BRITISH STANDARD

BS EN
50264-3-2:2008

Railway applications — Railway rolling stock power and control cables having special fire performance —

Part 3-2: Cables with crosslinked elastomeric insulation with reduced dimensions — Multicore cables

ICS 13.220.20; 29.060.20; 45.060.01

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 50264-3-2:2008.

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

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Railway applications - Railway rolling stock power and control cables having special fire performance - Part 3-2: Cables with crosslinked elastomeric insulation with reduced dimensions - Multicore cables

Applications ferroviaires - Câbles de puissance et de contrôle à comportement au feu spécifié pour matériel roulant ferroviaire - Partie 3-2: Câbles à enveloppe isolante réticulée de faibles dimensions - Câbles multiconducteurs

Bahnanwendungen - Starkstrom- und Steuerleitungen für Schienenfahrzeuge mit verbessertem Verhalten im Brandfall - Teil 3-2: Leitungen mit vernetzter elastomerer Isolierung mit reduzierten Abmessungen - Mehr- und vieladrige Leitungen

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Foreword

This European Standard was prepared by Working Group 12, Railway cables, of the Technical Committee CENELEC TC 20, Electric cables, as part of the overall programme of work in the Technical Committee CENELEC TC 9X, Electrical and electronic applications for railways.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50264-3-2 on 2008-03-01.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2009-03-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2011-03-01

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Introduction

The EN 50264 series covers cables, based upon halogen free materials, for use in railway rolling stock. It is divided into 5 parts under the generic title *"Railway applications - Railway rolling stock power and control cables having special fire performance"*.

Part 1	General requirements
Part 2-1	Cables with crosslinked elastomeric insulation – Single core cables
Part 2-2	Cables with crosslinked elastomeric insulation – Multicore cables
Part 3-1	Cables with crosslinked elastomeric insulation with reduced dimensions – Single core cables
Part 3-2	Cables with crosslinked elastomeric insulation with reduced dimensions – Multicore cables

Information regarding selection and installation of cables, including current ratings can be found in EN 50355 and EN 50343. The procedure for selection of cable cross-sectional area, including reduction factors for ambient temperature and installation type, is described in EN 50343.

Special test methods referred to in EN 50264 are given in EN 50305.

Part 1, "*General requirements*", contains a more extensive introduction to EN 50264, and should be read in conjunction with this Part 3-2.

1 Scope

EN 50264-3-2 specifies requirements for, and constructions and dimensions of, multicore cables of the following types and voltage ratings:

- 300/500 V screened or unscreened (1 mm^2, 1,5 mm^2 and 2,5 mm^2, number of cores from 2 to 40);
- 0,6/1 kV screened or unscreened, (1,5 mm^2 to 50 mm^2, 2, 3 and 4 cores).

NOTE Not all conductor sizes or number of cores are specified for every type.

All cables have class 5 tinned copper conductors to EN 60228, halogen-free insulation and halogen-free sheath. They are for use in railway rolling stock as fixed wiring, or wiring where limited flexing in operation is encountered. The requirements provide for a continuous conductor temperature not exceeding 90 °C and a maximum temperature for short circuit conditions of 200 °C based on a 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.

EN 50264-3-2 should be read in conjunction with Part 1 "*General requirements*".

2 Normative references

The following referenced documents are indispensable for the application 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 10002-1	Metallic materials – Tensile testing – Methods of test at ambient temperature
EN 50264-1:2008	Railway applications – Railway rolling stock power and control cables having special fire performance – Part 1: General requirements
EN 50266-2-4	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-4: Procedures – Category C
EN 50266-2-5	Common test methods for cables under fire conditions – Test for vertical flame spread of vertically-mounted bunched wires or cables – Part 2-5: Procedures – Small cables – Category D
EN 50305:2002	Railway applications – Railway rolling stock cables having special fire performance – Test methods
EN 50334	Marking by inscription for the identification of cores of electric cables
EN 60228	Conductors of insulated cables (IEC 60228)
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 (IEC 60332-1-2)

EN 60811-1-1:1995	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 60811-1-1:1993)
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 + A1:1989 + corr. May 1986)
EN 60811-1-3:1995	Insulating and sheathing materials of electric and optical cables – Common test methods – Part 1-3: General application – Methods for determining the density – Water absorption tests – Shrinkage test (IEC 60811-1-3:1993)
EN 60811-1-4:1995	Insulating and sheathing materials of electric and optical cables – Common test methods – Part 1-4: General application – Tests at low temperature (IEC 60811-1-4:1985 + A1:1993 + corr. May 1986)
EN 60811-2-1:1998	Insulating and sheathing materials of electric and optical cables – Common test methods – Part 2-1: Methods specific to elastomeric compounds – Ozone resistance, hot set and mineral oil immersion tests (IEC 60811-2-1:1998)
EN 61034-2	Measurement of smoke density of cables burning under defined conditions – Part 2: Procedure and requirements (IEC 61034-2)
HD 308	Identification of cores in cables and flexible cords

3 Definitions

For the purposes of this document, the terms and definitions given in EN 50264-1 apply.

