GOSSEN METRAWATT

STANDARDS-COMPLIANT TESTING OF DC CHARGING POINTS

DIAGNOSIS OF THE CHARGING INFRASTRUCTURE AND PERFORMANCE OF REQUIRED MEASUREMENTS AND FUNCTION TESTS

FAST CHARGING FOR ELECTRIC VEHICLES

Electromobility without restrictions is the goal when buying an electric vehicle – guaranteed mobility and flexibility by means of fast DC charging and its undesired dependence on the charging system and charging point equipment.

But what does fast charging mean and how safe is it for the user?

Charging with direct current always necessitates a connection between the electric vehicle and the charging point via a permanently connected charging cable. Cable-based charging of electric vehicles (EVs), also known as conductive charging, is possible in various charging modes which are defined in system standard DIN EN 61851-1 (VDE 0122-1). Charging mode 4 is specified for charging with direct current (DC charging) at permanently installed charging stations. This special DC charging infrastructure ensures high levels of electrical safety, as well as overload protection for the installation, e.g. fire protection. Further protection against touching and tampering is provided by locking the charging plug connection during the charging process. Communication and control for the charging process is handled by a special communication interface. The interface between the vehicle and the charging point is a decisive criterion for safe and convenient use of the charging infrastructure.

VARIOUS STANDARDS FOR FAST CHARGING

There are still many different, mutually incompatible charging plugs and coupling variants on the market today. Five fast-charging standards have established themselves worldwide:

- CCS (Combo 2) – combined charging system, primarily in Europe and the USA
- CCS (Combo 1) – single-phase combined charging system, primarily in the USA
- CHAdeMO – “CHArge DE MOve” standard, primarily in Japan
- Tesla Supercharger
- GB/T standard, primarily in China

3 fast DC charging systems are used for the most part in Germany, namely CCS (Combo 2), CHAdeMo and the Tesla Supercharger.

CCS (Combo 2)

The combined charging system (CCS) is an open, universal charging system for EVs based on international standards for charging equipment including IEC 61851-1, annex CC to IEC 61851-23 and IEC 61851-24.

Standards for charging plug connectors are defined in accordance with IEC 62196 (configurations EE and EF only). The CCS connection on the vehicle side combines charging with 3-phase alternating current and an option for fast DC charging.

The CCS system includes the plugs as well as the control functions and communication between the EV and the infrastructure.

Extended communication intended for DC charging with the CCS system is based on DIN SPEC 70121 or ISO 15118. Electrical safety on the vehicle side is specified in ISO 17409.

Figure 1: CCS Combo Type 2 Plug
(image: Wikipedia)

CHAdeMO

CHAdeMO is a plug system developed in Japan for charging electric cars and plug-in hybrids. CHAdeMO is an acronym for "CHArge de MOve", equivalent to "charge for motion", and is a play on words which suggests "O cha demo ikaga desuka", which means "let's have a cup of tea while charging" in Japanese.

CHAdeMO was the first plug to establish itself as a standard for charging electric vehicles with direct current. Automobile brands that use this plug as standard equipment include Toyota, Kia, Mitsubishi and Nissan. Tesla offers an adapter for several of its models for connection to CHAdeMO charging stations.

Figure 2: CHAdeMo Plug (image: Wikipedia)

FUNCTIONAL TESTING AND MEASUREMENT OF CHARGING SYSTEMS

The charging station is a stationary electrical system that can be operated by laypersons at publicly accessible and commercially used locations and should be tested in accordance with the standards. Testing (initial testing) for correct functioning and electrical safety is performed by a qualified electrician. The inspector should possess basic knowledge concerning the assessment of measured values and tests for fast DC charging systems.

Test content and test intervals are based on standards such as, amongst others, DIN EN 61851-1/22/23/24 (VDE 0122-1/2-2/2-3/2-4), ISO 15118-1, DIN SPEC 70121, IEC 60364-6 / DIN VDE 0100-600 and EN 50110-1 / DIN VDE 0105-100, as well manufacturer and installation instructions and, depending on installation location and type of use, legal requirements.

Further information is provided by the German Occupational Health and Safety Act, the Ordinance on Industrial Safety and Health, ZVEH guidelines and the accident prevention regulations of the trade associations.

