



SLOVENSKI STANDARD

SIST EN 50343:2014

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Železniške naprave - Vozna sredstva - Pravila za inštaliranje kablov

Railway applications - Rolling stock - Rules for installation of cabling

Bahnanwendungen - Fahrzeuge - Regeln für die Installation von elektrischen Leitungen

Applications ferroviaires - Matériel roulant - Règles d'installation du câblage

Ta slovenski standard je istoveten z: **EN 50343:2014**

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EUROPEAN STANDARD

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Railway applications - Rolling stock - Rules for installation of cabling

Applications ferroviaires - Matériel roulant - Règles
d'installation du câblageBahnanwendungen - Fahrzeuge - Regeln für die Installation
von elektrischen Leitungen

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Contents

1	Scope	6
2	Normative references	6
3	Terms, definitions and abbreviations	8
3.1	Terms and definitions	8
3.2	Abbreviations	10
4	Technical requirements	10
4.1	General requirements.....	10
4.2	Selection of type and size of cables	11
4.2.1	General	11
4.2.2	Selection of cable size for control cables.....	12
4.2.3	Selection of cable size for cables for power distribution, on the basis of continuous load current ...	12
4.2.4	Selection of cable size for cables for power distribution, on the basis of rating of protection device	18
4.2.5	Motor cables	18
4.2.6	Cables for protective bonding	18
4.2.7	Cables used under short time current (below 5 s).....	18
4.3	Bundling of cables	19
4.4	Flexibility of cables.....	19
4.5	Minimum cross-sectional area of conductors.....	20
4.6	Use of green and yellow colour	20
4.7	Bending radii and other mechanical requirements	20
4.8	Re-termination	22
4.9	Busbars	22
4.10	Connections to busbars.....	23
4.11	Separation of cables with different voltage levels and for safety reasons	23
4.12	Provisions for refurbishment and maintenance, including inspection and repair	24
4.13	Fire prevention, cable laying and cabling behaviour in case of fire	25
4.14	Provision of spares	26
4.14.1	Provision of spares for control cabling.....	26
4.14.2	Provision of spares for auxiliary power distribution cabling.....	26
4.15	Requirements for fixing	26
4.16	Clearances and creepage distances	27
4.17	Requirements for electrical terminations	27
4.17.1	General	27
4.17.2	Electrical terminations at the cable ends	28
4.17.3	Electrical terminations at the terminal or device side.....	28
4.18	Use of heat-shrinkable sleeves	30
4.19	Connections for return current.....	30
4.20	Storage of cables.....	30
4.21	Cable conduits.....	31
4.22	Electrical bolted connections	31
5	EMC requirements	33
5.1	General.....	33
5.2	Cable categories.....	34
5.3	Separation of cables.....	34
5.4	Return conductor	35
5.5	Use of conductive structure	35
5.6	Shielding and earthing.....	35
5.7	Supply connection from battery	35
5.8	Databus lines.....	36
6	Marking for identification	36
6.1	General.....	36
6.2	Marking for identification of cables and busbars	36
6.3	Marking for identification of terminal blocks, individual terminals, plugs and sockets.....	37
6.4	Marking of insulators	37
6.5	Marking for warning against electrical shock.....	37

6.6 Marking using heat-shrinkable sleeves	37
7 Testing.....	37
7.1 General concerning testing.....	37
7.2 Electrical insulation tests	38
7.2.1 General	38
7.2.2 Voltage withstand test.....	38
7.2.3 Insulation impedance test	40
Annex A (normative) Cable sizing – Calculation under short time current conditions	42
Annex B (informative) Cable sizing – Examples of current ratings	43
Annex C (normative) Cable sizing – Calculating current ratings for temperature classes other than 90 °C.....	45
Annex D (normative) Cable sizing – Correction factor k_1 for expected ambient temperature	46
Annex E (normative) Cable sizing – Prediction of cable lifetime	47
E.1 General cable lifetime considerations	47
E.2 Reducing cable lifetime	48
E.3 Increasing cable lifetime	49
Annex F (informative) Cable sizing – Calculation examples	50
Annex G (informative) Terminations	54
G.1 Methods of terminating cables	54
G.2 Tensile strength test values	60
Annex H (normative) Tests on marking when using heat-shrinkable sleeves	62
H.1 General.....	62
H.2 Preparation of specimens.....	62
H.3 Testing of specimens	63
H.4 Result of test.....	63
Annex I (informative) Effects of the number of earth connections to a cable screen.....	64
Annex J (informative) Differences of electrochemical potentials between some conductive materials.....	65
Electrolyte: water with 2 % NaCl salt.....	65
Source: EN 3197:2010.	65
Annex K (informative) Locations on board rolling stock to be distinguished.....	66
Bibliography	68
Tables	
Table 1 – Modification factor k_5 for individual cores within a multi core cable	15
Table 2 – Modification factor k_2 for installation type (grouping and installation conditions).....	16
Table 3 – Selection of cable conductor size on the basis of rating of protection device	18
Table 4 – Minimum internal bending radii R for static applications	21
Table 5 – Cable categories with respect to EMC	34
Table 6 – Minimum distances between cables of different EMC categories.....	34
Table 7 – Test voltages according to on-board voltages	40
Table 8 – Test voltages according to supply line voltages	40
Table A.1 – Modification factor k_4	42
Table B.1 – Examples of current ratings for standard wall cables, with 90 °C maximum conductor operating temperature	44
Table C.1 – Factor k^* , used when comparing current ratings for 90 °C maximum conductor operating temperature with other temperature classes	45

