



## **First Committee Draft (1CD)**

**Project:** New Recommendation

**Title:** Electrical Vehicle Supply Equipment (EVSE)

— Part 1: Metrological and technical requirements

— Part 2: Metrological controls and performance tests

**Clean version submitted for comments:** 04/09/2025

**Deadline for submitting comments:** 04/12/2025

**Document number:** TC12\_P3\_N048

**Project Group:** OIML TC 12/ P 3

**Convenership:** Dutch Authority for Digital Infrastructure (RDI) - Netherlands

**Convener:** Matthijs van der Wiel

---

OIML Rxx

**Electrical Vehicle Supply Equipment (EVSE)**

Metrological and technical requirements – Metrological controls and performance tests

- 1
- 2
- 3

## Contents

<i>Contents</i> .....	2
<i>Explanatory note</i> .....	4
<i>Foreword</i> .....	5
<i>Part 1 Metrological and technical requirements</i> .....	6
1 Scope.....	6
2 Terms and definitions.....	6
2.1 General terms .....	6
2.2 Definitions.....	8
2.3 Metrological characteristics.....	9
3 Metrological requirements.....	14
3.1 Units of measurement .....	14
3.2 Rated operating conditions.....	14
3.3 Accuracy requirements .....	15
3.4 Durability.....	20
4 Technical requirements.....	20
4.1 General .....	20
4.2 Markings .....	20
4.3 Suitability for use .....	21
4.4 Access to data .....	24
5 Requirements for software-controlled components and EVSE .....	28
5.1 General .....	28
5.2 Software identification.....	28
5.3 Audit trail.....	28
5.4 Detection of significant defects.....	29
5.5 Timestamps .....	29
5.6 Software update .....	29
5.7 Remote software verification capabilities.....	31
5.8 Software .....	33
5.9 Compatibility of operating system and hardware.....	33
5.10 Constraints for operation.....	34
5.11 Protection of transaction data .....	34
5.12 Client and verification interfaces.....	34
5.13 Communication interface.....	35
5.14 Separation of electronic devices and components .....	35
5.15 Separation of modules.....	36
5.16 Storage of data.....	36
5.17 Transmission of measurement data .....	38
<i>Part 2 Metrological controls and performance tests</i> .....	39
6 Type approval .....	39
6.1 Documentation.....	39
6.2 Type definition .....	40
6.3 Type test sampling .....	40

47	6.4	<i>Software validation procedure</i> .....	41
48	7	<i>Test procedures for type approval</i> .....	42
49	7.1	<i>Test programme</i> .....	42
50	7.2	<i>Test conditions</i> .....	42
51	7.3	<i>Tests for compliance with maximum permissible errors</i> .....	43
52	7.4	<i>Tests for influence quantities</i> .....	44
53	7.5	<i>Tests for disturbances</i> .....	52
54	8	<i>Examination for conformity with type</i> .....	61
55		.....	63
56			

*Annex A*

## Explanatory note

As a result of the transition from fossil fuels to sustainable forms of energy, worldwide developments in the area of charging electrical vehicles (EVs) have been proceeding at a rapid pace. In this developing market, it is important that trading parties have confidence that the amount of energy transferred is measured fairly and accurately. Regulators in various individual economies have started, or are starting, initiatives to develop national or regional metrology regulations for Electrical Vehicle Supply Equipment (EVSE), for which the requirements are not always mutually exchangeable.

The need for international guidance on metrology for EVSE was agreed upon by the Committee of OIML (CIML) at its 51st meeting in 2016 in Strasbourg, where the CIML decided on the mandate to revise OIML R 46:2012 *Active energy electricity meters*. Recommendations for EVSE metrology were initially foreseen to be included in the next version of R 46. By 2021, however, a separate Project Group was established, resulting in a separate, self-contained OIML Guide, G 22 *Electric vehicle supply equipment*, published in 2022. Immediately following the development of G 22, the same OIML Project Group produced a full Recommendation on EVSE. This Recommendation is a fine-tuned, more elaborate version of the text of G 22, and contains all the mandatory parts.

The intention of this Recommendation follows that of G 22: to provide a blueprint for requirements and procedures for type testing, to be used by national regulators and approval authorities to set up their own legislation. In this Recommendation, the EVSE is considered as a unique, built-for-purpose system, which incorporates alternating current (AC) or direct current (DC) energy metrology. Whether the metrology in the EVSE is accomplished using a separately type approved meter, or integrated into the electronics of the EVSE, does not affect the requirements for testing, or the performance of the EVSE.

This Recommendation covers both AC and DC EVSE. While practical technical experience in testing and approving AC measurement techniques is present, that for DC applications is not fully mature in various regions. However, DC charging applications constitute an important, growing portion of the EV charging market, and fair trade of electrical energy in DC is deemed at least as important as in AC.

With the publication of this Recommendation on EVSE, the OIML retracts G 22.

## Foreword

The International Organisation of Legal Metrology (OIML) is a worldwide, intergovernmental organisation whose primary aim is to harmonise the regulations and metrological controls applied by the national metrological services, or related organisations, of its Member States.

The main categories of OIML publications are:

- **International Recommendations (OIML R)**, which are model regulations that establish the metrological characteristics required of certain measuring instruments and which specify methods and equipment for checking their conformity. OIML Member States shall implement these Recommendations to the greatest possible extent;
- **International Documents (OIML D)**, which are informative in nature and which are intended to harmonise and improve work in the field of legal metrology;
- **International Guides (OIML G)**, which are also informative in nature and which are intended to give guidelines for the application of certain requirements to legal metrology; and
- **International Basic Publications (OIML B)**, which define the operating rules of the various OIML structures and systems.

OIML Draft Recommendations, Documents and Guides are developed by Project Groups linked to Technical Committees or Subcommittees which comprise representatives from OIML Member States. Certain international and regional institutions also participate on a consultation basis. Cooperative agreements have been established between the OIML and certain institutions, such as ISO and the IEC, with the objective of avoiding contradictory requirements. Consequently, manufacturers and users of measuring instruments, test laboratories, etc. may simultaneously apply OIML publications and those of other institutions.

International Recommendations, Documents, Guides and Basic Publications are published in English (E) and translated into French (F) and are subject to periodic revision.

Additionally, the OIML participates in Joint Committees with other Institutions for the development of **Vocabularies (OIML V)** and **Joint Guides** and periodically commissions legal metrology experts to write **Expert Reports (OIML E)**. Expert Reports are intended to provide information and advice, and are written solely from the viewpoint of their author, without the involvement of a Technical Committee or Subcommittee, nor that of the CIML. Thus, they do not necessarily represent the views of the OIML.

This publication – **reference** OIML R xx:20yy (E) – was developed by OIML Project Group TC 12/p 3 *Electric Vehicle Charging Stations*.

OIML Publications may be downloaded from the OIML website in the form of PDF files. Additional information on OIML Publications may be obtained from the Organisation's headquarters:

Bureau International de Métrologie Légale  
11, rue Turgot – 75009 Paris – France  
Telephone: +33 1 48 78 12 82  
Fax: +33 1 42 82 17 27  
E-mail: [biml@oiml.org](mailto:biml@oiml.org)  
Internet: [www.oiml.org](http://www.oiml.org)

# Part 1

## Metrological and technical requirements

### 1 Scope

This Recommendation provides metrological and technical requirements applicable to Electric Vehicle Supply Equipment (EVSE, both AC and DC) subject to legal metrological controls. The requirements are provided for type approval, initial verification and subsequent verification, possibly using on-site testing. This Recommendation does not apply to wireless charging systems.

The provisions set out here apply only to active electrical energy measurements and computation of transaction billing.

### 2 Terms and definitions

The terminology used in this Recommendation conforms to OIML International Document D 11 *General requirements for electronic measuring instruments* [1], OIML V 2-200:2012 *International Vocabulary of Metrology - Basic and General Concepts and Associated Terms (VIM)* [3] and OIML V 1:2013 *International vocabulary of terms in legal metrology (VIML)* [4]. Terminology from OIML International Document D 31:2023 *General requirements for software-controlled measuring instruments* [2] is also applicable, particularly for 5 and the associated validation procedures in 6.4. In addition, for the purposes of this Recommendation, the definitions in 2.1 to 2.3 below shall apply.

#### 2.1 General terms

##### 2.1.1 Electric Vehicle Supply Equipment (EVSE)

device intended to supply or receive electrical energy to or from an electric vehicle and to measure that energy, store and report the measurement result to the customer, and if necessary, transmit the information to a billing system

##### 2.1.2 EVSE with separately type approved meter

device such as defined in 2.1.1, but for which the basic metrology including generation and presentation of legally relevant transaction data is provided by a separately type approved meter which has been tested for compliance with a recognised metering standard with equal or more stringent requirements

*Note:* For EVSE with embedded metrology, the metrology is an integral part of the EVSE. In this case, separate type approval of the embedded metering functionality is not required, since it will be tested as part of the EVSE type approval process.

##### 2.1.3 unitary EVSE

EVSE, with either AC or DC output, in which all of the power and control electronics is located in a single enclosure supplied by the AC mains

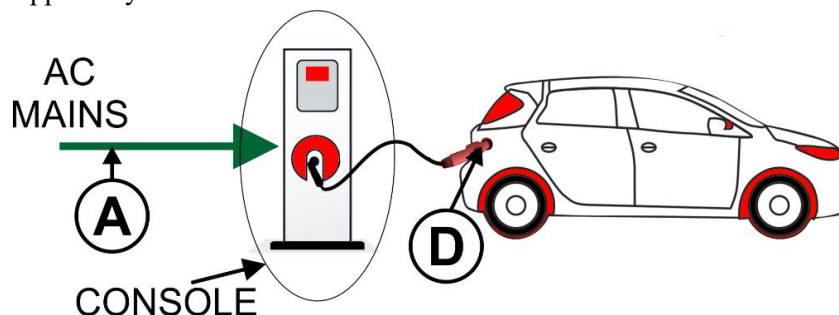


Figure 1 – Unitary EVSE

- A AC mains supply to the EVSE
- D Connection point (example where the charging cable is a fixed part of the EVSE according to 2.2.5)

2.1.4 complex DC EVSE

EVSE with DC output which is composed of multiple enclosures connected by DC power busses

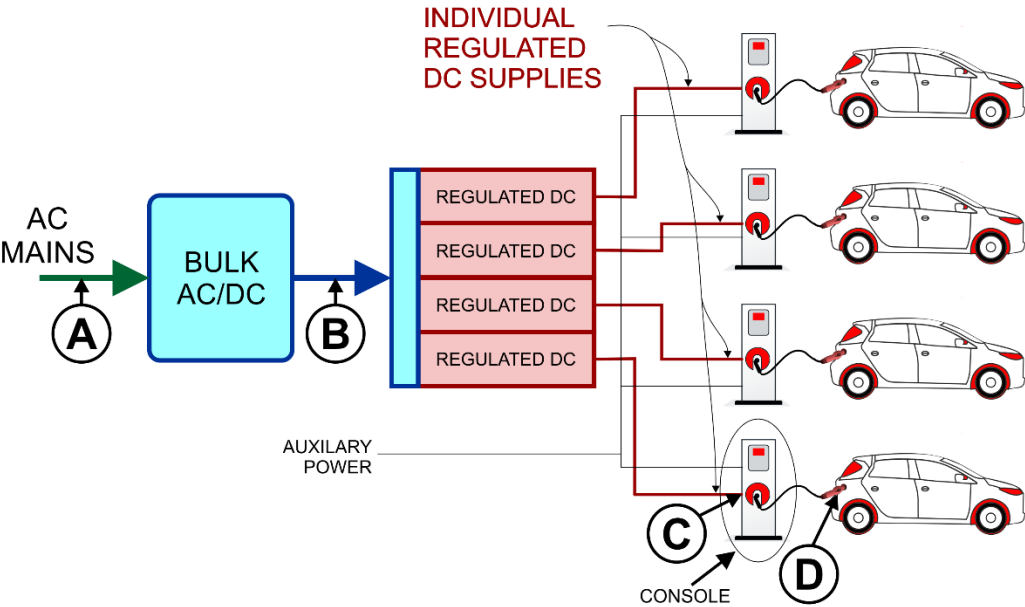


Figure 2 – Complex DC EVSE

- A AC mains supply to the EVSE
- B DC mains supply feed (generally at a fixed voltage, may be unregulated)
- C Regulated DC feed to a specific charging port
- D Connection point



173    **2.2            Definitions**

174    **2.2.1           adjustment device**

175    device or function incorporated in the EVSE that allows the error curve to be shifted with a view to  
176    bringing errors (of indication) within the maximum permissible errors

177    **2.2.2           ancillary device**

178    device within the EVSE that is not required to be active during the transaction

179    *Note:*            Since the testing used in this Recommendation is all transactional, any device which is routinely  
180                        required to be active during a transaction will have its effect tested automatically. Ancillary devices  
181                        are devices which may or may not be active at any time but which are not used as part of the  
182                        transactional process.

183    *Example:*        An EVSE might have a display which shows advertisements for a business. This would be an  
184                        ancillary device.

185    **2.2.3           cable assembly**

186    assembly consisting of flexible cable or cord fitted with a vehicle connector, that is used to establish the  
187    connection between the EV and the EVSE, mounted between the position at which the energy is  
188    measured and the connecting point

189    (source: modified from def. 3.5.2, IEC 61851-1:2017)

190    **2.2.4           client interface**

191    part of the EVSE that may be local or remote and which provides access to and displays the legally  
192    relevant transaction data to a user

193    **2.2.5           connection point**

194    point at which one electric vehicle is connected to the EVSE [definition 3.5.15 of  
195    IEC 61851-1]

196    *Note:*            If the charging cable is a fixed part of the EVSE, this point is defined as the connector at the end of  
197                        the cable. Otherwise, the connection point is defined as the point of the EVSE at which the cable is  
198                        plugged in.

199    **2.2.6           current circuit**

200    connections of the EVSE and part of the measuring element through which current flows to or from the  
201    electric vehicle connected to the EVSE

202    **2.2.7           indicating device**

203    part of the client interface that displays the legally relevant transaction data

204    *Note 1:*           An indicating device may also be used to display other relevant information.

205    **2.2.8           measuring element**

206    part of the EVSE that transforms a current and a voltage into a signal proportional to the power and/or  
207    energy

208    *Note:*            This may include both analogue and digital sensors and signal processing components.

209    **2.2.9           transaction**

210    process of authorising, connecting to the electric vehicle, delivering/receiving energy, terminating the  
211    delivery/reception, presenting the information relevant to the process to the customer, transmitting and  
212    receiving acknowledgement of receipt of any relevant information

**2.2.10 transaction types****2.2.10.1 ad hoc public transaction**

transaction for which a recharging service is available to an end user without the need for that end user to register, conclude a written agreement, or enter into a longer-lasting commercial relationship with the operator of that EVSE or with a charging network service provider, beyond the mere purchase of the service

**2.2.10.2 contractual public transaction**

transaction for which a recharging service is only available to an end user who has concluded in advance a written agreement, or entered into a longer-lasting commercial relationship with the operator of that EVSE or with a charging network service provider

**2.2.10.3 contractual private transaction**

transaction for which the use of the EVSE is limited to a single user who has concluded in advance a written agreement, or entered into a longer-lasting commercial relationship with the operator of that EVSE or with a charging network service provider

*Note:* In this type of transaction, charges may be made based on the total energy consumed over an extended billing period.

**2.2.11 verification interface**

part of the EVSE. that may provide local or remote access, be local or remote, and which provides access to and displays the legally relevant transaction data and any other data necessary for verification purposes, either being part of the instrument or provided as a tool to the relevant authorities

*Note:* The verification interface may be part of the client interface.

*Example:* The manufacturer provides a smartphone application that has a verification interface. The data transmission between the EVSE and the smartphone application complies with data transmission requirements. See clause 5.17.

**2.2.12 verification software**

software on a remote unit used for the purpose of verification of an EVSE

**2.2.13 voltage circuit**

connections, components, wiring and cables of the EVSE which provide voltage to the electric vehicle

*Note:* This includes the power source in DC EVSE (see Figure 2, from the regulated DC output up to and including the connection point).

**2.3 Metrological characteristics****2.3.1 accuracy class**

class of EVSE that meets the stated metrological requirements intended to keep measurement errors or instrumental uncertainties within specified limits under specified operating conditions

*Note:* In this Recommendation, the stated metrological requirements for accuracy class include permissible responses to disturbances.

**2.3.2 base maximum permissible error (BMPE)**

extreme values of the error (of indication) of an EVSE, permitted by this Recommendation, when the current (AC and DC EVSE) and voltage (DC EVSE) is varied within the intervals given by the rated operating conditions, and when the EVSE is otherwise operated at reference conditions

### 2.3.3 checking facility

facility incorporated in the EVSE and which enables faults to be detected and acted upon [OIML D 11:2013, 3.19]

*Note 1:* Typically, checking facilities detect and act upon incorrect functioning of a specific device of the EVSE, and/or disturbed communication between specific parts of the EVSE.

*Note 2:* “Act upon” refers to any adequate response by the EVSE (for example: a luminous signal, an acoustic signal, interruption or blocking of the measurement process, etc.).

### 2.3.4 current, $I$

value of the electrical current flowing to or from the EVSE through the connection point. For AC EVSE, the value is the RMS value of the current. For DC EVSE, the value is the average value of the current

### 2.3.5 starting current, $I_{st}$

lowest value of current specified at which the EVSE registers electrical energy

### 2.3.6 minimum current, $I_{min}$

lowest value of current at which the EVSE is specified to lie within a constant value of base maximum permissible error

*Note:* Below the minimum current and down to the starting current, the values of base maximum permissible errors are specified as a function of current.

### 2.3.7 transitional current, $I_{tr}$

value of current at and above which the EVSE is specified to lie within the smallest maximum permissible error corresponding to the accuracy class of the EVSE

### 2.3.8 maximum current, $I_{max}$

highest value of current at which the EVSE is specified by the manufacturer to meet the accuracy requirements of this Recommendation

### 2.3.9 distortion factor, $d$

ratio of the RMS value of the harmonic content (obtained e.g. by subtracting its fundamental term from a non-sinusoidal alternating quantity) to the RMS value of the fundamental term

*Note:* The distortion factor is usually expressed as a percentage. It is equal to the total harmonic distortion using the fundamental as the reference (denominator).

### 2.3.10 disturbance

influence quantity having a value within the limits specified in this Recommendation, but outside the specified rated operating conditions of the measuring instrument [OIML V1:2022, 5.19]

*Note:* An influence quantity is a disturbance if the rated operating conditions for that influence quantity are not specified.

