IEC TS 62196-3-1

Edition 1.0 2020-03

TECHNICAL SPECIFICATION

colour inside

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

IEC TS 62196-3-1:2020-03(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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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 ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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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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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

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

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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.

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.

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.

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.

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

[6] Under consideration.

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

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

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

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.

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

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.

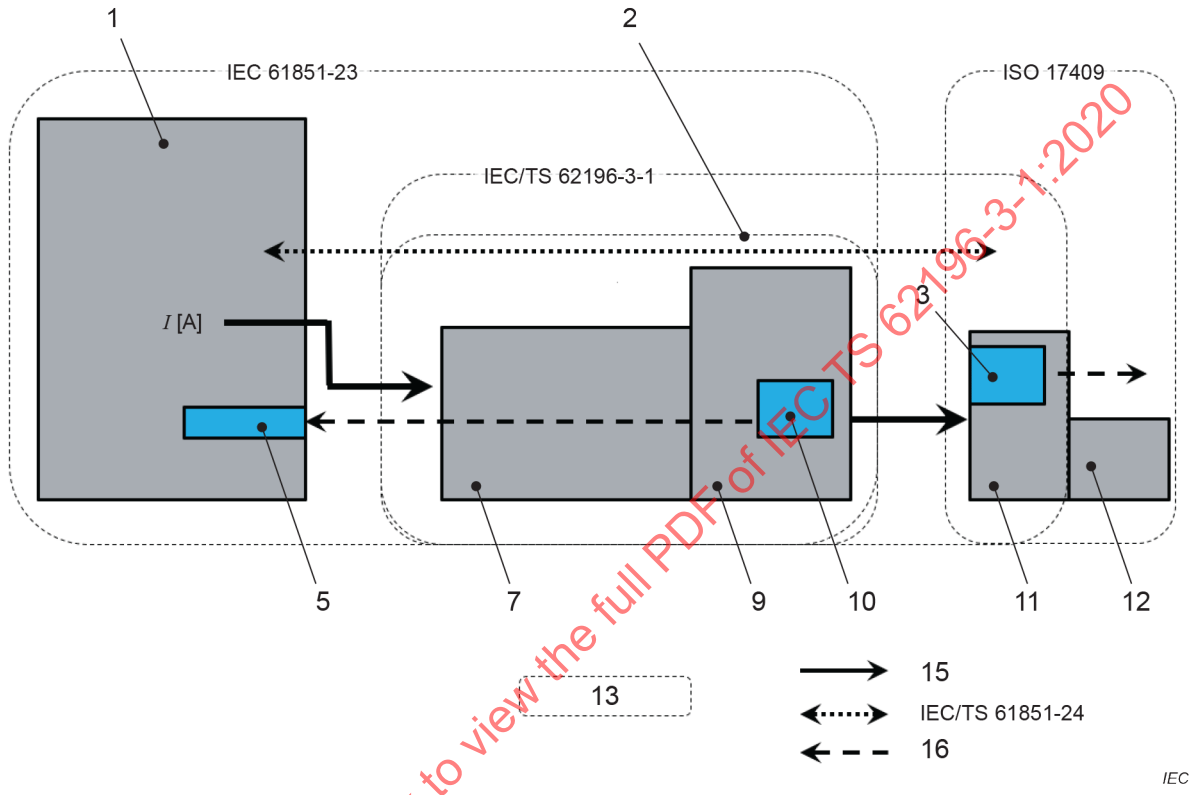
Additional subclauses:

4.101 System architecture

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

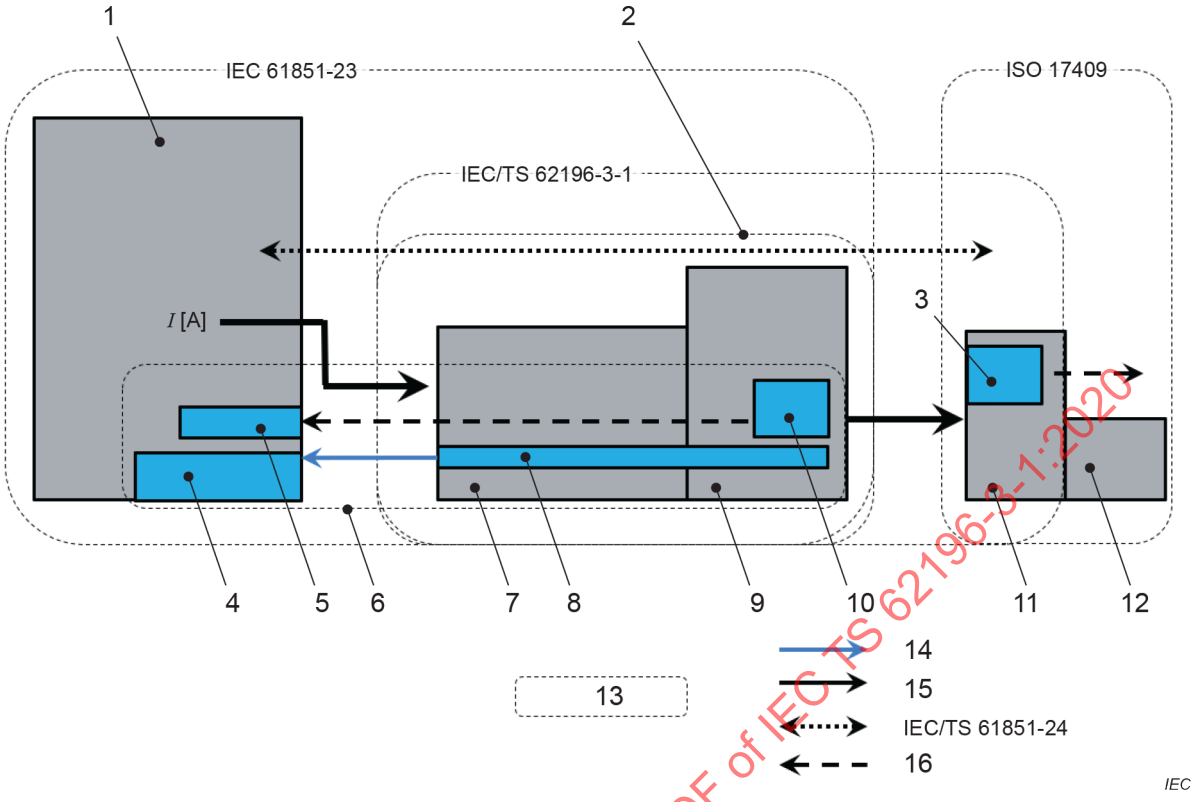
– thermal sensing without thermal transport; or
– thermal transport and thermal sensing.

For examples, see Figure 101 and Figure 102.



Key See Figure 102

Figure 101 – DC EV supply equipment with thermal sensing



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).

6 Connection between the power supply and the electric vehicle

Clause 6 of IEC 62196-3:2014 applies, except as follows:

Replacement of Table 4 of IEC 62196-1:2014 by the following Table 106:

Table 106 – Overview of the DC vehicle interface

Position number [a]	Configuration					
	AA		BB			
	U_{max} V	I_{max} A	U_{max} V	I_{max} A	Symbol	Function
1	1 000	400	950	250	DC +	DC +
2	1 000	400	950	250	DC –	DC −
3	30	10	30	2	CP	Control Pilot 1
4	30	10	30	2	CP2	Control Pilot 2
5	30	10	-	-	CP3	Control Pilot 3
6	30	2	30	2	COM1	Communication 1 (+)
7	30	2	30	2	COM2	Communication 1 (−)
8	30	2	-	-	IM	Isolation Monitor
9	-	-	950	Rated for fault [b]	E	Protective earth
10	30	2	-	-	PP or CS	Proximity detection or connection switch
11	-	-	30	20	AUX1	Auxiliary Power Supply 1 (+)
12	-	-	30	20	AUX2	Auxiliary Power Supply 1 (−)

[a] Position number does not refer to the location and/or identification of the contact in the accessory.

[b] "Rated for fault" means "rated for the highest fault current".

NOTE For DC vehicle interface, see IEC 62196-3:2014.

Replacement of Table 5 of IEC 62196-1:2014 by the following Table 107*:*

Table 107 – Overview of the combined AC/DC vehicle interface

Position number [a]	Configuration				Symbol	Function
	Group 2					
	EE		FF			
	U_{max} V	I_{max} A	U_{max} V	I_{max} A		
1	1 000	500	1 000	500	DC +	DC +
2	1 000	500	1 000	500	DC −	DC −
3	--[b]	--[b]	--	--		DC −
4	--	--	--[b]	--[b]		DC −
5	--	--	--[b]	--[b]		DC +
6	--[b]	--[b]	--	--		DC +
7	1 000 [c]	--	1 000 [c]	--	PE	Protective earth
8	30 [c]	2 [c]	30 [c]	2 [c]	CP	Control Pilot
9	30 [c]	2 [c]	30 [c]	2 [c]	PP or CS	Proximity detection or connection switch

[a] Position number does not refer to the location and/or identification of the contact in the accessory.

[b] This contact is only available in Configuration EE and FF Inlets, may be used as portion of basic interface in accordance with IEC 62196-2:2016, standard sheets 2-I, and 2-II.

[c] May be used as basic interface, requirements for basic interface, see IEC 62196-2:2016, standard sheets 2-I and 2-II.

7 Classification of accessories

Clause 7 of IEC 62196-3:2014 applies, except as follows:

Replacement of 7.2:

7.2 According to the method of connecting the conductors

– Rewireable accessories (only applicable for those without thermal transport);
– Non-rewireable accessories.

Replacement of 7.3:

7.3 According to serviceability

– Field serviceable accessories only.

Additional subclauses:

7.101 According to thermal management system

– With thermal sensing only;
– With thermal sensing and thermal transport.

8 Marking

Clause 8 of IEC 62196-3:2014 applies.

9 Dimensions

Clause 9 of IEC 62196-3:2014 applies, except as follows:

9.1 *Replacement:*

The standard sheets from IEC 62196-3:2014 apply with the supplement of Annex A, Annex B, Annex C or Annex D, whichever is applicable.

The vehicle connector and vehicle inlet shall comply with the relevant configuration shown in Table 108.

