

INTERNATIONAL STANDARD

IEC
62196-1

First edition
2003-04

Plugs, socket-outlets, vehicle couplers and vehicle inlets – Conductive charging of electric vehicles –

Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.

*Fiches, socles de prise de courant, prises mobiles
et socles de connecteur pour véhicule –
Charge conductive des véhicules électriques –*

*Partie 1:
Charge des véhicules électriques jusqu'à 250 A c.a.
et 400 A c.c.*



Reference number
IEC 62196-1:2003(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XB**

For price, see current catalogue

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

**Part 1: Charging of electric vehicles up to 250 A a.c.
and 400 A d.c.**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organisation for standardisation comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardisation in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and nongovernmental organisations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organisation for Standardisation (ISO) in accordance with conditions determined by agreement between the two organisations.
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International Standard IEC 62196-1 has been prepared by IEC subcommittee 23H: Industrial plugs and socket-outlets, of IEC technical committee 23: Electrical accessories.

The text of this standard is based on the following documents:

FDIS	Report on voting
23H/132/FDIS	23H/135/RVD

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

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

The committee has decided that the contents of this publication will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual edition of this standard may be issued at a later date.

INTRODUCTION

IEC 61851-1 specifies electric vehicle conductive charging equipment. This International Standard, referred to as the IEC 60309 series in IEC 61851-1, specifies the requirements for plugs, socket-outlets, connectors, inlets and cable assemblies as described in IEC 61851-1. Some charging can be achieved by direct connection from an electric vehicle to common mains socket outlets. Some modes of charging require a dedicated supply and charging equipment incorporating control and communication circuits. This standard covers the mechanical, electrical and performance requirements for dedicated plugs, socket outlets, vehicle connectors and vehicle inlets for interfacing between such dedicated charging equipment and the electric vehicle.

This International Standard may be published in several parts, as necessary, including this Part 1, comprising clauses of a general character, and subsequent parts, presenting particular requirements for individual types.

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

Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.

1 Scope

This part of IEC 62196 is applicable to plugs, socket-outlets, connectors, inlets and cable assemblies for electric vehicles, intended for use in conductive charging systems which incorporate control means, with a rated operating voltage not exceeding:

- 690 V a.c., 50 – 60 Hz, at a rated current not exceeding 250 A;
- 600 V d.c., at a rated current not exceeding 400 A.

These accessories and cable assemblies are intended to be used for circuits specified in IEC 61851-1 which operate at different voltages and frequencies and which may include ELV and communication signals.

These accessories and cable assemblies are to be used in an ambient temperature of between $-30\text{ }^{\circ}\text{C}$ and $+50\text{ }^{\circ}\text{C}$. In some countries, other requirements may apply.

These accessories are intended to be connected only to cables with copper or copper-alloy conductors.

The accessories covered by this standard are for use in certain modes of charging EV's. These modes are defined in IEC 61851-1. These definitions and a description of the types of connection (cases A, B and C), also described in IEC 61851-1, are reproduced herein as Annex A.

Table 1 illustrates the types of accessories (B , U_{32} , U_A , U_D) permitted for each charging situation (mode and case) and identifies where it is mandatory to use the accessories covered by this standard. These are indicated by the entries in the columns headed "62196" in Table 1.

The table also describes situations in which either an accessory covered by this standard, or other standardized accessories, are permitted to be used. They are identified by an entry in the column headed "62196" and the word "Any" under the column headed "Type".

This standard does not apply to those standardised accessories used in charging systems where the use of such accessories constructed to the requirements of other standards is permitted (e.g. in mode 1 and mode 2). Such standardized accessories may be used for those situations (mode and case) identified in Table 1 by the word "Any" under the column headed "Type" and with no corresponding entry under the column headed "62196".

This standard can be used as a guide for accessories with a lesser number of contacts and lower ratings for use with light duty vehicles.

