



SLOVENSKI STANDARD SIST-TS CLC/TS 50502:2008

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Railway applications - Rolling stock - Electric equipment in trolley buses - Safety requirements and connection systems

Bahnanwendungen - Fahrzeuge - Elektrische Ausrüstung in O-Bussen - Sicherheitsanforderungen und Verbindungssysteme
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Applications ferroviaires - Matériel roulant - Equipement électrique des trolleybus - Exigences de sécurité et systèmes de connexion
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English version

**Railway applications –
Rolling stock –
Electric equipment in trolley buses –
Safety requirements and connection systems**

Applications ferroviaires –
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This Technical Specification was approved by CENELEC on 2008-05-09.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

This Technical Specification was prepared by SC 9XB, Electromechanical material on board rolling stock, of Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to vote in accordance with the Internal Regulations, Part 2, Subclause 11.3.3.3 and was approved by CENELEC as CLC/TS 50502 on 2008-05-09.

This Technical Specification supersedes CLC/TS 50502:2007.

The following date was fixed:

- latest date by which the existence of the CLC/TS
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1 General

1.1 Scope

This Technical Specification applies to electrical systems on board trolley buses, as defined in 1.3.1, fed with a nominal line voltage (U_n) between 600 V d.c. and 750 V d.c.

This Technical Specification defines the requirements and constructional hints, especially to avoid danger of electrical kind to the public and to the personnel.

CLC/TS 50502 is normative only for vehicles ordered and designed after publication of the same.

This Technical Specification covers vehicles intended for public transport of persons.

It refers mainly to earthed networks, but reference is made also to galvanically insulated networks.

Annexes B and C are related to the connection systems. The detailed scope of these annexes is given in Annex B.

1.2 Normative references

The following referenced documents are indispensable for the application 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.

EN 45	Definition of weldability
EN 50119	Railway applications – Fixed installations – Electric traction overhead contact lines
EN 50121 series	Railway applications – Electromagnetic compatibility
EN 50122-1	Railway applications – Fixed installations Part 1: Protective provisions relating to electrical safety and earthing
EN 50124 series	Railway applications – Insulation coordination
EN 50125 series	Railway applications – Environmental conditions for equipment
EN 50153	Railway applications – Rolling stock – Protective provision relating to electrical hazards
EN 50155	Railway applications – Electronic equipment used on rolling stock
EN 50163	Railway applications – Supply voltages of traction systems
EN 50207 ¹⁾	Railway applications – Electronic power converters for rolling stock
EN 50215	Railway applications – Testing of rolling stock after completion of construction and before entry into service

¹⁾ Superseded by EN 61287-1.

EN 50264 series	Railway applications – Railway rolling stock cables having special fire performance – Standard wall
EN 50272-3	Safety requirements for secondary batteries and battery installations Part 3: Traction batteries
EN 50306 series	Railway applications – Railway rolling stock cables having special fire performance – Thin wall
EN 50343	Railway applications – Rolling stock – Rules for installation of cabling
EN 60077 series	Railway applications – Electrical equipment for rolling stock (IEC 60077 series, mod.)
EN 60322	Railway applications – Electrical equipment for rolling stock – Rules for power resistors of open construction (IEC 60322)
EN 60349-1	Electric traction – Rotating electrical machines for rail and road vehicles Part 1: Machines other than electronic convertor-fed alternating current motors (IEC 60349-1)
EN 60349-2	Railway applications – Rotating electrical machines for rail and road vehicles Part 2: Electronic converter-fed alternating current motors (IEC 60349-2, mod.)
EN 61373	Railway applications – Rolling stock equipment – Shock and vibration tests (IEC 61373)
EN ISO 9001	Quality management systems – Requirements https://standards.iteh.ai/catalog/standards/sist/ab989a2a-1e0b-46ce-9a43-66b78f78dad/sist-iso-9001-2015
ISO 10099	Pneumatic fluid power – Cylinders – Final examination and acceptance criteria

