggered by line safety circuits at the latest when:

a) the resistance to earth of the monitored ropes falls below 500 Ohm – below 200 Ohm for a haulage rope loop;

b) the resistance between monitored ropes falls below 500 Ohm;

c) in the case of d.c. line safety circuits, the series resistance (longitudinal resistance) increases to more than 10 000 Ohm;

d) in the case of d.c. line safety circuits, the series resistance reaches the same value at which the resistance to earth triggers an emergency stop.

7.1.6 In line safety circuits whose conductors are normally protected from direct contact but are not protected from direct contact during maintenance, voltages of not more than AC = 25 V, DC = 60 V shall be used. Only reliably isolating transformers or equivalent equipment shall be used to provide this voltage.

NOTE Protection against direct contact may be ensured by obstacles.

7.1.7 Tripping of an emergency stop may be delayed by up to 500 ms to avoid spurious disconnections as long as safety is not impaired in any impermissible way.

7.1.8 It is not permitted to connect elements, such as for example resistors, capacitors or diodes, in parallel with safety-critical break contacts or elements. Excluded from this shall be resistors whose values at best increase in the event of a fault, but never decrease.

7.1.9 It is sufficient to monitor ropes (7.1.3 and 7.1.4) only for breaks and earth faults if mutual contact between the monitored ropes or parts of the cableway electrically conductively connected to these ropes, except in the case of a rope rupture, is excluded.

7.1.10 The operability of the line safety circuits shall not be impaired either by a change of impedance on the line or by mutual interference between transmitter and receiver.

7.2 Monitoring of the onboard brakes of reversible aerial ropeways

The position of the onboard brakes and, if necessary, their opening devices, shall be monitored.

7.3 Rope position monitoring

7.3.1 When the position of a rope shall be monitored, if this monitoring is not ensured by line safety circuits, the position of the rope shall be monitored by suitable devices (e.g. derailment detectors, contact plates for track ropes).

7.3.2 Derailment detectors shall act on a line safety circuit in accordance with 7.1.1 by:

a) destruction of an element specially designed to break at two points at least (e.g. a breaking rod switch); or

b) at least positive opening of a contact (e.g. a line support structure switch with open contact); or

c) other devices which ensure an equivalent level of safety.

7.3.3 It shall be possible to check that the rope position monitoring devices act correctly on the line safety circuits simply and in situ, except in justified cases.

7.3.4 It shall be possible to change a broken rod or a whole switch simply. It shall be possible to remove a breaking rod for testing simply, except in justified cases.

7.3.5 The line support structure switches, connecting cables and terminals shall have adequate overvoltage strength and tracking resistance and shall be able to withstand mechanical stresses caused by vibrations.

7.3.6 In addition, the requirements on devices for detecting deropement shall be observed in accordance with EN 13223.

7.4 Other safety functions

All safety functions, which shall be executed in accordance with EN 12929 (all parts), EN 1908, EN 13223 and EN 13796-1, shall comply with this Standard.

8 Operating and testing devices

8.1 Signaling

8.1.1 According to the type of control system, at least the indicating devices listed in Annex C shall be provided at the control console and at other control points and supervision points.

8.1.2 The necessary indicating devices shall be installed so that operating personnel are informed about the operation and functioning of the installation. Fault indicators shall be provided so that a fault can be located as easily as possible.

8.1.3 Fault indicators shall persist, regardless of the type of fault, until manual resetting takes place.

8.1.4 In justified cases, visual indications may be replaced by audible indications or by clearly recognisable switch positions of the equipment.

8.1.5 Colours of operating and indicating devices shall be selected as follows, except in justified cases:

a) red: emergency hazardous condition, safe stopping;

b)	yellow:	abnormal	warning, indication of abnormal condition;
c)	green:	normal, safe	normal condition;
d)	blue:	mandatory	requires action;
e)	white/grey/black:	neutral	no special meaning, borderline cases.

8.1.6 The values of important voltages and currents and the presence of important monitoring signals shall be indicated with adequate accuracy by means of measuring instruments or other equivalent devices.