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

Mode	Amps	Phases	Plug & socket					EV connector & inlet					Comments			
			Power pins used & prot. earth	Control pins incl. pilot	Type	62196	Case	In line control box	Power pins used & prot. earth	Control pins incl. pilot	Type	62196		Case		
1	16	1	1+N, or 2	None	Any	[shaded]	A	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	A	See Note 1		
					Any		B						B or U ₃₂		B	
		3	3 + N	None	Any	[shaded]	A	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]		A	
					Any		B								B or U ₃₂	B
2	32	1	1+N, or 2	None	Any	[shaded]	B	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	B or U ₃₂	B	Uses in-line control box	
					Any		B						B or U ₃₂	B		
		3	3 + N	None	Any	[shaded]	B	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	B or U ₃₂	B	Uses in-line control box
					Any		B							B or U ₃₂	B	
3	32	1	1+N, or 2	4	[shaded]	[shaded]	A	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	B or U ₃₂	A		
							B						B			
							C						C			
		3	3 + N	4	[shaded]	[shaded]	[shaded]	A	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	B or U ₃₂		A
								B						B		
								C						C		
	250	1	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	U _A	C	
														C	C	
250	3	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	U _A	C	
														C	C	
400	-	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	[shaded]	U _D	C	
														C	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
 U₃₂ Universal interface rated for 32 A a.c. only
 U_A Universal interface rated for 32/250 A a.c. only
 U_D Universal interface prepared for 32/400 A d.c. only

NOTE 3 In the column headed "Type", the word "Any" indicates that any IEC standard plug/socket-outlet interface can be used.

NOTE 4 Either "L₁ with N" or "L₁ with L₂" are used for single-phase to match the supply.

NOTE 5 Earth-contact is mandatory in all accessories, pilot contact is mandatory in accessories in modes 2, 3, and 4. The other contacts are provided as required by the user.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60227 (all parts): *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60228:1978, *Conductors of insulated cables*

IEC 60245-4:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60269-1:1998, *Low-voltage fuses – Part 1: General requirements*

IEC 60269-2:1986, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorised persons (fuses mainly for industrial application)*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests¹*

IEC 60664-3:1992, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coatings to achieve insulation coordination of printed board assemblies*

IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 60999-2:1999, *Connecting devices – Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors – Part 2: Particular requirements for conductors from 35 mm² up to 300 mm²*

IEC 61851-1:2001, *Electric vehicle conductive charging system – Part 1: General requirements*

¹ There exists a consolidated edition 1.2 (2002) including edition 1.0 and its Amendments 1 (2000) and 2 (2002).

3 Definitions

For the purpose of this document, the following terms and definitions apply. Additional definitions may be found in IEC 61851-1.

Where the terms voltage and current are used, they imply r.m.s. values, unless otherwise specified.

Throughout this standard, the word “earthing” is used for “protective earthing”.

NOTE 1 The terms “basic interface” and “universal interface” refer to terms described in IEC 61851-1.

The application of accessories is shown in Figure 1.

NOTE 2 The term “accessory” is used as a generic term covering plugs, socket-outlets, vehicle connectors, vehicle inlets and cable assemblies.

3.1

basic insulation

insulation necessary for the proper functioning of the accessory and for basic protection against electric shock

3.2

cable assembly

piece of equipment which is used to establish the connection between the electric vehicle and the electric vehicle supply equipment. It may be either fixed to and included in one of these devices, or detachable. It includes the flexible cable, the vehicle connector and/or plug that are required for proper connection

NOTE A cable assembly may include one or more cables, with or without a fixed jacket, which may be in a flexible tube, conduit or wire way.

3.3

cable management system

device which is intended to protect a cable assembly from mechanical damage and/or to facilitate its handling

NOTE A cable suspension device is an example of a cable management system.

3.4

cap

part separated or attached, which may be used to provide the degree of protection of a plug or vehicle inlet, when it is not engaged with a socket-outlet or connector

3.5

clamping unit

part of a terminal necessary for the clamping and the electrical connection of the conductor

3.6

conditional short-circuit current

prospective current that an accessory, protected by a specified short-circuit protective device, can withstand satisfactorily for the total operating time of that device under specified conditions of use and behaviour

NOTE This definition differs from IEC 441-17-20 by broadening the concept of current-limiting device into a short-circuit protective device, the function of which is not only to limit the current.

