BS EN 50407-3:2014

BSI Standards Publication

Multi-pair cables used in high bit rate digital access telecommunications networks

Part 3: Indoor multi-pair/quad riser cables up to 100 MHz for maximum length of connection 100 m supporting universal services, xDSL and applications up to 100 Mbit/s over IP

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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English Version

Multi-pair cables used in high bit rate digital access telecommunications networks - Part 3: Indoor multi-pair/quad riser cables up to 100 MHz for maximum length of connection 100 m supporting universal services, xDSL and applications up to 100 Mbit/s over IP

Câbles multi-paires de l'utilisateur final utilisés dans les réseaux d'accès numériques de télécommunication à haut-débits - Partie 3 : Câbles intérieurs multi paires/quartes pour colonne de communication, performants jusqu'à 100 MHz, de longueur maximale de connexion de 100 m, supportant le service universel, le xDSL et les applications jusqu'à 100 MBits sur IP

Vielpaarige Kabel für digitale Telekommunikationsnetzwerke mit hoher Bitrate - Teil 3: Vielpaarige-/Vierer-Steigekabel im Innenbereich bis 100 MHz über eine maximale Verbindungslänge von 100 m für universelle Dienste, xDSL und Anwendungen bis zu 100 Mbit/s über Internetprotokoll (IP)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Foreword

This document (EN 50407-3:2014) has been prepared by CLC/SC 46XC “Multicore, multipair and quad data communication cables”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-03-10
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-03-10

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

1 Scope

This European Standard defines indoor multi-pair/quad cables for installation in Multi Dwelling units shaft supporting universal services, xDSL and applications up to 100 MBits over IP, their relative definitions and requirements.

NOTE Higher bit rate applications need cables specified in a relevant part of EN 50406 or EN 50288 series.

It covers cables, with an overall screen, with performances up to 100 MHz, to be used in indoor networks intended to connect the broadband outside plant to the individual customer dwelling for applications 100 Mbit/s over IP maximum length of connection 100 m.

The electrical, environmental, mechanical and transmission performance characteristics of the cables, related to their reference test methods, are detailed.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 10002-1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature*

EN 50289 (all parts), *Communication cables - Specifications for test methods (Basic reference standards)*

EN 50290 (all parts), *Communication cables (Basic reference standards)*

EN 60811-201, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 1-1: General application - Measurement of thickness and overall dimensions - Tests for determining the mechanical properties (IEC 60811-201)*

HD 402, *Standard colours for insulation for low-frequency cables and wires (IEC 60304)*

IEC 60028, *International standard of resistance for copper*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the terms and definitions of EN 50290-1-2:2004 apply.

3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

ADSL	Asymmetric Digital Subscriber Lines
ATM	Asynchronous Transfer Mode
DSL	Digital Subscriber Line
EMC	Electromagnetic Compatibility

EMI	Electromagnetic Interference
FSAN	Full Service Access Network
HDSL	High-bit-rate Digital Subscriber Lines
ISDN	Integrated Digital Services Network
ISDN-BRA	ISDN-Basic Rate Access
ISDN-PRA	ISDN-Primary Rate Access
Mbps	Mega-bits per second
TBD	To be determined
VDSL	Very-high-bit-rate Digital Subscriber Lines
XDSL	Generic term referring to all DSL, ISDN, HDSL, ADSL, VDSL, etc.

4 General information

4.1 General cable description

These cables are designed for indoor high bit rate telecommunication networks. They shall have an overall screen.

High bit rate applications targeted in this specification involve frequencies up to 100 MHz. To restrict emission and to ensure satisfactory electromagnetic immunity, these cables include an overall screen.

These cables contain from four pairs up to 100 pairs (ffs) that can be either in pair or quad construction.

4.2 Environment and product safety requirement

Safety local and regional regulation (e.g. Low Voltage European directive, CPR and other relevant directives) is assumed to be met by these cables.

4.3 Testing

According to the EN 60068 (HD 323), for all test procedures described in this section, the test conditions shall be the standard atmospheric conditions – (23 ± 5) °C and 20 % −70 % Relative Humidity –, unless otherwise stated. All measured and computed values are to be rounded to the number of decimal places given in the corresponding requirement or objective.

