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Vodilo za uporabo nizkonapetostnih harmoniziranih kablov

Guide to use of low voltage harmonized cables

Leitfaden für die Verwendung harmonisierter Niederspannungsstarkstromleitungen

Guide d'emploi des câbles harmonisés à basse tension

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HARMONIZATION DOCUMENT

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Guide to use of low voltage harmonized cables

Guide d'emploi des câbles harmonisés à basse tension

Leitfaden für die Verwendung harmonisierter Niederspannungsstarkstromleitungen

This Harmonization Document was approved by CENELEC on 1997-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this Harmonization Document on a national level.

Up-to-date lists and bibliographical references concerning such national implementation may be obtained on application to the Central Secretariat or to any CENELEC member.

This Harmonization Document exists in three official versions (English, French, German).

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CENELEC

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

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Foreword

This Harmonization Document was prepared by Technical Committee CENELEC TC 20, Electric cables.

HD 516 was originally published by CENELEC in April 1990.

This second edition incorporates all published amendments, plus new matter agreed by TC 20 at its meetings in Lisbon (November 1991) and Oslo (June 1992). In addition, the specific guidance originally given in Appendices 1 to HD 21.1 and HD 22.1 has been transferred to this HD, together with information relating to all newly published Parts of HD 21 and HD 22 up to September 1995.

The text of the draft was submitted to the CENELEC Unique Acceptance Procedure and approved by CENELEC as HD 516 S2 on 1997-07-01.

The following dates were fixed:

-	latest date by which the existence of the HD has to be announced at national level	(doa)	1997-12-01
-	latest date by which the HD has to be implemented at national level by publication of a harmonized national standard or by endorsement	(dop)	1998-06-01
-	latest date by which the national standards conflicting with the HD have to be withdrawn	(dow)	1998-06-01

For products which have complied with HD 516 S1:1990 and its amendments A1:1991, A2:1992, A3:1993, A4:1992, A5:1993 and A6:1993 before 1998-06-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-06-01.

Contents

Introduction

The aim in publishing this Harmonisation Document is to inform users of the properties and limiting conditions of electric cables, and thereby to avoid misuse of the cables.

The document gives guidance to equipment manufacturers, installers and end-users on the properties of harmonised low voltage electric cables, and the limitations considered necessary in order to safeguard life, buildings and goods.

The information is given as limiting values and illustrated by examples, which cannot be exhaustive but nevertheless indicate ways by which safety can be obtained. In specific cases where guidance is not given, nor is deducible from the general information given, it is recommended that the specific advice of TC 20 be sought.

1 Scope

This HD provides a guide to the proposed safe use of harmonised electric cables as presently covered in the various parts of:

HD 21 - Polyvinyl chloride insulated cables of rated voltage up to and including 450/750 V.

HD 22 - Rubber insulated cables of rated voltage up to and including 450/750 V.

These cables should only be used within the limits given and in the manner described in this HD. This HD should be read in conjunction with other HDs or ENs relating to particular types of equipment or installation conditions.

Legal or statutory requirements do take precedence over the guidance given in this document.

2 Normative references

HD 516 incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the 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 HD 516 only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

HD 21	Polyvinyl chloride insulated cables of rated voltage up to and including 450/750 V
HD 22	Rubber insulated cables of rated voltage up to and including 450/750 V
HD 384.2	International electrotechnical vocabulary Chapter 826: Electrical installation of buildings
HD 384.3	Electrical installations of buildings - Part 3: Assessment of general characteristics
HD 384.4.43	Part 4: Protection for safety - Chapter 43: Protection against overcurrent
HD 384.5.523	Part 5: Selection and erection of electrical equipment Chapter 52: Wiring systems Section 523: Current-carrying capacities
HD 405.1	Tests on electric cables under fire conditions Part 1: Test on a single vertical insulated wire or cable

IEC 287 Electric cables - Calculation of the current rating (100 % load factor)

R064.001 CENELEC report on current carrying capacities in conductors and cables

3 Definitions

The meaning and sense of the terms used in this HD are as defined in HD 384.2, relevant product specifications, or Annex A of this HD unless otherwise stated.

4 Requirements for Safety

4.1 Fundamental requirements

4.1.1 Safety of a cable means that the product does not present an unacceptable risk of danger to life or property whilst being used in its intended manner.