Table 108 – Interface overview

Configuration	Dimensions described in standard sheet	Maximum rated voltage V DC	Maximum rated current A	To be used only with DC charging station according to IEC 61851-23:—[7]
AA	3-I	1 000	400	Annex AA
BB	3-II	950	250	Annex BB
EE	3-III	1 000	500	Annex CC
FF	3-IV	1 000	500	Annex CC

10 Protection against electric shock

Clause 10 of IEC 62196-3:2014 applies.

11 Size and colour of protective earthing conductors

Replacement:

The protective earthing conductor shall be of sufficient cross-sectional area calculated by the I^2t-methodology according to the formula in 543.1.2 of IEC 60364-5-54:2011.

The I^2t-values for the respective system, used in the calculation above, shall be determined according to 7.2.4 of ISO 17409:2020 or according to IEC 61851-23:—[8], whichever provides the higher value.

NOTE 1 In the following countries the size and rating of the protective conductor is specified in national codes and regulations: US, CA.

The conductor connected to the protective earthing terminal shall be identified by the colour combination green-and-yellow.

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

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

NOTE 2 In the following countries the colour green may be used to identify the earthing conductor: JP, US, CA.

12 Provision for protective earthing

Clause 12 of IEC 62196-3:2014 applies, except as follows:

Replacement of Table 6 by Table 109:

Table 109 – Short-time test currents

Rating of the accessory	Minimum size for protective earthing (grounding) copper conductor		Time	Test current
A	mm^2	AWG	s	A
10 to 15	2,5	14	4	300
16 and 20	4	12	4	470
21 to 60	6	10	4	750
61 to 70	10	8	4	1 180
80 to 100	10	8	4	1 180
125	16	6	6	1 530
200	16	6	6	1 530
250	25	4	6	2 450
300	35	2	6	3 100
400	35	2	6	3 100
500	35	2	6	3 900
NOTE For accessories' ratings less than 10 A in Table 109, test current is based on the smallest size equipment protective earthing conductor permitted or can be determined by linear approximation of rated current (or 120 A per 1 mm^2), whichever is greater.				
The test is only applicable for accessories galvanically connected to the mains.				

13 Terminals

Clause 13 of IEC 62196-1:2014 applies, except as follows:

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

14 Interlocks

Clause 14 of IEC 62196-3:2014 applies.

15 Resistance to ageing of rubber and thermoplastic material

Clause 15 of IEC 62196-3:2014 applies.

16 General construction

Clause 16 of IEC 62196-3:2014 applies, except as follows:

16.5 *Replacement:*

The maximum permissible temperature of those parts of the accessory and cable assembly that can be grasped during normal operation carrying the rated current shall not exceed:

– 50 °C for metal parts,
– 60 °C for non-metal parts.

For parts which may be touched but not grasped, the permissible temperatures are:

– 60 °C for metal parts,
– 85 °C for non-metal parts.

Compliance is checked by the test of 24.102*.*

16.10 *Addition at beginning of the subclause:*

Only applicable for accessories without thermal transport.

Additional subclauses:

16.101 Thermal sensing device

The accessory manufacturer shall provide the intervention value of the thermal sensing device in the installation manual. The intervention value is the value before DC contacts reach 90 °C.

Compliance for the cable assembly is checked in accordance with 24.102 *and* 24.103.

Compliance for the vehicle inlet is checked in accordance with 24.104 *and* 24.105.

16.102 Loss of thermal transport

In case of loss of thermal transport, the accessories shall withstand the rated current applied with deactivated thermal transport for 20 s.

Compliance is checked at a room temperature of (40 ± 5) °C by the following test:

– *operation with rated current and activated thermal transport until thermal stabilization at the DC contacts is reached;*
– *deactivate thermal transport;*
– *continue applying rated current for 20 s.*

The test is passed if the insulation resistance and dielectric strength is maintained according to Clause 21 and there shall be no melting, cracking, or deformation to the extent that:

– *live parts or internal wiring are made accessible to the standard test finger shown in 10.1 of IEC 62196-1:2014;*
– *the integrity of the enclosure of the accessory is defeated so that acceptable mechanical or environmental (degrees of) protection is not provided;*
– *the polarization of the accessory is defeated;*
– *there is interference with the operation, function or installation of the accessory;*
– *the accessory does not provide adequate strain relief for the flexible cable;*
– *the creepage distances and clearances between live parts of opposite polarity, live parts and accessible dead or earthed metal are reduced below the values in 28.1 of IEC 62196-1:2014;*

– *this results in any other evidence of damage that could increase the risk of fire or electric shock;*

– *there is any leakage of the cooling system.*

16.103 Accessories using thermal sensing

For configuration AA accessories, thermal protective fuses and/or thermal sensing shall be installed in such a way that the thermal characteristics of the DC+ and the DC− contact are independently measured and independently signalled to the DC EV supply equipment, depending on the charging case as defined in IEC 61851-23. For configuration EE and FF accessories, thermal sensing devices shall be installed in such a way that the thermal characteristics of the DC+ and the DC− contact are independently measured and independently signalled to the DC EV supply equipment.

The thermal sensing devices of the cable assembly shall provide data representing the temperature of the DC contacts to the DC EV supply equipment.

The thermal sensing devices of the vehicle inlet shall provide data representing the temperature of the DC contacts to the EV.

Compliance is checked by the test of 24.103 *for the cable assembly or* 24.105 *for the vehicle inlet.*

16.104 Rated current for accessory

The DC contacts of the accessory shall not exceed 90 °C during continuous operation at the rated current and at an ambient temperature of 40 °C. The cable assembly should be designed in such a way that the thermal sensing is not negatively affected by the thermal transport, if any. The complementary accessory may have thermal transport.

Compliance is checked by the test of 24.102 *for the cable assembly or* 24.104 *for the vehicle inlet.*

16.105 Operation conditions of thermal management system

The manufacturer of the accessory shall provide installation instructions for the operation of the thermal management system. These shall include:

– rated pressure;

– maximum allowed pressure;

– type of coolant.

Additionally, data may include:

– type of cable;

– cross-section of conductors;

– maximum temperature of coolant;

– minimum flow rate of coolant;

– minimum cooling capacity.

The manufacturer of the accessory may provide information about a current for operation without thermal transport and thermal exchange to increase availability.

Compliance is checked by inspection.

16.106 Minimum cross section of line conductors

In order to have a sufficient short circuit current withstand, the line conductors DC+ and DC− shall be of sufficient minimum cross-sectional area calculated by the I^2t-methodology according to the formula of IEC 60364-5-54:2011, 543.1.2.

The I^2t-values for the respective system, used in the calculation above, shall be determined according to ISO 17409 or according to IEC 61851-23, whatever provides the higher value.

NOTE At the time of the publication of this document, ISO 17409 provides higher I^2t-values. For example, for conductors with a crosslinked insulation and a maximum short circuit temperature of 250 °C, a minimum cross section of 25 mm^2 is required.

Compliance is checked by inspection.

16.107 Contact temperature

The DC contacts of the accessory shall not exceed 90 °C during any operation condition.

Compliance for the cable assembly is checked in accordance with 24.102 *and* 24.103.

Compliance for the vehicle inlet is checked in accordance with 24.104 *and* 24.105.

17 Construction of socket-outlets

Clause 17 of IEC 62196-3:2014 applies.

18 Construction of plugs and vehicle connectors

Clause 18 of IEC 62196-3:2014 applies, except as follows:

Additional subclause:

18.101 DC contact surface

The plating of the DC contact tubes shall be made from silver or a silver alloy with at least 95 % silver. The plating requirements apply at the point of contact.

For accessories with contact pins, the plating of the DC contact pins shall be made from a silver alloy with at least 95 % silver. Table 110 applies at the contact area shown in Figure A.10, Figure C.10, or Figure D.10, as appropriate.

Table 110 – Properties of DC accessory contact plating for pin

Parameter [a]	Accessory	Dimension	Unit	Value
Hardness on the contact area	AA, EE, FF		HV[b]	70 min.
Layer thickness on the contact area	AA, EE, FF	L	µm	8 min.
Roughness on the contact area[c]	AA, EE, FF	Ra[d]	µm	1,0 max.

[a] The parameters should be verified by test, measurement, or other means.

[b] Vickers hardness.

[c] As defined in ISO 25178-1.

[d] Arithmetic mean deviation of the assessed profile.

Compliance of the accessory is checked by inspection and test.

19 Construction of vehicle inlets

Clause 19 of IEC 62196-3:2014 applies, except as follows:

Additional subclause:

19.101 DC contact surface

The plating of the DC contact surface shall be made from a silver alloy and shall fulfil the requirements of 18.101.

20 Degrees of protection

Clause 20 of IEC 62196-3:2014 applies.

21 Insulation resistance and dielectric strength

Clause 21 of IEC 62196-3:2014 applies.

22 Breaking capacity

Clause 22 of IEC 62196-3:2014 applies.

23 Normal operation

Clause 23 of IEC 62196-3:2014 applies, except as follows:

Replacement of Table 17 with Table 111 and note:

Table 111 – Normal operation

Rated current	Cycles of operation	
A	Load	No-load
DC (all ratings)	–	10 000

NOTE Use cases can require a higher number of operations and/or regular maintenance.

24 Temperature rise

Clause 24 of IEC 62196-3:2014 applies, except as follows:

24.1 *Not applicable*

24.2 *Not applicable*

Addition:

24.101 General test conditions

All tests shall be performed with a vehicle connector and an attached cable, and a test accessory, called a reference device (RD), which mates with the device under test (DUT).

24.102 Temperature rise test for cable assembly

Cable assemblies shall be so constructed that the temperature rise in normal use is not excessive.

Compliance is checked by the following test:

The DUT is a cable assembly with the cable attached to the vehicle connector having the longest length as specified by the manufacturer.

The reference device for this test complies with Figure A.1, Figure C.1, or Figure D.1, as appropriate.

The corresponding test setup complies with Figure A.2, Figure C.2, or Figure D.2, as appropriate.

The general test set-up complies with Figure A.9, Figure C.9, or Figure D.9, as appropriate.