Why is testing performed?

According to article 2 (2) of German constitutional law, everyone has the right to life and physical integrity. During the charging process, the user comes into direct contact with charging station equipment. Safety requirements must therefore be fulfilled under normal conditions (including various climatic conditions), with special consideration of foreseeable user error and misuse in the event of accidents and vandalism.

Testing determines the momentary actual status and compares it with or evaluates it relative to the target status. In the event of deviations outside the specified tolerance limits, repairs are carried out and testing is repeated.

In addition to legislation and the interests of the client, major business interest on the part of testing companies prevails now as well because according to the German Federal Network Agency, 6493 fast charging points have been officially registered in Germany as of 7 January 2021 in addition to the 38,876 normal public charging points.

Correct Selection of Measuring and Test Instruments

The safety of the inspector, i.e. the electrician, is of prime importance during testing. Correct selection of suitable measuring and test instruments is thus especially important. They must comply with applicable manufacturer and equipment standards. In particular the individual test procedures should comply with the standards. The corresponding standard is DIN EN 61557 (VDE 0413), Electrical safety in low voltage distribution systems up to 1000 V AC and 1500 V DC – Equipment for testing, measuring or monitoring of protective measures. The correct measurement category is also of prime importance. The measuring category specifies the permissible range of applications for measuring and test instruments for electrical operating equipment and systems in low-voltage systems. Assignment to a measuring category is determined in accordance with IEC 61010-1 (Safety requirements for electrical equipment for measurement, control and laboratory use).

Testing DC Charging Points with the PROFiTEST H+E XTRA C

Testing DC charging points in accordance with the standards includes all measures for verifying compliance of the electrical system and the communication process with the specified requirements.

This includes visual inspection, testing and measuring, as well as the preparation of a test report.

Figure 3: Test Setup at DC Charging Station with PROFiTEST H+E XTRA C and PROFiTEST PRIME

Visual Inspection

Visual inspection of the fast DC charging station is performed according to predefined specifications prior to functional testing of, amongst other things, communication functions. In this regard it must be noted that the charging station is a stationary electrical system which can be operated by a layperson! Visual inspection must be documented and may be supplemented with relevant images.

Functional Testing of DC-CCS Communication (per ISO 15118-1 / DIN SPEC 70121)

It's important to comply with all required safety instructions when testing the communication process. The PROFiTEST H+E XTRA C diagnostics unit must be connected to the DC charging point and the corresponding standard or series of standards, namely ISO 15118-1 or DIN SPEC 70121, must be preselected. Once started, authentication is accomplished via telephone hotline, cash payment, cash card, debit card, RFID card, NFC device, cell phone SMS, smartphone app, Internet, plug & charge or another available option. The diagnostics tester simulates an EV with DC load and DC source. During testing, the following test procedure steps are displayed along with related information.

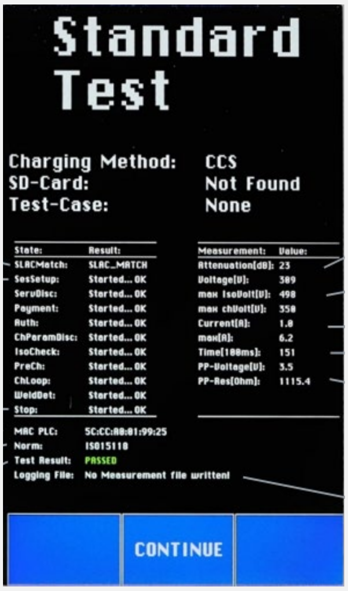
The following test sequence is started:

