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Električne inštalacije zgradb – 5. del: Izbira in namestitev električne opreme – 523. oddelek: Trajno dovoljeni toki v inštalacijskih sistemih (IEC 60364-5-523:1999, spremenjen)

Electrical installations of buildings -- Part 5: Selection and erection of electrical equipment -- Section 523: Current-carrying capacities in wiring systems

Elektrische Anlagen von Gebäuden -- Teil 5: Auswahl und Errichtung von elektrischen Betriebsmitteln -- Hauptabschnitt 523: Strombelastbarkeit in Kabel- und Leitungssystemen (-anlagen)

Installations électriques des bâtiments -- Partie 5: Choix et mise en oeuvre des matériels électriques -- Section 523: Courants admissibles dans les canalisations

Ta slovenski standard je istoveten z: **HD 384.5.523 S2:2001**

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91.140.50 Sistemi za oskrbo z elektriko Electricity supply systems

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HARMONIZATION DOCUMENT **HD 384.5.523 S2**

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English version

Electrical installations of buildings
Part 5: Selection and erection of electrical equipment
Section 523: Current-carrying capacities in wiring systems
(IEC 60364-5-523:1999, modified)

Installations électriques des bâtiments
Partie 5: Choix et mise en oeuvre des matériels électriques
Section 523: Courants admissibles dans les canalisations
(CEI 60364-5-523:1999, modifiée)

Elektrische Anlagen von Gebäuden
Teil 5: Auswahl und Errichtung von elektrischen Betriebsmitteln
Hauptabschnitt 523: Strombelastbarkeit in Kabel- und Leitungssystemen (-anlagen)
(IEC 60364-5-523:1999, modifiziert)

This Harmonization Document was approved by CENELEC on 2001-09-01. 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).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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

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Foreword

The text of the International Standard IEC 60364-5-523:1999, prepared by IEC TC 64, Electrical installations and protection against electric shock, together with the common modifications prepared by SC 64B, Protection against thermal effects, of Technical Committee CENELEC TC 64, Electrical installations of buildings, was submitted to the formal vote and was approved by CENELEC as HD 384.5.523 on 2001-09-01.

This Harmonization Document supersedes HD 384.5.523 S1:1991.

The following dates were fixed:

-	latest date by which the existence of the HD has to be announced at national level	(doa)	2002-03-01
-	latest date by which the HD has to be implemented at national level by publication of a harmonized national standard or by endorsment	(dop)	2002-09-01
-	latest date by which the national standards conflicting with the HD have to be withdrawn	(dow)	2004-09-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annex ZB is informative.
Annexes ZA and ZB have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60364-5-523:1999 was approved by CENELEC as a Harmonization Document with agreed common modifications as given below.

COMMON MODIFICATIONS

Introductory note

Some subclauses of HD 384.5.523 may involve the application of values in Tables 52-B, 52-C, 52-D and 52-E proposed in annex ZB. Those references to Tables 52-B, 52-C, 52-D and 52-E in the normative part of the text shall be regarded as informative.

523.8 Method of installation

Transfer the text of clause 523.8, together with Tables 52-B1 to 52-E5 inclusive, into an informative annex with unchanged clause numbering and the following title:

Annex ZB
(informative)

Methods of installation and current-carrying capacities

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This Harmonization Document 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 this Harmonization Document only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies

Publication	Year	Title	EN/HD	Year
IEC 60228 (mod)	1978	Conductors of insulated cables – First supplement: Guide to the dimensional limits of circular conductors	HD 383 S2[1)]	1996
IEC 60287	series	Electric cables – Calculation of the current rating	-	
IEC 60364-4-41 (mod)	1992	Electrical installations of buildings Part 4 : Protection for safety Chapter 41 : Protection against electric shock	HD 384.4.41 S2	1996
IEC 60364-4-42 (mod)	1980	Chapter 42 : Protection against thermal effects	HD 384.4.42 S1	1985
IEC 60364-4-43 (mod)	1977	Chapter 43 : Protection against overcurrent	HD 384.4.43.S1	1980
IEC 60364-5-52 (mod)	1993	Part 5 : Selection and erection of electrical equipment Chapter 52 : Wiring systems	HD 384.5.52 S1	1995

[1)] HD 383 S2 includes IEC 60228A:1982, mod.