If the cable assembly is equipped with thermal transport, then the thermal exchange parameters are used as specified by the manufacturer in the installation manual for an ambient temperature of 40 °C.

The test current is the rated current according to the DUT manufacturer's data sheet.

For a cable assembly with thermal sensing only, the test is performed at an ambient temperature of 20 °C to 40 °C and the obtained results are corrected to an ambient temperature of 40 °C.

For a cable assembly with thermal transport, the test is performed at an ambient temperature of (40 ± 5) °C. The results are corrected to an ambient temperature of 40 °C.

The tests are conducted in a draft-free environment without forced convection.

The cable assembly is mated to the reference device.

The cycle for the test is defined as follows:

The rated current is applied to the cable assembly at the DC+ and DC− contact. When thermal stabilisation is reached, the applied current shall be reduced to 0 A after 10 min.

The temperatures at the DC contacts measured by the temperature sensors (T_1+ and T_1−) and the provided values from the thermal sensing devices of the cable assembly (T_S+ and T_S−) are recorded with one or more sample per second throughout the test.

The values provided by the thermal sensing devices of the cable assembly are converted into temperature values according to the manufacturer's data sheet.

This test is passed if:

– the temperature rise measured by the temperature sensors (T_1+ and T_1−) has not exceeded 50 K; and

– the surface temperature of the cable assembly does not exceed the limits according to 16.5; and

– the measured values of the thermal sensing devices (T_S+ and T_S−) have not exceeded the intervention value provided by the manufacturer according to *16.101*.

24.103 Test for thermal sensing device of cable assembly

Cable assemblies shall be so constructed that the thermal sensing device in normal use is reliable.

Compliance is checked by the following test:

The DUT is a cable assembly with the cable attached to the vehicle connector having the shortest length as specified by the manufacturer.

The reference device for this test complies with Figure A.5, Figure C.5, or Figure D.5, as appropriate.

The corresponding test setup complies with Figure A.6, Figure C.6, or Figure D.6, as appropriate.

The general test setup complies with Figure A.9, Figure C.9, or Figure D.9, as appropriate.

If the cable assembly is equipped with thermal transport, then the thermal exchange parameters are used as specified by the manufacturer in the installation manual for an ambient temperature of 40 °C.

The test current is the rated current according to the DUT manufacturer's data sheet.

The test is performed at an ambient temperature of (40 ± 5) °C. The results are corrected to an ambient temperature of 40 °C.

The test is conducted in a draft-free environment without forced convection.

The temperatures at the DC contacts measured by the temperature sensors (T_1+ and T_1−) and the provided values from the thermal sensing devices of the cable assembly (T_S+ and T_S−) are recorded with one or more sample per second throughout the test.

The values provided by the thermal sensing devices of the cable assembly are converted into temperature values according to the manufacturer's data sheet.

Once thermal stabilisation has been reached, the over-temperature of the vehicle connector is stimulated by applying heat power ensuring a constant temperature rise of (2,5 ± 0,5) K/min measured by the temperature sensors T_1+ and T_1−.

The heating and current supplies are discontinued once one of the temperature sensors T_1+ or T_1− reaches 95 °C.

The gradient is calculated taking the times when the heating starts (t1) and stops (t2). For example, the gradient of T_S+ = (T_S+(t2) − T_S+(t1)) / (t2 − t1).

This test is passed if:

– the temperature gradient measured by the thermal sensing devices T_S+ and T_S− deviates by less than 1,5 K/min of the temperature gradient measured by the corresponding temperature sensors T_1+ or T_1−; and

– the mathematical absolute value of the equation:

|*(gradient of T_S+ / gradient of T_1+) – (gradient of T_S− / gradient of T_1−) / < 0,2; and*

– the temperature value of temperature sensors T_1+ and T_1− is equal to or less than 90 °C at the time when either thermal sensing device T_S+ or T_S− reaches the intervention value provided by the manufacturer according to *16.101*.

24.104 Temperature rise test for vehicle inlet

Vehicle inlets shall be so constructed that the temperature rise in normal use is not excessive.

Compliance is checked by the following test:

The DUT is a vehicle inlet with attached DC conductors of minimum 1 m length. The DUT is assembled as intended by the manufacturer.

The reference device is assembled as the DUT with the exception of contacts constructed according to *Figure A.1*, *Figure C.1*, or *Figure D.1*, as appropriate. The distance B according to *Figure A.1*, *Figure C.1*, or *Figure D.1* shall be chosen to be appropriate, for both the reference device (used in test step 1) and the DUT (used in test step 2) shall not vary by more than ±1 mm.

The test current is the rated current according to the DUT manufacturer's data sheet.

This test is performed with a cable assembly with the same rated current as the DUT or a maximum 100 A higher rated current than it. The said cable assembly shall already have been certified according to this document.

If the cable assembly is equipped with thermal transport, then the thermal exchange parameters are used as specified by the manufacturer in the installation manual for an ambient temperature of 40 °C.

The test is performed at an ambient temperature of 20 °C to 40 °C and the obtained results are corrected to an ambient temperature of 40 °C.

The test is conducted in a draft-free environment without forced convection.

NOTE Measurement deviations of the temperature sensors can be minimized by calibration of temperature sensors with calibration equipment.

The test is performed in the following two steps.

Test step 1, reference test:

a) The reference device according to Figure A.1, Figure C.1, or Figure D.1, as appropriate, is mounted in the position according to Figure A.9, Figure C.9 or Figure D.9, as appropriate.

b) The cable assembly is mated to the reference device according to Figure A.3, Figure C.3, or Figure D.3, as appropriate.

c) The test current is applied to the cable assembly at the DC+ and DC− conductors.

d) The temperature of each temperature sensor (T_1+, T_1−, T_2+, T_2−) is recorded. The temperature rise is monitored until thermal stabilization has been reached. After an additional 1 h, the temperature of each temperature sensor is recorded as the reference values to be used in test step 2.

e) Compliance is confirmed, if the values of T_1+, T_1−, do not exceed a temperature rise of 50 K.

Test step 2, DUT testing:

f) The test current is the same current as used in test step 1.

g) *The DUT is mounted in the position according to Figure A.9, Figure C.9, or Figure D.9, as appropriate.*

h) *The cable assembly used in test step 1 is mated to the DUT according to Figure A.4, Figure C.4, or Figure D.4, as appropriate.*

i) *The thermal exchange parameters (if any) are the same as used in test step 1.*

j) *The test current is applied to the cable assembly at the DC+ and DC− conductors.*

k) *The temperature of each temperature sensor (T_3+, T_3−) is recorded. The temperature rise is monitored until thermal stabilization has been reached. After an additional 1 h, the temperature of each temperature sensor is recorded.*

This test is passed if the recorded temperature of:

– each temperature sensor (T_3+, T_3−) in test step 2 does not exceed the temperature recorded for the corresponding temperature sensor (T_2+, T_2−) in test step 1, and

– each temperature sensor (T_3+, T_3−) does not exceed the temperature rise of 50 K.

24.105 Test for thermal sensing device of vehicle inlet

Vehicle inlets shall be so constructed that the thermal sensing device in normal use is reliable.

Compliance is checked by the following test:

The DUT is a vehicle inlet with attached DC conductors of minimum 1 m length. The DUT shall be assembled as intended by the manufacturer.

The reference device shall be assembled as shown in Figure A.7, Figure C.7, or Figure D.7, as appropriate.

The corresponding test setup shall be in compliance with Figure A.8, Figure C.8, or Figure D.8, as appropriate.

The test is performed at an ambient temperature of (25 ± 5) °C.

The test shall be conducted in a draft-free environment without forced convection.

A test current shall be applied, which reaches the same temperature value (±3 K) at thermal stabilisation at T_1+ and T_1− as measured at T_3+ and T_3− in k) listed under test step 2 in 24.104.

The temperatures at the DC contacts measured by the temperature sensors (T_1+ and T_1−) and the provided values from the thermal sensing devices of the DUT (T_S+ and T_S−) shall be recorded with one or more samples per second throughout the test.

The values provided by the thermal sensing devices of the DUT shall be converted into temperature values according to the manufacturer's data sheet.

Once thermal stabilisation has been reached, the over-temperature of the DUT is stimulated by applying heat power ensuring a constant temperature rise of (2,5 ± 0,5) K/min measured by the temperature sensors T_1+ and T_1−.

The heating and current supply shall be discontinued once one of the temperature sensors T_1+ or T_1− reaches 95 °C.

The gradient shall be calculated taking the times when the heating starts (t1) and stops (t2). For example, the gradient of T_S+ = (T_S+(t2) – T_S+(t1)) / (t2 − t1).

This test is passed if:

– The temperature gradient measured by the thermal sensing devices T_S+ and T_S− deviates by less than 1,5 K/min of the temperature gradient measured by the corresponding temperature sensors T_1+ or T_1−; and

– The mathematical absolute value of the equation: |(gradient of T_S+ / gradient of T_1+) – (gradient of T_S− / gradient of T_1−) | < 0,2; and

– The temperature value of temperature sensors T_1+ and T_1− shall be equal to or less than 90 °C at the time when either thermal sensing device T_S+ or T_S− reaches the intervention value provided by the manufacturer according to *16.101*.

25 Flexible cables and their connection

Clause 25 of IEC 62196-3:2014 applies, except as follows:

25.3 Plugs and vehicle connectors provided with a flexible cable

Addition:

Add after the fifth paragraph:

The test shall be performed using a cable.

If liquid coolant is provided, the test shall be performed under rated pressure specified by the manufacturer.

Replacement of Table 19 with Table 112:

Table 112 – Pull force and torque test values for cable anchorage

Rated current A	Pulling force N	Torque Nm	Maximum displacement mm
13 to 20	160	0,6	2
30 to 32	200	0,7	2
60 to 70	240	1,2	2
125	240	1,5	2
200	250	2,3	2
250	500	11,0	5
300	500	11,0	5
400	500	11,0	5
500	500	16,3	5

Add, at the end of the subclause:

Liquid coolant confining parts shall not be broken or damaged such that leakage can occur after the test.

Additional subclause:

25.101 Design of cables

The cables shall comply with the IEC 62893-4 series.

NOTE In the following countries requirements for flexible cables are given in national requirements: US, CA, MX, JP.

