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Kontaktni vmesnik za avtomatizirane priključne naprave

Contact Interface for Automated Connection Device

Kontaktschnittstelle für ein automatisches Kontaktierungssystem

Interface de contact pour les dispositifs de connexion automatisés

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European foreword

This document (EN 50696:2021) has been prepared by CLC/TC 23H, WG 5, “Contact interface for automated connection devices (ACD)”.

The following dates are fixed:

• latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2022-01-11
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Introduction

The electrical interface for charging electrically propelled vehicles with plugs, socket-outlets, vehicle connectors and vehicle inlets is described in EN 62196 series and EN 61851-23. For heavier vehicles such as buses and trucks, requirements of short charging times with high energy present a problem of handling, and safety with hand-held connecting devices. For these high current charging applications, an automated connection device (ACD) is of interest.

An automated coupler consists out of a mobile assembly with electrical contacts, called ACD and fixed electrical contacts, called ACD counterpart. Automated couplers allow an unmanned connection of high-current contacts and signal/control contacts.

This document contains requirements for all type of ACDs. Its annexes describe specific implementations and specific requirements. This document is expected to be read in conjunction with IEC 61851-23-1:—[1].

[1] Under preparation. Stage at time of publication: IEC CDV 61851-23-1:2020.

1 Scope

This document is applicable to ACDs of standardized configuration, intended for use in electric vehicle conductive charging systems which incorporate control means, with rated operating voltage up to 1 500 V DC.

This document applies to high power DC interfaces intended for use in isolated conductive charging systems, for circuits specified in IEC 61851-23-1:—[1].

The ACDs covered by this document are used only in charging mode 4, according to IEC 61851-23-1:—[1], 3.1.201 Case D or 3.1.202 Case E.

This document describes the requirements for an ACD in regard of safety, function and testing. This document describes basic parameters that can be standardized for different ACDs. ACDs following these standardized parameters will have the benefit of being compatible, even if they are based on different technologies.

This document does not apply to solutions based on a vehicle connector described in EN 62196-3 driven by an automated mechanism, as, for instance, a robotic arm.

This document does not cover all safety aspects related to maintenance.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

EN 1652, *Copper and copper alloys - Plate, sheet, strip and circles for general purposes*

EN 12163, *Copper and copper alloys - Rod for general purposes*

EN 12167, *Copper and copper alloys - Profiles and bars for general purposes*

EN 16005, *Power operated pedestrian doorsets – Safety in use – Requirements and test methods*

EN 50124-1, *Railway applications - Insulation coordination - Part 1: Basic requirements - Clearances and creepage distances for all electrical and electronic equipment*

EN 60068-2-11, *Environmental testing - Part 2: Tests - Test Ka: Salt mist (IEC 60068-2-11)*

EN 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements (IEC 60309-1:1999)*

EN 60512-2-2, *Connectors for electronic equipment - Tests and measurements – Part 2-2: Electrical continuity and contact resistance tests - Test 2b: Contact resistance – Specified test current method*

EN 60512-5-1, *Connectors for electronic equipment - Tests and measurements - Part 5-1: Current-carrying capacity tests - Test 5a: Temperature rise (IEC 60512-5-1)*

EN 60512-5-2, *Connectors for electronic equipment - Tests and measurements - Part 5-2: Current-carrying capacity tests - Test 5b: Current-temperature derating (IEC 60512-5-2)*

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

EN 60664-1, *Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests (IEC 60664-1)*

EN 61140, *Protection against electric shock - Common aspects for installation and equipment (IEC 61140)*

EN IEC 61851-1:2019, *Electric vehicle conductive charging system - Part 1: General requirements (IEC 61851-1:2017)*

EN 61984:2009, *Connectors - Safety requirements and tests (IEC 61984:2008)*

IEC 61851-23-1:—,[2] *Electric vehicle conductive charging system – Part 23-1: DC charging with an automated connection system*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61851-23-1:—[1] and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
working position
position reached when the ACD and the fixed ACD counterpart have mated and when the physical contact is established, and energy transfer is allowed

3.2
home position
position where the ACD is not engaged with its counterpart and where safe clearance is present with street and infrastructure

3.3
keep-out zone
space above and around automated coupler

4 Electrical requirements

4.1 Voltage and current requirements

4.1.1 Number of contacts

For systems described in IEC 61851-23-1:—[1], Annexes AA, BB and CC:

Four contacts: DC+, DC-, PE and CP (IEC 61851-23-1:—[1], Figure AA.1, IEC 61851-23-1:—[1], Figure BB.1 and IEC 61851-23-1:—[1], Figure CC.14)

For systems described in IEC 61851-23-1:—[1], Annex KK:

three contacts: DC+, DC-, PE (IEC 61851-23-1:—[1], Figure KK.14)

[2] Under preparation. Stage at time of publication: IEC CDV 61851-23-1:2020.

