

SLOVENSKI STANDARD

SIST HD 633 S1:2001

01-februar-2001

Tests on oil-filled (fluid filled), paper- or polypropylene paper laminate-insulated, metal-sheathed cables and accessories for alternating voltages up to and including 400 kV (Um = 420 kV)

Tests on oil-filled (fluid filled), paper- or polypropylene paper laminate-insulated, metal-sheathed cables and accessories for alternating voltages up to and including 400 kV (Um = 420 kV)

Prüfungen an Ölkabeln mit einer Isolierung aus Papier oder polypropylenbeschichtetem Papier und Metallmantel und Garnituren für Wechselspannungen bis einschließlich 400 kV (Um = 420 kV)

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Essais des câbles à huile fluide isolés au papier imprégné ou au complexe polypropylène contre-couché papier sous gaine métallique et de leurs dispositifs accessoires pour des tensions alternatives inférieures ou égales à 400 kV (Um = 420 kV)

Ta slovenski standard je istoveten z: HD 633 S1:1997

ICS:

29.060.20 Kabli Cables

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HARMONIZATION DOCUMENT
DOCUMENT D'HARMONISATION
HARMONISIERUNGSDOKUMENT

HD 633 S1

December 1997

ICS 29.060.20

Descriptors: Electrical installation, a.c. voltage, insulated cable, electrical insulating paper, accessory, test, oil-filled cable, protective sheath

English version

Tests on oil-filled (fluid filled), paper- or polypropylene paper laminate-insulated, metal-sheathed cables and accessories for alternating voltages up to and including 400 kV ($U_m = 420$ kV)

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This Harmonization Document was approved by CENELEC on 1997-10-01. 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 two official versions (English, French).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, 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

This Harmonisation Document was prepared by WG9 of CENELEC Technical Committee TC20, Electric Cables.

The document contains the following Parts:

- Part 1 - General test methods
- Part 2 - Additional test methods
- Part 3 - List of test requirements for specific cable designs

Part 3 is further divided into particular sections and, by decision of the Technical Board (D68/047) National Committees need at present only implement in their national language those sections having national applicability. The obligation remains however to announce the full HD in public by titles and numbers, and also to withdraw any conflicting national standards.

Page numbering reflects the arrangement into Parts and particular sections, e.g. Page 3-B-5 is page 5 of particular section B of Part 3.


References to other HDs, ENs and international standards are given in the particular parts or sections.

The draft was submitted to the formal vote and was approved by CENELEC as HD 633 S1 on 1997-10-01. By decision of the Technical Board (D81/139) this HD exists only in English and French.

The following dates were fixed:

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- latest date by which the existence of the HD has to be announced at national level (doa) 1998-03-01
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 - latest date by which the HD has to be implemented at national level by publication of a harmonised national standard or by endorsement (dop) 1998-09-01
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 - latest date by which the national standards conflicting with the HD have to be withdrawn (dow) 1998-09-01




 REPUBLIC OF SERBIA
 MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGICAL DEVELOPMENT
 1997-10-01
 PRESENT FOR METHOD OF HARMONIZATION

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HD 633 S1:1997

**TESTS ON OIL-FILLED (FLUID FILLED), PAPER- OR POLYPROPYLENE PAPER LAMINATE-INSULATED,
METAL-SHEATHED CABLES AND ACCESSORIES FOR ALTERNATING VOLTAGES UP TO AND
INCLUDING 400 kV ($U_m = 420$ kV)**

PART 1

General test methods

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TESTS ON OIL-FILLED (FLUID FILLED), PAPER- OR POLYPROPYLENE PAPER LAMINATE-INSULATED, METAL-SHEATHED CABLES AND ACCESSORIES FOR ALTERNATING VOLTAGES UP TO AND INCLUDING 400 kV ($U_m = 420$ kV)

Part 1: General test methods

1 General

1.1 Scope

HD 633 applies to tests on radial field, oil-filled (fluid-filled), paper or polypropylene paper laminate (PPL) insulated metal-sheathed cables and their accessories, which operate with a minimum static pressure of between 20 kPa (0,2 bar) and 300 kPa (3,0 bar) inclusive, a maximum static pressure of not more than 800 kPa (8,0 bar) and a minimum transient pressure of not less than 20 kPa (0,2 bar). (The quoted pressures are above atmospheric pressure.)

