

# Draft NIST Handbook 44 Device Code Requirements for Electric Vehicle Fueling

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## **Section 3.XX. Electricity-Measuring Devices – Tentative Code**

This tentative code has only a trial or experimental status and is not intended to be enforced. The requirements are designed for study prior to the development and adoption of a final code. Officials wanting to conduct an official examination of an Electric Vehicle Supply Equipment (EVSE) or system are advised to see paragraph G-A.3. Special and Unclassified Equipment.

(Tentative Code Added 20XX)

### **A. Application**

**A.1. General.** – This code applies to devices, accessories, and systems used for the measurement of electricity dispensed in vehicle fuel applications wherein a quantity determination or statement of measure is used wholly or partially as a basis for sale or upon which a charge for service is based.

**A.2. Exceptions.** – This code does not apply to:

- (a) The use of any measure or measuring device owned, maintained, and used by a public utility or municipality only in connection with measuring electricity subject to the authority having jurisdiction such as the Public Utilities Commission.
- (b) Electric Vehicle Supply Equipment (EVSEs) used solely for dispensing electrical energy in connection with operations in which the amount dispensed does not affect customer charges or compensation.
- (c) The wholesale delivery of electricity.

**A.3. Additional Code Requirements.** – In addition to the requirements of this code, Electricity-Measuring Devices shall meet the requirements of Section 1.10. General Code.

**A.3.1. Electric Vehicle Supply Equipment (EVSE) with Integral Time-Measuring Devices.** – An EVSE that is used for both the sale of electricity as vehicle fuel and used to measure time during which services (e.g., vehicle parking) are received. These devices shall also meet the requirements of Section 5.55. Timing Devices.

**A.4. Type Evaluation.** – The National Type Evaluation Program (NTEP) will accept for type evaluation only those EVSEs that comply with all requirements of this code and have received safety certification by a Nationally Recognized Testing Laboratory (NRTL).

### **S. Specifications**

**S.1. Primary Indicating and Recording Elements.**

**S.1.1. Electric Vehicle Supply Equipment (EVSE).** – An EVSE used to charge electric vehicles shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each transaction.

- (a) EVSEs capable of applying multiple unit prices over the course of a single transaction shall also be capable of indicating the start and stop time, the total quantity of energy delivered, the unit price, and the total price for the quantity of energy delivered during each discrete phase corresponding to one of the multiple unit prices.
- (b) EVSEs capable of applying additional fees for time-based and other services shall also be capable of indicating the total time measured; the unit price(s) for the additional time based service(s); the total computed price(s) for the time measured; and the total transaction price, including the total price for the energy and all additional fees.

**S.1.2. EVSE Indicating Elements.** – An EVSE used to charge electric vehicles shall include an indicating element that accumulates continuously and displays, for a minimum of 15 seconds at the activation by the user and at the start and end of the transaction, the correct measurement results relative to quantity and total price. Indications shall be clear, definite, accurate, and easily read under normal conditions of operation of the device. All indications and representations of electricity sold shall be clearly identified and separate from other time-based fees indicated by an EVSE that is used for both the sale of electricity as vehicle fuel and the sale of other separate time-based services (e.g., vehicle parking).

**S.1.2.1. Multiple EVSEs Associated with a Single Indicating Element** - A system with a single indicating element, for two or more EVSEs, shall be provided with means to display information from the individual EVSE(s) selected or displayed, and shall be provided with automatic means to indicate clearly and definitely which EVSE is associated with the displayed information.

**S.1.3. EVSE Units.**

**S.1.3.1. EVSE Units of Measurement.** –EVSEs used to charge electric vehicles shall be indicated and recorded in megajoules (MJ) or kilowatt-hours (kWh) and decimal subdivisions thereof.

**S.1.3.2. EVSE Value of Smallest Unit.** – The value of the smallest unit of indicated delivery by an EVSE, and recorded delivery, if the EVSE is equipped to record, shall be 0.005 MJ or 0.001 kWh.

**S.1.3.3. Values Defined.** – Indicated values shall be adequately defined by a sufficient number of figures, words, symbols, or combinations thereof. An indication of “zero” shall be a zero digit for all displayed digits to the right of the decimal mark and at least one to the left.

**S.2. EVSE Operating Requirements.**

**S.2.1. EVSE Return to Zero.**

- (a) The primary indicating and the primary recording elements of an EVSE used to charge electric vehicles, if the EVSE is equipped to record, shall be provided with a means for readily returning the indication to zero either automatically or manually.
- (b) It shall not be possible to return primary indicating elements, or primary recording elements, beyond the correct zero position.

**S.2.2. EVSE Indicator Zero Reset Mechanism.** – The reset mechanism for the indicating element of an EVSE used to charge electric vehicles shall not be operable during a transaction. Once the zeroing operation has begun, it shall not be possible to indicate a value other than the latest measurement, or “all zeros,” blank the indication, or provide other indications that cannot be interpreted as a measurement during the zeroing operation.