8.1.7 Important ranges and values shall be marked on measuring instruments.

8.1.8 An operating hours counter shall be incorporated.

8.2 Test devices

8.2.1 At least the following safety functions shall be capable of being tested simply by the operating personnel:

a) overspeed trips;

b) each individual entry monitoring system in reversible aerial ropeways or pulsed movement aerial ropeways or funicular railways;

c) if appropriate, each individual speed monitoring system on the line (e.g. line support structure passing points);

d) the safety functions for the exit, entry and movement of the carriers in stations in unidirectional aerial ropeways with detachable grips;

e) the individual actions of the service brakes;

f) the individual actions of the safety brakes;

g) each individual redundant tripping valve for the safety brakes (EN 13223);

h) the deceleration monitoring systems.

8.2.2 The test devices are not obligatory if the technology of the safety function displays no urgency in terms of the safety analysis. Additional safety devices may be required following the results of the risk analysis.

8.2.3 Nothing shall be changed on the device to be tested for the purpose of carrying out the tests, except in justified cases.

8.2.4 It shall be possible for the tests to be carried out simply. The test devices themselves and their actuation shall not lead to any hazard to normal operation.

8.2.5 A test device may be a mobile device.

8.2.6 When testing one brake, it shall be possible to apply the other brake.

9 Transmission of commands and information and telecommunication equipment

9.1 Carrier control system

9.1.1 The ready for operation signal or a start command shall only be given when all the necessary conditions (doors closed, safety circuit in the carrier made, etc.) are met.

9.1.2 A start command shall not be able to become effective until:

a) ready signal has been obtained from all the carriers and a start command has been issued from at least one accompanied carrier; or

b) the corresponding start command has been issued from all the carriers.

9.1.3 The running speed shall be capable of being reduced at any time during travel from accompanied carriers.

9.2 Public telephone

9.2.1 At least the control console shall be connected to the public telephone network.

9.2.2 In justified cases, connection to the public telephone network may be waived, if, during the entire operating time, it is ensured that another equivalent connection may be made at any time to a location of the railway company that is occupied during this time and has a connection to the public telephone network.

9.3 Internal communication system

9.3.1 The stations and the intermediate stops shall be interconnected by a service telephone system. Carriers that are normally accompanied shall also be connected to this telephone system.

9.3.2 In addition, the individual sections of a cableway shall be connected together by a service telephone installation.

9.3.3 The internal communication system shall ensure adequate transmission quality.

9.3.4 The internal communication system shall remain operational even in the case of electrical supply failure and emergency triggering of the line safety circuits as a result of actuation of safety functions or emergency stop devices, or a rope overlap on one side.

9.3.5 The service telephone system shall remain operational if safety functions have been partially or totally suspended.

9.4 Loudspeaker installation

The loudspeaker installation (EN 1909) shall remain operative even in the event of an electrical supply failure.

10 Maintenance

10.1 Maintenance shall be carried out in accordance with EN 1709, observing EN 50110 (all parts).

10.2 For maintainability, the precautions for the maintainability and precautions for energy isolation and energy discharge shall be observed according to EN ISO 12100.

11 Technical documents

The technical documents (site plans, circuit diagrams, programs, descriptions, parameter lists, part lists, etc.) shall be drawn up and shall bear the designation of the cableway and the name of the author. They shall be numbered and fully labelled.

12 Requirements for ski-tows

12.1 General

For electrical devices for ski-tows except for drive systems, only the following Subclauses from Clauses 4 to 11 apply together with the additional requirements given below.

In justified cases (for example low-level ski-tows), deviations shall be permissible.

