SLOVENSKI STANDARD
SIST HD 22.1 S3:1998

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Rubber insulated cables of rated voltages up to and including 450/750 V - Part 1: General requirements (IEC 60245-1:1994, related)

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Rubber insulated cables of rated voltages up to and including 450/750 V -- Part 1: General requirements

Gummi-isolierte Starkstromleitungen mit Nennspannungen bis 450/750 V -- Teil 1: Allgemeine Anforderungen

Conducteurs et câbles isolés au caoutchouc, de tension assignée au plus égale à 450/750 V -- Partie 1: Prescriptions générales

Ta slovenski standard je istoveten z: **HD 22.1 S3:1997**

ICS:

29.060.20 Kabli Cables

SIST HD 22.1 S3:1998 **en**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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HARMONIZATION DOCUMENT
DOCUMENT D'HARMONISATION
HARMONISIERUNGSDOKUMENT

HD 22.1 S3

September 1997

ICS 29.060.20

Supersedes HD 22.1 S2:1992 and its amendments

Descriptors: Conductor, cable, flexible cable, rigid cable, single core cable, multicore cable, conductor material, flat cable, compound, polychloroprene, rubber, elastomer, insulation compound, type test, sample test, routine test, rated voltage, mark, common marking, identification, colour scheme, construction, insulation, separator, filler, sheath, braid, inner layer, outer layer, thickness, mean value, specified value, electrical resistance, test, tensile strength, elongation at break, ageing, air oven, oxygen bomb, hot set, complete cable, overall dimensions, bending, flexing, voltage test, absence of short circuits, spark (test), insulation resistance, wear resistance, test (under) fire (conditions), guide to use

English version

Rubber insulated cables of rated voltages up to and including 450/750 V
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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).

CENELEC members are the national electrotechnical committees of Austria, Belgium, 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 edition 3 of HD 22.1 has been prepared by Technical Committee CLC/TC20, Electric cables.

HD 22 was originally adopted by CENELEC on 9th July 1975.

Edition 2 of HD 22 was implemented on 1st January 1984, and at that time contained four parts.

Since 1984, new parts have been published and original parts amended. This new edition provides a full updating and amalgamation of amendments since 1984.

HD 22.1 S3 is related to IEC 60245-1 (1994), but is not directly equivalent.

HD 22 now has the following parts:

HD 22.1 S3	-	General requirements
HD 22.2 S3	-	Test methods
HD 22.3 S3	-	Heat resistant silicone rubber insulated cables
HD 22.4 S3	-	Cords and flexible cables
HD 22.5	-	(Spare)
HD 22.6 S2	-	Arc welding cables
HD 22.7 S2	-	Cables with increased heat resistance for internal wiring for a conductor temperature of 110 °C
HD 22.8 S2	-	Polychloroprene or equivalent synthetic elastomer sheathed cable for decorative chains
HD 22.9 S2	-	Single core non-sheathed cables for fixed wiring having low emission of smoke and corrosive gases
HD 22.10 S1	-	EPR insulated and polyurethane sheathed flexible cables
HD 22.11 S1	-	EVA cords and flexible cables
HD 22.12 S1	-	Heat resistant EPR cords and flexible cables
HD 22.13 S1	-	Single and multicore flexible cables, insulated and sheathed with crosslinked polymer and having low emission of smoke and corrosive gases
HD 22.14 S1	-	Cords for applications requiring high flexibility

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In order that this revision of Part 1 of HD 22 does not introduce unnecessary changes to long-established clause numbers, the Normative References (which would otherwise be inserted as clause 2) are given in Annex A.

The draft Harmonisation Document was submitted to the Unique Acceptance Procedure and approved by CENELEC as HD 22.1 S3 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 22.1 S2: 1992 and its amendments A11:1992, A12:1992, A13:1992, A14:1994, A15:1993, A16:1994, A17:1995, A18:1995, A19:1995 and A20:1996 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.

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RUBBER INSULATED CABLES
OF RATED VOLTAGES UP TO AND INCLUDING 450/750V

Part 1 : General Requirements

1. General

1.1 Scope

HD 22 applies to rigid and flexible cables with insulation and sheath if any, based on vulcanised rubber, of rated voltages U_o/U up to and including 450/750V used in power installations of nominal voltage not exceeding 450/750V a.c.

NOTE: For some types of flexible cables, the term "cord" is used.