**S.2.3. EVSE Provision for Power Loss.**

**S.2.3.1. Transaction Information.** – In the event of a power loss, the information needed to complete any transaction (i.e., delivery is complete and payment is settled) in progress at the time of the power loss (such as the quantity and unit price, or sales price) shall be determinable through one of the means listed below or the transaction shall be terminated without any charge for the electrical energy transfer to the vehicle:

- at the EVSE;
- at the console, if the console is accessible to the customer;
- via on site internet access ; or
- through toll-free phone access.

For EVSEs in parking areas where vehicles are commonly left for extended periods, the information needed to complete any transaction in progress at the time of the power loss shall be determinable through one of the above means for at least 8 hours.

**S.2.3.2. Transaction Termination.** - In the event of a power loss, either: (a) the transaction shall terminate at the time of the power loss; or (b) the EVSE may continue charging without additional authorization if the EVSE is able to determine it is connected to the same vehicle before and after the supply power outage . In either case, there must be a clear indication on the receipt provided to the customer of the interruption, including the date and time of the interruption along with other information required under S.2.6. EVSE Recorded Representations.

**S.2.3.3. User Information.** – The EVSE memory, or equipment on the network supporting the EVSE, shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.

**S.2.4. EVSE Indication of Unit Price and Equipment Capacity and Type of Voltage.**

**S.2.4.1. Unit Price.** – An EVSE shall be able to indicate on each face the unit price at which the EVSE is set to compute or to dispense at any point in time during a transaction.

**S.2.4.2. Equipment Capacity and Type of Voltage.** – An EVSE shall be able to conspicuously indicate on each face the maximum rate of energy transfer (i.e., maximum power) and type of current associated with each unit price offered (e.g., 7 kW AC, 25 kW DC, etc.).

**S.2.4.3. Selection of Unit Price.** – When electrical energy is offered for sale at more than one unit price through an EVSE, the selection of the unit price shall be made prior to delivery through a deliberate action of the purchaser to select the unit price for the fuel delivery. Except when the conditions for variable price structure have been approved by the customer prior to the sale, a system shall not permit a change to the unit price during delivery of electrical energy.

Note: When electrical energy is offered at more than one unit price, selection of the unit price may be through the deliberate action of the purchaser: 1) using controls on the EVSE; 2) through the purchaser's use of personal or vehicle mounted electronic equipment communicating with the system; or 3) verbal instructions by the customer.

**S.2.4.4. Agreement Between Indications.** – All quantity, unit price, and total price indications within a measuring system shall agree for each transaction.

**S.2.5. EVSE Money-Value Computations.** – An EVSE shall compute the total sales price at any single-purchase unit price for which the electrical energy being measured is offered for sale at any delivery possible within either the measurement range of the EVSE or the range of the computing elements, whichever is less.

**S.2.5.1. Money-Value Divisions Digital.** – An EVSE with digital indications shall comply with the requirements of paragraph G-S.5.5. Money-Values, Mathematical Agreement, and the total price computation shall be based on quantities not exceeding 0.5 MJ or 0.1 kWh.

**S.2.5.2. Auxiliary Elements.** – If a system is equipped with auxiliary indications, all indicated money value and quantity divisions of the auxiliary element shall be identical with those of the primary element.

**S.2.6. EVSE Recorded Representations.** – a receipt providing the following information shall be available through a built-in or separate recording element at the completion of all transactions:

- (a) the total quantity of the energy delivered with unit of measure;
- (b) the total computed price of the energy sale;
- (c) the unit price of the energy; (for systems capable of applying multiple unit prices for energy during a single transaction, the following additional information is required):
  - (1) the start and stop time of each phase during which one of the multiple unit prices was applied;
  - (2) the unit price applied during each phase;
  - (3) the total quantity of energy delivered during each phase;
  - (4) the total purchase price for the quantity of energy delivered during each phase;
- (d) the maximum rate of energy transfer (i.e., maximum power) and type of current (e.g., 7 kW AC, 25 kW DC, etc.);
- (e) any additional separate charges included in the transaction (e.g., charges for parking time) including:
  - (1) the time and date when the service ends and the time and date when the service begins; or the total time interval purchased, and the time and date that the service either begins or ends;
  - (2) the unit price applied for the time-based service;
  - (3) The total purchase price for the quantity of time measured during the complete transaction;
- (f) the final total price of the complete transaction including all items;
- (g) the unique EVSE identification number;
- (h) the business name; and
- (i) the business location.

For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.).

**S.2.7. Indication of Delivery.** – The EVSE shall automatically show on its face the initial zero condition and the quantity delivered (up to the capacity of the indicating elements).

**S.3. Design of Measuring Elements and Measuring Systems.**

**S.3.1. Metrological Components.** – An EVSE measuring system shall be designed and constructed so that metrological components are adequately protected from environmental conditions likely to be detrimental to accuracy. The system shall be designed to prevent undetected access to adjustment mechanisms and terminal blocks by providing for application of a physical security seal or an audit trail.

**S.3.2. Terminals.** – The terminals of the EVSE system shall be arranged so that the possibility of short circuits while removing or replacing the cover, making connections, or adjusting the system, is minimized.

