

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**

ICS 13.220.20; 29.060.20; 45.060.01

National foreword

This British Standard is the UK implementation of EN 50264-3-1:2008.

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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 3-1: Cables with crosslinked elastomeric insulation
with reduced dimensions -
Single core cables**

Applications ferroviaires -
Câbles de puissance et de contrôle
à comportement au feu spécifié
pour matériel roulant ferroviaire -
Partie 3-1: Câbles à enveloppe isolante
réticulée de faibles dimensions -
Câbles monoconducteurs

Bahnanwendungen -
Starkstrom- und Steuerleitungen
für Schienenfahrzeuge mit verbessertem
Verhalten im Brandfall -
Teil 3-1: Leitungen mit vernetzter
elastomerer Isolierung
mit reduzierten Abmessungen -
Einadrige Leitungen

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CENELEC

European Committee for Electrotechnical Standardization
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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.

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The following dates were fixed:

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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 (Guide to use) and EN 50343 (Rules for installation of cabling). 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.

The cables in Part 3-1 may also be used in EN 50264-3-2 to build up multicore sheathed cables.

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

1 Scope

EN 50264-3-1 specifies requirements for, and constructions and dimensions of, single core cables of the following types and voltage ratings:

- 0,6/1 kV unscreened, unsheathed (1 mm² to 400 mm²);
- 1,8/3 kV unscreened, unsheathed (1,5 mm² to 400 mm²);
- 1,8/3 kV unscreened, sheathed (1,5 mm² to 400 mm²);
- 3,6/6 kV unscreened, sheathed (2,5 mm² to 400 mm²).

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 50264-3-1 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 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 single-core insulated cables shall be as follows:

- a) unsheathed: 0,6/1 kV; 1,8/3 kV;
- b) sheathed: 1,8/3 kV; 3,6/6 kV.

5 Marking and identification

5.1 Marking of cable

Cables shall be marked with the following:

- manufacturer's name;
- EN reference;
- voltage rating (U_0);
- conductor size;
- a code designation according to Annex A.

An example of a complete mark is:

XYZ EN 50264-3-1 1800 V 400 FF

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

5.2 Core identification

The core insulation of all cables shall be black unless otherwise specified. If a colour other than black is specified it shall be a colour in accordance with HD 308. The colour shall be throughout the whole of the insulation or on its surface.

The colour shall be clearly identifiable and durable. Durability shall be checked by the test given in EN 50305, 10.1.

Conformity with these requirements shall be verified by visual examination.

5.3 Sheath

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

6 Construction of cables

6.1 General

The cable shall conform to the applicable general requirements given in EN 50264-1 and to the specific requirements of this part.

Conformity with the requirements shall be checked by inspection and by the tests given in Table 5.

The cable dimensions shall be as given in Tables 1 to 4 as appropriate to the cable type.

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 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 Conductor screening

For cables in Table 4 conductor screening shall be as given in EN 50264-1, 6.1.6.

6.4 Separator

6.4.1 A separator may be used over the conductor if the cable construction does not include a conductor screen.

6.4.2 A separator may be included between the insulation and the sheath.

6.5 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 sheath 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 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, 6.5.

The sheath thickness shall conform to the specified value given in Tables 3 and 4.

6.7 Constructional components

6.7.1 Unsheathed cables (Tables 1 and 2 - 0,6/1 kV and 1,8/3 kV)

Cables in Tables 1 and 2 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 given in 6.5.

6.7.2 Sheathed cable (Table 3 - 1,8/3 kV)

Cables in Table 3 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 given in 6.5;
- separator optional;
- sheath a compound given in 6.6.

6.7.3 Sheathed cable (Table 4 - 3,6/6 kV)

Cables in Table 4 shall be composed of the following components in the order given:

- conductor flexible tin coated annealed copper, class 5;
- conductor screening as given in EN 50264-1, 6.1.6;
- insulation a compound or compounds given in 6.5;
- separator optional;
- sheath a compound given in 6.6.

