

# INTERNATIONAL STANDARD

**Charging cables for electric vehicles of rated voltages up to and including  
0,6/1 kV –  
Part 4-1: Cables for DC charging according to mode 4 of IEC 61851-1 –  
DC charging without use of a thermal management system**

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**CHARGING CABLES FOR ELECTRIC VEHICLES OF  
RATED VOLTAGES UP TO AND INCLUDING 0,6/1 kV –****Part 4-1: Cables for DC charging according to mode 4 of IEC 61851-1 –  
DC charging without use of a thermal management system**

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International Standard IEC 62893-4-1 has been prepared by IEC technical committee 20: Electric cables.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
20/1908/FDIS	20/1911/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

This document is to be read in conjunction with IEC 62893-1:2017 and IEC 62893-2:2017.

A list of all parts in the IEC 62893 series, published under the general title *Charging cables for electric vehicles of rated voltages up to and including 0,6/1 kV*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
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## CHARGING CABLES FOR ELECTRIC VEHICLES OF RATED VOLTAGES UP TO AND INCLUDING 0,6/1 kV –

### Part 4-1: Cables for DC charging according to mode 4 of IEC 61851-1 – DC charging without use of a thermal management system

#### 1 Scope

This part of IEC 62893 applies to cables for DC charging according to mode 4 of IEC 61851-1. These cables are not intended to be used with a thermal management system such as that specified in IEC 61851-23.

Charging cables specified in IEC 62893 (all parts) are intended to be used for electrical appliances of class II equipment.

The maximum conductor operating temperature for the cables in this document is 90 °C.

The test methods specified are given in IEC 62893-2, IEC 60245-2, IEC 60332-1-2, IEC 62821-1:2015, Annex B and in the relevant parts of IEC 60811.

IEC 62440 is intended to be used as guidance on the safe use of cables in this document together with Clause 5 of this document.

#### 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.

IEC 60227-2:1997, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 2: Test methods*

IEC 60245-2:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 2: Test methods*

IEC 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 60364-5-54, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60811-401:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven*  
IEC 60811-401:2012/AMD1:2017

IEC 61851-1, *Electric vehicle conductive charging system – Part 1: General requirements*

IEC 61851-23, *Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station*

IEC 62440:2008, *Electrical cables with a rated voltage not exceeding 450/750 V – Guide to use*

IEC 62821-1:2015, *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 62893-1:2017, *Charging cables for electric vehicles of rated voltages up to and including 0,6/1 kV – Part 1: General requirements*

IEC 62893-2:2017, *Charging cables for electric vehicles of rated voltages up to and including 0,6/1 kV – Part 2: Test methods*

### 3 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 62893-1 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **auxiliary power core**

core in the cable that is used to provide auxiliary power to operate on-vehicle electrical devices during the charging process without using battery power (e.g. climate control)

#### 3.2

##### **temperature sensor core**

core in the cable that is used to provide temperature signals to operate an EVSE

### 4 General purpose cables – Heavy duty flexible cables

#### 4.1 Code designation

The code designation is 62893 IEC 126 for halogen free cables with sheath compound EVM-1 and 62893 IEC 127 for halogen free cables with sheath compound EVM-2.

The code designation is 62893 IEC 128 for cables with sheath compound EVM-3.

#### 4.2 Rated voltage

0,6/1 kV AC up to and including 1,5 kV DC.

#### 4.3 Construction

##### 4.3.1 Sizes of cable

The sizes of cable shall be:

- Power cores:  
4 mm<sup>2</sup> to 150 mm<sup>2</sup> – two or more cores.
- Control or pilot cores:  
Number not specified, for size see 8.2 d) of IEC 62893-1:2017.
- Optional PE conductor – one core:

Minimum size of PE or PEM conductor shall be in accordance with Annex B, Table B.1 or Table B.2 or, in the case where there is agreement between manufacturer and customer about the short-circuit requirements, the nominal cross-section of the PE or PEM conductor shall comply with the calculations specified in IEC 60364-5-54 or with IEC 61851-23.

