



Examination Procedure Outlines (EPOs) for Commercial Weighing and Measuring Devices

EPO 30

Retail Electric Vehicle Fueling Systems

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**EPO No. 30:
NIST Examination Procedure Outline (EPO) for
Retail Electric Vehicle Fueling Systems**

It is recommended that this outline be followed as minimum criteria for examining retail electric vehicle fuel dispensers and consoles. The criteria are based on legal metrology requirements in the 2024 edition of NIST Handbook 44 *Specifications, Tolerances, and Other Technical for Weighing and Measuring Devices*. Nonretroactive requirements are followed by the applicable date in parentheses. Procedures that apply to corresponding requirements in multiple specific codes with similar paragraph designations are distinguished by that particular code section number followed by the appropriate paragraph designation, those from the Electric Vehicle Fueling Systems (EVFS) Code are preceded by 3.40, whereas those that apply to specific requirements in the Timing Devices Code are preceded by 5.55 and the letter “G” applies to requirements from the General Code which are preceded by 1.10. General Code criteria apply to equipment that is designed to be used for the sale of electrical energy and time related services. Code section 5.55 applies when the EVFS is used to assess fees for time-based services such as parking in addition to those fees that are associated with the sale of electrical energy in units of the kilowatt-hour. A retail Electric Vehicle Fueling Systems (EVFS) is also referred to as Electric Vehicle Supply Equipment (EVSE) or Electric Vehicle Chargers.

SAFETY NOTES

When excerpting this Examination Procedure Outline (EPO) for duplication, the National Institute of Standards and Technology (NIST) EPO Safety Annex (Safety Considerations and Glossary of Safety Key Phrases) should be duplicated and included with this outline.

Safety policies and regulations vary among jurisdictions. It is essential that inspectors and servicepersons be aware of all safety regulations and policies in effect at the inspection site and to practice their employer’s safety policies. The safety reminders included in this EPO contain general guidelines useful in alerting inspectors and servicepersons of the importance in taking adequate precautions to avoid personal injury. These guidelines can only be effective in improving safety when coupled with training in hazard recognition and control.

Prior to beginning any inspection, the inspector should read and be familiar with the NIST EPO Safety Annex - “Safety Considerations and Glossary of Safety Key Phrases.” The terms and key phrases in each safety reminder of this outline are found in the glossary of the EPO Safety Annex. The inspector is reminded of the importance of evaluating potential safety hazards prior to an inspection and taking adequate precautions to avoid personal injury or damage to the device. As a minimum, the following safety precautions should be noted and followed during the inspection:

- **Clothing**
- **Electrical Hazards**
- **Emergency Procedures**
- **Eye Protection**
- **Fire Extinguishers**
- **First Aid Kit**
- **Grounding**
- **Ignition Sources**
- **Lifting**
- **Location**
- **Obstruction**
- **Nature of Product**
- **Personal Protection Equipment**
 - e.g., Safety Glasses, Safety Gloves, etc., other if deemed necessary

- **Safety Cones/Warning Signs**
- **Traffic**
- **Transportation of Equipment**
- **Wet/Slick Conditions**

SAFETY REMINDER!!!

- **Check the inspection site carefully for safety hazards and take appropriate precautions.**
- **Learn the nature of hazardous products at, or near, the inspection site.**
- **Know the emergency procedures and location and operation of fire extinguishers and emergency shut offs.**
- **Post safety cones/warning signs and be aware of vehicular and pedestrian traffic patterns**
- **Use caution when moving in wet, slippery areas**
- **If leaks, spills, or exposed wiring cause hazardous testing conditions, it is recommended that the testing be discontinued until the unsafe conditions are corrected.**
- **Use personal protective equipment appropriate for the inspection site.**
- **Be sure that a first aid kit is available and that the kit is appropriate for the type of inspection activity.**
- **Use correct connections appropriate for interface with the device under test.**

Equipment List

The following criteria should be considered when selecting equipment for the test.

Test Standard - Electric Vehicle Charging System Test Standard:

Ensure the field standard is of a capacity and type of voltage matches that of the Electric Vehicle Fueling System (EVFS) under test. In accordance with NIST Handbook (HB) 44, General Code paragraph G-N.3. Test Methods, the test methods for determining compliance to NIST Handbook 44 Sections 1.10 and 3.40, and, where applicable, Section 5.55 outlined in this document does not preclude the use of additional or other methods and apparatus approved by the Director as outlined in Appendix A. Fundamental Considerations Section 3. Testing Apparatus paragraph 3.2. Tolerances for Standards. The tolerances for the combined error and uncertainty of any standard used for testing must be less than one-third the applicable device tolerance. The test standards must meet the “Element of Traceability” to ensure they are suitable and capable of measurements traceable to the International System of Units (SI) through NIST or other National Measurement Institute signatory of International Committee of Weights and Measures (CIPM) Mutual Recognition Arrangement (MRA) for accuracy. A Type 2 Transfer Standard is not recommended for use in testing electric vehicle fueling systems.

Test Standard - Field Standard Stopwatch or Interval Timer:

The test standard used in the verification of the EVFS commercial time measuring element conforms to NIST Handbook 105-5 Specifications and Tolerances for Field Standard Stopwatches or other suitable designated standard. NIST Handbook 105-5 is available on the NIST Office of Weights and Measures (OWM) website at: www.nist.gov/pml/owm/nist-handbooks. In accordance with NIST Handbook 44, Fundamental Considerations Section 3 paragraph 3.2, the combined error and uncertainty of any standard used for testing must be less than one-third the applicable device tolerance.