NOTE 1: The term 'oil-filled' is under consideration as it does not adequately reflect the nature of the impregnants used in modern cables.

NOTE 2: The cables in this HD are specifically excluded from the scope of the proposed Pressure Equipment Directive.

HD 633 is applicable also to cables and accessories with maximum static pressures exceeding 800 kPa (8,0 bar), except that sub-clauses 3.2, 4.5 and 5.2 may be appropriately modified by agreement between the purchaser and the manufacturer.

The tests are applicable to cables and accessories intended to be used in systems with nominal voltages not exceeding 400 kV between phases.

This Part (Part 1) specifies the general test methods applicable to these cables, unless otherwise specified in the particular sections of Part 3 of this HD. However, the summary of tests as listed in one only of the particular sections in Part 3 of this HD is mandatory for the particular cable ordered.

Part 2 specifies additional test methods applicable only to certain particular sections of Part 3 of this HD.

Part 3 specifies the lists of tests applicable to the particular cable type.

For cables manufactured in long lengths, the application of this HD is subject to agreement between the purchaser and the manufacturer.

1.2 Normative references

Part 1 of HD 633 incorporates by dated or undated reference, provisions from other publications. These 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 Part 1 of HD 633 only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

IEC 6071-1: 1993	Insulation co-ordination - Part 1 : Definitions, principle and rules
IEC 60183: 1984	Guide to the selection of high voltage cables
IEC 60229: 1982	Tests on cable oversheaths which have a special protective function and are applied by extrusion

IEC 60287: 1982	Calculation of the continuous current rating of cables (100% load factor)
HD 48:	Impulse tests on cables and their accessories
HD 383:	Conductors of insulated cables
EN 60811-1-1:	Common test methods for insulating and sheathing materials of electrical cables - Part 1: Methods for general application - Section One: Measurement of thickness and overall dimensions - Tests for determining the mechanical properties. Amendment No. 1 (1988), Amendment No. 2 (1989).

1.3 Definitions and symbols

For the purposes of this part of HD 633, the following definitions and symbols apply:

cables screened with carbon-black paper: Cables where carbon-black paper is applied as a screen over the conductor and where the carbon-black paper is in contact with the insulation.

cables not screened with carbon-black paper: Cables where the screen over the conductor consists of any material other than carbon-black paper, or is such that carbon-black paper, if present, is not in contact with the insulation. For the purpose of this standard, cables with unscreened conductors are to be included in this group.

The following definitions have been adopted for the purposes of this standard:

U_o = the rated power-frequency voltage between conductor and core screen for which the cable and its accessories are designed;

U = the rated power-frequency voltage between any two conductors for which the cable and its accessories are designed;

U_m = the maximum value of the highest permissible system voltage for which the equipment may be used;

U_p = the peak value of the impulse withstand voltage for which the cable and its accessories are designed.

1.4 Voltage designation

Cables and accessories shall be designated by the rated voltage between conductor and core screen U_o and by the rated voltage between conductors U , both in kilovolts, e.g. 64/110. Cables according to this standard can be operated in a system of the following categories:

Category A: this category comprises those systems where earth faults are cleared as rapidly as possible but in any case within 1 min.

Category B: this category comprises those systems which, under fault conditions, are operated for a short time with one phase earthed. According to IEC 60183, this period should not exceed 1 h.

For cables in this standard, a longer period not exceeding 8 h on any occasion can be tolerated. The total duration of earth faults per year should not exceed 125 h.

Category C: cables covered by HD 633 are not intended for operating in category C systems. Where there is such a requirement, agreement on the design of cables and accessories shall be made between the user and the manufacturer.