**S.3.3. Provision for Sealing.** – Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or physically applying security seals in such a manner that no adjustment may be made of:

- (a) each individual measurement element;
- (b) any adjustable element for controlling voltage or current when such control tends to affect the accuracy of deliveries;
- (c) any adjustment mechanism that corrects or compensates for energy loss between the system and vehicle connection; and
- (d) any metrological parameter that detrimentally affects the metrological integrity of the EVSE or system.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal. Audit trails shall use the format set forth in Table S.3.4. Categories of Device and Methods of Sealing.

<b><u>Table S.3.4.</u></b> <b><u>Categories of Device and Methods of Sealing</u></b>	
<b><u>Categories of Device</u></b>	<b><u>Method of Sealing</u></b>
<b><u>Category 1:</u></b> <u>No remote configuration capability.</u>	<u>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</u>
<b><u>Category 2:</u></b> <u>Remote configuration capability, but access is controlled by physical hardware.</u>  <u>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</u>	<u>The hardware enabling access for remote communication must be on-site. The hardware must be sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters. The event counters may be located either at the individual measuring EVSE or at the system controller; however, an adequate number of counters must be provided to monitor the calibration and configuration parameters of the individual EVSEs at a location. If the counters are located in the system controller rather than at the individual EVSE, means must be provided to generate a hard copy of the information through an on-site device.</u>
<b><u>Category 3:</u></b> <u>Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</u>  <u>The device shall clearly indicate that it is in the remote configuration mode and record such message if capable of printing in this mode or shall not operate while in this mode.</u>	<u>An event logger is required in the device; it must include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter. A printed copy of the information must be available through the EVSE or through another on-site device. The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the EVSE, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)</u>

**S.3.4. Data Storage and Retrieval.**

- (a) EVSE data accumulated and indicated shall be unalterable and accessible.
- (b) Values indicated or stored in memory shall not be affected by electrical, mechanical or temperature variations, radio-frequency interference, power failure, or any other environmental influences to the extent that accuracy is impaired.
- (c) Memory and/or display shall be recallable for a minimum of three years. A replaceable battery shall not be used for this purpose.

**S.3.5. Temperature Range for System Components.** – EVSEs shall be accurate and correct over the temperature range of -40 °C to +85 °C (-40 °F to 185 °F). If the system or any measuring system components are not capable of meeting these requirements, the temperature range over which the system is capable shall be stated on the NTEP CC, marked on the EVSE, and installations shall be limited to the narrower temperature limits.



**S.4. Connections.**

**S.4.1. Diversion of Measured Electricity.** – No means shall be provided by which any measured electricity can be diverted from the measuring device.

**S.4.1.1. Unauthorized Disconnection.** - Means shall be provided to automatically terminate the transaction in the event that there is an unauthorized break in the connection with the vehicle.

**S.4.2. Directional Control.** – If a reversal of energy flow could result in errors that exceed the tolerance for the minimum measured quantity, effective means, automatic in operation to prevent or account for the reversal of flow shall be properly installed in the system. (See N.3. Minimum Test Draft (Size))

**S.5. Markings.** – The following identification and marking requirements are in addition to the requirements of Section 1.10 General Code, paragraph G-S.1. Identification.

**S.5.1. Location of Marking Information; EVSE.** – The marking information required in General Code, paragraph G-S.1. Identification shall appear as follows:

- (a) within 60 cm (24 in) to 150 cm (60 in) from ground level;
- (b) on a portion of the EVSE that cannot be readily removed or interchanged (e.g., not on a service access panel).

**S.5.2. EVSE Identification and Marking Requirements.** – In addition to all the marking requirements of Section 1.10 General Code, paragraph G-S.1. Identification, each EVSE shall have the following information conspicuously, legibly, and indelibly marked:

- (a) Voltage rating;
- (b) Maximum current deliverable;
- (c) Type of current (AC or DC or, if capable of both, both shall be listed);
- (d) Minimum measured quantity (MMQ); and
- (e) Temperature limits, if narrower than and within -20°C to +50°C (-4°F to 122°F).

**S.5.3. Abbreviations and Symbols.** – The following abbreviations or symbols may appear on an EVSE system.

- (a) VAC = Volts Alternating Current;
- (b) VDC = Volts Direct Current;
- (c) MDA = maximum deliverable amperes;
- (d) J = Joule.

**S.6. Printer.** – When assembly system is equipped with means for printing the measured quantity, the printed information must agree with the indications on the EVSE for the transaction and the printed values shall be clearly defined.

**S.6.1. Printed Receipt.** – Any delivered, printed quantity shall include an EVSE identification number that uniquely identifies the EVSE from all other EVSEs within the seller's facility, the time and date, and the name of the seller. This information may be printed by the EVSE system or pre-printed on the ticket.

**S.7. Totalizers for EVSE Systems.** – EVSE systems shall be designed with a nonresettable totalizer for the quantity delivered through each separate measuring device. Totalizer information shall be adequately protected and unalterable. Totalizer information shall be provided by the system and readily available on site or via on site internet access.