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Installations électriques des bâtiments –

Partie 5:
Choix et mise en œuvre des matériels électriques –
Section 523: Courants admissibles dans les canalisations

Electrical installations of buildings –

Part 5:
Selection and erection of electrical equipment –
Section 523: Current-carrying capacities in wiring systems

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 5: Selection and erection of electrical equipment –

Section 523: Current-carrying capacities in wiring systems

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60364-5-523 has been prepared by IEC technical committee 64: Electrical installations of buildings.

This second edition cancels and replaces the first edition published in 1983, and constitutes a technical revision.

The text of this standard is based on the following documents:

FDIS	Report on voting
64/1039/FDIS	64/1056/RVD

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

Annexes A, B and C are for information only.

ELECTRICAL INSTALLATIONS OF BUILDINGS –

Part 5: Selection and erection of electrical equipment –

Section 523: Current-carrying capacities in wiring systems

523.1 General

523.1.1 Scope

The requirements of this International Standard are intended to provide for a satisfactory life of conductors and insulation subjected to the thermal effects of carrying current for prolonged periods of time in normal service. Other considerations affect the choice of cross-sectional area of conductors, such as the requirements for protection against electric shock (see chapter 41), protection against thermal effects (see chapter 42), overcurrent protection (see chapter 43), voltage drop (see section 525 of IEC 60364-5-52), and limiting temperatures for terminals of equipment to which the conductors are connected (see section 526 of IEC 60364-5-52).

For the time being, this standard relates only to non-armoured cables and insulated conductors having a nominal voltage not exceeding 1 kV a.c. or 1,5 kV d.c. This standard does not apply to armoured single-core cables.

NOTE – If armoured single-core cables are used, an appreciable reduction of the current-carrying capacities given in this standard may be required. The cable manufacturer should be consulted. This is also applicable to non-armoured single-core cables in single way metallic ducts (see 521.5).

523.1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this section of IEC 60364-5. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this section of IEC 60364-5 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60228:1978, *Conductors of insulated cables*

IEC 60287 (all parts), *Electric cables – Calculation of the current rating*

IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock*

IEC 60364-4-42:1980, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 42: Protection against thermal effects*

IEC 60364-4-43:1977, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 43: Protection against overcurrent*

IEC 60364-5-52:1993, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 52: Wiring systems*

523.1.3 The current to be carried by any conductor for sustained periods during normal operation shall be such that the appropriate temperature limit specified in table 52-A is not exceeded. The value of current shall be selected in accordance with 523.1.4, or be determined in accordance with 523.1.5.

Table 52-A – Maximum operating temperatures for types of insulation

Type of insulation	Temperature limit (see note 1) °C
Polyvinyl-chloride (PVC)	70 conductor
Cross-linked polyethylene (XLPE) and ethylene propylene rubber (EPR)	90 conductor
Mineral (PVC covered or bare exposed to touch)	70 sheath
Mineral (bare not exposed to touch and not in contact with combustible material)	105 sheath (see note 2)
NOTE 1 – The maximum permissible conductor temperatures given in table 52-A on which the values in table 52-C1 to 52-C4 and 52-C9 to 52-C12 are based, have been taken from IEC 60502: 1983 and IEC 60702: 1981 and are shown on these tables.	
NOTE 2 – When a conductor operates at a temperature exceeding 70 °C, it shall be ascertained that the equipment connected to the conductor is suitable for the resulting temperature at the connection.	
NOTE 3 – For certain types of cable, higher operating temperatures may be permissible dependent upon the temperature rating of the cable, its terminations, the environmental conditions and other external influences.	