A timing device shall be tested with a timepiece with an error of not greater than plus or minus 15 seconds per 24-hour period. In the test of timing devices with a nominal capacity of 1 hour or less, stopwatches with a minimum division of not greater than one fifth second shall be used. In the test of timing devices with a nominal capacity of more than one hour, the value of the minimum division on the timepiece shall be not greater than one second. Time pieces and stopwatches shall be calibrated with standard time signals as described in National Institute of Standards and Technology Special Publication 432, NIST Time and Frequency Services, or any superseding publication.

Optional Equipment:

An activation card (e.g., credit card, cash value card, debit card, or other card used to activate the EVFS) or other remote device (Radio Frequency Identification (RFID), swipe card (processed without insertion into a reader), etc.) to activate the EVFS for transactions.

SAFETY REMINDER!!!

- **Assess the overall safety condition of the EVFS.**
- **Report loose, exposed, frayed, or worn EVFS charge cables and damaged or worn connectors to the designated local responsible party.**
- **Avoid tests while standing on wet surfaces or in environments that expose the EVSE to damp or wet conditions.**
- **Ensure unobstructed access to the EVFS for the field examination process.**
- **Identify the EVFS's power capacity, voltage, type of current, amperage, and system's power transfer method, and verify compatibility with the test standard.**
- **For EVFSs equipped with an integral timing device, verify the timing test standard is appropriate.**
- **Identify the method of generating a transaction receipt onsite is accessible and determine it provides for safe access to the transaction receipt.**
- **Verify that the method of activating the EVFS is available for conduct of the test.**
- **Do not leave an activated dispenser unattended!**
- **Ground the test equipment.**

Electrical Energy Equation for Use in the Test of an EVFS

The time will vary to complete the delivery of the required minimum test draft and steps necessary to verify and document the indicated and recorded transaction information over the specified operating range of an EVFS. Using the formulas shown below, the official/service industry representative can calculate the approximate time for the delivery of the required minimum quantity of electrical energy for each level of charging specified for the test.

The electrical energy ratings information marked on the EVFS includes the system's:

- Voltage Rating:

$V_{EVFS \text{ RATING}}$ (e.g., 240 VAC [volts alternating current])

- Maximum Current Deliverable:

$A_{EVFS \text{ MAXIMUM CURRENT DELIVERABLE (MCD) OR } A_{EVFS \text{ MCD}}$ (e.g., 30 Amps)

In this case it is determined during the test the maximum deliverable amperes (MDA) achieved is also 30 Amps

- Minimum Measured Quantity (MMQ) (e.g., 0.5 kWh)

Equations can be used to determine information that can be used in preparation for testing prescribed in HB 44 3.40 paragraph N.3.2. Accuracy Testing This includes use of basic electrical formulas related to Ohm's Law [$I = V/R$] as shown in the formulas below:

Ohm's Law $I = V/R$

**Where: I is current expressed in Amps or A;
V is voltage expressed in Volts or V; and
R is resistance expressed in Ohms or R**

Power Formula $P = E \times I$

**Where: P is power expressed in Watts or W;
E is voltage expressed in Volts or V; and
I is current expressed in Amps or A**

The duration of the test is determined using the EVFS energy information communicated or signaled to the test standard which is then calculated as shown below in the following equations:

If the test is performed as specified in paragraph:

N.3.2.(a)(1) for a quantity of 2 x MMQ and at 85 percent maximum deliverable amperes (i.e., in this case the EVFS has a maximum current capability of 30 Amps and 85 percent of that is: $30 \text{ A} \times 0.85 = 25.5 \text{ A}$).

Using the Power Formula where $P = E \times I$ which is also stated as $I \times E = P$ based on the known current (I) and voltage (E) levels for the EVFS are available for solving the unknown power value in the equation.

$$25.5 \text{ A} \times 240 \text{ V} = 6120 \text{ W}$$

Converting the power value to the unit prescribed for measurement of electrical energy or the kW:

6120 W/1000 W/kW = 6.12 kW

A delivery twice the EVFS’s declared MMQ is required as a minimum for the full load test. Using the information calculated above the duration of the full load test is calculated using the equation:

Time for the Test = Test Load [in this case n(MMQ)]/Power Value:

Solving the equation with the known values is shown below:

Test Load [in this case n(mmq)]/Power Value = Time for the Test

2 (0.5 kWh)/6.12 kW = Time for the Test 1.0 kWh/6.12 kW = 0.16339869281 h

0.16339869281 h x 60 min/h = 9.804 min is the duration of the Full Load Test

Inspection

NOTE: Code references used throughout the document are drawn from NIST Handbook 44 (HB 44) General Code (Section 1.10), Electric Vehicle Fueling Systems Code (Section 3.40), and Timing Devices Code (Section 5.55) References. The references are shown to the right of each line item or task, with the title of the relevant code designated with the section number only. For example, NIST Handbook 44 (HB 44) General Code (Section 1.10) is designated as “1.10:” followed by the paragraph designation(s) relevant to the line item

Inspection	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
1. Accessibility and assistance in inspecting, testing, and sealing.	
Device must be readily accessible for purposes of testing. Assistance shall be provided by the firm if needed.	1.10: G-UR.2.3., G-UR.4.4.
2. General Considerations.	
<p>Selection and Suitability. System materials; design elements (to include computing capability, the details of its indicating and recording elements, and value of its smallest unit and unit prices); and construction must be suitable for the service and environment in which it is used. These elements must also make it probable accuracy is maintained, parts function as intended, data storage and retrieval, and adjustments are reasonably permanent under conditions of normal use.</p>	1.10: G-S.3., G-UR.1.1., G-UR.1.2. 3.40: S.3.4.
<p>Installation. The system and any associated equipment ensure the assembly, installation, and construction do not facilitate fraud. A system shall be installed according to manufacturer’s instruction and when installed in a fixed location its operation and performance will</p>	1.10: G-S.2., G-UR.2.1., G-UR.2.2. 3.40: S.4.2., UR.2.1. UR.2.2., UR.2.3.