The intended usage of the cables is given in Tables 1A, 1B, 2A and 2B.

4.1.2 Unless otherwise stated, cables should not be used for any other purpose than the transmission and distribution of electricity.

4.1.3 The test methods, test parameters and requirements described in HD 21 and HD 22 are only for the purposes of checking design with respect to safety and quality assurance. They should not be regarded as providing guidance that the cables are suitable for service under conditions equivalent to the test conditions.

4.2 General requirements

4.2.1 All conductors and cables should be selected so as to be suitable for the voltages and currents likely to occur under all conditions which are or should have been anticipated in the equipment or installation or that part thereof in which they are used.

4.2.2 Cables should be so constructed, installed, protected, used and maintained to prevent danger so far as it is reasonably practical.

4.2.3 The limiting conditions under which the cables can reasonably be expected to operate safely under normal circumstances are given in Tables 3A, 3B, 4A and 4B to this HD.

These conditions are those considered capable of ensuring a length of life in service which has been accepted as reasonable by experience of the particular type of cable and in particular conditions of use. The duration of acceptable performance of a particular type of cable depends upon the type of use, installation or electrical apparatus and on the particular combination of influences relating thereto. For example, the duration of acceptable performance considered as reasonable for a cable used in a fixed installation, for the distribution of electricity in a building, is more than that for a flexible cord.

4.2.4 Cables should be selected so that they are suitable for the operating conditions and equipment classification.

Examples of operating conditions are:

- voltage
- overcurrent
- protective measures
- grouping of cables
- method of installation
- accessibility

4.2.5 Cables should be selected so that they are suitable for any external influences which may exist.

Examples of external influences are:

- ambient temperature.
- presence of rain, steam or accumulation of water.
- presence of corrosive, chemical or polluting substances.
- mechanical stresses (such as through holes or sharp edges in metal work)
- fauna (such as rodents)
- flora (such as mould)
- radiation (such as sunlight)
- Note: in this respect it should be noted that colour is important, black giving a higher degree of protection.

4.3 Requirements for fixed cables

NOTE: Conductors: Cables for fixed wiring normally have conductors which are solid or stranded. These are covered by Class 1 and Class 2 respectively to HD 383, and designated "-U" and "-R" respectively under HD 361.

Under certain circumstances, for ease of installation, the conductor may be Class 5 to HD 383, in which case the designatory suffix under HD 361 is given by "-K".

The use of a Class 5 conductor designated "-K" does not indicate that the cable is suitable for repeated flexing.

4.3.1 Cables should not be installed in contact with or close to hot surfaces unless the cables are intended for such conditions.

4.3.2 Cables should not be buried directly in the ground.

4.3.3 Cables should be supported adequately. Recommended maximum spacing of supports is given in Table 5 of this HD.

In deciding the actual spacing, the weight of the cable between the supports should be taken into account so that the limiting value of mechanical tension (see also sub-clause 5.4.1) is not exceeded.

The cable should not be damaged by any mechanical restraint used for its support.

4.3.4 Cables which have been in use may be damaged if they are disturbed. This can arise from the effect of natural ageing on the physical properties of the materials used for cable insulation and sheathing, which ultimately results in hardening of these materials.

4.4 Requirements for flexible cables or cords

Note: Conductors: Flexible cables and cords normally have conductors which are built up from a multiplicity of small wires, bunched or stranded together. These are covered by Class 5 and Class 6 respectively to HD 383, and are designated "-F" or "-H" respectively under HD 361. (Arc welding cables in accordance with HD 22.6 have flexible and extra-flexible conductors of special construction, and are designated "-D" or "-E" respectively under HD 361).

In order to demonstrate that a cable with a Class 5 or Class 6 conductor, designated "-F" or "-H" , is suitable for applications involving repeated flexing additional requirements based on special tests may be called for in the particular cable specification.

4.4.1 Flexible cables or cords should be used for connections to all mobile equipment.

The length of such cables should not be so great as to prevent the short circuit protective device from operating correctly. (See also sub-clause 5.2.)

Such cables should also be of a minimum practical length to reduce the risk of mechanical damage.

Where PVC flexible cables and cords are acceptable, consideration should be given to the use of extensible leads as a means of limiting the length of the connection.