No.	Display	Meaning
1	**SLAC-Match**	SLAC-Match means that the tester is connected to a charging station. This query serves the purpose of communication before the actual test in order to establish connection to the charging station, after which testing of the charging station is started.
2	**SesSetup, ServDisc, Payment, Auth, ChParamDisc, IsoCheck, PreCh, ChLoop, WeldDet, Stop**	Indicates executed DC-CCS test phases. Green: The corresponding test phase has been successfully completed. Any given test has only been successfully completed if PASSED appears at the display.
3	**Attenuation [dB]**	Signal strength along the communication path – attenuation during SLAC may not exceed 45 dB. In the event of attenuation of greater than 45 dB: determine whether or not any damaged cables or interfering factors are located within the measuring environment and make sure that the PLC modem in the charging station is correctly connected to the CP signal.
4	**Voltage [V]**	Voltage
	Max. IsoVolt [V]	Maximum voltage during the insulation test
	Max. chVolt [V]	Maximum voltage during the charge loop
5	**Current [A]**	Actual DC current during the charging process
	max [A]	Maximum charging current during the entire charging process
6	**Time [100ms]**	Time after which the charging process was completed. The time is set to 0 before ChargeLoop starts.
7	**PP-Voltage [V]**	Voltage measured at the PP signal
	PP-Res [Ohm]	Resistance is calculated based on voltage measured at the PP signal. This value depends on the manufacturer. Take this value from the standard.
8	**Logging File**	Log file in which the test results are stored
9	**Test Result**	Test Results
10	**Standard**	The standard in accordance with which the test is performed is displayed here. These settings can be changed in the settings menu (see page 10 in section 6.2.1).
11	**MAC PLC**	MAC address of the connected charging station

Source :comemso GmbH

If the results are OK, the following statements can be made:

- Load during ChargeLoop (charging process) was greater than 3 A.
- The charging station functions and, in principle, the EV can be supplied with current.
- Communication in accordance with ISO 15118-1 / DIN SPEC 70121 is OK.



Manufactured by COMEMSO GmbH

Figure 4: Display of Measurement Results at the PROFITEST H+E XTRA

Functional Testing of CHAdeMo Communication

During testing, the following test procedure steps are displayed along with related information. Here too, it's important to ensure that all applicable safety instructions are adhered to when testing communication. The PROFiTEST H+E XTRA C diagnostics unit must be connected to the CHAdeMO DC charging point. Once started, authentication is accomplished via telephone hotline, cash payment, cash card, debit card, RFID card, NFC device, cell phone SMS, smartphone app, Internet, plug & charge or another available option. The diagnostics tester simulates an EV with DC load and DC source.

The following test sequence is started:

No.	Display	Meaning
1	**CAN Resistor**	CAN resistance of CAN communication Set point: ~60 ohms (+/- 10 ohms) If you start the device without the CHAdeMO connector connected, this value is ~120 ohms and indicates the resistance of the device instead of the resistance of the charging station.
2	**Actual State**	Signal strength along the communication path – attenuation during SLAC may not exceed 45 dB. In the event of attenuation of greater than 45 dB: determine whether or not any damaged cables or interfering factors are located within the measuring environment and make sure that the PLC modem in the charging station is correctly connected to the CP signal.
3	**Voltage**	Actual DC voltage during the charging process
	max	Maximum DC voltage during the entire charging process (except insulation test voltage)
4	**Current**	Actual DC current during the charging process
	max	Maximum charging current during the entire charging process
5	**Time [100ms]**	Time after which the charging process was completed
6	**Test Result**	Test Results

Source :comemso GmbH

If the results are OK, the following statements can be made:

- DC load in state E2 (charging) was greater than 3 A.
- The charging station functions and, in principle, the EV can be supplied with current.
- Communication is OK per versions 0.9.1, 1.0.0., 1.0.1 and 1.1.

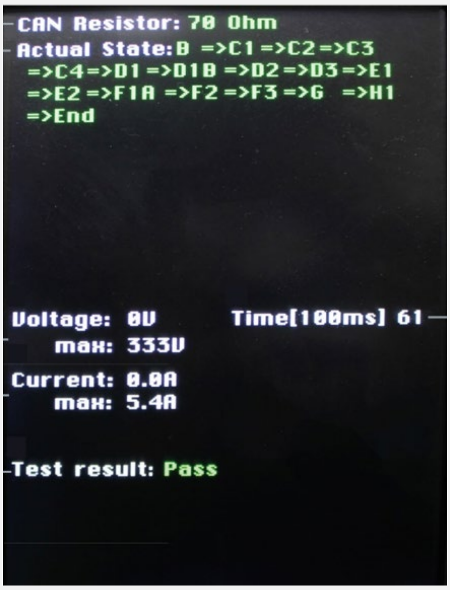


Figure 5: Display at PROFiTEST H+E XTRA C

Standards-Compliant Testing for Electrical Safety at the DC Charging Point

Testing for electrical safety is performed with the PROFITEST H+E XTRA or the PROFITEST H+E XTRA C in combination with the PROFITEST PRIME. Tests must be performed by a qualified electrician with standards-compliant measuring instruments.

