PD IEC TS 62196-3-1:2020

BSI Standards Publication

Plugs, socket-outlets, vehicle connectors and vehicle inlets — Conductive charging of electric vehicles

Part 3-1: Vehicle connector, vehicle inlet and cable assembly for DC charging intended to be used with a thermal management system

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National foreword

This Published Document is the UK implementation of IEC TS 62196-3-1:2020.

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Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles –
Part 3-1: Vehicle connector, vehicle inlet and cable assembly for DC charging intended to be used with a thermal management system

INTERNATIONAL
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PLUGS, SOCKET-OUTLETS, VEHICLE CONNECTORS AND VEHICLE INLETS – CONDUCTIVE CHARGING OF ELECTRIC VEHICLES –

Part 3-1: Vehicle connector, vehicle inlet and cable assembly for DC charging intended to be used with a thermal management system

FOREWORD

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Technical Specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

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IEC TS 62196-3-1, which is a Technical Specification, has been prepared by subcommittee 23H: Plugs, Socket-outlets and Couplers for industrial and similar applications, and for Electric Vehicles, of IEC technical committee TC 23: Electrical accessories.

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
23H/448/DTS	23H/460/RVDTS

Full information on the voting for the approval of this Technical Specification 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.

A list of all the parts in the IEC 62196 series, published under the general title *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electrical vehicles*, can be found on the IEC website.

This document is to be read in conjunction with IEC 62196-1:2014 and IEC 62196-3:2014. The particular requirements in this document supplement or modify the corresponding clauses in Part 3, which, in turn, is based on Part 1. Where the text indicates an "addition" to or a "replacement" of the relevant requirement, test specification or explanation of Part 3, these changes are made to the relevant text of Part 3 or Part 1, which then becomes part of this document. Where no change is necessary, the words "Clause X of IEC 62196-3:2014 applies" are used.

Subclauses, figures, tables or notes which are additional to those in IEC 62196-3 are numbered starting from 101.

In this document, the following print types are used:

– requirements proper: in roman type;
– *test specifications: in italic type;*
– notes: in smaller roman type.

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

- transformed into an International Standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

Responding to global challenges of CO_2 reduction and energy safety, the automobile industries have been accelerating the development and commercialization of electric vehicles (EV) and hybrid electric vehicles. In addition to the prevailing hybrid electric vehicles, battery electric vehicles including plug-in hybrid electric vehicles are going to be mass-marketed. To support the diffusion of such vehicles, this document provides the standard interface configurations of vehicle couplers and accessories to be used in conductive charging of electric vehicles, taking the most frequent charging situations into consideration.

To meet the market demand for increased electric vehicle ranges, batteries with larger capacities need to be integrated. To charge those batteries with larger capacity in similar times as existing charging times or even faster, the charging power needs to be increased. Besides increasing the charging voltage, the charging current also needs to be increased to boost the charging power. The larger charging current implies either larger conductor cross sections for the cable assembly according to existing standards or additional measures in the cable assembly.

The large conductor cross sections that are required according to the existing design requirements and test methods result in significantly thicker and heavier cable assemblies. These are difficult to handle and thus less desirable for public use. Therefore, to improve the usability of charging systems this document makes use of thermal management techniques to enhance the performance of the accessories.

This document provides definitions, requirements, and tests for EV couplers up to rated current according to IEC 62196-1, which supports backward compatibility to couplers according to IEC 62196-3:2014.

IEC 62196 is divided into several parts as follows:

– Part 1: General requirements, comprising clauses of a general character.

– Part 2: Dimensional compatibility requirements for AC pin and contact-tube accessories.

– Part 3: Dimensional compatibility requirements for DC and AC/DC pin and contact-tube vehicle couplers.

– Part 4[1]: Dimensional compatibility requirements for DC pin and contact-tube accessories for Class II or Class III applications.

– Part 6[2]: Dimensional compatibility requirements for DC pin and contact-tube couplers for applications using a system of protective electrical separation.

[1] Under preparation.

[2] Under consideration.

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PLUGS, SOCKET-OUTLETS, VEHICLE CONNECTORS AND VEHICLE INLETS – CONDUCTIVE CHARGING OF ELECTRIC VEHICLES –

Part 3-1: Vehicle connector, vehicle inlet and cable assembly for DC charging intended to be used with a thermal management system

1 Scope

This document applies to accessories and cable assemblies with the same configuration as specified in IEC 62196-3:2014 with rated operating voltage not exceeding 1 500 V DC and a rated current not exceeding 500 A that employ

– thermal sensing, or

– thermal transport and thermal sensing

with the system architecture described in 4.101.

