BS EN 50306-4:2020

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BSI Standards Publication

# Railway applications — Railway rolling stock cables having special fire performance — Thin wall

Part 4: Multicore and multipair screened or not screened sheathed cables

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## National foreword

This British Standard is the UK implementation of EN 50306-4:2020. It supersedes BS EN 50306-4:2002, which will be withdrawn on 30 December 2022.

The UK participation in its preparation was entrusted to Technical Committee GEL/20/12, Electric Cables - Railway Applications.

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

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

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English Version

# Railway applications - Railway rolling stock cables having special fire performance - Thin wall - Part 4: Multicore and multipair screened or not screened sheathed cables

Applications ferroviaires - Câbles pour matériel roulant ferroviaire ayant des performances particulières de comportement au feu - Isolation mince - Partie 4: Câbles multiconducteurs et multipaires gainés blindés ou non blindés

Bahnanwendungen - Kabel und Leitungen für Schienenfahrzeuge mit verbessertem Verhalten im Brandfall - Reduzierte Isolierwanddicken - Teil 4: Mehradrige und mehrpaarige Leitungen

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## European foreword

This document (EN 50306-4:2020) has been prepared by CLC/TC 20, “Electric 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) | 2020-12-30 |
| • latest date by which the national standards conflicting with this document have to be withdrawn | (dow) | 2022-12-30 |

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This document supersedes EN 50306-4:2002 and all of its amendments and corrigenda (if any).

This edition includes the following significant technical changes with respect to the previous edition:

— The documents have been updated to reflect the changes in the test standard EN 50305;

— The range of the conductor cross sections has been extended;

— The reference to cited standards (e.g. EN 60811 series) has been updated.

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

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## Introduction

The EN 50306 series covers a range of sheathed and unsheathed cables with thin wall thickness insulation, based on halogen-free materials, for use in railway rolling stock. It is divided into four parts:

Part 1: General requirements;

Part 2: Single core cables;

Part 3: Single core and multicore cables screened and thin wall sheathed;

Part 4: Multicore and multipair screened or not screened sheathed cables.

Special test methods referred to in the EN 50306 series are given in EN 50305. A guide to use is given in EN 50355 and rules for installation are given in EN 50343.

EN 50306-1:2020, General requirements, contains a more extensive introduction to the EN 50306 series and should be read in conjunction with this document.

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## 1 Scope

This document specifies requirements for, and constructions and dimensions of, multicore and multipair cables rated voltage $U_0/U$: 300/500 V, of the following types:

— unscreened, sheathed for either exposed or protected wiring (0,5 mm² to 2,5 mm², number of cores from 2 to 48);

— screened, sheathed for either exposed or protected wiring (0,5 mm² to 2,5 mm², number of cores from 2 to 8);

— unscreened, sheathed for either exposed or protected wiring (0,5 mm² to 1,5 mm², number of screened pairs of cores from 2 to 7).

— screened, sheathed for either exposed or protected wiring (0,5 mm² to 1,5 mm², number of unscreened pairs of cores from 2 to 7).

All cables have stranded tinned copper conductors, halogen-free, thin wall thickness insulation and standard wall thickness sheath. Cable types are specified for use in exposed situations (Class E), and for protected situations (Class P). They are for use in railway rolling stock as fixed wiring or wiring where limited flexing in operation is encountered.

These cables are rated for occasional thermal stresses causing ageing equivalent to continuous operational life at a temperature of 90 °C. For standard cables this is determined by the acceptance test defined in EN 50305, using accelerated long-term (5 000 h) thermal ageing indicating a 110 °C/20 000 h temperature index. If the customer were to require lifetime predictions this would be demonstrated based on the temperature index of the product as supplied by the manufacturer.

The maximum temperature for short circuit conditions is 160 °C based on duration of 5 s.

Under fire conditions the cables exhibit special performance characteristics in respect of maximum permissible flame propagation (flame spread) and maximum permissible emission of smoke and toxic gases. These requirements are specified to permit the cables to satisfy Hazard Level 3 of EN 45545-1 and EN 45545-2.

EN 50306-4:2020 is expected to be used in conjunction with EN 50306-1:2020, General requirements, EN 50306-2:2020, Single core cables, and EN 50306-3:2020, Single core and multicore cables.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 45545-1, *Railway applications - Fire protection on railway vehicles - Part 1: General*

EN 50264-1:2008, *Railway applications - Railway rolling stock power and control cables having special fire performance - Part 1: General requirements*

EN 50305:2020, *Railway applications - Railway rolling stock cables having special fire performance - Test methods*

EN 50306-1:2020, *Railway applications - Railway rolling stock cables having special fire performance - Thin wall - Part 1: General requirements*

EN 50306-2:2020, *Railway applications - Railway rolling stock cables having special fire performance - Thin wall - Part 2: Single core cables*

EN 50306-3:2020, *Railway applications - Railway rolling stock cables having special fire performance - Thin wall - Part 3: Single core and multicore cables screened and thin wall sheathed*

EN 60332-1-2, *Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame*

EN 60332-3-24, *Tests on electric and optical fibre cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category C*

EN 61034-2, *Measurement of smoke density of cables burning under defined conditions - Part 2: Test procedure and requirements*

EN 60811 (all parts), *Electric and optical fibre cables - Test methods for non-metallic materials*

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## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISOOnline browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

## 4 Multicore cables - sheathed

### 4.1 General

The completed cables shall conform to the applicable general requirements given in EN 50306-1:2020 and to the specific requirements of Clause 4 and Clause 5.

Conformity with the requirements shall be checked by inspection and by the tests given in Table 2.

### 4.2 Marking and code designation

#### 4.2.1 Marking of cable

Cables shall be marked with the following:

— Manufacturer's name;

— EN reference;

— table number;

— cable class (P or E);

— Voltage rating ($U_0$);

— No. of cores and conductor size;

— A code designation according for use of the cable (see 4.2.2);

— Conductor temperature rating

For example:

XYZ EN 50306-4 1E 300 V 2x1,5 MM 90

The marking shall conform to the requirements of EN 50306-1:2020, Clause 5.

#### 4.2.2 Code Designation

The following letters shall be used as a code to identify the suitability of a particular cable for use under one of the Hazard Levels of EN 45545-1, and to indicate performance levels relating to low temperature and to oil and fuel resistance:

Hazard Level EN 45545-1 HL3

— low temperature / oil resistance C

— extra low temperature / oil resistance F

— low temperature / extra oil and fuel resistance J

— extra low temperature / extra oil and fuel resistance M

For sheathed cables two letters are required, one for the insulation and one for the sheath

#### 4.2.3 Marking on the insulation of cores

The cores shall be marked 1, 2, etc., in accordance with the requirements, given in EN 50306-2:2020, 4.3.2.