### 2.3.11 durability

ability of a measuring instrument to maintain its performance characteristics over a period of use [OIML D 11:2013, 3.18]

### 2.3.12 energy, active, $E_a$

instantaneous active power integrated over time

$$E_a = \int_0^T p(t) \cdot dt$$

where:

$E_a$  is the active energy

$T$  is the total duration of the power delivery in a transaction

$t$  is time

Other symbols are as defined in 2.3.31.

*Note:* Active energy is usually expressed in kWh or MWh. Refer to 3.1 for requirements on units of measurement.

### **2.3.13 (energy) flow, bidirectional**

capability of an EVSE to measure energy flow in both directions (to the EV and from the EV)

### **2.3.14 (energy) flow, positive direction only**

capability of an EVSE to measure energy flow in only one direction (from the EVSE to the EV)

### **2.3.15 (energy) flow, positive**

direction of energy flow from the EVSE to the EV

### **2.3.16 (energy) flow, negative**

direction of energy flow from the EV through the EVSE to the nominal supply

### **2.3.17 harmonic**

part of a signal that has a frequency that is an integer multiple of the fundamental frequency of the power input to the EVSE

*Note:* The fundamental frequency is generally the nominal frequency,  $f_{\text{nom}}$ , for AC EVSE.

### **2.3.18 harmonic number**

integer number used to identify a harmonic. It is the ratio of the frequency of a harmonic to the fundamental frequency of the signal

### **2.3.19 influence factor**

influence quantity having a value within the rated operating conditions of the measuring instrument specified in this Recommendation [OIML D 11:2013, 3.15.1]

### **2.3.20 influence quantity**

quantity that, in a direct measurement, does not affect the quantity that is actually measured, but affects the relation between the indication and the measurement result [OIML V1:2022, 0.07]

*Note:* An influence quantity is not related to the measurand but is a quantity that affects the result of the measurement as indicated by the equipment under test (EUT).

### **2.3.21 initial intrinsic error**

intrinsic error of a measuring instrument as determined prior to performance tests and durability evaluations [OIML V1:2022, 5.11]

### **2.3.22 intrinsic error**

error of indication, determined under reference conditions [OIML V1:2022, 0.06]

### 2.3.23 legally relevant

software/hardware/data or part of the software/hardware/data of an EVSE which influences properties regulated by legal metrology, e.g. the accuracy of the measurement or the provision of transactional information to the customer

### 2.3.24 legally relevant software

all software modules of an EVSE that are subject to legal control

### 2.3.25 legally relevant transaction data

auditable data necessary to finalise a transaction

*Note:* The legally relevant transaction data includes the measurement result.

### 2.3.26 maximum permissible error (MPE)

extreme value of measurement error, with respect to a known reference quantity value, permitted by specifications or regulations for a given measurement, measuring instrument, or measuring system [OIML V1:2022, 0.05]

*Note 1:* Usually, the term “maximum permissible errors” or “limits of error” is used where there are two extreme values.

*Note 2:* The term “tolerance” shall not be used to designate “maximum permissible error”.

### 2.3.27 maximum permissible error shift

extreme values of the change in error (of indication) of an EVSE, permitted by this Recommendation, when a single influence factor is taken from its value at reference conditions and varied within the rated operating conditions

### 2.3.28 minimum measured quantity, MMQ

minimum quantity of energy delivered in a transaction for which the manufacturer specifies that the EVSE will meet the BMPE of the EVSE’s accuracy class

### 2.3.29 nominal output frequency, $f_{\text{nom}}$

frequency of the voltage (and current) specified by the manufacturer for the output power of the EVSE

*Note 1:* For AC EVSE, the frequency of the power supplied to the EVSE and the power the EVSE supplies to the vehicle are the same.

*Note 2:* For DC EVSE,  $f_{\text{nom}}$  is 0 Hz.

### 2.3.30 power factor, PF

cosine,  $\cos \varphi$ , of the phase difference,  $\varphi$ , between voltage,  $U$ , and current,  $I$ , under sinusoidal and either single-phase or symmetrical three-phase conditions

*Note:* An EVSE is only required to measure active energy. Performance is verified using a reference that can measure apparent energy and power factor.

### 2.3.31 power, instantaneous

rate at which energy is transported, the product of voltage and current at each instance of time

$$p(t) = u(t) \cdot i(t)$$

where:

$u(t)$  is the instantaneous voltage

365  $i(t)$  is the instantaneous current  
 366  $p(t)$  is the instantaneous power  
 367  $t$  is time

### 368 **2.3.32 rated operating condition**

369 operating condition that must be fulfilled during measurement in order that a measuring instrument or  
 370 measuring system perform as designed [OIML D 11:2013, 3.16]

371 *Note:* Rated operating conditions generally specify intervals of values for a quantity being measured and  
 372 for any influence quantity.

### 373 **2.3.33 reference condition**

374 operating condition prescribed for evaluating the performance of a measuring instrument or measuring  
 375 system or for comparison of measurement results [OIML D 11:2013, 3.17]

376 *Note 1:* Reference operating conditions specify intervals of values of the measurand and of the influence  
 377 quantities.

378 *Note 2:* In IEC 60050-300, item 311-06-02, the term “reference condition” refers to an operating condition  
 379 under which the specified instrumental measurement uncertainty is the smallest possible.

### 380 **2.3.34 relative error (of indication)**

381 measured quantity value minus reference quantity value, divided by the reference quantity value

382 *Note 1:* The relative error is usually expressed as a percentage.

383 *Note 2:* Since this Recommendation deals only with relative error, the short form “error” is used for relative  
 384 error.

### 385 **2.3.35 voltage, $U$**

386 *For AC EVSE:* RMS value of the electrical voltage supplied to the electric vehicle at the connection  
 387 point

388 *For DC EVSE:* value of voltage supplied to the electric vehicle at the connection point

### 389 **2.3.36 nominal voltage, $U_{\text{nom}}$**

390 voltage at which an AC EVSE is intended to operate, as specified by the manufacturer

391 *Note 1:* An EVSE may have multiple  $U_{\text{nom}}$

392 *Note 2:* Examples are: 110V, 230V.

### 393 **2.3.37 minimum voltage, $U_{\text{min}}$**

394 lowest output voltage value, specified by the manufacturer for normal operation of a DC EVSE

### 395 **2.3.38 maximum voltage, $U_{\text{max}}$**

396 highest output voltage value, specified by the manufacturer for normal operation of a DC EVSE

397

398

### 3 Metrological requirements

#### 3.1 Units of measurement

The active electrical energy shall be expressed using one of the following symbols: Wh, kWh, MWh, GWh.

#### 3.2 Rated operating conditions

Rated operating conditions are specified in Table 1.

**Table 1 Rated operating conditions**

Condition or influence quantity	Values, ranges															
Frequency <sup>(1)</sup>	$f_{\text{nom}} \pm 2 \%$ where $f_{\text{nom}}$ is to be specified by the manufacturer. If the manufacturer specifies more than one nominal frequency, the rated operating conditions shall be the combination of all frequency intervals.															
Voltage	<i>For AC EVSE:</i> For each $U_{\text{nom}}$ , $0.9 \times U_{\text{nom}}$ to $1.1 \times U_{\text{nom}}$ <i>For DC EVSE:</i> From $U_{\text{min}}$ to $U_{\text{max}}$ , while $U_{\text{min}} \leq 300 \text{ V}$ .															
Current <sup>(4)</sup>	<div><div><div><math>I_{\text{st}}</math> is to be specified by the manufacturer.</div><div><math>I_{\text{min}}</math> is to be specified by the manufacturer and shall be less than or equal to <math>I_{\text{tr}}</math>.</div><div><math>I_{\text{max}}</math> is to be specified by the manufacturer.</div></div><table><tr><th>Mode</th><th>AC</th><th>AC</th><th>DC</th><th>DC</th></tr><tr><td><math>I_{\text{tr}}</math></td><td><math>\leq 5.0 \text{ A}</math></td><td><math>\leq 0.10 I_{\text{max}}</math></td><td><math>\leq 25 \text{ A}</math></td><td><math>\leq 0.05 I_{\text{max}}</math></td></tr><tr><td><math>I_{\text{max}}</math></td><td><math>\leq 80 \text{ A}</math></td><td><math>&gt; 80 \text{ A}</math></td><td><math>\leq 500 \text{ A}</math></td><td><math>&gt; 500 \text{ A}</math></td></tr></table></div>	Mode	AC	AC	DC	DC	$I_{\text{tr}}$	$\leq 5.0 \text{ A}$	$\leq 0.10 I_{\text{max}}$	$\leq 25 \text{ A}$	$\leq 0.05 I_{\text{max}}$	$I_{\text{max}}$	$\leq 80 \text{ A}$	$> 80 \text{ A}$	$\leq 500 \text{ A}$	$> 500 \text{ A}$
Mode	AC	AC	DC	DC												
$I_{\text{tr}}$	$\leq 5.0 \text{ A}$	$\leq 0.10 I_{\text{max}}$	$\leq 25 \text{ A}$	$\leq 0.05 I_{\text{max}}$												
$I_{\text{max}}$	$\leq 80 \text{ A}$	$> 80 \text{ A}$	$\leq 500 \text{ A}$	$> 500 \text{ A}$												
Power factor <sup>(1)</sup>	$\geq 0.9$															
Temperature	From lower temperature limit to upper temperature limit as specified by manufacturer. The manufacturer shall specify the lower temperature limit from the values: −55 °C, −40 °C, −25 °C, −10 °C, +5 °C The manufacturer shall specify the upper temperature limit from the values: +30 °C, +40 °C, +55 °C, +70 °C, +85 °C.															
Humidity and water	With respect to humidity, the manufacturer shall specify the environment class for which the EVSE is intended: H1: enclosed locations where the EVSE are not subjected to condensed water, precipitation, or ice formations; H2: enclosed locations where the EVSE may be subjected to condensed water, to water from sources other than rain and to ice formations; H3: open locations with average climatic conditions.															
Harmonics <sup>(1)</sup>	<i>For AC EVSE:</i> The EVSE shall operate correctly when the supply voltage distortion is less than 10 % and the load current distortion is less than 5 % at all harmonics indices.															

Condition or influence quantity	Values, ranges
Ripple <sup>(2)</sup>	<i>For DC EVSE:</i> The EVSE shall not measure energy having frequencies above 2 kHz.
Load balance <sup>(1)</sup>	For polyphase EVSE, the EVSE shall operate correctly with any combination of phases enabled.
MMQ <sup>(3)</sup>	<i>For AC EVSE:</i> the MMQ shall not be greater than 0.1 kWh. <i>For DC EVSE:</i> the MMQ shall not be greater than 1.0 kWh.
<sup>(1)</sup> Only applies to AC EVSE. <sup>(2)</sup> Only applies to DC EVSE. <sup>(3)</sup> If no MMQ is marked the maximum value shall be assumed. <sup>(4)</sup> In case the EVSE is capable of handling negative energy flow, the current characteristics in the negative direction may be different from those in the positive direction. In that case, the current characteristics in the negative direction are to be specified by the manufacturer.	

406

407 **3.3 Accuracy requirements**408 **3.3.1 General**

409 The manufacturer shall specify the accuracy class of the EVSE to be one of A, B or C.

410 The EVSE shall be designed and manufactured such that its error does not exceed the maximum  
411 permissible error for the specified class under rated operating conditions.

412

413

414 **3.3.2 Direction of energy flow**

415 Where a manufacturer has specified that an EVSE is capable of bidirectional energy flow, the EVSE  
416 shall correctly handle both positive and negative mean energy flow and shall fulfil the requirement of  
417 this Recommendation for energy flow in both directions. For AC EVSE, the mean energy flow refers to  
418 the instantaneous power integrated over at least one cycle of the nominal frequency.

419 An EVSE shall fall into at least one of the following categories:

420 1 Two-register, bidirectional: where the EVSE is specified as being capable of measuring both  
421 positive and negative mean energy flow, and where the positive result and negative result are  
422 placed in different registers. Energy registration shall occur in the correct register when the  
423 direction of flow changes.

424 2 Single-register, positive direction only: where the EVSE is specified as being capable of  
425 measuring and registering only positive mean energy flow. It may inherently, by its design,  
426 register only positive mean energy flow or it may be equipped with a reverse running detent.  
427 The manufacturer shall specify which method is used.

428 *Note:* The terms “single-register” and “two-register” in the list above refer to the basic energy register(s)  
429 only. An EVSE may have other registers, e.g. for storage of tariff and/or phase information.

430 .



### 3.3.3 Base maximum permissible errors

The intrinsic error shall be within the base maximum permissible error stated in Table 2 for the specified current ranges when energy is at least MMQ and when the EVSE is otherwise operated at reference conditions.

**Table 2 – Accuracy classes**

Quantity		Base maximum permissible errors (%) for class		
Current, $I$	Power factor	A / 2	B / 1	C / 0.5
$I_{st} \leq I < I_{min}$	$> 0.9$	$\pm 2.5 I_{min}/I$	$\pm 1.5 I_{min}/I$	$\pm 1.0 I_{min}/I$
$I_{min} \leq I < I_{tr}$	$> 0.9$	$\pm 2.5$	$\pm 1.5$	$\pm 1.0$
$I_{tr} \leq I \leq I_{max}$	$> 0.9$	$\pm 2.0$	$\pm 1.0$	$\pm 0.5$

*Note:* Power factor is applicable to AC EVSE only and electric vehicles are constrained by standards to operate at power factors of greater than 0.9 (capacitive or inductive).

### 3.3.4 Allowed effects of influence quantities

The temperature coefficient of the EVSE shall fulfil the requirements of Table 3 when the EVSE is otherwise operated at reference conditions.

**Table 3 – Limits for temperature coefficient of error**

Influence quantity	Limits for temperature coefficient (%/K) for EVSE of class		
	A / 2	B / 1	C / 0.5
Temperature coefficient, $c$ , over any interval of the temperature range, which is not less than 15 °C and not greater than 23 °C, for current $I_{tr} \leq I \leq I_{max}$	$\pm 0.1$	$\pm 0.05$	$\pm 0.03$

When the load current is held constant at a point within the rated operating range with the EVSE otherwise operated at reference conditions, and when any single influence quantity is varied from its value at reference conditions to its extreme values defined in Table 4, the variation of error shall be such that the additional percentage error is within the corresponding limit of error shift stated in Table 4. The EVSE shall continue to function after the completion of each of these tests. Validation is provided in 7.4.

450

**Table 4 – Maximum permissible error shift due to influence quantities**

Influence quantity	Value	Test	Current	Maximum permissible error shift (%) for EVSE of class		
				A / 2	B / 1	C / 0.5
Self-heating	Continuous current at $I_{\max}$	7.4.2	$I_{\max}$	$\pm 1$	$\pm 0.5$	$\pm 0.25$
Voltage variation (AC EVSE only)	$0.9 \times \text{lowest } U_{\text{nom}}$ to $1.1 \times \text{highest } U_{\text{nom}}$	7.4.4 †	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 1.0$	$\pm 0.7$	$\pm 0.2$
Frequency variation of mains AC EVSE only	Each $f_{\text{nom}} \pm 2 \%$	7.4.5 †	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 0.8$	$\pm 0.5$	$\pm 0.2$
Harmonics in voltage and current circuits <sup>(1)</sup> AC EVSE only	$d < 5 \% I$ $d < 10 \% U$	7.4.6	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 1.0$	$\pm 0.6$	$\pm 0.3$
Reversed phase sequence (AC 3-phase only)	Any two phases interchanged	7.4.7 †	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 1.5$	$\pm 1.5$	$\pm 0.1$
Conducted disturbances, low frequency <sup>(5)</sup>	2 kHz–150 kHz	7.4.10.2 †‡	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 3.0$	$\pm 2.0$	$\pm 2.0$
Continuous (DC) magnetic induction of external origin <sup>(2)</sup>	200 mT at 30 mm from core surface <sup>(2)</sup>	7.4.8	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 3$	$\pm 1.5$	$\pm 0.75$
Magnetic field (AC, power frequency) of external origin	400 A/m	7.4.9 †	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 2.5$	$\pm 1.3$	$\pm 0.5$
Radiated, RF, electromagnetic fields	$f = 80 \text{ MHz} - 6000 \text{ MHz}$ , Field strength = 10 V/m	7.4.10.1 †	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 3$	$\pm 2$	$\pm 1$
Conducted disturbances, induced by radio frequency fields <sup>(3)</sup>	$f = 0.15 \text{ MHz} - 80 \text{ MHz}$ , Amplitude = 10 V	7.4.10.3 †‡	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 3$	$\pm 2$	$\pm 1$
Operation of ancillary devices <sup>(4)</sup>	Ancillary devices operated with $I = I_{\text{tr}}$ and $I_{\max}$	7.4.11	$I_{\text{tr}} \leq I \leq I_{\max}$	$\pm 0.7$	$\pm 0.3$	$\pm 0.15$

† These tests are not required for EVSE with a separately type approved meter if the type approval specifications meet or exceed those of this Recommendation.

‡ These tests are currently deemed not relevant in cases of DC EVSE where the influence will be filtered out by the AC to regulated DC conversion process.

(1) As long as the RMS value of the current is not higher than  $I_{\max}$  and the peak value of the current is not higher than  $1.41 \times I_{\max}$ .

(2) Manufacturers may additionally include an alarm upon detection of a continuous (DC) magnetic induction of greater than 200 mT.

(3) Direct or indirect, conducted disturbances induced by radio-frequency fields.

(4) Only applicable to those ancillary devices which might be used (but are not required) during a charging session.

(5) For DC EVSE, conducted interference in this frequency range is typically generated by the EVSE DC power supply. Therefore, it is always present any time a full system test is performed.

### 3.3.5 Allowed effects of disturbances

#### 3.3.5.1 General

The EVSE shall withstand disturbances that may be encountered under conditions of normal use. For any of the disturbances listed in Table 5, Table 6 and Table 7, no damage shall occur and the EVSE shall fulfil the requirements listed in these tables.

If a disturbance interrupts the transfer of energy, then either: (a) the transfer of energy is stopped and the transaction shall be completed correctly, or (b) when the disturbance is removed, the energy transfer is continued and the transaction shall be completed correctly after concluding the energy transfer. The legally relevant transaction data shall not be lost or corrupted.

If an EVSE is operated under the conditions outlined in Table 5, Table 6 or Table 7 and no transaction is in progress, any change in the registers or pulses of the test output shall not be taken into consideration.

#### 3.3.5.2 Electrical disturbances

The EVSE shall meet the requirements of 3.3.5.1 when exposed to the following electrical disturbances.

