BS EN 50117-4-2:2015

BSI Standards Publication

Coaxial cables

Part 4-2: Sectional specification for CATV cables up to 6 GHz used in cabled distribution networks

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EPL/46, Cables, wires and waveguides, radio frequency connectors and accessories for communication and signalling.

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

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Published by BSI Standards Limited 2015

ISBN 978 0 580 85694 5

ICS 33.120.10

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 October 2015.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50117-4-2

September 2015

ICS 33.120.10

English Version

Coaxial cables - Part 4-2: Sectional specification for CATV cables up to 6 GHz used in cabled distribution networks

Câbles coaxiaux - Partie 4-2: Spécification intermédiaire relative aux câbles des réseaux câblés de télévision jusqu'à 6 GHz, utilisés dans les réseaux de distribution par câbles

Koaxialkabel - Teil 4-2: Rahmenspezifikation für CATV-Kabel bis zu 6 GHz für Kabelverteilanlagen

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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

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European foreword

This document (EN 50117-4-2:2015) has been prepared by CLC/SC 46XA "Coaxial cables" of CLC/TC 46X "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)	2016-06-22
• latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2018-06-22

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

1 Scope

This sectional specification relates to EN 50117-1 and should be read in conjunction with this generic specification. This specification applies to indoor drop cables for use in cabled distribution systems operating at temperature between -40 °C and +70 °C[1)] and at frequencies between 5 MHz and 6 000 MHz and complying with the requirements of EN 50083. These cables are suitable to implement the network type Case D as depicted in Figure 1 and subclause 6.6 of EN 60728-1-1:2014.

The purpose of this European Standard is to specify the applicable test methods and requirements for the electrical, mechanical, and environmental and fire performance of the cables.

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 50117-1:2002, *Coaxial cables – Part 1: Generic specification*

EN 50289-1-6, *Communication cables – Specifications for test methods – Part 1-6: Electrical test methods – Electromagnetic performance*

EN 50289-3-9:2001, *Communication cables – Specifications for test methods – Part 3-9: Mechanical test methods – Bending tests*

EN 50290-1-2:2004, *Communication cables – Part 1-2: Definitions*

EN 50290-2-22, *Communication cables – Part 2-22: Common design rules and construction – PVC sheathing compounds*

EN 50290-2-27, *Communication cables – Part 2-27: Common design rules and construction – Halogen free flame retardant thermoplastic sheathing compounds*

prEN 50290-2-37, *Communication cables – Part 2-37: Common design rules and construction – Polyethylene insulation for coaxial cables*

prEN 50290-2-38, *Communication cables – Part 2-38: Common design rules and construction – Polyethylene insulation for coaxial cables*

EN 62153-1-1, *Metallic telecommunication cable test methods – Part 1-1: Electrical – Measurement of the pulse/step return loss in the frequency domain using the Inverse Discrete Fourier Transformation (IDFT) (IEC 62153-1-1)*

IEC 61196-1-115, *Coaxial communication cables – Part 1-115: Electrical test methods – Test for pulse return loss (regularity of impedance)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 50290-1-2:2004 and EN 50117-1:2002 apply.

1) This value is valid for applications without ampacity only.

4 Requirements for cable construction

4.1 General

Designing the cable, consideration should be paid to the maximum admissible current stated in the detail specification. It is assumed that the raise of temperature of the inner conductor when submitted to the maximum current under nominal ambient conditions does not affect the mechanical and electrical properties of the cable.

4.2 Inner conductor

The conductor shall meet the requirements of 4.2 of EN 50117-1:2002, and shall be solid and can be plain or metal coated. Dimensions shall be in accordance with the detailed specification.

There shall be no joint made subsequent to the last drawing operation.

4.3 Dielectric

The dielectric material(s) shall be in accordance with 4.3 of EN 50117-1:2002 and shall consist of polyolefin materials, with prEN 50290-2-37 (polyethylene) or prEN 50290-2-38 (polypropylene). Dimensions shall be in accordance with the detail specification.

Unless otherwise specified, the nominal diameter over the dielectric should be one of the preferred values, namely 3,7 mm [2)], 4,8 mm and 7,2 mm.

4.4 Outer conductor or screen

The construction and material of the outer conductor (or screen) shall be meet the requirements of 4.4 items b), f) or g) of EN 50117-1:2002. Where option b) is used, a double braid layer is required.

For braid constructions or helically wound wires, the braid angle shall be between 15° and 45°. The coverage factor shall be greater than or equal to 65 %, or, when the cable is provided with a metal foil, greater than or equal to 25 %. These values are also valid for cables with two bi-directional layers of helically wound wires.

