Electric Vehicle Supply Equipment (EVSE) Inspection

EVSE Training for W&M Inspectors and Service Agents

Garden Grove, CA

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U.S. Department of Commerce

Physical Measurement Laboratory
Office of Weights and Measures
National Legal Metrology Program

NIST Disclaimer Statement

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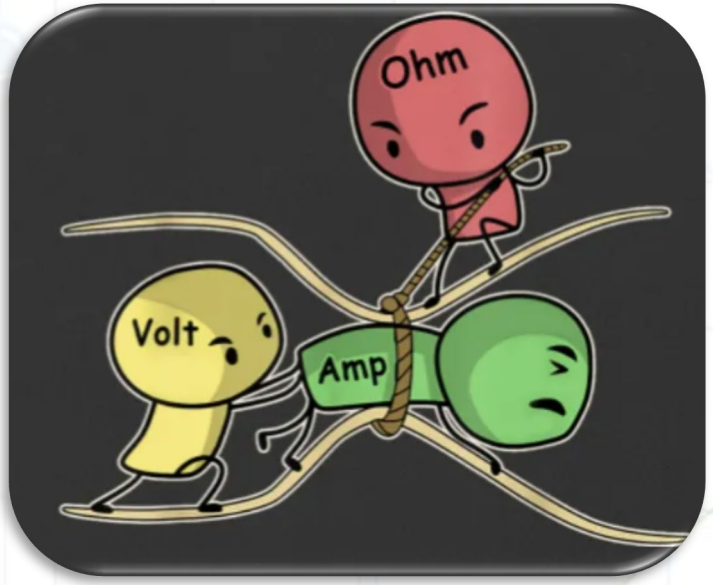
https://www.nist.gov/disclaimer

Electric Vehicle Supply Equipment (EVSE) Inspection

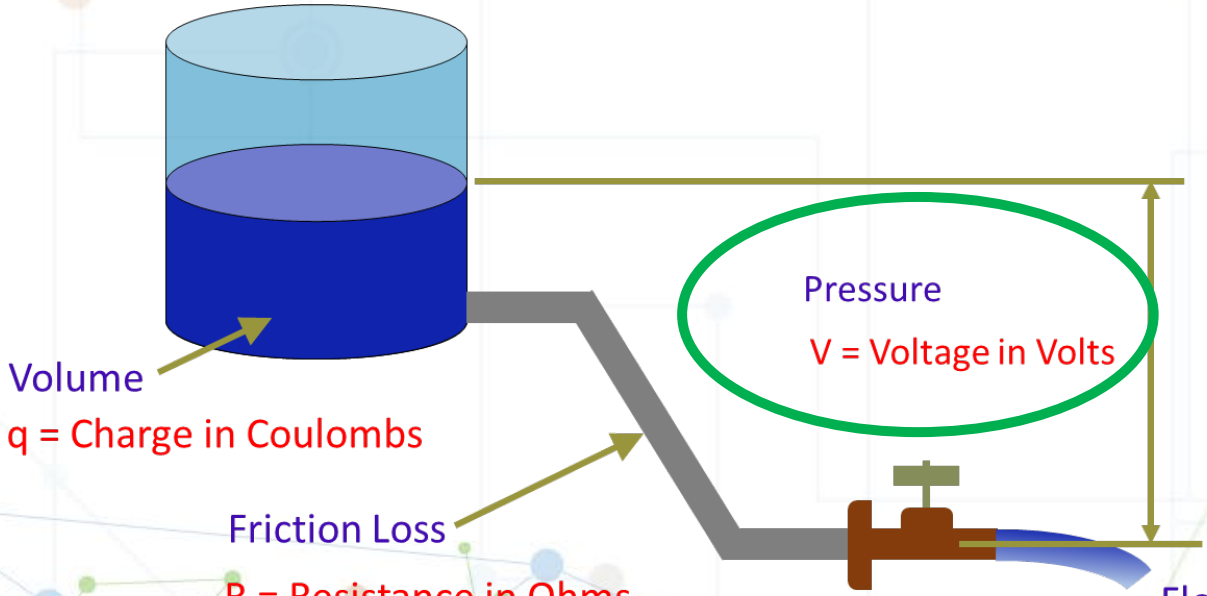
1. Electricity Basics
2. EVSE Overview
3. NIST Handbooks
   i. NIST Handbook 130 (MOS)
   ii. EPO 30/NIST Handbook 44