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1.3 Definitions

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

1.3.1

trolley bus

rubber tyred vehicle, connected to a direct current overhead contact line, driven by one or more electrical motors. The conductors of the overhead contact line are either both insulated or one insulated and one earthed

1.3.2

current collection system

the whole of the components, generally mounted on the vehicle roof, having the task of taking the current from the overhead lines to supply the equipment of the vehicle, both in standing and in running conditions

1.3.3

mass

conductive part of an electrical component which is accessible and which is not energized in normal conditions, but may become energized in fault conditions; the equipment defined in 2.6.1 as normal bus vehicle components are not covered in this definition. The conductive parts of the chassis and of the bodywork are defined as the vehicle mass

1.3.4**intermediate mass**

conductive part comprised between two insulating parts of a double insulated equipment (protection, enclosure, etc.), which shall be in any case not accessible to the public

1.3.5**main insulation**

insulation between the electric parts which are subject to be energized and the intermediate mass

NOTE In EN 50124-1 this insulation is named “basic insulation” and is defined as the insulation applied to live parts to provide basic protection against electric shock.

1.3.6**supplementary insulation**

insulation between the intermediate mass and the vehicle mass

1.3.7**double insulation**

insulation comprising both main (basic) insulation and supplementary insulation

1.3.8**nominal voltage U_n**

voltage value with which the system or one part of the same is nominated and which the general characteristics are referred to

1.3.9**rated voltage U_{Ne}**

voltage which, together with rated current, defines the use of the equipment and which the applicable tests and the use categories are referred to

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1.3.10**rated insulation voltage U_{Nm}**

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value the dielectric test voltages and the creepage distances are referred to. In no cases this value can be lower than U_{Ne} . When no value is defined by the purchaser for U_{Nm} , the maximum operating voltage U_{max1} , given by EN 50163 shall be assumed

1.3.11**power frequency withstand voltage U_a**

r.m.s. a.c. voltage which does not cause an insulation fault according to specified test conditions

1.3.12**highest non-permanent voltage U_{max2}**

maximum value of the voltage likely to be present for maximum 5 min

1.3.13**maximum current**

maximum current value which the current collection system is able to carry

1.3.14**maximum speed**

maximum speed the vehicle can reach, to be taken into account for the connection system to guarantee a proper operation of the same

1.3.15**static contact force**

value of force F (see Figure B.7) applied by the slipper on the contact line, as measured with standing vehicle. This value is referred to the mean height of the contact lines (see Figure B.2, dimension “d”), without displacement of the vehicle from the lines axis

1.3.16

dewirement

the accidental and permanent detachment of the trolley of one or both poles from the overhead contact line(s) with running trolley bus

1.3.17

overhead contact lines (OHL)

the fixed equipment intended to supply the power to the vehicle. The characteristics of the OHL shall be made known to the tenderer, together with the type of service, the environmental conditions and the road profile

1.3.18

trolley bus displacement from OHL

the allowed displacement of the vehicle axis from the longitudinal contact lines axis in both transversal directions as indicated in dimension “g” of Figure B.2

The minimum displacement is referred to the height “d” (see Figure B.2) and represents the allowed excess of the gauge in respect to the gauge normally allowed by the legislation

1.3.19

involved parties

- manufacturer: who actually is responsible for the design and the manufacture of the vehicle;
- supplier: who acts as selling partner in a contract;
- purchaser: who acts as purchasing partner in a contract;
- operator: the final entity which is entitled to use the vehicles for public service

1.3.20

main contactor

a remote controlled, two pole circuit breaker to connect/disconnect the entire downstream installation in normal service mode and emergency situations

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1.4 Voltages

The voltage definitions used in the Technical Specification are those of EN 50163 and EN 50124-1, where:

• U_n	nominal voltage	600 V d.c.	750 V d.c.
• U_N	rated voltage ($0,67 U_n$ to $1,2 U_n$)	402÷720 V d.c.	502,5÷900 V d.c.
• U_{Nm}	rated insulation voltage ($\geq U_{max1}$)	≥ 720 V d.c.	≥ 900 V d.c.
• U_{max2}	maximum applicable voltage	800 V d.c.	1 000 V d.c.
• U_a	power frequency withstand voltage	see Table 2	

1.5 Classification of the voltage bands

According to EN 50153, the voltage bands applicable to trolley buses are in accordance with Table 1.