12.2 Safety principles

See 4.2

12.3 Suspension of safety functions

12.3.1 See 5.1.1

12.3.2 See 5.1.2

12.3.3 See 5.1.4

12.4 Lightning protection and earthing

12.4.1 See 5.2.1

12.4.2 See 5.2.2

12.4.3 See 5.2.3

12.4.4 See 5.2.5

12.4.5 See 5.2.6

12.4.6 See 5.2.9

12.5 Main switch

See 6.1

12.6 Electrical equipment

See 6.2

12.7 Assembly and installation

12.7.1 See 6.3.1

12.7.2 See 6.3.3

12.7.3 See 6.3.4

12.7.4 See 6.3.5

12.8 Maintenance switches (safety switches) and emergency stop buttons

12.8.1 See 6.4.1

12.8.2 See 6.4.2

12.8.3 See 6.4.3

12.8.4 See 6.4.4

12.8.5 See 6.4.5

12.8.6 Maintenance switches (safety switches) shall remain in position after they have been operated and shall be lockable in the activated position (see also the requirements for drive systems for ski-tows in accordance with EN 13223).

12.8.7 At least one maintenance switch (safety switch) shall be installed in each of the following places: close to the drive system, at the ladders giving access to the drive and return sheaves in the return station and to the sheaves in deflection stations, and at the control point in the return station.

12.8.8 Emergency stop buttons shall be installed, in particular at the control points, at the operator's posts and directly adjacent to the loading and unloading points.

12.9 Special installations for line safety circuits

12.9.1 See 6.5.1.

12.9.2 See 6.5.2.

12.9.3 See 6.5.3.

12.10 Line safety circuits

12.10.1 Safety functions and emergency stopping devices on the line shall act on the line safety circuits by interruption or by producing a detectable variation in the signal. Those in the return station shall act directly or via safety circuits on the line safety circuits.

12.10.2 See 7.1.2

12.10.3 See 7.1.3

12.10.4 See 7.1.4

12.10.5 See 7.1.5

12.10.6 See 7.1.6

12.10.7 See 7.1.7

12.10.8 See 7.1.8

12.10.9 See 7.1.9

12.10.10 See 7.1.10

12.11 Rope position monitoring

See 7.3

12.12 Other safety functions

See 7.4

12.13 Signaling

See 8.1

12.14 Public Telephone

See 9.2

12.15 Internal communication system

12.15.1 In ski-tows with manned return stations, the stations shall be connected with each other by an internal telephone system.

12.15.2 See 9.3.4

12.15.3 See 9.3.5

12.16 Maintenance

See Clause 10

12.17 Technical documents

See Clause 11

13 Fire protection and fire fighting

During the planning, construction and operation of cableway installations, measures for fire protection and fire fighting shall be incorporated and the locally applicable fire regulations shall be taken into account.

Hazards from fire scenarios in the vicinity of the cableway installations shall be taken into account. In particular, the fact that ropes and rope terminations may be affected by lightning caused by the fire shall be taken into account in the proposed measures.

NOTE Attention is drawn to CEN/TR 14819 (all parts).

Annex A
(normative)
Determining the requirement class (in accordance with 4.2.2)