- Auxiliary power cores (optional):  
2,5 mm<sup>2</sup> to 6 mm<sup>2</sup> – two cores.
- Temperature sensor cores (optional):  
Number not specified, for size see 8.2 d) of IEC 62893-1:2017.

#### 4.3.2 Insulation

The insulation for power cores shall be a compound of type EVI-2 according to IEC 62893-1.

The insulation for pilot, auxiliary power, control or temperature sensor cores shall be a compound of type EVI-1 or EVI-2 specified in IEC 62893-1.

For auxiliary power cores the nominal wall thickness shall not be less than 0,8 mm.

#### 4.3.3 Screen(s) (optional)

The screen over a core or an assembly of cores (such as pairs or quads) shall consist of a copper braid with minimum 80 % optical coverage, as specified in Annex D.

#### 4.3.4 Core identification

Identification of the power cores of a cable shall be achieved by the use of coloured insulation or by a coloured surface. Each power core of a cable shall have only one colour, except the core identified by a combination of the colours green-and-yellow.

The colour of control (CC), pilot (CP), temperature sensor or any other core shall be clearly identified and different from the power cores.

Core identification using numbers could be applied if the insulation of the cores is of the same colour and numbered sequentially, starting by number 1. The numerals shall be legible and durable.

#### 4.3.5 Assembly

The cores shall be twisted together.

A centre filler may be used. A centre-core is not permitted.

A separator (e.g. tape) and/or filler may be applied around the core assembly before application of the sheath.

A screen according to 8.6 of IEC 62893-1:2017 may be applied over the core assembly.

#### 4.3.6 Sheath

The sheath shall be a compound of type EVM-1, as specified in IEC 62893-1 for cable type 62893 IEC 126, EVM-2, as specified in IEC 62893-1 for cable type 62893 IEC 127 and EVM-3, as specified in IEC 62893-1 for cable type 62893 IEC 128.

The application of the sheath shall give the finished cable a practically circular shape.

#### 4.3.7 Marking

The cable shall be marked with the corresponding code designation in accordance with 4.1.

Each cable shall have its full code designation according to the requirements in this document, marked continuously (Clause 6 of IEC 62893-1:2017) on the sheath and in addition:

- rated voltage;
- number and nominal cross section of power cores and PE conductor, if any.

Additional markings, for example the year of manufacture, are permitted, but are not required by this document. If an additional marking is applied, it shall neither conflict nor interfere with the required markings.

#### 4.3.8 Inductance between power cores

See Annex E.

#### 4.4 Requirements

Each cable shall comply with the appropriate requirements given in IEC 62893-1, and the particular requirements of this document.

Testing shall be in accordance with Annex A, and the relevant tests indicated in columns 6 and 7 of Table A.1.

- a) The thicknesses of insulation and sheath shall conform to Table B.1 for Type 126 and Table B.2 for Types 127 and 128.
- b) The insulation thickness of auxiliary cores should be 0,8 mm. For CP, PP and any other cores up to and including 0,75 mm<sup>2</sup>, see 8.3.3 of IEC 62893-1:2017.
- c) The requirements for the compatibility test shall be as given in Annex A of IEC 62893-1:2017.
- d) The test conditions and requirements for the cold impact test shall be as given in 5.8 of IEC 62893-2:2017.
- e) The test conditions and requirements for the crush resistance test shall be as given in 5.7 of IEC 62893-2:2017.
- f) The bending test (8.1 of Table A.1) shall be in accordance with Annex C.

#### 5 Guidance on use of cables

General guidance given in IEC 62440 shall be used. In addition, the specific information from Table 1 and Table 2 shall be taken into account for the products specified in this document.