**Table 5 – Electrical disturbances**

Disturbance quantity	Ref.	Level of disturbance	Requirement
Electrostatic discharges	7.5.2	6 kV contact discharge 8 kV air discharge	An error shift larger than 1.0 BMPE shall not occur during disturbance.
Fast transients	7.5.3 ††	Voltage and current circuits: 2 kV Auxiliary circuits: 1.0 kV	An error shift larger than 1.0 BMPE shall not occur during disturbance.
Voltage dips and interruptions	7.5.4 ††	Voltage dips to residual voltage levels of 0 %, 40 %, 70 %, 80 % for a duration of up to 5 s.	An error shift larger than 1.0 BMPE shall not occur during disturbance.
Surges on mains power lines	7.5.5 ††	Voltage circuits: 2 kV line to line, 4 kV line to earth Auxiliary circuits: 1 kV line to line, 2 kV line to earth	An error shift larger than 1.0 BMPE shall not occur during disturbance.
Short-time overcurrent	7.5.6 ††	$5 \times I_{\max}$ limited to a maximum of 3 kA	Within BMPE after disturbance.
† These tests are not required for EVSE with separately type approved meter if the type approval specifications meet or exceed those of this Recommendation. †† These tests are currently deemed not relevant in cases of DC EVSE where the disturbance will be filtered out by the AC to regulated DC conversion process.			

#### 3.3.5.3 Environmental disturbances

The EVSE shall meet the requirements of 3.3.5.1 when exposed to the following environmental disturbances.

483

**Table 6 – Environmental disturbances**

<b>Disturbance quantity</b>	<b>Ref.</b>	<b>Level of disturbance</b>	<b>Requirement</b>
Protection against solar radiation	7.5.7.1	Three cycles of 8 h irradiation, 16 h darkness.	No alteration in appearance of the markings and legibility of the indicating device, for outdoor EVSE exposed to direct sunlight only.
Dry heat	7.5.7.2	One standard temperature higher than upper specified temperature limit, 2 h	Within base MPE after disturbance
Cold	7.5.7.3	One standard temperature lower than lower specified temperature limit, 2 h	Within base MPE after disturbance
Damp heat	7.5.7.4, 7.5.7.5	H1: 30 °C, 85 %; H2: Cyclic 25 °C, 95 % to 40 °C, 93 %; H3: Cyclic 25 °C, 95 % to 55 °C, 93 %.	Within base MPE after disturbance. No evidence of any mechanical damage or corrosion.

484

485 **3.3.5.4** Mechanical disturbances

486 The EVSE shall meet the requirements of 3.3.5.1 when exposed to the following mechanical  
487 disturbances.

488 Mechanical disturbances are intended to simulate conditions encountered during transportation. These  
489 requirements may also be eliminated from type approval if *in situ* testing is performed prior to an EVSE  
490 being put into service.

491

492

**Table 7 – Mechanical disturbances**

<b>Disturbance quantity</b>	<b>Ref.</b>	<b>Level of disturbance</b>	<b>Requirements</b>
Vibrations	7.5.8.1	Vibrations in three mutually perpendicular axes.	Within base MPE after disturbance.
Shocks	7.5.8.2	Pulse shape: Half-sine Peak acceleration: 30 g <sub>n</sub> Pulse duration: 18 ms.	Within base MPE after disturbance.

### 493 3.4 Durability

494 The EVSE shall be designed to maintain an adequate stability of its metrological characteristics over its  
 495 intended lifetime, provided it is properly installed, maintained and used according to the manufacturer's  
 496 instructions when in the environmental conditions for which it is intended.

497 The EVSE shall be designed to reduce as far as possible the effect of a defect that would lead to an  
 498 inaccurate measurement result.

499 The maximum allowed error shift is 0.5 base MPE when tested according to the specifications provided  
 500 in 7.5.9.

501 *Note:* These tests are not required for EVSE with a separately type approved meter if the type approval  
 502 specifications meet or exceed those of this Recommendation.

## 503 4 Technical requirements

### 504 4.1 General

505 An EVSE shall fulfil all requirements in this Recommendation. This includes all the metrological  
 506 requirements and the requirements on software and the internal clock (if applicable).  
 507 Devices that are capable of servicing more than one vehicle shall comply with all applicable technical  
 508 and metrological requirements for each connection point available at the EVSE.

509 An EVSE shall be constructed in such a way that possibilities for unintentional, accidental, or  
 510 intentional misuse are minimal. All parts of the EVSE which are involved in the measurement of  
 511 electrical energy, data processing and, if applicable, physical indication of the legally relevant  
 512 transaction data, shall be secured by hardware seals.

513 The enclosure of the EVSE shall meet requirements of IP 51 for indoor applications and IP 54 for  
 514 outdoor applications.

515 *Note:* The IP rating requirements is in deviation from IEC 61851-1:2017 clause 12.4, which requires IP 4X for the  
 516 EVSE enclosure. It is deemed necessary to scale the ingress of dust protection at level 5, to align with product  
 517 safety requirement standards for electricity meters (IEC 62052-31:2024 clause 11).

### 518 4.2 Markings

519 The EVSE shall have a clearly visible nameplate on which the following markings shall be present:

- 520 ▪ approval mark;
- 521 ▪ approval number/identifier;
- 522 ▪ manufacturer;
- 523 ▪ year of manufacture;
- 524 ▪ manufacturer model;

- serial number;
- nominal voltage (AC EVSE) or output voltage range (DC EVSE);
- current characteristics (starting current, minimum current, transitional current and maximum current);
- nominal frequency in Hz (AC EVSE) or “DC” (DC EVSE);
- temperature range;
- accuracy class; and
- MMQ (minimum measured quantity).

Furthermore:

- current characteristics in negative direction, if applicable and if different from positive direction.

The markings shall be indelible, distinct and legible from outside the EVSE. The markings of EVSE intended for outdoor locations shall withstand solar radiation.

If the serial number is affixed to dismountable parts, the serial number shall also be provided in a position where it is not readily disassociated from parts determining the metrological characteristics.

Symbols or their equivalent may be used where appropriate. See e.g. IEC 62053-52, 6.4, or other designations accepted by national jurisdictions.

## **4.3 Suitability for use**

### **4.3.1 Accuracy at connection point**

Accuracy shall be determined at the connection point to the vehicle (reference D in Figure 1 and Figure 2).

### **4.3.2 Replacing cable assembly**

For cable assemblies, either of the following shall apply:

- a) a cable assembly is not replaceable without breaking a metrological seal; or
- b) a cable assembly is intended to be replaceable without breaking a metrological seal, in which case:
  - i) such a part is identified in the type approval certificate as replaceable, including mentioning a unique identification (such as its type designation or part number) or cable characteristics;
  - ii) such a part itself is marked with the approval number, as well as this unique identification or cable characteristics, as well as any other relevant marking if needed to distinguish between similar unapproved devices;
  - iii) after being mounted, such a part is sealed with an installer seal;
  - iv) every individual EVSE is marked with the unique identification or cable characteristics of the replaceable part, intended to be connected.

*Note:* In case b, inspection bodies and other authorities are able to check whether the replaceable part is applied correctly by comparing the marking on the replaceable part (item ii) with the information marked on the EVSE (item iv) as well as the information stated in the type approval document (item i).

### **4.3.3 Diversion of measured energy**

The EVSE shall have no means to allow measured energy to be diverted between the point of measurement and the EV.

#### 4.3.4 Bidirectional energy flow

If an EVSE is capable of receiving and measuring electrical energy from the vehicle, then:

- a) the client interface shall be able to display all the necessary information related to the transactions in both directions;
- b) the EVSE shall be of the “two-register, bidirectional” category, as defined in 3.3.2 of this Recommendation;
- c) the accuracy requirements shall be fulfilled for both directions; and
- d) all the metrological and technical requirements from clauses 3, 4 and 5 shall also be applicable to this kind of transaction.

#### 4.3.5 Transactions

##### 4.3.5.1 Legally relevant transaction data

4.3.5.1.1 The following information items shall be provided for each transaction, where ‘required’ items are mandatory. Ad hoc public transactions

Ad hoc public transactions are defined in 2.2.10.1.

- Required:
- Measured energy in the positive flow direction
  - Measured energy in the negative flow direction (if appropriate)
  - Unit price of energy
  - Total energy-based transaction cost
  - EVSE identifier
  - Transaction ID
  - If multiple rates (i.e., price per kWh) are used, for each occurrence of each different rate
    - Unit price of energy;
    - Measured energy at this rate;
    - Start time;
    - End time;
    - Energy-based cost at this rate.

- Recommended:
- Customer identifier
  - Time and date
  - Vendor identifier

##### 4.3.5.1.2 Contractual public transactions

Contractual public transactions are defined in 2.2.10.2.

- Required:
- Measured energy in the positive flow direction
  - Measured energy in the negative flow direction (if applicable)

600		EVSE identifier
601		If multiple rates are used, for each occurrence of each different rate
602		▪ Measured energy at this rate;
603		
604	Recommended:	Unit price of energy
605		Total energy-based transaction cost
606		If multiple rates are used, for each occurrence of each different rate
607		▪ Unit price;
608		▪ Start time;
609		▪ End time;
610		▪ Cost at this tariff.
611		Customer identifier
612		Time and date
613		Vendor identifier
614		
615	4.3.5.1.3	Contractual private transactions
616		Contractual private transactions are defined in 2.2.10.3.
617	Required:	Total energy measured for the billing period in the positive flow direction
618		Total energy measured for the billing period in the negative flow direction (if
619		applicable)
620		If multiple rates are used, for each occurrence of each different rate
621		▪ Measured energy at this rate;
622	Recommended:	If multiple rates are used, for each occurrence of each different rate
623		▪ Unit price of energy;
624		▪ Start time;
625		▪ End time;
626		▪ Energy-based cost at this rate.
627	4.3.5.2	Availability of legally relevant transaction data
628		Legally relevant data referenced in 4.3.5.1 shall be stored in the EVSE. The legally relevant data shall
629		be accessible to the end user through the client interface, see 4.4.2. Alternatively, the legally relevant
630		data shall be stored at an external IT billing system (backend). After the energy transfer is completed,
631		the legally relevant data shall be made available to the user. All externally located legally relevant data
632		is treated in a secure and protected manner.
633		After the energy transfer has been completed, the data may be printed.



### 4.3.5.3 Completing transaction at connection break

Means shall be provided to automatically terminate charging and complete the transaction in the event of a break in the connection with the vehicle. Any legally relevant data associated with the transaction shall be handled as though the transaction had been completed normally.

### 4.3.6 Multiple rates

An EVSE that can apply multiple rates during an energy transfer session shall meet the following requirements:

- 1) the price applied shall not change during a transaction unless approved in advance by the user;
- 2) the EVSE shall be able to measure and store all data relevant for billing;
- 3) the sum of all energy registered in multi-rate registers shall be equal to the total energy transferred during the transaction;
- 4) only one register can be active at any one time during a transaction;
- 5) for ad hoc transactions, it shall be clear for each part of the transaction:
  - a) the amount of energy transferred;
  - b) the time interval over which the energy was transferred;
  - c) the direction of the energy transfer, if applicable; and
  - d) the unit price that was applied.

Multiple rates shall not be applied unless the customer has agreed to variable pricing through interaction with the EVSE or a contractual agreement.

### 4.3.7 Power outage

In the event of a supply power outage:

- 1) the transaction shall be paused at the time of the supply power outage;
- 2) once power is restored:
  - a) if the EVSE is able to determine it is connected to the same vehicle before and after the supply power outage, the EVSE may continue charging without additional authorisation and the transaction that was in process can complete normally;
  - b) if the EVSE is not able to determine it is connected to the same vehicle before and after the supply power outage, the EVSE shall terminate the transaction at the point that the power failed:
    - i) the EVSE may abandon the charging session with no charge to the customer; or
    - ii) the EVSE may complete the transaction, charging the customer for only the services provided up to the point of power failure. In this case all the requirements for a completed transaction apply;
  - c) if a transaction cannot be resumed after a power failure, then once power is restored the information from the last transaction shall be displayed for 15 min, or until the next transaction begins, whichever comes first.

## 4.4 Access to data

EVSE shall be equipped with a client interface.

#### 4.4.1 Indication of the result

An EVSE shall indicate the legally relevant transaction data. This shall be done in accordance with 4.4.1.1 and/or 4.4.1.2. Both options may be implemented. Option 4.4.1.2 is only allowed under the condition that the transaction is initiated (authorised) by the same software on the same device, safeguarding that the non-local client interface is available.

**4.4.1.1** The EVSE is provided with a local client interface with an indicating device that is visible from the outside of the EVSE and that is capable of showing the legally relevant transaction data as indicated in 2.3.25, with a minimum character height of 4 mm. This indication device shall be positioned either on the front side of the EVSE or in the vicinity of a socket (socket version) or cable (cable version). The indication shall remain visible for at least 15 seconds before a new transaction can be initiated. The period of 15 seconds may be shortened when indication is explicitly dismissed by the end user through a simple interaction with the interface, or by connecting the next EV.

**4.4.1.2** The EVSE is provided with a non-local client interface to provide the end user access to the data, where the following minimum requirements shall be fulfilled:

- a) the EVSE is provided with communication means to send out all necessary legally relevant transaction data as indicated in 4.3.5.1;
- b) all transported legally relevant transaction data is protected by the EVSE, by state-of-the-art cryptographic means to ensure authenticity and integrity (see 5.17.2);
- c) the legally relevant transaction data shall be made accessible to the end user together with all the information required to check the authenticity, using fit for purpose technical means. These data shall be generated by the EVSE.
- d) In case a general fit for purpose device is used as a non-local client interface, the documentation to be submitted for type evaluation shall contain a description of the method implemented to check the integrity and authenticity of the measurement data. The documentation shall describe how possible integrity or authenticity violations are detected.

*Note 1:* National authorities may decide whether a local physical client interface with an indicating device according to 4.4.1.1 is mandatory, or whether the solution according to 4.4.1.2 can be allowed, or whether additional requirements are needed.  
*Example:* The legally relevant software generates a digital signature over the transaction data. It is appended to the dataset. The private and public keys used for signing are generated in a hardware security module which protects the private key against manipulation or reading and exports the public key. The client interface verifies the signature with the public key to check the authenticity and integrity of the transaction data. To prove the origin of the transaction data the reading program needs to know whether the public key really belongs to the EVSE. Therefore, the fingerprint of the public key is presented and can be registered once, e.g. together with the serial number of the instrument when it is verified in the field.

*Note 2:* Examples of appropriate to application cryptographic signature algorithms are published by institutes such as NIST, BSI etc.

#### 4.4.2 Client interfaces

The following requirements apply to all client interfaces:

- they shall be able to display all data legally relevant transaction data correctly and in an easily readable form;
- they shall display the energy being transferred, either continuously or on demand;

- they shall provide facilities to allow any user input relevant to a transaction;
- for multi-rate devices, the data for each rate applied shall be displayed;
- any decimal fractions shall be clearly indicated;
- local client interfaces shall not be significantly affected by exposure to normal operating conditions over the maximum duration of the EVSE lifetime.

#### **4.4.3 Registers**

Electronic registers shall be non-volatile so that they retain stored values upon loss of power. Measured values shall not be overwritten and shall be capable of being retrieved upon restoration of power. The register shall be capable of processing and displaying an amount of energy sufficient to ensure that no roll over will occur during a transaction. Otherwise, if maximum capacity of the register is reached, the transaction shall be terminated. This capability applies to all registers relevant for billing including positive and negative flow registers for bidirectional EVSE and tariff registers for multi-rate EVSE.

In the case of electronic registers, the minimum retention time is until the transaction is finalised or cancelled. If electronic indicating devices have segments, then the EVSE shall be provided with a display test that switches all the display segments on then off for the purpose of determining whether all the display segments are working.

The EVSE shall have one or more registers for the energy delivered to the electrical vehicle for a transaction, which shall be reset to zero at the beginning of a new transaction. The reset to zero function shall be disabled while a charging event is ongoing.

*Note:* National authorities may require an additional totalising register, which cannot be reset without breaking a metrological seal (physical and/or digital seal), where the function to reset the totalising register that stores the total energy of all metered transactions can be secured.

#### **4.4.4 Testability**

**4.4.4.1** The EVSE shall readily provide legally relevant energy data to the evaluator with the resolution specified in 4.4.4.1.1 or 4.4.4.1.2, where the least significant digit increments by 1, without any additional means.

*Note:* These resolutions are required in order to allow testing to be done within a reasonable amount of time.

**4.4.4.1.1** An AC EVSE shall be capable of providing test results with a resolution better than or equal to 0.0001 kWh (0.1 Wh).

**4.4.4.1.2** A DC EVSE shall be capable of providing test results with a resolution better than or equal to 0.001 kWh (1.0 Wh).

**4.4.4.2** For ad hoc transactions the EVSE shall provide the price per unit of measurement and the total money value of the transaction.

**4.4.4.3** The mode of testing shall be based on the energy displayed on the client interface of the EVSE. Transaction data should be read directly from the client interface or from the cryptographic secured data-package of the legally relevant data, via a communication interface.

A dedicated pulse output shall also be present for testing purposes. The pulse output shall conform to the following:

- 4.4.4.3.1 The energy per pulse shall be no greater than the resolution of the client interface.
- 4.4.4.3.2 There is a clear relationship between the pulse output and the indication on the client interface. Specifically, the energy represented by the pulse train during a transaction shall agree with that displayed on the client interface within  $\pm 1$  least significant digit, representing the energy measured at the connection point.
- 4.4.4.3.3 The characteristics of the optical output shall conform to the following:
- 1) The wavelength of the radiated signals for emitting systems shall be between 550 nm and 1000 nm.  
*Note:* In outdoor circumstances exposed to sunlight, detecting pulse signals at infrared wavelengths ( $>800$  nm) is likely to be easier than at optical wavelengths.
  - 2) The optical output in the EVSE shall generate a signal with a radiation strength,  $E_T$ , over a reference surface (optically active area) at a distance of  $10 \text{ mm} \pm 1 \text{ mm}$  from the surface of the EVSE, with the following limiting values:  
 ON-condition:  $250 \text{ } \mu\text{W}/\text{cm}^2 \leq E_T \leq 7\,500 \text{ } \mu\text{W}/\text{cm}^2$   
 OFF-condition:  $E_T \leq 2 \text{ } \mu\text{W}/\text{cm}^2$
  - 3) The existence of a pulse output does not eliminate the requirements of 4.4.4.1 and 4.4.4.2.
- 4.4.4.3.4 It shall be possible to examine the correctness of algorithms and functions of the EVSE by metrological tests, software tests, or software examination.
- 4.4.4.4** EVSE shall be equipped with a verification interface that meets all the requirements for client interfaces. The verification interface may be part of the client interface provided that access is adequately secured to prevent misuse. All information available through the verification interface shall be transmittable to the verification software.
- The verification interface shall be capable of displaying:
- a. the measurement data as required under 4.3.5.1,
  - b. the software-identification, see 5.2 and 5.9.6,
  - c. legally relevant parameters, see 5.10, and
  - d. information to check the integrity and authenticity of the software and parameters, specifically with regard to the digital signature, see 5.4;
  - e. the audit trail, see 5.3.
- Examples:*
- (1) The verification interface is part of the local client interface with an indicating device, which is realized as an LCD touch screen in the EVSE. To prevent unauthorized access to the verification interface, it is realized as a submenu of the client interface. The submenu can only be accessed after entering a password.
  - (2) The local client interface with an indicating device is realized as an LCD touch screen in the EVSE. The verification interface is an application on an arbitrary device and communicates with the EVSE using ISO 15118 protocols. To restrict access to the verification interface, mutual authentication by means of cryptographic certificates in accordance with ISO 15118-20 is employed between the EVSE software modules and the verification interface application.
  - (3) Client interface and verification interface are two separate applications running on an arbitrary device. A fully protected and secured software module of the EVSE checks identification, integrity and authenticity of the client interface (see 5.14.4) before initiating a communication connection using OCPP (Open Charge Point Protocol). The verification

801 interface communicates with the other parts of the EVSE using ISO 15118 protocols. To restrict  
802 access to the verification interface, mutual authentication by means of cryptographic certificates  
803 in accordance with ISO 15118-20 is employed between the other EVSE software modules and  
804 the verification interface application.