523.1.4 The requirement of 523.1.3 is considered to be satisfied if the current for insulated conductors and cables without armour does not exceed the appropriate values selected from tables 52-B1, 52-B2 and 52-C1 to 52-C12, subject to any correction factors from tables 52-D1 to 52-D3 and 52-E1 to 52-E5.

NOTE 1 – It is recognized that it may be desirable to adapt the tables of this section to a simplified form for national rules. An example of one acceptable method of simplification is given in annex A.

NOTE 2 – Preparation of simplified tables are under consideration, which are intended to be suitable for day-to-day use in smaller installations, and to be suitable for selection of cable sizes in relation to circuit design current and type and nominal current of the overcurrent protective device.

NOTE 3 – The values in the tables in this section apply to cables without armour and have been derived in accordance with the methods given in IEC 60287, using such dimensions as specified in IEC 60502 for cables of voltages up to 1 kV and conductor resistances given in IEC 60228. Known practical variations in cable construction (e.g. form of conductor) and manufacturing tolerances result in a spread of possible dimensions (and hence current-carrying capacities for each conductor size). Tabulated current-carrying capacities have been selected so as to take account of this spread of values with safety and to lie on a smooth curve when plotted against conductor cross-sectional area.

NOTE 4 – For multi-core cables having conductors with a cross-sectional area of 25 mm^2 or larger, tabulated values applicable to either circular or shaped conductors are permissible. These values have been derived from dimensions appropriate to shaped conductors.

523.1.5 The appropriate value of current-carrying capacities may also be determined as described in IEC 60287, or by test, or by calculation using a recognized method provided that the method is stated. Where appropriate, account shall be taken of the characteristics of the load and, for buried cables, the effective thermal resistance of the soil.

523.2 Ambient temperature

523.2.1 The ambient temperature is the temperature of the surrounding medium when the cable(s) or insulated conductor(s) under consideration are not loaded.

523.2.2 Where the value of current-carrying capacity is to be selected in accordance with the tables of this section, the reference ambient temperatures to be assumed are as follows:

- for insulated conductors and cables in air, irrespective of the method of installation: 30 °C;
- for buried cables, either directly in the soil or in ducts in the ground: 20 °C.

523.2.3 Where the tables of this standard are used, and the ambient temperature in the intended location of the insulated conductors or cables differs from the reference ambient temperature, the appropriate correction factor specified in tables 52-D1 and 52-D2 shall be applied to the values of current-carrying capacity set out in tables 52-C1 to 52-C12; however, for buried cables, correction is not needed if the soil temperature exceeds 25 °C for only a few weeks a year.

NOTE – For cables and insulated conductors in air, where the ambient temperature occasionally exceeds the reference ambient temperature, the possible use of the tabulated current-carrying capacities without correction is under consideration.

523.2.4 The correction factors in tables 52-D1 and 52-D2 do not take account of the increase, if any, due to solar or other infra-red radiation. Where the cables or insulated conductors are subject to such radiation, the current-carrying capacity shall be derived by the methods specified in IEC 60287.

523.3 Soil thermal resistivity

523.3.1 The current-carrying capacities tabulated in this section for cables in the ground relate to a soil thermal resistivity of 2,5 K·m/W. This value is considered necessary as a precaution for worldwide use when the soil type and geographical location are not specified (see annex A of IEC 60287).

In locations where the effective soil thermal resistivity is higher than 2,5 K·m/W, an appropriate reduction in current-carrying capacity shall be made, or the soil immediately around the cables shall be replaced by a more suitable material. Such cases can usually be recognized by very dry ground conditions. Correction factors for soil thermal resistivities other than 2,5 K·m/W are given in table 52-D3.

NOTE – The current-carrying capacities tabulated in this section for cables in the ground are intended to relate only to runs in and around buildings. For other installations, where investigations establish more accurate values of soil thermal resistivity appropriate for the load to be carried, the values of current-carrying capacity may be derived by the methods of calculation given in IEC 60287.

