SLOVENSKI STANDARD
oSIST prEN 50343:2012

01-junij-2012

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: **prEN 50343:2012**

ICS:

45.060.01	Železniška vozila na splošno	Railway rolling stock in general

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English version

Railway applications - Rolling stock - Rules for installation of cabling

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

Bahnanwendungen - Fahrzeuge - Regeln für die Installation von elektrischen Leitungen

This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
Deadline for CENELEC: 2012-09-07.

It has been drawn up by CLC/SC 9XB.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

This draft European Standard was established by CENELEC in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Foreword

This document [prEN 50343:2012] has been prepared by CLC/SC 9XB "Electromechanical material on board rolling stock".

This document is currently submitted to the Enquiry.

This document will supersede EN 50343:2003.

prEN 50343:2012 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 load 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;

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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 a copper conductor.

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.

CEN(CLC)/TS 45545 (all parts), *Railway applications – Fire protection on railway vehicles*

CEN/TS 45545-1:2009, *Railway applications – Fire protection on railway vehicles – Part 1: General*

CLC/TS 45545-5:2009, *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 50264-1, *Railway applications – Railway rolling stock power and control cables having special fire performance – Part 1: General requirements*

EN 50264-2-1, *Railway applications – Railway rolling stock power and control cables having special fire performance – Part 2-1: Cables with crosslinked elastomeric insulation – Single core cables*

EN 50264-2-2, *Railway applications – Railway rolling stock power and control cables having special fire performance – Part 2-2: Cables with crosslinked elastomeric insulation – Multicore cables*

EN 50264-3-1, R*ailway applications – Railway rolling stock power and control cables having special fire performance – Part 3-1: Cables with crosslinked elastomeric insulation with reduced dimensions – Single core cables*

EN 50264-3-2, *Railway applications – Railway rolling stock power and control cables having special fire performance – Part 3-1: Cables with crosslinked elastomeric insulation with reduced dimensions – Multicore cables*

EN 50306-1, *Railway applications – Railway rolling stock cables having special fire performance – Thin wall – Part 1: General requirements*

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

EN 50306-3, *Railway applications – Railway rolling stock cables having special fire performance – Thin wall – Part 3: Single core and multicore cables (pairs, triples and quads) screened and thin wall sheathed*

EN 50306-4, *Railway applications – Railway rolling stock cables having special fire performance – Thin wall – Part 4: Multicore and multipair cables standard wall sheathed*

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

EN 50382-1, *Railway applications – Railway rolling stock high temperature power cables having special fire performance – Part 1: General requirements*

EN 50382-2, *Railway applications – Railway rolling stock high temperature power cables having special fire performance – Part 2: Single core silicone rubber insulated cables for 120 °C or 150 °C*

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

EN 50553 [1)], *Railway applications – Requirements for running capability in case of fire on board of rolling stock*

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

EN 60684-3-212, *Flexible insulating sleeving – Part 3: Specifications for individual types of sleeving – Sheet 212: Heat-shrinkable polyolefin sleevings (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 60684-3-217 [2)], *Flexible insulating sleeving. Part 3: Specifications for individual types of sleeving – Sheet 217: Heat-shrinkable polyolefin sleeving, flame retarded shrink ratio 3:1 (IEC 60684-3-217)*

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1) To be published.

2) EN 60684-3-217 is superseded by EN 60684-3-212:2006.

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

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

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 and definitions

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

3.1
cable
assembly consisting of

- one or more cores (screened or unscreened),
- 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.]

3.2
conductor (of a cable)
part of a cable which has the specific function of carrying current

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

3.3
core
assembly comprising a conductor with its own insulation (and screens if any)

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

3.4
solid conductor
conductor consisting of a single wire

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

3.5
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.]

3.6
busbar
conductor consisting of a rigid metal profile

3.7
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.]

3.8
bundle
group of cables tied together

3.9
bolted connection
connection in which the pressure to the conductor is applied by bolting

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

3.10
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.]

3.11
spring-clamp connection
terminal connection in which the pressure between the conductor and terminal is applied by a spring

3.12
penetration (connection)
terminal connection in which the contact with the conductor is achieved by jaws which penetrate the insulation

3.13
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

3.14
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

3.15
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

3.16
manufacturer
organisation that has the responsibility for the supply of vehicle(s), equipment or groups of equipment to the purchaser

3.17
purchaser
organisation that orders the vehicle or equipment or groups of equipment and has the responsibility for direct negotiations with the manufacturer

4 Abbreviations

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

EMC Electromagnetic compatibility

CSA Cross sectional area

5 Technical requirements

5.1 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 (or busbars) 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 by thermal effects, dynamic loads as shock, vibration, car-body motions, etc. that are to be expected.

Where ambient conditions are considered, EN 50125-1 shall apply.

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

5.2 Selection of type and size of cables

5.2.1 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;

– 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 etc, as applicable.

