



**INTERNATIONAL ELECTROTECHNICAL COMMISSION**  
**TECHNICAL SUBCOMMITTEE NO. 23H: INDUSTRIAL, PLUGS AND SOCKET-  
OUTLETS**  
**PROJECT TEAM NO.62196: DIMENSIONAL INTERCHANGEABILITY  
REQUIREMENTS FOR PIN AND CONTACT-TUBE VEHICLE COUPLERS**

Introductory note

By decision of PT62196 (document SC23H/PT62196/VC012 item 4 published on January 5<sup>th</sup>, 2009) national committees are asked to submit alternative/additional standard sheets by January 31<sup>st</sup>, 2009.

This proposal, submitted by me as member of PT62196, is developed by MENNEKES Elektrotechnik GmbH & Co. KG and discussed within the german national committee, and german car manufacturers. The majority of the members of the german national committee support this proposal.

The aim of this proposal is to eliminate the shortcomings of the original proposal (document SC23H/PT62196/VC003) which is not in line with the requirements of IEC 62196-1 in some details e.g. not supporting the option of three phase charging. Additionally this proposal tries to adopt the further development of the standards (IEC 62196-1, IEC 61851-1 and SAE 1772) which should be taken into account as well as the needs specified by car manufacturers and power distributors.

Main features of EV Couplers to this proposal:

- three phase charging (mode B up to 32 A, mode C up to 63 A)
- single phase charging (mode B up to 32 A, mode C up to 70 A)
- immobilizer for EV
- bi-directional energie transfer
- use of the same type accessories on both ends of the charging cord
- data interchange by separate conductor as well as by HF (e.g. on the earthing wire)

Kirchhundem, January 29<sup>th</sup>, 2009

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## PLUGS, SOCKET-OUTLETS, AND VEHICLE COUPLERS - CONDUCTIVE CHARGING OF ELECTRIC VEHICLES –

### Part 2-X: Dimensional interchangeability requirements for pin and contact-tube vehicle couplers

#### 1 Scope

This part of IEC 62196 is applicable to vehicle couplers with pins and contact-tubes of standardized configurations, with nominal rated operating voltage of 400 V a.c. three phase, 50 – 60 Hz, and a rated current not exceeding 32 A, for use in conductive charging of electric vehicles.

NOTE Use of these couplers for single phase charging shall not be excluded.

NOTE Rated current might be extended to 63 A 3ph or to 70A 1ph for case C charging.

NOTE Accessories to standard sheet 2-1 are dimensioned to accept a voltage rating up to 500 V.

This standard applies to a basic interface for vehicle supply as specified in IEC 62196-1, and intended for use in conductive charging systems for circuits specified in IEC 61851-1. An immobilizer system is supported by use of the plug present contact. The system features bidirectional energy transmission, controlled by information interchange.

NOTE Due to bidirectional energy transmission the vehicle coupler can be used on environment side for supply of the EV, too. In this case the vehicle socket shall be the fixed part of installation.

This standard applies to vehicle couplers to be used in an ambient temperature of between – 30 °C and +50 °C. In some countries, other requirements may apply.

Table 101 illustrates the modes and permissible connections specified in this standard.

**Table 101 – Modes and permissible connections specified in IEC 61851-1**

Mode	Amps	Phases	EV connector & inlet					Comments
			In line control box	Power pins used & protective earth	Control pins including pilot	62196	Case	
1	16	1		1+N+E, or 2+E	None	B	B	See Note 1
		3		3+N+E	None	B	B	
2	32	1	yes	1+N+E, or 2+E	2	B	B	Uses in-line control box
		3	yes	3+N+E	2	B	B	Uses in-line control box
3	32	1		1+N+E, or 2+E	2	B	B	
							C	
		3		3+N+E	2	B	B	
							C	

NOTE 1 Restrictions regarding load less than 16 A should be recognized by the vehicle maker.

NOTE 2 In the column headed "62196", the items listed are defined as: B Basic

NOTE 3 Either "L1 with N" or "L1 with L2" are used for single-phase to match the supply.

NOTE 4 Earth-contact is mandatory in all accessories, pilot contact is mandatory in accessories in modes 2 and 3.

NOTE 5 Case C charging might be extended to single phase 70A or to three phase 63 A.

