TEST REPORT
IEC 61851-1: 2017
Electric vehicle conductive charging system – Part 1: General requirements

Report Number. .....:	64.105.21.30849.03
Date of issue .....:	2022-07-14
Total number of pages.....	28
Name of Testing Laboratory preparing the Report.....:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch 5F & 8F east, Communication Building, 163 Pingyun Rd, Huangpu West Ave. Guangzhou 510656 P.R. China
Applicant's name.....:	Autel New Energy Co.,Ltd.
Address .....:	Room 101, Building B2, Zhiyuan, No.1001 Xueyuan Avenue, Changyuan Community, Taoyuan Road, Nanshan District, Shenzhen, 518055, China
Test specification:	
Standard.....:	IEC 61851-1:2017
Test procedure .....:	CE-LVD + UKCA
Non-standard test method.....:	N/A
Test Report Form No.....:	IEC61851_1B
Test Report Form(s) Originator.....:	VDE Prüf- und Zertifizierungsinstitut GmbH
Master TRF.....:	Dated 2018-02-19

General disclaimer:

The test results presented in this report relate only to the object tested.
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Test item description ..... :	AC electric vehicle charging station
Trade Mark ..... :	Autel
Manufacturer ..... :	Autel New Energy Co.,Ltd. Room 101, Building B2, Zhiyuan, No.1001 Xueyuan Avenue, Changyuan Community, Taoyuan Road, Nanshan District, Shenzhen, 518055, China
Model/Type reference ..... :	Maxi C-SE AC series Maxi C-SE1 AC series (Maxi U W - XX - YY - L - ZZ I II III IV V VI I: "U" denotes for basic model designation, "U" can be: C-SE AC: C-SE AC series C-SE1 AC: C-SE1 AC series II: "W" denotes for power, "W" can be: W7: 7.4kW W11: 11kW W22: 22kW III: "XX" denotes for vehicle connection method, "XX" can be: BC3: vehicle connector with 3m cable at the condition of without connector holder BC5: vehicle connector with 5m cable at the condition of without connector holder BC7: vehicle connector with 7.5m cable at the condition of without connector holder C3: vehicle connector with 3m cable C5: vehicle connector with 5m cable C7: vehicle connector with 7.5m cable S: socket-outlet H: shutter-outlet IV: "YY" denotes for wireless function, "YY" can be: 4G: 4G function embedded Blank: Standard type V: "L" denotes for LCD panel function, "L" can be: L: LCD function embedded Blank: Standard type VI: "ZZ" denotes for colour, "ZZ" can be: DG: dark grey WH: white RG: rose gold SV: silver B: black)
Ratings ..... :	Voltage: For Maxi U W22-XX-YY-L-ZZ series: 3P+N+PE, 400Vac±15%, 50Hz; For Maxi U W11-XX-YY-L-ZZ series: 3P+N+PE, 400Vac±15%, 50Hz; For Maxi U W7-XX-YY-L-ZZ series: 1P+N+PE, 230Vac±10%, 50Hz. Current: For Maxi U W22-XX-YY-L-ZZ series: 32A; For Maxi U W11-XX-YY-L-ZZ series: 16A; For Maxi U W7-XX-YY-L-ZZ series: 32A. Power: For Maxi U W22-XX-YY-L-ZZ series: 22kW; For Maxi U W11-XX-YY-L-ZZ series: 11kW; For Maxi U W7-XX-YY-L-ZZ series: 7.4kW.

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Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):			
☒	**Testing Laboratory:**	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch	
Testing location/ address.....:		5F & 8F East, Communication Building, No.163 Pingyun Road, Huangpu Ave. West, Guangzhou 510656, China TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, China	
Tested by (name, function, signature).....:		Nino Chen (Project Handler)	Nino Che
Approved by (name, function, signature)...:		Song Lei (Designated Reviewer)	Soy
☐	**Testing procedure: CTF Stage 1:**		
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 2:**		
Testing location/ address.....:			
Tested by (name + signature) .....:			
Witnessed by (name, function, signature) .:			
Approved by (name, function, signature)...:			
☐	**Testing procedure: CTF Stage 3:**		
☐	**Testing procedure: CTF Stage 4:**		
Testing location/ address.....:			
Tested by (name, function, signature).....:			
Witnessed by (name, function, signature) .:			
Approved by (name, function, signature)...:			
Supervised by (name, function, signature) :			

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List of Attachments (including a total number of pages in each attachment):

Refer to the attachments:

Attachment No. I: Photo document (11 pages).

Summary of testing:

1. This Test Report 64.105.21.30849.03 used conjunction with Test Report 64.105.21.30849.02.

2. Maxi C-SE AC W22-C5-L-RG and Maxi C-SE AC W22-H-L-DG were subjected to below test and these models can represent other models. Test results were met with Standard mentioned above, which could refer to Test Data Sheet No. TDS_64.105.21.30849.03_UKCA_E, TDS2_('zhejiang fangyuan')_64.105.21.30849.03 and TDS3_64.105.21.30849.03_UKCA_E for details.