**Table 1 – Intended use of charging cables for EV (environmental conditions)**

<b>1</b>	<b>2</b>
Code designation	62893 IEC 126, 127 and 128
Shape of cable	Round
Conductor construction	Class 5
<b>1 Duty</b> <sup>a</sup>	
1.1 Heavy	+
<b>2 Presence of water</b>	
2.1 Condition AD 7 <sup>b</sup>	+
<b>3 Corrosive of polluting substances</b>	
3.1 Condition AF 3 <sup>b</sup>	+
<b>4 Impact</b>	
4.1 Condition AG 2 <sup>b</sup>	+
<b>5 Vibrations</b>	
5.1 Condition AH 3 <sup>b</sup>	+
<b>6 Flora</b>	
6.1 Condition AK 2 <sup>b</sup>	–
<b>7 Fauna</b>	
7.1 Condition AL 2 <sup>b</sup>	–
<b>8 Outdoor use</b>	
8.1 Condition AN 3 <sup>b</sup>	+
8.2 Permanent <sup>c</sup>	+
<b>9 Frequent flexing</b>	+
<b>10 Frequent torsion</b>	+
Key	
"+" = acceptable      "–" = not suitable	
<sup>a</sup> See Annex C of IEC 62440:2008 for definitions.	
<sup>b</sup> See Annex A of IEC 62440:2008 for definitions.	
<sup>c</sup> See Annex B of IEC 62440:2008 for definitions.	

**Table 2 – Recommended use of charging cables for EV**

<b>1</b>	<b>2</b>	<b>3</b>
<b>Code designation</b>	<b>Recommended use</b>	<b>Comments</b>
62893 IEC 126 and 127	Intended for use for charging mode 4 of IEC 61851-1.	Max. storage temperature: +45 °C Min. temperature for installation and handling: –25 °C They are intended for indoor and outdoor use.
62893 IEC 128	Intended for use for charging mode 4 of IEC 61851-1. Only for outdoor use (due to halogen content in the case of fire)	Max. storage temperature: +45 °C Min. temperature for installation and handling: –25 °C They are intended for outdoor use.

**Annex A**  
(normative)

**Tests for completed cables**

**Table A.1 – Tests for cable types 62893 IEC 126, 127 and 128**

1	2	3	4	5	6	7
Ref No.	Tests <sup>a</sup>	Category of test	Test method described in		Applicability of test	
			IEC standard	(Sub)-clause	62893	62893
					IEC 126 and IEC 127	IEC 128
1	<i>Electrical tests</i> <sup>b</sup>					
1.1	Resistance of conductors	T, S	60245-2:1994	2.1	X	X
1.2	Voltage test on completed cable – at 3500 V AC, or 7000 V DC	T, S	60245-2:1994	2.2	X	X
1.3	Voltage test at 3500 V AC on all cores	T	60245-2:1994	2.3	X	X
1.4	Insulation resistance at 90 °C	T	60227-2:1997	2.4	X	X
1.5	Long term resistance of insulation to DC on power cores at nominal voltage – voltage applied 0,9 kV DC – duration of test (240 ± 2) h – temperature 85 °C	T	62893-2:2017	5.1.1	X	X
2	<i>Constructional and dimensional tests</i>					
2.1	Checking of compliance with constructional provisions	T, S	62893-1:2017		X	X
2.2	Measurement of thickness of insulation	T, S	60245-2:1994	1.9	X	X
2.3	Measurement of thickness of sheath	T, S	60245-2:1994	1.10	X	X
2.4	Measurement of overall dimensions					
2.4.1	Mean value	T, S	60245-2:1994	1.10.2	X	X
2.4.2	Ovality	T, S	60245-2:1994	1.11	X	X
3	<i>Insulation material tests</i>	T	62893-1:2017 <sup>c</sup> ,	8.3.1	X	X
4	<i>Sheath material tests</i>	T	62893-1:2017 <sup>c</sup> ,	8.7.1	X	X
5	<i>Compatibility test</i>	T	60811-401:2012 and 60811-401:2012/AMD1:2017 62893-1:2017	4.2.3.4 Annex A	X	X
6	<i>Impact test at -35 °C</i> <sup>d</sup>	T	62893-2:2017	5.8	X	X
7	<i>Shrinkage test</i>	T	62893-1:2017	8.8.6	X	X
8	<i>Mechanical strength of completed cable</i>					
8.1	Bending test followed, after immersion in water, by a voltage test on cores as per 1.2 of this table.	T	62893-4-1	Annex C	X	X
9	<i>Crush resistance test</i>	T	62893-2:2017	5.7	X	X
10	<i>Weathering/UV resistance test</i>	T	62893-2:2017	5.2	X	X
11	<i>Resistance against chemicals</i>	T	62893-2:2017	5.3	X	X
12	<i>Tests under fire conditions</i>					
12.1	Test on single vertical cable	T	60332-1-2	-	X	X