<p style="text-align: center;">Inspection</p>	<p style="text-align: center;">HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References</p>
<p>not be adversely affected by the foundation, supports, or any other details of the installation or exceeding the rated maximum electrical energy capacity or load.</p> <p>A system is installed so that there is no obstruction between the primary indicating or recording element and the measuring element.</p> <p>A system is installed so that any reversal of energy flow does not result in errors exceeding tolerance.</p>	
<p>Position of Equipment.</p> <p>A device or system equipped with a primary indicating element and used in direct sales shall be positioned so that its indications may be accurately read and the measuring operation may be observed from some reasonable “customer” and “operator” position. The positioning shall be determined on a case-by-case basis, considering the individual circumstances including the size and character of the indicating element.</p>	<p>1.10: G-UR.3.3.</p>
<p>Use and Maintenance.</p> <p>The system and any associated equipment are to be operated and maintained as intended by the manufacturer.</p> <p>Unstable indications or other abnormal equipment performance observed during operation shall be corrected and, if necessary, brought to the attention of the firm.</p>	<p>1.10: G-UR.3.1., G-UR.4.1., G-UR.4.2. 3.40: UR.3.5.</p>
<p>Computing Capability</p>	<p>3.40: UR.1.1.</p>
<p>3. Indicating and Recording Elements.</p>	
<p>Design.</p> <p>Indicating and recording elements must be clear, definite, and easily read. The design shall be such that indications are clear and there is no interference between time measurements (when applicable) and electrical energy measurement. Multiple EVFSs may use a single indicating element that clearly and definitely displays information for each individual EVFS.</p>	<p>3.40: S.1.1., S.1.2., S.1.2.1.</p>
<p>Units - EVFSs.</p> <p>For AC systems, units shall not exceed 0.0001 kWh.</p> <p>For DC systems, units shall not exceed 0.001 kWh.</p>	<p>3.40: S.1.3.1., S.1.3.2.</p>
<p>Units – Integral Time-Based Systems.</p> <p>Integral time-based indications (where applicable).</p>	<p>5.55: S.1.1.2., S.1.1.3.</p>
<p>Readability.</p>	<p>1.10: G-S.5., G-S.6. (1/1/77), G-S.7.</p>

Inspection	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
Indicating and recording elements, operational controls must be adequately defined, clear, definite, and easily read.	3.40: S.1.3.3. 5.55: S.2.
Values of Intervals. Values of the graduated intervals must be uniform throughout the series of indicating elements or if equipped recording elements.	1.10: G-S.5.3., G-S.5.3.1. 3.40: S.1.3.3.
Indication of delivery.	3.40: S.1.1., S.2.1, S.2.7. (S.2.7. Retroactive 1/1/28 for DC Systems)
In-Service Indicator Light (if applicable). When so equipped, an in-service indicator light shall be operative only during the operation of the integral time feature of the EVFS.	5.55: S.1.1.5.
Money-Value Divisions. All money value divisions indicated on the primary and auxiliary indicating elements shall be identical.	3.40: S.2.5.2.
Unit Price and Product Identity. Electrical energy or associated time-based services offered for sale at more than one unit price through an EVFS shall be displayed and selectable prior to delivery. Pricing shall not change during a transaction, except when the conditions for variable pricing are approved by the customer prior to the sale.	3.40: S.2.4.1., S.2.4.3., UR.1.1., UR.3.1. 5.55: UR.1.
Multiple Unit Price Dispensers. Capability for multiple unit pricing or time-based services over a single transaction shall indicate specified transaction information and appropriately identify the unit prices which are selectable by the customer. Statement of rates in units of time (where applicable) for the service is clear and prominently displayed.	1.10: G-S.5.3.1. 3.40: S.1.1., S.1.2.1., S.2.4.3., UR.3.1. 5.55: UR.1.
Advancement and Return to Zero. Indicating and recording elements readily return to zero and it is not possible to return beyond the correct zero position. Zeroing operation not possible during delivery. Timing element advances only during operation of the device.	3.40: S.2.1., S.2.2., UR.3.2., UR.3.5. 5.55: S.1.1.4.
Recorded Representations.	
General.	1.10: G-S.5.6.
Provision for Sealing.	1.10: G-S.8. (1/1/90)