Multicore control cables, if installed so that they are continually flexed, shall be protected in a manner which prevents abrasion, cutting and sharp bends.

4.4.2 Flexible cables or cords (except for those heavy duty types used as fixed installations in temporary buildings) should not be used as fixed wiring unless contained in an enclosure affording mechanical protection, except when used as the final connection to fixed equipment. In which case they should be of, at least, the 'ordinary' type (see Annex B for definitions of duty.)

Exposed lengths of flexible cable or flexible cord used as final connections to fixed equipment should be as short as practically possible and should be directly connected to the fixed wiring in an appropriate manner.

4.4.3 Flexible cables or cords should not be subjected to excessive tension, (see sub-clause 5.4.1) crushing, abrasion, torsion and kinking, particularly at the inlet of the appliance and at the point of connection to the fixed wiring. They should not be damaged by any strain relief or clamping device.

4.4.4 Flexible cables or cords should not be placed under carpets or other floor coverings, where there is

a) any risk of thermal insulating effects, leading to excessive temperature rise (see sub-clause 5.3.1 a));

b) any risk of damage due to furniture or equipment resting on them or traffic passing over them.

4.4.5 Flexible cables or cords should be prevented from being in contact with or close to hot surfaces, unless the cables are intended for such conditions.

Because of their nature, particular attention should be paid to PVC insulated and/or sheathed cables or cords.

4.4.6 When flexible cables are required for use outdoors, whether of temporary or permanent usage, reference should be made to Table 2A and 2B of this HD to determine their suitability for such usage.

PVC flexible cables or cords are unsuitable for permanent use outdoors. Neither should those that have a temporary designation be used in that manner outdoors in adverse conditions eg. at temperatures below those given in Table 4A, column 11.

4.4.7 Non sheathed cords should not be used for any extension cord or for the replacement of any sheathed types.

They should not be used for any Class 2 appliance unless the usage is defined as extra light duty and is specifically permitted in the equipment specification.

4.4.8 The flexible cables covered by this HD are not suitable for use in deep mining operations, in quarrying, nor on moveable equipment such as cranes with spring-loaded reeling devices.

4.4.9 PVC flexible cables and cords in Table 2A may not necessarily be suitable for the manufacture of extensible leads.

4.4.10 Unless otherwise indicated in the particular specification the flexible cables covered by this HD are not designed for direct burial in the ground.

5 Limiting Conditions

The influence of all factors as outlined in this section should be considered in combination, not separately.

5.1 Voltage

The rated voltage of a cable is the reference voltage for which the cable is designed and which serves to define the electrical tests.

The rated voltage is expressed by the combination of two values U_o/U, expressed in volts:

U_o being the r.m.s. value between any insulated conductor and 'earth' (metal covering of the cable or the surrounding medium);

U being the r.m.s. value between any two phase conductors of a multicore cable or of a system of single core cables.

In an alternating current system, the rated voltage of a cable shall be at least equal to the nominal voltage of the system for which it is intended. This condition applies both to the value U_o and to the value U.

In a direct current system, the nominal voltage of the system shall be not higher than 1,5 times the rated voltage of the cable.

Note: The operating voltage of a system may permanently exceed the nominal voltage of such a system by 10%.

5.2 Current carrying capacity

5.2.1 The cross sectional area of every conductor size should be such that its current carrying capacity is not less than the maximum sustained current which will normally flow through it.

For the purposes of this HD, the limiting temperature to which the current carrying capacity is related should not exceed that appropriate to the type of cable insulation or sheath concerned.

5.2.2 The current carrying capacities of cables for fixed wiring, to meet the requirements of HD 384.5.523, are given in CENELEC Report R64.001.

Those for PVC and rubber insulated cords are given in Tables 7(a) and 7(b) respectively. Those for heavy duty H07RN-F cables, used as power supply to industrial plant, are given in Table 7(c). Those for arc welding cables are given in Tables 8, 9 and 10. Associated voltage drop figures for arc welding cables are given in Table 11.

The values given have been determined such that the limiting temperatures given in column 8, Tables 3A, 3B, 4A and 4B, of this HD are not exceeded under particular defined conditions where the cables are continuously loaded (100% load factor) with current having an alternating frequency of 50 Hz.