26 Mechanical strength

Clause 26 of IEC 62196-3:2014 applies, except as follows:

26.1 General

Add after the last dashed list point:

– for all connectors and cable assemblies, 26.4 applies;
– for all connectors and cable assemblies, 26.5 applies.

26.2 Degree of protection

Add after the first sentence:

The test shall be performed under rated pressure from the liquid coolant, if any.

Replacement of Table 20 with Table 113:

Table 113 – Impact energy for ball impact test

Rating A	Energy J
	Vehicle inlets
Up to and including 32	1
Above 32 and up to and including 100	2
Above 100 and up to and including 150	3
Above 150 and up to and including 500	4

Add at the end of the first dashed list in c):

– *liquid coolant confining parts shall not be broken or damaged such that leakage can occur after the test.*

26.3 Rewirable plugs and vehicle connectors

Add after the first sentence:

The test shall be performed under operating pressure from the liquid coolant, if any.

Add at the end of the subclause:

Liquid coolant confining parts shall not be broken or damaged such that leakage can occur after the test.

26.4 Non-rewirable accessories

Add after the first sentence:

The test shall be performed under rated pressure from the liquid coolant, if any.

Replacement of Table 21 with Table 114:

Table 114 – Mechanical load flexing test

Rated current A	Force N
Up to and including 20	20
from 21 up to and including 32	25
from 33 up to and including 70	50
from 71 up to and including 250	75
from 251 up to and including 400	100
from 401 up to and including 500	120

Add at the end of the subclause (after Figure 14):

Liquid coolant confining parts shall not be broken or damaged such that leakage can occur after the test.

27 Screws, current-carrying parts and connections

Clause 27 of IEC 62196-3:2014 applies.

28 Creepage distances, clearances and distances

Clause 28 of IEC 62196-3:2014 applies.

29 Resistance to heat, to fire and to tracking

Clause 29 of IEC 62196-3:2014 applies.

30 Corrosion and resistance to rusting

Clause 30 of IEC 62196-3:2014 applies.

31 Conditional short-circuit current withstand test

Clause 31 of IEC 62196-3:2014 applies.

32 Electromagnetic compatibility

Clause 32 of IEC 62196-3:2014 applies.

33 Vehicle driveover

Clause 33 of IEC 62196-3:2014 applies, except as follows:

33.2 *Addition:*

Add after the first paragraph:

The test shall be performed using a cable assembly.

If liquid coolant is provided, the test shall be performed under rated pressure specified by the manufacturer.

Add as the third item in the dashed list:

– *the integrity of the liquid coolant system, if any, is ruptured, damaged, or broken such that leakage occurs;*

101 Liquid coolants

101.1 Type of coolant

The requirements are only applicable for liquid coolants. Other coolants are for further study.

Multiple coolant types can be used, but coolants shall not be intermixed. Once a coolant type is chosen for an application, no change in coolant shall be made. This information shall be conveyed to the DC EV supply equipment manufacturer.

Warnings shall be provided in the installation manual or data sheet indicating that leakage or material degradation may occur if a coolant other than that specified by the manufacturer of the accessory is used.

Compliance is checked by inspection.

101.2 Environmental considerations

The liquid coolant shall be non-hazardous for the environment or shall be used in a manner such that any spills are contained within the equipment and isolated against the environment in accordance with the local regulations.

The liquid coolant utilized in the accessory shall be non-hazardous to the environment according to the United Nations Globally Harmonized System of Classification and Labelling of Chemicals.

At a minimum requirement, the liquid coolant utilized in the accessory shall have "ready biodegradability" according to OECD 301 and this shall be stated in the accessory manufacturer's data sheet.

NOTE Local regulations can require other compliances.

Environmental safety data shall be provided for all specified liquid coolants approved by the cable assembly manufacturer.

Compliance is checked by inspection.

101.3 Flammability

The liquid coolant shall not cause a fire if leaked onto exposed electrical parts within the accessory. The minimum flashpoint of the liquid coolant shall be 135 °C.

Compliance is checked by inspection of material safety data sheets or by the test according to ISO 2719.

101.4 Conductivity

Tests for the conductivity of the liquid coolant are under consideration.

NOTE This document is intended for use in conductive charging systems for circuits specified in IEC 61851-23. These systems already have a protection against electric shock.

101.5 Material compatibility

All liquid coolant confining parts of the accessory shall be resistant to the action of the liquid coolant and exposure to heat. Non-metallic parts shall be able to maintain their physical properties after being exposed to the liquid coolant and air oven ageing as follows.

Compliance is checked by the following tests.

Air oven ageing plastic parts and gaskets:

Six specimens are aged in an air circulating oven under one of the following conditions and shall maintain the physical properties of tensile strength and elongation:

– 121 °C for 7 days, or
– 101 °C for 28 days.

NOTE This test is done according to the concept of IEC 60216-1.

The tensile strength and ultimate elongation shall not be less than 60 % of the tensile strength and ultimate elongation of the as-received sample. The test method of IEC 60811-501 shall be followed.

Liquid coolant exposure:

Other specimens shall be immersed in the liquid coolant at (80 ± 2) °C for (70 ± ½) h.

Six samples of each material, 25,4 mm ± 0,1 mm wide and 203 mm ± 1 mm long and not thicker than the thinnest part in the application are required for this test. Three samples are tested as-received and three are tested after immersion.

The tensile strength and ultimate elongation shall not be less than 60 % of the tensile strength and ultimate elongation of the as-received sample.

101.6 Overpressure test

The liquid coolant confining parts of the accessory shall be capable of withstanding the maximum allowed pressure plus 1 bar without leaking, bursting or rupturing.

Compliance is checked by the following test.

The liquid confining parts of the accessory are pressurized to the maximum allowed pressure described in the data sheet of the cable assembly plus 1 bar using air and held for 15 min.

The accessory is submerged not deeper than 1 m in water during this test. There shall be no rupturing or bursting of the liquid coolant confining parts. There shall be no visible air bubbles during the test.

NOTE The DC EV supply equipment or the EV limits the maximum allowed pressure by its own means, for example, a pressure relief valve.

Annex A
(normative)

Specific information for configuration AA

A.1 General

References to the standard sheets 3-Ia, 3-Ib and 3-Ic of IEC 62196-3:2014 are applicable for any rated current up to 400 A.

A.2 Reference devices and test setups for configuration AA

A.2.1 Reference device and test setups for temperature rise test of cable assembly and vehicle inlet (configuration AA)

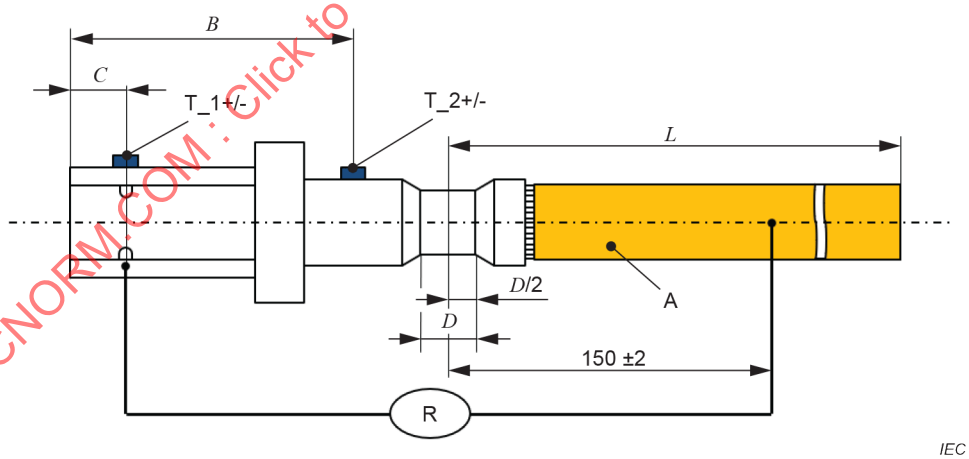
The reference device for the temperature rise tests consists of a vehicle inlet according to standard sheet 3-Ia of IEC 62196-3:2014 fitted with the DC power contacts according to Clause A.4 only without any grommet or sealing.

The DC power contacts are attached to a conductor forming a short-circuit bridge with a length of 2 m and a conductor cross section according to Table A.2.

The vehicle inlet is attached to a bracket to ensure usage in upright position.

The contact resistances of the reference device (including contact tube, contact body, mechanical joining and 150 mm of the attached conductor) measured by four-terminal sensing according to Figure A.1 shall comply with the maximum values as indicated in Table A.1.

Dimensions in millimetres



For the temperature rise test of the vehicle inlet, the distance B for both the reference device (used in test step 1) and the DUT (used in test step 2) shall not vary by more than ±1 mm.

Key

T_1, T_2 Temperature sensors on the reference device (RD)

For missing dimensions, see IEC 62196-3:2014, standard sheet 3-Ia.

Plating zone according to Figure A.10. Plating according to 18.101. Minimum material requirements in Table 110 plus 20 % max. shall be used.

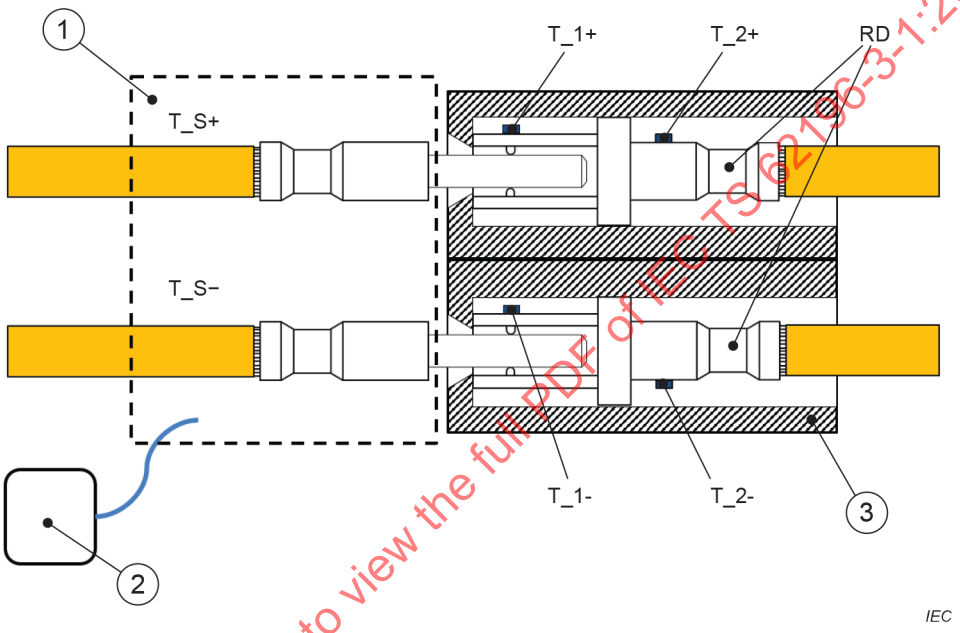
Figure A.1 – Reference device AA_0

Table A.1 – Maximum contact resistances and dimensions of reference device AA_0

Rated current A	A mm^2	L m	B, C, D mm	R[1)] µΩ
200	50	min.1	TBD by manufacturer	TBD[2)]
300	70			
400	95			

[1)] All strands to be connected during resistance measurement.

