SLOVENSKI STANDARD
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Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards

Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards

Elektrisch angetriebene Straßenfahrzeuge - Besondere Festlegungen für die Sicherheit - Teil 3: Schutz der Benutzer gegen elektrische Gefahren

Véhicules routiers a propulsion électrique - Prescriptions particulieres pour la sécurité - Partie 3: Protection des usagers contre les dangers électriques

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13.260	Varstvo pred elektriļnim udarom. Delo pod napetostjo	Protection against electric shock. Live working
43.120	Elektriļna cestna vozila	Electric road vehicles

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Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards

Véhicules routiers à propulsion électrique - Prescriptions particulières pour la sécurité - Partie 3: Protection des usagers contre les dangers électriques

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This European Standard was approved by CEN on 4 December 1997.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 301 "Electrically propelled road vehicles", the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 1998, and conflicting national standards shall be withdrawn at the latest by July 1998.

This EN 1987 consists of the following parts, under the general title "Electrically propelled road vehicles - Specific requirements for safety :

- Part 1 : On board energy storage ;

- Part 2 : Functional safety and protection against failure ;

- Part 3 : Protection of users against electrical hazards.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This standard specifies the requirements for electrically propelled road vehicles in terms of electrical safety, when the electrical vehicle is not connected to the external power supply. This is applicable to electric vehicles for which the maximum working voltage of any electrical circuit is 750 V dc or 500 V ac.

2 Normative references

This European Standard incorporates, by dated or undated reference, provisions from other publications. These normative references are cited at appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to, or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 1987-1 : 1997, Electrically propelled road vehicles - Specific requirements for safety - Part 1 : on board energy storage.

EN 60 529 : 1991, Degree of protection provided by enclosures (IP codes) (IEC 529 : 1989).

ISO 3864 : 1984, Safety colours and safety signs.

IEC 417K : 1991, Graphical symbols for use on equipment. Index, survey and compilation of the single sheets - Tenth supplement.

IEC 536 : 1976, Classification of electrical and electronic equipment with regard to protection against electric shock.

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 conductive part

A conductive part is a part which is capable of conducting current although it can not necessarily be energized in normal operating conditions.

3.2 live part

A live part is any conductor or conductive part intended to be electrically energized in normal use.

3.3 exposed conductive part

In accordance to International Electrotechnical Vocabulary, an exposed conductive part is a conductive part, which can readily be touched, and which is not electrically energized in normal use, but which can become energized under fault conditions (insulation failure).

For this standard, "readily be touched" means "can be touched with a test finger IPXXB as defined in EN 60 529".

> NOTE : This concept is relative to a specific electrical circuit, a life part in one circuit can be an exposed conductive part to another, e.g. a car body can be a live part of the auxiliary network but an exposed conductive part to the power circuit.

3.4 electrical circuit

An electrical circuit is a collection of connected live parts through which an electrical current is designed to pass in normal operating conditions.

3.5 nominal voltage of an electrical system

The nominal voltage of an electrical system is the value (rms) of the voltage for which the system is designed and to which its characteristics are referred.

3.6 working voltage of an electrical circuit

The working voltage of an electrical circuit is the highest rms value of the ac voltage or the highest value of the dc voltage which can occur (locally) across any insulation, transients being disregarded, in open circuit conditions or under normal operating conditions.

3.7 auxiliary function

The auxiliary function is the one which is common between Internal Combustion (IC) engine vehicle and electric vehicles, for instance lighting.

3.8 auxiliary electrical circuit

The auxiliary electrical circuit is the electrical circuit of lower working voltage than power circuit, supplying the auxiliary functions of the vehicle (lamps, warning, windscreen motor, side marker, etc.) and its nominal voltage is usually 12 or 24 V.

3.9 power circuit

The power circuit comprises all the power equipments such as traction battery, converter (inverter, chopper, etc.), traction motor and cables and connectors, used for the propulsion of the electric vehicle and other equipments (dc/dc converter, step-up, etc.) galvanically connected with these power equipments.

3.10 electrical chassis

An electrical chassis is a set made of conductive parts electrically linked together, and all other conductive parts electrically linked to them, whose potential is taken as reference.

3.11 direct contact

Direct contact is contact of persons or live stock with live parts.

3.12 indirect contact

Indirect contact is contact of persons or live stock with exposed conductive parts made live by an insulation failure.

3.13 basic insulation

Basic insulation is insulation of live parts necessary to provide basic protection against electric shock.

NOTE : Basic insulation does not necessarily include insulation used exclusively for functional purposes.

3.14 supplementary insulation

Supplementary insulation is independent insulation applied in addition to basic insulation in order to provide protection against electric shock in the event of a failure of basic insulation.

3.15 double insulation

Double insulation is insulation comprising both basic insulation and supplementary insulation.

3.16 reinforced insulation

Reinforced insulation is a single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation.

NOTE : The term "insulation system" does not imply that the insulation shall be one homogeneous piece. It can comprise several layers which cannot be tested singly as supplementary or basic insulation.

3.17 protection degree

In accordance with EN 60529:1991 a protection degree is "the extent of protection provided by an enclosure against ingress of solid foreign objects and/or against ingress of water, and verified by standardized test methods".

