
AC connection devices for electric vehicle conductive charging

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English version

**AC connection devices for electric vehicle
conductive charging**Connecteurs pour la charge des véhicules
électriques en courant alternatifNetzsteckverbindungen für
das konduktive Laden von
Elektrofahrzeugen**iTeh STANDARD PREVIEW
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This CENELEC Report has been prepared by the Technical Committee CENELEC TC 69X, Electrical systems for electric road vehicles. It was approved by TC 69X on 2001-09-25 and endorsed by the CENELEC Technical Board on 2001-12-04.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELECEuropean Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

Foreword

Considering the lack of widespread connection devices meeting the requirements of EV charging system in Europe, the CENELEC Technical Board asked Technical Committee TC 69X to prepare a technical report based on the functional requirements of EN 61851-1.

The text of the draft was approved by TC 69X on 2001-09-25 and endorsed by the CENELEC Technical Board on 2001-12-04.

CLC TC69X/WG3 is proposing, at this stage two different sets of requirements (characteristics and compatibility requirements) for connection devices suitable for EV charging, corresponding to two different approaches:

Approach 1: Electric vehicles should benefit from existing infrastructure. Compatibility requirements allow them to be charged on widely used standardized socket-outlets and to optimize the power transfer from the supply network.

Approach 2: Electric vehicles may only be charged on dedicated socket-outlets. The infrastructure (connection devices, connection to the distribution system, communication links,...) permits only mode 3 charging and prevents compatibility with existing socket outlets.

As a consequence, in this report two different types of specific connection devices are dealt with: type 1 connection devices and type 2 connection devices.

WG3 has compared technical solutions proposed by the industry and proposed draft standard sheets (in annexes).

The next step is to issue standard sheets in co-operation with IEC/SC23H/WG6. When this report was prepared, the document circulated in IEC was 23H/95/NP (future IEC 62196).

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1 Scope

This Technical report applies to connection devices specially designed for the purpose of delivering energy from the main supply to electric vehicles, jointly with additional control functions according to EN 61851-1.

The aspects covered include characteristics and compatibility requirements :

Connection devices addressed by this report have the following characteristics :

- rated voltage: 230/400 V,
- rated current: up to 32 A per phase,
- single or three phases,
- suitable for mode 1, 2 and 3 (according to EN 61851-1).

Connection devices (accessories) include socket-outlet, plug, connector and vehicle inlet.

2 References

EN 60309-1, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

EN 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact tube accessories*

EN 60320 (series), *Appliance couplers for household and similar purposes*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code)*

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

IEC 60083, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 62196-1¹⁾, *Plugs, socket-outlets, vehicle couplers and vehicle inlets - Conductive charging of electric vehicle – Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.*

3 Definitions

3.1 Definitions based on EN 61851-1

3.1.1

EV supply equipment (EVSE)

the conductors, including the phase, neutral and protective earth conductors, the EV couplers, attachment plugs, and all other accessories, devices, power outlets or apparatuses installed specifically for the purpose of delivering energy from the premise wiring to the EV and allowing communication between them if required

3.1.2

control pilot

the control conductor in the cable assembly connecting the in-cable control box or the fixed part of the EVSE, and the EV earth through the control circuitry on the vehicle. It may be used to perform several functions

1) In preparation.

3.1.3

Mode 1 charging

connection of the EV to the a.c. supply network (mains) utilizing standardized socket-outlets, rated up to 16 A, at the supply side, single-phase or three-phase, and utilizing phase(s), neutral and protective earth conductors

3.1.4

Mode 2 charging

connection of the EV to the a.c. supply network (mains) utilizing standardized socket-outlets, single-phase or three-phase, and utilizing phase(s), neutral, and protective earth conductors together with a control pilot conductor between the EV and the plug or in-cable control box

3.1.5

Mode 3 charging

direct connection of the EV to the a.c. supply network (mains) utilizing dedicated EVSE where the control pilot conductor extends to equipment permanently connected to the a.c. supply network (mains) are used.