4 Rated voltage

The rated voltage for multicore cables shall be as follows:

a) 300/500 V (1 mm^2 to 2,5 mm^2) control cables;

b) 0,6/1 kV (1,5 mm^2 to 50 mm^2) power cables.

5 Marking and identification

5.1 Marking of cable

Cables shall be marked with the following:

- manufacturer's name;
- EN reference;
- voltage rating (U_o);
- number of cores and conductor size;
- a code designation according to Annex A.

If a cable is screened, an additional letter, S, shall be added.

An example of a complete mark is:

XYZ EN 50264-3-2 300 V 37 x 1,5 FF S

The marking shall conform to the requirements of EN 50264-1, Clause 5.

5.2 Core identification

The cores of all cables, except the earthing conductor, shall be black unless otherwise specified.

The identification of the individual core in a cable, except the earthing conductor, shall be by printed number or colour. The number shall be printed in a colour, which contrasts with the core colour. If a colour other than black is specified it shall be a clearly identifiable colour in accordance with HD 308 and shall be durable. The colour shall be throughout the whole of the insulation or on its surface. Durability shall be checked by the test given in EN 50305, 10.1.

The marking by numbers shall conform to EN 50334, unless otherwise specified, and conformity shall be checked by visual examination and measurement.

5.3 Sheath

The sheath shall be black unless otherwise agreed between the manufacturer and purchaser.

6 Construction of cables

6.1 General

Cores complying with this part or EN 50264-3-1 may be used as components of multicore cables

The control cable dimensions shall be as given in Tables 1 or 2 as appropriate to the cable type.

The power cable core dimensions shall be as given in Table 3 and the other cable dimensions as given in Tables 4 to 9 as appropriate to the cable type.

If agreed between the purchaser and manufacturer, cables may be made with a number of cores not specified in Tables 1 and 2. In such cases the thickness of the sheath and diameter of the braid wire (if any) shall be those specified in the relevant table for the cable containing the next higher number of cores.

6.2 Conductor

Conductors shall be tin-coated annealed copper, class 5, according to EN 60228.

When tested in accordance with EN 10002-1 the minimum average elongation of the wires from the conductor shall be 15 %, with a minimum value of 10 % for any individual wire.

NOTE It is not necessary to test all individual wires. 5 % of wires or 10 wires, whichever is the least number, should be selected at random.

6.3 Insulation system

The insulation shall be one or more extruded materials as defined in EN 50264-1 applied so as to meet the requirements of compound type EI 106 to EI 110:

EI 106 low temperature resistant, oil resistant;

EI 107 extra low temperature resistant, oil resistant;

EI 108 low temperature resistant, extra oil and fuel resistant;

EI 109 extra low temperature resistant, extra oil and fuel resistant;

EI 110 extra low temperature resistant, non oil resistant.

To claim extra low temperature performance both insulation and sheaths shall be extra low temperature resistant.

The insulation shall be applied to meet the requirements of EN 50264-1, 6.2.

The insulation thickness shall conform to the specified value given in Tables 1 to 3.

6.4 Laying up of cores and fillers

The cores shall be twisted together with either a continuous right or left-hand direction of lay.

The pitch or lay for primary cores shall not be greater than 20 times the diameter of the bunch of cores in the cable.

NOTE Non-hygroscopic fillers may be applied as given in EN 50264-1, 6.3. A synthetic binder tape may be used over the laid-up assembly at the manufacturer's discretion.

6.5 Metallic screen

Where screens are applied over cores a tape shall be used between cores and screens. The metallic screening braid shall meet the requirements of EN 50264-1, 6.4.

6.6 Sheath

Sheath shall be an extruded material as defined in EN 50264-1 applied so as to meet the requirements of compound type EM 101 to EM 104:

EM 101 low temperature resistant, oil resistant;

EM 102 extra low temperature resistant, oil resistant;

EM 103 low temperature resistant, extra oil and fuel resistant;

EM 104 extra low temperature resistant, extra oil and fuel resistant.

The sheath shall consist of one or more extruded layers of the same type.

The sheath shall be applied to meet the requirements of EN 50264-1, 6.6.

The sheath thickness shall conform to the specified value given in Tables 1, 2 and 4 to 9.

6.7 Construction

Power and control cables of all types shall be composed of the following components in the order given:

- conductor — flexible tin coated annealed copper, class 5;
- separator — optional;
- insulation — a compound or compounds as given in 6.3;
- laying up and fillers — as given in 6.4;
- metallic screen (where required) — as given in 6.5 and specified in Tables 2, 5, 7, 9;
- separator — optional;
- sheath — compound as given in 6.6.