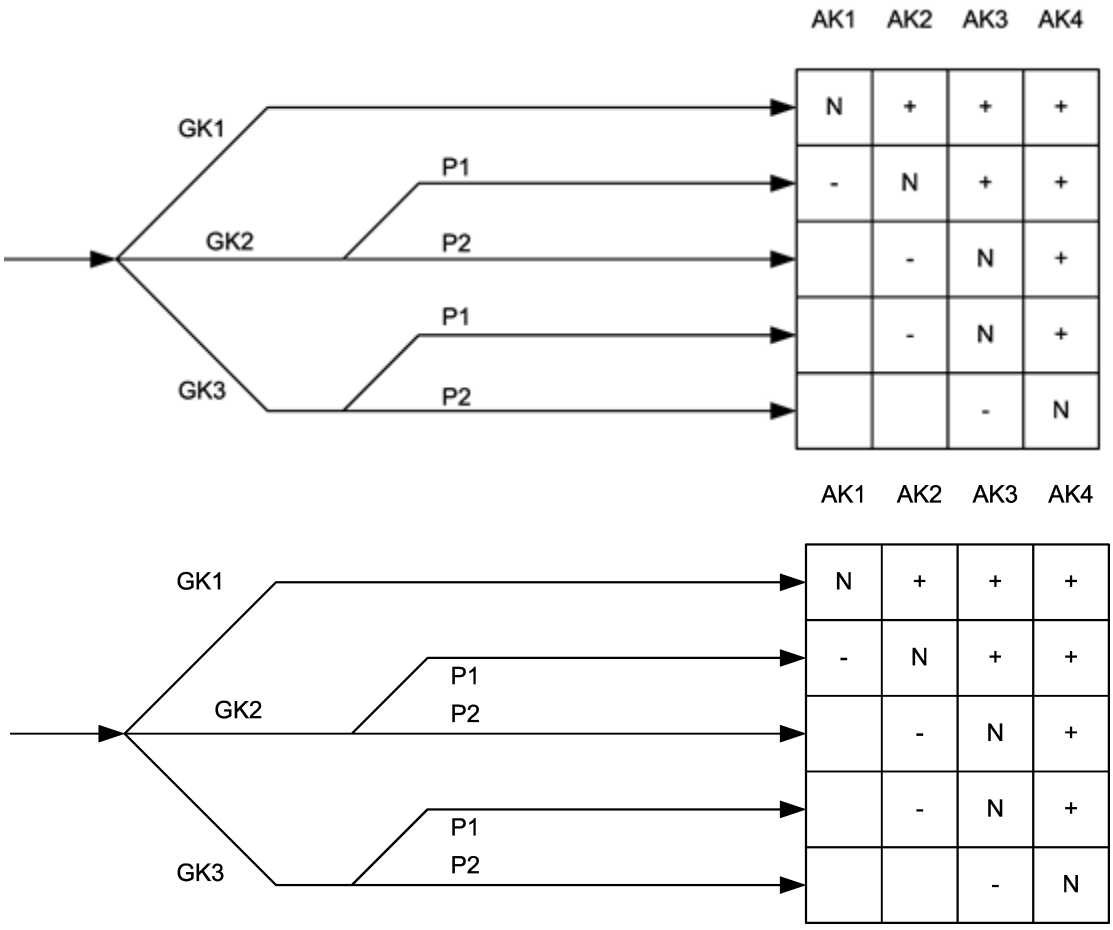


Figure A.1

Choice of the category:

N = normal category

\- = deviation to lower category (additional measures required)

\+ = deviation to higher category (permissible)

Parameter GK (hazard category):

For description of the hazard categories, in accordance with 4.2.2.1.

GK1 = no personal hazard

GK2 = slight (usually reversible) injuries to persons

GK3 = serious (usually irreversible) injuries, death of persons

Parameter P (possibility of avoiding the hazard):

P1 = possible under specific conditions (P1 only applicable in exceptional cases)

P2 = scarcely possible

Possibility of avoiding the hazard situation P1 and P2

It is important to know whether or not a hazard situation can be detected or avoided before it causes injuries to persons. An important consideration, for example, is whether the hazard situation can be directly identified by its physical properties or can only be detected by technical means, e.g. by displays. Other important aspects which influence the selection of the P parameter are, for example:

- operation with or without supervision by operating personnel with specific training;
- speed at which the hazard situation has occurred (e.g. fast or slow);
- possibilities for avoiding the hazard situation, (e.g. by fleeing);
- practical experiences with safety in relation to the process.

If a hazard situation occurs, P1 should then only be selected if there is a realistic possibility of avoiding personal injury or of considerably reducing the effects; P2 should be chosen, if there is virtually no possibility of avoiding the hazard situation.

In doing so, the following applies:

AK = requirement class, for description in accordance with 4.2.3.4

Annex B
(informative)

Allocation of performance level PL in accordance with EN ISO 13849-1 and safety integrity level SIL in accordance with EN 61508 (all parts) to the requirement classes AK

PL ➔ **Performance level** **EN ISO 13849-1**	**AK** **Requirement class** **EN 13243**	**➔ SIL** **Safety integrity level** **EN 61508 (all parts)**	**Brief description of the requirement classes in accordance with EN 13243**
a/b	1	- /1	control systems according to the state of the art
c/d	2	1	safety-proven components and principles/testing
d[1]	3	2	redundancy with partial fault recognition, in accordance with the state of the art
e	4	3	self-monitoring
NOTE Single-channel components (Cat. 2 in accordance with EN ISO 13849-1) of type B in accordance with 4.2.3.1 may not be used alone for safety functions greater than AK2.			