1	2	3	4	5	6	7
Ref No.	Tests <sup>a</sup>	Category of test	Test method described in		Applicability of test	
			IEC standard	(Sub)-clause	62893 IEC 126 and IEC 127	62893 IEC 128
13	<i>Assessment of halogens for all non-metallic materials</i> <sup>e</sup>	T, S	62821-1:2015	Annex B	X	-

<sup>a</sup> The order given does not imply a sequence of testing.

<sup>b</sup> Particular test conditions and requirements are given in column 6 of Table 4 of IEC 62893-1:2017.

<sup>c</sup> This document includes all the test methods and requirements for the material. Material to be tested is taken from the finished cable.

<sup>d</sup> In countries with extreme low temperatures other values may be used.

<sup>e</sup> Type IEC 126 (EVM-1) shall comply with IEC 62893-1:2017, 8.8.5.

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## Annex B (normative)

### Tables for cable dimensions and insulation resistance

NOTE 1 The overall dimensions of cables have been calculated in accordance with IEC 60719.

NOTE 2 Mean overall dimension values in Table B.1 and Table B.2 are referring to constructions with two or fewer control core(s).

**Table B.1 – General data for type 126 (EVM-1)**

1	2	3	4	5	6	7
Number and nominal cross-sectional area power conductors <sup>b</sup>  mm <sup>2</sup>	Nominal cross-sectional area PE conductor  mm <sup>2</sup>	Thickness of insulation <sup>c</sup>  Specified value  mm	Thickness of sheath  Specified value  mm	Mean overall dimensions <sup>a</sup>		Minimum insulation resistance <sup>d</sup> at 90 °C  MΩ·km
				Lower value  mm	Upper value  mm	
2 x 4	4	0,8	1,1	10,6	13,3	0,007 9
2 x 6	6	0,8	1,2	11,8	14,8	0,006 8
2 x 10	10	0,8	1,3	13,9	17,4	0,005 5
2 x 16	16	0,8	1,5	16,6	20,7	0,004 4
2 x 25	16	1,0	1,7	20,7	25,9	0,004 3
2 x 35	16	1,0	1,9	23,8	29,7	0,003 7
2 x 50	25	1,1	2,2	27,9	34,8	0,003 4
2 x 70	35	1,2	2,5	32,6	40,7	0,003 1
2 x 95	50	1,2	2,7	36,1	45,1	0,002 8
2 x 120	70	1,3	2,9	40,4	50,5	0,002 7
2 x 150	95	1,5	3,2	45,1	56,4	0,002 8

<sup>a</sup> Indicative values, for information only.

<sup>b</sup> Power cores could be split in two smaller cores.

<sup>c</sup> Thicknesses are given for power conductors. For PE conductors, the thickness corresponding to the same cross-section as that of the power conductor applies.

<sup>d</sup> Only applies to the test method of IEC 60227-2:1997.

**Table B.2 – General data for type 127 (EVM-2) and type 128 (EVM-3)**

1	2	3	4	5	6	7
Number and nominal cross-sectional area power conductors <sup>b</sup>	Nominal cross-sectional area PE conductor	Thickness of insulation <sup>c</sup> Specified value	Thickness of sheath Specified value	Mean overall dimensions <sup>a</sup>		Minimum insulation resistance <sup>d</sup> at 90 °C
				Lower value	Upper value	
mm <sup>2</sup>	mm <sup>2</sup>	mm	mm	mm	mm	MΩ·km
2 x 4	4	0,8	1,9	12,1	15,2	0,007 9
2 x 6	6	0,8	2,0	13,4	16,7	0,006 8
2 x 10	10	0,8	2,2	15,2	19,0	0,005 5
2 x 16	16	0,8	2,4	17,9	22,3	0,004 4
2 x 25	16	1,0	2,8	22,4	28,0	0,004 3
2 x 35	16	1,0	3,2	25,8	32,3	0,003 7
2 x 50	25	1,1	3,6	30,1	37,7	0,003 4
2 x 70	35	1,2	4,0	35,1	43,8	0,003 1
2 x 95	50	1,2	4,4	38,9	48,7	0,002 8
2 x 120	70	1,3	4,8	43,6	54,5	0,002 7
2 x 150	95	1,5	5,3	48,7	60,9	0,002 8

<sup>a</sup> Indicative values, for information only.