The parameters specified in this standard may be affected by measurement uncertainty arising either from measurement errors or calibration errors due to a lack of suitable standards. Acceptance criteria shall be interpreted with respect to this consideration.

5 Requirements for conductor

5.1 Construction and dimensions

The conductor shall consist of annealed copper, uniform in quality and free from defects. The properties of the copper shall be in accordance with IEC 60028.

The conductor shall be solid, circular in section. Normally the conductor should be drawn in one piece. Joints in the conductor are permitted, provided that the tensile strength of a joint is not less than 85 % of the un-jointed solid conductor.

The diameter of the conductor shall be in the range 0,5 mm to 0,8 mm .

5.2 Mechanical requirements

The conductor elongation at break shall be tested according to EN 10002-1 and shall be better than 15 % minimum.

5.3 Electrical requirements

5.3.1 Conductor resistance

When measured in accordance with EN 50289-1-2, the conductor resistance shall meet the computed values when using EN 50290-2-1:2005, 12.1.

5.3.2 Conductor resistance unbalance

When measured in accordance with EN 50289-1-2, the conductor resistance unbalance shall be maximum 2 %.

6 Requirements for insulation

6.1 Construction material and dimensions

6.1.1 Construction

Conductor insulation shall be composed of solid, cellular or composite (e.g. foam skin) polyolefin that comply with the relevant parts of EN 50290-2.

The insulated conductors shall be coloured for identification. Colours shall correspond reasonably with the standard colours shown in HD 402.

6.1.2 Colour code

The colour code shall be agreed between the customer and the manufacturer.

6.2 Mechanical requirements

Shrinkage of insulation shall be checked against the relevant parts of EN 50290-2. The shrinkage shall be less than 5 %.

6.3 Electrical requirements

6.3.1 Insulation resistance

When measured in accordance with EN 50289-1-4 the insulation resistance shall be greater than 5 000 MOhmkm at 500 V d.c. minimum.

6.3.2 Dielectric strength

Dielectric strength shall be tested according to EN 50289-1-3. The test shall be conducted with 1 kV d.c. or 700 V a.c. for 2 s.

7 Requirements for cable element

7.1 Construction and dimensions

The cable element is

- a pair consisting of two insulated conductors twisted together and designated wire “a” and wire “b”, or

- a quad consisting of four insulated conductors twisted together and designated wire “a”, wire “c”, wire “b” and wire “d” in order of rotation.

7.2 Screening of the cable element

Where a screen is required over the pair or assembly of pairs (quads….), to improve the external and internal immunity, it may consist of one of the following:

a) an aluminium tape laminated to a plastic tape;

b) an aluminium tape laminated to a plastic tape and a metal-coated or plain copper drain wire whereby the metal tape is in contact with the drain wire.

A protective wrapping may be applied under or/and over the screen.

7.3 Spare cable elements

The cable may be equipped with spare pairs or quads in accordance with the basic cable structure.

The number of spare cable elements is depending upon agreement between the customer and the supplier.

8 Requirements for cable core - Design

8.1 General

The cable unit may be laid up preferentially in four pair units screened or unscreened.

8.2 Screen

A screen is required over the unit which shall consist of one of the following:

a) an aluminium tape laminated to a plastic tape;

b) an aluminium tape laminated to a plastic tape and a metal-coated or plain copper drain wire whereby the metal tape is in contact with the drain wire.

A protective wrapping may be applied under or/and over the screen.

8.3 Interstitial fillers

In order to provide a compact and reasonably circular cable fillers may be used.

9 Requirements for filling compounds

Not applicable.

10 Requirements for the screening of the cable core

The cable core shall be screened by one of the following:

a) an aluminium tape laminated to a plastic tape and a metal-coated or plain copper drain wire whereby the metal tape is in contact with the drain wire.

b) An aluminium tape laminated to a plastic tape and a tinned copper braid in contact with the metal tape.

c) A protective wrapping may be applied under or/and over the screen.