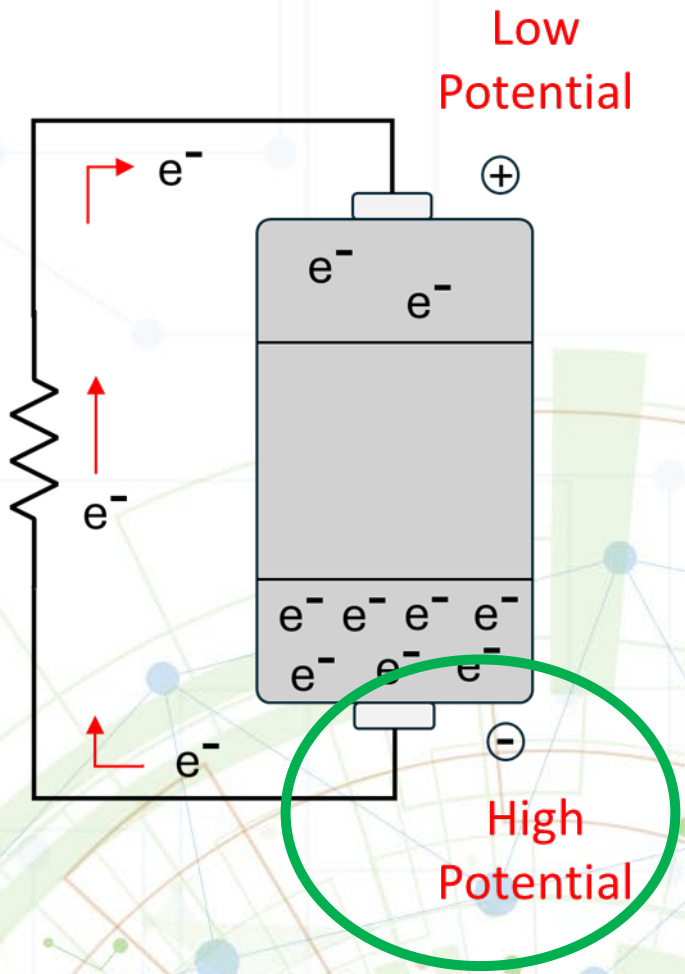


Electricity Basics

Voltage

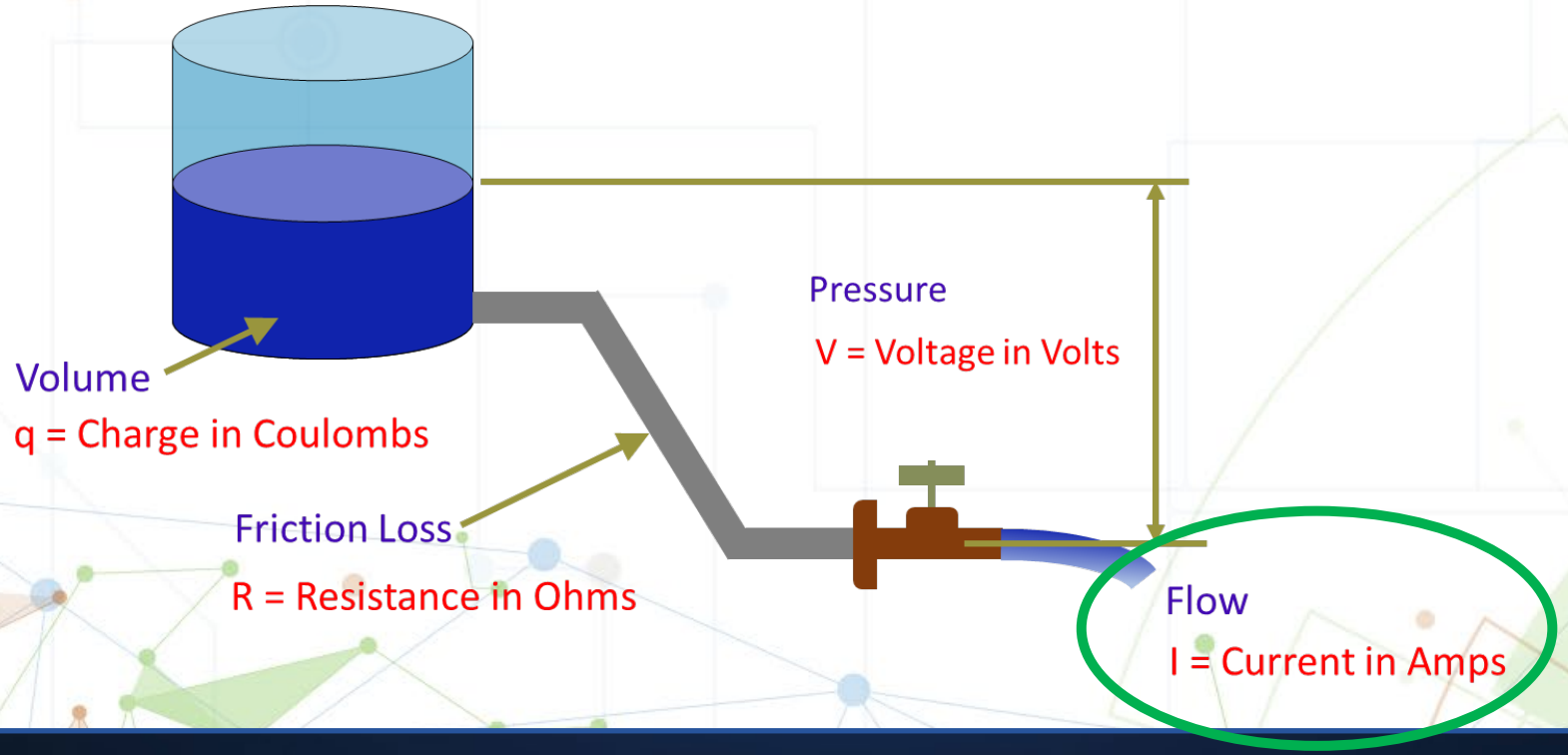
- **Force** (or pressure) that drives electric charge through a conductor/circuit.
- SI unit is the volt (V), with the symbol V.