Table D.1 – Modification factor k_1	46
Table E.1 – Examples of values of correction factor k_3 to allow for decrease in predicted cable lifetime for a 90 °C cable	46
Table G.1 – Methods of terminating cables – Conductor side	54
Table G.2 – Methods of terminating cables – Terminal side – Crimp connections (1/2)	55
Table G.3 – Methods of terminating cables – Terminal side – Screwed and bolted connection	57
Table G.4 – Methods of terminating cables – Terminal side – Connection by clamping	58
Table G.5 – Methods of terminating cables – Terminal side – Connection by insulation displacement or penetration	59
Table G.6 – National standards for termination methods	60
Table G.7 – Pull out force for crimp connections	61
Table H.1 – Preparation of heat-shrinkable sleeve for test of marking quality.....	62
Table I.1 – Effects of shielding	64
Table J.1 – Differences of electrochemical potentials between some conductive materials (in mV).....	65

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Foreword

This document (EN 50343:2014) has been prepared by CLC/SC 9XB "Electromechanical material on board rolling stock".

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-01-27
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-01-27

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

This document supersedes EN 50343:2003.

EN 50343:2014 includes the following significant technical changes with respect to EN 50343:2003:

- references to other standards updated and harmonized;
- factor k_5 concerning sizing of multi core cables introduced;
- factor k_2 detailed, see Table 2;
- short time current detailed;
- mechanical aspects detailed;
- separation of cables due to safety reasons and EMC reasons harmonized;
- details added and changed concerning electrical and mechanical requirements for electrical terminations;
- cable lifetime considerations updated.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association.

1 Scope

This European Standard specifies requirements for the installation of cabling on railway vehicles and within electrical enclosures on railway vehicles, including magnetic levitation trains and trolley buses.

NOTE With respect to trolley buses, this European Standard applies to the whole electric traction system, including current collecting circuits, power converters and the respective control circuits. The installation of other circuits is covered by street vehicle standards for example those for combustion driven buses.

This European Standard covers cabling for making electrical connections between items of electrical equipment, including cables, busbars, terminals and plug/socket devices. It does not cover special effect conductors like fibre optic cables or hollow conductors (waveguides).

The material selection criteria given here are applicable to cables with copper conductors.

This European Standard is not applicable to the following:

- special purpose vehicles, such as track-laying machines, ballast cleaners and personnel carriers;
- vehicles used for entertainment on fairgrounds;
- vehicles used in mining;
- electric cars;
- funicular railways.

As the field of cabling in rolling stock is also dealt with in the cable makers' standard, references are made to EN 50264 series, EN 50306 series, EN 50382 series and EN 50355.

This European Standard applies in conjunction with the relevant product and installation standards. Stricter requirements than those given in this European Standard may be necessary.

2 Normative references

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

EN 45545 (all parts), *Railway applications – Fire protection on railway vehicles*

EN 45545-1, *Railway applications – Fire protection on railway vehicles – Part 1: General*

EN 45545-2, *Railway applications – Fire protection on railway vehicles – Part 2: Requirements for fire behaviour of materials and components*

EN 45545-3 *Railway applications - Fire protection on railway vehicles - Part 3: Fire resistance requirements for fire barriers*

EN 45545-5, *Railway applications – Fire protection on railway vehicles – Part 5: Fire safety requirements for electrical equipment including that of trolley buses, track guided buses and magnetic levitation vehicles*