## 2 Normative references

This clause of part 1 is applicable except as follows:

Addition:

IEC 60617-2:1996, Graphical symbols for diagrams – Part 2: Symbol elements, qualifying symbols and other symbols having general application

## 3 Definitions

This clause of part 1 is applicable except as follows:

Replacement:

### 3.31

#### **vehicle coupler (EV coupler)**

a means enabling the connection at will of a flexible cable to an electric vehicle. It consists of two parts: a vehicle plug and a vehicle socket.

#### 3.31.1

##### **vehicle plug (EV plug)**

the part of the vehicle coupler integral with, or intended to be attached to, one flexible cable connected to the supply.

#### 3.31.2

##### **vehicle socket (EV socket)**

the part of the vehicle coupler incorporated in, or fixed to, the electric vehicle.

**Editorial note:** Where part 1 is defined as applicable the definition “vehicle connector (EV connector)” must be replaced by “vehicle plug (EV plug)”; “vehicle inlet (EV inlet)” must be replaced by “vehicle socket (EV socket)” accordingly.

## 4 General

This clause of part 1 is applicable.

## 5 Ratings

This clause of part 1 is applicable except as follows:

### 5.1 Replacement:

Rated operating voltages:

0 to 30 V (signal or control purposes only);

230 V a.c.

400 V a.c.

NOTE Accessories to standard sheet 2-I are dimensioned to accept a voltage rating up to 500 V.

**5.2 Replacement:**

Rated current: 32 A

NOTE Rated current might be extended for case C charging.

**5.4 Deleted.****6 Connection between the power supply and the electric vehicle**

This clause of part 1 is applicable except as follows:

**6.1 Replacement:**

This section provides a description of the physical conductive electrical interface requirements between the vehicle and the power supply, which allows the following design at the vehicle interface:

a basic interface for mode 1, 2 and 3 charging only, which provides for 32 A a.c.

NOTE Rated current might be extended for case C charging.

**6.2 Replacement:**

There shall be the following type of vehicle socket, identified by the marking specified in 8.2:

basic (B)

**6.3 Replacement:**

There shall be the following type of vehicle plugs, identified by the marking specified in Clause 8.2:

basic (B)

NOTE the letter B has been chosen to correlate with the term “basic”, as used in IEC 61851-1.

**6.4 Not applicable.**

**Table 102 – Overview of the basic vehicle interface**

Position n°	a.c.	Functions
1	400 V 32 A <sup>ab</sup>	L1 (mains 1)
2	400 V 32 A <sup>ab</sup>	L2 (mains 2)
3	400 V 32 A <sup>ab</sup>	L3 (mains 3)
4	400 V 32 A	N (neutral)
5	Rated for fault	PE (ground/earth)
6	30 V 2 A	CP (Control pilot)
7	30 V 2 A	PP (Plug Present)
<p>a In the following countries, the branch circuit overcurrent protection is based upon 125 % of the device rating: USA.</p> <p>b Rated current might be extended for case C charging.</p>		

## 6.5 Replacement:

The basic interface shall contain up to 7 power or signal contacts, with unique physical configurations of contact positions for three phase. The electrical ratings and their function are described in Table 102.

The basic vehicle socket shall be intermateable with the three-phase vehicle plug. The basic vehicle plug shall not mate with a universal a.c. or d.c. vehicle inlet.

This vehicle coupler is rated 400 V 32 A three-phase.

NOTE Rated current might be extended to 63 A 3ph or to 70A 1ph for case C charging.

NOTE Accessories to standard sheet 2-I are dimensioned to accept a voltage rating up to 500 V.

Replacement:

## 6.6 Contact sequencing

The contact sequence during the connection process shall be such that the earth connection and the plug present connection are made first. The pilot connection is made last. The order of connection of the other contacts is not specified. During disconnection, the pilot connection shall be broken first and the earth connection shall be broken last. The neutral contact N shall make before or simultaneously with contacts  $L_1$ ,  $L_2$  and  $L_3$  and break after or simultaneously with contacts  $L_1$ ,  $L_2$  and  $L_3$ . See 10.2.

## 7 Classification

This clause of part 1 is applicable except as follows:

7.1 Accessories are classified:

7.1.1 according to purpose: plug, socket, vehicle plug and vehicle socket;

7.1.2 according to the method of connecting the conductors:

- rewirable accessories;
- non-rewireable accessories

NOTE The vehicle plug shall be non-rewirable.