523.4 Groups containing more than one circuit

The group reduction factors are applicable to groups of insulated conductors or cables having the same maximum operating temperature.

For groups containing cables or insulated conductors having different maximum operating temperatures, the current-carrying capacity of all the cables or insulated conductors in the group shall be based on the lowest maximum operating temperature of any cable in the group together with the appropriate group reduction factor.

If, due to known operating conditions, a cable or insulated conductor is expected to carry a current not greater than 30 % of its grouped rating it can be ignored for the purpose of obtaining the reduction factor for the rest of the group.

523.4.1 Installation methods A to D in table 52-B1

The current-carrying capacities given in tables 52-C1 to 52-C12 relate to single circuits consisting of the following numbers of conductors:

– two insulated conductors or two single-core cables, or one twin-core cable;

– three insulated conductors or three single-core cables, or one three-core cable.

Where more insulated conductors or cables are installed in the same group, the group reduction factors specified in tables 52-E1 to 52-E3 shall be applied.

NOTE – The group reduction factors have been calculated on the basis of prolonged steady-state operation at a 100 % load factor for all line conductors. Where the loading is less than 100 % as a result of the conditions of operation of the installation, the group reduction factors may be higher.

523.4.2 Installation methods E and F in table 52-B1

The current-carrying capacities of tables 52-C7 to 52-C12 relate to the reference methods of installation.

For installations on trays, cleats and the like, current-carrying capacities for both single circuits and groups shall be obtained by multiplying the capacities as indicated in tables 52-C7 to 52-C12, given for the relevant arrangements of insulated conductors or cables in free air by the installation and group reduction factors given in tables 52-E4 and 52-E5.

NOTES to 523.4.1 and 523.4.2

NOTE 1 – Group reduction factors have been calculated as averages for the range of conductor sizes, cable types and installation conditions considered. Attention is drawn to the notes of each table. In some instances, a more precise calculation may be desirable.

NOTE 2 – Group reduction factors have been calculated on the basis that the group consists of similar equally loaded insulated conductors or cables. When a group contains various sizes of cables or insulated conductors, caution should be exercised over the current loading of the smaller ones (see 523.4.3).

523.4.3 Groups containing different sizes

Tabulated group reduction factors are applicable to groups consisting of similar equally loaded cables. The calculation of reduction factors for groups containing different sizes of equally loaded insulated conductors or cables is dependent on the total number in the group and the mix of sizes. Such factors cannot be tabulated but shall be calculated for each group. The method of calculation of such factors is outside the scope of this standard. Some specific examples of where such calculations may be advisable are given below.

NOTE – A group containing sizes of conductor spanning a range of more than three adjacent standard sizes may be considered as a group containing different sizes. A group of similar cables is taken to be a group where the current-carrying capacity of all the cables is based on the same maximum permissible conductor temperature and where the range of conductor sizes in the group spans not more than three adjacent standard sizes.

523.4.3.1 Groups in conduits, cable trunking or cable ducting

The group reduction factor, which is on the safe side, for a group containing different sizes of insulated conductors or cables in conduits, cable trunking or cable ducting is:

$$F = \frac{1}{\sqrt{n}}$$

where

F is the group reduction factor;

n is the number of multi-core cables or circuits in group.

The group reduction factor obtained by this equation will reduce the danger of overloading the smaller sizes but may lead to under-utilization of the larger sizes. Such under-utilization can be avoided if large and small sizes of cable or insulated conductor are not mixed in the same group.

The use of a method of calculation specifically intended for groups containing different sizes of insulated conductors or cables in conduits, cable trunking or cable ducting will produce a more precise group reduction factor.

This subject is under consideration.

523.4.3.2 Groups on trays

When a group contains different sizes of insulated conductors or cables, caution shall be exercised over the current loading of smaller sizes. It is preferable to use a method of calculation specifically intended for groups containing different sizes of insulated conductors or cables.