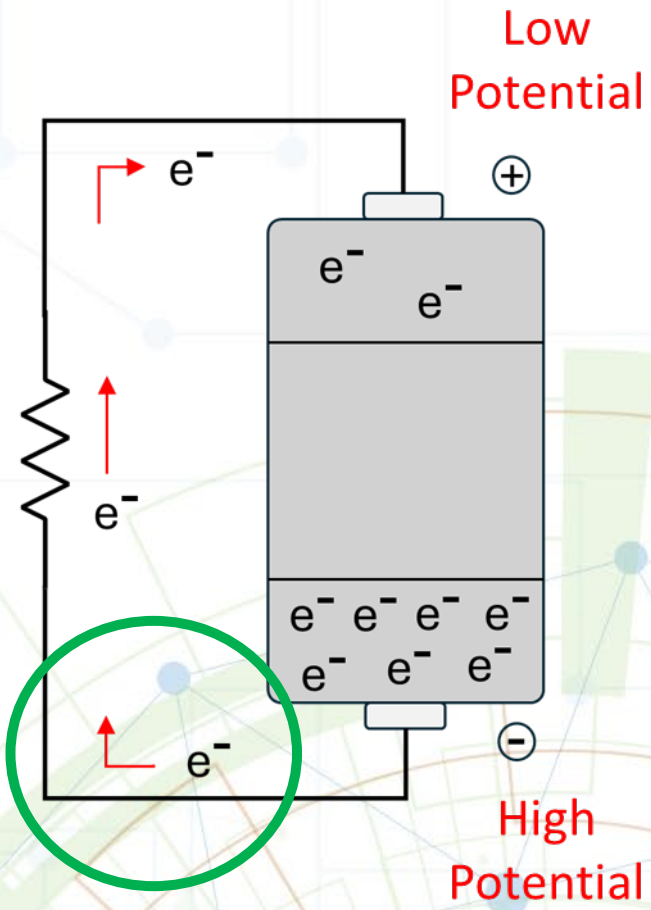




Current

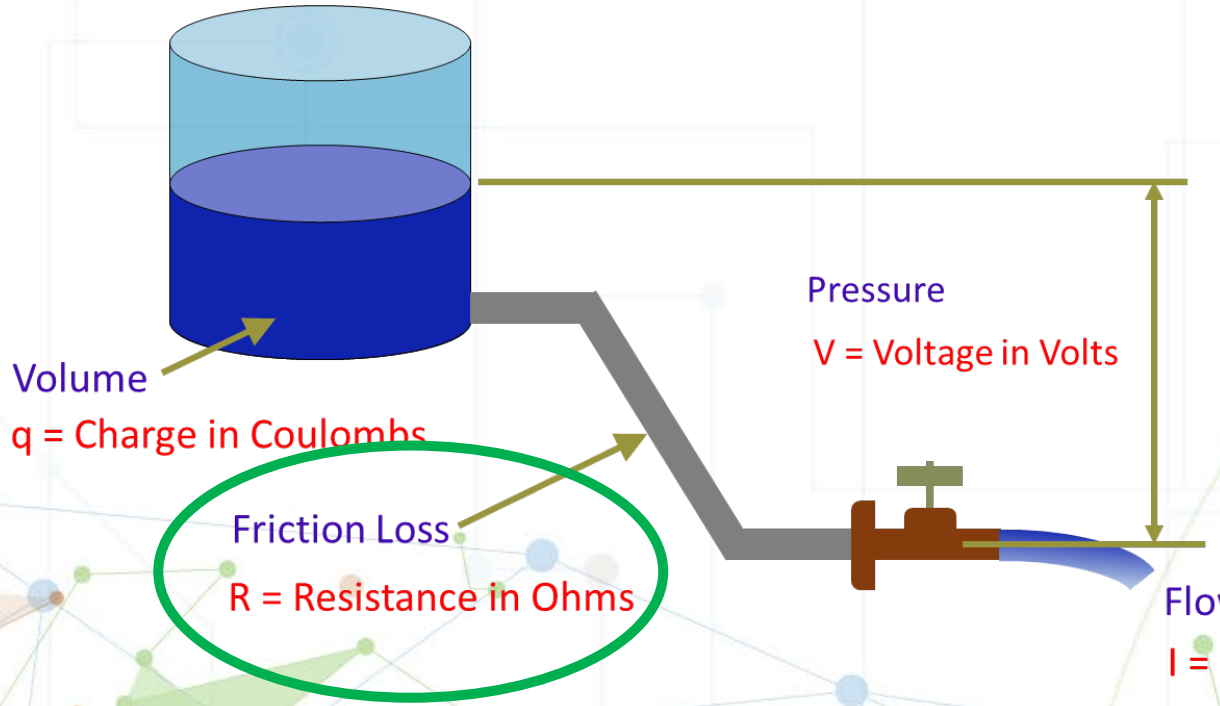
- A **flow** of charged particles (e.g., electrons) moving through a conductor.
- SI unit is the ampere (A), with the symbol I.