This Part 1 specifies the General Requirements applicable to these cables.

The test methods specified are given in Part 2 of this HD, in HD 405 and EN 60811.

The particular types of cables are specified in Part 3 onwards of this HD, and are hereafter referred to as "the particular specifications".

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The code designations of these types of cables are in accordance with HD 361.

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1.2 Object

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The objects of this Harmonisation Document are to standardise cables and cords that are safe and reliable when properly used, to state the characteristics and manufacturing requirements directly or indirectly bearing on safety, and to specify methods for checking conformity with those requirements.

1.3 Common Marking

The Common Marking (◃HAR▹) signifies that the manufacturer has been assessed and his production is subjected to continuing surveillance in accordance with the technical procedures by a recognised national Approval Organisation which is a signatory to the "Agreement on the use of a Commonly Agreed Marking for Cables and Cords complying with Harmonised Specifications."

Compliance with this Harmonisation Document may be certified by the application of the agreed technical procedures for granting the Common Marking(*), which are the recognised means of ensuring that a manufacturer is competent and takes all reasonable care to produce cables complying with this HD.

The Common Marking may be used, under these conditions, by manufacturers in countries which have implemented this HD and in which the national Approval Organisations are signatories to the Agreement.

NOTE: See Annex B to Part 1 for guidance on National Marking

(*) These are given in Appendices 4 and 5 of the 'Agreement on the use of a Commonly Agreed Marking for Cables and Cords complying with Harmonised Specifications'.

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2. Definitions

2.1 Definitions relating to insulating and sheathing materials and their processing

2.1.1 Cross-linking

The process of multiple intermolecular covalent bonding between polymer chains.

2.1.2 Vulcanisation

A post-application treatment taking place after the insulation and/or sheath has been applied in order to induce cross-linking of the rubber or synthetic elastomer.

NOTE: Vulcanisation is an historical term now largely limited to use with the longer-established materials which did, and in some cases still do, use sulphur as the primary chemical agent of cross-linking.

2.1.3 Type of compound

The category in which a compound is placed according to its properties, and determined by specific tests. The type designation is not directly related to the composition of the compound.

2.1.4 Rubber compound

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Combination of materials suitably selected, proportioned, treated, and vulcanised, of which the characteristic constituent is a rubber and/or synthetic elastomer.

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2.1.5 Polychloroprene compound or other equivalent synthetic elastomer

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A vulcanised compound in which the elastomer is polychloroprene or other equivalent synthetic elastomer providing a compound with properties similar to polychloroprene.

2.1.6 Chlorinated rubber compound

A vulcanised compound in which the characteristic constituent is a synthetic chlorinated rubber, e.g. Polychloroprene (PCP), Chlorosulphonated Polyethylene (CSP), Chlorinated Polyethylene (CPE), etc.

2.1.7 Ethylene-propylene rubber compound (EPR) or other equivalent synthetic elastomer

A cross-linked compound in which the elastomer is ethylene-propylene or other equivalent synthetic elastomer providing a compound with properties similar to EPR.

2.1.8 Ethylene vinyl acetate rubber compound (EVA) or other equivalent synthetic elastomer

A cross-linked compound in which the elastomer is ethylene vinyl acetate or other equivalent synthetic elastomer providing a compound with properties similar to EVA.

2.1.9 Polyolefin based cross-linked compound or other equivalent synthetic compound having a low level of emission of corrosive gase s when burned

A crosslinked compound in which the polymer is a polyolefin or equivalent synthetic non-halogenated polymer providing a compound which, when burned, has low emission of corrosive gases and is suitable for use in cables which, when burned, have low emission of smoke.

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2.1.10 Crosslinked polyvinyl chloride (XLPVC)

Combinations of materials of which polyvinyl chloride is the characteristic constituent, including adequate crosslinking agents, suitably selected, proportioned and treated which when crosslinked, meet the requirements given in the particular specification.

2.1.11 Cross-linked silicone rubber (SiR)

A compound based on a poly-siloxane polymer which, when cross-linked, meets the requirements given for the particular cable.

2.2 Definitions relating to the tests

2.2.1 Type tests (Symbol T)

Tests required to be made before supplying a type of cable covered by this standard 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 materials, design or type of manufacturing process which might change the performance characteristics.

2.2.2 Sample tests (Symbol S)

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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.