Table 1 – Voltage bands for trolley buses

Band	Rated voltage	
	a.c. V	d.c. V
I	$U_N \leq 25$	≤ 60
II	$25 < U_N \leq 50$	$60 < U_N \leq 120$
III	$50 < U_N \leq 1\ 000$	$120 < U_N \leq 1\ 500$

NOTE In France and Italy different limits apply because of legal prescriptions.

2 Trolley bus construction

2.1 Protection and electrical safety criteria

2.1.1 Protection criteria against direct and indirect contacts

The best criteria and arrangements shall be adopted in the design and in the manufacture of trolley buses to avoid, or at least minimise to a non-dangerous level, all contact voltages and in particular the voltage differential between mass and earth potentials and to detect leakages before the associated voltages reach a dangerous level. As reference, the requirements of EN 50153 apply for similar features.

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Provisions of this paragraph are independent from the overhead line network configuration (earthed or galvanically insulated).

2.1.2 Steps, handrails, slopes and access platforms

Steps and handrails facing all doors shall be insulated from vehicle mass or made of insulating material. Slopes and access platforms intended to assist handicapped people, shall be insulated from the vehicle mass. Alternatively when it is not insulated from mass the operation shall be interlocked with opening the main line contactor.

2.1.3 Doors

All door shutters and relevant accessories, except for control equipment not accessible to the public, shall be insulated from the vehicle mass or made of insulating material.

2.1.4 Cabling layout

Canalisation of cables fed at voltages of band III shall be segregated from those containing cables fed at voltages of bands I and II; band III canalisation shall be easily detectable by means of suitable markings. In case of double insulation canalisation of band III cables being part of different circuits shall be segregated according to EN 50343.

2.1.5 Open door interlocking

Traction equipment shall be provided with an interlock to prevent the vehicle from starting while the doors are open. This interlock device shall include a push button or a similar padlocked device enabling the driver to exclude the feature. Directive 2001/85/EC shall be complied.

2.1.6 Leakage detector

When the feature is applicable, trolley buses shall be equipped with an automatic safety device, defined as leakage detector. The device gives an optical/acoustic alarm signal when the insulating resistance, between the circuits fed at line voltage and the vehicle mass, decreases down to unacceptable limits such as those mentioned in EN 50153 or the vehicle body potential reaches the limits given in EN 50122-1.

When the above mentioned limit value is reached, the device actuates, when the vehicle is standing, the line contactor circuit breaker to open and the contact rods to lower automatically, when this feature is possible.

The leakage detector or at least the relevant acoustic/optic alarm device, if any, shall be mounted at the driving place, in a location easily visible by the driver.

The device, when required and supplied, shall be provided with self-checking means and shall satisfy intrinsic safety criteria; an authorized third party shall verify, in this case, the characteristics.

2.1.7 Intermediate mass insulation detector

In case of a leakage detector is provided, a device suitable to detect the insulation level of the various parts energised towards the relevant intermediate masses and towards the vehicle mass shall be provided on request. This device may be combined with the leakage detector described in 2.1.6. The intermediate masses shall be electrically insulated among themselves (see Table 2); it is allowed that, exceptionally and for justified constructional reasons, some intermediate masses of functionally homogeneous equipment are connected.

2.1.8 Capacitors

The capacitors fed with voltages within band III shall be provided with discharge resistances in parallel. To achieve the best safety conditions, steps shall be taken to avoid that personnel have access unintentionally to parts with harmful voltages. In this connection reference shall be made to the requirements given by EN 50153.

2.1.9 Equipotential connections

In case of articulated trolley bus or connected coaches, these elements of the vehicle shall be electrically interconnected, in order to have vehicle masses at the same potential. These connections shall be easily found and suitably marked.

