

MV impregnated paper insulated distribution cables of rated voltages of 3.8/6.6 kV to 19/33 kV

ICS 29.060.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee, GEL/20 Electric Cables, to Subcommittee GEL/20/16, Medium/high voltage cables, upon which the following bodies were represented:

- British Approvals Service for Cables
- British Cables Association
- British Plastics Association
- Electricity Association
- ERA Technology

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Committee reference: GEL/20/16

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Foreword

BS 7894 was prepared by Subcommittee GEL/20/16 in order to complete the implementation of nationally applicable parts and sections of HD 621 S1:1996 published by the European Committee for Electrotechnical Standardization (CENELEC), in accordance with the decision of the CENELEC Technical Board. Sections 3-J1, 3-J2, 4-J1 and 4-J2 of HD 621 are already implemented by BS 6480. BS 7894 therefore implements the remaining nationally applicable parts and sections, which are as follows:

Part 1: General requirements;
Part 2: Additional test methods;
Section 4-J3: Three core cables with aluminium sheath.

NOTE 1 Only the texts of these two parts and one section are reproduced here, together with the CENELEC foreword and contents page.

NOTE 2 The CENELEC foreword includes the statement that “By decision of the Technical Board (D68/047) National Committees need at present only implement in their national language those sections having national applicability”.

BS 7894, together with BS 6480, specifies a range of medium voltage impregnated paper insulated cables for power distribution having rated voltages up to and including 19/33 kV.

In the implementation of this HD the following change has been made:

in Section 4-J3, A.8 3) (marking clause) the standard number has been changed from “HD 621 4J-3” to “BS 7894”.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

WARNING This British Standard calls for the use of substances and/or procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, inside front cover, pages i and ii, the HD title page, pages 2 to 78, an inside back cover and a back cover.

ICS 29.040.20; 29.060.20

Descriptors: Electric cable, insulated cable, composition, dimension, construction characteristics, mechanical characteristics, test, marking, impregnated paper

English version

**Medium voltage impregnated paper insulated
distribution cables**

Câbles de distribution moyenne tension
isolés au papier imprégné

Energieverteilungskabel mit getränkter
Papierisolierung für Mittelspannung

This Harmonization Document was approved by CENELEC on 1996-03-05. 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

FOREWORD

This Harmonisation Document was prepared by WG9 of CENELEC Technical Committee TC20, Electric Cables. It was agreed by TC20 at its Helsinki meeting (May 1994) to be submitted for formal vote by National Committees.

The document contains the following Parts, arranged according to the main constructional features of the cables covered:

- Part 1 - General requirements
- Part 2 - Additional test methods
- Part 3 - Impregnated paper insulated cables-single core, also pre-assembled
- Part 4 - Impregnated paper insulated cables - three core

Each of Parts 3 and 4 are 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 4-C-3 is page 3 of particular section C of Part 4.

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

The draft was submitted to the CENELEC members for formal vote in August 1995 and was approved by CENELEC as HD 621 S1 on 1996-03-05 .

The following dates were fixed:

- | | | |
|--|-------|------------|
| - latest date by which the existence of the HD has to be announced at national level | (doa) | 1996-09-01 |
| - latest date by which the HD has to be implemented at national level by publication of a harmonised national standard or by endorsement | (dop) | 1997-03-01 |
| - latest date by which the national standards conflicting with the HD have to be withdrawn | (dow) | 1997-03-01 |