Dimensions shall be in accordance with the detail specification.

4.5 Filling compounds

Not applicable.

4.6 Moisture barriers

Not applicable.

4.7 Wrapping layers

Not applicable.

4.8 Sheath

Sheath material(s) shall meet the requirements of the EN 50290-2-22 for PVC or EN 50290-2-27 for halogen free flame retardant materials.

The sheath shall also meet the requirements of 4.8 of EN 50117-1:2002.

———————

2) Smaller cables are not suitable as the attenuation at 6 GHz might be too high.

Dimensions shall be in accordance with the detail specification.

4.9 Metallic protection

Not applicable.

4.10 Cable integral suspension strand (Messenger wire)

Not applicable.

4.11 Oversheath

Not applicable.

4.12 Fauna proofing

Not applicable.

4.13 Chemical and/or environmental proofing

Not applicable.

4.14 Cable identification

4.14.1 General

Cable identification shall be in accordance with 4.14 of EN 50117-1:2002.

4.14.2 Sheath marking

Sheath marking shall be achieved as a non-degradable print containing the following minimum information:

— designation of the cable;
— attenuation value (in dB/100 m at 800 MHz, rounded);
— screening class;
— Euro-class;
— name of supplier.

EXAMPLE EN 50117-4-2 21 < XXX > Class A < YYY >

4.15 Labelling

Unless otherwise specified in the detail specification drums or coils shall be provided with a label with a non-degradable print containing the following minimum information:

— designation of the cable;
— attenuation value (in dB/100 m at 800 MHz, rounded);
— screening class;
— Euro-class;
— name of supplier;
— batch part number;
— length of cable.

EXAMPLE EN 50117-4-2 21 < XXX > Class A < YYY > 03/12 543m

5 Tests for completed cables

5.1 General

When tested in accordance with the requirements of EN 50117-1, the requirements given below shall apply.

5.2 Electrical tests

5.2.1 Low-frequency and D.C. electrical measurements

Table 1 — Low-frequency and D.C. electrical measurements

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.1.1.1	Conductor resistance	Applicable, value in accordance with the detail specification
5.1.1.2	Dielectric strength	2 kV D.C. or 1,5 kV A.C. for 1 min
5.1.1.3	Insulation resistance	≥ 10^4 MΩ x km
5.1.1.4	Mutual capacitance	When required, in accordance with the detail specification
5.1.1.5	Voltage test of sheath	2,5 kV A.C. or 3,75 kV D.C., unless otherwise specified in the relevant detail specification. Test in accordance with EN 50289-1-X [a]
5.1.1.6	Discharge (corona) test	Not applicable
5.1.1.7	Voltage proof	Not applicable
5.1.1.8	Power rating	Not applicable
[a] Test procedure is under consideration by CLC/SC 46XA.		

5.2.2 High-frequency electrical and transmission measurements

Table 2 — High-frequency electrical and transmission characteristics measurements

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.1.2.1	Velocity of propagation	May be specified for information purposes only in the detail specification.
5.1.2.2	Longitudinal attenuation (operational attenuation)	The cable shall comply at any frequency with the equation $a \cdot \sqrt{f} + b \cdot f + c$, (dB/100 m). In case of copper clad conductor material a term $d / \sqrt{f}$ should be added, to better match the curve at low frequencies. The coefficients a, b, c and d shall be given in the relevant detail specification as well as the discrete values at 200 MHz, 800 MHz, 2 483 MHz and 5 875 MHz. Note 1: *f* is in MHz. Note 2: The value of d can be calculated using k-factors as defined in EN 50290-2-1:2005, 6.5 and Tables 8 and 20.
5.1.2.3	Characteristic impedance	75 Ω ± 3 Ω

