IEC 62995

Edition 1.0 2018-05

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Railway applications – Rolling stock – Rules for installation of cabling

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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RAILWAY APPLICATIONS – ROLLING STOCK – RULES FOR INSTALLATION OF CABLING

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International Standard IEC 62995 has been prepared by IEC technical committee 9: Electrical equipment and systems for railways.

This standard is based on EN 50343:2014 and EN 50343 A1:2017.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
9/2378/FDIS	9/2406/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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RAILWAY APPLICATIONS – ROLLING STOCK – RULES FOR INSTALLATION OF CABLING

1 Scope

This document 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 document 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 document 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, such as fibre optic cables or hollow conductors (waveguides).

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

This document 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.

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2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60228, *Conductors of insulated cables*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

IEC 60332-3-24, *Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C*

IEC 60332-3-25, *Tests on electric and optical fibre cables under fire conditions – Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category D*

IEC 60352 (all parts), *Solderless connections*

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

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

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

IEC 60695-7-2:2011, *Fire hazard testing – Part 7-2: Toxicity of fire effluent – Summary and relevance of test methods*

IEC 60757, *Code for designation of colours*

IEC 61034-2, *Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements*

IEC 61133:2016, *Railway applications – Rolling stock – Testing of rolling stock on completion of construction and before entry into service*

IEC 61180, *High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment*

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IEC 61991, *Railway applications – Rolling stock – Protective provisions against electrical hazards*

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IEC 62236-3-1, *Railway applications – Electromagnetic compatibility – Part 3-1: Rolling stock – Train and complete vehicle*

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IEC 62236-3-2, *Railway applications – Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus*

IEC 62497-1, *Railway applications – Insulation coordination – Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment*

IEC 62498-1, *Railway applications – Environmental conditions for equipment – Part 1: Equipment on board rolling stock*

IEC 62847, *Railway applications – Rolling stock – Electrical connectors – Requirements and test methods*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
insulated 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)

3.1.2
conductor <of a cable>
part of a cable which has the specific function of carrying current

[SOURCE: IEC 60050-461:2008, 461-01-01]

3.1.3
core
assembly comprising a conductor with its own insulation (and screens if any)

[SOURCE: IEC 60050-461:2008, 461-04-04, modified – The note has been deleted.]

3.1.4
solid conductor
conductor consisting of a single wire

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[SOURCE: IEC 60050-461:2008, 461-01-06, modified – The note has been deleted.]

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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 60050-461:2008, 461-01-07, modified – The notes have been deleted.]

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 electromagnetic field within the cable and/or to protect the cable from external electromagnetic influences

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 60050-461:2008, 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

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

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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

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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

Note 1 to entry: "Short time" means that the heat exchange against the surrounding material is not significant.

3.2 Abbreviated terms

AC alternating current
CSA cross-sectional area
DC direct current
EMC electromagnetic compatibility
IP international protection (ingress protection)
RMS root mean square
UV ultraviolet

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).

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

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

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

For consideration of environmental conditions, IEC 62498-1 shall apply.

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

For correct use of connectors, IEC 62847 shall apply.

For protection against electrical hazard, the cabling installed shall be in accordance with IEC 61991.

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;
– higher harmonics by electronical converters (skin-effect);
– 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 according to relevant standards as applicable.

NOTE 1 For example EN 50264 (all parts), EN 50382 (all parts), EN 50306 (all parts) and EN 45545 (all parts).

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Consideration should be given to the fire safety requirements of cables and cabling.

Cables for power, control and associated circuits, in the event of fire, shall limit the risk to people and improve the safety on railways in general. It covers sheathed and unsheathed cables with insulation and sheath based on halogen free crosslinked materials, for use in railway rolling stock. In the event of a fire affecting cables, they have a limited flame spread and limited emission of toxic gases. In addition, these cables, when burnt, produce limited amounts of smoke, which minimises loss of visibility in the event of a fire and aids reduced evacuation times. Using crosslinked halogen free materials in accordance with IEC 63010-2:2017, 5.3, is recommended.

Cables and cabling shall conform to the fire safety requirements specified in relevant standards.

NOTE 2 For example EN 45545-2, EN 45545-3 and EN 45545-5.

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 the following requirement.

Normal load is less than nominal current rating of protection device, while nominal current rating of protection device is less than or equal to current carrying capacity of the cable (I_{corr}, see definition in 4.2.3 b)).