## 805 **5 Requirements for software-controlled components and EVSE**

### 806 **5.1 General**

807 The software of an EVSE shall be designed in such a way that no unreasonable demands are required  
808 from the user to obtain a correct measurement result.

809 An EVSE shall be provided with the means to protect its metrological properties.

### 810 **5.2 Software identification**

811 Legally relevant software of an EVSE shall be uniquely and unambiguously identified with the software  
812 version. The identification may consist of more than one part but at least one part shall be dedicated to  
813 the legal purpose. It is permissible to have more than one legally relevant software part, however each  
814 legally relevant software part shall be identified.

815 The identification shall be made available via the verification interface, on command, permanently, or  
816 at start up.

817 If the software is modified, a new software identification is required.

818 The software identification and the means of identification shall be stated in the type approval certificate.

### 819 **5.3 Audit trail**

820 **5.3.1** Audit trails are part of the legally relevant software and shall be protected as such. It  
821 shall not be possible to delete or inadmissibly change the data of the audit trails and it  
822 shall not be possible to exchange the audit trails when the software is updated. The audit  
823 trail shall contain at minimum the following information:

- 824 • timestamp of the event;  
825 in the case of a traced update, see 5.6.3.9;
- 826 • in the case of a parameter change:
  - 827 ○ Identification of the changed parameter;
  - 828 ○ The old and new value of the changed parameter.

829 **5.3.2** The audit trail shall be made available via the verification interface and, if remote  
830 verification functionality is implemented, it shall be transmitted to the verification  
831 software. The certificate shall describe how the audit trail may be displayed or printed  
832 and specify if the audit trail is part of the remote verification procedure.

833 **5.3.3** If the audit trail has no more capacity, further changes shall be prevented.

834 *Note:* Further changes may be possible after the seal is broken, data is downloaded, and the device  
835 is re-verified.

**5.3.4** Data containing evidence of an intervention shall be displayed or printed on command and made available to the verification interface.

## **5.4 Detection of significant defects**

The EVSE shall carry out a check on the integrity of the legally relevant software at least once per week. In the event of detection of a significant defect, the EVSE shall cease to allow the performance of transactions.

The EVSE shall be equipped with software that detects defects in the hardware. In the case of detection of such a defect, the device shall cease to allow the performance of transactions.

*Note:* Examples of defects are: an open cabinet, alteration or unauthorized access to communication ports, integrity of memory devices, missing connector cables, damage to the indication device.

Significant defects shall be recorded. The event record of the facility shall have capacity for at least 100 events and shall be of a first-in-first-out type. It shall not be possible to change or zero the event record without breaking a seal and access shall be secured, for example by means of a code (password) or by means of a special device (hardware key, etc.).

*Note:* The checking facility event log is not the same as the audit trail (see 5.3).

The documentation provided for type evaluation shall enumerate the significant defects detected by the software, how the device will act upon these defects, and if necessary to understand its operation, a description of the detection algorithm.

## **5.5 Timestamps**

If timestamps are used in a transaction, these timestamps shall be in a consistent format, allowing for easy comparison of two records and tracking progress over time.

The EVSE shall use network (legal) time and may also be equipped with an internal clock to support timekeeping in the event of a network outage.

Timestamps used in transactions shall be accurate to  $\pm 60$  s with respect to legal time.

The internal clock shall synchronize to network time with sufficient frequency to prevent a drift of more than one minute ( $\pm 60$  s). The method of synchronization between the internal clock and the network time shall be described in documentation submitted for type approval. Synchronization shall not take place during a transaction.

*Note:* National jurisdictions may establish criteria for an appropriate time reference for 'legal time'.

## **5.6 Software update**

### **5.6.1 General**

Any version of legally relevant software installed in the EVSE shall conform to an approved type.

Updating the legally relevant software of an EVSE in the field should be considered as:

- a modification of the EVSE, when exchanging the software with another approved version;
- a repair of the EVSE, when re-installing the same version.

An EVSE which has been modified or repaired while in service may require initial or subsequent verification, dependent on national regulations.

Non-legally relevant software of the EVSE does not require verification after being updated.

An update shall not inadmissibly influence the measurement process.

The EVSE shall either remain inoperative during the update or ensure that the legally relevant functionality continues to meet its specifications throughout the process.

877 An update of the legally relevant software shall be either a verified update (5.6.2) or a traced update  
878 (5.6.3).

879 *Note:* National authorities may prescribe that the software update mechanism is disabled by means of a sealable  
880 setting (physical switch, secured parameter) where software updates for EVSEs in use are not allowed. In this case  
881 any updates of legally relevant software are prohibited.

882

### 883 **5.6.2 Verified update**

884 Verified update is the procedure of changing software in a verified device or component after which the  
885 subsequent verification is necessary.

886 The software to be updated can be loaded locally, i.e., directly on the measuring device, or remotely via  
887 a network. Loading and installation may be two different steps or combined into one, depending on the  
888 needs of the technical solution. After the update of the legally relevant software of an EVSE (exchange  
889 with another approved version or re-installation) the EVSE shall not be employed for legal purposes  
890 before a verification of the EVSE has been performed and the securing means have been renewed.

### 891 **5.6.3 Traced update**

892 **5.6.3.1** Traced update is the procedure of changing the software in a verified EVSE or  
893 component after which a subsequent verification is not necessary. The traced update shall  
894 not affect legally relevant parameters.

895 **5.6.3.2** The software to be updated can be loaded locally, i.e., directly on the measuring device or  
896 remotely via a network. The software update is recorded in an audit trail. The procedure  
897 for a traced update comprises several steps: loading, integrity checking, checking of the  
898 origin (authentication), installation, logging and activation. The software shall be  
899 implemented in the EVSE according to the requirements for Traced update.

900 **5.6.3.3** After initiation of the update procedure, a traced update of software shall run  
901 automatically. If some of the securing or protection measures of the EVSE are turned off  
902 to enable updating, they shall be turned on again immediately after update, independent  
903 of the result of the update process.

904 **5.6.3.4** During a traced update, existing information from protection measures, e.g. audit trail  
905 information, shall be retained.

906 **5.6.3.5** Technical means shall be employed to guarantee the authenticity of the loaded software,  
907 i.e., that it originates from the owner of the type approval certificate.

908 **5.6.3.6** Technical means shall be employed to ensure the integrity of the loaded software, i.e.,  
909 that it has not been inadmissibly changed before loading. This can be accomplished by  
910 adding a checksum or hash code of the loaded software and verifying it during the  
911 loading procedure.

912 **5.6.3.7** If the loaded software fails this test, the EVSE shall discard it and use the previous  
913 version of the software or switch to an inoperable mode. In this mode, the measuring

914		functions shall be inhibited. It shall only be possible to resume the download procedure,
915		without omitting any steps in the process for traced update, or to show an error.
916	<b>5.6.3.8</b>	An audit trail shall be employed to ensure that traced updates of legally relevant software
917		are adequately traceable within the EVSE for subsequent verification and surveillance or
918		inspection.
919	<b>5.6.3.9</b>	The audit trail shall contain at minimum the following information:
920		* success/failure of the update procedure;
921		* software identification of the installed version;
922		* software identification of the previous installed version;
923		* timestamp of the event;
924		* identification of the downloading party.
925		An entry shall be generated for each update attempt regardless of the success.
926	<b>5.6.3.10</b>	The storage device that supports the Traced Update shall have sufficient capacity to
927		ensure the traceability of traced updates of legally relevant software between at least two
928		successive verifications in the field or inspection. After having reached the limit of the
929		storage for the audit trail, it shall be ensured by technical means that further downloads
930		are impossible without breaking a seal.
931		<i>Note:</i> This requirement enables inspection authorities, which are responsible for the
932		metrological surveillance of legally controlled EVSEs, to back-trace traced updates of legally
933		relevant software over an adequate period of time (depending on national legislation).
934	<b>5.6.3.11</b>	When the software is updated, the audit trail shall not be erased or overwritten.
935	<b>5.7</b>	<b>Remote software verification capabilities</b>
936	<b>5.7.1</b>	<b>General</b>
937		The purpose of remote software verification is to check the proper functioning of the legally relevant
938		software. It does not include any type of hardware testing.
939		In case the EVSE facilitates remote verification of its software, the following requirements shall be met.
940		There shall be a description of the remote verification procedure for accessing/reading of remote
941		verification data and for executing remote verification procedures. In case remote verification is applied,
942		the description shall be made available to the relevant authorities on request.
943		The modules involved in the remote verification procedure are part of the legally relevant software and
944		shall fulfil the relevant requirements.
945		It shall always be possible to establish and ensure the integrity of the EVSE to be verified.
946	<i>Note:</i>	This requirement specifically also applies to the legally relevant software which sends data,
947		including the audit trail.
948		It shall be possible to establish the authenticity of the EVSE, i.e. the EVSE shall be uniquely identified,
949		and other means shall be provided to ensure authenticity.
950	<i>Note:</i>	This requirement specifically also applies to the legally relevant software which sends data,
951		including the audit trail.
952		The EVSE shall store logging data, audit trails, and make these available for remote verification
953		purposes.
954		For the purpose of remote verification, the EVSE shall
955		▪ use timestamps (5.5),
956		▪ provide evidence of an intervention (5.3.4),



- 957     ▪ use audit trails (5.3),
- 958     ▪ report software identification (5.2),
- 959     and
- 960     ▪ have a facility for detection of significant defects (5.4).
- 961     An ongoing measurement shall not be influenced by remote verification.
- 962     The use of the verification procedure shall not influence the compliance with other requirements.
- 963     The software integrity of the EVSE shall not be influenced by the remote verification procedure.
- 964     There shall be a legally relevant interface for data extraction for remote verification purposes.
- 965     Interfaces for remote verification shall be protected, see clauses 5.13, 5.14.2.
- 966     Access rights to the EVSE for remote verification shall be described in the documentation and made
- 967     available to the relevant authorities, see clause 6.1 in Part 2.
- 968     Provisions shall be made to securely store the result of the remote verification in the EVSE. This data
- 969     shall be protected and secured. Securing needs to ensure that only the remote verification software has
- 970     write permissions.
- 971     The result of the remote verification shall contain, at least, a unique ID (at least identifying the
- 972     verification authority) and the date of the verification.
- 973     Stored results of the verification in the EVSE shall comply with clause 5.16.
- 974     **5.7.2           Specific remote verification procedures**
- 975     For specific remote verification procedures the EVSE shall fulfil the following requirements.
- 976     **5.7.2.1       Direct extraction of test items**
- 977     When checking software integrity, the integrity measure (checksum, hash) shall be calculated
- 978     immediately before transmitting the integrity measure to the remote verification software.
- 979     Test items shall be uniquely identified. The obtained test items shall be unambiguously linked to the
- 980     measuring instrument to be verified.
- 981     Relevant test items [identified by the PG (To be added in section 9)] shall be available depending on the
- 982     specific requirement to be tested and the instrument type (e.g. approved type number, serial number,
- 983     legally relevant settings and parameters, verification information and status, software version
- 984     identification, software integrity, audit logs/trails, change logs, event logs etc.).
- 985     **5.7.2.2       Connection requirements**
- 986     The connection to the remote verification software shall comply with 5.17.

987 **5.8 Software**

988 **5.8.1** Legally relevant software shall be protected in such a way that evidence of any  
 989 intervention shall be available. Updates to legally relevant software are permitted if the  
 990 EVSE complies with the requirements of 5.6.

991 **5.8.2** Legally relevant software shall be protected against modification, loading, or changes by  
 992 swapping the component in which the software is stored. Mechanical sealing or other  
 993 technical means may be necessary to secure the EVSE.

994 **5.9 Compatibility of operating system and hardware**

995 If an operating system is part of the measuring instrument, then the operating system is legally relevant  
 996 and requirements according to 5.9.1– 5.9.8 shall be met.

997 **5.9.1 Hardware interfaces**

998 Hardware interfaces not equipped with a protective interface shall not be able to inadmissibly influence  
 999 the legally relevant software, parameters or measurement data.

1000 **5.9.2 Boot process**

1001 A secure boot process is needed to ensure protection of the legally relevant software.

- 1002 • The boot process shall ensure integrity and authenticity of the legally relevant software.
- 1003 • If a chain of trust is established over the individual steps of the boot process to ensure the  
 1004 integrity and authenticity of the legally relevant software, the processing of the chain of trust  
 1005 may be interrupted, as long as its integrity is preserved.
- 1006 • The boot configuration shall be secured and protected.
- 1007 • Booting via open interfaces shall be prohibited.

1008 **5.9.3 System resources**

1009 The combination of the legally relevant software and the operating system shall ensure that there are  
 1010 enough resources for the operation of the legally relevant application.

1011 **5.9.4 Protection during use**

1012 The operation of software that is not legally relevant shall not inadmissibly influence the legally relevant  
 1013 application.

1014 The combination of the legally relevant software and the operating system shall ensure that the legally  
 1015 relevant indication is distinguishable from other information.

1016 The access control feature of the operating system shall be configured in such way that the intended use  
 1017 cannot be inadmissibly influenced.

1018 The administration tasks of the legally relevant software shall be protected.

1019 *Note:* The term “administration task” addresses all reconfigurations and updates of the operating system.

1020 **5.9.5 Communication with legally relevant software**

1021 Communication with the legally relevant software shall be made via protective interfaces.

1022 It shall be demonstrated that the legally relevant software, parameters, and data of components that are  
 1023 legally relevant cannot be inadmissibly influenced by commands received via the protective interface

1024     **5.9.6           Identification and traceability**

1025     The configuration of the operating system shall be identifiable. The identifier shall be displayed on  
1026     command or during operation and, if applicable, transmitted to the verification software by the  
1027     measuring instrument.

1028     Legally relevant configuration settings of the operating system shall be protected, i.e. changes to the  
1029     legally relevant configuration shall be traceable.

1030     *Note 1:*         Replacing one legally relevant operating system part with a different one, i.e. by a newer version, is  
1031     considered a modification of the configuration.

1032     *Note 2:*         This implies that legally relevant operating system parts can only be changed by means of a verified  
1033     update (see 5.6.2) or by means of a traced update (see 5.6.3).

1034     **5.9.7           Suitable environment**

1035     The manufacturer shall identify the hardware and software environment that is suitable. Minimum  
1036     resources and a suitable software configuration management (e.g. processor, memory, specific  
1037     communication, version of operating system, configuration management of dynamic modules of legally  
1038     relevant software, etc.) necessary to guarantee correct functioning of the legally relevant software shall  
1039     be declared by the manufacturer and stated in the certificate.

1040     **5.9.8           Constraints for operation**

1041     The system shall be operated only in the environment specified by the manufacturer for its correct  
1042     functioning. If the minimum resources or a suitable configuration are not met, the legally relevant  
1043     software shall not operate.

1044

1045     **5.10           Parameters**

1046     Legally relevant parameters shall be secured and protected in such a way that evidence of an intervention  
1047     shall be available.

1048     All parameter changes shall be logged in the audit trail together with the source of the modification.

1049     It shall not be possible to make any modifications to parameters during a transaction.

1050     If necessary for the purpose of verification of a measuring instrument, parameter settings shall be made  
1051     available to the verification interface, and if applicable, transmitting the current relevant parameter  
1052     settings to the verification software shall be possible.

1053     **5.11           Protection of transaction data**

1054     During a transaction, the legally relevant transaction data as defined in 4.3.5 shall be protected and  
1055     secured.

1056     **5.12           Client and verification interfaces**

1057     All inputs to the client interface and verification interface shall be protected. Any function that can be  
1058     activated through the interface shall:

- 1059     •           be clearly documented
- 1060     •           not be able to inadmissibly influence the legally relevant characteristics of the instrument.

1061     *Note:*           The type evaluation authority decides whether all of these documented functions are acceptable.

### 5.13 Communication interface

All inputs from communication interfaces shall be handled by a protective interface. Any function that can be activated through a communication interface shall:

- be clearly documented
- not be able to inadmissibly influence the legally relevant characteristics of the instrument remotely, such as through a remote verification procedure or a software download.

*Note:* The type evaluation authority decides whether all of these documented functions are acceptable.

### 5.14 Separation of electronic devices and components

Legally relevant software modules or hardware components of the EVSE shall not be inadmissibly influenced by another device or by other modules or components of the EVSE.

**5.14.1** Components of an EVSE that perform legally relevant functions shall be identified, clearly defined, and documented. They form the legally relevant part of the measuring system.

**5.14.2** A legally relevant software-controlled component shall communicate with other components or devices through a protective interface. It shall not be possible to inadmissibly influence the legally relevant data through these interfaces.

This implies that there is an unambiguous assignment of each command to all initiated functions or data changes in the component.

*Note:* If legally relevant components interact with other legally relevant components or electronic devices, refer to 5.13.

*Note:* Non-legally relevant devices may exist and may be connected to the protective interface of the instrument also taking into consideration the requirement in 5.14.1.

**5.14.3** If software seals are used to prevent components from being exchanged and pairing parameters are part of the seal, then these pairing parameters are legally relevant and shall be secured and protected in such a way that evidence of an intervention is available.

**5.14.4** In the case of a non-local client interface the EVSE shall check the authenticity, identification and integrity of the non-local client interface. In case the authenticity, integrity or identity check fail, the EVSE shall cease to allow the performance of transactions.

**5.14.5** An EVSE that interacts with external devices such as mobile apps shall be designed such that interaction is limited to the following:

- Initiation of the transaction
- Termination of the transaction
- Payment for the transaction
- Indication of the legally relevant transaction data and the capability to check the authenticity and integrity of the data.

1098 If a component is shared by multiple components, e.g. one display for multiple sensors, then all the  
1099 components that share another component shall be unambiguously identified.