<sup>b</sup> Power cores could be split into two smaller cores.

<sup>c</sup> Thicknesses are given for power conductors. For PE conductors, the thickness corresponding to the same cross-section as that of the power conductor applies.

<sup>d</sup> Only applies to the test method of IEC 60227-2:1997.

## Annex C (normative)

### Bending test

See 8.8.3.3 of IEC 62893-1:2017.

NOTE 1 ISO 14572:2011, 5.9 will eventually be replaced by ISO 19642-2:2019, 5.3.4.

Additionally the apparatus shall be similar to the one shown in

Figure C.1. Any apparatus is acceptable as long as it meets the requirements of the test:

- 15 cycles per minute;
- Number of cycles: 5 000.

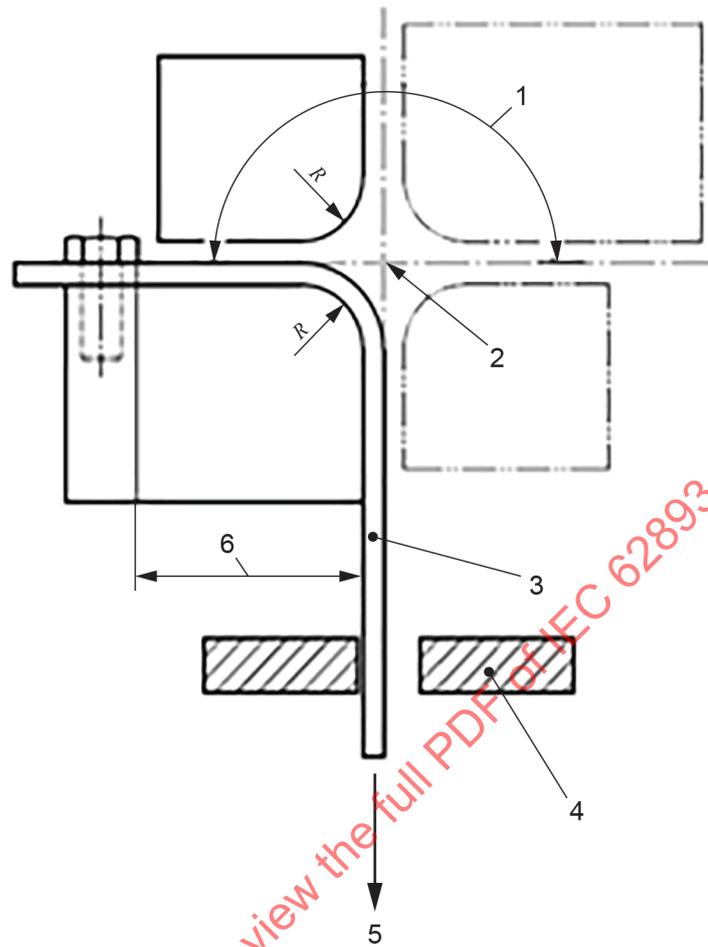
NOTE 2 One cycle is from position 0° to -90° and back and from 0° to +90° and back.

Bending radius  $R = 5$  times outside cable diameter (bending radius tolerance:  $_{-20}^0$  %).

In the case where one of the samples fails the requirements set in 8.8.3.3 of IEC 62893-1:2017, then two additional samples (taken from the same cable length) shall be tested. The test shall be deemed satisfactory if both tests meet the stated requirements.

In the case where sufficient length is not available anymore, the retest samples may be taken from another production length/order of the same construction.

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**Key**

- 1 one cycle (90° to each side)
- 2 pivot
- 3 cable
- 4 fixed guide (optional)
- 5 force,  $F$
- 6 fixing point distance (recommended minimum of 100 mm)

**Figure C.1 – Apparatus for cyclic bending**