1.5 Test conditions

1.5.1 Frequency and waveform of power-frequency test voltages

The frequency of alternating test voltages shall be not less than 49 Hz and not more than 61 Hz. The waveform of such voltages shall be substantially sinusoidal.

1.5.2 Waveform of impulse test voltages

The impulse wave shall be in accordance with HD 48.

1.5.3 Ambient temperature

Unless otherwise specified in the details for a particular test, tests shall be made at an ambient temperature of $(20 \pm 15)^\circ\text{C}$.

1.6 Characteristics

1.6.1 For the purpose of carrying out and recording the tests described in this standard, the following characteristics must be known or declared:

1.6.1.1 a) The rated voltage U_0 in kilovolts.

b) The lightning impulse withstand voltage U_p in kilovolts.

NOTE: The lightning impulse withstand voltage U_p specified above for each particular cable should be selected in accordance with IEC 60071-1.

1.6.1.2 The type of conductor, the material and the nominal cross-sectional area of the conductors in square millimetres, and conductor resistance (for conductor resistances refer to 2.2).

1.6.1.3 The conductor resistance, if the nominal cross-sectional area is not in accordance with the values given in HD 383.

1.6.1.4 The number of cores.

1.6.1.5 The capacitance between each conductor and core screen expressed in microfarads per kilometre.

1.6.1.6 The maximum permissible conductor temperature in degrees Celsius for continuous operation under the specified ambient and installation conditions.

1.6.1.7 The minimum and maximum permissible static oil pressure in kilopascals or bars.

1.6.1.8 The type and material of the metallic sheath and the construction of the sheath reinforcement, if any.

- 1.6.1.9 The thermal resistance between conductor(s) and metallic sheath, in Kelvins times metres per watt.

NOTE: The thermal resistance should be calculated using the formulae given in IEC 60287.

- 1.6.1.10 Voltage gradients (see 4.1.2 b), item 3, and 4.1.2 c), item 1 or item 2) in kV/mm.
- 1.6.1.11 Maximum design pressures of accessories in kilopascals (see 5).
- 1.6.1.12 Type of conductor screen (with or without carbon-black paper).
- 1.6.1.13 Specified minimum thickness of insulation, nominal thickness of the metallic sheath and anti-corrosion covering in millimetres.
- 1.6.1.14 The nominal outside diameter of the cable and conductor in millimetres.
- 1.6.1.15 The type and material of the corrosion-resistant covering over the metallic sheath.

- 1.6.2 The following additional characteristics shall be stated by the manufacturer when requested by the purchaser:

- 1.6.2.1 The maximum current rating in amperes under the specified installation and operating conditions.

- 1.6.2.2 The estimated effective (a.c.) resistance in ohms per kilometre of the cable at the maximum operating temperature and under the specified installation conditions.

- 1.6.2.3 The estimated inductance in Henry per kilometre per phase of the completed cable under the specified installation conditions.

1.7 Categories and frequency of tests

NOTE: Tests classified as Sample (S) or Routine (R) may be required as part of any type approval scheme.

1.7.1 Routine tests (Symbol R)

Tests made on all production cable lengths to demonstrate their integrity.

1.7.2 Sample tests (Symbol S)

1.7.2.1 Definition

Tests made on samples of completed cable, or components taken from a completed cable adequate to verify that the finished product meets the design specifications.

1.7.2.2 Frequency of the measurements of dimensions

This test shall be carried out on not more than 10 % of the number of delivery lengths - at least on one length - unless otherwise specified by the purchaser at the time of enquiry.

1.7.2.3 Frequency of the mechanical tests

Provided that the total length fixed in the contract exceeds 2 km of three-core cable or 4 km of single-core cable, the maximum frequency of these tests shall be in accordance with the following table:

Cable length				Number of samples taken from cables manufactured for the contract
Three-core cables		Single-core cables		
Above	Up to and including	Above	Up to and including	
km	km	km	km	
2	10	4	20	1
10	20	20	40	2
20	30	40	60	3
etc.	etc.	etc.	etc.	etc.