## 1100 **5.15 Separation of modules**

1101 All software modules (programs, subroutines, objects, etc.) that perform legally relevant functions or  
1102 that contain legally relevant data domains form the legally relevant software of an EVSE. They shall be  
1103 made identifiable as described in 5.2. If the separation of the software is not possible or needed, the  
1104 software shall be legally relevant as a whole.

1105 **5.15.1** All legally relevant software modules shall communicate with other modules through a  
1106 protective interface. It shall be demonstrated that the functions and data of modules that  
1107 are legally relevant cannot be inadmissibly influenced by commands received via the  
1108 protective interface. The legally relevant software modules and the protective interface  
1109 shall be clearly documented. All legally relevant functions and data domains of the  
1110 software shall be described to enable a type evaluation authority to decide on correct  
1111 software separation.

1112 **5.15.2** The software interface consists of program code and dedicated data domains. Defined  
1113 coded commands or data are exchanged between the software parts by storing to the  
1114 dedicated data domain by one software part and reading from it by the other. Writing and  
1115 reading program code is part of the software interface.

1116 **5.15.3** There shall be an unambiguous assignment of each command to all initiated functions or  
1117 data changes in the legally relevant part of the software. Commands that communicate  
1118 through the software interface shall be declared and documented. Only documented  
1119 commands are allowed to be activated through the software interface. The manufacturer  
1120 shall state the completeness of the documentation of commands.

1121 **5.15.4** Where the legally relevant software has been separated from the non-relevant software,  
1122 the legally relevant software shall have priority using the resources over non-relevant  
1123 software. The legally relevant process shall not be inadmissibly interrupted by legally  
1124 non-relevant software. The measurement process (realised by the legally relevant  
1125 software) shall not be delayed or blocked by other processes.

1126 Measuring functions shall not be inhibited/affected by continuous learning processes, if  
1127 present.

1128 The software documentation shall contain the description of the prioritization of using all  
1129 parts of legally relevant software.

1130 **5.15.5** If a display or printout is used both for legally relevant and legally non-relevant outputs,  
1131 the legally relevant information shall always be readable, and clearly distinguishable from  
1132 other information.

## 1133 **5.16 Storage of data**

### 1134 **5.16.1 General**

1135 If measurement data are stored for legal purposes, the following requirements shall apply. Requirements  
1136 regarding storage of data also apply to software identification, log files, results of diagnostics, result of  
1137 remote verification, etc.

### 1138 **5.16.2 Completeness of stored data**

1139 The stored measurement data shall include all relevant information necessary for future legally relevant  
1140 use, see clause 4.3.5 regarding transactions.

### 5.16.3 Protection of stored data

The storage component shall have sufficient permanency to ensure that the stored measurement data are not corrupted under normal storage conditions.

The stored legally relevant data shall be protected by appropriate means to guarantee the integrity and, if applicable, authenticity. A checking facility shall regularly check the availability of stored measurement results. In case of loss of data, the checking facility shall generate a permanent error message to be shown on the client interface.

Data can be stored using one of the following methods:

- By means of an integrated storage device, where authenticity is guaranteed by an appropriate hardware seal.
- By means of a storage device, directly connected and sealed to the EVSE, where authenticity is guaranteed because the storage device is hardware sealed to the EVSE.
- By means of network attached storage devices with limited functionality and protection capabilities. In this case, state-of-the-art cryptography shall be used that enable the retrieving software to check the integrity and authenticity of the records. Means shall be provided whereby cryptographic keys used by these methods can only be input or read if a seal is broken.

Intermediate measurement data shall always be stored locally.

The software that displays or further processes the measurement data shall check the integrity and if applicable the authenticity of the data after having read them from the storage. If an irregularity is detected, the data shall be discarded or marked unusable.

Software modules that prepare data for storing or sending, or that check data after reading or receiving, belong to the legally relevant software part.

*Note:* National authorities may establish conditions for retention of data.

### 5.16.4 Automatic storing

A checking facility shall regularly check the availability of storage. If no storage is available, no measurement shall be possible.

There shall be sufficient storage capacity for the intended application.

- Records of the measurement may be deleted if either:
  - the transaction is settled; or
  - these data have been printed by a printing device subject to legal control.

Records that provide evidence of an intervention, log files, and/or results of diagnostics, shall be kept for at least four successive verifications and/ or inspections of a measuring instrument. After that, if the storage device has no more capacity, the oldest entry of records that provide evidence of an intervention, contain the result of a remote verification, log files, results of diagnostics, may be deleted.

*Note:* This requirement enables inspection authorities, which are responsible for the metrological surveillance of legally controlled instruments, to trace intervention over an adequate period of time (depending on national legislation).

- Records that stores parameters or confidential information shall be secured and protected against deletion and overwriting.

1181       • Records that stores results of a remote verification shall be secured and protected against  
 1182       deletion and overwriting. Securing shall ensure that only the remote verification software has  
 1183       write-permissions.

1184       Records that store results of a remote verification shall be kept for at least four successive  
 1185       verifications and/ or inspections of a measuring instrument.

1186       After that, if the storage device has no more capacity the oldest entry of records may be deleted.

1187       No measurement shall be possible if the data storage device is not available.

1188       When the data necessary for the calculation of the measurement result are relevant for legal purposes,  
 1189       all measurement result relevant data included in the calculation shall be stored with the final value.

## 1190       **5.17           Transmission of measurement data**

1191       If measurement data are transmitted before they are used for legal purposes, the (below) requirements  
 1192       shall apply.

1193       Requirements regarding data transmission also apply to software identification, log files, results of  
 1194       diagnostics, data transfer during remote verification, etc

### 1195       **5.17.1       Completeness of transmitted data**

1196       The transmitted measurement data shall include all information necessary for future legally relevant use.

### 1197       **5.17.2       Protection of transmitted data**

1198       The transmitted legally relevant data shall be protected by software means to guarantee authenticity and  
 1199       integrity.

1200       *Example:*

1201       • In the case of a component that is directly connected and sealed to another component a standard protocol  
 1202       that enables checking of integrity may be used. Authenticity is guaranteed because the component is  
 1203       hardware sealed to prevent exchange.

1204       •

1205       The software that displays or further processes the measurement data shall check authenticity and  
 1206       integrity of the data received from a transmission channel. If an irregularity is detected the data shall be  
 1207       discarded or marked unusable.

1208       Software modules that prepare measurement data for sending, or that check measurement data after  
 1209       receiving, are considered part of the legally relevant software.

### 1210       **5.17.3       Transmission delay or interruption**

1211       The measurement shall not be inadmissibly influenced by a transmission delay or interruption. If  
 1212       network services become unavailable or very slow, no legally relevant measurement data shall be lost.

1213

## Part 2

# Metrological controls and performance tests

## 6 Type approval

### 6.1 Documentation

The documentation submitted with the application for type approval shall include:

- identification of the type, including
  - name or trademark and type designation;
  - version(s) of hardware and software;
  - drawing of name plate.
- metrological characteristics of the EVSE, including
  - description of the principle(s) of measurement;
  - metrological specifications such as accuracy class and rated operating conditions (3.2, 3.3);
  - any steps which should be performed prior to testing the EVSE.
- the technical specification for the EVSE, including
  - block diagram with a functional description of the components and devices;
  - drawings, diagrams and general software information, explaining the construction and operation, including interlocks;
  - description and position of seals or other means of protection;
  - any document or other evidence that the design and construction of the EVSE complies with the requirements of this Recommendation;
  - specified clock frequencies;
- user manual;
- installation manual;
- description of the checking facility , if applicable.

In addition, software documentation shall include:

- description of the legally relevant software and how the requirements are met:
  - list of software modules that belong to the legally relevant part including a declaration that all legally relevant functions are included in the description;
  - description of the software interfaces of the legally relevant software part and of the commands and data flows via this interface including a statement of completeness;
  - description of the generation of the software identification;
  - description of the software update mechanism;
  - list of parameters to be protected and description of protection means.
- description of security means of the operating system (password, etc. if applicable);
- description of the (software) sealing method(s);
- overview of the system hardware, e.g. topology block diagram, type of computer(s), type of network, etc.;
- where a hardware component is deemed legally relevant or where it performs legally relevant functions, this should also be identified;
- description of the accuracy of the algorithms (e.g. filtering of A/D conversion results, price calculation, rounding algorithms, etc.);



- 1255       ▪ description of the user interface, menus and dialogues;
- 1256       ▪ software identification and instructions for obtaining it from an instrument in use;
- 1257       ▪ list of commands of each hardware interface of the EVSE including a statement of
- 1258       completeness;
- 1259       ▪ description of data sets stored or transmitted;
- 1260       ▪ if fault detection is realised in the software, list of faults that are detected and a description of
- 1261       the detecting algorithm;
- 1262       ▪ software operating manual.

1263 Furthermore, if the type approval is partially based on existing type test documentation (such as approval  
1264 of a meter or safety testing), the application for type approval shall be accompanied by type test  
1265 documents or other evidence that supports the assertion that the design and characteristics of the  
1266 measuring instrument comply with the requirements of this Recommendation.

## 1267   **6.2           Type definition**

1268 EVSE produced by the same manufacturer may form a type, provided they have similar metrological  
1269 properties resulting from the use of the same uniform construction of parts/modules that determine the  
1270 metrological properties.

1271 A type may have several current ranges and several values of the nominal voltage and frequency, and  
1272 include several connection modes and several ancillary devices.

1273 *Note:*       The same uniform construction normally means the same construction of the measuring elements,  
1274               the same construction of metering software, the same construction of the register and indicating  
1275               device, the same temperature compensation mechanism, the same construction of case, terminal  
1276               block, and mechanical interface.

## 1277   **6.3           Type test sampling**

1278 The manufacturer shall provide at least as many specimens of the EVSE as are required by the authority  
1279 responsible for type evaluation. The type test shall be made on one or more specimens of the EVSE,  
1280 selected by the test laboratory , to establish its specific characteristics and to prove its conformity with  
1281 the requirements of this Recommendation. In the case of modifications to the EVSE made after or during  
1282 the type test and affecting only part of the EVSE, the authority responsible for type evaluation may deem  
1283 it sufficient to perform limited tests on the characteristics that may be affected by the modifications.  
1284

## 6.4 Software validation procedure

The software validation procedure consists of a combination of analysis methods and tests as shown in Table 8. The abbreviations used are described in Table 9.

**Table 8 – Validation procedures for specified requirements**

Requirement		Validation procedure
5.2	Software identification	AD + VFTSw
5.3	Audit trail	AD + VFTSw
5.4	Detection of significant defects	AD + VFTSw
5.5	Timestamps	AD + VFTM
5.6	Software update	AD + VFTSw
5.7	Remote verification update capabilities	AD + VFTSw
5.8	Software	AD + VFTSw
5.9	Compatibility of operating system and hardware	AD + VFTSw
5.10	Parameter	VFTM
5.11	Measurement data	AD + VFTSw
5.12	Client interface	AD + VFTSw
5.13	Communication interface	AD + VFTSw
5.14	Separation of electronic devices and components	AD
5.15	Separation of modules	AD
5.16	Storage of data	AD + VFTSw
5.17	Transmission of measurement data	AD + VFTSw

**Table 9 – Validation procedure abbreviations**

Abbreviation	Description OIML D 31:2023, clause 7.3.1
AD	Analysis of the documentation and evaluation of the design
VFTM	Verification by functional testing of metrological functions
VFTSw	Validation by functional testing of software functions

## **7 Test procedures for type approval**

### **7.1 Test programme**

EVSE testing is done using the same transactional process as is used in normal operation of the EVSE. This process consists of at least the following steps:

- 1) Initiating a charging session using the standard handshake exchange between the EVSE and a vehicle. For test purposes, a vehicle may be replaced by a simulated vehicle, as long as it conforms to the usual protocols for handshake exchange.
- 2) Charging at a specified power level for a quantity of energy that is equal to or greater than MMQ.
- 3) Terminate the transaction normally using the vehicle to EVSE communications protocol.
- 4) Compare the energy delivered and – for ad hoc transactions – the transaction cost provided by the EVSE with the measured energy of the reference standard and the cost computed based on that energy. Alternatively, the measurement is performed based on pulse comparison.

For a DC EVSE, the energy delivered shall be sufficient so that the amount of energy delivered during ramp up and ramp down are less than 10 percent of the energy delivered at the test power.

All influence and disturbance tests can be performed either with a real load or with a phantom load, in consultation with the manufacturer. However, for DC EVSE the intrinsic error test shall be performed with real load, while taking into account the possible effect of the applied amplifiers on the measuring part.

Power shall be applied to the EVSE for a period of 15 min before the start of testing.

The determination of the initial intrinsic error (at reference conditions) shall always be carried out before tests of influence quantities and before disturbance tests that relate to a limit of error shift requirement.

Otherwise, the order of tests is not prescribed in this Recommendation.

If an EVSE is specified for both single-phase and three-phase operation, then both configurations shall be tested.

For the purposes of the tests for DC EVSE the DC reference meter shall only measure energy up to 2 kHz.

Because of the nature of transactional testing, all tests contain transitional periods where the voltage and/or current are changing. Except during transitions between power levels, voltages and currents are typically slowly varying. As a result, no specific test with rapidly changing loads is present.

### **7.2 Test conditions**

Unless otherwise stated in the individual test instructions, all influence quantities except for the influence quantity being tested shall be held at reference conditions as given by Table 10 during type approval tests.

**Table 10 – Reference conditions for type approval testing**

Quantity	Reference conditions	Tolerance
----------	----------------------	-----------

Voltage(s) AC EVSE DC EVSE	Highest $U_{\text{nom}}$ 375 VDC and 750 VDC	$\pm 1 \%$ $\pm 50 \text{ VDC}$ $\pm 50 \text{ VDC}$
Ambient temperature	23 °C <sup>(1)</sup>	$\pm 2 \text{ °C}$
Frequency AC EVSE DC EVSE	$f_{\text{nom}}$ DC	$\pm 0.3 \%$ N/A
Waveform ( $U$ and $I$ ) AC EVSE DC EVSE	Sinusoidal DC	$d \leq 2 \%$ N/A
Magnetic induction of external origin at reference frequency	0 T	$B \leq 0.05 \text{ mT}$
Electromagnetic RF fields 30 kHz to 6 GHz	0 V/m	$\leq 1 \text{ V/m}$
Load balance (3-phase AC EVSE) <sup>(2)</sup>	Equal current in all current circuits	$\pm 2 \%$
<sup>(1)</sup> Tests may be performed at other temperatures if the results are corrected to the reference temperature by applying the temperature coefficient established in the type tests and provided an appropriate uncertainty analysis is carried out. <sup>(2)</sup> The requirement applies to both phase-to-phase and phase-neutral for poly-phase EVSE. <i>Note:</i> The reference conditions and their tolerance are given to ensure reproducibility between testing laboratories, not to determine the accuracy of the tests. The demands on short term stability during testing for influence factors may be much higher than shown in this table.		

1331

1332

**Table 11 – Load conditions and their tolerances in tests**

Quantity	Conditions	Tolerance
Current	Current range of device under test	Class A, B: $\pm 2 \%$ Class C: $\pm 1 \%$
Power factor (AC EVSE only)	Power factor range of device under test	Current to voltage phase difference: $\pm 2^\circ$
<i>Note:</i> The load conditions and their tolerance are given to ensure reproducibility between testing laboratories, not to determine the accuracy of the tests. The demands on short time stability during testing for influence factors may be much higher than shown in this table.		

### 1333 7.3 Tests for compliance with maximum permissible errors

#### 1334 7.3.1 Determination of initial intrinsic error

1335 Object of the test: To verify that the error of the EVSE at reference conditions is less than the  
1336 relevant BMPE given in Table 2.

1337 Test procedure: An EVSE that is specified as being capable of bidirectional or unidirectional  
1338 energy measurement as described in 3.3.2 shall meet the relevant BMPE  
1339 requirements of Table 2 for energy flow in both positive and negative  
1340 directions. For DC EVSE the test shall be performed with real load, while  
1341 taking into account the possible effect of the applied amplifiers on the  
1342 measuring part.

1343 The order of the test points for initial intrinsic error shall be from lowest  
1344 current to highest current and then from highest current to lowest current at  
1345 each nominal voltage, beginning at the lowest and proceeding to the highest.  
1346 For a DC EVSE, the test shall be run from the minimum output voltage to  
1347 the maximum output voltage.

1348 Mandatory test points:

1349 AC EVSE: Tests shall be conducted at unity power factor at  $I_{\min}$ ,  $I_{tr}$ , 50 %  $I_{\max}$  and  $I_{\max}$   
1350 for a delivered energy of at least the minimum measured quantity at each  
1351  $U_{\text{nom}}$ . If an EVSE is rated for multiple frequencies it shall be tested at all  
1352 nominal frequencies.

1353 DC EVSE: Tests shall be conducted at  $I_{\min}$ ,  $I_{tr}$ , 50 %  $I_{\max}$  and  $I_{\max}$  for a delivered energy  
1354 of at least the minimum measured quantity at  $U_{\min}$ ,  $U_{\max}$ , and the midpoint  
1355 between. The total quantity of energy delivered shall be sufficient such that  
1356 at least 90 % of the energy delivered is delivered at intended power level.

### 1357 7.3.2 Starting current

1358 Object of the test: To verify that the EVSE starts and continues to operate at  $I_{st}$  as given by  
1359 Table 1 and that it meets the accuracy requirements of Table 2.

1360 Test procedure: The EVSE shall be subjected to a current equal to the starting current  $I_{st}$  for  
1361 a delivered energy of the minimum measured quantity. If the EVSE is  
1362 designed for the measurement of energy in both directions, then this test shall  
1363 be applied once with energy flowing in each direction. The effect of an  
1364 intentional delay in measurement after reversal of the energy direction shall  
1365 be taken into account when performing the test.

1366 The EVSE shall fulfil the requirements of Table 1 and of Table 2.

1367 Mandatory test points: The voltage shall be at the lowest reference voltage.

## 1368 7.4 Tests for influence quantities

### 1369 7.4.1 General

1370 The purpose of these tests is to verify the requirements of 3.3.4 due to the variation of a single  
1371 influence quantity. For influence quantities listed in Table 4, it shall be verified that the error shift due  
1372 to the variation of any single influence quantity is within the corresponding limit of error shift stated in  
1373 Table 4 (see also the definition of maximum permissible error shift in 2.3.27).

1374 All tests for AC EVSE are performed at the reference voltage unless otherwise stated. All tests for DC  
1375 EVSE are performed at one of the reference voltages, unless otherwise stated.

### 1376 7.4.2 Self-heating

1377 Object of the test: To verify that the EVSE is able to carry  $I_{\max}$  continuously as specified in  
1378 Table 4.