<p style="text-align: center;">Inspection</p>	<p style="text-align: center;">HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References</p>
<p>Adequate provision shall be made for an approved means of security (e.g., data change audit trail) or for physically applying a security seal in such a manner that requires the security seal to be broken before an adjustment or interchange can be made of:</p> <ul style="list-style-type: none"> • any measuring or indicating element; • any adjustable element for controlling voltage and current when such controls tend to affect the accuracy of deliveries; • any adjustment mechanism that corrects or compensates for energy loss between the system and vehicle connection; and • any metrological parameter that will affect the metrological integrity of the EVFS. 	<p>3.40: S.3.3., Table S.3.3. 5.55: S.4.</p>
<p>Physical Means of Security. For devices designed with a physical means of security, check for:</p> <p><i>Accessibility of the Adjusting Mechanism.</i> When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.</p>	<p>3.40: S.3.3. 5.55: S.4.</p>
<p><i>Presence of Security Seals.</i> Check for the presence of security seals on the device. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Document missing seals on the official report and apply new seals as needed.</p>	<p>1.10: G-UR.4.5. 3.40: S.2.2. 5.55: S.4.</p>
<p>Audit Trails.</p> <p><i>Audit Trails - Format.</i> For devices using an audit trail(s) as a means of security, the audit trail(s) shall use the format set forth in Table S.3.3. Categories of Devices and Methods of Sealing.</p>	<p>1.10: G-S.8. (1/1/90) 3.40: S.3.3., Table S.3.3.</p>
<p><i>Audit Trail Information.</i> If the system is equipped with an audit trail, note the event counter settings on the report form for future reference. If equipped with an event logger, print a copy of the event log and attach it to the report form for future reference. Note that on some systems an electronic copy of the event log may also be available. Examine these records for any signs of misuse of adjustments.</p>	<p>1.10: G-S.8. (1/1/90) 3.40: S.3.3., Table S.3.3.</p>
<p><i>Event Logger.</i> If security is provided using an event logger, the event logger shall include an event counter (000 to 999), the parameter ID, the date and time of the change, and the new value of the parameter.</p> <p>The event logger information shall be available at the time of inspection either as a printed copy or in electronic format. The information may be printed by the device, printed by another on-site device, or transmitted electronically.</p>	<p>3.40: S.3.3., Table S.3.3.</p>

Inspection	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
The event logger shall have a capacity to retain records equal to 10 times the number of sealable parameters in the device, but not more than 1000 records are required. (Note: Does not require 1000 changes to be stored for each parameter.)	
<p>Adjustments Using Removable Digital Storage Devices. For devices and systems in which the configuration or calibration parameters can be changed by use of a removable digital storage device*, such as a secure digital (SD) card, USB flash drive, etc., security shall be provided for those parameters using either:</p> <ul style="list-style-type: none"> (1) an event logger in the device; or (2) a physical seal that must be broken in order to remove the digital storage device from the device (or system). <p>* This applies only to removable digital storage devices that must remain in the device or system for it to be operational.</p>	<p>1.10: G-S.8.2. 3.40: S.3.3., Table S.3.3. 5.55: S.4.</p>
For multiple measuring elements with a single provision for sealing, a change to the adjustment of any measuring element must be individually identified.	1.10: G-S.8.1. (1/1/10)
A metrologically-significant software change is a sealable event.	1.10: G-S.9.
Automatic Timeout, Pay-At-EVSE.	3.40: S.2.8. (1/1/20)
After authorization, the device must de-authorize in two minutes if not activated. If the time limit to deauthorize the device is programmable, it shall not accept an entry greater than two minutes.	3.40: S.2.8. (1/1/20)
4. Marking.	
General Markings:	1.10: G-S.1.
1) Identification – General.	G-S.1.
○ Name or ID of manufacturer.	G-S.1.(a)
○ Model designation.	G-S.1.(b)
○ Model designation identifier and abbreviations.	G-S.1.(b)(1) (1/1/03)
○ Nonrepetitive serial number.	G-S.1.(c) (1/1/68)
○ Serial number identifier and abbreviations.	G S.1.(c)(1) (1/1/86) G-S.1.(c)(2)(1/1/01)
2) Identification – Software Version Markings.	
○ Software version or revision identifier, software-based devices.	G-S.1.(d) (1/1/04)

Inspection	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
○ Software version or revision identifier for not-built-for-purpose software-based devices.	G-S.1.(d) (1/1/22)
○ Software version or revision identifier for all software-based devices.	G-S.1.(d)(1)(i) (1/1/07)
○ Software version or revision identifier continuously displayed or accessible via the display.	G-S.1.(d)(1)(ii) (1/1/22)
3) Other Markings	
○ NTEP CC Number.	G-S.1.(e)
○ NTEP CC Number identifier.	G-S.1.(e)(1)
○ Remanufactured as of 1/1/02.	G-S.1.2.
○ Name and ID of remanufacturer or distributor.	G-S.1.2.(a)
○ Model number if different from original number.	G-S.1.2.(b)
4) Device-Specific EVFS Additional Identification and Marking Information.	3.40: S.5.2.
○ Voltage rating.	3.40: S.5.2.(a)
○ Maximum amperes.	3.40: S.5.2.(b)
○ Type(s) of current.	3.40: S.5.2.(c)
○ Minimum Measured Quantity.	3.40: S.5.2.(d)
○ Temperature limits, if narrower than – 40 °F to 185 °F.	3.40: S.5.2.(e)
Location of Marking Information, Not-Built-For Purpose, Software-Based Devices.	1.10: G-S.1.1. (1/1/04)
Visibility of required markings after installation.	1.10: G-UR.2.1.1.
Location of Marking Information, Retail EVFS.	3.40: S.5.1.
Money-Operated Devices, Responsibility.	1.10: G-UR.3.4.
Limitation on Use.	3.40: S.5.2.
Equipment Capacity.	3.40: S.2.4.2.
5. Measuring Elements.	
Security Seals.	