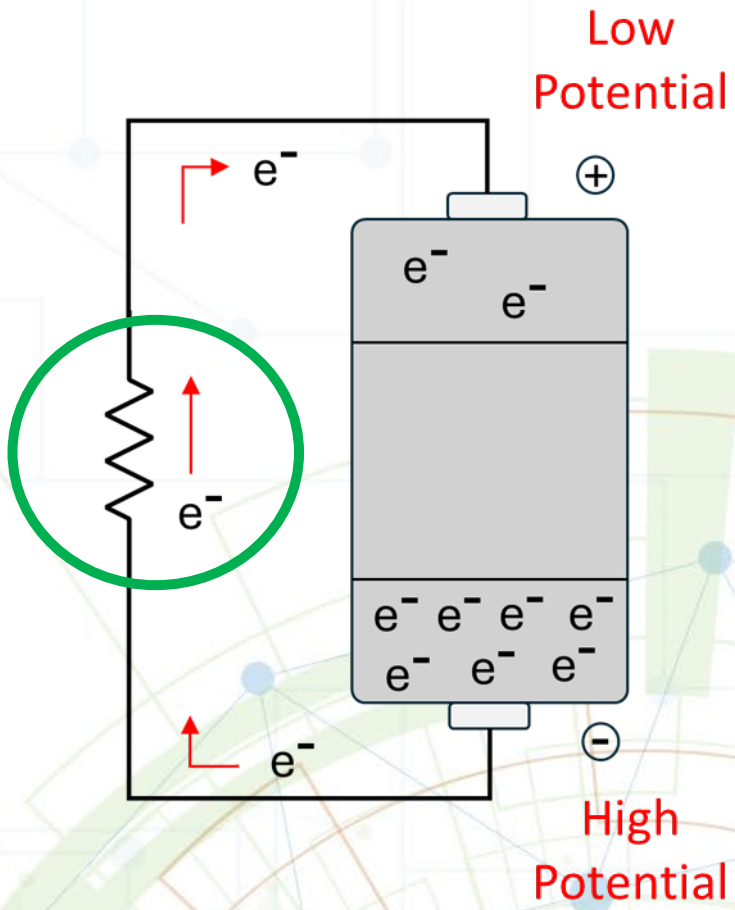




Resistance

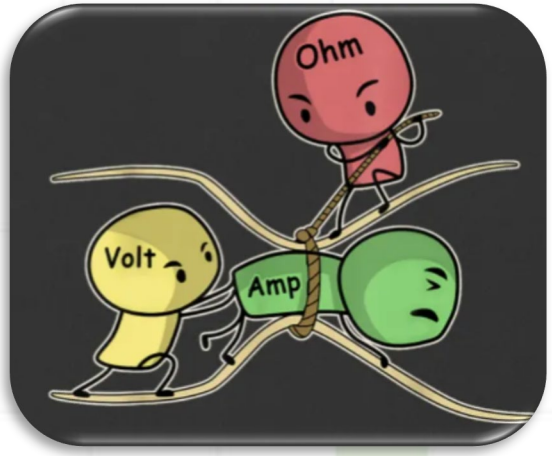
- A measure of the **<u>opposition</u>** to the flow of current.
- SI unit is the ohm (Ω), with the symbol R.

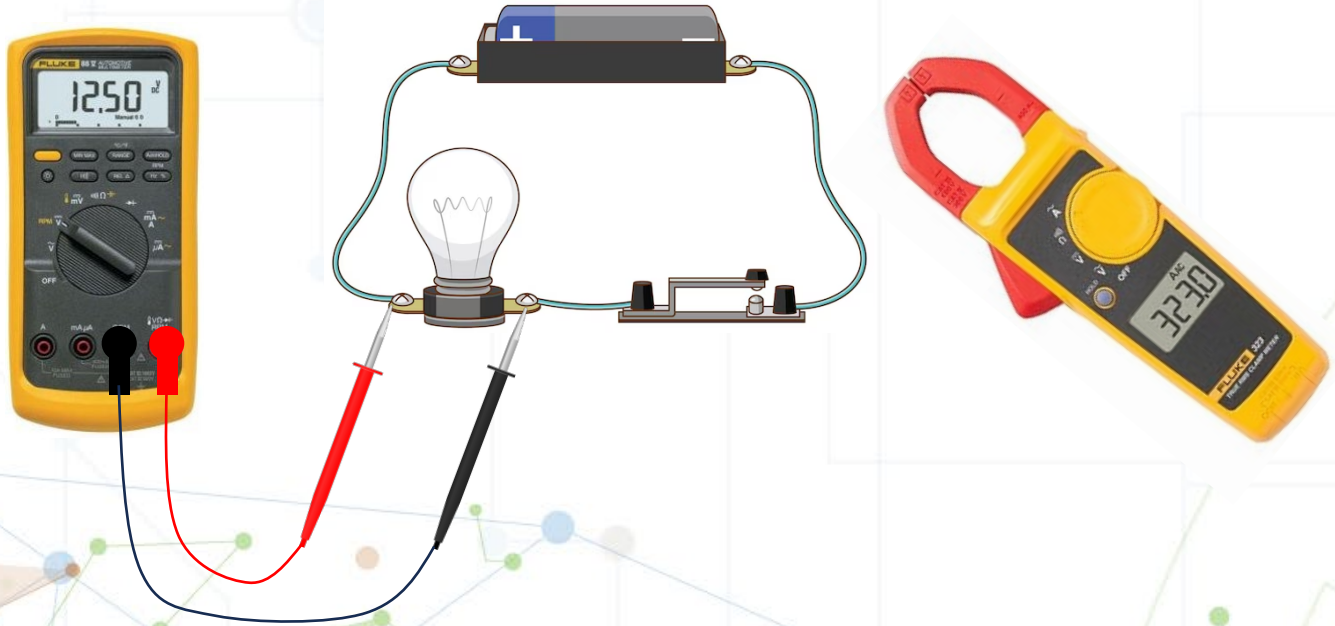




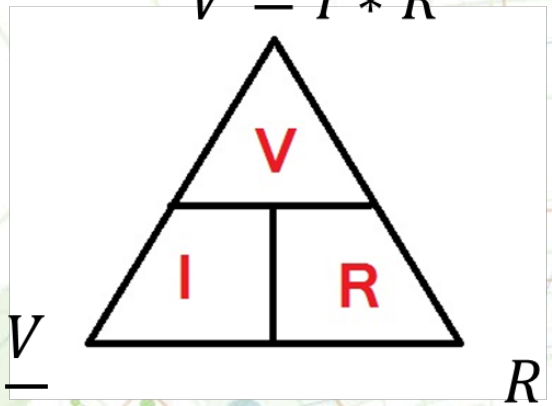
Ohm's Law

Formula that provides the **mathematical relationship** between voltage, current, and resistance in an electrical circuit. It states that the voltage across a conductor is directly proportional to the current flowing through it.