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- PART 1 General requirements
- PART 2 Additional test methods
- PART 3 Impregnated paper insulated cable-single core, also pre-assembled
- 3-A Single core draining or non-draining paper insulated cable - unarmoured; with or without thermoplastic sheath (Type 3A)
 - 3-B Single core cables with paper insulation, non-draining
 - 3-C Impregnated paper insulated cables - single core cables
 - 3-E Single core cables 12/20kV and 18/30kV
 - 3-F Single core cables, also pre-assembled
 - 3-G Cables with paper insulation - draining - unarmoured - PVC or PE sheathed - single core
 - 3-I Cables with PE sheath
 - 3-J-1 Single core and SL type paper insulated cables with lead sheath (up to and including 12,7/22kV)
 - 3-J-2 Single core and SL type paper insulated cables with lead sheath (19/33kV)
- PART 4 Impregnated paper insulated cables - three core
- 4-A Multicore draining or non-draining paper insulated cable - belted or screened cores - one or three metallic sheaths - armoured or unarmoured - thermoplastic sheath or not.
 - 4-B Multicore cables with paper insulation, non draining
 - 4-C Impregnated paper insulated cable - belted H and SL type cables.
 - 4-D Belted multicore cables with polypropylene yarn serving, or PVC or polyethylene sheath
 - 4-E Armoured three-core cables with lead sheaths 12/20kV and 18/30kV and three-core cables 12/15kV non-radial field
 - 4-F Multicore cables (Belted cables; three screened cores - one lead sheath; three metallic sheathed cores - one outer covering)
 - 4-G-1 Impregnated paper insulated cable - three core draining paper insulated cable - screened cores, one metallic sheath - armoured or unarmoured serving, PE or PVC sheath
 - 4-G-2 Impregnated paper insulated cable - three core draining paper insulated cable - belted, one metallic sheath - armoured or unarmoured serving, PE or PVC sheath
 - 4-H-1 Three-core belted and screened cables, with lead sheath and steel tape armour
 - 4-H-2 Three-core SL steel armoured cables
 - 4-I Cables with one lead sheath (Type 4I-1) and with three lead sheaths (Type 4I-2) and with sheaths of PE
 - 4-J-1 Three core cables with lead sheath (19/33kV)
 - 4-J-2 Three core cables with lead sheath, up to and including 12,7/22kV
 - 4-J-3 Three core cables with aluminium sheath
 - 4-K Armoured three core cables with lead sheaths and a rated voltage 23/40kV

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HD 621 S1:1996

**MEDIUM VOLTAGE IMPREGNATED
PAPER INSULATED DISTRIBUTION CABLES**

PART 1 - GENERAL REQUIREMENTS

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REFERENCES

Part 1 of HD 621 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 621 only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 60811	Common test methods for insulating and sheathing materials of electric cables
HD 383	Conductors of insulated cables (Endorsing IEC 228 and 228A)
HD 405	Tests on electric cables under fire conditions
HD 605	Electric cables: Additional test methods
IEC 55-1	Paper-insulated metal-sheathed cables for rated voltages up to 18/30kV (with copper or aluminium conductors and excluding gas-pressure and oil-filled cables). Part 1: Tests.
IEC 229	Tests on cable oversheaths which have a special protective function and are applied by extrusion
IEC 287	Calculation of the continuous current rating of cables (100% load factor)

1. General

1.1 Scope

HD 621 applies to impregnated paper insulated cables for rated voltages $U_0/U(U_m)$ from 3,6/6(7,2)kV up to 20,8/36(42)kV used in power distribution systems.

This part (Part 1) specifies the general requirements applicable to these cables, unless otherwise specified in the particular sections of this HD.

Test methods specified are given in HD 605, EN 60811, HD 383 and HD 405 and in IEC 55-1 and IEC 229.

Part 2 covers all those test methods which are specific to paper insulated cables, and not included in HD 605.

The particular types of cables are specified in Parts 3 and 4.

1.2 Object

The objects of this Harmonisation Document are:

- to standardise cables that are safe and reliable when properly used, in relation to the technical requirements of the system of which they form a part;
- to state the characteristics and manufacturing requirements which have a direct or indirect bearing on safety;
- and to specify methods for checking conformity with those requirements.

2. Definitions

2.1 Definitions relating to insulating and sheathing materials

The insulation covered by this HD is paper, made from tapes, impregnated with suitable draining or non-draining compound. A suitable metallic sheath (lead or aluminium) is applied over the individual cores (single or separately lead sheathed cores) or over the assembly of the insulated cores (3-core belted or screened cables). The cable may be protected by an armouring and relevant serving and/or an outer sheath.

2.2 Definitions relating to the tests

Note: Tests classified as sample (S) or routine (R) maybe required as part of any type approval schemes.