These accessories and cable assemblies are intended to be used in conductive charging systems for circuits specified in IEC 61851-23.

NOTE Edition 2 of IEC 61851-23 is under development.

The accessories covered by this document are intended to be used in charging mode 4 according to IEC 61851-1. These accessories are intended to be connected to cables according to the IEC 62893 series for DC cables.

2 Normative references

Clause 2 of IEC 62196-3:2014 applies, except as follows:

Additional normative references:

IEC 60364-5-54:2011, *Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors*

IEC 60811-501, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulating and sheathing compounds*

IEC 61851-23:—[3], *Electric vehicle conductive charging system – Part 23: DC electric vehicle supply equipment*

IEC 62196-1:2014, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements*

IEC 62196-2:2016, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability requirements for AC pin and contact-tube accessories*

[3] Second edition under preparation. Stage at the time of publication: IEC CDV 61851-23:2020

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IEC 62196-3:2014, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 3: Dimensional compatibility and interchangeability requirements for DC and AC/DC pin and contact-tube vehicle couplers*

IEC 62893-4-1:—[4], *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*

ISO 2719:2016, *Determination of flash point – Pensky-Martens closed cup method*

ISO 17409:2020, *Electrically propelled road vehicles – Conductive power transfer – Safety requirements*

ISO 25178-1:2016, *Geometrical product specifications (GPS) – Surface texture: Areal – Part 1: Indication of surface texture*

Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Eighth revised edition, United Nations, 2019

OECD Guidelines for the Testing of Chemicals, Section 3, Test No. 301: Ready Biodegradability, 17 Jul 1992

3 Terms and definitions

Clause 3 of IEC 62196-3:2014 applies, except as follows:

Additional terms and definitions:

3.101
thermal sensing
method for obtaining temperature data of accessories, cable assemblies or parts thereof

3.102
thermal sensing device
means for providing temperature data of accessories, cable assemblies or parts thereof

3.103
thermal transport
method for managing the heat dissipation of accessories, cable assemblies or parts thereof, independent of changing the current

3.104
thermal transport device
means for managing the heat dissipation of accessories, cable assemblies or parts thereof, independent of changing the current

3.105
thermal exchange
method for cooling and dissipating thermal energy from the thermal transport

3.106
thermal exchange device
means for cooling and dissipating thermal energy from the thermal transport

[4] Under preparation. Stage at the time of publication: IEC FDIS 62893-4-1:2020.

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3.107
thermal management system
combination of thermal sensing, thermal transport and thermal exchange in order to regulate temperature

3.108
rated pressure
maximum pressure assigned by the manufacturer to the thermal transport coolant liquid of a cable assembly under normal and continuous operating conditions

3.109
maximum allowed pressure
maximum pressure assigned by the manufacturer to the thermal transport coolant liquid of a cable assembly

3.110
accessory
vehicle connector or vehicle inlet or cable assembly for use in conductive charging systems or electric vehicles

4 General

Clause 4 of IEC 62196-3:2014 applies, except as follows:

4.1 General requirements

Addition after the second paragraph:

Accessories with thermal sensing and without thermal transport are intended for use with cables in accordance with IEC 62893-4-1[5] .

Accessories with thermal sensing and thermal transport are intended for use with cables in accordance with IEC 62893-4-2[6].

Replacement of the existing text of 4.2.2, 4.2.3, 4.2.4 with the following:

4.2.2 Unless otherwise specified, the samples are tested as delivered and under normal conditions of use at an ambient temperature of (20 ± 5) °C.

4.2.3 Unless otherwise specified, the tests shall be performed in the order shown in 4.2.4.

4.2.4 The tests shall be performed as indicated, if applicable.

Table 101 is intended to give an overview of applicable tests for different classifications of accessories. However, the requirements are contained within the clauses of this document.

Tests are grouped in test sequences A to D. Each sequence shall be performed in accordance with the test sequences indicated in Table 102 to Table 105 with new sets of samples for each sequence. On request of the manufacturer the same set of samples may be subjected to more than one of these test sequences.