However, the core number one may be marked as the relevant single core in accordance with the requirements of EN 50306-2:2020, 4.3.2.

Durability of marking shall be in accordance with EN 50305:2020, 10.1.

### 4.3 Rated voltage

The rated voltage recognized for the purposes of this standard shall be $U_0/U$ = 300V / 500V

NOTE See EN 50355 and 50343 for further information.

### 4.4 Construction

#### 4.4.1 Cores

Each insulated single core shall conform to the requirements given in EN 50306-2:2020.

#### 4.4.2 Laying-up of cores

The cores shall be twisted together.

The pitch of lay for the cores shall not be greater than 20 times the diameter of the laid-up cores in the cable.

#### 4.4.3 Sheath

The sheath shall be a compound of type EM 101 to EM 104, and shall be applied by extrusion. Compounds type EM 101 to EM 104 together with their requirements are defined in EN 50264-1.

The sheath material from the finished cable shall be tested in accordance with the requirements given in EN 50264-1:2008, Table 4.

The sheath shall be smooth and uniformly applied; the application shall ensure that cables with a class E sheath are substantially circular. The thickness of sheath shall conform to the specified value given in Table 1 according to the class.

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The sheath colour shall be black, unless otherwise specified.

**Table 1 — Requirements for construction of multicore cables - sheathed**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Number of cores and nominal cross-section of the conductor | Cables class E | | | Cables class P | | |
| | Average minimum thickness of sheath | Overall diameter | | Minimum thickness of sheath at any point | Overall diameter | |
| | | min. | max. | | min. | max. |
| mm² | mm | mm | mm | mm | mm | mm |
| 2 × 0,5 | 1,0 | 4,9 | 5,9 | 0,42 | 3,5 | 4,5 |
| 3 × 0,5 | 1,0 | 5,1 | 6,1 | 0,42 | 3,8 | 4,8 |
| 4 × 0,5 | 1,0 | 5,5 | 6,5 | 0,42 | 4,1 | 5,3 |
| 7 × 0,5 | 1,0 | 6,3 | 7,3 | 0,42 | 4,9 | 6,1 |
| 13 × 0,5 | 1,0 | 8,3 | 9,3 | 0,56 | 7,3 | 8,5 |
| 19 × 0,5 | 1,0 | 9,0 | 10,2 | 0,56 | 8,1 | 9,3 |
| 37 × 0,5 | 1,0 | 12,3 | 13,5 | 0,56 | 10,8 | 12,2 |
| 2 × 0,75 | 1,0 | 5,3 | 6,3 | 0,42 | 4,0 | 5,0 |
| 3 × 0,75 | 1,0 | 5,5 | 6,5 | 0,42 | 4,2 | 5,2 |
| 4 × 0,75 | 1,0 | 6,0 | 7,0 | 0,42 | 4,6 | 5,8 |
| 7 × 0,75 | 1,0 | 6,9 | 7,9 | 0,42 | 5,5 | 6,6 |
| 13 × 0,75 | 1,0 | 9,1 | 10,3 | 0,56 | 8,2 | 9,4 |
| 19 × 0,75 | 1,0 | 10,0 | 11,2 | 0,56 | 9,0 | 10,4 |
| 37 × 0,75 | 1,0 | 13,2 | 14,4 | 0,56 | 12,2 | 13,6 |
| 48 × 0,75 | 1,0 | 14,8 | 16,4 | 0,56 | 13,9 | 15,7 |
| 2 × 1,0 | 1,0 | 5,6 | 6,6 | 0,42 | 4,3 | 5,3 |
| 3 × 1,0 | 1,0 | 5,9 | 6,9 | 0,42 | 4,6 | 5,6 |
| 4 × 1,0 | 1,0 | 6,3 | 7,3 | 0,42 | 4,9 | 6,1 |
| 7 × 1,0 | 1,0 | 7,3 | 8,3 | 0,42 | 6,0 | 7,2 |
| 13 × 1,0 | 1,0 | 9,7 | 10,9 | 0,56 | 8,7 | 10,1 |
| 19 × 1,0 | 1,0 | 10,7 | 11,9 | 0,56 | 9,8 | 11,2 |
| 37 × 1,0 | 1,0 | 14,0 | 15,6 | 0,56 | 13,3 | 14,7 |
| 2 × 1,5 | 1,0 | 6,3 | 7,3 | 0,42 | 5,0 | 6,0 |
| 3 × 1,5 | 1,0 | 6,6 | 7,6 | 0,42 | 5,3 | 6,3 |
| 4 × 1,5 | 1,0 | 7,4 | 8,4 | 0,42 | 6,0 | 7,2 |
| 7 × 1,5 | 1,0 | 8,6 | 9,8 | 0,56 | 7,7 | 8,9 |
| 13 × 1,5 | 1,0 | 11,7 | 12,9 | 0,56 | 10,7 | 12,1 |
| 19 × 1,5 | 1,0 | 13,0 | 14,2 | 0,56 | 12, | 13,4 |
| 37 × 1,5 | 1,0 | 17,2 | 18,8 | 0,56 | 16,2 | 18, |

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Number of cores and nominal cross-section of the conductor | Cables class E | | | Cables class P | | |
| | Average minimum thickness of sheath | Overall diameter | | Minimum thickness of sheath at any point | Overall diameter | |
| | | min. | max. | | min. | max. |
| mm² | mm | mm | mm | mm | mm | mm |
| 2 × 2,5 | 1,0 | 7,7 | 8,7 | 0,56 | 6,7 | 7,9 |
| 3 × 2,5 | 1,0 | 8,1 | 9,1 | 0,56 | 7,1 | 8,3 |
| 4 × 2,5 | 1,0 | 8,8 | 10,0 | 0,56 | 7,9 | 9,1 |

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For other compositions (number of cores), sheath thicknesses shall follow in principle the value mentioned in the Table 1 or ask the manufacturer for adequate technical design depending on the application requirements. The cable marking shall keep the standard name as EN 50306-4:2020.

# 5 Tests

## 5.1 Definitions relating to tests

The definition of Type (T), Sample (S) and Routine (R) tests is as given in EN 50306-1:2020, Clause 3.

NOTE 1 Tests classified as Sample (S) or Routine (R) could be required as part of any approval schemes.

NOTE 2 Annex A gives guidance on the selection of cables for type approval.

## 5.2 Voltage test on cable

The test shall be carried out in accordance with EN 50305:2020, 6.2.1, using an AC or DC voltage and the following conditions:

— sample length 20 m

— voltage (AC) 2 kV

— voltage (DC) 4,8 kV

— duration of application 5 min

— test temperature (20 ± 5) °C

At the conclusion of the test there shall be no breakdown of the insulation.