1379 Test procedure: AC EVSE: The EVSE shall be run for 3 h at  $I_{\max}$ .  
1380 DC EVSE: The EVSE shall be run for three charge sessions of 25 kWh  
1381 each, at a current of  $I_{\max}$  with no more than 5 min in between.

1382 Before and immediately following the above, an accuracy test shall be  
1383 performed at the same current value higher than or equal to  $I_{tr}$ . The error shift  
1384 compared to the intrinsic error shall comply with the requirements given in  
1385 Table 4.  
1386

1387 In case the EVSE applies de-rating, where charging is started at maximum  
1388 output current, while after a certain time interval the current is reduced to a  
1389 lower value (for e.g. safety reasons), the self-heating test is performed under  
1390 these conditions.

1391

#### 1392 7.4.3 Temperature dependence

1393 Object of the test: To verify that the temperature coefficient requirements of Table 3 are  
1394 fulfilled.

1395 Test procedure: The error of the EVSE shall be determined after reaching temperature  
1396 stabilisation. The error shall be determined at each of the upper and lower  
1397 ambient temperature limits specified for the EVSE, and at each of the  
1398 temperatures from the following list in between:

1399  $-55\text{ }^{\circ}\text{C}$ ,  $-40\text{ }^{\circ}\text{C}$ ,  $-25\text{ }^{\circ}\text{C}$ ,  $-10\text{ }^{\circ}\text{C}$ ,  $+5\text{ }^{\circ}\text{C}$ ,  
1400  $+23\text{ }^{\circ}\text{C}$ ,  $+40\text{ }^{\circ}\text{C}$ ,  $+55\text{ }^{\circ}\text{C}$ ,  $+70\text{ }^{\circ}\text{C}$ ,  $+85\text{ }^{\circ}\text{C}$

1401 Furthermore, for each pair of test points the temperature coefficient,  $c$ , shall  
1402 be determined as follows:

$$1403 \quad c = \frac{e_u - e_l}{t_u - t_l}$$

1404 where:  $e_u$  and  $e_l$  are the errors at the upper and the lower temperatures  
1405 respectively in the temperature interval of interest; and

1406  $t_u$  and  $t_l$  are the upper and the lower temperatures respectively in  
1407 the temperature interval of interest.

1408 Each temperature coefficient shall be in accordance with the requirements  
1409 of Table 3.

1410 The test can be limited to an accuracy test at the extreme temperatures for  
1411 EVSE with separately type approved meter.

1412 Mandatory test points: The test shall be performed at whichever reference voltage allows the largest  
1413 current.

1414 The test shall, at minimum, be performed at a current of  $I_{tr}$  and 50 %  $I_{max}$ .

1415 For AC EVSE a test point is added at  $I_{max}$ .

1416

#### 1417 7.4.4 Voltage variation (AC EVSE)

1418 Object of the test: To verify that the error shift due to voltage variations complies with the  
1419 requirements of Table 4.

1420 Test procedure: The error shift, compared to the intrinsic error at  $U_{nom}$ , shall be measured  
1421 when the voltage is varied within the corresponding rated operating range.  
1422 For poly-phase EVSE, the test voltage shall be balanced.

1423 Mandatory test points: If several  $U_{nom}$  values are stated, the test shall be run at the  $0.9 \times$  the lowest  
1424  $U_{nom}$ , all  $U_{nom}$ , and  $1.1 \times$  the highest  $U_{nom}$ . The test current shall be 50 %  $I_{max}$ .

1425 Acceptance criteria: The error shift shall not exceed that stated in Table 4.

**1426 7.4.5 Frequency variation (AC EVSE)**

1427	Object of the test:	To verify that the error shift due to frequency variations complies with the
1428		requirements of Table 4.
1429	Test procedure:	The error shift, compared to the intrinsic error at $f_{\text{nom}}$ , shall be measured
1430		when the frequency is varied within the corresponding rated operating range.
1431		If several $f_{\text{nom}}$ values are stated, the test shall be repeated with each $f_{\text{nom}}$ value.
1432	Mandatory test points:	The test shall, at minimum, be performed at a current of 50 % $I_{\text{max}}$ , and at
1433		frequencies of $f_{\text{nom}} \pm 2\%$ .
1434	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.

**1435 7.4.6 Harmonics in voltage and current (AC EVSE)**

1436	Object of the test:	To verify that the error shift due to harmonics for an AC EVSE complies
1437		with the requirements of Table 4.
1438	Test procedure:	The error shift, compared to the intrinsic error at sinusoidal conditions, shall
1439		be measured under each set of conditions described below.
1440		Harmonic amplitudes are calculated relative to the amplitude of the
1441		fundamental frequency component of the voltage or current respectively.
1442		Phase angle is calculated relative to the zero-crossing of the fundamental
1443		frequency voltage or current component respectively.
1444	Mandatory test points:	The test shall, at minimum, be performed at 50 % $I_{\text{max}}$ .
1445	Test #1:	With a sinusoidal reference voltage and current of waveform EV#1 with a
1446		fundamental of 50 % $I_{\text{max}}$ measure the energy for a delivery of not less than
1447		the MMQ.
1448	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1449	Test #2:	With voltage of waveform EV#1 with the fundamental equal to the reference
1450		voltage and current of waveform EV#1 with a fundamental of 50 % $I_{\text{max}}$
1451		measure the energy for a delivery of not less than the MMQ.
1452	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1453	Test #3:	With voltage waveform EV#2 with the fundamental equal to the reference
1454		voltage and current waveform EV#1 with a fundamental of 50 % $I_{\text{max}}$
1455		measure the accuracy for a delivery of not less than the MMQ.
1456	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1457		

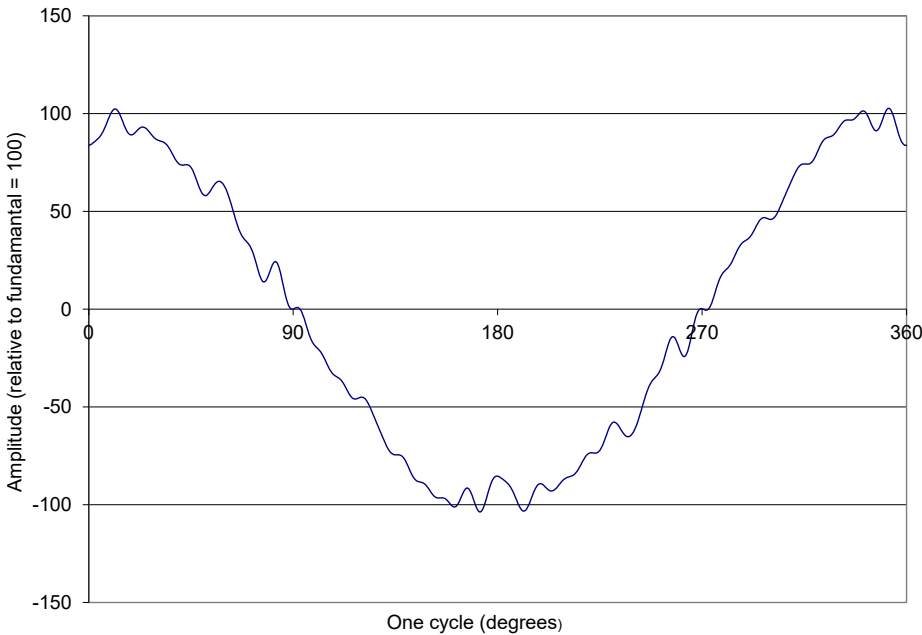
1458

Table 12 – EV waveform #1

Harmonic number	Amplitude (%)	Phase angle (°)	Harmonic number	Amplitude (%)	Phase angle (°)
1	100.00	0	2	0.25	188
3	3.00	217	4	0.20	150
5	2.40	212	6	0.16	232
7	2.28	159	8	0.15	205
9	2.16	143	10	0.14	165
11	2.05	254	12	0.00	0.00
13	1.95	95	14	0.00	0.00
15	1.85	188	16	0.00	0.00
17	1.76	266	18	0.00	0.00
19	1.67	168	20	0.00	0.00
21	1.59	216	22	0.00	0.00
23	1.51	247	24	0.00	0.00
25	1.43	240	26	0.00	0.00
27	1.36	120	28	0.00	0.00
29	1.29	239	30	0.00	0.00
31	1.23	29	32	0.00	0.00
33	1.17	133	34	0.00	0.00
35	1.11	59	36	0.00	0.00
37	1.05	135	38	0.00	0.00
39	1.00	370	40	0.00	0.00

1459

Figure 3 – EV waveform #1





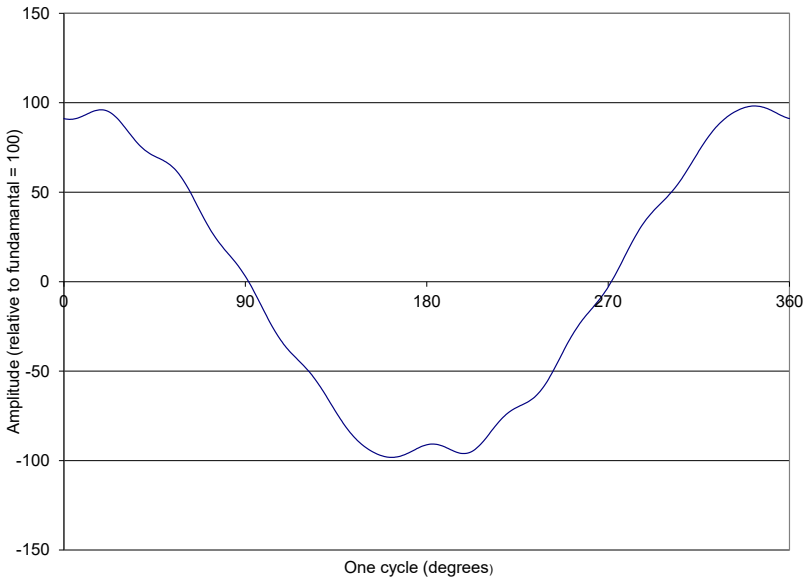
1460

**Table 13 – EV waveform #2**

<b>Harmonic number</b>	<b>Amplitude (%)</b>	<b>Phase (°)</b>	<b>Harmonic number</b>	<b>Amplitude (%)</b>	<b>Phase (°)</b>
1	100	0	2	0.00	0.00
3	3.80	217	4	0.00	0.00
5	2.40	212	6	0.00	0.00
7	2.28	159	8	0.00	0.00
9	2.16	143	10	0.00	0.00
11	2.05	254	12	0.00	0.00
13	1.70	95	14	0.00	0.00
15	1.85	188	16	0.00	0.00
17	1.76	266	18	0.00	0.00
19	1.67	168	20	0.00	0.00
21	0.00	0.00	22	0.00	0.00
23	0.00	0.00	24	0.00	0.00
25	0.00	0.00	26	0.00	0.00
27	0.00	0.00	28	0.00	0.00
29	0.00	0.00	30	0.00	0.00
31	0.00	0.00	32	0.00	0.00
33	0.00	0.00	34	0.00	0.00
35	0.00	0.00	36	0.00	0.00
37	0.00	0.00	38	0.00	0.00
39	0.00	0.00	40	0.00	0.00

1461

Figure 4 – EV waveform #2



1462     **7.4.7     Reversed phase sequence (any two phases interchanged) (AC EVSE)**

- 1463     Object of the test:     To verify that the error shift due to interchanging any two of the three phases  
1464                                         complies with the requirements of Table 4. This test only applies to three-  
1465                                         phase AC EVSE.
- 1466     Test procedure:     The error shift, compared to the intrinsic error at reference conditions, shall  
1467                                         be measured when any two of the three phases are interchanged.
- 1468     Mandatory test points:     The test shall, at minimum, be performed at a reference current of 50 %  $I_{\max}$   
1469                                         with any two of the three phases interchanged.
- 1470     Acceptance criteria:     The error shift shall not exceed that stated in Table 4.

1471     **7.4.8     Continuous (DC) magnetic induction of external origin**

- 1472     Object of the test:     To verify that the error shift due to continuous (DC) magnetic induction of  
1473                                         external origin complies with the requirements of Table 4.
- 1474     Test procedure:     The error shift, compared to the intrinsic error at reference conditions, shall  
1475                                         be measured when the EVSE is subjected to continuous magnetic induction  
1476                                         with a probe in the form of a permanent magnet with a surface area of at  
1477                                         least 2000 mm<sup>2</sup>. The magnetic field along the axis of the magnet's core shall  
1478                                         comply with details specified in Table 14.

1479     **Table 14 – Specifications of the field along axis of the magnet's core**

Distance from magnet surface	Magnetic induction	Tolerance
30 mm	200 mT	±30 mT
<i>Note:</i> The DC magnet produces the above mentioned magnetic field at the distance of 30 mm. However, during the test, the magnet is positioned directly on the surface of the EVSE under test.		

- 1480     Mandatory test points:     Six points evenly distributed across each EVSE surface, especially at areas  
1481                                         where metrologically relevant components are located. The test current shall  
1482                                         be higher than or equal to  $I_{tr}$ . The greatest error shift is to be noted as the  
1483                                         test result.

1484	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1485	<i>Note:</i>	Neodymium or niobium permanent magnets are recommended for
1486		this test.
1487	<b>7.4.9</b>	<b>Magnetic field (AC, power frequency) of external origin</b>
1488	Applicable standard:	IEC 61000-4-8 and where applicable IEC 61851-21-2.
1489	Object of the test:	To verify that the error shift due to an AC magnetic field at power frequency
1490		complies with the requirements of Table 4.
1491	Test procedure:	The error shift, compared to the intrinsic error at reference conditions, shall
1492		be measured when the EVSE is exposed to a magnetic field at each $f_{\text{nom}}$ under
1493		the most unfavourable condition of phase and direction.
1494	Test severity:	Continuous field, 400 A/m.
1495	Mandatory test points:	The test current shall be higher than or equal to $I_{\text{tr}}$ .
1496	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1497	<i>Note:</i>	Testing can be limited to the metrologically relevant parts, for EVSE of large dimensions.
1498	<b>7.4.10</b>	<b>Electromagnetic fields</b>
1499	<b>7.4.10.1</b>	<b>Radiated, radio frequency (RF), electromagnetic fields</b>
1500	Applicable standard:	IEC 61000-4-3 or IEC 61000-4-20, and where applicable IEC 61851-21-2.
1501	Object of the test:	To verify that the error shift due to radiated, radio frequency,
1502		electromagnetic fields complies with the requirements of Table 4.
1503	Test procedure:	The error shift, compared to the intrinsic error at sinusoidal conditions, shall
1504		be measured when the EVSE is subjected to electromagnetic RF fields. The
1505		electromagnetic field strength shall be as specified by the severity level and
1506		the field uniformity shall be as defined by the standard referenced. The
1507		frequency ranges to be considered are swept with the modulated signal,
1508		pausing to adjust the RF signal level or to switch oscillators and antennas as
1509		necessary. Where the frequency range is swept incrementally, the step size
1510		shall not exceed 1 % of the preceding frequency value. The test time for a
1511		1 % frequency change shall not be less than the time to make a measurement
1512		and in any case not less than 3 s.
1513		The cable length exposed to the electromagnetic field shall be at least 1 m.
1514		The test shall be performed with the generating antenna facing each side of
1515		the EVSE. When the EVSE can be used in different orientations (i.e., vertical
1516		or horizontal) all sides shall be exposed to the fields during the test.
1517		The carrier shall be modulated with 80 % AM at 1 kHz sine wave.
1518		
1519	Test condition:	During the test, the EVSE shall be energised with at the lowest $U_{\text{nom}}$ and a
1520		current higher than or equal to $I_{\text{tr}}$ . The measurement error of the EVSE shall
1521		be monitored by comparison with a reference standard not exposed to the
1522		electromagnetic field or immune to the field, or by an equally suitable
1523		method. The error at each 1 % incremental interval of the carrier frequency
1524		shall be monitored and compared to the requirements of Table 4. When using
1525		a continuous frequency sweep, this can be accomplished by adjusting the
1526		ratio of the sweep time and the time of each measurement.

1527	Test severities:	80 MHz to 6000 MHz at a field strength of 10 V/m.
1528	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1529	<b>7.4.10.2</b>	Immunity to conducted disturbances, induced by low frequency fields
1530	Applicable standard:	IEC 61000-4-19 and where applicable IEC 61851-21-2.
1531	Object of the test:	To verify an EVSE's immunity against disturbing differential currents in the
1532		2 kHz–150 kHz frequency range originating from power electronics and
1533		power line communication systems.
1534	Test procedure:	The test is performed with disturbances in the current only; the test with
1535		voltage disturbances is not required. The test shall be carried out according
1536		to IEC 61000-4-19:2014, with the following conditions:
1537		The differential test current, $I_{\text{diff}}$ , shall be applied to the mains port:
1538		1) 2 kHz to 30 kHz: $I_{\text{diff}} = (2 \pm 0.2) \% I_{\text{max}}$ ,
1539		2) 30 kHz to 150 kHz: $I_{\text{diff}} = (0.5 \pm 0.1) \% I_{\text{max}}$ .
1540		The test waves profiles “CW (Continuous Wave) pulses with pause” and
1541		“rectangular modulated pulses” shall be used (IEC 61000-4-19:2014, 5.2.2
1542		and 5.2.3).
1543		Tests shall be performed at the following frequencies:
1544		2 kHz, 3 kHz, 5 kHz, 7 kHz, 10 kHz, 15 kHz, 20 kHz, 30 kHz, 40 kHz,
1545		50 kHz, 70 kHz, 85 kHz, 100 kHz, 120 kHz, 150 kHz
1546	Test conditions:	Voltage set to the lowest $U_{\text{nom}}$
1547		Current set to higher than or equal to $I_{\text{tr}}$
1548	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.
1549	<b>7.4.10.3</b>	Immunity to conducted disturbances, induced by radiofrequency fields
1550	Applicable standard:	IEC 61000-4-6 and where applicable IEC 61851-21-2
1551	Object of the test:	To verify that the error shift due to conducted disturbances, induced by RF
1552		fields complies with the requirements of Table 4.
1553	Test procedure:	A radiofrequency electromagnetic current to simulate the influence of
1554		electromagnetic fields shall be coupled or injected into the power ports and
1555		I/O ports of the EVSE using coupling/decoupling devices as defined in the
1556		standard referenced. The performance of the test equipment consisting of an
1557		RF generator, (de)coupling devices, attenuators, etc. shall be verified.
1558		During the test, the EVSE shall be energised with voltage set to the lowest
1559		$U_{\text{nom}}$ and a current higher than or equal to $I_{\text{tr}}$ . The error at each 1 %
1560		incremental interval of the carrier frequency shall be monitored and
1561		compared to the requirements of Table 4. When using a continuous
1562		frequency sweep, this can be accomplished by adjusting the ratio of the
1563		sweep time and the time of each measurement. When using incremental 1 %
1564		frequency steps, this can be accomplished by adjusting the dwell time on
1565		each frequency to fit the measurement time. The test time for a 1 %
1566		frequency change shall not be less than the time to make a measurement and
1567		in any case not less than 3 s.
1568		

1569	Test severity:	RF amplitude (50 $\Omega$ ):	10 V (e.m.f.)
1570	Frequency range:	0.15 MHz to 80 MHz	
1571	Modulation:	80 % AM, 1 kHz sine wave	
1572	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.	