3.Tests performed (test clause and name of test):

1) Clause 6.3.1.2 - Continuous continuity checking of the protective conductor
2) Clause 6.3.1.3 - Verification that the EV is properly connected to the EV supply equipment
3) Clause 6.3.1.4 - Energization of the power supply to the EV
4) Clause 6.3.1.5 - De-energization of the power supply to the EV
5) Clause 6.3.1.6 - Maximum allowable current
6) Clause 8.1 - IP test of EVSE
7) Clause 8.2.2 - Loss of supply voltage to permanently connected EV supply equipment
8) Clause 8.3 - Fault protection
9) Clause 11.6 - Strain relief
10) Clause 12.2.6 - Inrush current
11) Clause 12.4 - IP degrees
12) Clause 12.5 - Insulation resistance
13) Clause 12.6 - Touch current
14) Clause 12.7.1 - AC withstand voltage
15) Clause 12.7.2 - Impulse dielectric withstand test
16) Clause 12.8 - Temperature rise
17) Clause 12.9 - Damp heat functional test
18) Clause 12.10 - Minimum temperature functional test
19) Clause Annex A - Pilot function through a control pilot circuit using PWM modulation and a control pilot wire

Testing location:

1. TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch

5F & 8F East, Communication Building, No.163 Pingyun Road, Huangpu Ave. West, Guangzhou 510656, China

TÜV SÜD Testing Center, D1 building, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou 511447, China

2. ZHEJIANG FANGYUAN ELECTRIC EQUIPMENT TESTING Co., LTD

No.400 Guangqiong Road, Jiaxing City, Zhejiang Province

Summary of compliance with National Differences (List of countries addressed):

IEC 61851-1:2017 was approved by CENELEC and BSI as European and British standard without any modification.

☒ **The product fulfils the requirements of** EN IEC 61851-1:2019 and BS EN IEC 61851-1:2019 of Electrical Equipment (Safety) Requirements 2016 regulation by UK Government.

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Test item particulars ..... :	
Equipment mobility ..... :	☐ movable ☐ hand-held ☐ transportable ☒ stationary ☐ for building-in ☐ direct plug-in
Connection to the mains ..... :	☐ pluggable equipment ☐ type A ☐ type B ☒ permanent connection ☐ detachable power supply cord ☐ non-detachable power supply cord ☐ not directly connected to the mains
EV charging modes ..... :	☐ Mode 1 charging ☐ Mode 2 charging ☒ Mode 3 charging ☐ Mode 4 charging
Type of EV connection ..... :	☐ Case A ☒ Case B: ☒ Case C:
Access location ..... :	☒ operator accessible ☐ service access area ☐ restricted access location
Over voltage category (OVC) ..... :	☐ OVC I ☐ OVC II ☒ OVC III ☐ OVC IV ☐ other:
Mains supply tolerance (%) or absolute mains supply values ..... :	For Maxi U W22-XX-YY-L-ZZ series: ±15%; For Maxi U W11-XX-YY-L-ZZ series: ±15%; For Maxi U W7-XX-YY-L-ZZ series: ±10%.
Tested for IT power systems ..... :	☐ Yes ☒ No
IT testing, phase-phase voltage (V) ..... :	N/A
Class of equipment ..... :	☒ Class I ☐ Class II ☐ Class III ☐ Not classified
Considered current rating (A) ..... :	For Maxi U W22-XX-YY-L-ZZ series: 32A; For Maxi U W11-XX-YY-L-ZZ series: 16A; For Maxi U W7-XX-YY-L-ZZ series: 32A.
Pollution degree (PD) ..... :	☐ PD 1 ☐ PD 2 ☒ PD 3
IP protection class ..... :	For Maxi U W-XX-YY-L-ZZ series: IP65; For Maxi U W-S-YY-L-ZZ series: IP54; For Maxi U W-H-YY-L-ZZ series: IP54.
Altitude during operation (m) ..... :	Up to 2000
Altitude of test laboratory (m) ..... :	200
Mass of equipment (kg) ..... :	Apr. 6.9kg for Maxi U W22-XX-YY-L-ZZ; Apr. 6.3kg for Maxi U W11-XX-YY-L-ZZ & U W7-XX-YY-L-ZZ; Apr. 3.9kg for Maxi U W22-S-YY-L-ZZ & Maxi U W22-H-YY-L-ZZ; Apr. 3.6kg for Maxi U W11-S-YY-L-ZZ, Maxi U W7-S-YY-L-ZZ, Maxi U W11-H-YY-L-ZZ & Maxi U W7-H-YY-L-ZZ.
Possible test case verdicts:	
- test case does not apply to the test object ..... :	N/A
- test object does meet the requirement ..... :	P (Pass)
- test object does not meet the requirement ..... :	F (Fail)
Testing ..... :	

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Date of receipt of test item.....:	2022-03-10
Date (s) of performance of tests .....:	2022-04-24~2022-07-13

General remarks:

"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.

Throughout this report a ☐ comma / ☒ point is used as the decimal separator.

Manufacturer's Declaration per sub-clause 4.2.5 of IECEE 02:

The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided..... :	☐ **Yes** ☒ **Not applicable**

When differences exist; they shall be identified in the General product information section.