[2)] It is recommended to take the values from Table C.1.



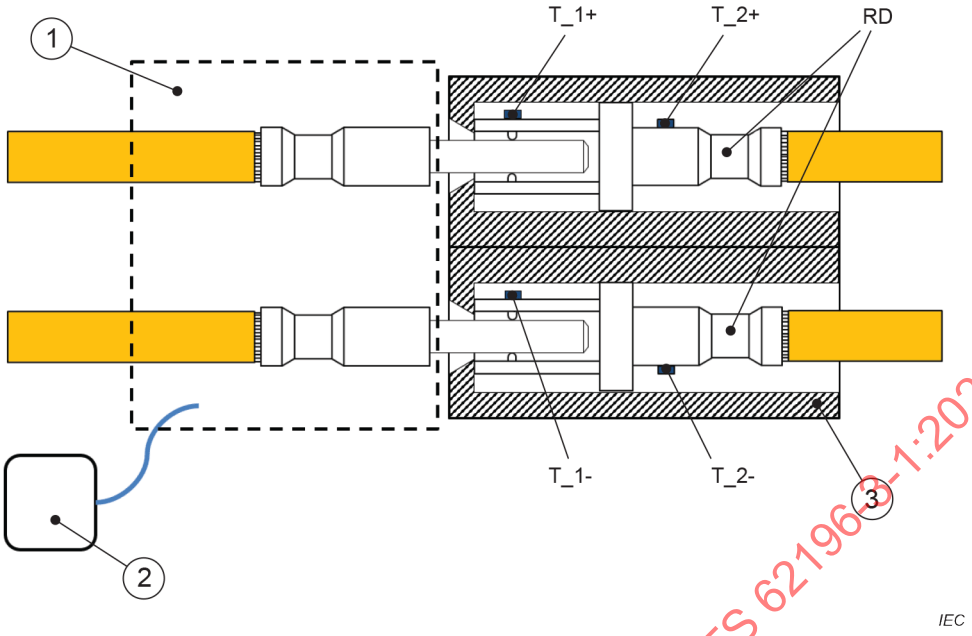
Key

①	Device under test
②	Thermal exchange device – if any
③	Housing and support
RD	Reference device AA_0
T_S+, T_S-	Thermal sensing device inside vehicle connector at DC+ and DC−
T_1, T_2	Temperature sensors on the reference device (RD)

For missing dimensions, see IEC 62196-3:2014, standard sheet 3-Ib.

The reference device shall have a silver plating according to 18.101.

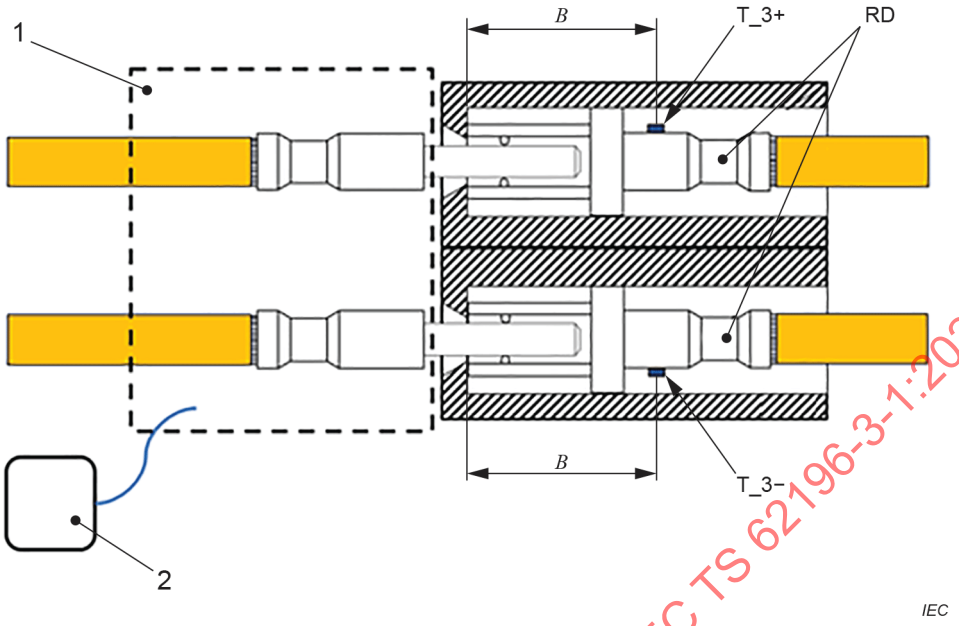
Figure A.2 – Test setup AA_0



Key

RD	Reference device AA_0
①	Certified vehicle connector
②	Thermal exchange device – if any
③	Housing and support
T_1, T_2	Temperature sensors on the reference device (RD)

Figure A.3 – Test setup AA_1

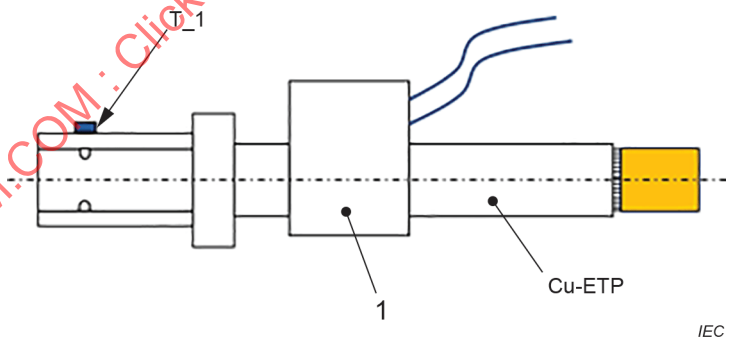


Key

DUT	Device under test
T_3+, T_3−	Temperature sensor T_3+ and T_3−
①	Certified vehicle connector
②	Thermal exchange device – if any
B	See Figure A.1

Figure A.4 – Test setup AA_2

A.2.2 Reference device and test setup for thermal sensing device test of cable assembly (configuration AA)



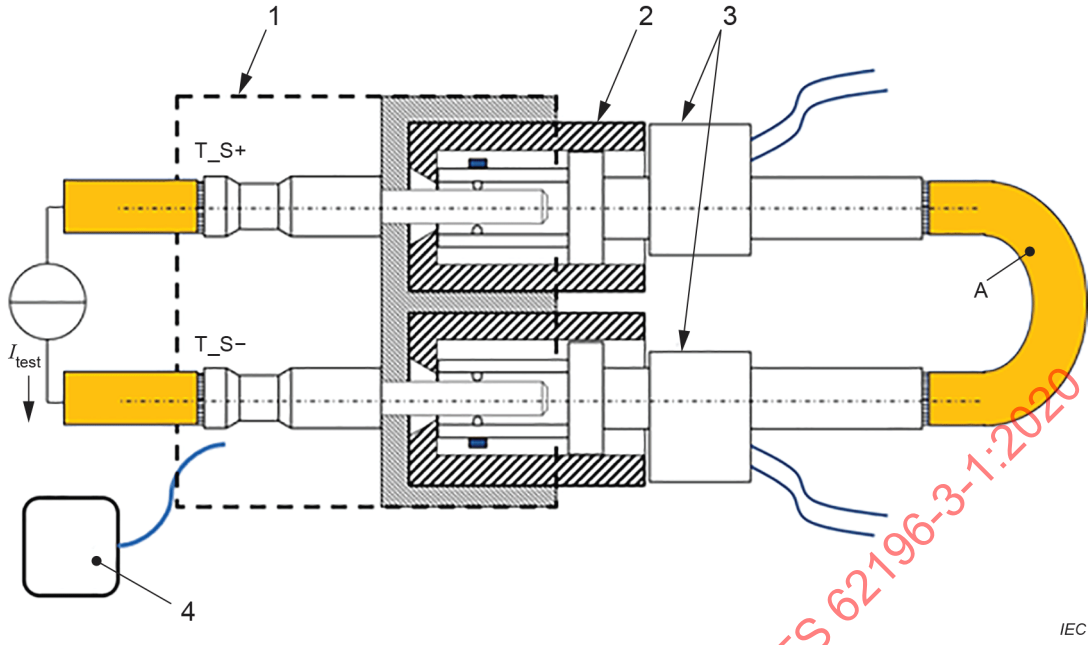
Key

①	Heating unit (min. 50 W recommended)
T_1	Temperature sensor T_1+ or T_1−
Cu-ETP	Electrolytic tough-pitch copper (99,9 % purity)

For missing dimensions, see IEC 62196-3:2014, standard sheet 3-Ia.