**S.8. Minimum Measured Quantity.** – The minimum measured quantity shall satisfy the conditions of use of the measuring system as follows:

- (a) Measuring systems shall have a minimum measured quantity not exceeding 2.5 MJ or 0.5 kWh.

## **N. Notes**

**N.1. No Load Test.** – A no load test may be conducted on an EVSE measuring system by applying rated voltage to the system under test and no load applied.

**N.2. Starting Load Test.** – A system starting load test maybe conducted by applying rated voltage and 0.5-ampere load.

**N.3. Minimum Test Draft (Size).** – Full and light load tests shall require test of the EVSE System for a delivery of the minimum measured quantity as declared by the manufacturer.

**N.4. EVSE System Test Loads.** - EVSE measuring system testing shall be accomplished by connecting the test load and test standard at the point where the fixed cord is connected to the vehicle. Losses in the cord between the meter under test and the test standard should be automatically corrected for in the EVSE quantity indication for direct comparison to the test standard and also while the EVSE is in normal operation. For EVSEs that require a customer supplied cord, system testing shall be accomplished by connecting the test load and test standard at the point where the customer’s cord is connected to the EVSE.

**N.5. Test of an EVSE System.**

**N.5.1 Performance Verification in the Field** – Testing in the field is intended to validate the transactional accuracy of the EVSE system. The following testing is deemed sufficient for field a validation.

**N.5.2 Accuracy Testing** – The testing methodology compares the total energy delivered in a transaction and the total cost charged as displayed/reported by the EVSE with that measured by the measurement standard.

(a) For AC systems:

(1) Accuracy test of the EVSE system at a load of not less than 85 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least twice the minimum measured quantity (MMQ). If the MDA would result in maximum deliverable power of greater than 7.2kW, then the test may be performed at 7.2kW.

(2) Accuracy test of the EVSE system at a load of not greater than 10 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least the minimum measured quantity (MMQ).

(b) For DC systems (see note):

(1) Accuracy test of the EVSE system at a load of not less than 85 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least twice the minimum measured quantity (MMQ).

(2) Accuracy test of the EVSE system at a load of not more than 10 percent of the maximum deliverable current (MDA) as determined from the pilot signal for a total energy delivered of at least the minimum measured quantity (MMQ).

Note: For DC systems it is anticipated that an electric vehicle may be used as the test load. Under that circumstance testing at the load presented by the vehicle shall be sufficient.

**N.6. Repeatability Tests.** – Tests for repeatability should include a minimum of three consecutive tests at the same load, similar time period, etc. and be conducted under conditions where variations in factors are reduced to minimize the effect on the results obtained.

## **T. Tolerances**

### **T.1. Tolerances, General.**

(a) The tolerances apply equally to errors of underregistration and errors of overregistration.

(b) The tolerances apply to all deliveries measured at any load within the rated measuring range of the EVSE.

(c) Where instrument transformers or other components are used, the provisions of this section shall apply to all system components.

### **T.2. Load Test Tolerances.**

**T.2.1. EVSE Load Test Tolerances.** – The tolerances for EVSE load tests are Acceptance Tolerance: 1.0 % and Maintenance Tolerance: 2.0 %.

**T.3. Repeatability.** – When multiple load tests are conducted at the same load condition, the range of the load test results shall not exceed 25% of the absolute value of the maintenance tolerance and the results of each test shall be within the applicable tolerance.

**T.4. Tolerance Application in Type Evaluation Examinations for EVSEs.** – For type evaluation examinations, the acceptance tolerance values shall apply under the following conditions:

- (a) at any temperature, voltage, load, and power factor within the operating range of the EVSE, and
- (b) regardless of the influence factors in effect at the time of the conduct of the examination, and
- (c) for all quantities greater than the minimum measured quantity.

**T 5. No Load Test.** – An EVSE measuring system shall not register when no load is applied.

**T.6. Starting Load.** – An EVSE measuring system shall register starting load test at a 0.5 ampere load.

## **UR. User Requirements**

### **UR.1. Selection Requirements.**

**UR.1.1. Computing-Type Device; Retail EVSE.** – An EVSE used to charge electric vehicles shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each delivery.

**UR.1.2. Connection Cord-Length.** – An adequate means for cord management shall be in use when the cord exceeds 25 ft in length.

### **UR.2. Installation Requirements.**

**UR.2.1. Maximum Deliverable Current.** – The marked maximum deliverable current shall not exceed the total capacity in amperes of the EVSE or the thermal overload protectors of the installation site.

**UR.2.2. Manufacturer’s Instructions.** – An EVSE shall be installed in accordance with the manufacturer’s instructions, and the installation shall be sufficiently secure and rigid to maintain this condition.

**UR.2.3. Load Range.** – An EVSE shall be installed so that the current and voltage will not exceed the rated maximum values over which the EVSE is designed to operate continuously within the specified accuracy. Means to limit current and/or voltage shall be incorporated in the installation if necessary.