Name and address of factory (ies) .....:	Autel Intelligent Technology Corp.,Ltd. Guangming Branch 6F, West Wing and 7F&6F, East Wing, Building 2, and 6F of Electronical Building, Yanxiang Industrial Zone, Gaoxin Rd, Dongzhou Community of Guangming New District, Shenzhen, 518000,China

General product information and other remarks:

1. The charging system is Class I appliance for indoor/outdoor use.
2. The live part separated from earthing metal enclosure by basic insulation. The live part separated from SELV by reinforce insulation.
3. Maxi U W11-XX-YY-L-ZZ models use 16A cables.
4. Maxi U W7-XX-YY-L-ZZ models are single phase models and remove partial components on PCB board.
5. Certified RCBO should be installed upstream close to the charging station for "Maxi EU1 AC" series.
6. The Type A RCD and 6mA DC fault current disconnection device test button shall be tested every month.
7. 6mA DC fault current disconnection device report refers to report No. 64.105.21.30160.01, RDC-PD see report No. 64.105.21.30939.01.
8. All models use the same enclosure dimension.

Original Test Report Ref. No. 64.105.21.30159.01:

The original Test Report Ref. No. 64.105.21.30159.01, dated 2021 Sep 27 was modified on 2021 Oct 29 to include the following changes and/or additions:

1. Add fuse F1 before auxiliary power module.
2. Change from chip U13 to relay K5 and surrounding relay circuits.
3. Add relay K5 and surrounding relay circuits to earthing.
4. Mains supply tolerance for Maxi C-SE AC W7-XX-YY-L-ZZ models change from 230V~±15% to 230V~±10%.
5. Remove RG: rose gold colour, and add B: black colour.
6. Remove the vehicle connector holder on front panel for models with vehicle connector.

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Report No. 64.105.21.30849.02:

The original Test Report Ref. No. 64.105.21.30159.01, dated 2021 Oct 29 was modified on 2022 Jan 10 to include the following changes and/or additions:

1. Add “Maxi C-SE AC” & “Maxi C-SE1 AC” series. “Maxi C-SE1 AC” series are the original models with external RCD required. “Maxi C-SE AC” series equipped with embedded Type A RCD with 6mA DC fault device (MC003E3-C1), RDC-PD see report No. 64.105.21.30939.01.

Report No. 64.105.21.30849.03, used conjunction with previous reports:

The original Test Report Ref. No. 64.105.21.30849.02, dated 2022 Jan 10 was modified on 2022 Jul 08 to include the following changes and/or additions:

1. Revised Test Report Ref. No. 64.105.21.30159.01 issue date: Changed from “Sep 27” to “Oct 29”.

2. Updated the name of model series: model series “Maxi U W-XX-YY-L-ZZ” is identical to the previous model series “Maxi U W-XX-YY-ZZ”, except for the LCD panel function embedded.

3. Revised model name: Changed model name from “Maxi U W-C5-YY-ZZ“ to “Maxi U W-BC5-YY-L-ZZ”.

4. New models added: The two new models “Maxi U W-BC3-YY-L-ZZ” and “Maxi U W-BC7-YY-L-ZZ” are identical to the previous model “Maxi U W-C5-YY-ZZ”, except for the cable length.

5. New models added: The three new models “Maxi U W-C3-YY-L-ZZ”, “Maxi U W-C5-YY-L-ZZ” and “Maxi U W-C7-YY-L-ZZ” are similar to the previous model “Maxi U W-C5-YY-ZZ”, except for the model name, the cable length and be with EV connector holder on the charging station panel.

6. Updated the construction of Enclosure: Models “Maxi U W-C3-YY-L-ZZ”, “Maxi U W-C5-YY-L-ZZ” and “Maxi U W-C7-YY-L-ZZ”, updated a drain channel within EV connector holder on the charging station panel.

7. New model added: A new model “Maxi U W11-S-YY-L-ZZ” is identical to the previous model “Maxi U W22-S-YY-ZZ”, except for the lower current and lower power.

8. New series added: A new series of “Maxi U W-H-YY-L-ZZ” is similar to the previous series of “Maxi U W-S-YY-ZZ” and extra 11kW model, except for the type of socket.

9. Added new colour of enclosure: Added RG: rose gold.

10. Updated photo document.

11. Updated details of the Component Data Form are following:

1) Revised type description of RCD Sensor (U5), Changed from MC003E5-C1 (For used with Maxi EU1 AC Series) to MC003E5-C1 (For used with Maxi C-SE1 AC Series), and changed from MC003E3-C1 (For used with Maxi EU AC Series) to MC003E3-C1 (For used with Maxi C-SE AC Series).

2) Added Shutter-outlet (3 Phase), model V3-DSIEC2a-GEL-EV32S-3.

3) Added Shutter-outlet (1 Phase), model V3-DSIEC2a-GEL-EV32S.

4) Added a new cable gland for alternate, model MGB32-25B, only used for the series of “Maxi U W-H-YY-L-ZZ”.