Table 1 - Multicore cables - unscreened (300/500 V)

1	2	3	4	5	6	7	8	9	10	11	1
Number and nominal cross-sectional area [a]	Conductor diameter *d* [b]	Mean thickness of insulation	Core dimensions		Mean thickness of sheath	Overall diameter *D*		Conductor resistance at 20 °C	Insulation resistance at 20 °C EI 110	Insulation resistance at 20 °C EI 106, 107, 108, 109	Number and nominal cross-sectional area [a]
			min.	max.		min.	max.	max.	min.	min.	
n × mm^2	mm	mm	mm	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	n × mm^2
2 × 1		0,4			0,6	5,3	6,2	20,0	15,0	7,5	2 × 1
4 × 1		0,4			0,6	6,1	7,2	20,0	15,0	7,5	4 × 1
7 × 1		0,4			0,7	7,5	8,7	20,0	15,0	7,5	7 × 1
9 × 1		0,4			0,7	9,1	10,6	20,0	15,0	7,5	9 × 1
12 × 1	1,25	0,4	2,0	2,4	0,7	9,8	11,5	20,0	15,0	7,5	12 × 1
19 × 1		0,4			0,8	11,7	13,7	20,0	15,0	7,5	19 × 1
24 × 1		0,4			1,0	14,1	16,5	20,0	15,0	7,5	24 × 1
32 × 1		0,4			1,0	15,5	18,2	20,0	15,0	7,5	32 × 1
37 × 1		0,4			1,0	16,1	18,9	20,0	15,0	7,5	37 × 1
40 × 1		0,4			1,0	16,7	19,6	20,0	15,0	7,5	40 × 1
4 × 1,5		0,5			0,7	7,3	8,6	13,7	14,0	7,0	4 × 1,5
7 × 1,5		0,5			0,7	8,7	10,2	13,7	14,0	7,0	7 × 1,5
9 × 1,5	1,5	0,5	2,4	2,9	0,8	10,9	12,7	13,7	14,0	7,0	9 × 1,5
12 × 1,5		0,5			0,8	11,8	13,8	13,7	14,0	7,0	12 × 1,5
19 × 1,5		0,5			1,0	14,2	16,6	13,7	14,0	7,0	19 × 1,5
24 × 1,5		0,5			1,0	16,6	19,5	13,7	14,0	7,0	24 × 1,5
32 × 1,5		0,5			1,2	18,7	21,9	13,7	14,0	7,0	32 × 1,5
37 × 1,5		0,5			1,2	19,5	22,8	13,7	14,0	7,0	37 × 1,5

Table 1 - Multicore cables - unscreened (300/500 V) *(continued)*

1	2	3	4	5	6	7	8	9	10	11	1
Number and nominal cross-sectional area [a]	**Conductor diameter *d* [b]**	**Mean thickness of insulation**	**Core dimensions**		**Mean thickness of sheath**	**Overall diameter *D***		**Conductor resistance at 20 °C**	**Insulation resistance at 20 °C EI 110**	**Insulation resistance at 20 °C EI 106, 107, 108, 109**	**Number and nominal cross-sectional area [a]**
			min.	**max.**		**min.**	**max.**	**max.**	**min.**	**min.**	
n × mm²	mm	mm	mm	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	n × mm²
4 × 2,5		0,5			0,7	8,3	9,8	8,21	13,0	6,5	4 × 2,5
7 × 2,5		0,5			0,8	10,2	11,9	8,21	13,0	6,5	7 × 2,5
9 × 2,5	1,95	0,5	2,9	3,4	1,0	12,9	15,1	8,21	13,0	6,5	9 × 2,5
12 × 2,5		0,5			1,0	13,9	16,3	8,21	13,0	6,5	12 × 2,5
19 × 2,5		0,5			1,0	16,3	19,1	8,21	13,0	6,5	19 × 2,5
24 × 2,5		0,5			1,2	19,6	22,9	8,21	13,0	6,5	24 × 2,5

[a] One core may be coloured green and yellow and shall be contained in the outer layer.

[b] For information, indicative only.

Table 2 - Multicore cables - screened (300/500 V)