**UR.2.4. Regulation Conflicts and Permit Compliance.** – If any provision of Section UR.2. Installation Requirements is less stringent than that required of a similar installation by the serving utility, the installation shall be in accordance with those requirements of the serving utility.

The installer of any EVSE shall obtain all necessary permits.

**UR. 2.5. Responsibility, Unattended EVSE.** – An unattended EVSE shall have clearly and conspicuously displayed thereon, or immediately adjacent thereto, adequate information detailing the name, address, and phone number of the local responsible party for the device.

### **UR.3. Use of EVSE.**

**UR.3.1. Unit Price for Retail EVSE Devices.** – The unit price at which the EVSE is set to compute shall be conspicuously displayed or posted on the face of a retail EVSE used in direct sale.

**UR.3.2. Return of Indicating and Recording Elements to Zero.** – The primary indicating elements (visual) and the primary recording elements shall be returned to zero immediately before each transaction.

**UR.3.3. Printed Ticket.** –A receipt providing the following information shall be available through a built-in or separate recording element at the completion of all transactions:

- (a) the total quantity of the energy delivered with unit of measure;
- (b) the total computed price of the energy sale;
- (c) the unit price of the energy; (for systems capable of applying multiple unit prices for energy during a single transaction, the following additional information is required):
  - (1) the start and stop time of each phase during which one of the multiple unit prices was applied;
  - (2) the unit price applied during each phase;
  - (3) the total quantity of energy delivered during each phase;
  - (4) the total purchase price for the quantity of energy delivered during each phase;
- (d) the maximum rate of energy transfer (i.e., maximum power) and type of current (e.g., 7 kW AC, 25 kW DC, etc.);
- (e) any additional separate charges included in the transaction (e.g., charges for parking time) including:
  - (1) the time and date when the service ends and the time and date when the service begins; or the total time interval purchased, and the time and date that the service either begins or ends;
  - (2) the unit price applied for the time-based service;
  - (3) The total purchase price for the quantity of time measured during the complete transaction;
- (f) the final total price of the complete transaction including all items;
- (g) the unique EVSE identification number;
- (h) the business name; and
- (i) the business location.

For systems equipped with the capability to issue an electronic receipt, the customer may be given the option to receive the receipt electronically (e.g., via cell phone, computer, etc.).

**UR.3.4. EVSE in Operation.** – The EVSE shall be permanently, plainly, and visibly identified so that it is clear which EVSE and connector is in operation.

**UR.3.5. Steps After Charging.** – After delivery to a customer from a retail EVSE:

- (a) the EVSE shall be shut-off at the end of a charge, through an automatic interlock that prevents subsequent charging until the indicating elements and recording elements, if the EVSE is equipped and activated to record, have been returned to their zero positions; and
- (b) the vehicle connector shall not be returned to its starting position unless the zero set-back interlock is engaged or becomes engaged by the act of disconnecting from the vehicle or the act of returning the connector to the starting position.

## Appendix D. Definitions

The specific code to which the definition applies is shown in [brackets] at the end of the definition. Definitions for the General Code [1.10] apply to all codes in Handbook 44.

### A

**active (real) power.** – The component of electric power that performs work, typically measured in kilowatts (kW) or megawatts (MW). Also known as "real power." The terms "active" or "real" power are used to modify the base term "power" to differentiate it from reactive and apparent power. The active power ( $P_{ac}$ ) or real power measured by a system, is the product of voltage (E) times current (I) times the cosine of the angle by which the current lags the voltage ( $\cos \phi$ ) or power factor (pf).  $P_{ac} = (E) (I) (\text{pf}) = (E) (I) (\cos \phi)$  where  $\phi$  is the phase angle of the lag.[3.XX]  
(Added 20XX)

**alternating current (AC).** – An electric current that reverses direction in a circuit at regular intervals.[3.XX]  
(Added 20XX)

**ampere.** – The practical unit of electric current. It is the quantity of current caused to flow by a potential difference of one volt through a resistance of one ohm. One ampere is equal to the flow of one coulomb of charge per second. One coulomb is the unit of electric charge equal in magnitude to the charge of  $6.24 \times 10^{18}$  electrons.[3.XX]  
(Added 20XX)

**apparent power.** – The product of the RMS current (I) and the RMS voltage (E) in a circuit.[3.XX]  
(Added 20XX)

**audit trail.** – An electronic count and/or information record of the changes to the values of the calibration or configuration parameters of a device.[1.10, 2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.XX, 5.56(a)]  
(Added 1993) (Amended 20XX)

### B

**balanced load.** – Balanced load is used to indicate equal currents in all phases and relatively equal voltages between phases and between each phase and neutral (if one exists); with approximately equal watts in each phase of the load.[3.XX]  
(Added 20XX)

**basic lightning impulse insulation level (BIL).** – A specific insulation level expressed in kilovolts of the crest value of a standard lightning impulse. (Example: BIL = 10 Kv)[3.XX]  
(Added 20XX)