3.7

connection

a single conductive path

3.8

cover

means providing the degree of protection of an accessory when it is not engaged with a socket-outlet or vehicle connector. It can be used as the retaining means or a part of the retaining means

NOTE Caps, lids, shutters and similar devices can perform the function of a cover.

3.9

domestic

intended for household and similar purposes, up to a maximum current rating of 30 – 32 A a.c.

3.10

double insulation

insulation comprising both basic insulation and supplementary insulation.

3.11

electric vehicle (EV)

any vehicle propelled by an electric motor drawing current from a rechargeable storage battery or from other portable energy storage devices (rechargeable using energy from a source off the vehicle such as residential or public electric service), which is manufactured primarily for use on public streets, roads or highways

3.12

in-cable control box

device which is incorporated in the cable assembly and which performs control functions. It is located within the plug or within 0,3 m of the plug or the electric vehicle supply equipment

3.13

insulation voltage

the voltage assigned to the accessory by the manufacturer and to which dielectric tests, clearances and creepage distances are referred

3.14

integral switching device

mechanical switching device constructed as a part of an accessory covered by this standard

3.15

interlock

device, either electrical or mechanical, which prevents the contacts of a socket-outlet from becoming live before it is in proper engagement with a plug, and which either prevents the plug from being withdrawn while its contacts are live or makes the contacts dead before separation

3.16

intermateability

the ability of like accessories to join together with the mating accessories they are intended to be used with

3.17

lid

a means to ensure the degree of protection on a socket-outlet or a vehicle connector

3.18**mechanical switching device**

switching device designed to close and open one or more electric circuits by means of separable contacts

3.19**non-rewireable accessory**

accessory so constructed that the cable or wiring cannot be separated from the accessory without making it permanently useless

NOTE A plug which is integrally moulded to the cable is an example of a non-rewireable accessory.

3.20**plug and socket-outlet**

a means enabling the connection at will of a flexible cable to fixed wiring. It consists of two parts: a socket-outlet and a plug

3.20.1**plug**

the part of a plug and a socket-outlet integral with or intended to be attached to one flexible cable connected to the electric vehicle or to a vehicle connector. It may include mechanical, electrical or electronic components and circuitry, which perform control functions

3.20.2**socket-outlet**

the part of a plug and a socket-outlet intended to be installed with the fixed wiring or incorporated in equipment

3.21**rated current(s)**

current assigned to each pole of the accessory by the manufacturer

3.22**rated operating voltage**

nominal voltage of the supply(ies) for which the pole of the accessory is intended to be used

3.23**reinforced insulation**

an improved basic insulation with such mechanical and electrical qualities that it provides the same degree of protection against electric shock as double insulation

3.24**retaining means**

a mechanical arrangement which holds a plug or vehicle connector in position when it is in proper engagement, and prevents its unintentional withdrawal

3.25**rewireable accessory**

accessory so constructed that the cable or wiring can be replaced. It can be either a user-serviceable accessory or a field-serviceable accessory

3.26**user-serviceable accessory**

accessory so constructed that it can be rewired, or parts can be replaced, using commonly available tools and without having to replace individual parts of the accessory

NOTE An ordinary plug, which can be disassembled and wired using a common screwdriver, is an example of user-serviceable accessory.

3.27

field-serviceable accessory

accessory so constructed that it shall only be rewired by the manufacturer's authorised personnel

3.28

switched socket-outlet

socket-outlet with an associated switching device to disconnect the supply from the socket-outlet contacts

3.29

supplementary insulation (protective insulation)

independent insulation provided in addition to the basic insulation, in order to ensure protection against electric shock in the event of a failure of the basic insulation

3.30

terminal

conductive part provided for the connection of a conductor to an accessory

3.30.1

pillar terminal

terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw or screws. The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw

NOTE See Figure 13a.

3.30.2

screw terminal

a terminal in which the conductor is clamped under the head of the screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device

NOTE See Figures 13b and 13c.

3.30.3

stud terminal

a terminal in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device

NOTE See Figure 13d.

3.30.4

saddle terminal

a terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts

NOTE See Figure 13e.

3.30.5

lug terminal

a screw terminal or stud terminal designed for clamping a cable lug or bar by means of a screw or nut

NOTE See Figure 13f.