1.7.3 Type tests (Symbol T)

Tests required to be made before supplying a type of cable covered by this HD on a general commercial basis in order to demonstrate satisfactory performance characteristics to meet the intended application. These tests are of such a nature that, after they have been made, they need not be repeated unless changes are made in the cable material, design or type of manufacturing process which might change the performance characteristics.

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1.7.4 Tests after installation

Tests intended to demonstrate the integrity of the cable and its accessories.

2 Routine tests on cables

2.1 General

The tests specified in sub-clauses 2.2 to 2.6 shall be carried out on all finished cables as defined in 1.7.1, forming the subject of a contract. For the tests specified in sub-clauses 2.3, 2.4 and 2.5, the cables shall be installed with suitable terminations and the oil pressure at the highest position adjusted to a value not exceeding 200 kPa (2,0 bar) or the minimum - static pressure (see 1.6.1.7) plus 50 kPa (0,5 bar) whichever is the greater.

2.2 Conductor resistance test

The d.c. resistance of conductors in the finished cable shall be measured. The measured value of resistance for three-core cables (with a nominal cross-sectional area not exceeding 400 mm² and for single-core cables (with a nominal cross-sectional area not exceeding 2000 mm²), when corrected to a temperature of 20°C and a length of 1 km shall not exceed the value specified for class 2 conductors in columns 8 and 9 (for copper conductors), and column 10 (for aluminium conductors) of table II of HD 383.

For cables with a nominal cross-sectional area greater than that mentioned above or not included in table II of HD 383, the d.c. resistance shall meet the value stated by the manufacturer.

The correction for temperature and length shall be made in accordance with HD 383.

The cable shall be maintained at a reasonably constant temperature for at least 12 h before the test. If it is doubtful whether the conductor temperature is the same as the ambient temperature the period should be extended to 24 h.

2.3 Capacitance test

The capacitance shall be measured at power frequency by means of an a.c. bridge; the capacitance of each core shall be not greater than 8 % above the declared value (see 1.6.1.5).

2.4 Tan δ measurement test

Tan δ shall be measured at ambient temperature between each conductor and core screen employing a power-frequency test voltage as defined in 1.5.1.

For values of U_0 not exceeding 87 kV, the measurements shall be made at the rated voltage U_0 and at $2 U_0$; for values of U_0 exceeding 87 kV, the measurements shall be made at the rated voltage U_0 and at $1,67 U_0$.

If the measurements are made at a temperature below 20°C, the results shall be corrected to 20°C, either by subtracting from the measured value 2% of this value per °C of the difference between the test temperature and 20°C or by use of a correction curve appropriate to the insulant if agreement on such a curve has been reached between the purchaser and the manufacturer. No correction shall be made if the test temperature is 20°C or higher.

The tan δ and the tan δ difference shall not exceed the appropriate values given in table 1, or the declared values, whichever are the lower.

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2.5 High-voltage test

This test shall be made at ambient temperature, with a power-frequency a.c. test voltage applied for 15 min between each conductor and core screen. The value of the test voltage (see table 2) shall be:

$2 U_0 + 10$ kV for cables with U_0 not exceeding 87 kV;

$1,67 U_0 + 10$ kV for cables with U_0 exceeding 87 kV.

The voltage shall be gradually increased to the specified value. No breakdown of the insulation shall occur.

A d.c. test may be applied as an alternative to the a.c. test specified above, the value of the test voltage being 2.4 times the a.c. test voltage (see table 2) and the duration of the test 15 min. No breakdown of the insulation shall occur.

NOTE: The a.c. test may be made in conjunction with the measurement of tan δ (see sub-clause 2.4).

2.6 Test on corrosion-resistant coverings

Corrosion-resistant coverings shall comply with the test requirements of IEC 60229.