**burden (B).** – The impedance of the circuit connected to the instrument transformer's secondary winding. (Example: B = 21 Ohms Max.)[3.XX]  
(Added 20XX)

### C

**calibration parameter.** – Any adjustable parameter that can affect measurement or performance accuracy and, due to its nature, needs to be updated on an ongoing basis to maintain device accuracy, e.g., span adjustments, linearization factors, and coarse zero adjustments.[2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.XX, 5.56(a)]  
(Added 1993) (Amended 20XX)

**central location.** – A laboratory or shop used for the testing of systems to measure in-service accuracy.[3.XX]  
(Added 20XX)

**configuration parameter.** – Any adjustable or selectable parameter for a device feature that can affect the accuracy of a transaction or can significantly increase the potential for fraudulent use of the device and, due to its nature, needs to be updated only during device installation or upon replacement of a component, e.g., division value (increment), sensor range, and units of measurement.[2.20, 2.21, 2.24, 3.30, 3.37, 3.XX, 5.56(a)]

(Added 1993) (Amended 20XX)

**connection line impedance.** – The impedance of the circuit used to convey energy sold from a fueling device to the storage of an electric vehicle.[3.XX]

(Added 20XX)

**creep.** – A continuous apparent measurement of energy indicated by a system with operating voltage applied and no power consumed (load terminals open circuited) .[3.XX]

(Added 20XX)

**current.** – The rate of the flow of electrical charge past any one point in a circuit. The unit of measurement is amperes or coulombs per second.[3.XX]

(Added 20XX)

## D

**direct current (DC).** – an electric current that flows in one direction.

(Added 20XX)

## E

**electric vehicle, plug-in.** – A vehicle that employs electrical energy as a primary or secondary mode of propulsion. Plug-in electric vehicles may be all-electric vehicles (EV's) or plug-in hybrid electric vehicles (PHEV's). All-electric vehicles are powered by an electric motor and battery at all times. All-electric vehicles may also be called battery-electric vehicles (BEV's). Plug-in hybrid electric vehicles employ both an electric motor and an internal combustion engine that consumes either conventional or alternative fuel or a fuel cell. In a parallel type hybrid-electric vehicle, either the electric motor or the engine may propel the vehicle. In a series type hybrid-electric vehicle, the engine or fuel cell generates electricity that is then used by the electric motor to propel the vehicle. EV's, BEV's, and PHEV's are capable of receiving and storing electricity via connection to an external electrical supply. Not all hybrid-electric vehicles are of the plug-in type. Hybrid-electric vehicles that do not have the capability to receive electrical energy from an external supply (HEV's) generate electrical energy onboard with the internal combustion engine, regenerative braking, or both.[3.XX]

(Added 20XX)

**electric vehicle supply equipment (EVSE).** – A device or system designed and used specifically to transfer electrical energy to an electric vehicle, either as charge transferred via physical or wireless connection, by loading a fully charged battery, or by other means.[3.XX]

(Added 20XX)

**electricity as vehicle fuel.** – Electrical energy transferred to and/or stored onboard an electric vehicle primarily for the purpose of propulsion.[3.XX]

(Added 20XX)

**electricity meter.** – A device that measures and registers the integral of an electrical quantity with respect to time.[3.XX]

**element (stator).** – A combination of a voltage-sensing unit and a current-sensing unit, which provides an output proportional to the quantities measured.[3.XX]

(Added 20XX)

**energy.** – The integral of active power with respect to time.[3.XX]  
(Added 20XX)

**energy flow.** – The flow of energy between line and load terminals (conductors) of an electricity system. Flow from the line to the load terminals is considered energy delivered. Energy flowing in the opposite direction (i.e., from the load to line terminals) is considered as energy received.[3.XX]  
(Added 20XX)

**equipment, commercial.** – Weights, measures, and weighing and measuring devices, instruments, elements, and systems or portion thereof, used or employed in establishing the measurement or in computing any basic charge or payment for services rendered on the basis of weight or measure. As used in this definition, measurement includes the determination of size, quantity, value, extent, area, composition (limited to meat and poultry), constituent value (for grain), or measurement of quantities, things, produce, or articles for distribution or consumption, purchased, offered, or submitted for sale, hire, or award.[1.10, 2.20, 2.21, 2.22, 2.24, 3.30, 3.31, 3.32, 3.33, 3.34, 3.35, 3.38, 3.XX, 4.40, 5.51, 5.56.(a), 5.56.(b), 5.57, 5.58, 5.59]  
(Added 2008)(Amended 20XX)

**event counter.** – A nonresettable counter that increments once each time the mode that permits changes to sealable parameters is entered and one or more changes are made to sealable calibration or configuration parameters of a device.[2.20, 2.21, 3.30, 3.37, 3.39, 3.XX, 5.54, 5.56(a), 5.56(b), 5.57]  
(Added 1993)(Amended 20XX)

**event logger.** – A form of audit trail containing a series of records where each record contains the number from the event counter corresponding to the change to a sealable parameter, the identification of the parameter that was changed, the time and date when the parameter was changed, and the new value of the parameter.[2.20, 2.21, 3.30, 3.37, 3.39, 3.XX, 5.54, 5.56(a), 5.56(b), 5.57]  
(Added 1993)(Amended 20XX)