4.1.2 Quality of DC charging voltage

Since the ACD is part of the power transmitting system, its influence on the quality of DC charging voltage shall be considered, to not exceed the levels indicated in IEC 61851-23-1:—[1].

4.1.3 Rated continuous current

The maximum current may exceed the limits defined in EN 62196-1. The rated current can be a continuous current or the average of an intermittent current.

The rated current is defined by the vehicle and the application. The manufacturer of the ACD shall guarantee that his system is sized and safe for this current by confirming the physical values described in this document.

In the case of an automated coupler consisting of an ACD and an ACD counterpart from different or unknown manufacturers, the minimum current requirements that fulfil the requirements for a particular annex of this document shall be assumed unless there are sensing devices that can reliably determine if the ACD is operating within the defined limits of this document. However, if the ACD and the ACD counterpart can be definitively determined to be of a particular type and manufacturer, higher currents with or without sensing devices can be used, according to manufacturer's specifications.

4.1.4 Short-circuit current

In case of short circuit, the ACD shall not cause dangerous situation such as an explosion or a fire. After such a short circuit, the ACD shall be checked for proper function prior further service.

As in ISO 17409:2020 leaf the short-circuit value for systems with an automated coupler open, an automatic coupler shall be designed that way that it withstands a short-circuit current of 12 000 000 A^2s to be on a safe side.

NOTE 12 000 000 A^2s can be reached with 34 600 A in 10 ms or 11 000 A in 100 ms or 3 460 A in 1 s.

The ACD shall be designed in such a way that a peak current of 30 kA, considered in ISO 17409:2020, 7.2.4.2 shall not lead to damages or dangerous situations in regard of the Lorentz force etc.

4.1.5 Maximum temperature of contacts

The contacts of the automated coupler have a temperature rise depending on the charging current (rated continuous current or intermitted current). This temperature rise shall not have any damaging influence on materials or devices in the surrounding of the automated coupler. These materials or devices require a maximum temperature of 90 °C according to ISO 17409.

Compliance is checked by test in Clause 8, Table 4.

4.2 Signals

The minimum signals required are the status (the position) of the ACD. All other signalling necessary for pairing or charging are described in IEC 61851-23-1:—[1] or in ISO 15118.

ACD is in home position

ACD has reached working position (see annexes for specific implementation).

The home position signal is safety relevant.

There shall be a timeout if ACD is moved but the working position has not been reached in a specific time frame. This information shall be verified by overall system electric vehicle (EV) EVSE, not by the ACD.

5 Safety requirements

5.1 EN 61140

In case of blocking contaminants, the ACD might not reach the home position. There shall be an installed system that monitors the ACD to reach the home position. This shall be realized by the ACD itself and communicated to the overall system (EV or EVSE).

NOTE For reaction of this missing home position signal, refer to IEC 61851-23-1:—[1], CC.5.201, KK.5.201 or ISO 17409.

5.2 Contact sequence

According to IEC 61851-23-1:—[1], the connection and disconnection of the ACD shall be done without current. It is not necessary to have a contact sequence because no dangerous voltage is present.

NOTE Under emergency situation without a first disconnecting CP or PE, arcing cannot be avoided. It is proposed to have a first disconnecting CP/PE or a guaranteed arc resistive system, so that no danger situation due to that arc can occur (f. e. fire). Scope is safety and not abrasion.