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.1.2.4	Return loss [a]	<u>For cables where $\alpha \leq$ 18 dB/100 m at 800 MHz</u> RL ≥ 23 dB from 5 MHz to 30 MHz RL ≥ 23 dB from 30 MHz to 470 MHz RL ≥ 20 dB from 470 MHz to 1 000 MHz RL ≥ 18 dB from 1 000 MHz to 2 000 MHz RL ≥ 16 dB from 2 000 MHz to 3 000 MHz RL ≥ 15 dB from 3 000 MHz to 6 000 MHz (ffs) <u>For cables where α > 18 dB/100 m at 800 MHz</u> RL ≥ 20 dB from 5 MHz to 30 MHz RL ≥ 20 dB from 30 MHz to 470 MHz RL ≥ 18 dB from 470 MHz to 1 000 MHz RL ≥ 16 dB from 1 000 MHz to 2 000 MHz RL ≥ 15 dB from 2 000 MHz to 3 000 MHz RL ≥ 15 dB from 3 000 MHz to 6 000 MHz (ffs) (α is the longitudinal attenuation) **Measurement accuracy** In case of digital signal processing, the accuracy of the return loss measurement, $\Delta a_{r,f}$ depends on the frequency step Δf in the measured frequency range. The frequency spacing in the measured frequency range is frequency dependent and shall be in accordance with the following equation $$\Delta f \leq 1{,}4 \cdot \frac{300 \cdot v_r}{868{,}6 \cdot \pi} \cdot a(f) \cdot \sqrt{10^{\frac{\Delta a_{r,f}}{10}} - 1}$$ where *a(f)* is the attenuation of the cable at the measured frequency point in dB/100 m, $\Delta a_{r,f}$ is the maximum uncertainty of measurement due to frequency spacing; and v_r is the nominal propagation velocity. The measurement inaccuracy $\Delta a_{r,f}$ shall be ≤ 1 dB unless otherwise stated in the relevant detail specification. [b]
5.1.2.5	Regularity of impedance	Perform on both ends of tested cable Regularity ≥ 40 dB respectively ≤ 1 % Test procedure: IEC 61196-1-115 [c], (time domain) or EN 62153-1-1, (transformation from frequency domain into time domain by IDFT).
5.1.2.6	Transfer impedance	Screening Class A: ≤ 5 mΩ/m from 5 MHz to 30 MHz; Screening Class A+: ≤ 2,5 mΩ/m from 5 MHz to 30 MHz. Test procedure according to EN 50289-1-6, triaxial method, after completion of the flexure test according to 5.2.9 of this standard.

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.1.2.7	Screening attenuation	Screening Class A: ≥ 85 dB from 30 MHz to 1 000 MHz; ≥ 75 dB from 1 000 MHz to 2 000 MHz; ≥ 65 dB from 2 000 MHz to 3 000 MHz. ≥ 55 dB from 3 000 MHz to 6 000 MHz (ffs) Screening Class A+: ≥ 95 dB from 30 MHz to 1 000 MHz; ≥ 85 dB from 1 000 MHz to 2 000 MHz; ≥ 75 dB from 2 000 MHz to 3 000 MHz. ≥ 65 dB from 3 000 MHz to 6 000 MHz (ffs) Test procedure according to EN 50289-1-6, triaxial method, after completion of the flexure test according to 5.2.9 of this standard.
[a] In each frequency band, 3 peak of return loss values up to 4 dB lower than the stated specified limit are permissible but not at the frequency band of 2,4 GHz – 2,4835 GHz and 5,15 GHz – 5,725 GHz. [b] A more detailed description of the subject is given in 46XA/Sec104/INF and 46XA/Sec105/INF. [c] An EN test procedure is under consideration by CLC/SC 46XA.		

5.3 Mechanical tests

Table 3 — Mechanical tests

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.2.1	Conductor elongation at break	Applicable for copper clad steel conductors only
5.2.2	Adhesion of dielectric	Sample length for inner conductor diameters of < 1,6 mm = 25 mm ≥ 1,6 mm = 50 mm. Pressure force F_a [a] required to remove dielectric shall be 0,1 MPa ≤ F_a ≤ 1,0 MPa
5.2.3	Crush resistance of the cable	Load = 700 N, applied for 2 min After a 5 min recovery time, the maximum impedance irregularity shall be less than 1 %, measured with a pulse, having a width of (1 ± 0,1) ns, (see 5.1.2.5).
5.2.4	Impact resistance of the cable	Under consideration
5.2.5	Abrasion resistance of the sheath	Not applicable
5.2.6	Abrasion resistance of the sheath markings	Procedure, diameter of the needle, force and number of cycles in accordance with the relevant detail specification. Markings shall remain legible.