2.2.1 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.

2.2.2 Sample tests (Symbol S)

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)

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

2.2.4 Tests after installation

Installation tests are made to demonstrate the integrity of the cable and its accessories as installed.

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 the following values U_0/U (U_m) expressed in kV.

U_0 is the rms value between any insulated conductor and earth (metal covering of the cable).

U is the rms value between any two phase-conductors of a multicore cable or of a system of single core cable.

U_m is the maximum rms value of the highest system voltage for which the equipment may be used.

The standard rated voltages U_0/U (U_m) of the cables in this HD are as follows:

U_0/U (U_m) = 3,6/6 (7,2) - 3,8/6,6 (7,2) - 6/10 (12) - 6,6/11 (12) - 7/12 (14,5) -
8,7/15 (17,5) - 12/20 (24) - 12,7/22 (24) - 15/20 (24) -
15/26 (30,5) - 18/30 (36) - 19/33 (36) - 20,8/36 (42) - kV rms

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. If used in DC systems, the maximum voltage has to be specified in the particular sections.

3. Marking

3.1 Indication of origin

Cables shall be provided with an identification of origin consisting of the marking of the manufacturer's name or trademark, or (if legally protected) identified number by one of the three following alternative methods:

- (a) printed tape within the cable;
- (b) printing on the insulation of at least one core;
- (c) printing, indenting or embossing on the sheath.

3.1.1 Continuity of marks

The distance between the end of one complete set of marks and the beginning of the next is specified in the particular sections.

3.2 Additional marking

Additional marking requirements may be specified in the particular sections.

3.3 Durability

Printed markings shall be durable.

3.4 Legibility

All markings shall be legible. Printed markings shall be in contrasting colours.

3.5 Common marking

Under consideration.

3.6 Use of the name CENELEC

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

4. Core identification

If required, the cores shall be identified by numbers, or by other schemes detailed in the particular sections of this HD.

5. Construction of cables

Compliance with the requirements specified in sub-clauses 5.1 to 5.11 and in the particular sections of this HD shall be checked by inspection and by measurement according to the test methods listed in the particular sections.

5.1 Conductors

5.1.1 Material

Conductors shall be either plain annealed copper or plain aluminium in accordance with HD 383 and with the requirements specified in the particular sections of this HD.

Conductors shall be stranded either circular or shaped, or (for aluminium only) solid.

5.1.2 Electrical resistance

The resistance of each conductor shall be in accordance with the requirements in HD 383 for the given class of conductor.

5.2 Insulation

5.2.1 Material

Insulation shall be made of paper tapes, helically applied around the conductor and impregnated with suitable draining or non draining compound.

Test requirements for the insulation are specified in the particular sections.

5.2.2 Thickness

Insulation thickness values for the core and the belt insulation are specified in the particular sections for each cable type, size and voltage.

The mean value of the insulation thickness shall be not less than the nominal value specified in the particular sections of this HD.

The minimum measured value shall not be less than the minimum value specified in the particular sections of this HD.

Compliance shall be checked by the test method given in part 2.

5.2.3 Additional characteristics, if any

These are specified in the particular sections.

5.2.4 Belted cables

In a belted cable a further thickness of insulating paper shall be applied around the assembled unscreened cores.

5.3 Screening of cores

Screening of cores, when required, shall consist of an insulation screening with or without a conductor screening, as specified in the particular sections of this HD. The screening shall consist of a semi-conducting and/or a metallised paper tape, as given in the particular sections of this HD.

5.4 Assembly of cores

In multicore cables, the cores shall be laid up helically or with another suitable method.

5.5 Fillers and binder tape

For each type of cable, the particular sections detail whether that cable includes fillers or not.

A centre filler may be used in multicore cables, and the assembly of cores and fillers may be held together by a binder tape.

5.5.1 Materials

The fillers and binder tapes, if any, shall be composed of a suitable material. When fillers or binder tapes are applied, there shall be no harmful interactions between their constituents and the insulation and/or the sheath.

5.5.2 Application

Fillers in multicore cables shall be laid up together with the cores to form a round and compact cable.