Recommended conductor cross section, see Table A.2

Figure A.5 – Reference device AA_1



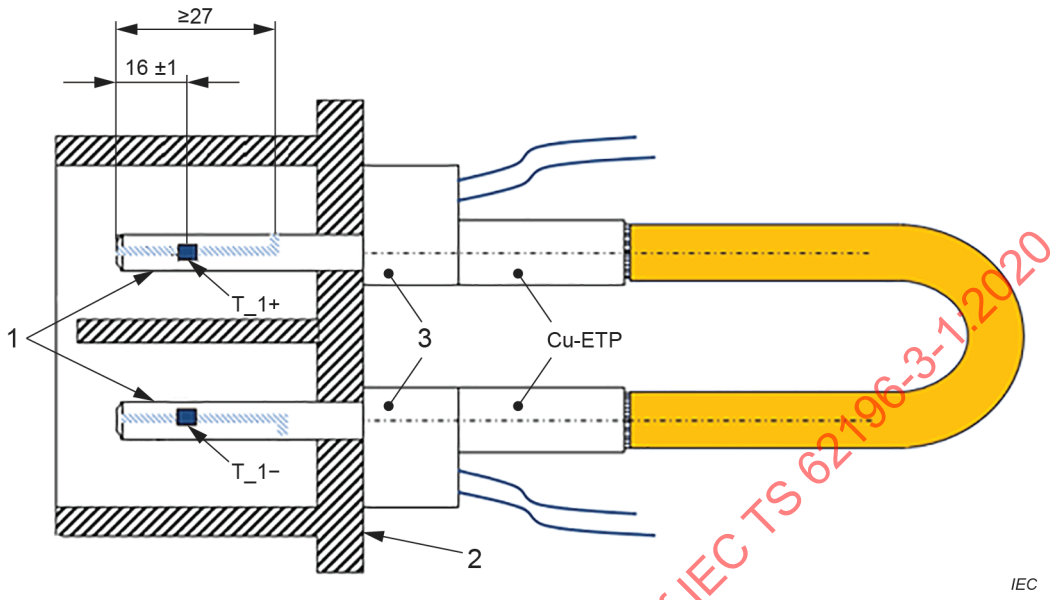
Key

①	DUT
②	Mating face according to IEC 62196-3:2014, standard sheet 3-Ia
③	Reference device AA_1
④	Thermal exchange device – if any
T_S+, T_S−	Thermal sensing device inside vehicle connector at DC+ and DC−
A	Conductor cross section according to Table A.2

Figure A.6 – Test setup AA_3

A.2.3 Reference device and test setup for thermal sensing device test of vehicle inlet (configuration AA)

Dimensions in millimetres



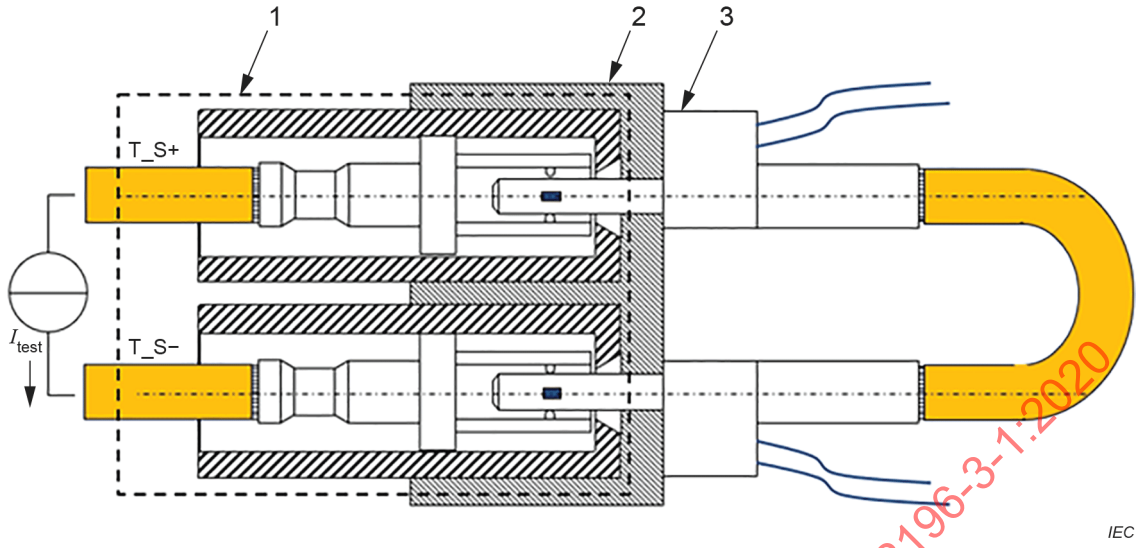
Key

T_1+, T_1−	Temperature sensor T_1+ / T_1−
Cu-ETP	Electrolytic tough-pitch copper (99,9 % purity)
①	Contact pin
②	Mating face
③	Heating unit (min. 50 W recommended) Other means to increase the temperature rise described in 24.105 are permissible as long as they provide equivalent test behaviour

For missing dimensions, see IEC 62196-3:2014, standard sheet 3-Ib.

The reference device shall have a silver plating according to 18.101.

Figure A.7 – Reference device AA_2



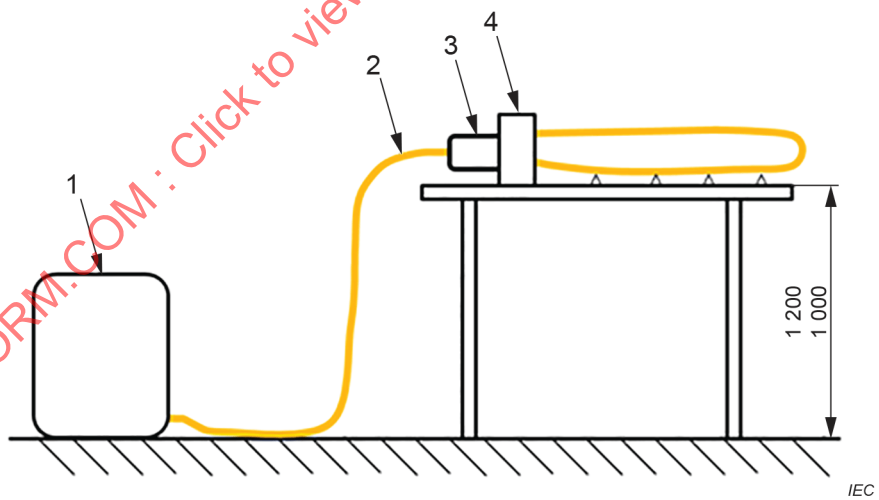
Key

T_S+, T_S−	Thermal sensing device inside vehicle inlet at DC+ and DC−
①	Device under test
②	Mating face according to IEC 62196-3:2014, standard sheet 3-Ib
③	Reference device AA_2

Figure A.8 – Test setup AA_4

A.3 Test setup for configuration AA

Dimensions in millimetres



Key

①	Thermal exchange device – if any
②	Flexible cable
③	Device under test for test according to 24.102 and 24.103, or certified vehicle connector for test according to 24.105
④	Reference device for test according to 24.102, 24.103 and 24.104 in test step 1, or device under test for test according to 24.104 in test step 2

Figure A.9 – General test setup for temperature rise tests and thermal sensing device tests (configuration AA)

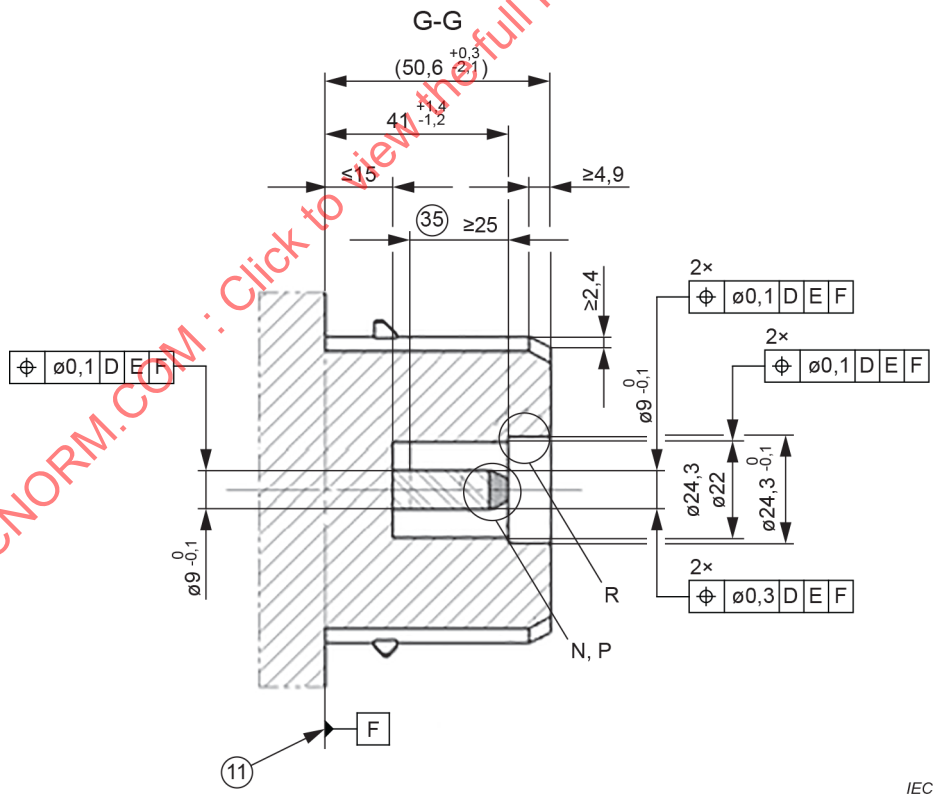
Table A.2 – Dimensions for reference device conductor

With thermal transport		Without thermal transport [a)]	
I_{test}	Conductor cross section	I_{test}	Conductor cross section
A	mm²	A	mm²
125 A < I_{max} ≤ 200 A	50	150 A < I_{max} ≤ 200 A	50
200 A < I_{max} ≤ 300 A	70	200 A < I_{max} ≤ 250 A	70
300 A < I_{max} ≤ 400 A	95	250 A < I_{max} ≤ 350 A	120
		300 A < I_{max} ≤ 400 A	150
a) Values under consideration			

A.4 Contacts for configuration AA

Additionally to the information provided in standard sheet 3-I in IEC 62196-3:2014, the plating of the contacts shall be deployed according to Figure A.10.

Dimensions in millimetres



Key

(11) Datum plane

(35) Plating area

Figure A.10 – Plating of contacts for configuration AA

Annex B
(informative)

Specific information for configuration BB

For further study.