## 5.3 Tests at low temperature

a) Bending test for cable diameter ≤ 12,5mm

The test shall be carried out at (- 40 ± 2) °C in accordance with EN 60811-504.

At the conclusion of the test there shall be no cracks in the sheath.

Where cables sheaths are not to be used at extra low temperature, the test may be carried out at (- 25 ± 2) °C.

b) Elongation test for cable diameter > 12,5mm

The test shall be carried out at (- 40 ± 2) °C in accordance with EN 60811-505.

The elongation of the sheath shall be not less than 30 %.

Where cables sheaths are not to be used at extra low temperatures, the test may be carried out at (- 25 ± 2) °C.

c) Impact

The test shall be carried out at (- 25 ± 2) °C in accordance with EN 50305:2020, 5.1.

At the conclusion of the test there shall be no cracks in the inside or the outside of the sheath, nor on the outside of the insulation.

## 5.4 Ozone resistance of sheath

The test shall be carried out either in accordance with EN 60811-403 (for Method A) or EN 50305:2020, 7.4.2, (for Method B), using the following conditions:

The choice of Method A or Method B may be made by the supplier.

**Method A:**

concentration (%) (250 to 300) × $10^{-4}$

test temperature (25 ± 2) °C

test duration 24 h

test requirements no cracks

**Method B:**

concentration (%) (200 ± 50) × $10^{-6}$

test temperature (40 ± 2) °C

relative humidity (%) 55 ± 5

test duration 72 h

test requirements no cracks

## 5.5 Compatibility

The test shall be carried out in accordance with EN 50305:2020, 7.1. Cable shall be aged for 7 days at the following temperatures:

(100 ± 2) °C for cables with a designated operating temperature of 90 °C;

Test requirement:

— tensile strength variation ± 30 % maximum

— elongation at break variation ± 30 % maximum

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## 5.6 Fire performance

The completed cable shall conform to the requirements given in EN 50306-1:2020, 8.1, 8.2.1, 8.2.2 or 8.2.3 (depending upon overall diameter) and 8.3.

The sheath shall conform to the requirements of EN 50306-1:2020, Clause 9.

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**Table 2 — Schedule of tests for multicore cables - sheathed**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Catego-ry of test | Test method given in | | Requirement given in |
| | | | EN | (Sub)clause | [a] |
| 1 | Electrical tests | | | | |
| 1.1 | Electrical resistance of conductors | T, S | EN 50305:2020 | 6.1 | Table 1 of EN 50306-2:2020 |
| 1.2 | Voltage test on complete cable | T, S | EN 50305:2020 | 6.2.1 | 5.2 |
| 2 | Provisions covering constructional and dimensional characteristics | | | | |
| 2.1 | Checking of conformity and constructional provisions | T, S | EN 50306-1 | Inspection | 3.4 and Clause 6 of EN 50306-1:2020 |
| 2.2 | Sheath: | | | | |
| | (a) Application | S | EN 50306-1 | Inspection and manual test | 6.6.2 of EN 50306-1:2020 |
| | (b) Thickness | T, S | EN 50306-1 | A.2 | Table 1 |
| 2.3 | Overall diameter | T, S | EN 50306-1 | 6.7 | Table 1 |
| 2.4 | Identification and marking | T, S | EN 50306-4 | Inspection and measurement | 4.2.1 and 4.2.3 |
| 2.5 | Durability of identification | T, S | EN 50305:2020 | 10.1 | 5.3 of EN 50306-1:2020 |
| 3 | Tests of sheath material | | | | |
| 3.1 | Mechanical properties of sheath in state as delivered | T, S | EN 60811-501 | 9.2 | Table 4 of EN 50264-1:2008 |
| 3.2 | Tests at low temperature | | | | |
| | Bending (diameter ≤ 12,5 mm) | T | EN 60811-504 | 8.2 | 5.3(a) |
| | Elongation (diameter > 12,5 mm) | T | EN 60811-505 | 8.4 | 5.3(b) |
| | Impact resistance | T | EN 50305:2020 | 5.1 | 5.3(c) |
| 3.3 | Ozone resistance | T | EN 50305:2020 | 7.4.2 | 5.4 |
| 3.4 | Water absorption (Gravimetric) | T | EN 60811-402 | | Table 4 of EN 50264-1:2008 |
| 3.5 | Compatibility test | T | EN 50305:2020 | 7.1 | 5.5 |
| 4 | Fire performance | | | | |

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| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Catego-ry of test | Test method given in | | Requirement given in |
| | | | EN | (Sub)clause | [a] |
| 4.1 | Flame propagation | | | | |
| | single cable | T, S | EN 60332-1-2 | - | 4.6 and 8.1 of EN 50306-1:2020 |
| | bunched cable (diameters ≥ 12 mm) | T | EN 60332-3-24 | - | 4.6 and 8.2.1 of EN 50306-1:2020 |
| | bunched cable (diameters > 6 mm < 12 mm) | T | EN 50305:2020 | 9.1.1 | 4.6 and 8.2.2 of EN 50306-1:2020 |
| | bunched cable (diameters ≤ 6mm) | T | EN 50305:2020 | 9.1.2 | 4.6 and 8.2.3 of EN 50306-1:2020 |
| 4.2 | Halogen-Free / Determination of halogens – Elemental test | T | EN 50305:2020 | Annex F and Annex G | |
| 4.3 | Smoke emission | T | EN 61034-2 | - | 4.6 and 8.3 of EN 50306-1:2020 |
| 4.4 | Toxicity of sheath | T | EN 50305:2020 | 9.2 | 4.6 and Clause 9 of EN 50306-1:2020 |
| [a] According to EN 50306-4 unless otherwise specified. | | | | | |

# 6 Multicore cables - screened and sheathed

## 6.1 General

The completed cables shall conform to the applicable general requirements given in EN 50306-1:2020 and the specific requirements of Clause 6 and Clause 7.

Conformity with the requirements shall be checked by inspection and by the tests given in Table 4.

## 6.2 Designation, marking and coding

### 6.2.1 Marking of cable

Cables shall be marked with the following:

— Manufacturer's name;

— EN reference;

— table number;

— cable class (P or E);

— Voltage rating ($U_0$);

— No. of cores and conductor size;

— A code designation according for use of the cable (see 4.2.2);

— Screening (S);

— Conductor temperature rating

For example:

XYZ EN 50306-4 3E 300 V 2x1,5 MM S 90

The marking shall conform to the requirements of EN 50306-4:2020, Clause 5.

NOTE For sheathed cables two letters are required, the first for the insulation and the second for the sheath.