Annex C
(normative)

Indicating devices

The following shall be displayed at least once by indicating devices as specified in 8.1.1, depending on the type of control system:

(see next pages)

Abbreviations:

Meaning of columns:

- SB = aerial ropeways and funicular railways;
- KS = at control console;
- BS = control point in the drive station, e.g. on the platform;
- Fz = control point in carriers of reversible aerial ropeways and funicular railways with carrier control systems;
- UST = control point in the return station of uni-directional aerial ropeways;
- AP = supervision post in funicular railways with automatic operation (EN 12929-1);
- Type = type of cableway (excluding ski-tows);
- SA = ski-tow.

Meaning of symbols:

- A = all types of cableway (excluding ski-tows);
- St = only funicular railways;
- P = only reversible aerial ropeways;
- x = this indicating device shall be installed:
- o = at least one of these indicating devices shall be installed.

Table C.1

No.	Display	SB	Control point SB				SB	SA	Comments
		KS	BS	Fz	UST	AP	Type	KS	
1	Ready for operation	X	X	X	–	X	A	X	–
2	Direction of travel	X	–	–	–	–	A	–	–
3	Running speed	X	–	X	–	–	A	X*	*only if v ≠ constant
4	Important voltages and currents (e.g. main drive motor current)	X	–	–	–	–	A	X	–
5	Position of brakes in the drive system	X	–	–	–	–	A	–	–
6	Level of braking force control system (if appropriate)	X	–	–	–	–	A	–	–
7	Triggering of safety devices in the relevant station or carrier	X	X*	X	X	X	A	X	*At least the fault messages which can be reset from this position shall be displayed
8	Interruption, short-circuit and earth fault of line safety circuits	X	–	–	–	–	A	X	(In the case of the haul rope monitoring system, the indication shall be visual and audible)
9	Stopping and ready commands from stations and carriers (selective)	X	–	–	–	X*	A	X	*only stopping commands from the carriers
10	Suspension of each individual safety function in the relevant station or carrier	X	–	X	X		A	X	Flashing light or rotating beacon
11	Type of drive in use (main, auxiliary, recovery or evacuation drive), if this is not easily visible	X	–	–	–	–	A	–	–
12	Type of operation of main drive	X	–	–	–	–	A	–	–
13	Type of control system of main drive	X	–	–	–	–	A	–	–
14	Approach of carriers to station, at least acoustic	X	–	X	–	–	P,St	–	–
15	Approach of carriers to the line support structures or crossing points, at least acoustic (only for manual control) if the permissible running speed shall be less than the maximum running speed	X	–	–	–	–	P,St	–	–
16	Carriers ready for operation	X	–	–	–	–	P,St	–	–
17	Other carrier ready for operation	X	–	X	–	–	P,St	–	–

No.	Display	SB	Control point SB				SB	SA	Comments
		KS	BS	Fz	UST	AP	Type	KS	
18	Wind speed	X	–	–	O	–	A	–	–
19	Wind alarm: in accordance with EN 12929-1 Wind measuring devices	X	–	X		–	A	–	–
20	Wind direction	X	–	–	–	–	A	–	–
21	Requirements for opening carrier doors fulfilled, if doors are opened by attendant	X	–	X	X	–	P	–	–

Annex D
(informative)
Assessment of the level of fault detection (FG) for functions and modules

D.1 Examples for level of fault detection (FG)

Table D.1 – Assessment of the level of fault detection (FG)