EN 50121-3-1, *Railway applications – Electromagnetic compatibility – Part 3-1: Rolling stock – Train and complete vehicle*

EN 50121-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

EN 50124-1, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

EN 50125-1, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

EN 50153, *Railway applications – Rolling stock – Protective provisions relating to electrical hazards*

EN 50200, *Method of test for resistance to fire of unprotected small cables for use in emergency circuits*

EN 50215:2009, *Railway applications – Rolling stock – Testing of rolling stock on completion of construction and before entry into service*

EN 50264 (all parts), *Railway applications – Railway rolling stock power and control cables having special fire performance*

EN 50306 (all parts), *Railway applications – Railway rolling stock cables having special fire performance – Thin wall*

EN 50306-2, *Railway applications – Railway rolling stock cables having special fire performance – Thin wall – Part 2: Single core cables*

EN 50355:2013, *Railway applications - Railway rolling stock cables having special fire performance - Guide to use*

EN 50362, *Method of test for resistance to fire of larger unprotected power and control cables for use in emergency circuits*

EN 50382 (all parts), *Railway applications – Railway rolling stock high temperature power cables having special fire performance*

EN 50467, *Railway applications – Rolling stock – Electrical connectors, requirements and test methods*

EN 50553, *Railway applications – Requirements for running capability in case of fire on board of rolling stock*

EN 60228, *Conductors of insulated cables (IEC 60228)*

EN 60423, *Conduit systems for cable management - Outside diameters of conduits for electrical installations and threads for conduits and fittings (IEC 60423)*

EN 60684-3-212, *Flexible insulating sleeving – Part 3: Specifications for individual types of sleeving – Sheet 212: Heat-shrinkable polyolefin sleeveings (IEC 60684-3-212)*

EN 60684-3-216, *Flexible insulating sleeving – Part 3: Specifications for individual types of sleeving – Sheet 216: Heat-shrinkable, flame-retarded, limited-fire hazard sleeving (IEC 60684-3-216)*

EN 60684-3-271, *Flexible insulating sleeving – Part 3: Specifications for individual types of sleeving – Sheet 271: Heat-shrinkable elastomer sleeveings, flame retarded, fluid resistant, shrink ratio 2:1 (IEC 60684-3-271)*

EN 61180-1, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements (IEC 61180-1)*

EN 61386-1, *Conduit systems for cable management - Part 1: General requirements (IEC 61386-1)*

EN 61310-2, *Safety of machinery – Indication, marking and actuation – Part 2: Requirements for marking (IEC 61310-2)*

HD 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors (IEC 60364-5-54:2011)*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1

cable

assembly consisting of

- one or more cores (screened or unshielded),
- their individual covering(s) (if any),
- assembly protection (if any),
- screen(s) (if any),
- sheath (if any)

[SOURCE: IEC 60050-461, 461-06-01, mod.]

3.1.2

conductor (of a cable)

part of a cable which has the specific function of carrying current

[SOURCE: IEC 60050-461, 461-01-01]

3.1.3

core

assembly comprising a conductor with its own insulation (and screens if any)

[SOURCE: IEC 60050-461, 461-04-04]

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3.1.4

solid conductor

conductor consisting of a single wire

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[SOURCE: IEC 60050-461, 461-01-06, mod.]

3.1.5

stranded conductor

conductor consisting of a number of individual wires or strands all or some of which generally have a helical form

[SOURCE: IEC 60050-461, 461-01-07, mod.]

3.1.6

busbar

conductor consisting of a rigid metal profile

3.1.7

screen (of a cable)

conducting layer(s) having the function of control of the electro magnetic field within the cable and/or to protect the cable from external electro magnetic influences

[SOURCE: IEC 60050-461, 461-03-01, mod.]

3.1.8

bundle

group of cables tied together

3.1.9**bolted connection**

connection in which the pressure to the conductor is applied by bolting

[SOURCE: IEC 60050-461, 461-19-05]

3.1.10**crimp**

cable termination in which a permanent connection is made by applying pressure, inducing the deformation or reshaping of a barrel part of the termination around the conductor

[SOURCE: IEC 60050-461, 461-19-01, mod.]

3.1.11**spring-clamp connection**

terminal connection in which the pressure between the conductor and terminal is applied by a spring

3.1.12**penetration (connection)**

terminal connection in which the contact with the conductor is achieved by jaws which penetrate the insulation

3.1.13**plug**

connector intended to be coupled at the free end of an insulated conductor or cable, to be inserted into a matching socket, or readily removed when required.