1	2	3	4	5	6	7	8	9	10	11	12	1
Number and nominal cross-sectional area [a]	Conductor diameter *d* [b]	Mean thickness of insulation	Core dimensions		Wire diameter of screen	Mean thickness of sheath	Screened overall diameter *D*		Resistance of conductor at 20 °C	Insulation resistance at 20 °C EI 110	Insulation resistance at 20 °C EI 106, 107, 108, 109	Number and nominal cross-sectional area [a]
			min.	max.	max.		min.	max.	max.	min.	min.	
n × mm^2	mm	mm	mm	mm	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	n × mm^2
2 × 1		0,4			0,16	0,6	6,0	7,1	20,0	15,0	7,5	2 × 1
4 × 1		0,4			0,16	0,7	7,0	8,2	20,0	15,0	7,5	4 × 1
7 × 1		0,4			0,16	0,7	8,2	9,6	20,0	15,0	7,5	7 × 1
9 × 1		0,4			0,21	0,8	10,2	11,9	20,0	15,0	7,5	9 × 1
12 × 1	1,25	0,4	2,0	2,4	0,21	0,8	10,9	12,7	20,0	15,0	7,5	12 × 1
19 × 1		0,4			0,26	1,0	13,2	15,4	20,0	15,0	7,5	19 × 1
24 × 1		0,4			0,26	1,0	15,2	17,8	20,0	15,0	7,5	24 × 1
32 × 1		0,4			0,26	1,0	16,6	19,4	20,0	15,0	7,5	32 × 1
37 × 1		0,4			0,26	1,0	17,2	20,1	20,0	15,0	7,5	37 × 1
40 × 1		0,4			0,26	1,2	18,2	21,3	20,0	15,0	7,5	40 × 1
4 × 1,5		0,5			0,16	0,7	8,0	9,4	13,7	14,0	7,0	4 × 1,5
7 × 1,5		0,5			0,21	0,7	9,6	11,3	13,7	14,0	7,0	7 × 1,5
9 × 1,5	1,5	0,5	2,4	2,9	0,21	1,0	12,1	14,2	13,7	14,0	7,0	9 × 1,5
12 × 1,5		0,5			0,21	1,0	13,0	15,2	13,7	14,0	7,0	12 × 1,5
19 × 1,5		0,5			0,26	1,0	15,3	17,9	13,7	14,0	7,0	19 × 1,5
24 × 1,5		0,5			0,26	1,2	18,1	21,2	13,7	14,0	7,0	24 × 1,5
32 × 1,5		0,5			0,26	1,2	19,8	23,2	13,7	14,0	7,0	32 × 1,5
37 × 1,5		0,5			0,26	1,2	20,5	24,0	13,7	14,0	7,0	37 × 1,5

Table 2 - Multicore cables - screened (300/500 V) *(continued)*

1	2	3	4	5	6	7	8	9	10	11	12	1
Number and nominal cross-sectional area [a]	**Conductor diameter** *d* [b]	**Mean thickness of insulation**	**Core dimensions**		**Wire diameter of screen**	**Mean thickness of sheath**	**Screened overall diameter** *D*		**Resistance of conductor at 20 °C**	**Insulation resistance at 20 °C EI 110**	**Insulation resistance at 20 °C EI 106, 107, 108, 109**	**Number and nominal cross-sectional area** [a]
			min.	**max.**	**max.**		**min.**	**max.**	**max.**	**min.**	**min.**	
n × mm^2	mm	mm	mm	mm	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	n × mm^2
4 × 2,5		0,5			0,21	0,7	9,2	10,8	8,21	13,0	6,5	4 × 2,5
7 × 2,5		0,5			0,21	0,8	11,1	13,0	8,21	13,0	6,5	7 × 2,5
9 × 2,5	1,95	0,5	2,9	3,4	0,26	1,0	13,9	16,3	8,21	13,0	6,5	9 × 2,5
12 × 2,5		0,5			0,26	1,0	15,0	17,5	8,21	13,0	6,5	12 × 2,5
19 × 2,5		0,5			0,26	1,2	17,8	20,8	8,21	13,0	6,5	19 × 2,5
24 × 2,5		0,5			0,26	1,2	20,6	24,1	8,21	13,0	6,5	24 × 2,5

[a] One core may be coloured green and yellow and shall be contained in the outer layer.

[b] For information, indicative only.

Table 3 - Dimensions of core (0,6/1 kV)

1	2	3	4	5	6	1
Nominal-cross-sectional area	**Conductor diameter** ***d*** [a]	**Mean thickness of insulation**	**Core diameter** ***D***		**Resistance of conductor at 20 °C**	**Nominal-cross-sectional area**
			min.	**max.**	**max.**	
mm^2	mm	mm	mm	mm	Ω/km	mm^2
1,5	1,5	0,7	2,8	3,3	13,7	1,5
2,5	1,95	0,7	3,2	3,8	8,21	2,5
4	2,5	0,7	3,8	4,4	5,09	4
6	3,0	0,7	4,2	5,0	3,39	6
10	3,9	0,7	5,1	5,9	1,95	10
16	5,0	0,7	6,1	7,2	1,24	16
25	6,4	0,9	7,8	9,1	0,795	25
35	7,7	0,9	9,0	10,6	0,565	35
50	9,2	1,0	10,6	12,4	0,393	50

[a] For information, indicative only.

NOTE This table should be read in conjunction with Tables 4 to 9.