Once the cable type has been selected, the selection of conductor size when the cable is intended for power distribution shall be based on either load current and current carrying capacity calculated in accordance with 5.2.3, or based on protection device size in accordance with 5.2.4.

Short circuit conditions should additionally be checked according to HD 60364-4-43 and 5.2.7. Recommended short circuit ratings for rolling stock cables are given in EN 50355. 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.

NOTE 1 This short circuit or overload case should be checked according to:

Normal load < nominal switching level of protection device < current carrying capacity of the cable

(I_{corr} , see definition in 5.2.3 b)).

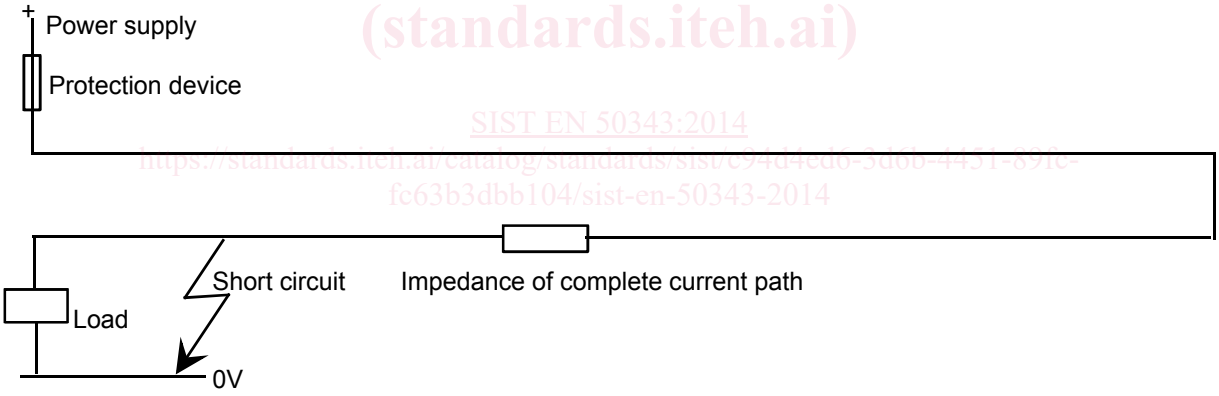

Figure 1 – Example of short circuit condition where cable size will have influence on protection device behaviour

The cross-sectional area of any conductor shall be not less than the value specified in 5.5.

Only cabling which conforms to the fire safety requirements specified in Clause 6 of CEN/TS 45545-1:2009 and CLC/TS 45545-5:2009 shall be used.

NOTE 2 The number of different types of cables installed on any one type of vehicle should be minimized for practical reasons.

5.2.2 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 5.5. 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 5.2.3.

5.2.3 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 load, up to 5 s, see 5.2.7.

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.

NOTE 3 This subclause only deals with thermal degradation of insulation material and it should be noted that mechanical stresses (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:

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

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

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 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, $T_{\text{c(max)}}$.

The values I_{cable}, T_{ref} and $T_{c(max)}$ to be used, shall be those provided by the cable manufacturer, however, some examples are presented in Annex B.

I_{cable} for maximum conductor temperatures other than $T_{c(max)}$ = 90 °C, shall be calculated according to Annex C.

The current carrying capacity of the cable in service, I_{corr}, in amperes (A) shall be calculated from I_{cable} using correction factors to take into account the expected ambient temperature, the installation type, etc., in accordance with the following formula.

$$I_{corr} = I_{cable} \times k_1 \times k_2 \times k_3 \times k_4 \times k_5$$

where

k_1 is a correction factor for the expected ambient temperature. It shall be calculated according to the following formula:

$$k_1 = \sqrt{\frac{T_{c(max)} - T}{T_{c(max)} - T_{ref}}}$$

where

$T_{c(max)}$ is the maximum conductor temperature, in degrees Celsius (°C), in service, which will allow the predicted lifetime of the cable to be achieved;

T is the estimated value of the actual ambient temperature, in degrees Celsius (°C) during operation, on the outside of the bundle or of the tube - if any. T is an average value;

T_{ref} is the reference ambient temperature, in degrees Celsius (°C), for which the I_{cable} value is valid.

Examples of k_1 values are given in Table D.1.

k_2 is a correction factor for installation type (grouping and installation conditions).

Values for k_2 given in Table 2 shall be used. Interpolation between the different numbers of cables in Table 2 is allowed.

k_3 is a correction factor to allow for a decrease in predicted cable lifetime, calculated according to the formula in Annex E. In all cases where the standard predicted cable lifetime shall be used, the value of k_3 shall be 1,0.

k_4 is a correction factor to take into account short time current when operation is not continuous, calculated according to the procedure in Annex A. When operation is continuous, the value of k_4 shall be 1,0.

k_5 is a correction factor for multi core cables only; the correction factor k_5 is applicable for each individual conductor within a multi core cable. Values for k_5 are given in Table 1. Interpolation between the different number of cores in Table 1 is allowed. When single core cables are used, the value of k_5 shall be 1,0.