11 Requirement for the armour

Not applicable.

12 Requirements for the sheath

12.1General

The sheath shall have adequate mechanical strength and elasticity to meet the mechanical requirements of the cable. Under normal environmental conditions, these requirements should be met during the whole expected life time of the cable.

The sheath shall be continuous, having a thickness as uniform as possible. The minimum thickness of the sheath shall be determined in accordance with the method specified in EN 60811-201. The thickness of the sheath shall be agreed between the customer and the manufacturer.

The sheath shall be applied to fit closely to the core of the cable. In the case of screened cables, the sheath shall not adhere to the screen except when it is intentionally bonded to it.

The sheath material shall meet the requirements specified in EN 50290-2-27.

Attention should be paid to the U.V. resistance if required

12.2Colour of sheath

The colour of the sheath shall be agreed between the customer and the supplier. .

12.3Mechanical requirements

The abrasion resistance of the sheath marking shall be tested according to EN 50289-3-8.

13 Cable identification

The cable identification will include the supplier identification and, if required,

a) year of manufacture,

b) cable type (with the number of pairs and the size of conductors),

c) length,

using one of the following methods:

d) coloured threads or tapes;

e) printing on the sheath;

Additional markings may be required on the sheath depending upon agreement between the customer and the manufacturer. Sheath numbering in case of breakout cables should be provided

14 Requirements for finished cable

14.1Mechanical requirements

14.1.1Bending

The bending performance of the cable shall be tested in accordance with EN 50289-3-9:2001, Clause 4, procedure 1. The minimum bending radius shall be less than 8 x OD.

14.1.2Impact

If required, the impact resistance of the cable shall be tested in accordance with EN 50289-3-6. The test conditions shall be agreed between customer and manufacturer depending upon the targeted conditions of installation.

14.1.3Tensile strength

14.1.3.1 Tensile strength during installation

The tensile performance of the cable shall be tested in accordance with EN 50289-3-16. The maximum load per pair shall be 20 N.

Should an installation require greater pulling tensions a strength member shall be required.

14.1.3.2 Long term tensile load

(Under consideration).

14.1.4Crush resistance

The crush resistance of the cable shall be tested in accordance with EN 50289-3-5 with 1 000 N/1 min/100 mm

Near end Crosstalk, Return Loss and Characteristic Impedance shall remain within the specified limits.

14.2Environmental requirements

14.2.1Temperature range

The ambient temperature range of these cables shall be between –10 °C +60 °C.

14.2.2Cold bend

The cold bend performance of the cable shall be tested in accordance with EN 50289-3-9. The test conditions shall be as follow:

- mandrel diameter: 8 x OD;
- number of turns: 4;
- temperature: (–15 ± 2) °C.

14.2.3Rodent and Fauna protection

Depending upon agreement between the customer and the supplier fauna and/or rodent protection may be required [1)].

14.2.4Moisture barriers

Not applicable.

15 Electrical requirements

NOTE The transmission requirements (15.5 to 15.14) are normally defined up to 100 MHz. However depending upon an agreement between the customer and the supplier they may be restricted to the maximum frequency of the DSSL targeted application (i.e. 10 MHz, 30 MHz or 60 MHz).

15.1Dielectric strength

Dielectric strength shall be tested according to EN 50289-1-3. The test shall be conducted with

- 1 kV d.c. or 700 V a.c. for 2 s between conductors,
- 1 kV d.c. or 700 V a.c. for 2 s between conductors and screen.

The above requirements are intended to ensure LVD compliance when the cable is fed with power that are found in telecommunication application.

WARNING: The maximum voltages, currents and temperatures shown in Table 1 apply to cables specified in this European Standard which are intended to be used solely for communication technologies. The cables specified in this European Standard are not intended for and shall not be connected to and/or used on the mains utility electricity supply.

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1) Safety local and regional regulation about dangerous substances (e.g. relevant European directives) is assumed to be met by these cables.