- Measurement of low-resistance protective conductor continuity
- Measurement of loop resistance between DC+ and DC-
- Testing of insulation monitoring in the CCS system
- Insulation resistance measurement
- Residual voltage measurement
- Touch current measurement
- Testing of the residual current device

The special feature of tests performed on DC charging points is that most of the measurements and tests only have to be performed when the load is connected to the source (loop measurement amongst others)!

Amongst others, the following standards from the field of electrical installation and for protection against electric shock must be taken into consideration:

- DIN EN 61140 (VDE 0140-1; 2016-11, Protection against electric shock – Common aspects for installation and equipment)
- DIN IEC/TS 60479-1 (VDE 0140-479-1; 2007-05, Effects of current on human beings and livestock – Part 1: General aspects)
- IEC 60364-5-54 (DIN VDE 0100-540; 2012-06, Low-voltage electrical installations – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors)
- IEC 60364-4-41 (DIN VDE 0100-410; 2018-10, Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock)
- IEC 60364-5-53 (DIN VDE 0100-530; 2018-06, Low-voltage electrical installations – Part 5-53: Selection and erection of electrical equipment – Switchgear and control gear)
- IEC 60364-7-722 (DIN VDE 0100-722; 2019-06, Low-voltage electrical installations – Part 7-722: Requirements for special installations or locations – Supply of electric vehicles)
- IEC 60364-6 (DIN VDE 0100-600; 2017-06, Low-voltage electrical installations – Part 6: Verification)
- EN 50110 (DIN VDE 0105-100; 2015-10, Operation of electrical installations – Part 100: General requirements)
- IEC 60364-6 (DIN VDE 0105-100/A1; 2017-06, Operation of electrical installations – Part 100: General requirements; Amendment A1: Periodic verification)

Measurement of Low-Resistance Protective Conductor Continuity in the CCS System with 200 mA

In accordance with IEC 60364-6/DIN VDE 0100-600, the continuity of protective conductors (including the equipotential bonding conductor via the main grounding busbar and the additional equipotential bonding conductor) and active conductors in final ring circuits must be tested.

Measuring method – Continuity of conductors is ascertained by means of a constant test current and voltage drop at the device under test.

Measurement is performed between PE at the plug system of the DC charging point and the protective conductor in the upstream electrical system.

Good to Know:

- If direct voltage is used as the test voltage, DIN EN 61557-4 specifies performance of the measurement with polarity reversal. And thus measurement must be performed with (automatic) polarity reversal of the measuring voltage or with the flow of current in one direction (+ pole to PE) and then the other (- pole to PE).
- Resistances which do not demonstrate a stable value until after a “settling-in period” should not be measured with automatic polarity reversal, but rather one after the other with positive and negative polarity.
- Examples of resistances whose values may change during measurement include:
  - Lamp resistance with changing values caused by warming due to measuring current
  - Resistances with a large inductive component
  - Contact resistance
  - Line reactors

Determining the Limit Value

The limit value is calculated from conductor resistance and contact resistance (see DIN VDE 0100-600:2017-06, appendix A.A, table A1).

Measurement of Low-Resistance Protective Conductor Continuity in the CCS System with 25 A

Due to the high amperage of the utilized test current, this type of measurement is above all suitable for precise continuity testing of especially low-resistance protective conductor systems, i.e. in the case of large cross-sections and/or short cable lengths. In this case, continuity of protective conductor systems is determined by feeding a test current with line frequency and measuring the resultant voltage drop.

Here too, testing is performed at the Combo 2 plug system (PE measuring input on the PROFiTEST H+E XTRA C) and at a PE measuring point at the charging or transformer station.

Good to Know:

Due to the high amperage of the test current, small cross-sections may result in undesired warm-up or damage under certain circumstances.

