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Section 3.40. Electric Vehicle Fueling Systems

Section 3.40. Electric Vehicle-Fueling Systems was added as a “tentative code” in 2015. In July 2022, the status of the code was changed from “tentative” to “permanent” effective January 1, 2023.

(Amended 2022)

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, Electric Fueling Systems 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 an 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. – EVSE units used to charge electric vehicles shall be indicated and recorded in kilowatt-hours (kWh) and decimal subdivisions thereof.

(Amended 2022)

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:

- (a) for AC systems shall not exceed 0.0001 kWh;
- (b) for DC systems shall not exceed 0.001 kWh; and
- (c) the value of the kWh shall be expressed only as a decimal submultiple of 1 that satisfy (a) and (b).

(Amended 2022)

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; “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:

- (a) at the EVSE;

- (b) at the console, if the console is accessible to the customer;
- (c) via on site internet access; or
- (d) 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 eight 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 the 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 at the end of the transaction shall be based on quantities not exceeding 0.01 kWh.

(Amended 2023)

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 to those of the primary element.

S.2.6. EVSE Recorded Representations. – A receipt, either printed or electronic, providing the following information shall be available 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, and 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 begins and the time and date when the service ends; 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.

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).

All DC EVSE are exempt from this requirement until January 1, 2028.

(Amended 2022)

S.2.8. Automatic Timeout – Pay-At-EVSE. – *Once an EVSE has been authorized, it must deauthorize within two minutes if not activated. Reauthorization of the EVSE must be performed before any electrical energy is delivered and/or timing charges assessed. If the time limit to deauthorize the EVSE is programmable, it shall not accept an entry greater than two minutes.*

[Nonretroactive as of January 1, 2020]

(Added 2019)

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. – For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device, security shall be provided for those parameters as specified in G-S.8.2. Devices and Systems Adjusted Using Removable Digital Storage Devices. For parameters adjusted using other means, the following applies.

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 can 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.3.3. Categories of Device and Methods of Sealing.

(Amended 2019)

Table S.3.3. Categories of Device and Methods of Sealing	
Categories of Device	Method of Sealing
<p>Category 1: No remote configuration capability.</p>	<p>Seal by physical seal or two event counters: one for calibration parameters and one for configuration parameters.</p>
<p>Category 2: Remote configuration capability, but access is controlled by physical hardware.</p> <p>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.</p>	<p>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 copy of the information through an on-site device; this information may be provided electronically in lieu of or in addition to a hard copy at the time of inspection.</p>
<p>Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).</p> <p>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.</p>	<p>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. The event logger information may be provided electronically in lieu of or in addition to a hard copy at the time of inspection, provided the event logger information is retained in the system for future reference. 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.)</p>

(Amended 2021)

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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $+185\text{ }^{\circ}\text{F}$). 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; and
- (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 deliverable amperes;
(Amended 2023)
- (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 $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $+185\text{ }^{\circ}\text{F}$).
(Amended 2021)

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) kWh = kilowatt hour.
(Amended 2023)

S.6. Printer. – When a 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 (MMQ). – 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:

- (1) 0.5 kWh for AC EVSE; and
- (2) 1.0 kWh for DC EVSE.

Note: To minimize the duration of required testing, manufacturers may want to consider limiting the declared MMQ to the level of 0.1 kWh for AC EVSE.

(Note Added 2023)

(Amended 2023)

N. Notes

N.1. 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.2. 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 EVSE 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.3. Test of an EVSE System.

N.3.1. 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 a field validation.

N.3.2. 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 % of the maximum deliverable amperes (expressed as 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 7.2 kW, then the test may be performed at 7.2 kW.
- (2) Accuracy test of the EVSE system at a load of not greater than 10 % of the maximum deliverable amperes (expressed as 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 % of the maximum deliverable amperes current (expressed as MDA) as determined from the digital communication message from the DC EVSE to the test standard 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 % of the maximum deliverable amperes (expressed as MDA) as determined from the digital communication message from the DC EVSE to the test standard for a total energy delivered of at least the minimum measured quantity (MMQ).

All DC EVSE are exempt from this requirement until January 1, 2028.

(Amended 2022)

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.4. Repeatability Tests. – Tests for repeatability shall 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:

- (a) Acceptance Tolerance: 1.0 %; and
- (b) Maintenance Tolerance: 2.0 %.

All DC EVSE are exempt from this requirement until January 1, 2028.

(Amended 2022)

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;
- (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.

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 the 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. EVSE Recorded Representations. – A receipt, either printed or electronic, providing the following information shall be available 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; and 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 begins and the time and date when the service ends; 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.

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.

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