5) Added a new cable gland convertor, model 1013B, only used for the series of “Maxi U W-H-YY-L-ZZ”.

6) Added coating, model Bectron PL 4122/#, used on the PCB of Power board.

7) Added LCD panel, model SDM-L769050CN-A0, only used for models with LCD panel function embedded.

8) Added PCB of LCD panel, model ML1, only used for models with LCD panel function embedded.

9) Updated software version: Changed Control Board version from “V1.00” to “V1.14.05”, and changed Power Board version from “V1.00” to “V1.02.04”.

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict

6.3	**Functions provided in Mode 2, 3 and 4**		—
6.3.1	**Mandatory functions in Modes 2, 3, and 4**		P
6.3.1.1	**General**		P
	The following control pilot functions shall be provided by the EV supply equipment:		P
	•Continuous continuity checking of the protective conductor according to 6.3.1.2;		P
	•Verification that the EV is properly connected to the EV supply equipment according to 6.3.1.3;		P
	•Energization of the power supply to the EV according to 6.3.1.4;		P
	•De-energization of the power supply to the EV according to 6.3.1.5;		P
	•Maximum allowable current according to 6.3.1.6.		P
	If EV supply equipment can supply more than one vehicle simultaneously, it shall ensure that the control pilot function performs the above functions independently at each connecting point.		N/A
	EV supply equipment designed for Mode 2 or Mode 3, using the control pilot conductor and utilizing accessories according to IEC 62196-2, shall be provided with control pilot function according to Annex A.		P
6.3.1.2	**Continuous continuity checking of the protective conductor**		P
	While charging in Mode 2, the electrical continuity of the protective earthing conductor between the ICCB and the respective EV contact shall be continuously monitored by the ICCB.		N/A
	While charging in Mode 3, the electrical continuity of the protective earthing conductor between the EV charging station and the respective EV contact shall be continuously monitored by the EV supply equipment.		P
	While charging in Mode 4, the electrical continuity of the protective conductor between the EV charging station and the respective EV contact shall be continuously monitored by the EV supply equipment.		N/A
	The EV supply equipment shall disconnect the supply to the EV in case of:		P
	•loss of electrical continuity of the protective conductor (i.e. open control pilot circuit), within 100 ms.	54.238ms	P
	•incapacity to verify the continuity of the protective conductor (e.g. short circuit between pilot wire and	95.499ms	P

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
	protective conductor), within 3 s.		
6.3.1.3	**Verification that the EV is properly connected to the EV supply equipment**		P
	The EV supply equipment shall be able to determine that the EV is properly connected to the EV supply equipment.		P
6.3.1.4	**Energization of the power supply to the EV**		P
	The EV socket-outlet or the vehicle connector shall not be energized unless the control pilot function between EV supply equipment and EV has been established correctly with signal states allowing energization.		P
	The presence of such states does not imply that energy will be transferred between the EV supply equipment and the EV as this may be subject to other external conditions, e.g. energy management system.		P
	If the EV requests ventilation, the EV supply equipment shall only energize the system if such ventilation is provided by the installation or the premises.		N/A
6.3.1.5	**De-energization of the power supply to the EV**		P
	If the control pilot signal is interrupted the power supply to the EV shall be interrupted according to 6.3.1.2.		P
	If the control pilot signal status no longer allows energization, the power supply to the EV shall be interrupted but the control pilot signalling may remain in operation.		P
6.3.1.6	**Maximum allowable current**		P
	A means shall be provided to inform the EV of the value of the maximum current it is allowed to draw. The value of the maximum current permitted shall be transmitted and shall not exceed any of the following:		P
	•the rated output current of the EV supply equipment,		P
	•the rated current of the cable assembly.		P
	The transmitted value may change, without exceeding the maximum allowed current, to adapt to power limitations, e.g. for load management.		P
	The EV supply equipment may interrupt the energy supply if the current drawn by the EV exceeds the transmitted value.		P
8.1	**Degrees of protection against access to hazardous-live-parts**		—
	The different parts of the EV supply equipment as mentioned shall fulfil the following requirements:		P