NOTE : This definition leads to define IPXXB, IPXXC and IPXXD protection degrees, which relate to the contact of a test jointed finger (IPXXB), test rod (IPXXC) or a test wire (IPXXD) with live parts.

3.18 class I equipment

Class I equipment denotes an appliance in which protection against electric shock is ensured by using basic insulation over live parts and connecting together the exposed conductive parts of this equipment by a protective conductor.

3.19 class II equipment

Class II equipment denotes an appliance in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions, such as double insulation or reinforced insulation are provided.

3.20 opening parts

The opening parts are the following parts of an electric vehicle: doors, bonnet, boot, hatch back, access flaps (for access to the charging socket flaps or the fuel filler tank), sunroof, hardtop (if any).

3.21 temperature rise

In accordance with International Electrotechnical Vocabulary, temperature rise is the "difference between the temperature of the part under consideration and the temperature of the cooling air or of the water, at the intake of the cooling equipment".

3.22 ground clearance between the axles

The ground clearance between the axles is the shortest distance between the ground plane and the lowest fixed point of the vehicle, as shown in figure 1.

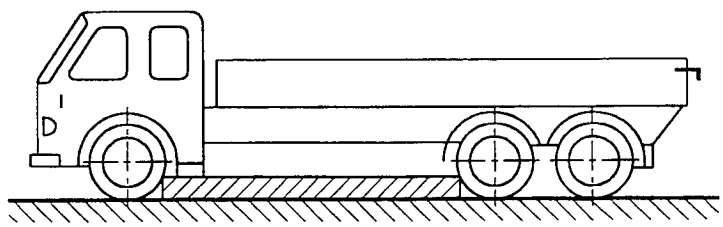

Figure 1 : Ground clearance between the axles

4 Voltage classes of an electrical circuit

Depending on its working voltage *U*, an electrical circuit belongs to one of the voltage classes from table 1.

Table 1

Voltage classes	dc Systems V	ac Systems (15 Hz to 100 Hz) rms V
A	$0 < U \leq 60$	$0 < U \leq 25$
B	$60 < U \leq 750$	$25 < U \leq 500$

NOTE 1 : The limit values of the voltage classes take into account the humid weather conditions.

NOTE 2 : For non ac but repetitive pulse voltages, if the peak duration is above 10 ms, the considered working voltage is then the maximum value of the peak. If the peak duration is less than 10 ms, the working voltage is then the real rms value of the signal.

NOTE 3 : The reported ac voltage values are the most critical within the specified frequency range.

5 Protection against direct contacts

People shall be protected against any hazards resulting from the contact with live parts of any electrical circuit. Depending on the voltage class of the electrical circuit as in table 1, following means of protection shall be provided for.

5.1 Class A

No specific protection against direct contact is required.

5.2 Class B

Protection against direct contact shall be ensured as follows:

a) Either by insulation : the live parts of the electrical system shall be completely, by assembly of the vehicle, encapsulated by insulation (basic, supplementary or reinforced) which can only be removed by destroying it.

The insulating material shall be suitable to the nominal voltage and to the working voltage of the electrical system. Insulating varnish, dope, enamel and other similar products are not acceptable as basic insulation ;

b) Or by barriers or enclosures: the live parts shall be placed inside enclosures or behind barriers in order to ensure at least the IPXXD protection degree. If the ground clearance of the vehicle between the axles is less than 30 cm , the IPXXB protection is sufficient for equipment fitted underneath the vehicle. The enclosure shall be able to tolerate mechanical, electrical and thermal stresses that may occur.

Enclosure can be of three types :

- Type S0 : cover, removal of which does not directly open the electrical circuits to which the live parts they contain belong.

- Type S1 : enclosure openable in such a way that by its opening the circuit of which the live parts it contains form part is opened, e.g. connectors, fuses, etc.

- Type S2 : enclosure, removal or opening of which switches off the electrical power supply to the concerned live parts.

Table 2 specifies the requirements and opening methods of the enclosure types to be met for class B equipment.

Table 2

Types	Method of opening	In passenger and load compartment	Elsewhere
S0	With tools or maintenance keys	If the level of protection is IPXXB or less when the cover is removed, the enclosure shall be marked according to IEC 417K:1991 and ISO 3864:1984.	
	Without tools or maintenance keys	Not allowed.	
S1	With tools or maintenance keys	Separable enclosure shall maintain IPXXB protection criteria in the open condition.	
	Without tools or maintenance keys	Not allowed.	Separable enclosure shall maintain IPXXB protection criteria in the open condition.
S2	With tools or maintenance keys	Switching on again shall only be possible after replacing the enclosure or the barrier.	
	Without tools or maintenance keys	Not allowed.	Switching on again shall only be possible after replacing the enclosure or the barrier.

If an enclosure does not comply with the requirements of table 2, this enclosure shall be protected by a supplementary enclosure which satisfies them.

6 Protection against indirect contacts

People shall be protected against any hazards resulting from contacts with exposed conductive parts in case of failures of the vehicle's electrical circuits.

The verification concerning the protection against indirect contacts shall be performed by the vehicle manufacturer on each part of the equipment involved.

Depending on the voltage class of the electrical circuit as in table 1, following means of protection shall be provided for.