#### 6.2.2 Marking on the insulation of cores

The cores shall be marked 1, 2, etc. in accordance with the requirements given in EN 50306-2:2020, 4.3.2.

However, the core number one may be marked as the relevant single core in accordance with the requirements of EN 50306-2:2020, 4.3.2.

Durability of marking shall be in accordance with EN 50305:2020, 10.1.

### 6.3 Rated voltage

The rated voltage recognized for the purposes of this standard shall be $U_0/U$ = 300 V/500 V.

NOTE Refer to EN 50355 and 50343 for further information.

### 6.4 Construction

#### 6.4.1 Cores

Each insulated single core shall conform to the requirements given in EN 50306-2:2020.

#### 6.4.2 Laying-up of cores

The cores shall be twisted together.

The pitch of lay for the cores shall not be greater than 20 times the diameter of the laid-up cores in the cable.

An optional tape may be included at the manufacturer's discretion.

#### 6.4.3 Metallic braid screening

The braid shall consist of tinned, annealed copper wires. There shall be no more than one splice in any spindle of the braid over any 100 mm length of the braid. The braid shall be applied evenly, and it should neither slip nor leave an imprint on the insulation.

The filling factor *Kr* shall be according to the formula:

$$Kr = \frac{m \times n \times d}{2\pi\phi} \times \left[1 + \frac{\pi^2\phi^2}{L^2}\right]^{0,5}$$

The wires of the braid shall be not less than 0,10 mm diameter. The filling factor *Kr* shall be 0,55 minimum.

The lay angle (the angle of a braid wire and the centreline of the cable) shall be between 15° and 35°, and shall be checked by application of the following formula:

$$1,072 < \left(1 + \frac{\pi^2\phi^2}{L^2}\right) \leq 1,490$$

where



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$\phi$ = diameter under the braid + 2$d$

$d$ = nominal diameter of a wire

$m$ = total number of spindles

$n$ = number of wires per spindle

$L$ = braiding pitch

### 6.4.4 Sheath

The sheath shall be a compound of type EM 101 to EM 104, and shall be applied around the braid by extrusion. Compounds type EM 101 to EM 104, together with their requirements, are defined in EN 50264-1.

The sheath material from the finished cable shall be tested in accordance with the requirements given in EN 50264-1:2008, Table 4.

The sheath shall be smooth and uniformly applied. The application shall ensure that cables with a class E sheath are substantially circular. The thickness of sheath shall conform to the specified value given in Table 3 according to the class.

The sheath colour shall be black unless otherwise specified.

**Table 3 — Requirements for the construction of multicore cables - screened and sheathed**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Number of cores and nominal cross-section of the conductor | Cables class E | | | Cables class P | | |
| | Minimum average thickness of sheath at any point | Overall diameter | | Minimum thickness of sheath at any point | Overall diameter | |
| | | min. | max. | | min. | max. |
| mm² | mm | mm | mm | mm | mm | mm |
| 2 × 0,5 | 1,0 | 5,5 | 6,5 | 0,42 | 4,1 | 5,3 |
| 3 × 0,5 | 1,0 | 5,7 | 6,7 | 0,42 | 4,3 | 5,5 |
| 4 × 0,5 | 1,0 | 6,1 | 7,1 | 0,42 | 4,7 | 5,9 |
| 6 × 0,5 | 1,0 | 6,9 | 7,9 | 0,42 | 5,5 | 6,8 |
| 8 × 0,5 | 1,0 | 7,5 | 8,5 | 0,42 | 6,0 | 7,3 |
| 2 × 0,75 | 1,0 | 5,9 | 6,9 | 0,42 | 4,5 | 5,7 |
| 3 × 0,75 | 1,0 | 6,2 | 7,2 | 0,42 | 4,7 | 5,9 |
| 4 × 0,75 | 1,0 | 6,5 | 7,5 | 0,42 | 5,2 | 6,4 |
| 6 × 0,75 | 1,0 | 7,5 | 8,5 | 0,42 | 6,1 | 7,4 |
| 8 × 0,75 | 1,0 | 8,2 | 9,2 | 0,42 | 6,6 | 7,9 |
| 2 × 1,0 | 1,0 | 6,2 | 7,2 | 0,42 | 4,7 | 5,9 |
| 3 × 1,0 | 1,0 | 6,5 | 7,5 | 0,42 | 5,1 | 6,2 |
| 4 × 1,0 | 1,0 | 6,9 | 7,9 | 0,42 | 5,5 | 6,7 |
| 6 × 1,0 | 1,0 | 8,0 | 9,0 | 0,42 | 6,6 | 7,9 |

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| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Number of cores and nominal cross-section of the conductor | Cables class E | | | Cables class P | | |
| | Minimum average thickness of sheath at any point | Overall diameter | | Minimum thickness of sheath at any point | Overall diameter | |
| | | min. | max. | | min. | max. |
| mm² | mm | mm | mm | mm | mm | mm |
| 8 × 1,0 | 1,0 | 8,6 | 9,8 | 0,56 | 7,7 | 9, |
| 2 × 1,5 | 1,0 | 7,1 | 8,1 | 0,42 | 5,7 | 6,9 |
| 3 × 1,5 | 1,0 | 7,4 | 8,4 | 0,42 | 6,0 | 7,2 |
| 4 × 1,5 | 1,0 | 8,0 | 9,0 | 0,42 | 6,6 | 7,8 |
| 6 × 1,5 | 1,0 | 9,2 | 10,4 | 0,56 | 8,3 | 9,6 |
| 8 × 1,5 | 1,0 | 10,2 | 11,4 | 0,56 | 8,9 | 10,4 |
| 2 × 2,5 | 1,0 | 8,3 | 9,3 | 0,56 | 7,3 | 8,5 |
| 3 × 2,5 | 1,0 | 8,6 | 10,2 | 0,56 | 7,7 | 8,9 |
| 4 × 2,5 | 1,0 | 9,4 | 10,6 | 0,56 | 8,4 | 9,8 |

For other compositions (number of cores), sheath thicknesses shall follow in principle the value mentioned in the Table 3 or ask the manufacturer for adequate technical design depending on the application requirements. The cable marking shall keep the standard name as EN 50306-4.

# 7 Tests

## 7.1 Definitions relating to tests

The definition of Type (T), Sample (S) and Routine (R) tests is as given in EN 50306-1:2020, Clause 3.

NOTE 1 Tests classified as Sample (S) or Routine (R) could be required as part of any approval schemes.

NOTE 2 Annex A gives guidance on the selection of cables for type approval.

## 7.2 Voltage test on cable

The voltage test shall be carried out in accordance with EN 50305:2020, 6.2.2(a), using either an AC or DC voltage and the following conditions:

| | |
|---|---|
| sample length | 20 m |
| voltage (AC) | 2 kV |
| voltage (DC) | 4,8 kV |
| duration of application | 5 min |
| test temperature | (20 ± 5) °C |

At the conclusion of the test there shall be no breakdown of the insulation.