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
	•IP ratings for enclosures shall be at least IPXXC;		P
	•vehicle connector when mated with vehicle inlet: IPXXD;		P
	•plug mated with socket-outlet: IPXXD;		N/A
	•vehicle connector intended for Mode 1 use, not mated: IPXXD;		N/A
	•vehicle connector intended for Mode 2 use, not mated: IPXXB and fulfilling the following:		N/A
	Minimum opening of the contact equal to the clearance according to IEC 60664-1 considering overvoltage category 2 (e.g. the value given in IEC 60664-1 for 230 V/400 V is 2,5 kV rated impulse voltage withstand that implies 1,5 mm separation of contacts) and inhibits the charging and warns the user in case of welded contact.		N/A
	•vehicle connector and EV socket-outlet intended for Mode 3 use, not mated: IPXXB provided it is associated directly upstream with a mechanical switching device (see also 12.3) and fulfilling one of the following:		P
	a) minimum opening of the contact equal to the clearance according to IEC 60664-1 considering overvoltage category 3 (e.g. the value given in IEC 60664-1 for 230 V/400 V is 4 kV rated impulse voltage withstand that implies at least 3 mm separation of contacts);		P
	b) presence of monitoring of the switching contacts associated with a means to operate another mechanical switching device providing isolating function upstream the above in case of fault of operation of the switching device upstream the accessory;		N/A
	c) presence of shutters on live entry hole of the socket-outlets or connectors for case C.		P
8.2.2	**Loss of supply voltage to permanently connected EV supply equipment**		P
	The voltage between power lines or power lines and protective earthing conductor, when measured at the input supply terminals of the EV supply equipment, shall be less than or equal to 60 V DC or the stored energy shall be less than or equal to 0,2 J within 5 seconds after disconnecting the power supply voltage to the EV supply equipment.	The voltage of 5 seconds: Between L1 and N: 12.0V Between L1 and PE: 20.0V	P
8.3	**Fault protection**		—
	Fault protection shall consist of one or more protective measures as permitted according to IEC 60364-4-41:		P
	•automatic disconnection of supply;		P
	•double or reinforced insulation;		P

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
	•electrical separation if limited to the supply of one item of current-using equipment;		P
	•extra low-voltage (SELV and PELV).		P
	Electric separation is fulfilled if there is one electrically separated circuit for each EV.		N/A
11.6	**Strain relief**		—
	The strain relief of the cable in the vehicle connector, EV plug or in the standard plug shall be as specified in the relevant product standard (e.g. IEC 62196-1, IEC 60309-1 or IEC 60884-1).		P
	For case C the strain relief at the EV supply equipment shall be in accordance with the requirements in IEC 62196-1.		P
12.2.6	**Inrush current**		P
	AC EV supply equipment shall withstand the inrush current according to 8.2.2 of ISO 17409:2015.		P
	The following values are specified in ISO 17409:		P
	•After closing the contactor in the EV supply equipment at the peak value of the supply voltage, the EV supply equipment shall be able to withstand 230 A peak within the duration of 100 µs.		P
	•During the next second the EV supply equipment shall be able to withstand 30 A (rms).		P
	The protection means shall be selected not to trip for inrush current.		P
12.4	**IP degrees**		—
12.4.1	**Degrees of protection against solid foreign objects and water for the enclosures**		P
	Enclosures of the EV supply equipment shall have an IP degree, according to IEC 60529 as follows:		P
	•indoor use: at least IP41;		P
	•outdoor use: at least IP44.	For Cable models with vehicle connector: IP65; For “S” models with socket-outlets: IP54; For “H” models with shutter-outlets: IP54.	P
	The minimum IP degree for socket-outlets and the vehicle connectors shall be in accordance with their appropriate standards.		P
	IPX4 may be obtained by the combination of the socket-outlet or connector and the lid or cap,		P

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
	EV supply equipment enclosure or EV enclosure.		
12.2.4	**Degrees of protection against solid foreign objects and water for basic, universal and combined and DC interfaces**		P
	The minimum IP degrees for ingress of objects and liquids shall be:		P
	•Indoor use:		P
	– vehicle connector when mated with vehicle inlet: IP21;		P
	– EV plug mated with EV socket-outlet: IP21;		N/A
	– vehicle connector for case C when not mated: IP21;		P
	– vehicle connector for case B when not mated: IP24.		N/A
	•Outdoor use:		P
	– vehicle connector when mated with vehicle inlet: IP44;		P
	– EV plug mated with EV socket-outlet: IP44;		N/A
	– vehicle connector when not mated: IP24;		P
	– vehicle connector for case B when not mated: IP24;		P
	– socket-outlet when not mated: IP24.		P
	IPX4 may be obtained by the combination of the socket-outlet or connector and the lid or cap, EV supply equipment enclosure or EV enclosure.		P
12.5	**Insulation resistance**		—
	The insulation resistance measured with a 500 V DC voltage applied between all inputs/outputs connected together (power source included) and the accessible parts shall be:		P
	•for a class I EV supply equipment: R > 1 MΩ;	Between hazardous part and earthing: 2.1GΩ.	P
	•for a class II EV supply equipment: R > 7 MΩ.	Between hazardous part and SELV: 2.451GΩ. Between hazardous part and plastic enclosure: 11.8GΩ.	N/A
	For this test all extra low voltage (ELV) circuits shall be connected to the accessible parts during the test.		P
	The measurement of insulation resistance shall be carried out with the protective impedances disconnected, and after applying the test voltage for the duration of 1 min and immediately after the damp heat continuous test of IEC 60068-2-78, test Ca, at 40 °C ± 2 °C and 93 % relative humidity for four days.	Test after 12.9, then 12.5.12.6 test	P