Figure 6: Test Setup with PROFiTEST H+E XTRA and PROFITEST PRIME

Use for Testing the Effectiveness of Protective Measures at Electric Charging Stations

Protection against electric shock must be ensured for electrical installations. Specific requirements in accordance with DIN VDE 0100 must also be met for DC installations because there's an increased risk of fire due to insulation faults that can cause non-extinguishing arcs.

The evaluation of the effectiveness of protection against electric shock and protection by means of automatic shutdown at AC/DC charging stations in the event of overcurrent can be verified by the PROFITEST H+E XTRA or the PROFITEST H+E XTRA C in combination with the PROFITEST PRIME.

In this case, the actual measurement is performed by the PROFITEST PRIME test instrument. The PROFITEST H+E XTRA or the PROFITEST H+E XTRA C functions as an adapter in this case.

DC Loop Resistance Measurement

Due to the fact that even small contact resistances can be very dangerous, this measurement should be performed with the PROFiTEST PRIME as recommended.

With currents of up to 400 A, even low contact resistances at the plug cause considerable heat loss. A resistance of just 0.15 mΩ is enough to turn the plug into a 25 W soldering iron.

The existing CCS 2 compact plastic plug (combined charge system) will nevertheless be retained, from which heat is poorly dissipated. Since the plugs are open systems and the contact surfaces can be contaminated or damaged by dust or other environmental influences, even higher contact resistances could quickly cause them to burn through – with potentially fatal consequences. (source: Matthias Kübel, VW)

DC Measuring Method

Depending on how contact is established, the PROFITEST PRIME permits measurement of loop impedance from DC+ to DC-, DC+ to PE or DC- to PE. Loop impedance Z is measured and short-circuit current IK is ascertained in order to determine whether or not the breaking requirements for protective devices have been fulfilled. In the case of the DC charging point, the measurement is only relevant for determining loop impedance, as well as the plug system's contact resistance.

Good to Know:

Loop impedance should be measured for each electrical circuit at the farthest point, in order to ascertain maximum loop impedance for the system.

Figure 7: Test Setup with PROFiTEST H+E XTRA and PROFITEST PRIME

Testing Insulation Monitoring in the CCS System

The insulation monitoring test is conducted by simulating specifically defined insulation resistances and constitutes a safety test of the EVSE for verifying the detection of insulation faults. This test is only performed for DC-CCS.

The PROFiTEST XTRA C simulates an EV with DC load and DC source. The charging process stops automatically after a few seconds. The tested ISO value appears at the diagnostics unit's display panel.

Note! The charging gun is automatically locked during the test procedure and cannot be pulled out.

<u>Characteristic values:</u>

HDC+: High insulation resistance value between DC+ and PE: 475 kΩ

LDC+: Low insulation resistance value between DC+ and PE: 95 kΩ

HDC-: High insulation resistance value between DC- and PE: 475 kΩ

LDC-: Low insulation resistance value between DC- and PE: 95 kΩ

Figure 8: Test Setup with PROFiTEST H+E XTRA and PROFITEST PRIME

Residual Voltage Measurement

Measurement of residual voltage is recommended in order to ensure that there's no risk when touching dangerous active parts. This applies in particular to vehicle inlets where voltage exceeds 60 V DC or 30 V AC (RMS) between any contacts during charging.

After disconnecting the vehicle inlet from the plug, 2 requirements should be fulfilled, provided that the contacts of the vehicle inlet do not meet IPXXB in accordance with IEC 60529:1.

1. The charge between all contacts must be less than 50 µC within 1 second, i.e. voltage must not exceed 60 V DC or 30 V AC (RMS) within 1 second after disconnection.

2. Energy between all contacts must be less than 0.2 J within 10 seconds, i.e. voltage must not exceed 60 V DC or 30 V AC (RMS) within 10 seconds after disconnection.

With the PROFiTEST PRIME, testing for the absence of voltage is performed by means of a voltage measurement which involves measuring discharge time.

Testing the Residual Current Device

According to the relevant standards, DC charging stations should be equipped with special protective measures. DC charging points for electric vehicles with permanently attached charging cable should be equipped with an RCD on the cable or in the power supply device. Further information concerning protective measures against residual current in stationary installations can be found in IEC 60364-7-722. Compatibility with a type A RCD installed upstream can also be achieved by using double or reinforced insulation for the circuit which is causing DC leakage current to any other circuit and protective earth, or by using special sensor technology for the detection of residual currents of 6 mA DC.