[5] Under preparation. Stage at the time of publication: IEC FDIS 62893-4-1:2020.

[6] Under consideration.

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Further, tests indicated as "to be checked by inspection" and not included in Table 101 shall be performed. These tests may use samples already used in tests mentioned in Table 101.

Table 101 – Overview of applicable tests for different classifications of accessories

Clause/ subclause	IEC 62196-1:2014 [2]	IEC 62196-3:2014 [2]	IEC TS 62196-3-1:2020 [2]		Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
8				Marking						
8.8	X			Durability of marking	X	X	X	X	X	X
9				Dimensions						
9.1		X		Compatibility with configurations	X	X	X	X	X	X
9.3	X			Single-pole connections	X	X	X	X	X	X
9.4	X			Misinsertion	X	X	X	X	X	X
10				Protection against electrical shock						
10.1		X		Accessibility of live parts	X	X	X	X	X	X
10.2	X [1]	X [1]	X [1]	Shutters	X [1]	X [1]	X [1]	X [1]	X [1]	X [1]
10.3	X	X		Contact sequence	X	X	X	X	X	X
10.4	X	X		Misassembly	X	X	X	X	X	X
12				Provision for protective earthing						
12.1		X		Provision for protective earthing	X	X	X	X	X	X
12.2	X			PE connection to accessible metal parts	X	X	X	X	X	X
12.3	X	X	X	Short-time test	X	X	X	X	X	X
12.5	X			Clean data earth contact	X	X	X	X	X	X
13				Terminals						
13.1.4	X			Material analysis of terminals	X	X	X	X	X	X
13.1.5	X			Material analysis of body	X	X	X	X	X	X
13.1.6	X			Terminal fixing	X			X		
13.1.8	X			Terminal loosening	X			X		
13.1.9	X			Loose strands	X			X		
13.2	X			Screw type terminal	X			X		
13.3	X			Test for terminals	X			X		
14				Interlocks						
14.1.4	X			Latching device holding	X	X	X	X	X	X
14.1.5	X			Latch pull test	X	X	X	X	X	X
14.1.6	X			Latch moment pull test	X	X	X	X	X	X
14.3	X			Cycling of switching devices	X	X	X	X	X	X
14.4	X			Pilot contacts and auxiliary circuits	X	X	X	X	X	X
14.301		X		Latching function	X	X	X	X	X	X

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Clause/ subclause	IEC 62196-1:2014 [2]	IEC 62196-3:2014 [2]	IEC TS 62196-3-1:2020 [2]		Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
15	X			Resistance to ageing	X	X	X	X	X	X
16				General construction						
16.3	X			Position of PE	X	X	X	X	X	X
16.4	X			Degree of protection	X	X	X	X	X	X
16.5			X	Surface temperature	X	X	X	X	X	X
16.6	X			Contact pressure	X	X	X	X	X	X
16.8	X			Retention means, pull test	X	X	X			
16.10	X		X	Construction of rewireable accessories	X			X		
16.12	X			Mechanical strength against electric shock	X	X	X	X	X	X
16.13	X			Cable entries	X	X	X			
16.14	X			Mechanical strength of insulation	X	X	X	X	X	X
16.15	X	X		Force to insert and withdraw	X	X	X			
16.101			X	Thermal sensing device	X	X	X	X	X	X
16.102			X	Loss of thermal transport			X			X
16.103			X	Accessories using thermal sensing	X	X	X	X	X	X
16.104			X	Rated current for accessory	X	X	X	X	X	X
18				Construction of plugs and vehicle connectors						
18.1	X			Conductors properly connected	X					
18.2	X			Reliable fixing of parts	X	X	X			
18.4	X			IP when plugged in	X	X	X			
18.101			X	DC contact surface	X	X	X			
19				Construction of vehicle inlets						
19.1	X			IP when plugged in				X	X	X
19.3	X			Drain-hole				X	X	X
19.101			X	DC contact surface				X	X	X
20				Degrees of protection						
20.1	X			Minimum degrees of protection	X	X	X	X	X	X
20.2	X			Water exposure test (IP)	X	X	X	X	X	X
20.3	X			Proof against humid conditions	X	X	X	X	X	X
21				Insulation resistance and dielectric strength						
21.2	X			Insulation resistance	X	X	X	X	X	X
21.3	X			Dielectric strength	X	X	X	X	X	X
21.4	X			Non-interchangeability	X	X	X	X	X	X