5.6 Metallic sheath

The metallic sheath shall be applied as a common sheath over the laid up cores including the belt insulation (if any) or separately over individual cores.

It is commonly made of lead, lead alloy or aluminium; requirements are given in the particular sections.

5.7 Inner covering (bedding)

The inner covering may be extruded or lapped (e.g. bitumen impregnated paper tapes) over the metallic sheaths.

5.7.1 Material

The material used for inner coverings shall be compatible with the cable components with which it is in contact, and shall be selected by reference to the maximum conductor temperature of the cable in normal operation.

5.7.2 Thickness

Unless otherwise specified for the particular type, the thickness of lapped beddings need not be checked by measurement.

The thickness of extruded inner covering for each type of cable shall be specified in the particular sections.

Compliance shall be checked by the test specified in the particular sections.

5.8 Inner sheath (if any)

An inner sheath may be specified in the particular sections.

5.8.1 Material

The material used for the extruded inner sheath shall be compatible with the cable components with which it is in contact, and shall be selected by reference to the maximum conductor temperature of the cable in normal operation.

The test requirements are specified in tables 4A and 4B unless stated otherwise in the particular sections.

5.8.2 Application

The inner sheath shall be extruded in a single layer as specified in the particular sections.

5.8.3 Thickness

The thickness of the extruded inner sheath shall be as detailed in the particular sections.

5.9 Armouring (if any)

The following types of armourings may be applied as specified in particular sections:

- (a) steel round wire or flat wire armouring;
- (b) steel tape armouring;
- (c) non magnetic armouring.

Detailed constructions of armourings are given in the particular sections.

5.10 Serving (if any)

Over the armouring a suitable serving made of fibrous material is applied; requirements for the applications as well as for the materials are given in the particular sections.

5.11 Outer sheath (if any)

5.11.1 Material

The outer sheath shall be applied as specified in the particular sections and shall be of an extruded synthetic material suitable for the maximum conductor temperature in normal operation and of the type detailed in the particular sections.

The test requirements for these compounds are specified in Tables 4A and 4B unless stated otherwise in the particular sections.

5.11.2 Thickness

5.11.2.1 Sheath applied over a smooth surface

For a sheath applied on a smooth cylindrical surface, such as a metallic sheath, unless otherwise specified, the mean value of the thickness of the outer sheath shall be not less than the specified value for each type and size of cable in the particular sections.

However, the thickness at any place may be less than the specified value provided that the difference does not exceed $0,1\text{mm} + 15\%$ of the specified value.

Compliance shall be checked by the test methods given in HD 605, sub-clause 2.1.2.

5.11.2.2 Sheath applied over an uneven surface

For a sheath applied on an irregular cylindrical surface, such as a corrugated metallic sheath or a sheath applied directly over an armour, unless otherwise specified the minimum thickness measured at any point of the outer sheath shall not fall below the specified value given in the particular sections by more than $0,2\text{mm} + 20\%$ of the specified value.

Compliance shall be checked by the test methods given in HD 605,

5.11.3 Mechanical properties before and after ageing

The sheath shall have appropriate mechanical characteristics.

Compliance shall be checked according to the requirements specified in Tables 4A and 4B unless otherwise stated in the particular sections.

5.11.4 Additional properties

These are specified in the particular sections.

6. Completed cables

All cables shall comply with the requirements specified in sub-clauses 5.1 to 5.11 and in the particular sections of this HD and shall be checked by inspection and by measurements according to the test methods in documents listed in the particular sections.

7. Sealing and packing

Prior to storage or shipment, cable ends shall be sealed by appropriate caps so that water ingress is efficiently prevented, as well as to prevent leakage of the impregnating compound.

Cables shall be packed on drums. Refer to the particular sections.

8. Current carrying capacity

The current intensity that cables to this document can carry is determined by different conditions, either electrical (voltage drop) or thermal, whichever is most demanding.

The current-carrying capacity resulting from thermal limitations are calculated according to IEC Publication 287 or equivalent existing methods.

These calculations shall take into account the operation and installation conditions.