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### 7.3 Spark test on the sheath

The test shall be carried out in accordance with EN 50305:2020, 6.5, and EN 60230, using one of the following conditions:

- AC (50 Hz) 3 kV
- impulse 8 kV
- DC 4,5 kV
- High frequency 4,5kV

There shall be no breakdown of the sheath.

### 7.4 Tests at low temperature

a) Bending test for cable diameter ≤ 12,5mm

The test shall be carried out at (- 40 ± 2) °C in accordance with EN 60811-504.

At the conclusion of the test there shall be no cracks in the sheath.

Where cables sheaths are not to be used at extra low temperature, the test may be carried out at (- 25 ± 2) °C.

b) Elongation test for cable diameter > 12,5mm

The test shall be carried out at (- 40 ± 2) °C in accordance with EN 60811-504.

The elongation of the sheath shall be not less than 30 %.

Where cables sheaths are not to be used at extra low temperatures, the test may be carried out at (- 25 ± 2) °C.

c) Impact

The test shall be carried out at (- 25 ± 2) °C in accordance with EN 50305:2020, 5.1.

At the conclusion of the test there shall be no cracks in the sheath, nor on the outside of the insulation.

### 7.5 Ozone resistance

The test shall be carried out either in accordance with EN 60811-403 (for Method A) or EN 50305:2020, 7.4.2, (for Method B), using the following conditions:

The choice of Method A or Method B may be made by the supplier.

**Method A:**

concentration (% by volume) (250 to 300) × $10^{-4}$

test temperature (25 ± 2) °C

test duration 24 h

test requirements no cracks

**Method B:**

concentration (% by volume) (200 ± 50) × $10^{-6}$

test temperature (40 ± 2) °C

relative humidity (%) 55 ± 5

test duration 72 h

test requirements no cracks

### 7.6 Fire performance

The completed cable shall conform to the requirements given in EN 50306-1:2020, 8.1, 8.2.2 or 8.2.3 (depending on diameter) and 8.3.

The sheath shall conform to the requirements of EN 50306-1:2020, Clause 9.

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**Table 4 — Schedule of tests for multicore cables - screened and sheathed**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Category of test | Test method given in | | Requirements given in |
| | | | EN | (Sub) clause | [a] |
| 1 | Electrical tests | | | | |
| 1.1 | Electrical resistance of conductors | T, S | EN 50305:2020 | 6.1 | Table 1 of EN 50306-2:2020 |
| 1.2 | Voltage test on complete cable | T, R | EN 50305:2020 | 6.2.2(a) | 7.2 |
| 1.3 | Spark test on the sheath | R | EN 50305:2020 | 6.5 | 7.3 |
| 2 | Provisions covering constructional and dimensional characteristics | | | | |
| | - | | | | |
| 2.1 | Checking of conformity and constructional provisions | T, S | EN 50306-1 | Inspection | 5.4 and Clause 6 of EN 50306-1:2020 |
| 2.2 | Metallic screen: | | | | |
| | (a) Diameter of wire | T, S | Measurement | 5.4.3 | 6.4.3 |
| | (b) Coverage factor | T, S | Measurement | 5.4.3 | 6.4.3 |
| 2.3 | Sheath: | | | | |
| | (a) Application | S | EN 50306-1 | Inspection and manual test | 6.6.2 of EN 50306-1:2020 |
| | (b) Thickness | T, S | EN 50306-1 | A.2 | Table 3 |
| 2.4 | Overall diameter | T, S | EN 50306-1 | 6.7 | Table 3 |
| 2.5 | Identification and marking | T, S | EN 50306-4 | Inspection and measurement | 6.2.1 and 6.2.2 |
| 2.6 | Durability of identification | T, S | EN 50305:2020 | 10.1 | 5.3 of EN 50306-1:2020 |
| 3 | Tests of sheath material | T | | | |
| 3.1 | Mechanical properties of sheath in state as delivered | T, S | EN 60811-501 | | Table 4 of EN 50264-1:2008 |

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| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Category of test | Test method given in | | Requirements given in |
| | | | EN | (Sub) clause | [a] |
| 3.2 | Test at low temperature | | | | |
| | Bending (diameter ≤ 12,5 mm) | T | EN 60811-504 | | 7.4(a) |
| | Elongation (diameter > 12,5 mm) | | | | 7.4(b) |
| | Impact resistance | T | EN 50305:2020 | 5.1 | 7.4(c) |
| 3.3 | Ozone | T | | | |
| | - Method A | | EN 60811-403 | | 7.5 |
| | - Method B | | EN 50305:2020 | 7.4.2 | 7.5 |
| 4 | Fire performance | | | | |
| 4.1 | Flame propagation | | | | |
| | (a) single cable | T, S | EN 60332-1-2 | - | 6.6 and 8.1 of EN 50306-1:2020 |
| | (b) bunched cable (diameters > 6 mm < 12 mm) | T | EN 50305:2020 | 9.1.1 | 6.6 and 8.2.2 of EN 50306-1:2020 |
| | (c) bunched cable (diameters ≤ 6mm) | T | EN 50305:2020 | 9.1.2 | 6.6 and 8.2.3 of EN 50306-1:2020 |
| 4.2 | Halogen-Free / Determination of halogens – Elemental test | T | EN 50305:2020 | Annex F and Annex G | |
| 4.3 | Smoke emission | T | EN 61034-2 | - | 6.6 and 8.3 of EN 50306-1:2020 |
| 4.4 | Toxicity of sheath | T | EN 50305:2020 | 9.2 | 6.6 and Clause 9 of EN 50306-1:2020 |

[a] According to EN 50306-4 unless otherwise specified.

# 8 Multipair cables - individually screened and sheathed and with an overall sheath

## 8.1 General

The completed cables shall conform to the applicable general requirements given in EN 50306-1:2020 and the specific requirements of Clause 8 and Clause 9.

Conformity with the requirements shall be checked by inspection, by the tests given in Table 6.

## 8.2 Designation, marking and coding

### 8.2.1 Marking of the cable

Cables shall be marked with the following:

— Manufacturer's name;

— EN reference;

— table number;

— cable class (P or E);

— Voltage rating ($U_0$);

— number of pairs and conductor size;

— A code designation according for use of the cable (see 4.3.2);

— Screening (S);

For example:

XYZ EN 50306-4 5E 300 V 7x2x0,75 MMM S

The marking shall conform to the requirements of EN 50306-1:2020, Clause 5.