**EVSE field reference standard.** – A portable apparatus that is traceable to NIST and is used as a standard to test EVSEs in commercial applications. This instrument is also known as a portable standard or working standard.[3.XX]  
(Added 20XX)

## F

**face.** – That portion of a computing-type pump or dispenser which displays the actual computation of price per unit, delivered quantity, and total sale price. In the case of some electronic displays, this may not be an integral part of the pump or dispenser.[3.30, 3.XX]  
(Added 1987)(Amended 20XX)

**form designation (FM).** –An alphanumeric designation denoting the circuit arrangement for which the meter is applicable and its specific terminal arrangement. The same designation is applicable to equivalent meters for all manufacturers. (Example: FM 2S)[3.XX]  
(Added 20XX)

## H

**hertz (Hz).** – Frequency or cycles per second. One cycle of an alternating current or voltage is one complete set of positive and negative values of the current or voltage.[3.XX]  
(Added 20XX)



**I**

**instrument transformer ratio.** – The stated ratio of the primary circuit current or voltage compared to the secondary circuit current or voltage. (Example: CTR = 200 : 0.1)[3.XX]  
(Added 20XX)

**J**

**megajoule (MJ).** – An SI unit of energy equal to 1,000,000 joules.[3.XX]  
(Added 20XX)

**K**

**kilowatt (kW).** – A unit of power equal to 1,000 watts.[3.XX]  
(Added 20XX)

**kilowatt-hour (kWh).** – A unit of energy equal to 1,000 watthours.[3.XX]  
(Added 20XX)

**L**

**line service.** – The service terminals or conductors connecting the EVSE to the power source.[3.XX]  
(Added 20XX)

**load service.** – The service terminals or conductors connecting the EVSE to the electrical load (e.g., vehicle, tenant, etc.)[3.XX]  
(Added 20XX)

**load, full.** – A test condition with rated voltage, current at 100% of test amps level, and power factor of 1.0.[3.XX]  
(Added 20XX)

**load, light.** – A test condition with rated voltage, current at 10% of test amps level, and power factor of 1.0.[3.XX]  
(Added 20XX)

**M**

**master meter, electric.** – An electric watthour meter owned, maintained, and used for commercial billing purposes by the serving utility. All the electric energy served to a submetered service system is recorded by the master meter.[3.XX]  
(Added 20XX)

**meter, electricity.** – An electric watthour meter.[3.XX]  
(Added 20XX)

**metrological components.** – Elements or features of a measurement device or system that perform the measurement process or that may affect the final quantity determination or resulting price determinations. This includes accessories that can affect the validity of transactions based upon the measurement process. The measurement process includes determination of quantities; the transmission, processing, storage, or other corrections or adjustments of measurement data or values; and the indication or recording of measurement values or other derived values such as price or worth or charges.[3.XX]  
(Amended 20XX)

**N**

**nationally recognized testing laboratory (NRTL).** – A laboratory that conducts testing and certification that is recognized by OSHA.[3.XX]  
(Added 20XX)

**nonresettable totalizer.** – An element interfaced with the measuring or weighing element that indicates the cumulative registration of the measured quantity with no means to return to zero.[3.30, 3.37, 3.39, 3.XX]  
(Amended 20XX)

## O

**ohm.** – The practical unit of electric resistance that allows one ampere of current to flow when the impressed potential is one volt.[3.XX]  
(Added 20XX)

## P

**percent registration.** – Percent registration is calculated as follows:

$$\text{Percent Registration} = \frac{\text{Wh measured by EVSE}}{\text{Wh measured by STANDARD}} \times 100$$

[3.XX]  
(Added 20XX)

**percent error.** – Percent Error = Percent Registration – 100. A system is said to be “slow” that has percent registration below 100% and negative percent error.[3.XX]  
(Added 20XX)

**point-of-sale system.** – An assembly of elements including a weighing or measuring element, an indicating element, and a recording element (and may also be equipped with a “scanner”) used to complete a direct sales transaction.[2.20, 3.30, 3.32, 3.37, 3.39, 3.XX]  
(Added 1986) (Amended 1997 and 20XX)

**power factor.** – The ratio of the active power to the apparent power in an AC circuit. The power factor is a number between 0 and 1 that is equal to 1 when the voltage and current are in phase (load is entirely resistive).[3.XX]  
(Added 20XX)

**primary indicating or recording elements.** – The term “primary” is applied to those principal indicating (visual) elements and recording elements that are designed to, or may, be used by the operator in the normal commercial use of a device. The term “primary” is applied to any element or elements that may be the determining factor in arriving at the sale representation when the device is used commercially. (Examples of primary elements are the visual indicators for meters or scales not equipped with ticket printers or other recording elements and both the visual indicators and the ticket printers or other recording elements for meters or scales so equipped.) The term “primary” is not applied to such auxiliary elements as, for example, the totalizing register or predetermined-stop mechanism on a meter or the means for producing a running record of successive weighing operations, these elements being supplementary to those that are the determining factors in sales representations of individual deliveries or weights. (See “indicating element” and “recording element.”)[1.10, 3.XX]  
(Amended 20XX)