2.2.3 Routine tests (Symbol R)

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

2.3 Rated 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 (U) of the cable.

NOTE: The operating voltage of a system may permanently exceed the nominal voltage of such a system by 10%. A cable can be used at a 10% higher operating voltage than its rated voltage if the latter is at least equal to the nominal voltage of the system.

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3. Marking

3.1 Indication of origin

Cables shall be provided with an identification of origin consisting of:

(1) Either the manufacturer's identification thread,
(2) Or the continuous marking of the manufacturer's name or trademark, or (if legally protected) identification number, by one of the three following methods:

(a) Printed tape within the cable;
(b) Printing, indenting or embossing on the insulation of at least one core (the core coloured light blue, if any);
(c) Printing, indenting or embossing on the sheath, if any.

3.2 Continuity of marks

Each specified mark shall be regarded as continuous if the distance between the end of the mark and the beginning of the next identical mark does not exceed:

550 mm if the marking is on the outer sheath or the covering of the cable;
275 mm if the marking is:

(i) on the insulation of an unsheathed cable;
(ii) on the insulation of a sheathed cable;
(iii) on a tape within a sheathed cable.

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NOTE: A 'Specified Mark' is any mandatory mark covered by this Part of the HD or by the particular requirements of Part 3 onwards of this HD, or the optional common marking (◂HAR▸).

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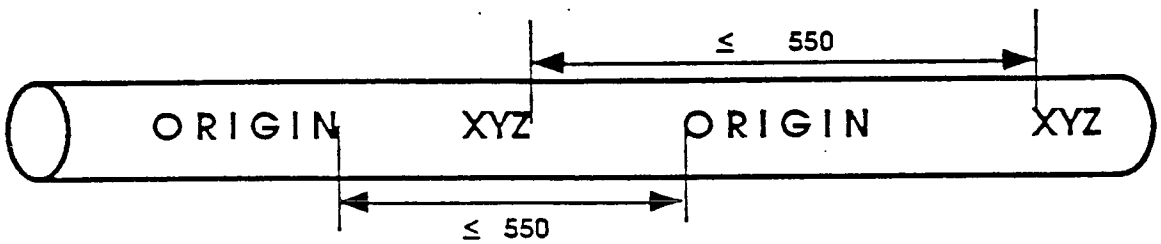
The diagram below shows an example of the marking as used on the outer sheath of the cable.



3.3 Durability

Printed markings shall be durable. Compliance with this requirement shall be checked by the test given in sub-clause 1.8 of Part 2.

3.4 Legibility

All markings shall be legible.

The colours of the identification threads shall be easy to recognise or easily made recognisable, if necessary by cleaning with petrol or other suitable solvent.

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3.5 Common Marking

If the Common Marking (◂HAR▸) is used, it shall be as specified in the "Agreement on the use of a Commonly Agreed Marking for Cables and Cords complying with Harmonised Specifications". It will consist of :

(1) Either the common thread as specified and allotted in Appendix 2 to the above mentioned "Agreement".

(2) Or a continuous (see 3.2) marking of the symbols specified and allotted in Appendix 1 to the above mentioned "Agreement", by one of the three methods a), b), c) specified in sub-clause 3.1.

3.6 Use of the name CENELEC

The name CENELEC, in full or abbreviated, shall not be marked on, or in, the cables.

3.7 Outer marking

In order to distinguish between:

(i) those cables having a sheath made of ordinary ethylene propylene rubber or any other 60°C rubber (designatory letter 'R' in Table 2a of HD 361), and

(ii) other rubber sheaths for cables to HD 22,

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an outer marking is required for cables to item (ii) as specified case by case in the particular specification.

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4. Core identification

4.1 General requirements

Identification of the cores of a cable shall be achieved by the use of coloured insulation or by a coloured surface.

Each core of a multicore cable shall have only one colour, except the core identified by a combination of the colours green and yellow. In multicore cables, the colours green and yellow shall not be used separately as single colours.

The colours shall be clearly identifiable and durable. Durability shall be checked by the test given in sub-clause 1.8 of Part 2.

4.2 Colour schemes

4.2.1 Flexible Cables

The core colours, and their rotational position, for flexible cables and cords shall be in accordance with HD 308.