NOTE 'For screened and sheathed pair with an overall sheath, three letters are required, the first for the insulation, the second for the individual sheath and the third for the overall sheath.'

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#### 8.2.2 Marking on the insulation of cores

In each pair the cores shall be marked 1 and 2, in accordance with the requirements given in EN 50306-2:2020, 4.3.2.

However, the core number one in each pair may be marked as the relevant single core in accordance with the requirements of EN 50306-2:2020, 4.3.2.

Durability of marking shall be in accordance with EN 50305:2020, 10.1.

#### 8.2.3 Marking on the sheath of the pair

The screened and sheathed pairs shall be marked 1, 2, etc.

However, the screened pair number one may be marked as the relevant screened pair in accordance with the requirements of EN 50306-3:2020.

Durability of marking shall be in accordance with EN 50305:2020, 10.1.

### 8.3 Rated voltage

The rated voltage recognized for the purposes of this standard shall be $U_0/U$ = 300/500 V.

NOTE See EN 50355 and EN 50343 for further information.

### 8.4 Construction

#### 8.4.1 Pairs

Each screened and sheathed pair shall conform to the requirements given in EN 50306-3:2020.

#### 8.4.2 Laying-up of pairs

The screened and sheathed pairs shall be twisted together.

The pitch of lay for the pairs shall not be greater than 20 times the diameter of the laid-up pairs in the cable.

Outer sheath of the cable

The sheath shall be a compound of type EM 101 to EM 104, and shall be applied around the laid-up pairs by extrusion. Compounds type EM 101 to EM 104, together with their requirements, are defined in EN 50264-1.

The sheath material from the finished cable shall be tested in accordance with the requirements given in EN 50264-1:2008, Table 4.

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The sheath thickness shall conform to the specified value given in Table 5 according to the class.

The sheath colour shall be black unless otherwise specified.

**Table 5 — Requirements for the construction of multipair cables - individually screened and sheathed and with an overall sheath**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| Number and nominal cross-section of the core | Cables class E | | | Cables class P | | |
| | Minimum average thickness of overall sheath | Overall diameter | | Minimum thickness of overall sheath at any point | Overall diameter | |
| | | min. | max. | | min. | max. |
| $mm^2$ | mm | mm | mm | mm | mm | mm |
| 2 × 2 × 0,5 | 1,0 | 10,1 | 11,3 | 0,56 | 9,0 | 10,2 |
| 3 × 2 × 0,5 | 1,0 | 10,8 | 12,0 | 0,56 | 9,6 | 10,8 |
| 4 × 2 × 0,5 | 1,0 | 11,8 | 13,0 | 0,56 | 10,7 | 12,0 |
| 7 × 2 × 0,5 | 1,0 | 13,9 | 15,5 | 0,56 | 13,0 | 14,2 |
| 2 × 2 × 0,75 | 1,0 | 10,9 | 12,1 | 0,56 | 9,8 | 11,0 |
| 3 × 2 × 0,75 | 1,0 | 11,6 | 13,0 | 0,56 | 10,5 | 11,7 |
| 4 × 2 × 0,75 | 1,0 | 12,8 | 14,3 | 0,56 | 11,6 | 12,8 |
| 7 × 2 × 0,75 | 1,0 | 15,1 | 16,9 | 0,56 | 14,0 | 15,6 |
| 2 × 2 × 1,0 | 1,0 | 11,3 | 12,5 | 0,56 | 10,2 | 11,6 |
| 3 × 2 × 1,0 | 1,0 | 12,0 | 13,5 | 0,56 | 10,9 | 12,3 |
| 4 × 2 × 1,0 | 1,0 | 13,2 | 14,7 | 0,56 | 12,1 | 13,3 |
| 7 × 2 × 1,0 | 1,0 | 15,7 | 17,3 | 0,56 | 14,6 | 16,3 |
| 2 × 2 × 1,5 | 1,0 | 13,3 | 14,5 | 0,56 | 12,2 | 13,4 |
| 3 × 2 × 1,5 | 1,0 | 14,0 | 15,6 | 0,56 | 13,1 | 14,3 |
| 4 × 2 × 1,5 | 1,0 | 15,5 | 17,1 | 0,56 | 14,3 | 15,9 |
| 7 × 2 × 1,5 | 1,0 | 18,7 | 20,5 | 0,56 | 17,6 | 19,2 |

For other compositions (number of cores), sheath thicknesses shall follow in principle the value mentioned in the Table 5 or ask the manufacturer for adequate technical design depending on the application requirements. The cable marking shall keep the standard name as EN 50306-4.

## 9 Tests

### 9.1 Definitions relating to tests

The definition of Type (T), Sample (S) and Routine (R) tests is as given in EN 50306-1:2020, Clause 3.

NOTE 1 Tests classified as Sample (S) or Routine (R) could be required as part of any approval schemes.

NOTE 2 Annex A gives guidance on the selection of cables for type approval.

## 9.2 Voltage test

The voltage test shall be carried out in accordance with EN 50305:2020, 6.2.2 a) and b), using the following conditions:

- sample length 20 m
- voltage (AC) 2 kV
- voltage (DC) 4,8 kV
- duration of application 5 min
- test temperature (20 ± 5) °C

At the conclusion of the test there shall be no breakdown of the insulation.

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**Table 6 — Schedule of tests for multipair cables – individually screened and sheathed and with an overall sheath**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Category of test | Test method given in | | Requirement given in |
| | | | EN | (Sub)clause | [a] |
| 1 | Electrical tests | | | | |
| 1.1 | Electrical resistance of conductors | T, S | EN 50305:2020 | 6.1 | Table 1 of EN 50306-2:2020 |
| 1.2 | Voltage test | T, S | EN 50305:2020 | 6.2.2 a and b | 9.2 |
| 2 | Provisions covering constructional and dimensional characteristics | | | | |
| 2.1 | Checking of conformity and constructional provisions | T, S | EN 50306-1 | Inspection | 7.4 and Clause 6 of EN 50306-1:2020 |
| 2.2 | Outer Sheath: | | | | |
| | (a) Application | S | EN 50306-1 | Inspection and manual test | 6.6.2 of EN 50306-1:2020 |
| | (b) Thickness | T, S | EN 50306-1 | A.2 | Table 5 |
| 2.3 | Overall diameter | T, S | EN 50306-1 | 6.7 | Table 5 |
| 2.4 | Identification and marking | T, S | EN 50306-4 | Inspection and measurement | 8.2.2 and 8.2.3 |
| 2.5 | Durability of identification | T, S | EN 50305:2020 | 10.1 | 5.3 of EN 50306-1:2020 |
| 3 | Tests of outer sheath material | T | | | |
| 3.1 | Mechanical properties of sheath in state as delivered | T, S | EN 60811-501 | | Table 4 of EN 50264-1:2008 |
| 3.2 | Test at low temperature | | | | |
| | Bending (diameter ≤ 12,5 mm) | T | EN 60811-504 | | 5.3(a) |
| | Elongation (diameter > 12,5 mm) | T | EN 60811-505 | | 5.3(b) |
| | Impact resistance | T | EN 50305:2020 | 5.1 | 5.3(c) |