#### 1573 **7.4.11 Operation of ancillary devices**

1574	Object of the test:	To verify compliance with the requirements of Table 4 under conditions of	
1575		operation of ancillary devices. The operation of ancillary devices shall be	
1576		tested to ensure that they do not affect the metrological performance of the	
1577		EVSE.	
1578	Test procedure:	In this test, the EVSE shall be operated at reference conditions and its error	
1579		continuously monitored, while ancillary devices such as communication	
1580		devices, relays and other I/O circuits are operated.	
1581	Allowed effects:	The functionality of the EVSE shall not be impaired and the error shift due	
1582		to the operation of the ancillary devices shall always be less than the error	
1583		shift limit specified in Table 4.	
1584	Mandatory test point:	higher than or equal to $I_{tr}$	
1585	Acceptance criteria:	The error shift shall not exceed that stated in Table 4.	

### 1586 **7.5 Tests for disturbances**

#### 1587 **7.5.1 General instructions for disturbance tests**

1588	These tests are to verify that the EVSE fulfils the requirements for the influence of disturbances as given		
1589	by Table 5, Table 6 and Table 7. Tests are to be performed using one disturbance at a time; all other		
1590	quantities shall be set to reference conditions unless otherwise stated in the relevant test description.		
1591	Temporary loss of functionality is allowed as long as the EVSE returns to normal functionality		
1592	automatically, without any manual intervention, when the disturbance is removed.		
1593	For AC EVSE the mandatory test point for the check of base maximum permissible error is at $U_{nom}$ and		
1594	at 50 % $I_{max}$ , PF = 1.		
1595	For DC EVSE the mandatory test point(s) are at a current higher than or equal to $I_{tr}$ and at one of the		
1596	reference voltages unless otherwise stated.		

#### 1597 **7.5.2 Electrostatic discharge**

1598	Applicable standard:	IEC 61000-4-2 and where applicable IEC 61851-21-2	
1599	Object of the test:	To verify compliance with the requirements of 3.3.5.2 and Table 5 under	
1600		conditions of direct and indirect electrostatic discharge.	
1601	Test procedure:	An ESD generator shall be used with performance characteristics specified	
1602		in the referenced standard. Before starting the tests, the performance of the	
1603		generator shall be verified. At least 10 discharges, in both positive and	
1604		negative polarities, shall be applied. For an EVSE not equipped with a	
1605		ground terminal, the EVSE shall be fully discharged between discharges.	
1606		Contact discharge is the preferred test method. Air discharges shall be used	
1607		where contact discharge cannot be applied. The time interval between	
1608		successive discharges shall be at least 1 second. The test pulses shall be	
1609		applied continuously during the measurement time.	
1610	Test severity:	Contact discharge voltage (1):	6 kV

1611		Air discharge voltage (2):	8 kV
1612	Direct application:	In the contact discharge mode to be carried out on conductive surfaces, the electrode shall be in contact with the EVSE. In the air discharge mode on insulated surfaces, the electrode is approached to the EVSE and the discharge occurs by spark.	
1613			
1614			
1615			
1616	Indirect application:	The discharges are applied in the contact mode to coupling planes mounted in the vicinity of the EVSE.	
1617			
1618	Test:	A transaction shall be performed at the mandatory test point specified in 7.5.1, for a sufficient quantity of energy to allow all of the discharges to be applied.	
1619			
1620			
1621		Apply the discharges during the transaction.	
1622	Allowed effects:	See requirements of 3.3.5.2 and Table 5.	
1623			
1624			
1625	<b>7.5.3</b>	<b>Fast transients</b>	
1626	Applicable standards:	IEC 61000-4-1, IEC 61000-4-4 and where applicable IEC 61851-21-2.	
1627	Object of the test:	To verify compliance with the requirements of 3.3.5.2 and Table 5 under conditions where electrical bursts are superimposed on voltage and current circuits, and I/O and communication ports.	
1628			
1629			
1630	Test procedure:	A burst generator shall be used with the performance characteristics specified in the referenced standard. The EVSE shall be subjected to bursts of voltage spikes for which the repetition frequency of the impulses and peak values of the output voltage on 50 $\Omega$ and 1000 $\Omega$ loads are defined in the referenced standard. The characteristics of the generator shall be verified before connecting the EVSE. Both positive and negative polarity bursts shall be applied. The duration of the test shall not be less than 1 min for each amplitude and polarity. A capacitive coupling clamp, as defined in the standard, shall be used to couple to I/O and communication lines. The test pulses shall be applied continuously during the measurement time.	
1631			
1632			
1633			
1634			
1635			
1636			
1637			
1638			
1639			
1640	Test conditions:	The EVSE voltage and auxiliary circuits shall be energised with reference voltage.	
1641			
1642		The cable length between the coupling device and the EVSE shall be 1 m.	
1643		Duration of test: 60 s at each polarity.	
1644		Repetition rate: 100 kHz.	
1645		The test voltage shall be applied in common mode (line-to-earth) to:	
1646		<ul style="list-style-type: none"> <li>▪ the input power circuits;</li> </ul>	
1647		<ul style="list-style-type: none"> <li>▪ the I/O and communication lines, if separated from the voltage circuits in normal operation.</li> </ul>	
1648			
1649	Test severity:	Test voltage on the input power circuits: 2 kV.	
1650		Test voltage on I/O and communication lines: 1 kV.	
1651	Performance verification:	Accuracy test during the exposure to the fast transients.	
1652	Allowed effects:	See requirements of 3.3.5.2 and Table 5.	

1653 **7.5.4 Voltage dips and interruptions**

1654 **7.5.4.1 AC voltage dips and interruptions**

1655 Applicable standards: IEC 61000-4-11, IEC 61000-4-34.

1656 Object of the test: To verify compliance with the requirements of 3.3.5.2 and Table 5 under  
1657 conditions of short time mains voltage reductions (dips and interruptions).

1658 Test procedure: A test generator, which is able to reduce the amplitude of the AC mains  
1659 voltage over an operator-defined period of time, shall be used in this test.  
1660 The performance of the test generator shall be verified before connecting the  
1661 EVSE.

1662 The mains voltage reductions shall be repeated 10 times with an interval of  
1663 at least 10 s.

1664 Test conditions: Disturbances shall be applied during a transaction in progress with voltage  
1665 circuits energised with the lowest nominal voltage ( $U_{\text{nom}}$ ) and the transition  
1666 current ( $I_{\text{tr}}$ ) flowing. If the EVSE shuts down at any point during either test  
1667 that test is considered complete.

1668 Test severities: Voltage dips and interruptions:

Event	Residual voltage (% ref)	Duration				Inception angle (degrees)
		50 Hz		60 Hz		
		cycles	s	cycles	s	
Voltage dip 1	0%	0.5	0.010	0.5	0.0083	0 and 180
Voltage dip 2	0%	1	0.020	1	0.0167	0
Voltage dip 3	40%	10	0.200	12	0.200	0
Voltage dip 4	70%	25	1	30	1	0
Voltage dip 5	80%	250	5	300	5	0
Voltage interruption 6	0%	250	5	300	5	0

1669 Allowed effect: If the EVSE shuts down, the transfer of energy may terminate , as long as  
1670 the energy transferred until then is correctly taken into account in the  
1671 transaction., or the transaction shall be cancelled, unless it can be completed  
1672 once power is restored with certainty that the transaction data is correct.  
1673 Alternatively, once the voltage returns to reference conditions, the energy  
1674 transfer may be continued and the transaction shall be completed correctly  
1675 after concluding the energy transfer (see 3.3.5.1). In any case, no loss of  
1676 measurement data from before the application of the disturbance is allowed.

1677 Performance verification: Accuracy test during voltage dips and interruptions.

1678

1679 Allowed effects: See requirements of 3.3.5.2 and Table 5.

1680 **7.5.4.2 DC voltage dips and interruptions**

1681 Applicable standards: IEC 61000-4-29

1682 Object of the test: To verify compliance with the requirements of 1.1.1.1 and Table 5 under  
 1683 conditions of short time mains voltage reductions (dips and interruptions)  
 1684 for EVSE fed by DC networks.

1685 This test is only applicable for EVSE where no AC/DC converter is supplied  
 1686 by the manufacturer.

1687 Test procedure: A test generator which complies to the applicable standard shall be used in  
 1688 this test. The performance of the test generator shall be verified before  
 1689 connecting the EVSE.

1690 A sequence of 3 dips/interruptions shall be applied with intervals of at least  
 1691 10 s between each test event.

1692 Test conditions: Disturbances shall be applied during a transaction in progress with voltage  
 1693 circuits energized with the lowest nominal ( $U_{nom}$ ) and the transition current  
 1694 ( $I_{tr}$ ) flowing in the current circuit. The test generator shall be able to manage  
 1695 the value of the transition current during this test.

1696 Test severities: Voltage dips and interruptions:

Event	Residual Voltage (%Vref)	Impedance condition	Duration (ms)
Voltage interruption 1	0%	High	1
Voltage interruption 2	0%	Low	3
Voltage interruption 3	0%	High	10
Voltage interruption 4	0%	Low	30
Voltage interruption 5	0%	High	100
Voltage interruption 6	0%	Low	300
Voltage dip 7	40%	N/A	1000
Voltage dip 8	70%	N/A	1000

1697 Allowed effect: If the EVSE shuts down, the transfer of energy may terminate, as long as  
 1698 the energy transferred until then is correctly taken into account in the  
 1699 transaction., or the transaction shall be cancelled, unless it can be completed  
 1700 once power is restored with certainty that the transaction data is correct.  
 1701 Alternatively, once the voltage returns to reference conditions, the energy  
 1702 transfer may be continued and the transaction shall be completed correctly  
 1703 after concluding the energy transfer (see 3.3.5.1). In any case, no loss of  
 1704 measurement data from before the application of the disturbance is allowed.

1705 Performance verification: Accuracy test during voltage dips and interruptions.

1706 Allowed effects: See requirements of 3.3.5.2 and Table 5.

## 1707 7.5.5 Surges on mains power lines

1708 Applicable standard: IEC 61000-4-5 and where applicable IEC 61851-21-2

1709 Object of the test: To verify compliance with the requirements of 3.3.5.2 and Table 5 under  
 1710 conditions where electrical surges are superimposed on the mains voltage  
 1711 and, if applicable, on I/O and communication ports.



1712	Test procedure:	A surge generator shall be used with the performance characteristics
1713		specified in the referenced standard. The test consists of exposure to surges
1714		for which the rise time, pulse width, peak values of the output
1715		voltage/current on high/low impedance load, and minimum time interval
1716		between two successive pulses are defined in the referenced standard.
1717		The characteristics of the generator shall be verified before connecting the
1718		EVSE.
1719	Test conditions:	The EVSE shall be in operating condition:
1720		▪ voltage circuits energised with highest $U_{\text{nom}}$ ;
1721		▪ current circuit connected as provided in IEC 61851-21-2;
1722		▪ cable length between surge generator and EVSE: 1 m;
1723		▪ tested in differential mode (line to line) and common mode (line to
1724		earth <sup>(1)</sup> );
1725		▪ phase angle: pulses to be applied at 0°, 90°, 180° and 270° relative
1726		to zero crossing of AC supply.
1727	Test severities:	Voltage circuits:
1728		▪ Line to line: Test voltage: 2.0 kV, generator source impedance: 2 $\Omega$ ;
1729		▪ Line to earth <sup>(1)</sup> : Test voltage: 4.0 kV, generator source impedance:
1730		2 $\Omega$ ;
1731		▪ Number of tests: five positive and five negative;
1732		▪ Repetition rate: maximum 1/min.
1733		Auxiliary circuits with a reference voltage over 40 V:
1734		▪ Line to line: Test voltage 1.0 kV, generator source impedance 42 $\Omega$ ;
1735		▪ Line to earth <sup>(1)</sup> : Test voltage 2.0 kV, generator source impedance
1736		42 $\Omega$ ;
1737		▪ Number of tests: five positive and five negative;
1738		▪ Repetition rate: maximum 1/min.
1739		<i>Note</i> <sup>(1)</sup> : For cases where the earth of the EVSE is separate to neutral.
1740	Performance verification:	Accuracy test during exposure to surges.
1741	Allowed effects:	See requirements of 3.3.5.2 and Table 5.
1742	<b>7.5.6 Short-time overcurrent</b>	
1743	Object of the test:	To verify compliance with the requirements of 3.3.5.2 and Table 5 under
1744		conditions of a short time overcurrent.
1745	Test procedure:	The EVSE shall be able to handle the current caused by a short-circuit within
1746		the electric vehicle.
1747		<i>Note:</i> National authorities may specify specific fuses or breakers to be
1748		applied.
1749	Test current:	A current equivalent to $5 \times I_{\text{max}}$ (+0 %, –10 %), for 0.5 cycle.
1750		The test current shall be applied to one phase at the time. The test current
1751		value given is the RMS value, not the peak value.

1752 Note: If the design of the EVSE includes technical means to limit the  
1753 overcurrent in case of a fault, the current of this test can be limited.

1754

1755 Performance verification: Accuracy test after exposure to a short-time overcurrent.

1756 Allowed effects: See requirements of 3.3.5.2 and Table 5.

1757

## 1758 **7.5.7 Environmental disturbances**

1759 Tests 7.5.7.1–7.5.7.5 comprise a suite of tests for immunity to various environmental disturbances. All  
1760 tests are performed with the EVSE unpowered. Tests may be performed in any order. All tests in 7.5.7  
1761 may be performed as a group with a single accuracy test before and after the group of tests.

1762 For complex DC EVSE, these tests shall be applied to the console only.

### 1763 **7.5.7.1 Protection against solar radiation**

1764 Applicable standard: IEC 60068-2-5:2018.

1765 Object of the test: To verify whether the markings comply with the requirements of 4.2 and  
1766 3.3.5.3 and Table 6 regarding protection against solar radiation.

1767 Test conditions: The EVSE shall be in non-operating condition.

1768 Test procedure: Test procedure A: 8 h irradiation and 16 h darkness; upper temperature  
1769 +55 °C; duration 3 cycles or 3 days.

1770 Allowed effects: See requirements of 3.3.5.3 and Table 6. After the test the markings of the  
1771 EVSE shall be visually inspected. The appearance and, in particular, the  
1772 legibility of markings and indicating devices shall not be altered.

### 1773 **7.5.7.2 Extreme temperatures - dry heat**

1774 Applicable standards: IEC 60068-2-2, IEC 60068-3-1.

1775 Object of the test: To verify compliance with the requirements of 3.3.5.3 and Table 6 after  
1776 exposure to dry heat.

1777 Test procedure: The test consists of exposure to the specified high temperature under “free  
1778 air” conditions for 2 h (beginning from when the temperature of the EVSE  
1779 is stable), with the EVSE in a non-operating state.

1780 The change of temperature shall not exceed 1 °C/min during heating up and  
1781 cooling down.

1782 The absolute humidity of the test atmosphere shall not exceed 20 g/m<sup>3</sup>.

1783 Test severity: The test shall be performed at a standard temperature one step higher than  
1784 the upper temperature limit specified for the EVSE.

1785 Possible temperatures: 40 °C, 55 °C, 70 °C, 85 °C.

1786 If the specified upper temperature limit is 85 °C, then this test shall be  
1787 performed at 85 °C.

1788 Allowed effects: See requirements of 3.3.5.3 and Table 6.

1789

### 1790 **7.5.7.3 Extreme temperatures - cold**

1791 Applicable standards: IEC 60068-2-1, IEC 60068-3-1.

1792	Object of the test:	To verify compliance with the requirements of 3.3.5.3 and Table 6 after
1793		exposure to low temperatures.
1794	Test procedure:	The test consists of exposure to the specified low temperature under “free
1795		air” conditions for 2 h (beginning from the time when the temperature of the
1796		EVSE is stable) with the EVSE in a non-operating state.
1797		The change of temperature shall not exceed 1 °C/min during heating up and
1798		cooling down.
1799	Test severity:	The test shall be performed at a standard temperature one step lower than the
1800		lower temperature limit specified for the EVSE.
1801	Possible temperatures:	–10 °C, –25 °C, –40 °C, –55 °C.
1802		If the specified lower temperature limit is –40 °C or lower, then this test
1803		shall be performed at the specified lower temperature limit.
1804	Allowed effects:	See requirements of 3.3.5.3 and Table 6.
1805		
1806		
1807	<b>7.5.7.4</b>	Damp heat, steady-state (non-condensing), for humidity class H1
1808	Applicable standards:	IEC 60068-2-78, IEC 60068-3-4.
1809	Object of the test:	To verify compliance with the requirements of 3.3.5.3 and Table 6 after
1810		exposure to high humidity and constant temperature. This test applies to
1811		EVSE that are specified for enclosed locations where the EVSE are not
1812		subjected to condensed water, precipitation, or ice formations (H1).
1813	Test procedure:	The test consists of exposure to the specified high-level temperature and the
1814		specified constant relative humidity for a certain fixed time defined by the
1815		severity level. The EVSE shall be handled such that no condensation of
1816		water occurs on it.
1817	Test conditions:	Voltage and auxiliary circuits energised with reference voltage;
1818		Without any current in the current circuits.
1819	Test severity:	Temperature: 30 °C;
1820		Humidity: 85 %;
1821		Duration: 2 days.
1822	Allowed effects:	During and after the test the EVSE shall operate correctly. Immediately after
1823		the test the EVSE shall operate correctly and comply with the requirements
1824		of 3.3.5.3 and Table 6.
1825		There shall be no evidence of any mechanical damage or water ingress which
1826		may affect the functional properties of the EVSE.
1827	<b>7.5.7.5</b>	Damp heat, cyclic (condensing) for humidity classes H2 and H3
1828	Applicable standards:	IEC 60068-2-30, IEC 60068-3-4.
1829	Object of the test:	To verify compliance with the requirements in 3.3.5.3 and Table 6 after
1830		exposure to high humidity and temperature variations. This test applies to
1831		EVSE with a humidity class specification either for enclosed locations where
1832		EVSE can be subjected to condensed water or for open locations (humidity
1833		classes H2 and H3).

1834 Test procedure: The test consists of exposure to cyclic temperature variation between 25 °C  
 1835 and the temperature specified as the upper temperature according to the test  
 1836 severities below, whilst maintaining the relative humidity above 95 %  
 1837 during the temperature change and low temperature phases, and at 93 %  
 1838 during the upper temperature phases. Condensation should occur on the  
 1839 EVSE during the temperature rise.