Inspection	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
General.	1.10: G-S.8. (1/1/90), G-S.9. 3.40: S.3.3., Table S.3.3. 5.55: S.4.
Security seal on adjusting mechanism. Check for the presence of security seals on the device. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Document missing seals on the official report and apply new ones as needed.	1.10: G-UR.4.5. 3.40: S.3.3. 5.55: S.4.
6. Connection Cord.	
Length and Protection.	3.40: UR.1.2.
7. Facilitation of Fraud.	
Facilitation of Fraud, General.	1.10: G-S.2.
8. Totalizers for EVFS Systems.	3.40: S.7.

Pre-Test Determination Notes

Before testing the EVFS, verify the following.

- 1) The system is safe, legal, and suitable with respect to the installation for commercial use.
- 2) The jurisdiction permits the sale of electrical energy as a vehicle fuel.
- 3) If charges are also assessed for time related services, verify these additional fees are:
 - (1) associated with an EV charging session;
 - (2) calculated based on a recognized unit of time; and
 - (3) separate from fees assessed for the sale of electricity that is based on a recognized unit of electrical energy.
- 4) If specific tariff rules apply, they are:
 - o properly interpreted,
 - o itemized in printed and/or electronically recorded representations and/or posted,
 - o accurately calculated, and
 - o where applicable, coordinated with other agencies that overlap as parking authorities.

Pretest Determinations	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
1. Tolerances.	
Acceptance/Maintenance Tolerances.	1.10: G-T.1., G-T.2.
Application.	1.10: G-T.3. 3.40: T.1., T.4. 5.55: T.1.
Basic Values.	3.40: T.2.1. (Retroactive 1/1/28 for DC Systems) 5.55: T.1.3., Table T.1.3.
All DC EVFSs are exempt from T.2. Load Test Tolerances (3.40) until January 1, 2028. Requirements and provisions from the General Code and other device codes apply when equipment does not fall clearly in an established separate code.	1.10: G-A.3. 3.40: T.2.1. (Retroactive 1/1/28 for DC Systems)
Repeatability.	3.40: N.4., T.3.
2. Digital Indications and Representations.	
To the tolerances that would otherwise be applied add an amount on-half the minimum value that can be indicated or recorded.	5.55: T.2.
3. Statement of Rates.	
Where time fees are assessed in association with the electrical energy charging session the pricing for time rates are clearly, prominently, and conspicuously displayed.	5.55: UR.1.
4. Test Load.	
Identify the test site conditions under which testing will be conducted on an EVFS. When conducting any tests on an EVFS, verify that the EVFS’s power capacity, voltage, type of current, amperage, and system’s power transfer method, and whether the system includes an integral timing device for testing is appropriate. As a minimum, a “light load test;” and a “full load test” shall be conducted on an EVFS. The tests are as specified in N.3.2. Accuracy Testing. All DC EVFSs are exempt from this requirement until January 1, 2028. Requirements and provisions from the General Code and other device codes apply when equipment does not fall clearly in an established separate code.	1.10: G-A.3. 3.40: N.2., N.3.1., N.3.2.
5. Test Draft Size Time Test.	
	5.55: UR.1.

<p align="center">Pretest Determinations</p>	<p align="center">HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References</p>
<p>Determine the duration of the time and interference time tests which is representative of the time lapsed during typical charging sessions for that business type or based on the posted rates.</p>	
<p>6. Test Draft Size Electrical Energy Test. “Light Load” tests shall be conducted at a quantity as close as practical, but never below the minimum measured quantity (MMQ) declared by the manufacturer. Full load tests shall be conducted at a quantity of at least two times the MMQ declared by the manufacturer. All DC EVFSs are exempt from the provisions of N.3.2.(b) Accuracy Testing, For DC systems until January 1, 2028. Requirements and provisions from the General Code and other device codes apply when equipment does not fall clearly in an established separate code.</p>	<p>1.10: G-A.3. 3.40: N.1., N.3.1., N.3.2.</p>
<p>7. Test Methods. This EPO does not preclude the use of test methods and test standard apparatus that have been approved by the Director as described in NIST Handbook 44, Appendix A, Section 3. Testing Apparatus. If other test standards apparatus or equipment is used, corresponding adjustments to the test procedures described in this EPO may be needed to reflect the use of that test standard equipment.</p>	<p>1.10: G-N.3. Appendix A, Section 3. Testing Apparatus</p>

SAFETY REMINDER!!!

- **Wear appropriate personal protection equipment such, nonskid safety shoes (to prevent possible injury from spills or slipping on slick surfaces), protective clothing, and eye protection to prevent injury from projected objects.**
- **Do not leave an activated dispenser unattended!**
- **Ensure the test standard and associated equipment is properly grounded.**

Test Notes	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
1. Totalizers.	
To determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts. The system shall include this design feature for the quantity delivered for each device and this information shall be readily available on site or through on-site internet access.	3.40: S.7.
2. Steps in the Test of an EVFS.	
<ul style="list-style-type: none"> • EVFS and Test Standard Connection Process 	
a. Select the appropriate setup for the test standard; type of current and power transfer method and voltage based on the EVFS’s fuel rating.	
b. After connecting to the EVFS coupler, test procedures will be initiated using a laptop/table PC, software, and load control/DAQ hardware.	3.40: N.2
c. Connect the laptop/tablet PC to the DAQ system via USB cable.	
d. Utilize the authorization/activation method that has been identified to initiate the EV charging transaction/session.	
e. Determine the maximum deliverable current from the pilot signal or digital communication message communicated/signaled from the EVFS to the test standard.	3.40: N.3.2.
f. Automatic Timeout - Pay-At-EVSE. Once the device has been authorized, it must de-authorize within 2 minutes if the device has not been activated. To verify this operation, first authorize the EVFS. Next, without dispensing electrical energy or, where applicable, time being assessed in association with the charging session, wait 2 minutes and then attempt to dispense product. The system must not dispense electricity nor assess time fees.	3.40: S.2.8. (1/1/20)
g. Verify, at the activation of the EVFS and at the start of the transaction measurements are continuously accumulating to display the quantity and total price for at least 15 seconds.	3.40: S.1.2.
h. Determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts.	3.40: S.7.