Table 4 - Two cores - (0,6/1 kV) unscreened

1	2	3	4	5	6	1
Nominal cross-sectional area	**Mean thickness of sheath**	**Overall diameter *D***		**Insulation resistance at 20 °C EI 110**	**Insulation resistance at 20 °C EI 106, 107, 108, 109**	**Nominal cross-section**
		min.	**max.**	**min.**	**min.**	
mm^2	mm	mm	mm	MΩ.km	MΩ.km	mm^2
1,5	0,70	7,2	9,0	21,0	10,5	1,5
2,5	0,70	8,0	10,0	17,2	8,6	2,5
4	0,70	9,1	11,3	14,2	7,1	4
6	0,80	10,1	12,4	12,2	6,1	6
10	1,00	12,5	15,4	9,8	4,9	10
16	1,00	14,9	18,4	7,9	3,9	16
25	1,20	18,7	23,0	7,3	3,6	25
35	1,20	21,2	25,9	6,7	3,3	35
50	1,40	25,1	30,7	6,3	3,1	50

Table 5 - Two cores - (0,6/1 kV) screened

1	2	3	4	5	6	7	1
Nominal cross-sectional area	**Wire diameter of screen**	**Mean thickness of sheath**	**Overall diameter *D***		**Insulation resistance at 20 °C EI 110**	**Insulation resistance at 20 °C EI 106, 107,108, 109**	**Nominal cross-sectional area**
	max.		**min.**	**max.**	**min.**	**min.**	
mm^2	mm	mm	mm	mm	MΩ.km	MΩ.km	mm^2
1,5	0,16	0,70	7,9	9,9	21,0	10,5	1,5
2,5	0,16	0,70	8,7	10,7	17,2	8,6	2,5
4	0,21	0,80	10,2	12,7	14,2	7,1	4
6	0,21	0,80	10,9	13,6	12,2	6,1	6
10	0,21	1,00	13,4	16,6	9,8	4,9	10
16	0,26	1,00	16,0	19,8	7,9	3,9	16
25	0,26	1,20	19,8	24,6	7,3	3,6	25
35	0,31	1,40	22,8	27,9	6,7	3,3	35
50	0,31	1,40	26,4	32,3	6,3	3,1	50

Table 6 - Three cores - (0,6/1 kV) unscreened

1	2	3	4	5	6	1
Nominal cross-sectional area	**Mean thickness of sheath**	**Overall diameter *D***		**Insulation resistance at 20 °C EI 110**	**Insulation resistance at 20 °C EI 106, 107, 108, 109**	**Nominal cross-section**
		min.	**max.**	**min.**	**min.**	
mm^2	mm	mm	mm	MΩ.km	MΩ.km	mm^2
1,5	0,70	7,7	9,5	21,0	10,5	1,5
2,5	0,70	8,5	10,5	17,2	8,6	2,5
4	0,70	9,7	12,0	14,2	7,1	4
6	0,80	10,7	13,2	12,2	6,1	6
10	1,00	13,3	16,5	9,8	4,9	10
16	1,00	16,0	19,6	7,9	3,9	16
25	1,20	20,0	24,7	7,3	3,6	25
35	1,20	23,0	28,2	6,7	3,3	35
50	1,40	26,3	32,2	6,3	3,1	50

Table 7 - Three cores - (0,6/1 kV) screened

1	2	3	4	5	6	7	1
Nominal cross-sectional area	Wire diameter of screen	Mean thickness of sheath	Overall diameter *D*		Insulation resistance at 20 °C EI 110	Insulation resistance at 20 °C EI 106, 107,108, 109	Nominal cross-sectional area
	max.	min.	min.	max.	min.	min.	
mm^2	mm	mm	mm	mm	MΩ.km	MΩ.km	mm^2
1,5	0,16	0,70	8,4	10,4	21,0	10,5	1,5
2,5	0,16	0,70	9,2	11,4	17,2	8,6	2,5
4	0,21	0,80	10,8	13,3	14,2	7,1	4
6	0,21	0,80	11,6	14,3	12,2	6,1	6
10	0,26	1,00	14,4	18,0	9,8	4,9	10
16	0,26	1,20	17,4	21,3	7,9	3,9	16
25	0,26	1,20	21,3	26,1	7,3	3,6	25
35	0,31	1,40	24,5	29,8	6,7	3,3	35
50	0,31	1,60	28,3	34,6	6,3	3,1	50

Table 8 - Four cores - (0,6/1 kV) unscreened

1	2	3	4	5	6	1
Nominal cross-sectional area	**Mean thickness of sheath**	**Overall diameter *D***		**Insulation resistance at 20 °C EI 110**	**Insulation resistance at 20 °C EI 106, 107,108, 109**	**Nominal cross-sectional area**
		min.	**max.**	**min.**	**min.**	
mm^2	mm	mm	mm	MΩ.km	MΩ.km	mm^2
1,5	0,70	8,5	10,5	21,0	10,5	1,5
2,5	0,70	9,4	11,6	17,2	8,6	2,5
4	0,80	10,9	13,4	14,2	7,1	4
6	1,00	12,2	14,9	12,2	6,1	6
10	1,00	14,7	18,2	9,8	4,9	10
16	1,20	18,0	22,1	7,9	3,9	16
25	1,40	22,6	27,6	7,3	3,6	25
35 + 25 [a]	1,40	25,7	31,2	6,7	3,3	35 + 25
50 + 25 [a]	1,60	30,0	36,5	6,3	3,1	50 + 25

[a] The first number indicates the size of the three phase conductors, and the second indicates the size of the neutral conductor.