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Clause/ subclause	IEC 62196-1:2014 [2]	IEC 62196-3:2014 [2]	IEC TS 62196-3-1:2020 [2]		Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
23				Normal operation						
23.1	X		X	Normal operation	X	X	X	X	X	X
23.2	X	X		Mating cycle	X	X	X	X	X	X
23.4	X			Lid springs	X	X	X			
24				Temperature rise						
24.102			X	Temperature rise test for cable assembly	X	X	X			
24.103			X	Test for thermal sensing device of cable assembly	X	X	X			
24.104			X	Temperature rise test for vehicle inlet				X	X	X
24.105			X	Test for thermal sensing device of vehicle inlet				X	X	X
25				Flexible cables and their connection						
25.3	X		X	Strain relief	X	X	X			
25.301		X		Pull out test	X	X	X	X	X	X
26				Mechanical strength						
26.2	X		X	Ball impact				X	X	X
26.3	X		X	Drop test	X	X	X			
26.4	X		X	Flexing test	X	X	X			
26.5	X			Cable glands test	X	X	X			
26.6	X			Shutter tests	X [1]	X [1]	X [1]	X [1]	X [1]	X [1]
26.7	X			Insulated end caps test	X [1]	X [1]	X [1]	X [1]	X [1]	X [1]
26.8	X			Insulated end caps – change of temperature	X [1]	X [1]	X [1]	X [1]	X [1]	X [1]
26.9	X			Insulated end caps – pull test	X [1]	X [1]	X [1]	X [1]	X [1]	X [1]
27				Screws, current-carrying parts and connections						
27.1	X			Screws transmitting contact pressure	X			X		
27.2	X			Screws in insulating material	X	X	X	X	X	X
27.4	X			Screws as electrical and mechanical connections	X	X	X	X	X	X
27.5	X			Current-carrying parts other than terminals	X	X	X	X	X	X
27.6	X			Contacts, subjected to a sliding action	X	X	X	X	X	X
28				Creepage distances, clearances						
28.1	X			Creepage distances, clearances	X	X	X	X	X	X
28.4	X			Tracking test (CTI), if applicable	X	X	X	X	X	X

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Clause/ subclause	IEC 62196-1:2014 [2]	IEC 62196-3:2014 [2]	IEC TS 62196-3-1:2020 [2]		Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
29				Resistance to heat, to fire and to tracking						
29.2	X			Heat only (oven)	X	X	X	X	X	X
29.3	X			Ball pressure	X	X	X	X	X	X
29.5	X			Glow-wire test	X	X	X	X	X	X
29.6	X			Resistant to tracking PTI	X	X	X	X	X	X
30	X			Corrosion and resistance to rusting	X	X	X	X	X	X
33.2	X		X	Vehicle driveover (5 000 N)	X	X	X			
101				Liquid coolants						
101.1			X	Type of coolant			X			X
101.3			X	Flammability			X			X
101.5			X	Material compatibility			X			X
101.6			X	Overpressure test			X			X

1) If any.

2) A cross indicates which parts of the IEC 62196 series shall be considered for the respective test.

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Table 102 – Test sequence A

Test sequence A No. of samples: 3			Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable Assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
Order	Subclause							
1	26.2	Ball impact				X	X	X
2	26.3	Drop test	X	X	X			
3	20.2	Water exposure test (IP)	X	X	X	X	X	X
4	21.2	Insulation resistance	X	X	X	X	X	X
5	21.3	Dielectric strength	X	X	X	X	X	X
6	26.4	Flexing test	X	X	X			
7	21.3	Dielectric strength	X	X	X			
8	24.103	Test for thermal sensing device of cable assembly	X	X	X			
9	24.105	Test for thermal sensing device of vehicle inlet				X	X	X

Table 103 – Test sequence B

Test sequence B No. of samples: 3			Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
Order	Subclause							
1	23.1	Normal operation	X	X	X	X	X	X
2	24.102	Temperature rise test for cable assembly	X	X	X			
2	24.104	Temperature rise test for vehicle inlet				X	X	X