<p style="text-align: center;">Test Notes</p>	<p style="text-align: center;">HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References</p>
<p>• After Each Test Load Delivery:</p>	
<p>a. Print a ticket if the device is so equipped and verify required information is provided on the receipt. Verify that appropriate abbreviations are used for indicated and recorded representation of units. Required recorded representation include itemized timing charges when time services are assessed separately from charges for electrical energy as specified in Section 3.40. Electric Vehicle Fueling Systems paragraph S.2.6. EVSE Recorded Representations.</p>	<p>1.10: G-S.5.6., G-S.5.6.1. 3.40: S.2.6., UR.3.3. 5.55: S.1.4.1.</p>
<p>b. Verify that any options for obtaining a recorded representation are appropriate. The customer may be given the option of not receiving the recorded representation.</p>	<p>1.10: G-S.5.6.</p>
<p>c. If the system is equipped with the capability, the customer may also be given the option of receiving the recorded representation electronically in lieu of or in addition to a hard copy.</p>	<p>1.10: G-S.5.6. 3.40: S.2.6.</p>
<p>d. Verify that required information is printed on the receipt for each transaction.</p>	<p>3.40: S.6., S.6.1.</p>
<p>e. Duplicate receipts are permissible, provided the word “duplicate” or “copy” is included on the receipt.</p>	<p>5.55: S.1.4.1.1.</p>
<p>f. Check price computations on all indicators (including consoles) and on recorded representations for mathematical agreement with its associated quantity representation or indication to the nearest 1 cent of money value.</p>	<p>1.10: G-S.5.5 3.40: S.2.5., S.2.5.1.</p>
<p>g. Check for agreement of quantity, unit price, and total price values between indicated and recorded representations.</p>	<p>1.10: G-S.5.2.2. 3.40: S.2.4.4., S.2.5.2.</p>
<p>h. Verify, after a delivery is completed, that the quantity and total price are displayed for at least 15 seconds.</p>	<p>3.40: S.1.2.</p>
<p>3. Automatic Timeout, Pay-At-EVSE Retail Devices.</p>	
<p>For Pay-At-EVSE retail devices, once the EVFS has been authorized, it must de-authorize within two minutes if the EVFS has not been activated. To verify this operation</p> <ul style="list-style-type: none"> • First authorize the dispenser. 	<p>3.40: S.2.8. (1/1/2020)</p>

<p style="text-align: center;">Test Notes</p>	<p style="text-align: center;">HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References</p>
<ul style="list-style-type: none"> • Next, without dispensing product, wait two minutes and then attempt to dispense product. • The system must not dispense product. <p>If the time limit to deauthorize the device is programmable, it shall not accept an entry greater than two minutes.</p>	
<p>4. Confirm Results.</p>	
<p>If the result of any test is at, near, or exceeds the applicable tolerance limit, repeat that test to confirm the results and to help ensure you did not inadvertently introduce error into the test process. If necessary, conduct a “Repeatability Test” as described under the “Test” section of this EPO.</p>	<p>1.10: G-S.5.4. 3.40: N.3., N.4., T.3.</p>
<p>5. Display of Quantity and Total Price After Delivery.</p>	
<p>Verify, after a delivery is completed, that the quantity and total price are displayed for a minimum of 15 seconds at the activation by the user and at the start and end of the transaction. Electrical Energy sold shall be clearly identified and separate from other time-based fees indicated by the EVFS.</p> <p>A system with a single indicating element for two or more EVFSs shall provide a means to indicate clearly which EVFS is associated with the displayed information.</p>	<p>3.40: S.1.2., S.1.2.1.</p>
<p>6. Use of Adjustments.</p>	
<p>Verify that adjustments are used only to correct for conditions that these elements are designed to control and that adjustments are made to bring performance errors as close to zero value as possible. Verify that equipment is properly maintained and that errors are not predominantly in favor of the device user.</p>	<p>1.10: G-UR.4.1., G-UR.4.2., G-UR.4.3.</p>

SAFETY REMINDER!!!

- Use proper lifting techniques when lifting any equipment associated with the test standard and the testing process.
- Be aware of and attempt to eliminate potential ignition sources in or near the inspection site.
- Be aware of vehicular and pedestrian traffic when moving between the EVFS and test standard.
- Do not conduct the test when particulates and other airborne debris are present in the environment that can be drawn into the air intake for the test standard or test load emulator.
- Caution should be exercised to avoid contact with the high temperatures of the exhaust elements of the test load emulator.
- Operate the test standard only when the ambient temperature is within the temperature range recommended by the test standard manufacturer.
- Maintenance of the test standard should be performed as necessary to ensure the equipment’s proper operation while in service.
- There should be a clear perimeter and no site fixtures, other equipment, or landscaping that obstruct access to the test standard and the electric vehicle when used as the test load.