**primary watt-hour constant (PK<sub>h</sub>).** – The meter watt-hour constant per revolution or pulse (K<sub>h</sub>) multiplied by the product of the current and/or voltage transformer ratio(s):

$$PK_h = K_h (\text{Current Transformer Ratio} \times \text{Voltage Transformer Ratio})$$

[3.XX]  
(Added 20XX)

## R

**reactive power.** – For sinusoidal quantities in a two-wire circuit, reactive power is the product of the voltage, the current, and the sine of the phase angle between them, using the current as the reference.[3.XX]  
(Added 20XX)

**recorded representation.** – The printed, electronically recorded, or other representation that retains a copy of the quantity and any other required information generated by a weighing or measuring device.[1.10, 3.XX]  
(Amended 20XX)

**recording element.** – An element incorporated, connected to, or associated with ~~in~~ a weighing or measuring device by means of which its performance relative to quantity or money value is permanently recorded in a printed or electronic form.[1.10, 3.XX]  
(Amended 20XX)

**remote configuration capability.** – The ability to adjust a weighing or measuring device or change its sealable parameters from or through some other device that is not itself necessary to the operation of the weighing or measuring device or is not a permanent part of that device.[2.20, 2.21, 2.24, 3.30, 3.37, 3.39, 3.XX, 5.56(a)]  
(Added 1993) (Amended 20XX)

**retail device.** – A measuring device primarily used to measure electrical energy for the purpose of sale to the end user.[3.30, 3.32, 3.37, 3.39, 3.XX]  
(Amended 1987, ~~and~~ 2004, and 20XX)

**revolution equivalent.** – The number of watthours represented by one increment (pulse period) of serial data.[3.XX]  
(Added 20XX)

**root mean square (RMS).** – The mathematical convention used to describe the average quantity of a property (such as current) that is varying as a sine wave.[3.XX]  
(Added 20XX)

## S

**serving utility.** – The utility distribution company that owns the master meter and sells electric energy to the owner of a submeter system.[3.XX]  
(Added 20XX)

**starting load.** – The minimum load above which the device will indicate energy flow continuously.[3.XX]  
(Added 20XX)

**submeter.** – A system furnished, owned, installed, and maintained by the customer who is served through a utility owned master meter.[3.XX]  
(Added 20XX)

## T

**tenant.** – The person or persons served electric energy from a submetered service system.[3.XX]  
(Added 20XX)

**test accuracy – in-service.** – The device accuracy determined by a test made during the period that the system is in service. It may be made on the customer's premises without removing the system from its mounting, or by removing the EVSE for testing either on the premises or in a laboratory or shop.[3.XX]  
(Added 20XX)

**test amperes (TA).** – The full load current (amperage) specified by the EVSE manufacturer for testing and calibration adjustment. (Example: TA 30)[3.XX]  
(Added 20XX)

**test block.** – Device that facilitates safe meter testing by disconnecting the meter from the circuit without interrupting the service to the tenant.[3.XX]  
(Added 20XX)

**thermal overload protector.** – A circuit breaker or fuse that automatically limits the maximum current in a circuit.[3.XX]  
(Added 20XX)

## U

**unit price.** – The price at which the electrical energy is being sold and expressed in whole units of measurement.[1.10, 3.30, 3.XX]  
(Added 1992) (Amended 20XX)

## V

**vehicle connector.** - A device that by insertion into an vehicle inlet, establishes an electrical connection to the electric vehicle for the purpose of providing power and information exchange, with means for attachment of electric vehicle cable. This device is a part of the vehicle coupler.  
(Added 20XX)

**vehicle coupler.** - A means enabling the connection, at will, of an electric vehicle cable to the equipment. It consists of a vehicle connector and a vehicle inlet.  
(Added 20XX)

**vehicle inlet.** - The part incorporated in, or fixed to the vehicle, which receives power from a vehicle connector.  
(Added 20XX)

**volt.** – The practical unit of electromotive force. One volt will cause one ampere to flow when impressed across a resistance of one ohm.[3.XX]  
(Added 20XX)

**voltage transformer.** – A device that provides a secondary voltage that is a precise fraction of the primary voltage.[3.XX]  
(Added 20XX)

## W

**watt.** – The practical unit of electric power. In an alternating-current circuit (AC), the power in watts is volts times amperes multiplied by the circuit power factor.[3.XX]  
(Added 20XX)

**watthour (Wh).** – The practical unit of electric energy, which is expended in one hour when the average power consumed during the hour is one watt.[3.XX]  
(Added 20XX)

**watthour – test constant (K<sub>t</sub>).** – The expression of the relationship between the energy applied to the meter system and corresponding occurrence of one test output indication expressed as watthours per test output indication.[3.XX]  
(Added 20XX)

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