Table 1 - General data - Cable type 0,6/1 kV unsheathed

1 Nominal cross-sectional area	2 Conductor diameter d^a	3 Mean thickness of insulation	4 Overall diameter D		6 Resistance of conductor at 20 °C	7 Insulation resistance at 20 °C		8 Insulation resistance at 90 °C		1 Nominal cross-sectional area
			min.	max.		min.	max.	min.	max.	
mm ²	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	MΩ.km	mm ²	
1,0	1,25	0,6	2,4	2,8	20	11,4	11,4	0,114	1,0	
1,5	1,5	0,7	2,8	3,3	13,7	11,0	11,0	0,110	1,5	
2,5	1,95	0,7	3,2	3,8	8,21	9,1	9,1	0,091	2,5	
4	2,5	0,7	3,8	4,4	5,09	7,5	7,5	0,075	4	
6	3,0	0,7	4,2	5,0	3,39	6,5	6,5	0,065	6	
10	3,9	0,7	5,1	5,9	1,95	5,2	5,2	0,052	10	
16	5,0	0,7	6,1	7,2	1,24	4,2	4,2	0,042	16	
25	6,4	0,9	7,8	9,1	0,795	4,1	4,1	0,041	25	
35	7,7	0,9	9,0	10,6	0,565	3,5	3,5	0,035	35	
50	9,2	1,0	10,6	12,4	0,393	3,3	3,3	0,033	50	
70	11,0	1,1	12,5	14,6	0,277	3,0	3,0	0,030	70	
95	12,5	1,1	13,9	16,3	0,210	2,7	2,7	0,027	95	
120	14,2	1,2	15,7	18,4	0,164	2,7	2,7	0,027	120	
150	15,8	1,4	17,6	20,6	0,132	2,7	2,7	0,027	150	
185	17,5	1,6	19,6	22,9	0,108	2,6	2,6	0,026	185	
240	20,1	1,7	22,2	26,0	0,081 7	2,6	2,6	0,026	240	
300	22,5	1,8	24,6	28,8	0,065 4	2,4	2,4	0,024	300	
400	25,8	2,0	28,1	32,9	0,049 5	2,4	2,4	0,024	400	

^a For information, indicative only.

Table 2 - General data - Cable type 1, 8/3 kV unsheathed

1 Nominal cross-sectional area	2 Conductor diameter d^a	3 Mean thickness of insulation	4 Overall diameter D		6 Resistance of conductor at 20 °C	7 Insulation resistance at 20 °C	8 Insulation resistance at 90 °C	1 Nominal cross-sectional area
			min.	max.				
mm ²	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	mm ²
1,5	1,5	2,0	5,3	6,2	13,7	21,0	0,210	1,5
2,5	1,95	2,0	5,7	6,7	8,21	18,0	0,180	2,5
4	2,5	2,0	6,2	7,3	5,09	15,5	0,155	4
6	3,0	2,0	6,7	7,8	3,39	13,7	0,137	6
10	3,9	2,0	7,5	8,8	1,95	11,5	0,115	10
16	5,0	2,0	8,6	10,0	1,24	9,5	0,095	16
25	6,4	2,0	9,9	11,6	0,795	7,9	0,079	25
35	7,7	2,0	11,1	13,0	0,565	6,8	0,068	35
50	9,2	2,0	12,5	14,6	0,393	5,9	0,059	50
70	11,0	2,0	14,2	16,6	0,277	5,0	0,050	70
95	12,5	2,2	16,0	18,7	0,210	4,5	0,045	95
120	14,2	2,2	17,6	20,6	0,164	4,0	0,040	120
150	15,8	2,2	19,1	22,3	0,132	3,7	0,037	150
185	17,5	2,4	20,9	24,4	0,108	3,4	0,034	185
240	20,1	2,4	23,7	27,5	0,081 7	3,0	0,030	240
300	22,5	2,4	25,6	30,1	0,065 4	2,7	0,027	300
400	25,8	2,6	29,2	34,2	0,049 5	2,4	0,024	400

^a For information, indicative only.