The group reduction factor obtained in accordance with 523.4.3.1 will provide a value which is on the safe side.

This subject is under consideration.

523.5 Number of loaded conductors

523.5.1 The number of conductors to be considered in a circuit are those carrying load current. Where it can be assumed that conductors in polyphase circuits carry balanced currents with negligible harmonics, the associated neutral conductor need not be taken into consideration. Under these conditions a four-core cable, in a three-phase circuit, is given the same capacity as a three-core cable having the same conductor cross-sectional area for each phase conductor. Four- and five-core cables may have higher current-carrying capacities when only three conductors are loaded.

523.5.2 Where the neutral conductor in a multi-core cable carries current as a result of an unbalance in the line currents, the temperature rise due to the neutral current is offset by the reduction in the heat generated by one or more of the line conductors. In this case, the conductor size shall be chosen on the basis of the highest line current.

In all cases, the neutral conductor shall have a cross-sectional area in compliance with 523.1.4.

523.5.3 Where the neutral conductor carries current without corresponding reduction in load of the phase conductors, the neutral conductor shall be taken into account in ascertaining the rating of the circuit. Such currents may be caused by a significant harmonic current in three-phase circuits. If the harmonic content is greater than 10 %, the neutral conductor shall not be smaller than the phase conductors. Thermal effects due to the presence of harmonic currents and the corresponding reduction factors for higher harmonic currents are given in annex C.

523.5.4 Conductors which serve the purpose of protective conductors only (PE conductors) are not to be taken into consideration. PEN conductors shall be taken into consideration in the same way as neutral conductors.

523.6 Conductors in parallel

Where two or more conductors are connected in parallel in the same phase or pole of the system, either:

a) measures shall be taken to achieve equal load current sharing between them;

This requirement is considered to be fulfilled if the conductors are of the same material, have the same cross-sectional area, are approximately the same lengths and have no branch circuits along the length, and if

- the conductors in parallel are multi-core cables or twisted single-core cables or insulated conductors; or
- the conductors in parallel are non-twisted single-core cables or insulated conductors in trefoil or flat formation and have a cross-sectional area less than or equal to 50 mm^2 in copper or 70 mm^2 in aluminium; or
- the conductors in parallel are non-twisted single-core cables or insulated conductors in trefoil or in flat formation and have cross-sectional areas greater than 50 mm^2 in copper or 70 mm^2 in aluminium and the special configurations necessary for such formations are adopted. These configurations, consisting of suitable groupings and spacings of the different phases or poles, are under consideration.

b) special consideration shall be given to the load current sharing to meet the requirements of 523.1.3.

523.7 Variation of installation conditions along a route

Where the heat dissipation differs in one part of a route from another, the current-carrying capacity shall be determined so as to be appropriate for the part of the route having the most adverse conditions.

523.8 Methods of installation

523.8.1 Reference methods (see table 52-B1)

The reference methods are those methods of installation for which the current-carrying capacity has been determined by test or calculation.

Reference methods A1 (insulated conductors in a conduit in a thermally insulated wall) and **A2** (multi-core cable in a conduit in a thermally insulated wall).

The wall consists of an outer weatherproof skin, thermal insulation and an inner skin of wood or wood-like material having a thermal conductance of at least 10 $W/m^2 \cdot K$. The conduit is fixed so as to be close to, but not necessarily touching, the inner skin. Heat from the cables is assumed to escape through the inner skin only. The conduit can be metal or plastic.

Reference methods B1 (insulated conductors in a conduit on a wooden wall) and **B2** (multi-core cable in a conduit on a wooden wall).

Conduit is mounted on a wooden wall so that the gap between the conduit and the surface is less than 0,3 times the conduit diameter. The conduit can be metal or plastic. Where the conduit is fixed to a masonry wall, the current-carrying capacity of the cable, or insulated conductors, may be higher. This subject is under consideration.