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| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Category of test | Test method given in | | Requirement given in |
| | | | EN | (Sub)clause | [a] |
| 3.3 | Ozone | T | EN 50305:2020 | 7.4.2 | 5.4 |
| 3.4 | Water absorption (Gravimetric) | T | EN 60811-402 | | Table 4 of EN 50264-1:2008 |
| 3.5 | Compatibility test | T | EN 50305:2020 | 7.1 | 5.5 |
| 4 | Fire performance | | | | |
| 4.1 | Flame propagation | | | | |
| | single cable | T, S | EN 60332-2-1 | - | 4.6 and 8.1 of EN 50306-1:2020 |
| | bunched cable (diameters ≥ 12 mm) | T | EN 60332-3-24 | - | 4.6 and 8.2.1 of EN 50306-1:2020 |
| | bunched cable (diameters > 6 mm < 12 mm) | T | EN 50305:2020 | 9.1.1 | 4.6 and 8.2.2 of EN 50306-1:2020 |
| | bunched cable (diameters ≤ 6 mm) | T | EN 50305:2020 | 9.1.2 | 4.6 and 8.2.3 of EN 50306-1:2020 |
| 4.2 | Halogen-Free / Determination of halogens – Elemental test | T | EN 50305:2020 | Annex F and Annex G | |
| 4.3 | Smoke emission | T | EN 61034-2 | - | 4.6 and 8.3 of EN 50306-1:2020 |
| 4.4 | Toxicity of outer sheath | T | EN 50305:2020 | 9.2 | 4.6 and Clause 9 of EN 50306-1:2020 |

[a] According to EN 50306-4 unless otherwise specified.

# 10 Multipair cables – general screened and sheathed

## 10.1 General

The completed cables shall conform to the applicable general requirements given in EN 50306-1:2020 and the specific requirements of Clause 10 and Clause 11.

Conformity with the requirements shall be checked by inspection, by the tests given in Table 8.

## 10.2 Designation, marking and coding

### 10.2.1 Marking of cable

Cables shall be marked with the following:

— manufacturer's name;

— EN reference;

— table number;

— cable class (P or E);

— voltage rating;

— number of pairs and conductor size;

— identifier for the particular use of cable (see 4.2.2);

— screening (S)

— temperature rating

For example:

XYZ EN 50306-4 7E 300 V 7x2x0,75 MM S 90

The marking shall conform to the requirements of EN 50306-1:2020, Clause 5.

NOTE For general screened and sheathed pair cables two letters are required, the first for the insulation and the second for the sheath"

#### 10.2.2 Marking on the insulation of cores

The cores in the pair shall be marked in the first with 1, 2 and in the second pair 3, 4 and etc. in accordance with the requirements given in EN 50306-2:2020, 4.3.2. However, the core number one in each pair may be marked as the relevant single core in accordance with the requirements of EN 50306-2:2020, 4.3.1.

Durability of marking shall be in accordance with EN 50305:2020, 10.1.

### 10.3 Rated voltage

The rated voltage recognized for the purposes of this standard shall be $U_0/U$ = 300/500 V.

NOTE See EN 50355 and EN 50343 for further information.

### 10.4 Construction

#### 10.4.1 Pairs

Each insulated core of pair shall conform to the requirements given in EN 50306-2:2020.

#### 10.4.2 Laying-up of pairs

The pairs shall be twisted together.

The pitch of lay for the pairs shall not be greater than 20 times the diameter of the laid-up pairs in the cable.

#### 10.4.3 Metallic braid screening

The braid shall consist of tinned, annealed copper wires. There shall be no more than one splice in any spindle of the braid over any 100 mm length of the braid. The braid shall be applied evenly, and it should neither slip nor leave an imprint on the insulation.

The filling factor *Kr* shall be according to the formula:

$$Kr = \frac{m \times n \times d}{2\pi\phi} \times \left[1 + \frac{\pi^2 \phi^2}{L^2}\right]^{0,5}$$

The wires of the braid shall be not less than 0,10 mm diameter. The filling factor *Kr* shall be 0,55 minimum.

The lay angle (the angle of a braid wire and the centreline of the cable) shall be between 15° and 35°, and shall be checked by application of the following formula:



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$$1,072 < \left(1 + \frac{\pi^2 \phi^2}{L^2}\right) \leq 1,490$$

where

$\phi$ = diameter under the braid + 2$d$

$d$ = nominal diameter of a wire

$m$ = total number of spindles

$n$ = number of wires per spindle

$L$ = braiding pitch

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### 10.4.4 Outer sheath of the cable

The sheath shall be a compound of type EM 101 to EM 104, and shall be applied around the laid-up pairs by extrusion. Compounds type EM 101 to EM 104, together with their requirements, are defined in EN 50264-1.

The sheath material from the finished cable shall be tested in accordance with the requirements given in EN 50264-1:2008, Table 4.

The sheath thickness shall conform to the specified value given in Table 7 according to the class.

The sheath colour shall be black unless otherwise specified.

**Table 7 — Requirements for the construction of multipair cables - general screened and sheathed**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|
| **Number and nominal cross-section of the core** | **Cables class E** | | | **Cables class P** | | |
| | **Average minimum thickness of overall sheath** | **Overall diameter** | | **Minimum thickness of overall sheath at any point** | **Overall diameter** | |
| | | **min.** | **max.** | | **min.** | **max.** |
| $mm^2$ | mm | mm | mm | mm | mm | mm |
| 2 × 2 × 0,5 | 1,0 | 7,1 | 8,9 | 0,56 | 6,6 | 7,9 |
| 3 × 2 × 0,5 | 1,0 | 7,5 | 9,1 | 0,56 | 7,0 | 8,1 |
| 4 × 2 × 0,5 | 1,0 | 8,3 | 9,7 | 0,56 | 7,7 | 8,7 |
| 7 × 2 × 0,5 | 1,0 | 9,6 | 11,6 | 0,56 | 9,0 | 10,6 |
| 2 × 2 × 0,75 | 1,0 | 7,6 | 10,0 | 0,56 | 7,1 | 9,0 |
| 3 × 2 × 0,75 | 1,0 | 8,2 | 10,2 | 0,56 | 7,7 | 9,2 |
| 4 × 2 × 0,75 | 1,0 | 9,5 | 10,8 | 0,56 | 9,0 | 10,0 |
| 7 × 2 × 0,75 | 1,0 | 11,4 | 12,8 | 0,56 | 10,8 | 11,8 |
| 2 × 2 × 1,0 | 1,0 | 8,3 | 10,5 | 0,56 | 7,8 | 9,5 |
| 3 × 2 × 1,0 | 1,0 | 8,8 | 10,7 | 0,56 | 8,3 | 9,7 |
| 4 × 2 × 1,0 | 1,0 | 9,6 | 11,3 | 0,56 | 9,1 | 10,3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 × 2 × 1,0 | 1,0 | 11,6 | 13,4 | 0,56 | 10 | 12,4 |
| 2 × 2 × 1,5 | 1,0 | 10,3 | 12,2 | 0,56 | 9,8 | 11,2 |
| 3 × 2 × 1,5 | 1,0 | 11,0 | 12,4 | 0,56 | 10,4 | 11,4 |
| 4 × 2 × 1,5 | 1,0 | 12,1 | 13,1 | 0,56 | 11,6 | 12,6 |
| 7 × 2 × 1,5 | 1,0 | 14,5 | 16,3 | 0,56 | 14,0 | 15,3 |