Measure	FG
Input unit	
Cyclic test impulse by means of dynamic change to the input signals	90 %
Plausibility test, e.g. use of closer and opener contacts of relays with positive-action contacts	99 %
Cross reference of input signals without dynamic test	0 % to 99 %, depending on how often a signal change is made by the application
Cross reference of input signals with dynamic test, if short-circuits cannot be detected (in the case of multiple inputs/outputs)	90 %
Indirect monitoring (e.g. monitoring by pressure switches, electric position monitoring of actuation elements)	90 % to 99 %, depending on the application
Direct monitoring (e.g. electric position monitoring of the control valves, monitoring of the electromechanical units by means of constraints)	99 %
Fault detection by the process	0 % to 99 %, depending on the application
Monitoring of some of the properties of the sensor (response time, the area of analogue signals, e.g. electrical resistance, capacity)	60 %
Logic	
Indirect monitoring (e.g. monitoring by pressure switches, electric position monitoring of actuation elements)	90 % to 99 %, depending on the application
Direct monitoring (e.g. electric position monitoring of the control valves, monitoring of the electromechanical units by means of constraints)	99 %
Dynamic principles (all logic components require a status change IN-OUT-IN if the safety function is required), e.g. interlocking circuits in the relay technology	99 %
Fault detection by the process	0 % to 99 %, depending on the application

Measure	FG
Output units	
Monitoring of the outputs by a channel without dynamic testing	0 % to 99 %, depending on how often a signal change is made by the application
Cross reference of output signals without dynamic test	0 % to 99 %, depending on how often a signal change is made by the application
Cross reference of output signals with dynamic test, no short-circuit detection (in the case of multiple inputs/outputs)	90 %
Redundant switch-off path without monitoring the drive element	0 %
Redundant switch-off path with monitoring of one of the drive elements either by the logic or by a test facility	90 %
Redundant switch-off path with monitoring of the drive elements by the logic and a test facility	99 %
Indirect monitoring (e.g. monitoring by pressure switches, electric position monitoring of actuation elements)	90 % to 99 %, depending on the application
Fault detection by the process	0 % to 99 %, depending on the application
Direct monitoring (e.g. electric position monitoring of the control valves, monitoring of the electromechanical units by means of constraints)	99 %

D.2 Assessment of the average FG

The level of fault detection can theoretically be determined as the relationship between the failure rate of detected hazardous failures and the failure rate of all hazardous failures.

The average level of fault detection FG_{avg} can be assessed using the following simplified equation:

$$FG_{avg} = \frac{FG1 + FG2 + \ldots + FGN}{N}$$

All components shall be taken into consideration and summed up.

Annex ZA
(informative)

Relationship between this European Standard and the Essential Requirements of the EU Directive 2000/9/EC

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association to provide a means of conforming to essential requirements of the New Approach Directive 2000/9/EC relative to cableway installations designed to carry persons.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the Clauses of this standard given in Table ZA.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding Essential Requirements of that Directive and associated EFTA regulations.

Table ZA.1 — Correspondence between this European Standard and the Directive (2000/9/EC)

Clause(s)/Subclause(s) of this EN	Essential Requirements of Directive 2000/9/EC	Qualifying remarks/Notes
4.1.3	2.2, 2.6, 7.1	
4.2.3	2.2, 2.6, 7.1	
4.2.3.13	2.3	
5.1	7.1, 7.2	
5.2	2.6.6	
6.1	7.1	
6.2	2.3, 2.4, 4.3, 2.7.2, 2.7.3	
6.3	2.5	
6.4	2.7, 2.8, 7.1	
6.5	2.7	
6.5.2	2.3	
6.6	5.1	
Clause 7	2.7	
7.3 (12.11)	4.1	
8	5.4, 7.1	
9.1	4.3, 5.1, 5.4, 7.1	
9.3	4.4	
9.4	4.4	
Clause 10	2.8	
Clause 11	7.1	
12.8	2.7.2, 2.8	
Annex A	2.2	
Annex C	5.4, 7.2	

WARNING — Other requirements and other EU Directives may be applicable to the product(s) falling within the scope of this standard.

Bibliography

[1] CEN/TR 14819 (all parts), Safety recommendations for cableway installations designed to carry persons – Prevention and fight against fire

[2] EN 50205, Relays with forcibly guided (mechanically linked) contacts[3] EN 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems(IEC 61508 (all parts)*

[4] EN ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1)*

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