Annex C
(normative)

Specific information for configuration EE

C.1 General

References to standard sheets 3-IIIa, 3-IIIb, 3-IIIc and 3-IIId of IEC 62196-3:2014 are applicable for any rated current up to 500 A and a rated voltage of 1 000 V DC.

C.2 Reference devices and test setups for configuration EE

C.2.1 Reference device and test setups for temperature rise test of cable assembly and vehicle inlet (configuration EE)

The reference device for the temperature rise tests consists of a vehicle inlet according to standard sheets 3-IIIa of IEC 62196-3:2014 fitted with the DC power contacts according to Clause C.4 only without any grommet or sealing.

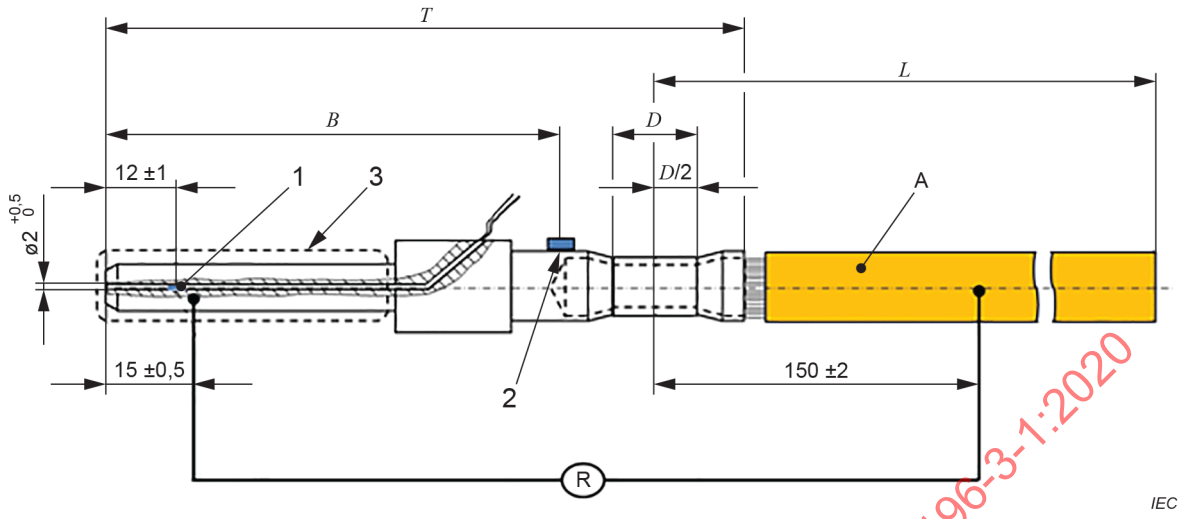
The DC power contacts are attached to a conductor forming a short-circuit bridge with a length of 2 m and a conductor cross section according to Table C.2.

The vehicle inlet is attached to a bracket to ensure usage in upright position.

The contact resistances of the reference device (including pin contact, contact body, mechanical joining and 150 mm of the attached conductor) measured by four-terminal sensing according to Figure C.1 shall comply with the values as indicated in Table C.1. For the test of 24.102 the reference device shall have a resistance larger than the minimum of the given resistance range. For the test of 24.104 the reference device shall have a resistance lower than the maximum of the given resistance range.

If the resistance of the reference device falls within the range given in Table C.1, it can be used for the tests of both 24.102 and 24.104. Otherwise two different devices shall be used for the tests.

Dimensions in millimetres



For the temperature rise test of the vehicle inlet, the distance B for both the reference device (used in test step 1) and the DUT (used in test step 2) shall not vary by more than ±1 mm.

Key

T 133 max.

① Temperature sensor T_1+ or T_1−

② Temperature sensor T_2+ or T_2−

③ DC power contact according to Clause C.4

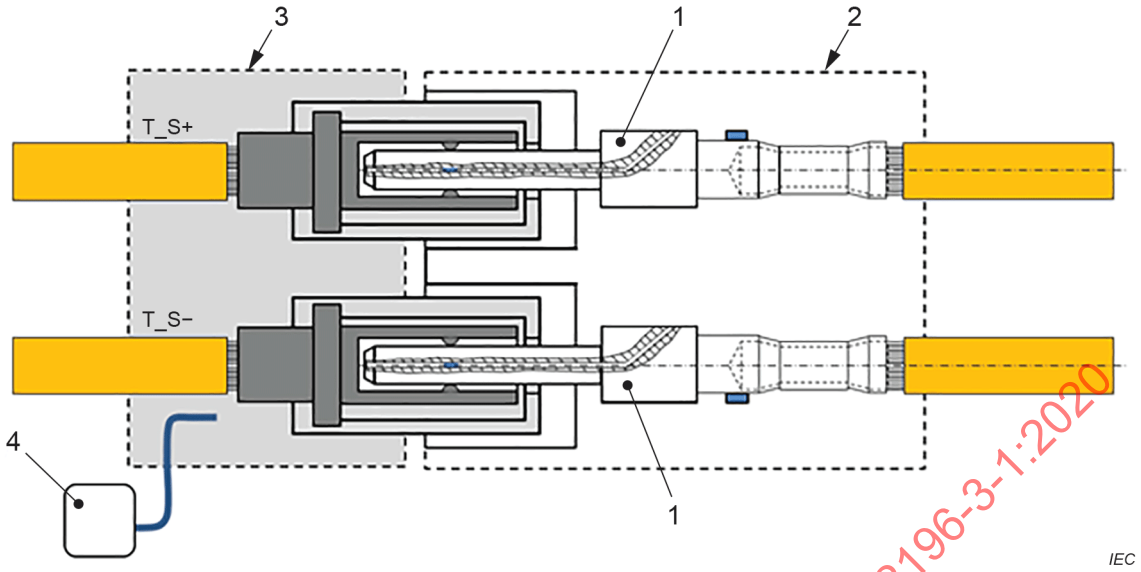
Missing dimensions according to standard sheet 3-IIIa.

Plating zone according to Figure C.10. Plating according to 18.101. Minimum layer thickness as in Table 110 plus 20 % max. shall be used.

Figure C.1 – Reference device EE_0

Table C.1 – Contact resistances and dimensions of reference device EE_0

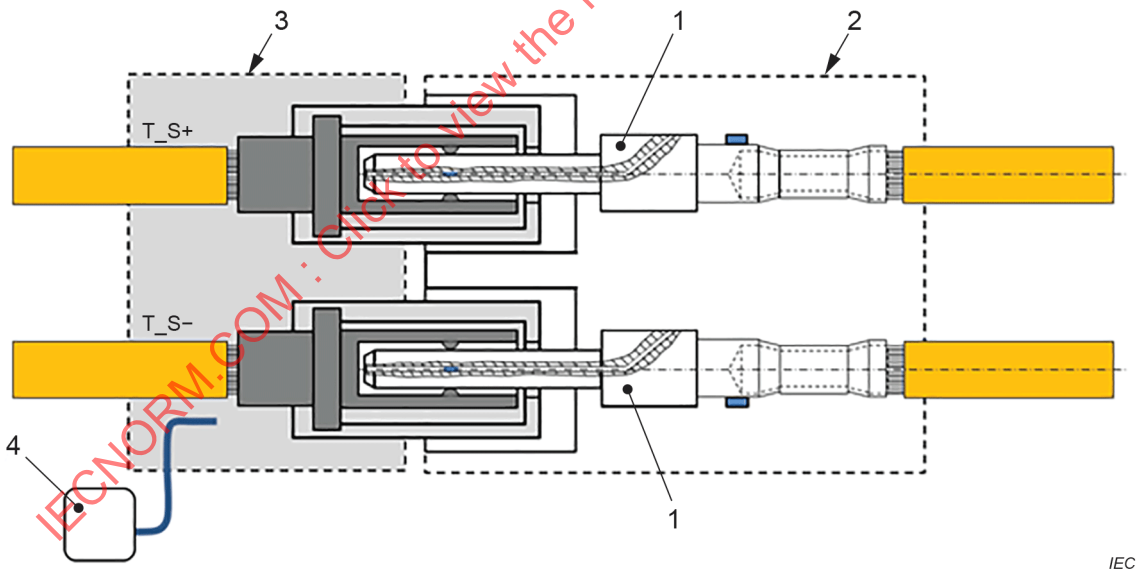
Rated current A	**A** mm²	***L*** m	***B*, *D*** mm	**R**[a) b)] μΩ
200	50	min. 1	TBD by manufacturer	123 to 128
300	70			91 to 96
400	95			65 to 70
500	120			57 to 62
a) All strands to be connected during resistance measurement b) Resistance values at 25 °C				



Key

T_S+ Thermal sensing device inside vehicle connector at DC+
T_S− Thermal sensing device inside vehicle connector at DC−
① Reference device EE_0
② Housing and support for reference device EE_0
③ Device under test
④ Thermal exchange device – if any

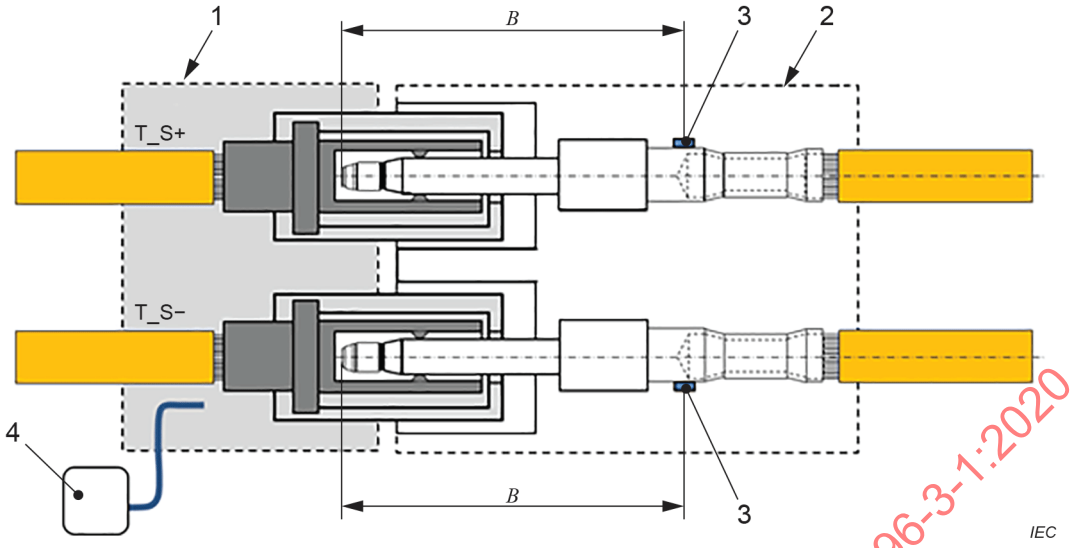
Figure C.2 – Test setup EE_0



Key

T_S+ Thermal sensing device inside vehicle connector at DC+ (not used in this test case)
T_S− Thermal sensing device inside vehicle connector at DC− (not used in this test case)
① Reference device EE_0
② Housing and support for reference device EE_0
③ Certified vehicle connector
④ Thermal exchange device – if any

Figure C.3 – Test setup EE_1



For the temperature rise test of the vehicle inlet, the distance B for both the reference device (used in test step 1) and the DUT (used in test step 2) shall not vary by more than ±1 mm.