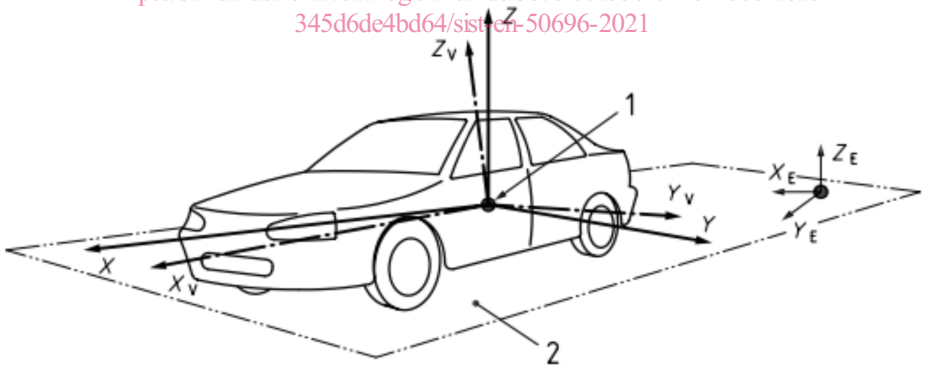
5.3 Return to home position

In case of an intentional or unintentional loss of supply power for the actuator of the ACD, the ACD shall return to its home position. For details refer to IEC 61851-23-1:—[1], Clause 201.3 “Loss of power”

Compliance is checked by test in Clause 8, Table 1 *Test Number B3.*

6 Mechanical requirements

6.1 Grid of parallels and meridians



Key

No	Part
1	Reference point – axle A as explained in 6.2
2	Ground level

Figure 1 — Grid of parallels and meridians according ISO 8855

6.2 Specific mechanical requirements for busses

Distinction shall be made with regards to the several vehicle dimensions, for instance double/single deck busses, resulting in several distances between the ACD and the ACD counterpart.

For the position of ACD or the ACD counterpart on the vehicle the reference point is centred over axle A.

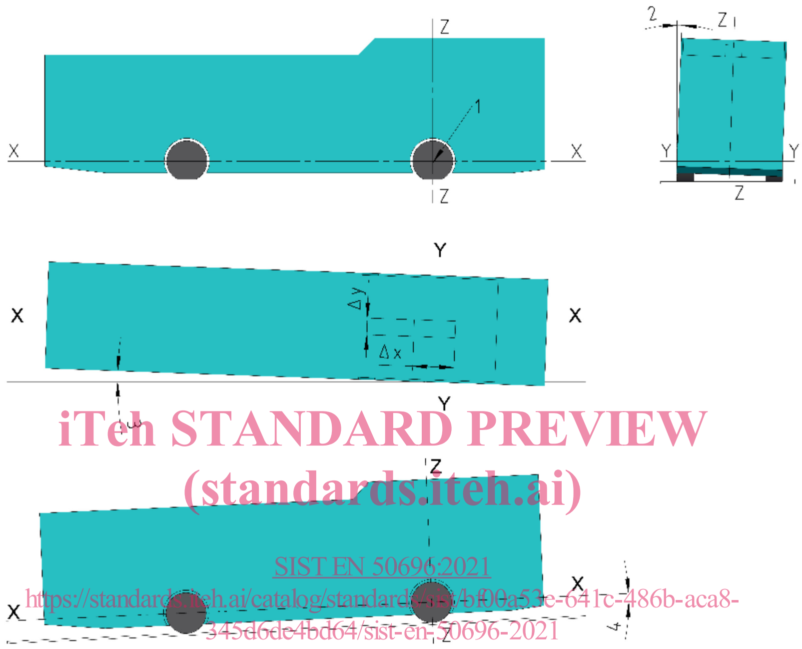
Axle A is defined as the first front axle in regard of the driving direction of the vehicle.

This is the reference point for the parking tolerances during charging: x-centre, y-centre, z-centre of axle A

6.3 Tolerances of parking position

6.3.1 General

Figure 2 shows the location of contact systems and positioning tolerances.



Key

No	Part
1	Axle A
2	ΦZ
3	ΦX
4	ΦSlope

Figure 2 — Location of a Contact System and Positioning Tolerances

6.3.2 Minimum normative requirement for parking

The minimal positioning tolerances that have to be compensated while positioning the vehicle for charging, are in X- and Y- directions and, for positioning angle, between vehicle and curb:

X at least ± 200 mm (Δx)

Y at least ± 200 mm (Δy), Y at least 0 to + 200 mm for Annex C

Angle between vehicle and curb (Φx) up to ± 2°

Being connected and the vehicle being immobilized, the ACD shall also deal with tolerances of the vehicle caused by dynamic movements due to kneeling, wind and passenger on and off, and has to avoid losing contact.

The minimum dynamic tolerance dY = 110 mm for a 3,1 m vehicle height and 2° kneeling (Φz)

The minimum dynamic tolerance dX = 70 mm for back to front kneeling

The minimum dynamic tolerance dZ = ± 70 mm due to air suspension.