Tabulated values of current-carrying capacities according to the cable for typical installation conditions may be found in the particular sections.

9. Guide to use and selection of cables

For guidance on the use of cables see particular sections of this HD.

When selecting the cables, attention is drawn to the fact that national conditions or regulations, covering, e.g. climatic conditions or installation requirements, may exist. These should therefore be followed in conjunction of this HD.

Table 4A - Requirements of sheathing compounds : PVC

1	2	3	4	7	8	9	10	11
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMV 1 PVC sheath 70	DMV 10 PVC sheath 90	DMV 13 PVC sheath 90	DMV 18 PVC sheath 90	DMV 23 PVC sheath 90	DMV 25 PVC sheath 90
MAXIMUM OPERATING TEMPERATURE OF THE CONDUCTOR								
Mechanical properties								
- <i>before ageing on sample</i> minimum tensile strength minimum elongation at break		MPa %	12,5 125	12,5 150	12,5 125	12,5 150	12,5 150	12,5 150
- <i>after ageing on sample</i> temperature duration T1 minimum tensile strength maximum variation T1/T0 minimum elongation at break maximum variation T1/T0		°C h MPa % % %	80 168 12,5 ±20 125 ±20	100 168 12,5 ±25 150 ±25	100 168 12,5 ±20 125 ±20	100 168 12,5 ±25 150 ±25	100 168 12,5 ±25 150 ±25	100 168 12,5 ±25 150 ±25
- <i>after ageing on complete cable (non contamination test)</i> temperature duration T1 duration T2 minimum tensile strength maximum variation T2/T0 maximum variation T2/T0 minimum elongation at break maximum variation T2/T0 maximum variation T2/T1		°C h h MPa % % % % %	80 168 ±25 ±25	100 168 12,5 ±25 150 ±25	100 168 12,5 ±20 125 ±20	100 168 ±25 ±25	100 168 ±25 ±25	100 168 12,5 ±25 ±25
Physical and chemical properties								
Shrinkage test duration temperature maximum of shrinkage		h °C %						

Note: 1MPa = 1N/mm²

Remark: The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Table 4A - Requirements of sheathing compounds : PVC (continued)

1	2	3	4	7	8	9	10	11
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMV 1 PVC sheath 70	DMV 10 PVC sheath 90	DMV 13 PVC sheath 90	DMV 18 PVC sheath 90	DMV 23 PVC sheath 90	DMV 25 PVC sheath 90
Physical and chemical properties (continued)								
loss of mass	duration temperature maximum loss of mass	h °C mg/cm ²	168 100 2	168 100 1,5		168 100 1,5	168 100 1,5	168 100 1,5
pressure test at high temperature	duration temperature coefficient k maximum depth of indentation	h °C %	4/6 80 0,8 50	6 90 0,8 50	4/6 90 0,6/0,7 50	4/6 80 0,8 50	4/6 90 0,6/0,8 50	6 90 50
heat shock test	duration temperature	h °C	1 150	1 150	1 150	1 150	1 150	1 150
tests at low temperature								
elongation test at low temperature	temperature minimum elongation	°C %	-15 20	-25 20	-15 20	-15 20	-15 20	-15 20
impact test at low temperature	temperature	°C	-15	-20	-15	-15	-15	-15
bending test at low temperature	temperature	°C	-15	-25	-15	-15	-15	-15
thermal stability	temperature duration	°C min	200 30					200 80

Note: 1MPa = 1N/mm²

Remark: The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Table 4A - Requirements of sheathing compounds : PVC (continued)