1840 The 24 h cycle consists of:

- 1841 a) temperature rise during 3 h;
- 1842 b) temperature maintained at upper value until 12 h from the start of  
 1843 the cycle;
- 1844 c) temperature reduced to lower value within 3 h to 6 h, the rate of fall  
 1845 during the first hour and a half being such that the lower value would  
 1846 be reached in 3 h;
- 1847 d) temperature maintained at lower value until the 24 h cycle is  
 1848 completed.

1849 The stabilising period before and recovery after the cyclic exposure shall be  
 1850 such that all parts of the EVSE are within 3 °C of their final temperature.

1851 Test conditions: Voltage and auxiliary circuits energised with reference voltage;

1852 Without any current in the current circuits;

1853 Mounting position according to manufacturer's specification.

1854 Test severities: EVSE with a humidity class specification for enclosed locations where  
 1855 EVSE can be subjected to condensed water shall be tested at severity level 1.  
 1856 EVSE with a humidity class specification for open locations shall be tested  
 1857 at severity level 2.

1858

Specified humidity class:	H2	H3
Severity levels:	1	2
Upper temperature (°C):	40	55
Duration (cycles):	2	2

1859

1860 Allowed effects: During and after the test the EVSE shall operate correctly.

1861 Immediately after the test the EVSE shall comply with the requirements of  
 1862 3.3.5.3 and Table 6.

1863 There shall be no evidence of any mechanical damage or water ingress which  
 1864 may affect the functional properties of the EVSE.

## 1865 7.5.8 Mechanical disturbances

1866 EVSE having a maximum mass of 10 kg are submitted to vibrations and shocks. They are applied to  
 1867 unitary EVSE and to the console of complex DC EVSE.

1868 Both tests may be performed as a group with a single accuracy test before and after the group of tests.

1869 If these tests are eliminated from type approval, initial verification testing shall be performed after  
 1870 installation of the EVSE and prior to the EVSE being put into service.

**1871 7.5.8.1 Vibrations**

1872 Applicable standards: IEC 60068-2-47, IEC 60068-2-64.

1873 Object of the test: To verify compliance with the requirements of 3.3.5.4 and Table 7.

1874 Test procedure: The EVSE shall, in turn, be tested in three, mutually perpendicular axes  
1875 whilst mounted on a rigid fixture by its normal mounting means.

1876 During the test, the EVSE shall not be operational and it shall be mounted in  
1877 its normal position, so that the gravitational force acts in the same direction  
1878 as it would in normal use. Where the effect of gravitational force is not  
1879 important the EVSE may be mounted in any position. The EVSE shall be  
1880 fixed to the vibration-testing machine.

1881 Test severity:

Total frequency range	10 Hz to 150 Hz
Total RMS level	$7 \text{ m s}^{-2}$
Acceleration Spectral Density (ASD) level 10–20 Hz	$1 \text{ m}^2 \text{ s}^{-3}$
Acceleration Spectral Density (ASD) level 20–150 Hz	–3 dB/octave
Duration per axis:	at least 2 min

1882

1883 Performance verification: Accuracy test.

1884 Allowed effects: See requirements of 3.3.5.4 and Table 7.

**1885 7.5.8.2 Shocks**

1886 Applicable standard: IEC 60068-2-27.

1887 Object of the test: To verify compliance with the requirements of 3.3.5.4 and Table 7.

1888 Test procedure: The EVSE is subjected to non-repetitive shocks of standard pulse shapes  
1889 with specified peak acceleration and duration. During the test, the EVSE  
1890 shall not be operational and it shall be fastened to a fixture or to the shock-  
1891 testing machine.

1892 Test severity: Pulse shape: Half-sine

1893 Peak acceleration:  $30 g_n$

1894 Pulse duration: 18 ms

1895 Performance verification: Accuracy test.

1896 Allowed effects: See requirements of 3.3.5.4 and Table 7.

**1897 7.5.9 Durability test**

1898 Object of the test: To verify compliance with the requirements of 3.4 for durability.

1899 Test procedure: The test procedure for durability shall subject a number of EVSE to the  
1900 conditions below. The EVSE accuracy shall be determined prior to and after  
1901 the durability test.

1902 Test conditions: A minimum of one EVSE.

1903	Test temperature:	Maximum operating temperature specified by the manufacturer.
1904	Test voltage:	Reference voltage (highest $U_{nom}$ for AC, highest reference voltage for DC, see Table 10).
1905		
1906	.	
1907	Test load:	50 % $I_{max}$ .
1908	Test sequence:	Application of the load during 8 h, followed by 16 h without any current.
1909	Test duration:	10 cycles.
1910	Mandatory test points:	For initial and final measurement, the voltage shall be the reference voltage, with the following test points: $I_{tr}$ and 50 % $I_{max}$ .
1911		
1912	Allowed effects:	The EVSE shall comply with the requirements of 3.4.
1913	<i>Note 1:</i>	As indicated in clause 7 the test is allowed to be performed with either real power or phantom power.
1914	<i>Note 2:</i>	This test is not required for EVSE with a separately type approved meter if the type approval specifications meet or exceed those of this Recommendation. Testing based on the IEC 62059-32-1 is deemed to cover the durability requirement of this Recommendation.
1915		
1916		
1917		
1918		

## 1919     **8                   Examination for conformity with type**

1920	An examination for conformity to type should determine whether a EVSE complies with all the requirements in Part 1, clause 3, 4 and 5, and whether documentation supplied by the manufacturer complies with the requirements in 6.1.
1921	
1922	
1923	An EVSE may only be deemed to have passed examination for conformity to type if the results of all the type tests comply with the requirements in Part 1, clause 3, 4 and 5. The measurement uncertainty must be small enough to allow clear discrimination between a pass result and a fail result. In particular, an uncertainty less than one fifth of the maximum permissible error given for the corresponding test point must be obtained for tests described in 7.3, unless otherwise specified in the relevant test description.
1924	
1925	
1926	
1927	
1928	
1929	The scope of the tests performed and the test severities used shall be consistent with the manufacturer's specifications and with the requirements of Part 1, clause 3, 4 and 5.
1930	
1931	

1932

1936

1937

## Bibliography

(Informative)

### Annex A

Ref.	Standards and reference documents	Description
[1]	OIML D 11:2013 <i>General requirements for electronic measuring instruments</i>	Guidance for establishing appropriate metrological performance testing requirements for influence quantities that may affect the measuring instruments covered by OIML Recommendations.
[2]	OIML D 31:2023 <i>General requirements for software controlled measuring instruments</i>	Guidance for establishing appropriate requirements for software related functionalities in measuring instruments covered by OIML Recommendations.
[3]	OIML V 2-200:2012 <i>International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM)</i>	Vocabulary, prepared by a joint working group consisting of experts appointed by BIPM, IEC, IFCC, ISO, IUPAC, IUPAP, and OIML.
[4]	OIML V 1:2013 <i>International vocabulary of terms in legal metrology (VIML)</i>	The VIML includes only the concepts used in the field of legal metrology. These concepts concern the activities of the legal metrology service, the relevant documents, as well as other problems linked with this activity. Also included in this Vocabulary are certain concepts of a general character which have been drawn from the VIM.
[5]	OIML G 1-100:2008 <i>Evaluation of measurement data - Guide to the expression of uncertainty in measurement (GUM)</i>	This Guide establishes general rules for evaluating and expressing uncertainty in measurement that are intended to be applicable to a broad spectrum of measurements.
[6]	OIML G 20:2017 <i>Surveillance of utility meters in service on the basis of sampling inspections</i>	This Guide relates to the method and procedure according to which the period of validity of the verification of utility meters forming part of a defined lot is extended if the correctness of the meters has been proved by sampling inspections prior to the expiry of the period of validity of the verification.
[7]	IEC 60060-1:2010 High-voltage test techniques - Part 1: General definitions and test requirements	This part of IEC 60060 is applicable to: <ul style="list-style-type: none"> <li>– dielectric tests with direct voltage;</li> <li>– dielectric tests with alternating voltage;</li> <li>– dielectric tests with impulse voltage;</li> <li>– dielectric tests with combinations of the above.</li> </ul>



Ref.	Standards and reference documents	Description
[8]	IEC 60068-2-1:2007 Environmental testing - Part 2-1: Tests - Test A: Cold	<p>This part of IEC 60068 deals with cold tests applicable to both non heat-dissipating and heat-dissipating specimens.</p> <p>The object of the cold test is limited to the determination of the ability of components, equipment or other articles to be used, transported or stored at low temperature.</p> <p>Cold tests covered by this Standard do not enable the ability of specimens to withstand or operate during the temperature variations to be assessed. In this case, it would be necessary to use IEC 60068-2-14.</p>
[9]	IEC 60068-2-2:2007 Environmental testing - Part 2-2: Tests. Test B: Dry heat	<p>This part of IEC 60068 deals with dry heat tests applicable both to heat-dissipating and non heat-dissipating specimens.</p> <p>The object of the dry heat test is limited to the determination of the ability of components, equipment or other articles to be used, transported or stored at high temperature.</p> <p>These dry heat tests do not enable the ability of specimens to withstand or operate during the temperature variations to be assessed. In this case, it would be necessary to use IEC 60068-2-14 Test N: Change of temperature.</p>
[10]	IEC 60068-2-18:2017 Environmental testing - Part 2-1: Test R and guidance: Water	<p>Provides methods of test applicable to products which, during transportation, storage or in service, may be subjected to falling drops, impacting water or immersion.</p> <p>The primary purpose of water tests is to verify the ability of enclosures, covers and seals to maintain components and equipment in good working order after and, when necessary, under a standardized dropfield or immersion in water.</p>
[11]	IEC 60068-2-27:2008 Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock	<p>Provides a standard procedure for determining the ability of a specimen to withstand specified severities of non-repetitive or repetitive shocks. The purpose of this test is to reveal mechanical weakness and/or degradation in specified performances, or accumulated damage or degradation caused by shocks.</p>
[12]	IEC 60068-2-30:2005 Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	<p>Determines the suitability of components, equipment and other articles for use and/or storage under conditions of high humidity when combined with cyclic temperature changes.</p>
[13]	IEC 60068-2-47:2005 Environmental testing - Part 2-47: Test - Mounting of specimens for vibration, impact and similar dynamic tests	<p>Provides methods of mounting components, and mounting requirements for equipment and other articles, for the families of dynamic tests in IEC 60068-2, that is impact (Test E), vibration (Test F) and acceleration, steady-state (Test G).</p>

Ref.	Standards and reference documents	Description
[14]	IEC 60068-2-64:2008 Environmental testing - Part 2-64: Test methods - Test Fh: Vibration, broad-band random (digital control) and guidance	Determines the ability to withstand specified severities of broad-band random vibration. Applies to specimens which may be subjected to vibration of a stochastic nature by transportation or operational environments, for example in aircraft, space vehicles and land vehicles.  Has the status of a basic safety publication in accordance with IEC Guide 104.
[15]	IEC 60068-2-78:2012 Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state	Provides a test method for determining the suitability of electrotechnical products, components or equipment for transportation, storage and use under conditions of high humidity. The test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation on the specimen over a prescribed period.
[16]	IEC 60068-3-1:2011 Environmental testing - Part 3-1: Supporting documentation and guidance - Cold and dry heat tests	Gives background information for Tests A: Cold (IEC 68-2-1), and Tests B: Dry heat (IEC 68-2-2). Includes appendices on the effect of: chamber size on the surface temperature of a specimen when no forced air circulation is used; airflow on chamber conditions; on surface temperatures of test specimens; wire termination dimensions and material on surface temperature of a component; measurements of temperature, air velocity and emission coefficient.
[17]	IEC 60068-3-4:2001 Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	Provides the necessary information to assist in preparing relevant specifications, such as standards for components or equipment, in order to select appropriate tests and test severities for specific products and, in some cases, specific types of application. The object of damp heat tests is to determine the ability of products to withstand the stresses occurring in a high relative humidity environment, with or without condensation, and with special regard to variations of electrical and mechanical characteristics. Damp heat tests may also be utilized to check the resistance of a specimen to some forms of corrosion attack.
[18]	IEC 60512-14-7:1997 Electromechanical components for electronic equipment - Basic testing procedures and measuring methods - Part 14: Sealing tests - Section 7: Test 14g: Impacting water	Defines a standard test method to assess the effects of impacting water or specified fluid on electrical connecting devices.
[19]	IEC 60529:1989 + AMD1:1999 + AMD2:2013 CSV Consolidated version  Degrees of protection provided by enclosures (IP code)	Applies to the classification of degrees of protection provided by enclosures for electrical equipment with a rated voltage not exceeding 72.5 kV.  Has the status of a basic safety publication in accordance with IEC Guide 104.

Ref.	Standards and reference documents	Description
[20]	IEC TR 61000-4-1:2016 Electromagnetic compatibility (EMC) - Part 4-1: Testing and measurement techniques - Overview of IEC 61000-4 series	Gives applicability assistance to the users and manufacturers of electrical and electronic equipment on EMC standards within the IEC 61000-4 series on testing and measurement techniques.  Provides general recommendations concerning the choice of relevant tests.
[21]	IEC 61000-4-2:2008 Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	Relates to the immunity requirements and test methods for electrical and electronic equipment subjected to static electricity discharges, from operators directly, and to adjacent objects. Additionally defines ranges of test levels which relate to different environmental and installation conditions and establishes test procedures. The object of this standard is to establish a common and reproducible basis for evaluating the performance of electrical and electronic equipment when subjected to electrostatic discharges. In addition, it includes electrostatic discharges which may occur from personnel to objects near vital equipment.
[22]	IEC 61000-4-3:2020 Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	Applies to the immunity of electrical and electronic equipment to radiated electromagnetic energy. Establishes test levels and the required test procedures. Establishes a common reference for evaluating the performance of electrical and electronic equipment when subjected to radio-frequency electromagnetic fields.
[23]	IEC 61000-4-4:2012 Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity tests	Establishes a common and reproducible reference for evaluating the immunity of electrical and electronic equipment when subjected to electrical fast transient/burst on supply, signal, control and earth ports. The test method documented in this part of IEC 61000-4 describes a consistent method to assess the immunity of an equipment or system against a defined phenomenon.
[24]	IEC 61000-4-5:2014+AMD1:2017 CSV Consolidated version Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test	Relates to the immunity requirements, test methods, and range of recommended test levels for equipment to unidirectional surges caused by overvoltages from switching and lightning transients. Several test levels are defined which relate to different environment and installation conditions. These requirements are developed for and are applicable to electrical and electronic equipment. Establishes a common reference for evaluating the performance of equipment when subjected to high-energy disturbances on the power and inter-connection lines.
[25]	IEC 61000-4-6 (2013) Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields	Relates to the conducted immunity requirements of electrical and electronic equipment to electromagnetic disturbances coming from intended radio-frequency (RF) transmitters in the frequency range 9 kHz – 80 MHz. Equipment not having at least one conducting cable (such as mains supply, signal line or earth connection), which can couple the equipment to the disturbing RF fields is excluded.

Ref.	Standards and reference documents	Description
[26]	IEC 61000-4-8:2009 (Ed. 2.0) Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques-- Power frequency magnetic field immunity test	Relates to the immunity requirements of equipment, only under operational conditions, to magnetic disturbances at power frequency related to:  – residential and commercial locations;  – industrial installations and power plants; and  – medium voltage and high voltage sub-stations.
[27]	IEC 61000-4-11:2020 Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variation immunity tests for equipment with input current up to 16 A per phase	Defines the immunity test methods and range of preferred test levels for electrical and electronic equipment connected to low-voltage power supply networks for voltage dips, short interruptions, and voltage variations. This standard applies to electrical and electronic equipment having a rated input current not exceeding 16 A per phase, for connection to 50 Hz or 60 Hz AC networks.
[28]	IEC 61000-4-12:2017 Electromagnetic compatibility (EMC) - Part 4-12: Testing and measurement techniques - Ring wave immunity test	Relates to the immunity requirements and test methods for electrical and electronic equipment, under operational conditions, to non-repetitive damped oscillatory transients (ring waves) occurring in low-voltage power, control and signal lines supplied by public and non-public networks.
[29]	IEC 61000-6-1:2016 Electromagnetic compatibility (EMC) - Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments	Defines the immunity test requirements in relation to continuous and transient, conducted and radiated disturbances, including electrostatic discharges, for electrical and electronic apparatus intended for use in residential, commercial and light-industrial environment, and for which no dedicated product or product-family standard exists. Immunity requirements in the frequency range 0 kHz - 400 GHz are covered and are specified for each port considered. This standard applies to apparatus intended to be directly connected to a low-voltage public mains network or connected to a dedicated DC source which is intended to interface between the apparatus and the low-voltage public mains network.

Ref.	Standards and reference documents	Description
[30]	IEC 61000-6-2:2016 Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments	<p>Applies to electrical and electronic apparatus intended for use in industrial environments, for which no dedicated product or product-family immunity standard exists. Immunity requirements in the frequency range 0 Hz-400 GHz are covered, in relation to continuous and transient, conducted and radiated disturbances, including electrostatic discharges. Test requirements are specified for each port considered.</p> <p>Apparatus intended to be used in industrial locations are characterised by the existence of one or more of the following:</p> <ul style="list-style-type: none"> <li>- a power network powered by a high or medium voltage power transformer dedicated to the supply of an installation feeding manufacturing or similar plant;</li> <li>- industrial, scientific and medical (ISM) apparatus;</li> <li>- heavy inductive or capacitive loads that are frequently switched;</li> <li>- currents and associated magnetic fields that are high.</li> </ul>
[31]	IEC 62052-11:2020 Electricity metering equipment - General requirements, tests and test conditions - Part 11: Metering equipment	Covers type tests for electricity metering equipment for indoor and outdoor application and to newly manufactured equipment designed to measure the electric energy on 50 Hz or 60 Hz networks, with a voltage up to 600 V. It applies to electromechanical or static meters for indoor and outdoor application consisting of a measuring element and register(s) enclosed together in a meter case. It also applies to operation indicator(s) and test output(s).
[32]	IEC 62053-52:2005 Electricity metering equipment (AC) - Particular requirements - Part 52: Symbols	Applies to letter and graphical symbols intended for marking on and identifying the function of electromechanical or static AC electricity meters and their auxiliary devices. The symbols specified in this standard shall be marked on the name-plate, dial plate, external labels or accessories, or shown on the display of the meter as appropriate.
[33]	ISO 4892-3:2016 Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps	Specifies methods for exposing specimens to fluorescent UV radiation and water in apparatus to designed reproduce the weathering effects that occur when materials are exposed in actual end-use environments to daylight, or to daylight through window glass.

1945

1946

1947