Good to Know:

- Residual current devices (RCDs) are used for protection by means of automatic shutdown of supply power in the event of indirect contact. The effectiveness of this measure must be examined by means of visual inspection and measurement. It must be verified that shutdown takes place no later than upon reaching rated differential current $I_{\Delta N}$, and the agreed upon limit value for permissible touch voltage must not be exceeded.
- The PROFiTEST PRIME makes it possible to test RCDs which are sensitive to alternating, pulsed and direct current with non-delayed (general type), short-time delayed (type G) or time delayed tripping (type S).

Special Measuring Method with PROFiTEST PRIME

The test instrument uses a measuring current of only ⅓ nominal residual current for the determination of touch voltage $U_{\Delta N}$ which occurs at nominal residual current. This prevents tripping of the RCD. This measuring method is especially advantageous, because touch voltage can be measured quickly and easily at any electrical outlet without tripping the RCD. The usual, complex measuring method involving testing for proper functioning of the RCD at a given point, and subsequent substantiation that all other system components requiring protection are reliably connected at low resistance values to the selected measuring point via the PE conductor, is made unnecessary.

New – Testing of 6 mA Residual Current Devices, RDC-DD / RCMB

DIN VDE 0100-722 (Requirements for special installations or locations – Supplies for electric vehicles) specifies that all outlets for charging electric vehicles must be protected by a separate RCD. Furthermore, additional protection is required for multiphase charging with smooth DC fault current. Either a type B RCD, an RDC-DD (residual direct current detecting device) or an RCMB (residual current monitoring module) can be used to this end. RDC-DDs are tested in accordance with IEC 62955 and RCMBs in accordance with IEC 62752. The specified time-to-trip values are listed below:

Time to Trip – RDC-DD		Time to Trip – RCMB	
6 mA	10.0 s	6 mA	10.0 s
60 mA	0.3 s	60 mA	0.3 s
200 mA	0.1 s	300 mA	0.04 s

Insulation Resistance Measurement

In order to avoid hazards or damage resulting from fault current and creepage current which can occur due to faulty cable insulation, testing of insulation resistance is required between the active conductors and the protective conductor connected to earth.
Insulation resistance is measured by outputting a constant direct voltage and a test current of at least 1 mA in accordance with DIN EN 61557-2.
Testing is conducted on DC charging stations without an insulation monitoring system.
If the DC charging station for electric vehicles has multiple DC outputs which are intended for simultaneous use, each output circuit must also be isolated from all other output circuits by basic insulation, double insulation or reinforced insulation. An additional measurement of insulation resistance between the DC charging points is recommended in this case.

Good to Know:

- Insulation resistance may only be measured at voltage-free devices.
- Do not touch the test probes during the measurement – danger of injury!
- Capacitive devices under test are charged during this measurement. Incorrect discharging results in a life-threatening situation. For this reason, the connection between the test instrument and the device under test may not be interrupted until voltage at the test probes has dropped to below 10 V.
- Before performing insulation measurement, the test probes on the measurement cables should be short-circuited in order to assure that the instrument displays a value of less than 1 kΩ. In this way, incorrect connection can be avoided and interrupted measurement cables can be detected.

Touch Current Measurement

Touch current is measured while charging an electric vehicle at a DC charging station under certain conditions. Touch current has a specified value of 3.5 mA RMS. If this value is exceeded, requirements in accordance with DIN EN 61851-23 must be met for protection class I DC charging stations for electric vehicles.

Good to Know:

- The part to be measured must be voltage-free! In case of doubt, testing for absence of voltage is performed before starting the measurement.
- Before testing, circuit components connected to the protective conductor via a fixed resistor or common reference (e.g. checking the connection of the EV) should be disconnected.

Conclusions

Legal requirements are putting more and more pressure on automobile manufacturers all over the world to reduce the carbon dioxide emissions of their vehicles. As a result, demand for charging facilities and various charging concepts is also growing. However, the lack of an adequate infrastructure is forcing many users to charge their vehicles at home for the time being. But for longer trips, they expect the charging process to be as fast as possible.
In response to these demands, the DC charging infrastructure will be further expanded and must also be tested.