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Table 104 – Test sequence C

Test sequence C No. of samples: 3			Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
Order	Subclause							
1	20.3	Humidity conditioning test	X	X	X	X	X	X
2	21.2	Insulation resistance test	X	X	X	X	X	X
3	21.3	Dielectric strength test	X	X	X	X	X	X
4	33.2	Vehicle driveover (5 000 N)	X	X	X			
5	20.2	Water exposure test (IP)	X	X	X			
6	21.3	Dielectric strength test	X	X	X			
7	24.103	Test for thermal sensing device of cable assembly	X	X	X			

Table 105 – Test sequence D

Test sequence D No. of samples: 3			Cable assembly (thermal sensing only, rewireable)	Cable assembly (thermal sensing only, non-rewireable)	Cable assembly (thermal sensing and thermal transport, non-rewireable)	Vehicle inlet (thermal sensing only, rewireable)	Vehicle inlet (thermal sensing only, non-rewireable)	Vehicle inlet (thermal sensing and thermal transport, non-rewireable)
Order	Subclause							
1	101.6	Overpressure test			X			X

4.2.6 *Addition at the end of the subclause:*

Table 7 of IEC 62196-1:2014 does not apply. Accessories are tested according to manufacturer's specification.

Additional subclauses:

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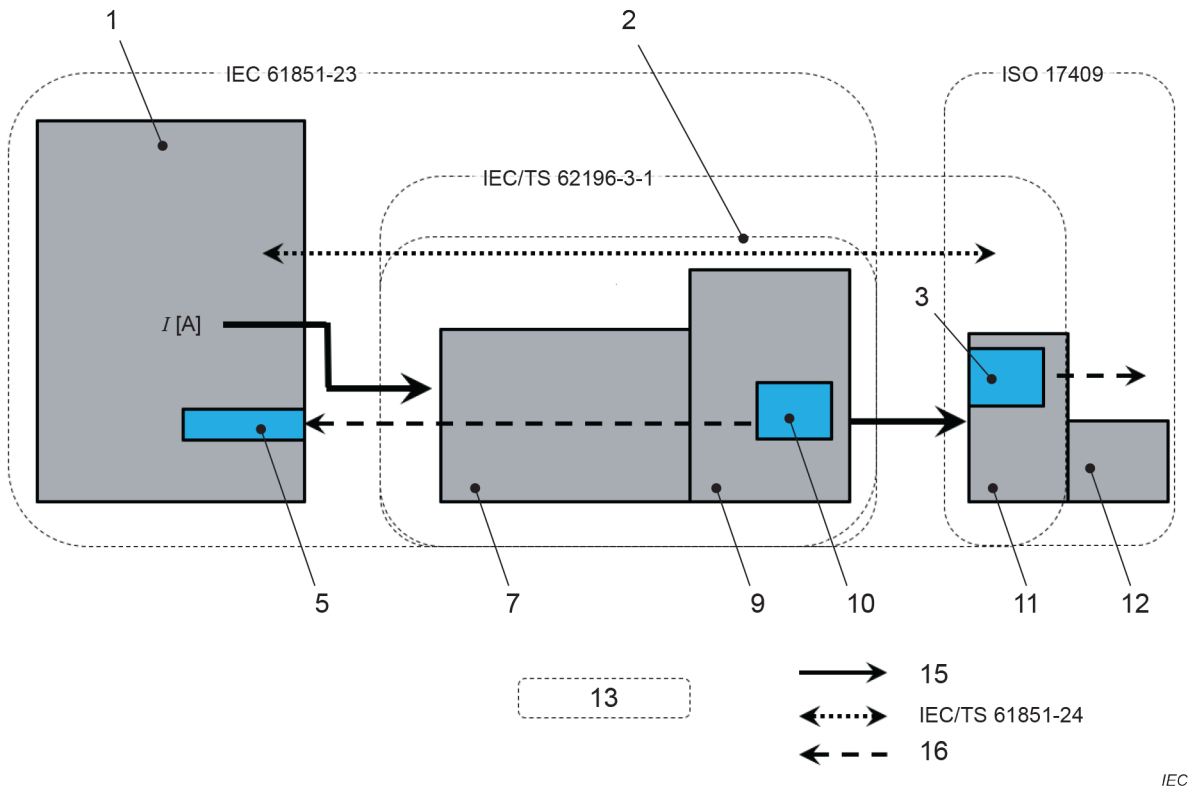
4.101 System architecture

Accessories and cable assemblies according to this document shall be provided with either:

– thermal sensing without thermal transport; or
– thermal transport and thermal sensing.