Table 9 - Four cores - (0,6/1 kV) screened

1	2	3	4	5	6	7	1
Nominal cross-sectional area	Wire diameter of screen	Mean thickness of sheath	Overall diameter *D*		Insulation resistance at 20 °C EI 110	Insulation resistance at 20 °C EI 106, 107,108, 109	Nominal cross-sectional area
	max.		min.	max.	min.	min.	
mm^2	mm	mm	mm	mm	MΩ.km	MΩ.km	mm^2
1,5	0,16	0,70	9,1	11,3	21,0	10,5	1,5
2,5	0,21	0,80	10,4	12,9	17,2	8,6	2,5
4	0,21	0,80	11,8	14,5	14,2	7,1	4
6	0,21	1,00	13,1	16,1	12,2	6,1	6
10	0,26	1,00	15,9	19,5	9,8	4,9	10
16	0,26	1,20	19,3	23,6	7,9	3,9	16
25	0,31	1,40	24,0	29,3	7,3	3,6	25
35 + 25 [a]	0,31	1,40	26,9	32,9	6,7	3,3	35 + 25
50 + 25 [a]	0,31	1,60	31,5	38,2	6,3	3,1	50 + 25

[a] The first number indicates the size of the three phase conductors, the second indicates the size of the neutral conductor.

7 Tests

7.1 Definitions relating to tests

The definition of Type (T), Sample (S) and Routine (R) tests shall be as given in EN 50264-1, Clause 3.

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

7.2 Conductor resistance

The test shall be carried out in accordance with EN 50305, 6.1.

The values obtained shall not exceed the maximum values given in Tables 1, 2 or 3 appropriate to the size of conductor.

7.3 Voltage test

7.3.1 Insulation

The test shall be carried out in accordance with EN 50305, 6.2.1 or 6.2.2, using either an a.c. or d.c. voltage and the following conditions:

- sample length 20 m;
- duration of application 5 min;
- test temperature (20 ± 5) °C.

Test voltage to be applied:

Rated voltage (U_o)	Test voltage (r.m.s.)	Test voltage (d.c.)
kV	kV	kV
0,3	2,0	4,8
0,6	3,5	8,4

There shall be no breakdown of the insulation.

7.3.2 Sheath of screened cables

The test shall be carried out in accordance with EN 50305, 6.3, using one of the following conditions:

- a.c. (50Hz) 3,0 kV;
- impulse 6,0 kV;
- d.c. 4,5 kV.

There shall be no breakdown of the sheath.

7.4 Insulation resistance

The test shall be carried out at 20 °C in accordance with EN 50305, 6.4.1.

The values obtained shall not be below those given in Tables 1, 2, 4, 5, 6, 7, or 9 appropriate to the type of insulation as well as type and size of cable.

7.5 Dielectric strength on sample

The test shall be carried out in accordance with EN 50305, 6.8, using the following conditions:

- water temperature (20 ± 5) °C;
- immersion duration 1 h.

Rated voltage (U_o)	Minimum breakdown voltage (a.c.)
kV	kV
0,3	4
0,6	6

At the conclusion of the test there shall be no breakdown below the minimum voltage.

7.6 Spark test

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

a) Test voltage a.c.(50 Hz):

3 kV + (5 x tabulated insulation thickness (mm)) kV.

b) Test voltage d.c.:

V a.c. x 1,5.

7.7 Surface resistance

The test shall be carried out in accordance with EN 50305, 6.6.

The measured leakage current shall not exceed the value of current, in mA, equal to half the measured diameter of the sample of cable in mm, e.g. for a cable 10 mm in diameter the maximum measured leakage current shall not exceed 5 mA.

At the completion of this test the cable shall withstand a voltage of 10 kV a.c. without flashover.

7.8 Ageing test

The insulation and sheath shall be tested in accordance with EN 60811-1-2, 8.1, using the following conditions:

- temperature (135 ± 2) °C;
- duration of treatment 168 h.

The maximum variation shall be:

- for the tensile strength ± 30 %;
- for the elongation at break ± 30 %

for each insulation and sheathing compounds.

7.9 Hot set test

The test shall be carried out in accordance with EN 60811-2-1, Clause 9, using the following conditions:

- temperature (200 ± 3) °C;
- time under load 15 min;
- mechanical stress 20 N/cm^2.

The maximum elongation shall be:

- under load 100 %;
- after unloading 25 %.

7.10 Compatibility

The test shall be carried out in accordance with EN 50305, 7.1, using the following conditions:

- temperature (100 ± 2) °C;
- duration 168 h.

Maximum variation shall be:

- tensile strength ± 30 %;
- elongation at break ± 40 %.

7.11 Water absorption test on sheath

The test shall be carried out on the complete cable in accordance with EN 60811-1-3, 9.2, using the following conditions:

- temperature of water (70 ± 2) °C;
- immersion duration 168 h.

At the completion of the test the maximum weight increase shall not exceed 15 mg/cm².

7.12 Ozone resistance

The test shall be carried out in accordance with EN 50305, 7.4.2, using either Method A or Method B, as given below.