7.1.3 This subclause of part 1 is applicable-

7.1.4 according to electrical operation:

- not suitable for making and breaking an electrical circuit under load;

NOTE The system is interlocked. So making and breaking under load is impossible.

7.1.5 according to the function as specified in Clause 6:

- basic (B);

## 8 Marking

This clause of part 1 is applicable except as follows:

- 8.1** Delete the first item of enumeration.
- 8.2** This subclause of part 1 is applicable.
- 8.3** Deleted.
- 8.4** Deleted.
- 8.5** This subclause of part 1 is applicable.
- 8.6** For rewirable accessories, the contacts shall be marked L1, L2, L3, N, ⊕, CP and PP as indicated in Table 102.

These markings shall be placed close to the relevant terminals; they shall not be placed on screws, removable washers or other removable parts.

Compliance is checked by inspection.

## **9 Dimensions**

This clause of part 1 is applicable except as follows:

### **9.1 Replacement:**

Vehicle couplers having rated operating voltages not exceeding 400 V and rated current 32 A shall comply with the Standard Sheet 2-1.

NOTE Use of these couplers for single phase charging shall not be excluded.

NOTE Rated current might be extended for case C charging.

Deviations from the dimensions specified in the standard sheets may be made, but only if they provide a technical advantage and do not adversely affect the purpose and safety of the vehicle couplers complying with the standard sheet, especially with regard to interchangeability and non-interchangeability.

## **10 Protection against electric shock**

This clause of part 1 is applicable.

## **11 Size and colour of earthing conductors**

Replacement:

The core connected to the earthing terminal shall be identified by the colour combination green/yellow. The nominal cross/sectional area of the earthing conductor and of the neutral conductor, if any, shall be at least equal to that of the phase conductors.

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

## **12 Provision for earthing**

This clause of part 1 is applicable.

## **13 Terminals**

This clause of part 1 is applicable except as follows:

Addition:

NOTE For terminals placed in the vehicle there might be additional requirements according to the environmental needs of vehicles.

## **14 Interlocks**

Replacement:

Accessories to this standard shall be provided with an interlock according to standard sheet 2-I (Continuation 3) to prevent the connection to be separated unintentionally or by unauthorized persons.

## **15 Resistance to ageing of rubber and thermoplastic material**

This clause of part 1 is applicable.

## **16 General construction**

This clause of part 1 is applicable except as follows:

**16.8 Not applicable.**

**16.9 Not applicable.**

## **17 VOID**

Replacement:

## **18 Construction of vehicle plugs**

**18.1** The enclosure of vehicle plugs shall completely enclose the terminals and the ends of the flexible cable.

Accessories shall be so designed that they can only be reassembled so as to ensure the correct relationship between the components as originally assembled.

*Compliance is checked by inspection and, if necessary, by manual tests.*

**18.2** The various parts of a vehicle plug shall be reliably fixed to one another in such a way that they will not work loose in normal use. It shall not be possible to dismantle vehicle plugs without the aid of a tool.

*Compliance is checked by manual test and by the test of 25.3.*

**18.3** Vehicle plugs shall incorporate means for ensuring the marked degree of protection when in complete engagement with the complementary accessory.

Where there is an attached cap, which cannot be removed without the aid of a tool, then the vehicle plug shall also meet this requirement when that cap is correctly fitted.

It shall not be possible to dismantle these means without the aid of a tool.

*Compliance is checked by inspection and by the tests of Clauses 20 and 21.*

**18.4** Not applicable.

Replacement:

## **19 Construction of vehicle sockets**

**19.1** Vehicle sockets shall incorporate means for ensuring the marked degree of protection when an appropriate vehicle plug is completely engaged.

The IP degree of protection of the vehicle socket must be considered, assuming that any accessible parts that may be live when a vehicle plug is connected are not live when the vehicle plug is removed and may be touched by the test finger.

Where there is an attached cap, which cannot be removed without the aid of a tool, then the vehicle socket shall also meet this requirement when that cap is correctly fitted.

It shall not be possible to dismantle these means without the aid of a tool.

*Compliance is checked by inspection and by the tests of Clauses 19 and 20. When no vehicle plug is present, the vehicle manufacturer must ensure the IP degree.*

Vehicle sockets having operating voltage exceeding 50 V shall be provided with earthing contacts.