For examples, see Figure 101 and Figure 102.



Key See Figure 102

Figure 101 – DC EV supply equipment with thermal sensing

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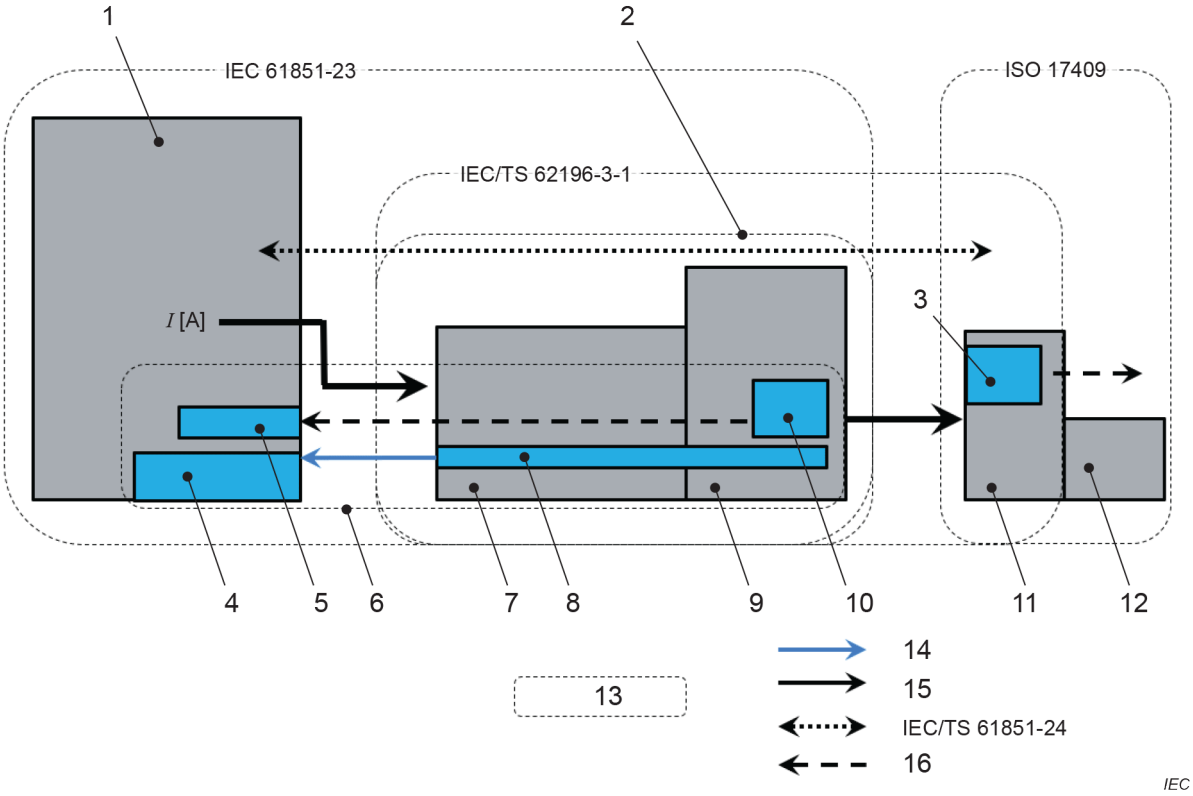

Key

1	DC EV charging station	9	Vehicle connector
2	Cable assembly	10	Thermal sensing
3	Thermal sensing	11	Vehicle inlet
4	Thermal exchange	12	Wiring harness
5	Control unit	13	System boundary
6	Thermal management system	14	Energy thermal
7	Cable	15	Energy electric
8	Thermal transport	16	Temperature information

Figure 102 – DC EV supply equipment with thermal sensing, thermal transport and thermal exchange

4.102 Thermal stabilisation

Thermal stabilisation is considered to have occurred when three successive readings, taken at intervals of not less than 10 min, indicate no increase greater than 2 K.

4.103 Manufacturers data sheet

The manufacturer shall provide a data sheet. For recommended data, see Annex E.

Compliance is checked by inspection.

5 Ratings

Clause 5 of IEC 62196-3:2014 applies, except as follows.

5.2.1 *Addition at the end of the list of preferred currents:*

300 A (DC only)

500 A (DC only).

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