3.1.14**socket**

connector intended to be mounted on a rigid surface and to hold a matching plug, such that the conductors contained within the socket make electrical contact individually with those in the plug

3.1.15**heat-shrinkable sleeve**

tube that on exposure to heat during installation, will at a critical temperature, permanently reduce in diameter, while increasing in wall thickness

3.1.16**manufacturer**

organisation that has the responsibility for the supply of vehicle(s), equipment or groups of equipment to the purchaser

3.1.17**purchaser**

organisation that orders the vehicle or equipment or groups of equipment and has the responsibility for direct negotiations with the manufacturer

3.1.18**cable tie**

mechanical construction needed for either keeping cables or assemblies of cables together, or for attaching them in a defined place.

3.1.19

Short time current

Certain operation case where an electrical circuit carries a current that will introduce an amount of heat into the electrical circuit, which in general will increase its temperature. "Short time" means that the heat exchange against the surrounding material is not significant.

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

EMC	Electromagnetic compatibility
CSA	Cross sectional area
IP	Ingress protection
UV	Ultraviolet
rms	root mean square
DC	Direct current
AC	Alternating current

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4 Technical requirements

4.1 General requirements

Cables and installation materials shall be type tested, selected for size and installed so as to be suitable for their function under their operating conditions. Size and installation of cables (including busbars and bare conductors) shall take into account the particular stresses to be expected in rolling stock. The materials used and methods of cabling shall be such as to prevent strain or chafing and excessive lengths of unsupported cable shall be avoided.

Cables on rolling stock shall not be used for any purpose other than for transmission, distribution and collection of electrical energy, electrical controls or monitoring systems. All components of cabling shall be selected, installed, protected, used and maintained so as to prevent danger (e.g. electrical or fire hazard, EMC problems).

The electrical connections shall be made in such a way that they can not be unintentionally disconnected or interrupted during service.

Effects that have impact on electrical connections and should be considered are at least:

- thermal effects
- dynamic loads as shock, vibration, car-body motions.
- material creepage

For consideration of environmental conditions, EN 50125-1 shall apply.

When considering operating conditions and environmental conditions, the locations as presented in Annex K (informative) should be taken into account.

For correct use of connectors, EN 50467 shall apply.

For protection against electrical hazard, the cabling installed shall be in accordance with EN 50153.

4.2 Selection of type and size of cables

4.2.1 General

When selecting cables or busbars the expected operating conditions should be taken into account. These should include but are not limited to the following parameters:

- voltage;
- current;
- overload current;
- short time current;
- voltage drop;
- short-circuit current;
- shape and frequency of current;
- fusing characteristic of the protection device;
- grouping of cables;
- ambient temperature and temperature due to load current;
- methods of installation;
- predicted cable lifetime;
- presence of rain or steam or snow or accumulation of condensing water;
- presence of corrosive, polluting or damaging substances;
- mechanical stresses;
- radiation such as sunlight.

Consideration should be given to the expected lifetime of the cabling compared with the expected lifetime of the vehicle.

The cable type (i.e. cable family) shall be selected in accordance with EN 50264 series, EN 50382 series or EN 50306 series, as applicable.

Once the cable type has been selected, the selection of conductor size if the cable is intended for power distribution shall be based on either load current and current carrying capacity calculated in accordance with 4.2.3 or based on protection device size in accordance with 4.2.4.

Short-circuit conditions and overload conditions should be checked with respect to the fusing characteristic of the protection device and the resistance of the chosen cable. See example in Figure 1.

Short-circuit conditions should be checked according to 4.2.7.

This short-circuit or overload case should be checked according to:

Normal load < nominal current rating of protection device \leq current carrying capacity of the cable

(I_{corr} , see definition in 4.2.3 b).