Table 3 - General data - Cable type 1,8/3 kV sheathed

1 Nominal cross-sectional area	2 Conductor diameter d^a	3 Mean thickness of insulation	4 Mean thickness of sheath	5 Overall diameter D		7 Resistance of conductor at 20 °C	8 Insulation resistance at 20 °C		9 Insulation resistance at 90 °C		1 Nominal cross-sectional area
				min.	max.		max.	min.	min.	min.	
mm ²	mm	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	MΩ.km	mm ²	
1,5	1,5	1,3	0,8	5,7	6,7	13,7	21,8	0,218	0,218	1,5	
2,5	1,95	1,3	0,8	6,0	7,0	8,21	18,8	0,188	0,188	2,5	
4	2,5	1,3	0,8	6,5	7,6	5,09	16,2	0,162	0,162	4	
6	3,0	1,3	0,8	7,0	8,1	3,39	14,4	0,144	0,144	6	
10	3,9	1,5	0,8	8,2	9,6	1,95	12,8	0,128	0,128	10	
16	5,0	1,5	0,8	9,2	10,8	1,24	10,7	0,107	0,107	16	
25	6,4	1,8	1,0	11,5	13,4	0,795	10,3	0,103	0,103	25	
35	7,7	1,8	1,0	12,7	14,9	0,565	8,9	0,089	0,089	35	
50	9,2	1,8	1,0	14,1	16,5	0,393	7,8	0,078	0,078	50	
70	11,0	1,8	1,0	15,8	18,5	0,277	6,7	0,067	0,067	70	
95	12,5	2,2	1,0	18,0	21,0	0,210	6,5	0,065	0,065	95	
120	14,2	2,2	1,0	19,6	22,9	0,164	6,1	0,061	0,061	120	
150	15,8	2,2	1,2	21,4	25,1	0,132	5,8	0,058	0,058	150	
185	17,5	2,4	1,2	23,4	27,4	0,108	5,6	0,056	0,056	185	
240	20,1	2,4	1,2	25,9	30,3	0,081 7	5,0	0,050	0,050	240	
300	22,5	2,4	1,2	28,1	32,9	0,065 4	4,5	0,045	0,045	300	
400	25,8	2,6	1,4	32,0	37,4	0,049 5	4,4	0,044	0,044	400	

^a For information, indicative only.

Table 4 - General data - Cable type 3,6/6 kV sheathed

1 Nominal cross-sectional area	2 Conductor diameter d^a	3 Mean thickness of insulation	4 Mean thickness of sheath	5 Overall diameter D		7 Resistance of conductor at 20 °C	8 Insulation resistance at 20 °C	9 Insulation resistance at 90 °C	1 Nominal cross-sectional area
				min.	max.				
mm ²	mm	mm	mm	mm	mm	Ω/km	MΩ.km	MΩ.km	mm ²
2,5	1,95	2,6	0,8	8,6	10,1	8,21	24,6	0,246	2,5
4	2,5	2,6	0,8	9,1	10,7	5,09	21,6	0,216	4
6	3,0	2,6	0,8	9,6	11,2	3,39	19,5	0,195	6
10	3,9	2,6	0,8	10,4	12,2	1,95	16,7	0,167	10
16	5,0	2,6	0,8	11,5	13,4	1,24	14,2	0,142	16
25	6,4	2,9	1,0	13,7	16,1	0,795	13,1	0,131	25
35	7,7	2,9	1,0	14,9	17,5	0,565	11,6	0,116	35
50	9,2	2,9	1,0	16,4	19,1	0,393	10,2	0,102	50
70	11,0	2,9	1,0	18,0	21,1	0,277	8,9	0,089	70
95	12,5	2,9	1,0	19,5	22,8	0,210	8,0	0,080	95
120	14,2	2,9	1,2	21,4	25,1	0,164	7,5	0,075	120
150	15,8	2,9	1,2	22,9	26,8	0,132	6,9	0,069	150
185	17,5	3,2	1,2	25,1	29,4	0,108	6,7	0,067	185
240	20,1	3,4	1,4	28,3	33,1	0,081 7	6,4	0,064	240
300	22,5	3,4	1,4	30,6	35,8	0,065 4	5,9	0,059	300
400	25,8	3,4	1,4	33,7	39,4	0,049 5	5,2	0,052	400

^a For information, indicative only.

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 Table 1, 2, 3 or 4 appropriate to the size of cable.

7.3 Voltage test

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

- sample length 20 m;
- duration of application 5 min;
- test temperature $(20 \pm 5) ^\circ\text{C}$.

Test voltage to be applied:

Rated voltage (U_0)	Test voltage (r.m.s.)	Test voltage (d.c.)
kV	kV	kV
0,6	3,5	8,4
1,8	6,5	15
3,6	11	26

There shall be no breakdown of the insulation.

7.4 Insulation resistance

The test shall be carried out at 20 °C and at 90 °C in accordance with EN 50305, 6.4.1 and 6.4.2.

The values obtained shall not be below those given in columns 7 and 8 of Tables 1 and 2 and in columns 8 and 9 of Tables 3 and 4 appropriate to the type and size of cable.

7.5 Dielectric strength

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

- water temperature $(20 \pm 5) ^\circ\text{C}$;
- immersion duration 1 h.

Rated voltage(U_0)	Minimum breakdown voltage (a.c.)
kV	kV
0,6	6
1,8	10
3,6	20

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:

- Test voltage a.c.(50 Hz):
3 kV + (5 x tabulated insulation thickness (mm)) kV.
- Test voltage d.c.:
V a.c. x 1,5.