5.2.3 In the case of soft soldered joints or terminations the limiting temperature for the conductor under short circuit conditions is reduced to 160°C. Account of this limitation should be taken in selecting and operating cables.

5.2.4 Tinned copper conductors should not be used at temperatures above 200°C because of the risk of mutual adhesion.

5.2.5 Defined conditions include the method of installation of the cable used. Account should be taken of these conditions in determining the current carrying capacity of a cable.

Correction factors for quoted current carrying capacities may be available for particular conditions such as:

- ambient temperature (see R64.001).
- cable grouping (see R64.001)
- type of overcurrent protection (see HD 384.4.43 for rules)
- presence of thermal insulation (see R64.001)
- reeled/drummed cables
- frequency of supply (if different from 50 Hz etc)
- effect of harmonics

5.2.6 If cables are operated for any prolonged periods at temperatures above those given in Tables 3A, 3B, 4A and 4B then they may be seriously damaged, leading to premature failure, or their properties significantly reduced.

5.2.7 The selection of the cross sectional area of any conductor should not be based on current carrying capacity alone, account should be taken of the influence of the requirements for protection against:
- electric shock
- thermal effects
- overload and short circuit current
- voltage drop
- mechanical strength

Examples of particular influence of which account should be taken are:

- limiting temperatures for terminals of equipment, busbars or bare conductors.
- limiting short circuit temperature
- the carrying of current by the neutral conductor as, for example, resulting from the presence of significant harmonic current in a three phase circuit.
- electromagnetic effects.
- inhibition of heat dissipation.
- requirements determining the size of the circuit protective conductor.
- solar or infra red radiation.

5.3 Thermal effects

5.3.1 The limiting temperatures of the individual types of cables are given in Tables 3A, 3B, 4A and 4B of this HD. The values given should not be exceeded by any combination of the heating effect of current in the conductors and the ambient conditions.

a) Cables in free air should be so installed that the natural air convection is not impeded. When cables are covered or embedded in building thermal insulation, or when the heat dissipation is impeded by other means, the corresponding reduction of the current carrying capacity must be observed.

b) The temperature of cable sheaths can be significantly higher than the ambient temperature when the cables are subjected to radiation e.g. solar or infra red. Where these situations cannot be avoided their effect should be taken into account in assessing the current carrying capacity or the temperature of the cable relative to the limiting temperature and its service life.

c) Account should be taken of the temperatures occurring within equipment, appliances, luminaires and at their terminals, when selecting the types of cables to be used in them and connected thereto.

d) Exposure of PVC insulated cables to temperatures greater than those given in Tables 3A and 4A, Column 8, even for short periods, may cause the insulation to soften. Account should be taken of this effect particularly when mechanical stress is also an influence.

e) The minimum limiting temperatures given in Column 11 of Tables 3A, 3B, 4A and 4B of this HD are minimum ambient temperatures. All insulation and sheath materials used for cables become progressively stiffer as their temperature is lowered below the normal ambient temperature to the point where they become brittle. This behaviour has been taken into account in establishing the values. (See also 7.3.1).

5.3.2 Cables should be selected, located and installed so that their intended heat dissipation is not inhibited and they do not present a fire hazard to adjacent materials.

a) In the case of fire initiated elsewhere, cables can provide a source of fuel and a means of propagating a fire along its length.

In these circumstances the insulation and sheath materials of cables in burning can give rise to smoke, and toxic and corrosive fumes. Account should be taken of these facts when selecting and installing cables.

In cases where it is considered that these facts constitute a hazard, and particularly where it is necessary to ensure safe evacuation of the premises, for example in public buildings, offices, hotels, hospitals etc., cables having defined low emission of smoke and corrosive gases should be installed. Alternatively, cables should be installed and segregated in such a way that any emissions from the cables during a fire do not impede evacuation of the premises.

Guidance should be sought from the cable manufacturers in selecting cables required to maintain the integrity of electrical circuits when this is necessary to the safety of life and property in the case of fire.

b) Where a particular hazard exists or is likely to exist in the presence of explosive or flammable atmospheres, specific regulations apply. The requirements of these regulations shall be taken into account in selecting the type, current carrying capacity and constructional features of the cable involved to assure safety as influenced by the cable.