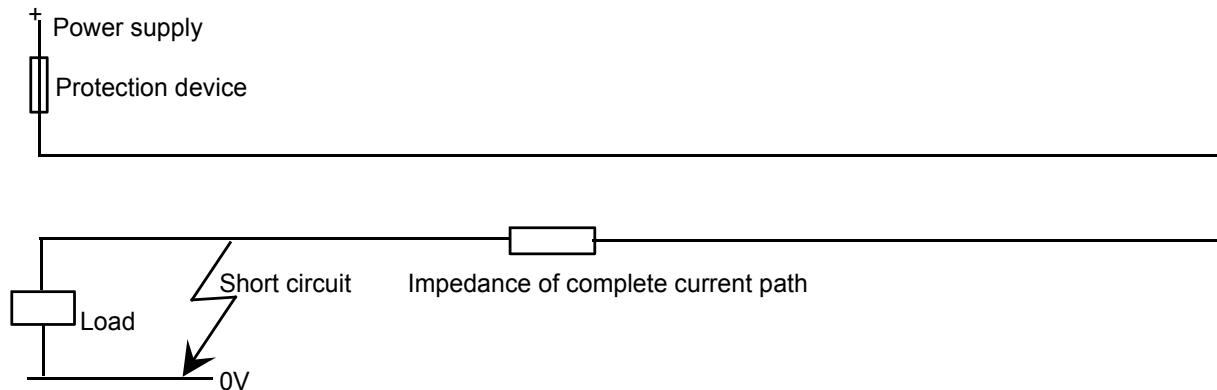


Figure 1 – Example of short-circuit condition where cable size will have influence on protection device behaviour

The cross-sectional area of any conductor shall be not less than the value specified in 4.5.

Cables and cabling shall be conform to the fire safety requirements specified in EN 45545-2, EN 45545-3 and EN 45545-5.

The number of different types of cables installed on any one type of vehicle should be minimized for practical reasons.

4.2.2 Selection of cable size for control cables

Control cables, which are intended to carry control signals only, shall have a minimum conductor cross-sectional area as specified in 4.5. This is also valid if the load current would make a smaller cross-sectional area possible.

NOTE It is not necessary for the conductor size of these cables to be selected according to 4.2.3.

4.2.3 Selection of cable size for cables for power distribution, on the basis of continuous load current

This subclause specifies a method for calculation of continuous maximum load current, of time duration longer than 5 s, of different cable sizes dependent on their method of installation and ambient temperature, to enable cables to be selected so as to ensure that the predicted lifetime is achieved.

For short time current, up to 5 s, see 4.2.7.

Correction factors from cable manufacturers should not be combined with correction factors given in this standard, in order to avoid miscalculation or oversizing.

The continuous maximum conductor temperature for the cable types defined in the various parts of EN 50264, EN 50306 and EN 50382 is either 90 °C, 105 °C and 120 °C or 150 °C. This is based either on proven experience and reliability over many years or in the case of newer, less well defined, insulations upon an acceptance test, using long-term thermal endurance ageing to demonstrate a lifetime of at least 20 000 h at 110 °C, 125 °C and 140 °C or 170 °C respectively (i.e. 20 °C above the continuous rating). Data from this thermal testing can, with care, be extrapolated to the conductor temperature to provide a predicted lifetime of the cable when continuously loaded. This predicted lifetime may be used in conjunction with the known duty cycle of the vehicle, and its predicted time out of service, to estimate the ability of the cable to function reliably for the predicted lifetime of the whole vehicle.

NOTE 1 Because the cable standards allow a variety of solutions for insulation type, it is important to confirm lifetime extrapolations with the cable manufacturer.

NOTE 2 A predicted lifetime of cable of 100 000 h may be used as a theoretical basis value for cables according to EN 50264, EN 50306 or EN 50382 series and their specific maximum conductor temperature at continuous operation.

This subclause only deals with thermal degradation of insulation material and it should be noted that mechanical stresses (bending, wear, etc.) and other environmental factors (such as presence of fluids such as cleaning detergents, aggressive atmosphere) may be the limiting factor determining predicted cable lifetime.

For cables intended for power distribution, the cable size shall be selected on the basis of the load current and the current carrying capacity in accordance with the following procedure (i.e. the three steps a), b) and c)).

a) The load current

The load current I_{load} , in amperes (A) which a cable has to carry for sustained periods during normal service shall be a basic value for cable sizing.

When the circuit(s) being supplied by the cable is in continuous or sustained cyclic operation, I_{load} shall be calculated according to the following formula:

$$I_{load} = \sqrt{\frac{1}{t_1} \int i^2 dt}$$

where

t_1 is the duration of a typical duty cycle during service, in minutes (min);

i is the instantaneous current – including overload, if any - in amperes (A).

NOTE 3 For continuous direct current operation, the above formula has the simple form $I_{load} = i$.

When operation is not continuous or sustained cyclic, I_{load} shall be calculated according to Annex A.

b) The current carrying capacity

The permissible continuous current carrying capacity I_{cable} in amperes (A) of a single-core cable or a single core within a multi core cable being operated in free air shall be another basic value for cable sizing. A particular value of I_{cable} is valid for a particular reference ambient temperature T_{ref} and for a particular maximum conductor temperature in service, $T_{c(max)}$.