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
	The conditioning test for the insulation test and the touch current can be avoided if the conditioning for test of 12.9 followed by test of 12.5, 12.6 and final test of 12.9, are conducted sequentially in that order.		P
12.6	**Touch current**		—
	The touch current between any AC supply network poles and the accessible metal parts connected with each other, and with a metal foil covering insulated external parts, is measured in accordance with IEC 60990 and shall not exceed the values indicated in Table 1.		P
	The touch current shall be measured within one hour after the damp heat continuous test of IEC 60068-2-78, test Ca, at 40 °C± 2 °C and 93 % relative humidity for four days, with the electric vehicle charging station connected to AC supply network in accordance with IEC 60990.	Test after 12.9, then 12.5.12.6 test	N/A
	The test voltage shall be 1,1 times the maximum rated voltage.		P
	Table 1 – Touch current limits		P
	Between any network poles and the accessible metal parts connected with each other and a metal foil covering insulated external parts:		P
	Class I 3,5 mA	Not exceed 0.55mA.	P
	Class II 0,25 mA		N/A
	Between any network poles and the metal inaccessible parts normally non-activated (in the case of double insulation):		N/A
	Class I N/A		N/A
	Class II 3,5 mA		N/A
	Between inaccessible and accessible parts connected with each other and a metal foil covering insulated external parts (additional insulation):		N/A
	Class I N/A		N/A
	Class II 0,5 mA		N/A
	This test shall be made when the EV supply equipment is functioning with a resistive load at rated output power.		P
	Circuitry that is connected through a fixed resistance or referenced to earth (for example, proximity function and control pilot function) are disconnected before this test.		P
	The equipment is fed through an isolating transformer or installed in such a manner that it is isolated from the earth.		P
12.7	**Dielectric withstand voltage**		—

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
12.7.1	**AC withstand voltage**		P
	The dielectric withstand voltage, at power frequency of 50 Hz or 60 Hz, shall be applied for 1 min as follows:		P
	1) For a class I EV supply equipment. (Un + 1 200 V) (r.m.s.) in common mode (all circuits in relation to the exposed conductive parts) and differential mode (between each electrically independent circuit and all other exposed conductive parts or circuits) as specified in 5.3.3.2 of IEC 60664-1:2007.		P
	2) For a class II EV supply equipment. 2 times (Un +1 200 V) (r.m.s). in common mode (all circuits in relation to the exposed conductive parts) and differential mode (between each electrically independent circuit and all other exposed conductive parts or circuits) as specified in 5.3.3.2.3 of IEC 60664-1:2007.		N/A
	3) For both class I and class II AC EV supply equipment where the insulation between the AC supply network and the extra low voltage circuit is double or reinforced insulation, 2 times (Un + 1 200 V) (r.m.s.) shall be applied to the insulation.		P
	Alternatively the test can be carried out using a DC voltage equal to the AC peak values.		P
	For this test, all the electrical equipment shall be connected, except those items of apparatus which, according to the relevant specifications, are designed for a lower test voltage; current consuming apparatus (e.g. windings, measuring instruments, voltage surge suppression devices) in which the application of the test voltage would cause the flow of a current, shall be disconnected.		P
	Such apparatus shall be disconnected at one of their terminals unless they are not designed to withstand the full test voltage, in which case all terminals may be disconnected		P
12.7.2	**Impulse dielectric withstand (1,2 µs/50 µs)**		P
	The dielectric withstand of the power circuits at impulse test shall be tested according to IEC 60664-1.		P
	The impulse voltage shall be applied to live parts and exposed conductive parts.		P
	The test shall be carried out in accordance with the requirements of IEC 61180.		P
	Parts of the EV supply equipment directly connected to the public AC supply network shall be tested according to overvoltage category IV.		N/A