2.1.10 Electromagnetic compatibility (EMC)

The electrical and electronic equipment on board shall not cause or suffer in the vehicle and in the surrounding ambient interferences of electrical, magnetic or electromagnetic origin at such a level as to endanger the correct operation of the control, calibration, safety, radio-transmission devices etc., due to emissions conducted, induced or radiated.

Reference shall be made to EN 50121 series.

2.2 Electrical components in band III voltage (high voltage)

2.2.1 General

The electrical components fed at a voltage of band III and connected to the OHL shall be specifically made for electric traction, suitable for use in trolley bus service, with the pole terminals isolated from intermediate mass.

For the electrical and mechanical characteristics the specific standards for the specific product apply.

2.2.2 Current collection system

See Annex B.

2.2.3 Cables

Cable shall have characteristics for fire of non-propagating flame, reduced smoke, toxic and corrosive gases emissions. They shall comply with the European Standards (see EN 50343, EN 50264 and EN 50306) as applicable for these types of traction cables when applied on trolley buses.

2.2.4 Auxiliary groups

The auxiliary groups fed at the line voltage, e.g. the auxiliary motors for driving the compressor, the fans, the hydroguide pump, etc., the auxiliary generators, the static converters, and so on, shall have a double insulation in respect to the vehicle mass, independent from the overhead line network configuration (earthed or galvanically insulated).

The equipment supplied through circuits galvanically insulated from the line may be mounted without the double insulation.

Protective provisions against electrical hazard shall be in accordance with EN 50153 for insulated supply systems.

2.2.5 Climatisation devices

When space heaters or air conditioning equipment, for different uses, imply components supplied by band III voltages, the requirements given in 2.2.4 apply. Ventilation ducts, if made of conducting material, shall be connected to the vehicle mass.

2.3 Electric traction equipment

2.3.1 General

The electrical traction equipment mainly comprises the traction motor(s), the driving equipment for the operation and the braking, the resistor, if any, for starting and braking.

The control and the calibration equipment are considered part of the traction equipment on the functional point of view.

2.3.2 Traction motors

For the traction motors EN 60349 series apply.

The motors shall be arranged to have a double insulation both in respect to the fixing to the chassis and to the connection to the transmission outputs.

2.3.3 Traction and braking drive

EN 50207 applies to the electronic power equipment.

EN 60077 series applies in case of electromechanical drive.

EN 50155 applies to electronic control equipment.

The equipment shall be installed in body compartments or enclosures, suitably ventilated and accessible only to the personnel attending the trolley buses. All the live parts shall have double insulation in respect to the vehicle mass, except for those galvanically insulated from the line voltage, and shall be in any case protected from undue accidental contacts when excited.

2.3.4 Starting and braking resistors

EN 60322 applies to the electrical resistors. They shall be mounted in order to have the live parts with double insulation against the vehicle mass and with suitable barriers or arrangements for protection from undue accidental contacts when excited.

When the heat produced by the resistors is used for heating the ambient, the relevant conduits, if made of conducting material shall be electrically connected to the vehicle mass.

2.4 Emergency running equipment (independent from OHL)

2.4.1 General

Trolley buses may be equipped with an equipment for running with an auxiliary source of electrical energy, differing from the overhead contact line.

This equipment may be an electro generating thermal engine, a group of batteries or other equivalent mean suitable to supply the traction motor(s).

As far as the control and safety systems are concerned, they can remain in use as in normal running.

2.4.2 Independence of emergency equipment and insulation requirements

All electrical components for specific use for the operation in independent running shall have the same characteristics as required for equipment fed at the same voltage band.

Except for special features, any electrical connection between overhead contact line and the electrical source for independent running shall be excluded without the need of lowering the contact rods. In this case double insulation is not required, but intermediate test connection has to be defined between purchaser and supplier.

The equipment under 2.3.1 may be used for feeding the traction motor(s).