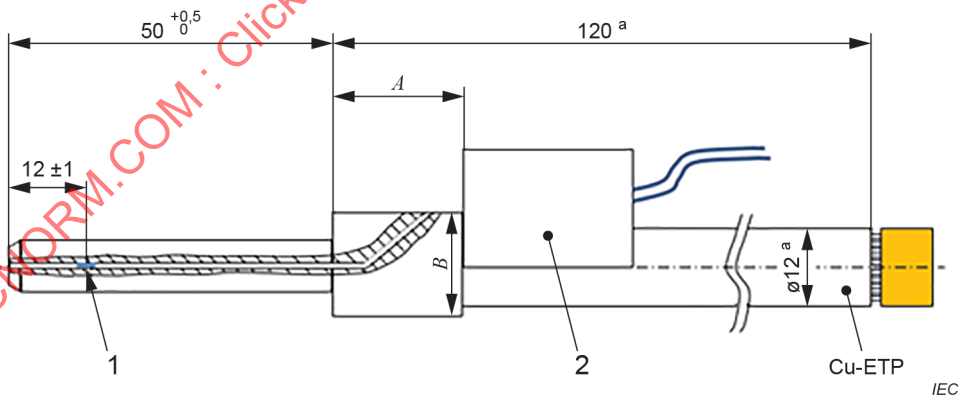
Key

T_S+	Thermal sensing device inside vehicle connector at DC+ (not used in this test case)
T_S−	Thermal sensing device inside vehicle connector at DC− (not used in this test case)
①	Certified vehicle connector
②	DUT
③	Temperature sensor T_3+ and T_3−
④	Thermal exchange device – if any

Figure C.4 – Test setup EE_2

C.2.2 Reference device and test setups for thermal sensing device test of cable assembly (configuration EE)

Dimensions in millimetres



a) The diameter and length of termination (Ø12 and 120) are recommended values

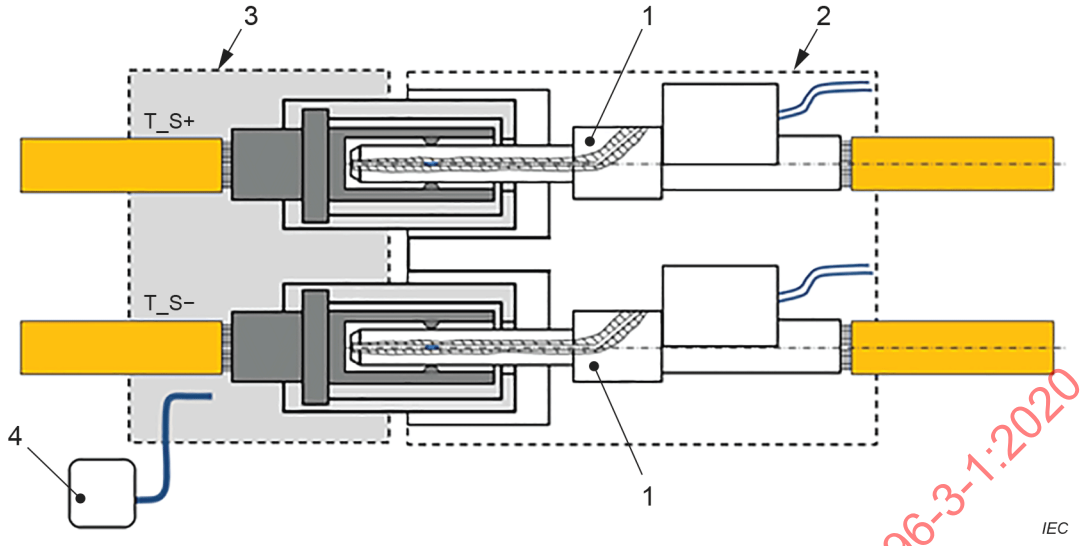
Key

Cu-ETP	Electrolytic tough-pitch copper (99,9 % purity)
①	Temperature sensor T_1+ or T_1−
②	Heating unit
A	Defined by the manufacturer
B	Defined by the manufacturer

For missing dimensions, see IEC 62196-3:2014, standard sheet 3-IIIa.

The reference device shall have a silver plating according to 18.101.

Figure C.5 – Reference device EE_1



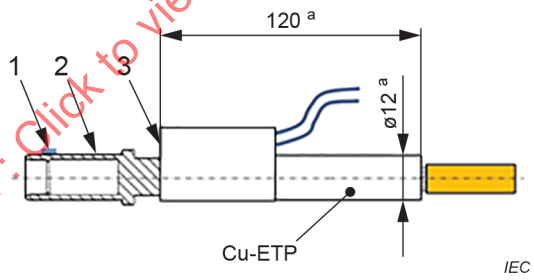
Key

T_S+	Thermal sensing device inside vehicle connector at DC+
T_S−	Thermal sensing device inside vehicle connector at DC−
①	Reference device EE_1
②	Housing and support for reference device EE_1
③	Device under test
④	Thermal exchange device – if any

Figure C.6 – Test setup EE_3

C.2.3 Reference device and test setups for thermal sensing device test of vehicle inlet (configuration EE)

Dimensions in millimetres

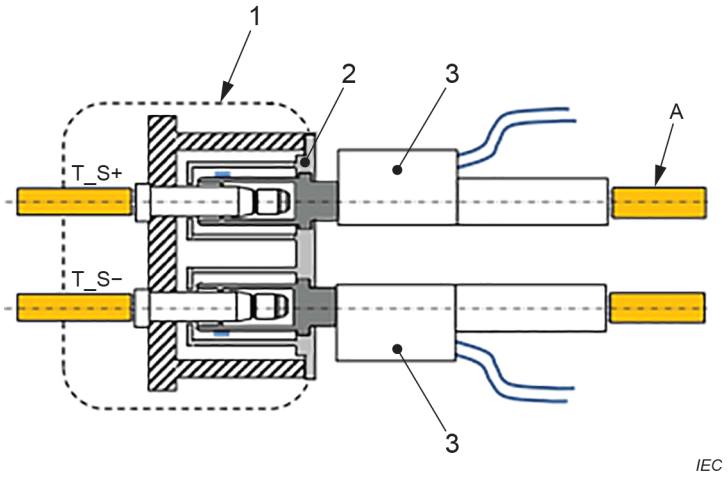


a) The diameter and length of termination (Ø12 and 120) are recommended values

Key

A	Conductor cross section according to Table C.2
Cu-ETP	Electrolytic tough-pitch copper (99,9 % purity)
①	Temperature sensor T_1+ or T_1−
②	Contact tube according to IEC 62196-3:2014, standard sheet 3-IIIb For missing dimensions, see IEC 62196-3:2014, standard sheet 3-IIIb. The reference device shall have a silver plating according to 18.101
③	Heating unit

Figure C.7 – Reference device EE_2



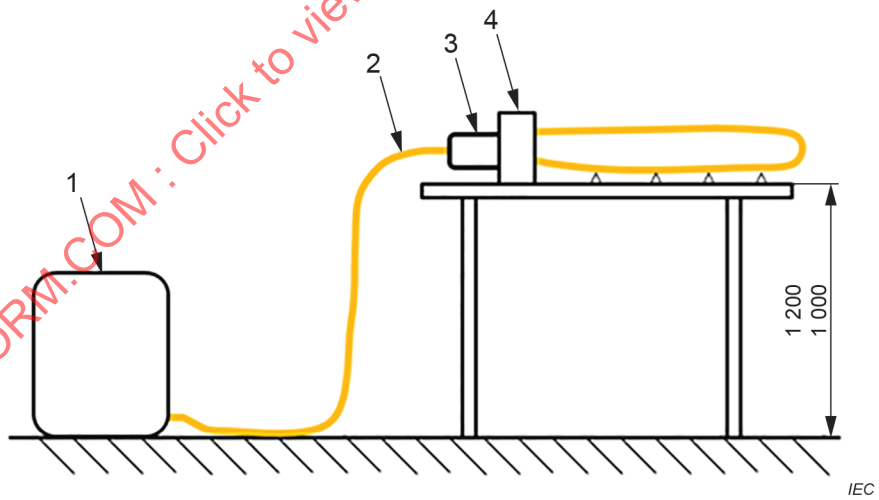
Key

A	Conductor cross section according to Table C.2
T_S+	Thermal sensing device inside vehicle inlet at DC+
T_S−	Thermal sensing device inside vehicle inlet at DC−
①	Device under test
②	Mating face according to IEC 62196-3:2014, standard sheet 3-IIIb
③	Reference device EE_2

Figure C.8 – Test setup EE_4

C.3 Test setup for configuration EE

Dimensions in millimetres



Key

①	Thermal exchange device – if any
②	Flexible cable
③	Device under test for test according to 24.102 and 24.103, or Certified vehicle connector for test according to 24.104
④	Reference device for test according to 24.102, 24.103 and 24.104 in test step 1, or device under test for test according to 24.104 in test step 2

Figure C.9 – General test setup for temperature rise tests and thermal sensing device tests (configuration EE)