Testing fast charging stations, i.e. DC charging points, is presenting experienced electricians with new challenges. Basic knowledge of the communication processes used by the various charging systems, as well as fundamental knowledge of the relevant measuring methods and their application, make it possible to perform testing and to assess the results.

TESTING REPORT
Test report container - 2022-01-11
No.: -Preview document-
Testing date: 1/11/2022

GOSSEN METRAWATT

Client:	GOSSEN METRAWATT Südwestpark 15 90449 Nürnberg	Contractor:	
Department:		Tester:	undef.
Account:			
Contact:			

Tested object	Part of: GOSSEN METRAWATT (CU0030)		
ID:	I0001	Manufacturer:	
Designation:	BUILDING 1	Type:	
Comment:			

#	Step type	Min	Max	Result	Assessment	Attachments
1	Identifiable damage or defects			✓	Passed	
2	Stand and anchorage fastening			✓	Passed	
3	Enclosure and housing of the unit			✓	Passed	
4	Cables and plugs			✓	Passed	
5	External factors at the location			✓	Passed	
6	Suitability for location			✓	Passed	
7	Protection against water penetration			✓	Passed	
8	Protection against humidity			✓	Passed	
9	Unhindered water drainage			✓	Passed	
10	Protection against direct contact			✓	Passed	
11	Cross-section, identification, safe conn.			✓	Passed	
12	Installation, protection indirect contact			✓	Passed	
13	Assignment of conductor cross-section			✓	Passed	
14	Selection, connection			✓	Passed	
15	Presence, correct selection			✓	Passed	
16	Presence, complete			✓	Passed	
17	complete			✓	Passed	
18	Condition, connections			✓	Passed	
19	Presence, readable			✓	Passed	
20	Air permeability, pollution			✓	Passed	
21	Pollution, animal colonisation			✓	Passed	
22	Correct selection of oper. equipment			✓	Passed	
23	No damage to operating equipment			✓	Passed	
24	Correct IP protection			✓	Passed	
25	Filter, fan cleaned			✓	Passed	
26	Correct cable routing			✓	Passed	
27	Accessibility maintained			✓	Passed	
28	Stability charging point			✓	Passed	
29	Low voltage safely isolated			✓	Passed	
30	Cable connection correct			✓	Passed	
31	Protection against direct contact			✓	Passed	
32	Main equipotential bonding available			✓	Passed	
33	Additional equipotential bonding avail.			✓	Passed	
34	Earthing system complete			✓	Passed	
35	Overvoltage protection functional			✓	Passed	
36	Charging cable undamaged			✓	Passed	
37	Plug connections correct			✓	Passed	
38	Identification PE, DC+, DC-, wire ident.			✓	Passed	
39	Labelling of equipment			✓	Passed	

#	Step type	Min	Max	Result	Assessment	Attachments
	IMD Testing H+E XTRA HDC+			✓	Passed	
	IMD Testing H+E XTRA HDC-			✓	Passed	
	IMD Testing H+E XTRA LDC+			✓	Passed	
	IMD Testing H+E XTRA LDC-			✓	Passed	
	URES: 2.1 V U: 338 V f: < 15.0 Hz		5 s	0.3 s		
	Parameters:- tu: <5 s - URES: <60 V				Passed	
	RISO UISO: 520 V	500 kΩ		990 kΩ		
	RISO – Rated voltage: 500 V RISO - Method: constant Parameters: RISO - Leiter: DC+ - PE RISO/RLO Measuring time: AUTO				Passed	

Testing devices

Description	Manufacturer	Type	Serial no.	Calibration
Profitest Prime (COM8): CL5831370012	GOSSEN METRAWATT	PROFITEST PRIME+AC	CL5831370012	9/8/2020

Testing result: Passed	Interval:
Date: 1/11/2022 Signature:	Next testing date: Report created by:

Page 2 of 2 of Testing Report 1/11/2022

Figure 9: Charging Point Test with PROFiTEST H+E XTRA and PROFITEST PRIME

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GMC INSTRUMENTS

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