Table 1 - Maximum recommended voltage, current, current density and conductor temperature

Parameter	Unit	Requirement
Maximum voltage	V	300
Maximum current density	A/mm^2	3
Maximum short circuit power density	W/mm^2	350
Maximum service power density	W/mm^2	100
Maximum element temperature in service	°C	70

15.2Mutual capacitance

If required mutual capacitance tested according to EN 50289-1-5, shall meet the values agreed between customer and manufacturer.

15.3Capacitance unbalance

Capacitance unbalance pair to earth tested according EN 50289-1-5, shall be less than 1 200 pF/km.

15.4Velocity of propagation

When measured according to EN 50289-1-7, the relative velocity of propagation shall be greater than 60 % at 1 MHz.

15.5Attenuation

Attenuation shall be tested according to EN 50289-1-8 in the frequency range 1 MHz to 100 MHz. Depending on the installation the attenuation values below are applicable to a 100 m cable (see Table 2), and other values are calculated by multiplying for 200 m or 300 m using Table 2 values (200 m, multiply values by 2). The appropriate conductor size shall be chosen to suit the length of installation.

The attenuation shall be less than the following values that are derived from:

$$\alpha \leq 1{,}9108\sqrt{f} + 0{,}0222f + 0{,}2/\sqrt{f},\ 1\ \text{MHz} \leq f \leq 100\ \text{MHz} \quad (1)$$

Where,

f is the frequency in MHz

Attenuation in dB/100 m

NOTE See Table 2

Table 2 - Frequency and Attenuation

Frequency	Attenuation
1	2,1
4	4,0
10	6,3
16	8,0
20	9,0
30	11,2
60	16,2
100	21,3

Though, the attenuation is not measured below 1 MHz, the above characteristics result in compliance for ISDN application.

15.6Longitudinal Conversion Loss (LCL)

When measured according to EN 50289-1-9, Longitudinal Conversion Loss (LCL) shall be better than 40 dB at 1 MHz.

15.7Near End Crosstalk (NEXT)

When measured according to EN 50289-1-10, Near End Crosstalk (NEXT) shall be better than the values given in Table 3.

15.8Equal Level Far-End Crosstalk (ELFEXT)

When required it will be measured according to EN 50289-1-10, Far End Crosstalk (FEXT).

15.9Power Sum (PS) of crosstalk losses

When required it will be measured according to EN 50289-1-10.

15.10 Mean impedance

When measured according to EN 50289-1-11, the mean impedance shall be Zo ± 10 Ω between 20 MHz and 40 MHz in Table 3, where Zo is the required nominal impedance given in Table 3.

15.11 Return loss

When required, the return loss shall be measured according to EN 50289-1-11 and shall be better than the requirements in Table 3.

15.12 Coupling attenuation [2)]

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2) Depending upon agreement between the customer and the manufacturer and the M/313 related requirements coupling attenuation or transfer impedance should be measured.

The Coupling attenuation shall be measured according to EN 50289-1-6 and shall be greater than 55 dB.

15.13 Transfer impedance [2)]

The Transfer Impedance shall be measured according to EN 50289-1-6 and shall be less than 100 mΩ/m at 30 MHz.

15.14 Transmission properties

The transmission properties shall be as given in Table **3.**

Table 3 - Transmission properties

Property	Units	Values	
Frequency range	MHz	0,3 - 100	
NEXT	dB	62 - 15.Log(f)	
Impedance (Z0)	Ω	100 and 120	
Return Loss	dB	0,772 ≤ f ≤ 10	RL ≥ 17 + 5.Log(f)
		10 < f ≤ 20	RL ≥ 22
		20 < f ≤ 100	RL ≥ 22 - 7.Log(f/20)

16 Product qualification requirements

The supplier could use a quality system according to EN ISO 9000 and if required a product specific quality system agreed between supplier and customer.

Bibliography

[1] EN 60811-1-2:1995, *Insulating and sheathing materials of electric cables - Common test methods – Part 1-2: General application - Thermal ageing methods (IEC 60811-1-2:1985 + corrigendum May 1986 + A1:1989)*

[2] EN 60068/HD 323, (series) *Environmental testing (IEC 60068 series)*

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