*Compliance is checked by inspection.*

**19.2** IP 44 vehicle sockets, designed for only one mounting position, may have provision for opening a drain-hole at least 5 mm in diameter or 20 mm<sup>2</sup> in area with a width of at least 3 mm which is effective when the vehicle socket is in the mounting position.

## **20 Degrees of protection**

This clause of part 1 is applicable.

## **21 Insulation resistance and dielectric strength**

This clause of part 1 is applicable.

## **22 Breaking capacity**

Not applicable.

## **23 Normal operation**

This clause of part 1 is applicable except as follows:

Add a Note to Table 12:

NOTE Accessories for case C charging with 70A 1ph or 63A 3ph shall be tested as required for accessories for 32 A but with the nominal current.

## **24 Temperature rise**

This clause of part 1 is applicable except as follows:

Add a Note to Table 13:

NOTE Accessories for case C charging with 70A 1ph or 63A 3ph shall be tested as required for accessories for 32 A but with nominal current and a conductor size of 16 mm<sup>2</sup> for plugs and of 25 mm<sup>2</sup> for sockets.

## **25 Flexible cables and their connection**

This clause of part 1 is applicable.

## **26 Mechanical strength**

This clause of part 1 is applicable.

## **27 Screws, current-carrying parts and connections**

This clause of part 1 is applicable.

## **28 Creepage distances, clearances and distances**

This clause of part 1 is applicable.

## **29 Resistance to heat, fire and tracking**

This clause of part 1 is applicable.

## **30 Corrosion and resistance to rusting**

This clause of part 1 is applicable.

## **31 Conditional short-circuit current withstand test**

This clause of part 1 is applicable.