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

Method A:

- ozone concentration (by volume) (%) (250-300) x 10^{-4};
- test temperature (25 ± 2) °C;
- test duration 24 h;
- test requirement no cracks.

Method B:

- ozone concentration (by volume) (%) (200 ± 50) x 10^{-6};
- test temperature (40 ± 2) °C;
- test duration 72 h;
- test requirement no cracks.

7.13 Mineral oil resistance

The test shall be carried out in accordance with EN 60811-2-1, Clause 10, using the following conditions:

Compound type EI 106, EI 107, EM 101 and EM 102

Treatment:

- type of oil IRM 902;
- temperature (100 ± 2) °C;
- duration 24 h.

Compound type EI 108, EI 109, EM 103 and EM 104

Treatment:

- type of oil IRM 902;
- temperature (100 ± 2) °C;
- duration 72 h.

The maximum variation shall be:

- for the tensile strength ± 30 %;
- for the elongation at break ± 40 %

for each insulating and sheathing compound.

7.14 Fuel resistance

The test shall be carried out in accordance with EN 60811-2-1, Clause 10, using the following conditions:

Compound type EI 108, EI 109, EM 103 and EM 104

Treatment:

- type of liquid IRM 903;
- temperature (70 ± 2) °C;
- duration 168 h.

The maximum variation shall be:

- for tensile strength ± 30 %;
- for elongation at break ± 40 %

for each insulating and sheathing compound.

7.15 Acid and alkali resistance

The test shall be carried out in accordance with EN 60811-2-1, Clause 10, but using the following conditions and test fluids:

Compound type EI 106 to EI 109 and EM 101 to EM 104

Treatment:

- type of acid N-oxalic acid solution;
- type of alkali N-sodium hydroxide solution;
- temperature (23 ± 2) °C;
- duration 168 h.

Requirements:

- variation of tensile strength ± 30 % max.;
- elongation at break 100 % min.

for each insulating and sheathing compound.

NOTE Two separate tests are required; one in acid solution and one in alkali solution.

7.16 Bending test at low temperature (cores and cables with OD ≤ 12,5 mm)

a) For cables manufactured with compounds type EI 106, EI 108, EM 101 and EM 103 the test shall be carried out at (-25 ± 2) °C in accordance with EN 60811-1-4, 8.1 or 8.2.

b) For compounds type EI 107, EI 109, EI 110, EM 102 and EM 104 the test shall be carried out at (-40 ± 2) °C in accordance with EN 60811-1-4, 8.1 or 8.2.

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

7.17 Cold elongation test (cores and cables with OD > 12,5 mm)

a) For compounds type EI 106, EI 108, EM 101 and EM 103 the test shall be carried out at (-25 ± 2) °C in accordance with EN 60811-1-4, 8.3 or 8.4.

b) For compounds type EI 107, EI 109, EI 110, EM 102 and EM 104 the test shall be carried out at (-40 ± 2) °C in accordance with EN 60811-1-4, 8.3 or 8.4.

The minimum elongation at break for all compounds shall be 30 %.

7.18 Impact test at low temperature

For cables manufactured with compounds type EI 107, EI 109, EI 110, EM 102 and EM 104 the test shall be carried out at (-25 ± 2) °C in accordance with EN 50305, 5.1.

NOTE These compounds are described as “extra low temperature resistant“.

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

7.19 Reaction to fire – Cable

The completed cable shall conform to the requirements given in EN 50264-1, Clause 8.

7.20 Reaction to fire – Components

Samples of insulation, sheath and where applicable fillers and tapes, shall conform to the requirements given in EN 50264-1, Clause 9.

Table 10 - Schedule of tests for cables

1	2	3	4	5	6
Ref No.	**Tests**	**Category of test**	**Test method described in**		**Requirements given in clause** [a]
			EN	**Clause**	
1	**Electrical tests**				
1.1	Conductor resistance	T, S	50305	6.1	7.2
1.2	Voltage test on cable	T, S	50305	6.2.1 or 6.2.2 or 6.3	7.3
1.3	Dielectric strength on sample	T	50305	6.8	7.5
1.4	Surface resistance	T	50305	6.6	7.7
1.5	Spark test on insulation	R	50305	6.5	7.6
1.6	Insulation resistance at 20 °C	T, S	50305	6.4.1	7.4
2	**Provisions covering constructional and dimensional characteristics**				
2.1	Checking of compliance with constructional provisions	T, S.	Inspection and manual tests		6.1 & 6.7
2.2	Conductor material and construction	T, S.	Visual examination and		
			50264-1	6.1	6.2
2.3	Insulation:				
	(a) application	S	Visual examination		6.3 and EN 50264-1, 6.2.3
	(b) thickness	T, S	60811-1-1	8.1	Tables 1-3 and EN 50264-1, 6.2.4
2.4	Core identification	S	Visual examination and measurement		5.2
2.5	Metallic screen:				
	(a) diameter of wire	T, S	Measurement	6.5.1	6.5.1
	(b) filling factor	T, S	Measurement	6.5.1	6.5.1
2.6	Sheath:				
	(a) application	S.	Visual examination		6.6 and EN 50264-1, 6.5.2
	(b) thickness	T, S	60811-1-1	8.2	Tables 1-9 (except Table 3) and EN 50264-1, 6.5.3
2.7	Overall diameter	T,S	60811-1-1	8.3	EN 50264-1, 6.6
2.8	Cable marking and identification	T, S	Visual examination and measurement		5.1 and Annex A