3.1.6

Mode 4 charging

indirect connection of the EV to the a.c. supply network (mains) utilizing an off-board charger where the control pilot conductor extends to equipment permanently connected to the a.c. supply

3.1.7

basic system of connection devices

system having a basic interface which provides for domestic a.c. only for modes 1, 2 and 3 charging

3.1.2

universal system of connection devices

system having a universal interface which provides for either high power a.c. and domestic a.c. or high power d.c. and domestic a.c. for all modes of charging

3.2 Other definitions

For the purpose of this report, the following concepts are defined:

3.2.1

type 1

system in which an accessory can be inserted into the corresponding EN 60309-2 accessory with the power contacts and earth engaging but without the auxiliary contacts necessarily present or engaging

3.2.2

type 2

system in which an accessory cannot be inserted into an accessory of any other system of IEC 60083 or EN 60309-2 or EN 60320

3.2.3

compatible systems

systems in which the connection devices fit together without necessarily providing all electrical functions

3.2.4

interpluggable systems

compatible systems of connection devices in which the plug (resp. connector) can be fully inserted in the socket-outlet (resp. inlet) and only the mains power contacts correctly connect. Rated currents of the two connection devices may be different. In this case the lowest rated value applies

3.2.5

interchangeable systems

compatible systems of connection devices with the same rated currents and in which all contacts (mains power and control contacts) correctly connect

4 General

Connection devices include plugs, socket-outlets, connectors and vehicle inlets.

Depending on the country and the kind of installation, available power can be from as low as 10 A single-phase (230 V) up to 32 A three-phase (230/400 V).

The control pilot contact shall be provided according to EN 61851-1. The contact sequence during the connection process shall be such that the pilot connection is made last. The order of the connection of the other contacts is as specified in EN 60309. During disconnection, the pilot connection shall be broken first.

5 Electrical interface requirements

This clause provides a description of the electrical interface requirements for the connection of an EV based on the basic connector design (EN 61851-1). These requirements apply to all connection devices.

The basic interface contains up to three control contacts, an earth contact, and up to four power contacts. They are rated as indicated in Table 1 and Table 2.

Table 1 - Requirements for the single-phase interface

Position No. ^a	Rating	Function
1	230V/32A	L1
4	230V/32A	N
5	Rated for faults	PE
6	30V/2A	Control pilot
7	30V/2A	Power indicator1
8	30V/2A	Power indicator2

^a The contact numbers are chosen to be in line with EN 61851-1

Table 2 - Requirements for the three-phase interface

Position	Rating	Function
1	400V/32A	L1
2	400V/32A	L2
3	400V/32A	L3
4	400V/32A	N
5	Rated for faults	PE
6	30V/2A	Control pilot
7	30V/2A	Power indicator1
8	30V/2A	Power indicator2

6 Connection devices type 1

6.1 General

In order to open a wide market to the manufacturers and to take advantage of existing infrastructure, the specified design is based on EN 60309-2.

Specific additional requirements apply, to meet the needs of EV's :

- The connection device system should allow the use of mode 1, 2 or 3.
- According to EN 61851-1 modern mobile applications, such as electric vehicles, may be able to adjust their power consumption, in the range of 10 A to 32 A, to the local source rating. Without any information about the rated power of the source transmitted through the control contacts, the on-board charger defaults to mode 1, operating current of not more than 16 A, whatever its rated power would be.

The specific additional requirements are :

- Plug and inlet are interpluggable with the corresponding 16/20 A industrial socket-outlet and connector EN 60309-2.
- Power contacts are rated 32 A.
- Up to 3 additional contacts for signal (one mandatory for the control pilot and two optional for the power indicator).
- Accessories may be fitted with a device to detect a fully inserted mating accessory.

NOTE The detection of the mating accessory is required at the vehicle side and may be ensured by combination of the accessory and the vehicle design.

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6.2 Design

Type 1 connection devices shall comply with the appropriate standard sheets. A drawing of the concept is given in Annex 1.

Plugs shall be interpluggable with the widely used EN 60309-2, Standard Sheet 2-I, 16/20A–6h socket-outlets or connectors.

Type 1 connection devices shall have the minimum degree of protection of IP 44 according to EN 60529. The IP degree is evaluated as specified in EN 60309-1.

For systems to be used in places where the public has access, means may be provided to lock the connector into the vehicle inlet or the plug into the socket-outlet.

6.3 Specific requirements for vehicle inlets

The inlet is mounted inside the body of the vehicle.

As a consequence,

- a suitable means is recommended to guide the connector lid during insertion,
- a convenient means shall be provided to release the retaining devices.

The vehicle inlet, in road position, shall have the minimum degree of protection of IP 55 which may be obtained by the combination of the inlet construction and the vehicle design.