1	2	3	12	13	14	15	16
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMV 26 PVC sheath 90	DMV 27 PVC sheath 90	DMV 28 PVC sheath 90	DMV 29 PVC sheath 90	DMV 41 PVC sheath 70
MECHANICAL PROPERTIES							
- before ageing on sample minimum tensile strength minimum elongation at break		MPa %	12,5 150	12,5 200	12,5 150	12,5 150	12,5 125
		°C h	100 168	100 168	100 168	100 168	80 168
		MPa % % %	12,5 ±25 150 ±25	17,5 ±25 200 ±25	12,5 ±25 150 ±25	12,5 ±25 150 ±25	12,5 ±20 125 ±20
- after ageing on sample temperature duration T1 maximum variation T1/T0 maximum variation T1/T0		°C h	100 168	100 168	100 168	100 168	80 168
		MPa % % %	12,5 ±25 150 ±25	17,5 ±25 200 ±25	12,5 ±25 150 ±25	12,5 ±25 150 ±25	12,5 ±20 125 ±20
		°C h h MPa % % % %	100 168 12,5 ±25 150 ±25	100 336 1008 ±30 ±20 ±30 ±20	100 168 12,5 ±25 150 ±25	100 168 12,5 ±25 150 ±25	
- after ageing on complete cable (non contamination test) minimum tensile strength minimum elongation at break		°C h h MPa % % % %	100 168 12,5 ±25 150 ±25	100 336 1008 ±30 ±20 ±30 ±20	100 168 12,5 ±25 150 ±25	100 168 12,5 ±25 150 ±25	
		°C h h MPa % % % %	100 168 12,5 ±25 150 ±25	100 336 1008 ±30 ±20 ±30 ±20	100 168 12,5 ±25 150 ±25	100 168 12,5 ±25 150 ±25	
		°C h h MPa % % % %	100 168 12,5 ±25 150 ±25	100 336 1008 ±30 ±20 ±30 ±20	100 168 12,5 ±25 150 ±25	100 168 12,5 ±25 150 ±25	
Physical and chemical properties							
shrinkage test duration temperature maximum of shrinkage		h °C %		6 120 4			
		h °C %		6 120 4			
		h °C %		6 120 4			

Note: 1MPa = 1N/mm²

Remark:

The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Table 4A - Requirements of sheathing compounds : PVC (continued)

1	2	3	12	13	14	15	16
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMV 26 PVC sheath 90	DMV 27 PVC sheath 90	DMV 28 PVC sheath 90	DMV 29 PVC sheath 90	DMV 41 PVC sheath 70
Physical and chemical properties (continued)							
loss of mass duration temperature maximum loss of mass		h °C mg/cm ²	168 100 1,5	168 100 1,5	168 100 2	168 100 1,5	
pressure test at high temperature duration temperature coefficient k maximum depth of indentation		h °C %	6 80 50	6 80 0,8 50	6 90 0,7 50	6 90 0,7 50	4/6 80 60
heat shock test duration temperature		h °C	1 150		1 150	1 150	
tests at low temperature <i>elongation test at low temperature</i> temperature minimum elongation <i>impact test at low temperature</i> temperature <i>bending test at low temperature</i> temperature		°C % °C °C	-15 20 -15	-15 20 -15	-20 20 -20 -20	-15 20 -15 -15/-25	-15
thermal stability temperature duration		°C min	200 80				

Note: 1MPa = 1N/mm²

Remark: The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Table 4A - Requirements of sheathing compounds : PVC (continued)

1	2	3	20	21	22
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMV 44 PVC sheath 90	DMV 45 PVC sheath 70	DMV 46 PVC sheath 70
MAXIMUM OPERATING TEMPERATURE OF THE CONDUCTOR					
Mechanical properties					
- <i>before ageing on sample</i> minimum tensile strength minimum elongation at break					
		MPa %	12,5 125	12,5 125	12,5 125
- <i>after ageing on sample</i> minimum tensile strength minimum elongation at break	temperature duration T1	°C h	80 168	80 168	80 168
	maximum variation T1/T0	MPa %	12,5 ±20	12,5 ±20	12,5 ±20
	maximum variation T1/T0	% %	125 ±20	125 ±20	125 ±20
- <i>after ageing on complete cable (non contamination test)</i> minimum tensile strength minimum elongation at break	temperature duration T1 duration T2	°C h h	80 168 12,5 ±20	80 168 12,5 ±20	80 168 ±25 ±25
	maximum variation T2/T0	MPa %	12,5 ±20	12,5 ±20	125 ±20
	maximum variation T2/T0	% %	125 ±20	125 ±20	±25
	maximum variation T2/T0	% %			
	maximum variation T2/T1	%			
Physical and chemical properties					
shrinkage test	duration temperature maximum of shrinkage	h °C %			