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4.2.2 Single core non-sheathed cables

(a) For cable types H05G (Part 7, clause 3) and H05Z (Part 9, clauses 4 and 5) the following mono-colours are recognised: black, blue, brown, grey, orange, pink, red, turquoise, violet, white, green and yellow. Bi-colours or any combination of the above mono-colours are permitted. The distribution of the colours for the core bi-coloured green/yellow shall comply with Part 1 sub-clause 4.3.

NOTE: The use of green or yellow in some countries may be forbidden or restricted by National safety or other regulations. In some countries, green is specifically permitted for decorative chains.

(b) For cable type H07G (Part 7, clause 2) and H07Z (Part 9, clauses 2 and 3) the following mono-colours are recognised: black, blue, brown, grey, orange, pink, red, turquoise, violet and white.

Bi-colours shall not be used except the combination of the mono-colours green and yellow, the distribution of the colours of which shall comply with Part 1 sub-clause 4.3.

NOTE: Other mono-colours are permitted by National standards, pending CENELEC TC64 harmonisation of installation rules.

4.3 Colour combination green/yellow

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The distribution of the colours for the core coloured green/yellow shall comply with the following condition (which is in accordance with HD 308): for every 15 mm length of core, one of these colours shall cover at least 30% and not more than 70% of the surface of the core, the other colour covering the remainder.

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NOTE: Information on the use of the colours green/yellow and light blue.

It is understood that the colours green and yellow when they are combined as specified above are recognised exclusively as a means of identification of the core intended for use at earth connection or similar protection, and that the colour light blue is intended for the identification of the core intended to be connected to neutral. If, however, there is no neutral, light blue can be used to identify any core except the earthing or protective conductor.

4.4 Core Identification of flexible cables by the 'Marking by Inscription' Method

Where cables of more than five cores are identified by marking by inscription, this shall be in accordance with HD 186.

For special types of cable in this HD (see for instance HD 22.4 clause 6) other means of identification are permitted.

5. General requirements for the construction of cables

5.1 Conductors

5.1.1 Material

The conductors shall consist of annealed copper. Unless otherwise specified in the particular specifications, the wires of conductors may be plain or tinned. Tinned wires shall be covered with an effective layer of tin.

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5.1.2 Construction

The maximum diameters of the wires of flexible conductors and the minimum number of wires of rigid conductors shall be in accordance with HD 383, unless otherwise specified in the particular specifications.

The classes of the conductors relevant to the various types of cables are given in the particular specifications.

5.1.3 Separator between conductor and insulation

If permitted or required in the particular specification a separating tape may or shall be placed between the conductor and the insulation.

5.1.4 Check of construction

Compliance with the requirements of Part 1 sub-clauses 5.1.1 and 5.1.2, including the requirements of HD 383 shall be checked by inspection and by measurement.

5.1.5 Electric resistance

Unless otherwise specified in the particular specifications, the resistance of each conductor at 20°C shall be in accordance with the requirements of HD 383 for the given class of the conductor.

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Compliance shall be checked by the test given in Part 2 sub-clause 2.1.

5.1.6 Solderability test for untinned conductors

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To assess any possible interaction between insulation and bare copper conductor, untinned conductors shall comply with the solderability test specified in Part 2, sub-clause 1.12, unless otherwise specified in the particular specifications of the HD.

5.2 Insulation

5.2.1 Material

The insulation shall be an elastomeric based compound, cross-linked or vulcanised, of the type specified for each type of cable in the particular specifications:

Type EI 2 for cables insulated with silicone rubber compound
Type EI 3 for cables insulated with compound based on EVA or equivalent material
Type EI 4 for cables insulated with ordinary ethylene-propylene rubber compound.

Types EI 5 and EI 8 for cables insulated with polyolefin-based cross-linked compound having a low level of emission of corrosive gases when burned and which is suitable for use in cables which, when burned, have low emission of smoke. Type EI 8 is for flexible cables.

Types EI 6 and EI 7 for cables insulated with ethylene propylene rubber or equivalent synthetic elastomer. Type EI 6 is for cables requiring handling down to -40°C.

The test requirements for these compounds are specified in Part 1 Table 1.

The maximum continuous conductor operating temperatures for cables insulated with any of the above types of compound and covered by the particular specifications are as follows:

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Insulation compound EI 4 : 60°C
Insulation compound EI 2 : 180°C, if there are no limits imposed by environmental conditions
Insulation compound EI 3 : 110°C
Insulation compounds EI 5, EI 6 and EI 7 : 90°C
Insulation compound EI 8 : 70°C

The maximum temperatures for short-circuit conditions for each insulation compound are given in Table 1.