Test:	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
1. Accuracy Test.	
For this and subsequent tests, verify that other conditions of use do not exceed marked or manufacturer-specified limitations.	1.10: G-UR.3. 3.40: S.5.2., UR.2.
At the beginning of the first delivery, start with an initial zero condition.	3.40: S.2.1.
If the result of the first test is at or near the tolerance limit, repeat this test. If necessary, conduct a Repeatability Test.	1.10: G-S.5.4. 3.40: N.2., N.4., T.3.
General and Load Test Tolerances All DC EVFSs are exempt from T.2. Load Test Tolerances until January 1, 2028. Requirements and provisions from the General Code and other device codes apply when equipment does not fall clearly in an established separate code.	1.10: G-A.3. 3.40: N.1., N.3., T.1., T.2. T.2.1.

Test:	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
a. Light Load Test.	
(1) Connect the EVFS to the test set.	
(2) Verify proper levels on the proximity and control pilot (CP) lines.	
(3) Based on the CP signal determine the maximum current available from the EVFS.	
(4) Set the test set load to a value not greater than 15 % of the available current.	
(5) Start energy measurement on the test set.	
(6) Start a charging transaction on the EVFS.	
(7) Cycle the CP from State A to State B to State C.	
(8) Continue the measurement for an accumulated energy of not less than the minimum measured quantity (MMQ) as declared by the manufacturer.	
(9) Cycle the CP from State C to State B to State A.	
(10) Verify that the transaction on the EVFS has completed.	
(11) Record the energy delivered as displayed on the EVFS.	
(12) Record the price per kWh.	
(13) Record the total price of the transaction.	
(14) Record the energy delivered as displayed on the test set.	
(15) Verify Accuracy of Indications and Recorded Representations. Verify the resulting energy indications and recorded representations are within applicable tolerances and meet requirements for agreement of indications.	1.10: G-S.5.2.2. 3.40: S.2.4.4.
(16) Calculate the energy measurement error as follows: $\% \text{ Energy Error} = \left(\frac{\text{Test Standard Indicated Energy} - \text{EVSE Indicated Energy}}{\text{Test Standard Indicated Energy}} \right) \times 100$	
(17) Based on the unit price(s) [fixed or variable] per kWh, calculate and record the itemized and total computed price for the transaction.	

Test:	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
(18) Calculate the total sales price as follows: Quantity of Energy × Energy Unit Price (\$/kWh) = Sales Price ± ½ cent	
(19) <i>Agreement of Indications.</i> Verify the energy sales price indications and recorded representations agree to within the nearest one cent of the mathematically computed money value and those money values agree with one another. If the result of the first test is at or near the tolerance limit, repeat this test. If necessary, conduct a Repeatability Test.	1.10: G-S.5.4., G-S.5.5. 3.40: S.2.5.1., N.4., T.3.
Full Load Test	
(1) Connect the EVFS to the test set.	
(2) Verify proper levels on the proximity and control pilot (CP) lines.	
(3) Based on the CP signal determine the maximum current available from the EVFS.	
(4) Set the test set load to a value not less than 85 % of the maximum available current; if the maximum current available would result in a maximum deliverable power greater than 7.2 kW, perform the test at 7.2 kW.	
(5) Start energy measurement on the test set.	
(6) Start a charging transaction on the EVFS.	
(7) Cycle the CP from State A to State B to State C.	
(8) Continue the measurement for an accumulated energy of not less than the minimum measured quantity (MMQ) as declared by the manufacturer.	
(9) Cycle the CP from State C to State B to State A.	
(10) Verify that the transaction on the EVFS has completed.	
(11) Record the energy delivered as displayed on the EVFS.	
(12) Record the price per kWh.	
(13) Record the total price of the transaction.	
(14) Record the energy delivered as displayed on the test set.	
(15) <i>Verify Accuracy of Indications and Recorded Representations.</i> Verify the resulting energy indications	1.10: G-S.5.2.2. 3.40: S.2.4.4.

Test:	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
and recorded representations are within applicable tolerances and meet requirements for agreement of indications.	
(16) (16) Calculate the energy measurement error as follows: $\% \text{ Energy Error} = \left(\frac{\text{Test Standard Indicated Energy} - \text{EVSE Indicated Energy}}{\text{Test Standard Indicated Energy}} \right) \times 100$	
(17) Based on the unit price(s) [fixed or variable] per kWh, calculate and record the itemized and total computed price for the transaction.	
(18) Calculate the total sales price as follows: Quantity of Energy × Energy Unit Price (\$/kWh) = Sales Price ± ½ cent	
(19) <i>Agreement of Indications.</i> Verify the energy sales price indications and recorded representations agree to within the nearest one cent of the mathematically computed money value and those money values agree with one another. If the result of the first test is at or near the tolerance limit, repeat this test. If necessary, conduct a Repeatability Test.	1.10: G-S.5.4., G-S.5.5. 3.40: S.2.5.1., N.4., T.3.
2. Time Test.	
If the EVFS assesses charges for time-based services in addition to those charged for electrical energy, conduct a time test representative of a transaction where the EVFS is metering time. <ul style="list-style-type: none"> • Establish the time interval for the test based on the rate structure applied by the EVFS. • Initiate the EVFS in time mode and at the end of the time test interval record the time registration error. • Determine if the rate calculations displayed and recorded representation (where applicable) are mathematically correct. If the result of this test is at, near, or exceeds the tolerance limit, repeat the test.	5.55: N.1., N.2., T.1.3., Table T.1.3.
3. Interference Test.	
If EVFS assesses charges for time-based services in addition to those charged for electrical energy, conduct an interference test representative of a transaction where both the assessment of fees for the delivery of electrical energy and the time associated with that charging session are both metered through the EVFS.	5.55: N.3., T.1.3.