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IEC 61851-1			
Clause	Requirement + Test	Result - Remark	Verdict
	Permanently connected EV supply equipment shall be tested according to an overvoltage category III except for the socket-outlet or the vehicle connector in case C where an overvoltage category II applies.		P
	EV supply equipment supplied through a cable and plug shall be tested according to an overvoltage category II.		N/A
12.8	**EV supply equipment shall comply with IEC TS 61439-7.**		**P**
12.9	**Damp heat functional test**		**—**
	Following the conditioning defined below, the EV supply equipment is deemed to pass the test, if, it passes the normal sequences test according to A.4.7 of Annex A. The precision of the timing does not need to be verified.		P
	Conditioning:		P
	– For indoor units, 6 cycles of 24 h each to a damp heat cycling test according to IEC 60068-2-30 (Test Db) at (40±3) °C and relative humidity of 95 %;		N/A
	– For outdoor units, two ~~12 day~~ periods, with each period consisting of 5 cycles of 24 h each to a damp heat cycling test according to IEC 60068-2-30 (Test Db) at (40±3) °C and relative humidity of 95 %.	10 cycle	P
12.10	**Minimum temperature functional test**		**—**
	The EV supply equipment shall be pre-conditioned in accordance with IEC 60068-2-1, test Ab, at the minimum operating temperature (either -5 °C for indoor, -25 °C outdoor or lower values declared by the manufacturer ± 3 K) for (16 ± 1) h.	-30 °C	P
	The EV supply equipment is deemed to pass the test, if, immediately after the preconditioning, it passes the sequences test according to A.4.7 of Annex A while at the minimum operating temperature. The precision of the timing does not need to be verified.		P
A	**ANNEX A – CONTROL PILOT FUNCTION TROUGH A CONTROL PILOT CIRCUIT USING A PWM SIGNAL AND A CONTROL PILOT WIRE**		P
A.1	**General**		**—**
A.2	**Control pilot circuit**		**—**
A.2.1	**General**		P
	Figures A.1 and A.2 illustrate an electric equivalent circuit of the control pilot circuit. The EV supply equipment shall set the duty cycle of the PWM control pilot signal to indicate the maximum current according to Table A.7.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	The indicated maximum current transmitted shall not exceed the value according to 6.3.1.6.		P
	The EV supply equipment may open the switching device that energizes the EV if the EV draws a higher current than the PWM signal (duty cycle) indicates. In this case, the EV supply equipment shall respect the following conditions:		P
	•the allowed response time of the EV, according to Table A.6 (e.g. sequence 6).		P
	•the current tolerance related to the duty cycle generated by the EV supply equipment (1 percentage point).		P
	•the tolerances of the current measurement used in the EV supply equipment itself.		P
	The control pilot circuit shall be designed in accordance with Figures A.1 or A.2 with the values defined in Table A.2, Table A.3 and Table A.4.		P
	The functionality of the control pilot circuit shall follow the requirements defined in Table A.4, Table A.6, Table A.7 and Table A.8.		P
A.2.2	**Typical control pilot circuit (see IEC 61851-1:2017)**		P
	The EV supply equipment communicates by setting the duty cycle of a PWM signal or a continuous DC voltage signal (Table A.7).		P
	The EV supply equipment may change the duty cycle of the PWM signal at any time.		N/A
	The EV responds by applying a resistive load to the positive half-wave to the control pilot circuit.		P
	For further information about the PWM signal see also Table A.2, Table A.3 and Table A.4.		P
	EVs using typical control pilot circuit (Figure A.1) shall be able to create state B and use it according to the sequences specified in Table A.6.		P
	EV using a typical control pilot circuit shall determine the maximum current from EV supply equipment from the duty cycle of the PWM signal (Table A.8).		P
A.2.3	**Simplified control pilot circuit (see IEC 61851-1:2017)**		N/A
	An EV using the simplified control pilot circuit shall limit itself to single phase charging and shall not draw a current of more than 10 A.		N/A
	EV supply equipment that supports an EV using the simplified control pilot shall modulate the PWM signal in the same manner as done for EVs using the typical control pilot circuit.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	EVs using simplified control pilot circuit (Figure A.2) are not able to create state B.		N/A
	An EV using the simplified control pilot circuit can measure the duty cycle.		N/A
	The designer of an EV using the simplified control pilot should be aware that the EV supply equipment can open its switching device, if the EV supply equipment indicates less current (by the duty cycle) than the EV draws (see A 2.1).		N/A
	It is not recommended to use the simplified control pilot circuit for new EV design.		N/A
A.2.4	**Additional components and high frequency signals**		P
	Digital communication as described in ISO/IEC 15118 series may be carried out over the control pilot conductor. Additional components can be needed to couple this high-frequency signal onto the control pilot signal.		P
	Additional components required for signal coupling shall not deform the control pilot signal beyond the limits defined in Tables A.2 and A.4.		P
	The maximum inductance of the control pilot circuit of the EV supply equipment is limited to 1 mH (see Table A.3).		P
	The maximum inductance of the control pilot circuit of the EV is limited to 1 mH (see Table A.2).		P
	The additional signal for digital communication shall have a frequency of at least 148 kHz.		P
	The voltage of the high frequency signal (used for digital communication) shall be in accordance with the values given in Table A.1.		P
	One further capacitive (max of 2 000 pF) branch (on the vehicle and on the EV supply equipment) can be used for detection of the high frequency signals, provided the resistance/impedance to ground is higher than 10 kΩ. Such capacitive/resistive branch would typically be used for signal inputs and automatic signal voltage control (refer to Table A.1).		P
A.3	**Requirements for parameters and system behaviour**		—
	The control pilot circuit parameters shall be in accordance with Table A.2 and Table A.3 and are shown in Figures A.1 and A.2.		P
	EV pilot circuit values and parameters as indicated on Figures A.1 and A.2 are given in Table A.3.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Value ranges shall be maintained over full useful life and under design environmental conditions.		P
	1 % tolerance resistors are commonly recommended for this application.		P
	Table A.4 indicates the pilot voltage range based on components values in Tables A.2 and A.3. It incorporates an increased voltage margin for Va to allow for measurement tolerances of the EV supply equipment.		P
	There is no undefined voltage range, for the PWM signal, between the system states.		P
	The state is valid if it is within the above values. The state detection shall be noise resistant, e.g. against EMC and high frequency data signals on the control pilot circuit.		P
	For reliable detection of a state, it is recommended to apply averaging of the measurement over several milliseconds or PWM cycles.		P
	The EV supply equipment shall verify that the EV is properly connected by verifying the presence of the diode in the control pilot circuit, before energizing the system.		P
	This shall be done at the transition from x1 to x2 or at least once during state x2, before closing the supply switching device.		P
	Presence of the diode is detected if the low side of the PWM-signal is within the voltage range defined in Table A.4.		P
	The EV supply equipment shall open or close the supply switching device within the time indicated in Table A.6.		P
	Compliance is tested as in Clause A.4.		P
	The state changes between A, B, C and D are caused by the EV or by the user.		P
	The state changes between state x1 and x2 are created by the EV supply equipment.		P
	A change between states x1 and x2 indicates an availability (x2) or unavailability (x1) of power supply to the EV.		P
	After changing to state F and while the reason for changing to state F persists, an EV supply equipment with permanently attached cable (case C) shall:		P
	– remain in state F, or		P
	– remain in state F for at least 300 ms and then change to state x1 (and stays there), in order to detect if an EV is connected.		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	If the failure is not recovered after disconnecting the vehicle connector, the EV supply equipment shall:		P
	– remain in or change to state F, or		P
	– remain in state x1, if the EV supply equipment provides an indicator (e.g. a display) which shows “not available”.		N/A
	In the absence of a fault condition in the EV supply equipment, the EV supply equipment shall not use the state F in order to signal that the EV supply equipment will not deliver the energy to the EV. Instead, this shall be done by the state x1.		P
	A transition from state E or state F to any other state (x1 or x2) is allowed.		P
	If the EV is connected to the EV supply equipment which does not use 5 % duty cycle, and authentication (e.g. RFID identification, payment, etc.) is needed, the control pilot signal shall stay at x1 as long as the energy is not allowed to be supplied.		N/A
	In case, no authentication is needed, the system may go to state x2.		P
	In case EV supply equipment requires authentication to supply power, a change from states CX or DX to state BX shall not lead to loss of authentication.		P
	This means that no repeated authentication shall be needed.		P
	Table A.6 indicates the principle sequences and transitions from one state to another with the timing requirements where applicable. Some transitions that may take place are not indicated in the table.		P
	If the EV supply equipment or the EV changes to a new state within the timing indicated for that sequence, the new sequence is initiated and replaces the previous sequence.		P
A.4	**Test procedures**		—
A.4.1	**General**		—
A.4.2	**Constructional requirements of the EV simulator**		P
A.4.3	**Test procedure**		P
A.4.4	**Test List – Oscillator frequency and generator voltage test**	(see table 4.4)	P
A.4.5	**Duty Cycle test**	(see table 4.5)	P
A.4.6	**Pulse wave shape test**	(see table 4.6)	P