For other compositions (number of cores), sheath thicknesses shall follow in principle the value mentioned in the Table 7 or ask the manufacturer for adequate technical design depending on the application requirements. The cable marking shall keep the standard name as EN 50306-4:2020.

## 11 Tests

### 11.1 Definitions relating to tests

The definition of Type (T), Sample (S) and Routine (R) tests is as given in EN 50306-1:2020, Clause 3.

NOTE 1 Tests classified as Sample (S) or Routine (R) could be required as part of any approval schemes.

NOTE 2 Annex A gives guidance on the selection of cables for type approval.

### 11.2 Voltage test - core to screen

The voltage test shall be carried out in accordance with EN 50305:2020, 6.2.2(b), using the following conditions:

— sample length 20 m

— voltage (a.c.) 2 kV

— voltage (d.c.) 4,8 kV

— duration of application 5 min

— test temperature (20 ± 5) °C

At the conclusion of the test there shall be no breakdown of the insulation.

**Table 8 — Schedule of tests for multipair cables – general screened and sheathed**

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| **Ref No** | **Test** | **Category of test** | **Test method given in** | | **Requirement given in** [a] |
| | | | **EN** | **(Sub)clause** | |
| 1 | Electrical tests | | | | |
| 1.1 | Electrical resistance of conductors | T, S | EN 50305:2020 | 6.1 | Table 1 of EN 50306-2:2020 |
| 1.2 | Voltage test – core to screen | T, S | EN 50305:2020 | 6.2.2(a) | 9.2 |
| 1.3 | Spark test on the sheath | R | EN 50305:2020 | 6.5 | 7.3 |

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| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Category of test | Test method given in | | Requirement given in [a] |
| | | | EN | (Sub)clause | |
| 2 | Provisions covering constructional and dimensional characteristics | | | | |
| 2.1 | Checking of conformity and constructional provisions | T, S | EN 50306-1 | Inspection | 9.4 and Clause 6 of EN 50306-1:2020 |
| 2.2 | Outer Sheath: | | | | |
| | (a) Application | S | EN 50306-1 | Inspection and manual test | 6.6.2 of EN 50306-1:2020 |
| | (b) Thickness | T, S | EN 50306-1 | A.2 | Table 7 |
| 2.3 | Overall diameter | T, S | EN 50306-1 | 6.7 | Table 7 |
| 2.4 | Identification and marking | T, S | EN 50306-4 | Inspection and measurement | 10.2.2 |
| 2.5 | Durability of identification | T, S | EN 50305:2020 | 10.1 | 5.3 of EN 50306-1:2020 |
| 3 | Tests of outer sheath material | | | | |
| 3.1 | Mechanical properties of sheath in state as delivered | T, S | EN 60811-501 | | Table 4 of EN 50264-1:2008 |
| 3.2 | Test at low temperature | | | | |
| | Bending (diameter ≤ 12,5 mm) | T | EN 60811-504 | | 5.3(a) |
| | Elongation (diameter > 12,5 mm) | T | EN 60811-505 | | 5.3(b) |
| | Impact resistance | T | EN 50305:2020 | 5.1 | 5.3(c) |
| 3.3 | Ozone | T | EN 50305:2020 | 7.4.2 | 5.4 |
| 3.4 | Water absorption (Gravimetric) | T | EN 60811-402 | | Table 4 of EN 50264-1:2008 |
| 3.5 | Compatibility test | T | EN 50305:2020 | 7.1 | 5.5 |
| 4 | Fire performance | | | | |
| 4.1 | Flame propagation | | | | |
| | single cable | T, S | EN 60332-1-2 | - | 4.6 and 8.1 of EN 50306-1:2020 |
| | bunched cable (diameters ≥ 12 mm) | T | EN 60332-3-24 | - | 4.6 and 8.2.1 of EN 50306-1:2020 |
| | bunched cable (diameters > 6 mm < 12 mm) | T | EN 50305:2020 | 9.1.1 | 4.6 and 8.2.2 of EN 50306-1:2020 |
| | bunched cable (diameters ≤ 6 mm) | T | EN 50305:2020 | 9.1.2 | 4.6 and 8.2.3 of EN 50306-1:2020 |
| 4.2 | Halogen-Free / Determination of halogens – Elemental test | T, S | EN 50305:2020 | Annex F and Annex G | |

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| Ref No | Test | Category of test | Test method given in | | Requirement given in [a] |
| | | | EN | (Sub)clause | |
| 4.3 | Smoke emission | T | EN 61034-2 | - | 4.6 and 8.3 of EN 50306-1:2020 |
| 4.4 | Toxicity of outer sheath | T | EN 50305:2020 | 9.2 | 4.6 and Clause 9 of EN 50306-1:2020 |
| [a] According to EN 50306-4 unless otherwise specified. | | | | | |

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# Annex A
(informative)

## Guidance on selection of cables for type approval

Electric cables meeting a requirement at two different diameters with identical formulations are be considered to comply with the requirement at all intermediate diameters.

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# Bibliography

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EN 50343, *Railway applications - Rolling stock - Rules for installation of cabling*

EN 50355, *Railway applications - Railway rolling stock cables having special fire performance - Guide to use*

EN 60332-3-25, *Tests on electric and optical fibre cables under fire conditions - Part 3-25: Test for vertical flame spread of vertically-mounted bunched wires or cables - Category D*

EN 60684-2, *Flexible insulating sleeving - Part 2: Methods of test*

EN 60754-1, *Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content*

EN 60754-2, *Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (by pH measurement) and conductivity*

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