Table 10 - Schedule of tests for cables *(continued)*

1	2	3	4	5	6
Ref No.	**Tests**	**Category of test**	**Test method described in**		**Requirements given in clause** [a]
			EN	**Clause**	
3	**Tests for insulating and sheathing materials**				
3.1	Non-electrical tests				
3.1.1	Tensile test in the state as delivered	T, S			
	a) insulation		60811-1-1	9.1	Table 2b of EN 50264-1
	b) sheath		60811-1-1	9.2	Table 4 of EN 50264-1
3.1.2	Tensile test before and after ageing in air oven	T	60811-1-2 and:	8.1	
	a) insulation		60811-1-1	9.1	Table 2b of EN 50264-1
	b) sheath		60811-1-1	9.2	Table 4 of EN 50264-1
3.1.3	Hot set test:	T, S	60811-2-1	9	
	a) insulation				7.9
	b) sheath				7.9
3.1.4	Water absorption test on sheath	T	60811-1-3	9.2	7.11
3.1.5	Ozone resistance	T	50305	7.4.2	
	a) insulation				7.12
	b) sheath				7.12
3.1.6	Mineral oil resistance	T	60811-2-1	10	
	a) insulation [b]				7.13
	b) sheath				7.13
3.1.7	Fuel resistance	T	60811-2-1	10	
	a) insulation [b]				7.14
	b) sheath				7.14
3.1.8	Acid and alkaline resistance	T	60811-2-1	10	
	a) insulation [b]				7.15
	b) sheath				7.15
3.1.9	Assessment of halogens	T,S	50264-1, Annexes A and B		EN 50264-1, 9.1
	a) insulation				
	b) non-metallic components				
	c) sheath				
3.1.10	Toxicity	T	50305	9.2	EN 50264-1, 9.2

Table 10 - Schedule for tests for cables *(continued)*

1	2	3	4	5	6
Ref No.	**Tests**	**Category of test**	**Test method described in**		**Requirement given in clause** [a]
			EN	**Clause**	
4	**Tests on complete cable**				
4.1	Bending test at low temperature [c]	T	60811-1-4	8.1 or 8.2	7.16
4.2	Elongation test at low temperature [d]	T	60811-1-4	8.3 or 8.4	7.17
4.3	Impact test at low temperature [e]	T	50305	5.1	7.18
4.4	Compatibility test	T	50305	7.1	7.10
4.5	Flame propagation:				
4.5.1	One vertical cable	T,S	60332-1-2		EN 50264-1, 8.1
4.5.2	Bunched cables				
	≥ 12 mm	T	50266-2-4 NMV 1,5 l/m		EN 50264-1, 8.2.1
	> 6 mm and < 12 mm	T	50266-2-5 NMV 0,5 l/m		EN 50264-1, 8.2.2
	≤ 6 mm	T	50305	9.1.2	EN 50264-1, 8.2.3
4.6	Smoke emission	T	61034-2		EN 50264-1, 8.3

[a] According to EN 50264-3-2 unless otherwise stated.

[b] Not for EI 110 insulation.

[c] The test is only applicable to cables with OD ≤ 12,5 mm.

[d] The test is only applicable to cables with OD > 12,5 mm.

[e] Only for extra low temperature resistant types.

Annex A
(normative)

Code designation

A.1 Code designations

The cable shall be identified by one or two letters, the first of which shall identify the insulation compound, and the second the sheathing compound (where applicable).

Insulation system:

C EI 106

F EI 107

J EI 108

M EI 109

O EI 110

Sheath:

C EM 101

F EM 102

J EM 103

M EM 104

A.2 Additional codes

Additional letters shall be added after the conductor temperature to identify specific cable parameters, as follows:

G cable containing a green-and-yellow earth core

S cable with a metallic screen

NOTE The use of these codes as part of the complete marking is shown in 5.1.

Bibliography

EN 50264-2-1 Railway applications – Railway rolling stock power and control cables having special fire performance – Part 2-1: Cables with crosslinked elastomeric insulation – Single core cables

EN 50264-2-2 Railway applications – Railway rolling stock power and control cables having special fire performance – Part 2-2: Cables with crosslinked elastomeric insulation – Multicore cables

EN 50264-3-1 Railway applications – Railway rolling stock power and control cables having special fire performance – Part 3-1: Cables with crosslinked elastomeric insulation with reduced dimensions – Single core cables

EN 50343 Railway applications – Rolling stock – Rules for installation of cabling

EN 50355 Railway applications – Railway rolling stock cables having special fire performance – Thin wall and standard wall – Guide to use

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