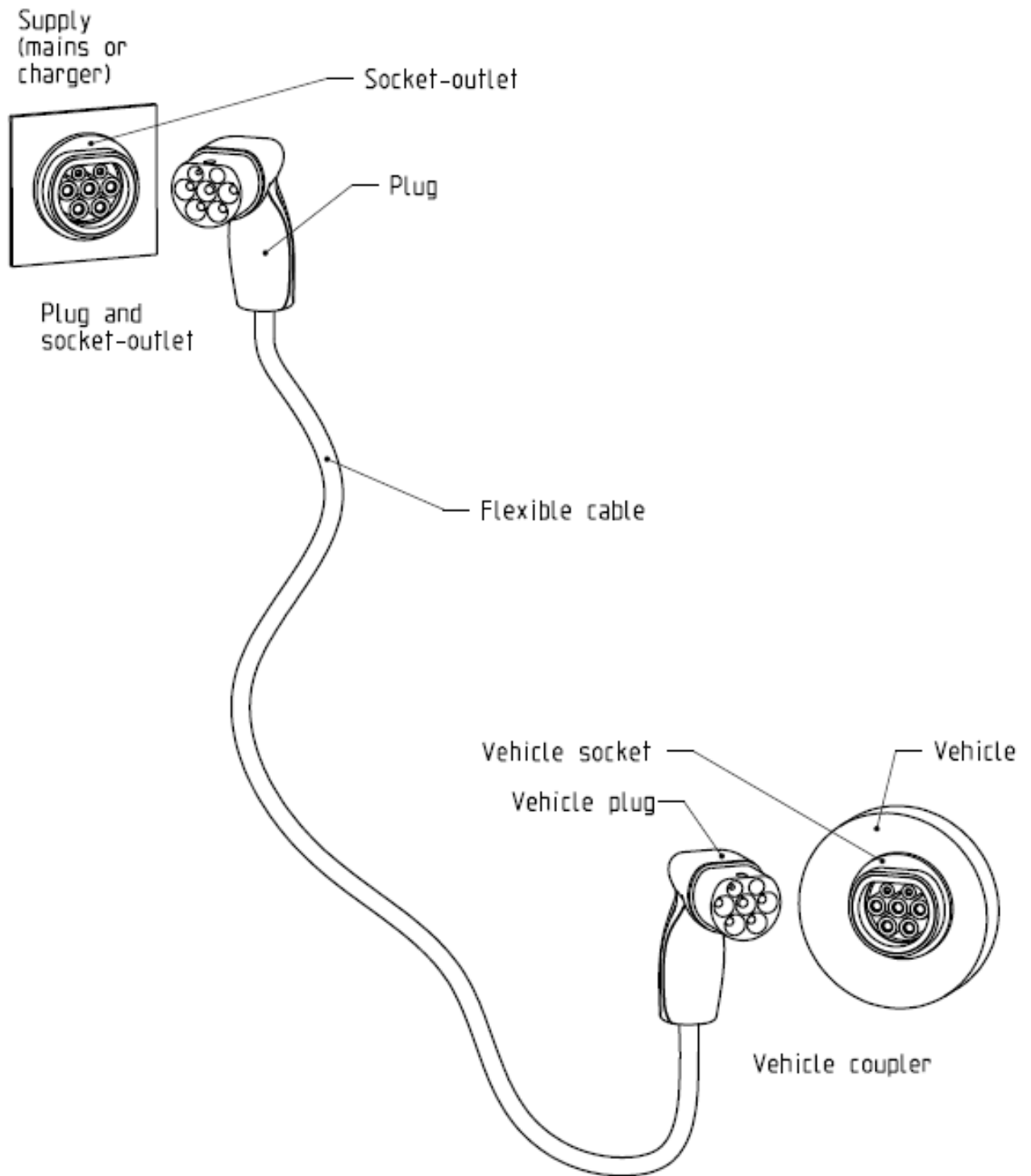
## **32 Electromagnetic compatibility**

This clause of part 1 is applicable.

## **33 Vehicle drive over**

This clause of part 1 is applicable except 33.3 and 33.4.

Replacement:

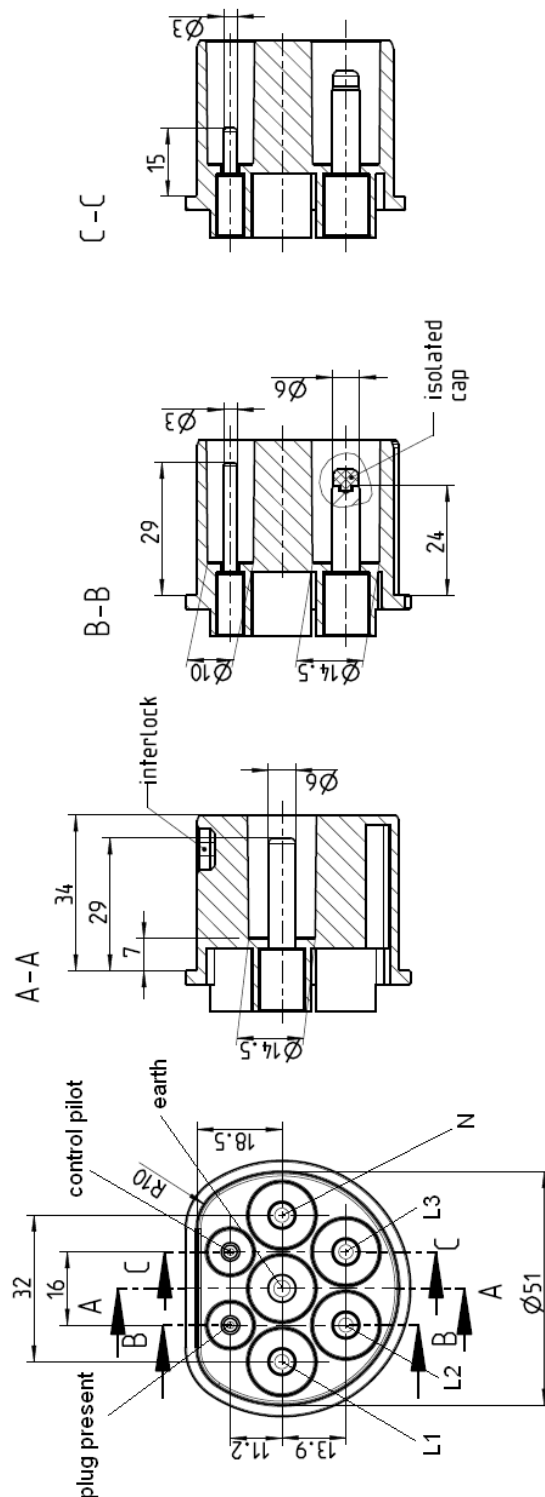


**Figure 1 – Diagram showing the use of the accessories**

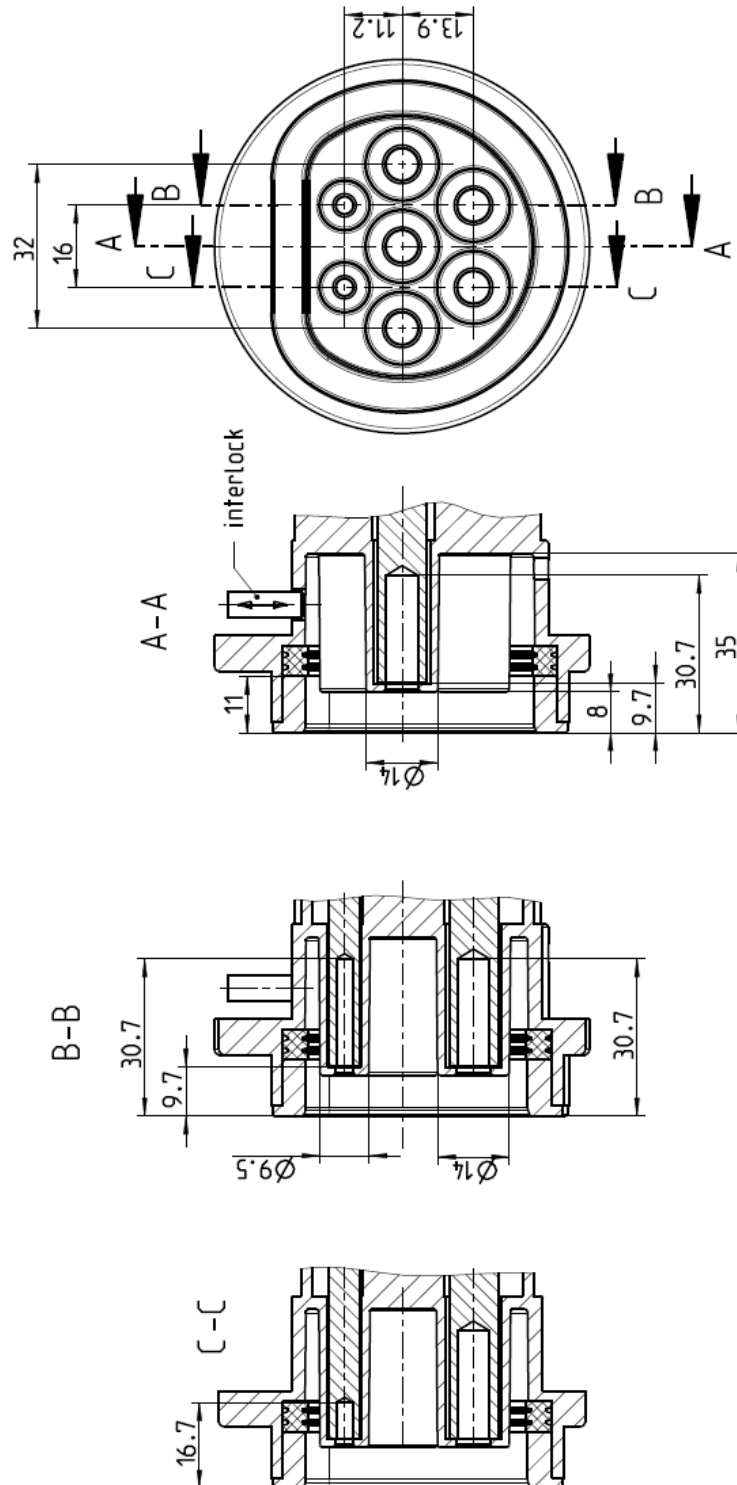
## STANDARD SHEET 2-I

### 32 A VEHICLE PLUG AND SOCKET HAVING RATED OPERATING VOLTAGES UP TO 400 V A.C.

#### Vehicle plug



NOTE Same dimensions will be applicable for proposed extension of rated current of the accessories to 63A 3ph and 70A 1ph.

**STANDARD SHEET 2-I***(Continuation 1)***Vehicle socket**

NOTE Same dimensions will be applicable for proposed extension of rated current of the accessories to 63A 3ph and 70A 1ph.