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.2.7	Simulated installation testing of the cable, (bending under tension).	Procedure according to EN 50289-3-9:2001, Clause 8, procedure 1, 180°, U-bend. Sample length: ≥ 50 m, Length between point A and B: 5 m. Radius of the pulleys: 10 times the outer diameter of the cable under test. Pulling force respectively weight: Max. pulling force according to the detail specification. Number of cycles: One move forward and back. Pulling speed: ≤ 1 m/s. The longitudinal attenuation, the characteristic impedance, and the return loss shall remain within the specified limits.
5.2.8	Tensile performance	Not applicable
5.2.9	Flexure	**Procedure A:** EN 50289-3-9:2001, 8.3.2, test procedure 2 [b] Radius of the pulleys: 10 times the outer diameter of the cable under test. Pulling force respectively weight: Max. pulling force of the cable under test, according to the detail specification. Number of cycles: Three moves forward and back with a turn of the sample of 120° in the longitudinal axis after each move. Pulling speed: ≤ 1 m/s. **Procedure B:** EN 50289-3-9:2001, 4.3.1 Radius of the mandrel: 10 times the outer diameter of the cable under test. Number of cycles: Three, whereas the sample under test shall be turned at 120° along its longitudinal axis after the first and the second turn. Pulling force respectively weight: Max. pulling force of the cable under test, according to the detail specification. Turns per helix: The length of the helix shall at least comply with the length under test of the screening tests according to 5.1.2.6 and 5.1.2.7. The longitudinal attenuation, the characteristic impedance, and the return loss shall remain within the specified limits.
5.2.10	Flexing endurance	Not applicable

[a] The adhesion of the dielectric to the inner conductor, F_a is given in MPa by the following equation: $F_a = \frac{F}{\pi \cdot d \cdot l}$

[b] Contrary to EN 50289-3-9 also the pulleys may be moved from point A to point B, while the cable with the weight is fixed.

5.4 Environmental tests

Table 4 — Environmental tests

EN 50117-1 Subclause n°	Parameter	Requirements/Remarks
5.3.1	Cold bend performance of the cable	After a storage time of ≥ 24 h samples shall be tested in accordance to EN 50289-3-9:2001, Clause 4, procedure 1 at a temperature as stated in the detail specification[a]. Radius of test mandrel: 10 x outer diameter of the cable under test No. of turns: 3 No. of cycles: 1 No physical damages of conductors, dielectric and sheaths.
5.3.2	Water penetration test	Not applicable
5.3.3	Moisture permeation test	Not applicable
5.3.4	Resistance to solvents and contaminating fluids	Not applicable
5.3.5	Climatic sequence	TA = -40 °C; TB = +70 °C; t1 = 24 h, unless otherwise specified in the detail specification. No. of cycles: 3. Influenced mechanical and electrical characteristics shall be as specified in the relevant detail specification.
5.3.6	Aeolian vibration test for aerial cables	Not applicable.
5.3.7	Damp heat, steady state	Influenced mechanical and electrical characteristics shall be as specified in the relevant detail specification.
5.3.8	UV resistance	Not applicable.
[a] During the bending procedure, the sample under test shall remain in the cold chamber.		

5.5 Fire performance test methods

Fire performance tests shall be in accordance with 5.4 of EN 50117-1:2002.

6 Cable types

Table 5 — Cable types - Dimensions and ratings

Characteristic/Type	23 A+/A	18 A+/A	13 A+/A
Nom. diameter [mm]			
over dielectric	3,7	4,8	7,2
outer diameter	6,0	7,0	10,5
Attenuation max. [a]			
[dB/100 m]			
@ 200 MHz	12	9	6
@ 800 MHz	23	18	13
@ 2 483 MHz	44	34,3	24,5
@ 5 875 MHz	71	56,4	41,4
Attenuation coeff. [b]			
a	0,77	0,54	0,39
b	0,002 1	0,002 0	0,001 8
c	0,40	0,40	0,17
d [c]			
Screening class	A+/A	A+/A	A+/A
Max. D.C. current [A]	TBD	TBD	TBD
Euroclass	Under consideration	Under consideration	Under consideration

[a] Excerpt from EN 60728-1-1:

6.6.6 Main characteristics of coaxial cables

In-home coaxial cables are defined by EN 50117 where the main parameters are given; the loss per 100 m of cables can be 19 dB at 800 MHz, about 36 dB at 2 483 MHz and 62 dB at 5 875 MHz.

[b] $a \cdot \sqrt{f} + b \cdot f + c$. [dB/100 m]. In case of copper clad conductor material a term $d / \sqrt{f}$ should be added, to better match the curve at low frequencies.

[c] The value of d can be calculated using k-factors as defined in EN 50290-2-1:2005, 6.5 and Tables 8 and 20.

Bibliography

EN 50083 series, *Cable networks for television signals, sound signals and interactive services*

EN 50290-2-1:2005, *Communication cables – Part 2-1: Common design rules and construction*

EN 50290-4-1, *Communication cables – Part 4-1: General considerations for the use of cables – Environmental conditions and safety aspects*

EN 60728-1-1, *Cable networks for television signals, sound signals and interactive services – Part 1-1: RF cabling for two way home networks (IEC 60728-1-1)*

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