Test:	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
For an EVFS with an integral design feature where the device also has the capability to assess fees associated with the delivery of electrical energy to an electric vehicle which represent the registration of time that has elapsed simultaneously during the electrical energy charging session and/or immediately after that charging session, there shall be no interference of in the registration or continuous indication between the electrical energy and time portion of the transaction.	5.55: S.1.4.1., S.1.4.1.1., S.1.4.2.
Verify the recorded values for both electrical energy and time are properly itemized and appropriately identified.	3.40: UR.3.3.
4. Repeatability Test.	
If necessary, conduct a repeatability test. A repeatability test must include at least three consecutive test loads. Test loads must be conducted under approximately the same conditions (e.g., energy rate and temperature) and be of approximately the same draft size and duration.	3.40: N.4., T.3.
5. Money-Value Computations and Recorded Representations.	
Check money-value computations on for a sales transaction for a fixed price and selectable variable pricing. Check that the computed price is mathematically correct.	1.10: G-S.5.5. 3.40: S.2.5.1., S.2.4.3.
Print a ticket if device is so equipped and check price computations for agreement with indication display.	G-S.5.2.2.
6. RFI/EMI Test.	
<p>A system shall meet performance requirements when associated and nonassociated equipment is operated in a customary manner and location. This testing is typically done during the inspection of a new installation. It is conducted subsequently only if a problem is suspected. This would include potential sources of interference such as, but not limited to:</p> <ul style="list-style-type: none"> • Radio Frequency Interference (RFI) • Electromagnetic Interference (EMI) 	1.10: G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.
7. Zero-Set-Back Interlock.	
Check the effectiveness of the zero-setback interlock.	3.40: S.2.1.
On equipment activated with a single remote controller, activate one EVFS and check all others operated by the same controller to make certain they will not operate without activating the individual EVFS starting mechanism.	3.40: S.2.2., S.3.4., S.2.3.2., S.2.3.3. 5.55: S.5.

Test:	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
Power Loss Test.	
<p>At the time of the power loss, the transaction shall either:</p> <ol style="list-style-type: none"> (1) terminate; or (2) continue without additional authorization after restoration of power if the EVFS is able to determine it is connected to the same vehicle before and after the power outage. In this case, the information needed to complete the transaction in progress at the time of the power loss shall be available at the EVFS, console, internet, or toll-free phone access. There must also be a clear indication on the receipt provided to the customer of the interruption, including: <ul style="list-style-type: none"> • the date and time of the interruption; • other information required by S.2.6. EVSE Recorded Representations. 	<p>3.40: S.2.3., S.2.3.1, S.2.3.2., S.2.6.</p>
<p>The EVFS memory, or equipment on the network supporting the EVFS, shall retain information on the quantity of fuel dispensed and the sales price totals during power loss.</p>	<p>3.40: S.2.3.3.</p>
<p>It is not typically necessary nor is it recommended to repeat this test for every inspection; however, this does not preclude the test from being conducted when deemed necessary by the regulatory authority or service person to ensure continued compliance with this requirement. As a minimum, this test should be conducted on the examination of a system or device that is put into service for the first time to verify proper installation and set-up. It may also be warranted in response to specific complaints where the test would be relevant. NIST recommends that, prior to conducting a test to verify compliance with these requirements, you check with your supervisor to verify your jurisdiction’s or organization’s policy regarding this test.</p>	

Post-Test Tasks	HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References
1. Security Means.	
Adequate provision shall be made for applying a physical security seal and/ or providing other approved means of security such as a data change audit trail.	1.10: G-S.8. (1/1/90), G-S.8.1. (1/1/10) 3.40: S.3.3. Table S.3.3. 5.55: S.4.
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.	1.10: G-S.8.2. 3.40: S.3.3. 5.55: S.4.
For multiple measuring elements with a single provision for sealing, a change to the adjustment of any measuring element must be individually identified.	1.10: G-S.8.1. (1/1/10)
A metrologically-significant software change is a sealable event.	1.10: G-S.9.
<i>Audit Trail Information.</i> If the system is equipped with an audit trail, note the event counter settings on the test report form for future reference. If equipped with an event logger, print a copy of the event log and attach it to the report form for future reference. Note that some systems may be equipped to provide an electronic copy of the event counter or the event log in place of or in addition to providing a hard copy of the security information at the time of the inspection. This data shall not be affected or alterable. Examine these records for any signs of misuse of adjustments.	1.10: G-S.8. (1/1/90) 3.40: S.3.3, Table S.3.3., S.3.4.
<i>Security Seals.</i> Check for the presence of security seals on the device. A security seal shall be affixed to any adjustment mechanism designed to be sealed. Document missing seals on the official report and apply new ones as needed.	1.10: G-UR.4.5.
2. Record Total Quantity. Note the final totalizer reading and record the total quantity of electricity dispensed and (where time-based fees are assessed in association with the electrical energy charging session service) the total time during the test on the official test report. Verify totalizers are working correctly.	1.10: G-UR.4.1., G-UR.4.2. 3.40: S.7.
3. Review/Analyze Results. After all equipment at a location has been tested, review the results to determine compliance with requirements for equipment maintenance and use of adjustments.	1.10: G-UR.4.1., G-UR.4.3.

<p>Post-Test Tasks</p>	<p>HB 44 General Code (1.10), Electric Vehicle Fueling Systems Code (3.40), and Timing Devices Code (5.55) References</p>
<p>4. Record Compliance Action and Explain Results. Record the compliance action and disposition of the device on the report and explain the results to the device owner.</p>	

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