5.3.3 Where the limiting temperature given in Column 10 of Tables 3A, 3B, 4A and 4B is such that the temperature of the surface of the cable is liable to exceed 50°C, the cable should be so located or guarded as to prevent contact of persons or animals therewith. Cable surface temperatures above this can cause involuntary reaction in the event of contact with exposed skin. Account should be taken of these possibilities in the selection and use of cables.

5.3.4 Account should be taken of the effect of heat generated by the passage of current through the conductor on the material of which it is made and on the material used in making joints or terminations.

5.4 Mechanical stress

In assessing risks of mechanical damage to cables, account should be taken of any mechanical strains likely to be imposed during the normal process of erection of cables.

5.4.1 Tension

The tension applied to a cable should not exceed the values of tensile stress per conductor given below. This is subject to a total maximum tensile force of 1 000N unless otherwise agreed by the cable manufacturer.

50 N/mm² for non flexible cables during installation.

15 N/mm² for flexible cables, under static tensile stress and for non flexible cables in service in fixed circuits.

In circumstances where a stress exceeding the above values would result, a separate stress bearing member or device should be used. The method of attaching such a member or device to the cable should be such that the cable is not damaged.

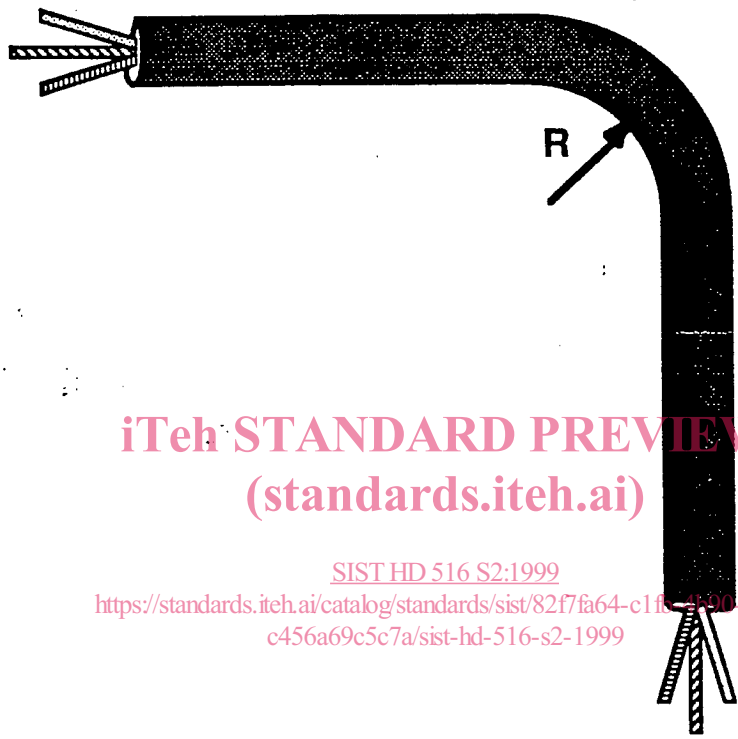
In circumstances where flexible cables are under dynamic stress (including those due to inertia e.g. reeling drums) the permissible tensions or fatigue life should be agreed between the design engineer and the cable manufacturer.

Cables which are installed vertically, without intermediate support, which are inaccessible and unlikely to be moved or disturbed, should be supported at the top of the run such that the internal radius of the resultant bend is not less than the appropriate minimum bending radius for normal use according to Table 6(a), or for fixed installation according to Tables 6(b) and 6(c). The unsupported vertical length of such runs should not exceed 5 metres.

5.4.2 **Bending**

The internal radius of every bend in a cable should be such as not to cause damage to the cable.

The definition of the internal bending radius is as given in Figure 1.



R = Internal bending radius

Figure 1: Definition of internal bending radius

The internal bending radii for different types of cable are given in Tables 6(a), (b) and (c) of this HD. Any decision to use lower values than those specified must be taken in consultation with the manufacturer of the cable.

Care must be taken when stripping the insulation to ensure that no damage occurs to the conductor since this will severely affect the bending radii.

The bending radii specified are for ambient temperatures of (20 ± 10)°C. For temperatures outside these limits, the cable manufacturer's recommendation should be obtained.