NOTE: The maximum temperatures for short-circuit conditions for a particular cable may be lower than that given for the specific insulation compound. See HD 516 for further guidance.

5.2.2 Application to the conductor

The insulation shall be closely applied to the conductor or separator. In the particular specifications it is stated, for each type of cable, whether the insulation shall be applied in a single layer or in a number of layers, and whether it shall or shall not be covered with a proofed tape. It shall be possible to remove the insulation, without damage to the insulation itself, to the conductor, or to the tin or metal coating if any. Compliance shall be checked by inspection and by manual test.

5.2.3 Thickness

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The mean value of the thickness of insulation shall be not less than the specified value of each type and size of cable shown in the tables of the particular specifications.

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However, the thickness at any place may be less than the specified value, provided that the difference does not exceed 0,1 mm + 10% of the specified value.

Compliance shall be checked by the test given in Part 2 sub-clause 1.9.

5.2.4 Mechanical properties before and after ageing

The insulation shall have appropriate mechanical characteristics within the temperature limits to which it may be exposed to normal use.

Compliance shall be checked by carrying out the tests specified in Part 1, Table 1.

The applicable test methods and the results to be obtained are specified in Part 1 Table 1.

TABLE 1

Requirements for the non-electrical tests for cross-linked rubber insulation

1	2	3	4	5	6	7	8	9	10	11	12
Ref. No.	Test	Unit	Test method described in EN 60811*		Type of compound						
			Section	Clause	EI 2	EI 3	EI 4	EI 5	EI 6	EI 7	EI 8
	Maximum rated conductor temperature	°C			180 (but see sub-clause 5.2.1)	110	60	90	90	90	70
	Maximum temperatures for short circuit conditions	°C			350	250	200	250	250	250	250
1.	**Mechanical properties**										
1.1	Properties before ageing		1-1	9.1							
1.1.1	Values to be obtained for the tensile strength: - median, min.	N/mm²			5,0	6,5	5,0	10,0	5,0	5,0	5,0
1.1.2	Values to be obtained for the elongation at break: - median, min.	%			150	200	200	125	200	200	125
1.2	Properties after ageing in air oven		1-2	8.1							
1.2.1	Ageing conditions: 2) 4) - temperature - duration of treatment	°C h			200 ± 3 10x24	150 ± 2 10x24	100 ± 2 7x24	135 ± 2 7x24	135 ± 2 7x24	135 ± 2 7x24	110 ± 2 7x24
1.2.2	Value to be obtained for the tensile strength: - median, min. - variation 1) max.	N/mm² %			4,0 -	- ±30	4,2 ±25	- ±30	5,0 ±30	5,0 ±30	- -30 (3)
1.2.3	Values to be obtained for the elongation at break: - median, min. - variation 1) max.	% %			120 -	- ±30	200 ±25	- ±30	- ±30	- ±30	125 ±30

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TABLE 1

Requirements for the non-electrical tests for cross-linked rubber insulation
(continued)

1	2	3	4	5	6	7	8	9	10	11	12
Ref. No.	Test	Unit	Test method described in EN 60811*		Type of compound						
			Section	Clause	EI 2	EI 3	EI 4	EI 5	EI 6	EI 7	EI 8
1.3	(Spare)										
1.4	(Spare)										
1.5	Properties after ageing in the air bomb		1-2	8.2							
1.5.1	Ageing conditions[4] - temperature - duration of treatment	°C h				150±2 7x24	127±2 40	- -	127 ±2 40	127±2 40	- -
1.5.2	Values to be obtained for the tensile strength - median, min - variation 1) max	N/mm² %				6,0 -	- ±30	- -	- ±30	- ±30	- -
1.5.3	Values to be obtained for the elongation at break - variation 1) max	%			-	-30(3)	±30	-	±30	±30	-
2.	**Hot set test**		2-1	2							
2.1	Conditions of treatment - temperature - time under load - mechanical stress	°C min N/cm²			250±3 15 20	200±3 15 20	200±3 15 20	200±3 15 20	250±3 15 20	250±3 15 20	200±3 15 20
2.2	Test requirements - max. elongation under load - max. elongation after unloading	% %			100 25	100 25	100 25	100 25	100 25	100 25	100 25

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