The minimum dynamic tolerance dZ = + 0/ −87 mm for 2 500 mm vehicle width due to 2° kneeling (Φz).

If any of above required tolerances are exceeded in service by accidence, no dangerous or damaging situation shall occur. This can be done by physical limits, as for instance, curbs or sensors detecting the right position.

NOTE 1 Kneeling is considered only to one side.

NOTE 2 Considering his requirements, the operator can require increased tolerance values if necessary.

NOTE 3 Besides public bus transports and specifically for autonomous vehicle or autonomous vehicle parking, e.g. automated driven bus depots, smaller tolerances can be agreed between contracting parties.

The physical dimensions of the ACD shall be considered for the dimensions of the vehicle and national or city regulations for minimum clearance in street traffic. A total load inclusive the force of the contact pressure shall be considered for the fixing points.

7 Environmental requirements

7.1 Degree of pollution

ACD which are IPXXB when mated shall be designed for pollution degree 3 according to EN 60664-1.

ACD which are IP00 when mated shall be designed for pollution degree PD4 according to railway standard EN 50124-1.

For covered or cleaned contacts, the normative described reduction of the creepage and air gap distance can be used.

NOTE Special pollutions such as leaves, branches etc. can be present and require regular cleaning of the interface. The cleaning schedule of the automated coupler can be agreed between the operator and the manufacturer of the ACD as its operation is highly dependent on the rate of pollution.

7.2 Overvoltage category

The over voltage category for the ACD shall be equal or higher than required in IEC 61851-23-1:—[1] and in ISO 17409.

According to IEC 61851-23-1:—[1], Clause 12.7.101 Suppression of overvoltage (insulation coordination), the DC EV charging station shall reduce overvoltage between DC ± and protective conductor to 2 500 V.

NOTE This document applies to EN IEC 61851-1 in regard of altitudes up to 2 000 m.

7.3 Ambient or operation temperature

According to EN IEC 61851-1:2019, Clause 11.8.2, an ambient temperature of −25/+40 °C shall be considered.

NOTE In some countries, other requirements could apply, for example. −35 °C or +50 °C

Consideration shall be given that due to continuous intense sunshine, the surface of the bus could get hotter and this can have an impact to the ACD.

7.4 Noise

Noise in regard of the ACD can be emitted by moving the ACD from or to home position, in the connecting moment and also when vehicle is driving by wind effects. Existing national or local requirements shall be taken into consideration.

EXAMPLE The “TA Laerm” in Germany.

7.5 Wind

The defined parking and contact tolerances shall also apply under the influence of wind forces. Wind forces have an impact on the vehicle and on the station, in detail for example the support of the ACD. The manufacturer of the ACD shall provide a datasheet that identifies the forces on the mounting interface of the ACD and the contact forces in dependence of wind speed. In addition to that, also the worst-case displacement by wind within the working range of the ACD shall be in that datasheet.

The responsibility of safe operation under all wind circumstances shall lie at the system integrator.

8 Test specification and procedure

The following Tables 1 to 6 contain required tests for type testing and Routine Testing. The tables show testing standards and requirements for testing automated coupler. These tests are under respect to cover both cases, that automated coupler are from the same or from different manufacturers.

Critical system limits are characterized by current capacity testing, ensuring the system stays within it temperature limits and the system sustainability. Before doing the contact quality tests, Table 4 and following, during heat run test in Table 3 has to verify the system limits for temperature, contact resistance and contact voltage drop. These limits shall be used for the following tests.

An ACD shall be tested with a standardized fixed ACD counterpart that is defined in the appropriate annex. A fixed ACD counterpart shall be tested with a standardized ACD that is defined in the appropriate annex.

These tests are valid for all systems described in all annexes. If there are system specific tests or requirements they are described in the respective annex.

Table 1 — Dimensional inspections

Test N°	Test Name	Description / Measurements to be performed / Requirements	Type Test	Routine Test
A1	Visual Inspection	System complete to drawing and structure	X	X
A2	Weighing	Mass of assembled ACD shall be within tolerance limits of the specification	X	
A3	Functional Dimensions	General functional dimensions, described in the respective annexes, should be checked: - fixing point - contact arrangement and dimensions - keep-out zone Dimensions shall be within the tolerances specified in the annex	X	
A4	Limited dimensions in home position		X	X
A5	complete working and moving range maximum extension		X	X