7.7 D.C. stability

The test shall be carried out in accordance with EN 50305, 6.7, using the following conditions:

- water temperature (85 ± 2) °C;
- duration of immersion and application of voltage 240 h.

Rated voltage (U_0)	Voltage test (d.c.)
kV	kV
0,6	1,5
1,8	4,5
3,6	9

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

7.8 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.

7.9 Ageing test

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

Insulation:

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

Sheath:

- temperature (120 ± 2) °C;
- duration of treatment 240 h.

The maximum variation shall be:

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

for each insulation and sheathing compound.

7.10 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/cm².

The maximum elongation shall be:

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

7.11 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 %.

7.12 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.

7.13 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.

7.14 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 $(100 \pm 2) ^\circ\text{C}$;
- duration 72 h.

The maximum variation shall be:

- for the tensile strength $\pm 30 \%$;
- for the elongation at break $\pm 40 \%$

for each insulating and sheathing compound.

7.15 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 $(70 \pm 2) ^\circ\text{C}$;
- duration 168 h.

The maximum variation shall be:

- for tensile strength $\pm 30 \%$;
- for elongation at break $\pm 40 \%$

for each insulating and sheathing compound.

7.16 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 $(23 \pm 2) ^\circ\text{C}$;
- 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.

7.17 Bending test at low temperature (cores and cables with OD $\leq 12,5$ 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.

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

- 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.

7.18 Cold elongation test (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 %.

7.19 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.

7.20 Reaction to fire – Cables

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

7.21 Reaction to fire – Components

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

Table 5 - Schedule of tests for cables

1	2	3	4	5	6
Ref No.	Test	Category of test	Test method described in		Requirement 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	7.3
1.3	Dielectric strength on sample	T	50305	6.8	7.5
1.4	Surface resistance	T	50305	6.6	7.8
1.5	Spark test on insulation	R	50305	6.5	7.6
1.6	Insulation resistance (20 °C)	T,S	50305	6.4.1	7.4
1.7	Insulation resistance (90 °C)	T	50305	6.4.2	7.4
1.8	D.C. stability	T	50305	6.7	7.7
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 50264-1	6.1	6.2
2.3	Insulation:				
	a) application	S	Visual examination		6.5 and EN 50264-1, 6.2.3
	b) thickness	T,S	60811-1-1	8.1	Tables 1-4 and EN 50264-1, 6.2.4
2.4	Core identification	S	Visual examination and measurement		5.2
2.5	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 3 and 4 and EN 50264-1, 6.5.3
2.6	Overall diameter	T,S	60811-1-1	8.3	EN 50264-1, 6.6
2.7	Cable marking and identification	T,S	Visual examination and measurement		5.1 and Annex A

Table 5 - Schedule of tests for cables (continued)

1	2	3	4	5	6
Ref No.	Test	Category of test	Test method described in		Requirement 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 delivery	T,S			
	a) insulation		60811-1-1	9.1	EN 50264-1, Table 2b
	b) sheath		60811-1-1	9.2	EN 50264-1, Table 4
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	EN 50264-1, Table 2b
	b) sheath		60811-1-1	9.2	EN 50264-1, Table 4
3.1.3	Hot set test	T,S	60811-2-1	9	
	a) insulation				7.10
	b) sheath				7.10
3.1.4	Water absorption on sheath (gravimetric)	T	60811-1-3	9.2	7.12
3.1.5	Ozone resistance	T	50305	7.4.2	
	a) insulation				7.13
	b) sheath				7.13
3.1.6	Mineral oil resistance	T	60811-2-1	10	
	a) insulation ^b				7.14
	b) sheath				7.14
3.1.7	Fuel resistance	T	60811-2-1	10	
	a) insulation ^b				7.15
	b) sheath				7.15
3.1.8	Acid and alkaline resistance	T	60811-2-1	10	
	a) insulation ^b				7.16
	b) sheath				7.16
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 5 - Schedule of tests for cables (continued)

1	2	3	4	5	6
Ref No.	Test	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	7.17
4.2	Elongation test at low temperature ^d	T	60811-1-4	8.3 or 8.4	7.18
4.3	Impact test at low temperature ^e	T	50305	5.1	7.19
4.4	Compatibility	T	60811-1-2	7.1	7.11
4.5	Flame propagation				
4.5.1	Single 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 50264-3-1 unless otherwise stated. ^b Not for EI 110 insulation – see also Annex C of EN 50264-1. ^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:

S	Cable with a metallic screen
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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 – Cables with crosslinked insulation – Part 2-1: 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 50264-3-2 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
- 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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