1MPa = 1N/mm²Note:
Remark:

The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Table 4A - Requirements of sheathing compounds : PVC (concluded)

1	2	3	20	21	22
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMV 44 PVC sheath 90	DMV 45 PVC sheath 70	DMV 46 PVC sheath 70
MAXIMUM OPERATING TEMPERATURE OF THE CONDUCTOR					
Physical and chemical properties (continued)					
loss of mass	duration	h	168	168	168
	temperature				
pressure test at high temperature	maximum loss of mass	°C	80	80	80
	duration				
heat shock test	temperature	°C	2	2	2
	coefficient k				
tests at low temperature	maximum depth of indentation	%	4/6	4	4
	duration				
elongation test at low temperature	temperature	°C	80	70	80
	minimum elongation				
impact test at low temperature	temperature	°C	0,6/0,8	50	0,8
	temperature				
bending test at low temperature	temperature	°C	50	1	150
	temperature				
thermal stability	temperature	°C	-15	-20	-15
	duration				
thermal stability	temperature	°C	-15	-15/-25	-15/-25
	duration				

1MPa = 1N/mm²

The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Note:

Remark:

Table 4B - Requirements of sheathing compounds : PE

1	2	3	5	6	7	8	9
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMP 5 PE sheath 90	DMP 8 PE sheath 90	DMP 9 PE sheath 90	DMP 10 PE sheath 90	DMP 11 PE sheath 90
MAXIMUM OPERATING TEMPERATURE OF THE CONDUCTOR							
Mechanical properties							
- <i>before ageing on sample</i> minimum tensile strength minimum elongation at break		MPa %	12.5 300	18 300	15 350	10 300	10 300
- <i>after ageing on sample</i> minimum tensile strength minimum elongation at break	temperature duration T1 maximum variation T1/T0 maximum variation T1/T0	°C h MPa % % %	110 336 300	110 336 300	110 336 15 ±25 350 ±25	100 240 300	100 240 ±25 300
- <i>after ageing on complete cable (non contamination test)</i> minimum tensile strength minimum elongation at break	temperature duration T1 duration T2 maximum variation T2/T0 maximum variation T2/T0 maximum variation T2/T0 maximum variation T2/T1	°C h h MPa % % % %	100 168 ±25 ±25	100 168 300	100 168 15 ±25 350 ±25	100 168 300	100 168 300

Note: 1MPa = 1N/mm²

Remark: The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections

Table 4B - Requirements of sheathing compounds : PE (continued)

1	2	3	5	6	7	8	9
COMPOUND NO. TYPE	TEST METHOD	UNIT °C	DMP 5 PE sheath 90	DMP 8 PE sheath 90	DMP 9 PE sheath 90	DMP 10 PE sheath 90	DMP 11 PE sheath 90
MAXIMUM OPERATING TEMPERATURE OF THE CONDUCTOR							
Physical and chemical properties							
pressure test at high temperature	duration temperature coefficient k maximum depth of indentation	h °C %	6 115 50	6 115 30	6 115 30	6 90 0,7 50	6 90 0,7 50
shrinkage test	duration temperature maximum shrinkage	h °C %	5 80 4	5 x 6 80 7	5 x 5 80 7		
tests at low temperature							
elongation test at low temperature	temperature minimum elongation	°C %				-20 20	
impact test at low temperature	temperature	°C				-20	
bending test at low temperature	temperature	°C				-20	
carbon black content	minimum	%	2,5 ± 0,5	2,5 ± 0,5	2,3	2	2,0
shore-D hardness	minimum			55			55
melt index	maximum				**		0,4
stress cracking resistance	maximum			48	*		
UV resistance							

Note:

* under consideration

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Remark:

1 MPa = 1N/mm²

No value required but a variation of ± 20% with respect to granulates

The tolerance on temperature values is given in HD 605 sub-clause 1.5.2 but may be varied if specified in the particular sections