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Clause	Requirement + Test	Result - Remark	Verdict
A.4.7	**Sequences test**	(see table 4.7)	P
A.4.7.1	**General**		P
A.4.7.2	**Sequence test using the typical control pilot circuit**	(see table 4.7.2)	P
A.4.7.3	**Sequence test using the simplified control pilot circuit**	(see table 4.7.3)	N/A
A.4.7.4	**Optional testing the EV supply equipment that support grid**	(see table 4.7.4)	N/A
A.4.8	**Test of interruption of the protective conductor**	(see table 4.8)	P
A.4.9	**Test of short-circuit values of the voltage**	(see table 4.9)	P
A.4.10	**Example of a test simulator of the vehicle (informative)**		P
A.4.11	**Optional hysteresis test**		N/A
A.4.11.1	**General**		N/A
A.4.11.2	**Test sequence for hysteresis between states B and C**		N/A
A.4.11.3	**Test sequence for hysteresis between states C-E, D-E**		N/A
A.4.11.4	**Test sequence for hysteresis between states C-D**		N/A
A.5	**Implementation hints**		—
A.5.1	**Retaining a valid authentication until reaching CP State B**		N/A
A.5.2	**Load control using transitions between state x1 and x2**		N/A
A.5.3	**Information on difficulties encountered with some legacy EVs for wake-up after a long period of inactivity (informative)**		N/A
B	**ANNEX B – PROXIMITY DETECTION AND CABLE CURRENT CODING CIRCUITS FOR THE BASIC INTERFACE**		N/A
B.1	**Circuit diagram for vehicle couplers using an auxiliary switch associated with the proximity detection contact**		—
	The vehicle couplers using the proximity contact with an auxiliary switch and without current capability coding of the cable assembly shall use the circuit diagram as indicated in Figure B.1 and Table B.1.		N/A
B.2	**Circuit for simultaneous proximity detection and current coding**		—
	Vehicle connectors and plugs using the proximity contact for simultaneous proximity detection and current capability coding of the cable assembly shall have a resistor electrically connected		N/A

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Clause	Requirement + Test	Result - Remark	Verdict
	between the proximity contact and the earthing contact (see Figure B.2) with a value as indicated in Table B.2.		
	The resistor shall be coded to the maximum current capability of the cable assembly.		N/A
	The EV supply equipment shall interrupt the current supply if the current capability of the cable is exceeded as detected by the measurement of the Rc, as specified by the values for the recommended interpretation range in Table B.2.		N/A
	The EV supply equipment shall detect the current coding by measurement of the Rc, as defined in Table B.2 and use the result to set the value of the maximum allowed current, if necessary, according to 6.3.1.6.		N/A
	The resistor is also used for proximity detection.		N/A

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