$$V = I * R$$

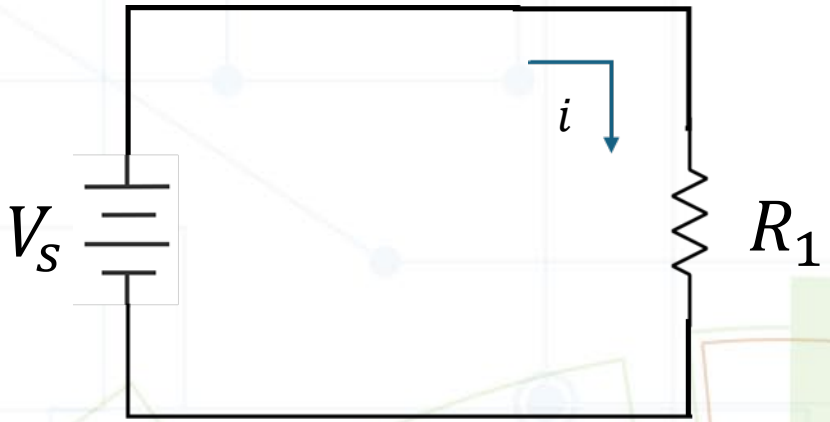


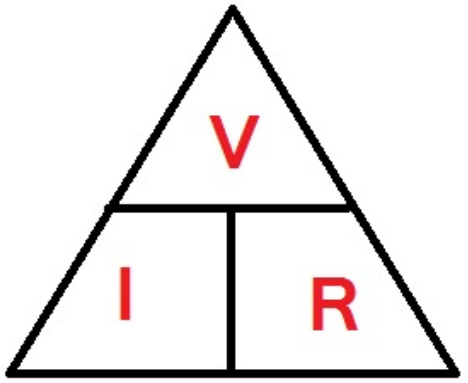
$$I = \frac{V}{R} \qquad R = \frac{V}{I}$$

Ohm's Law in Circuits

- Simple circuit example:
  - $V_s = 3\ V$
  - $R_1 = 50\Omega$
  - Calculate I

$$I = \frac{V_s}{R_1} = \frac{3\ V}{50\ \Omega} = \mathbf{0.06\ A}$$

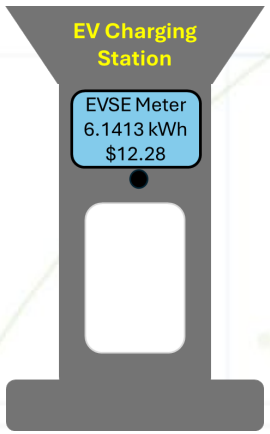




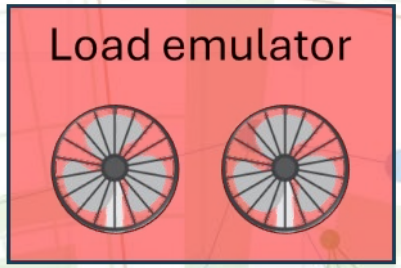
Ohm's Law in Circuits

- Simple circuit example:
  - $V_s = 120\ V$
  - $R_1 = 12\ \Omega$
  - Calculate I

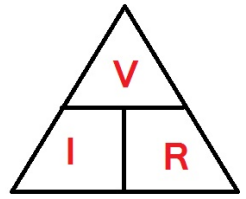
$$I = \frac{V_s}{R_1} = \frac{120\ V}{12\ \Omega} = \mathbf{10\ A}$$



Level 1 Charger



Hair Dryer



Energy

- A form of energy based on **current flow,** and is the amount of power used over a specific duration
- SI unit for Energy is the joule (J), *however*
- Electrical energy typically measured and sold by the kilowatt hour (kWh)

Power

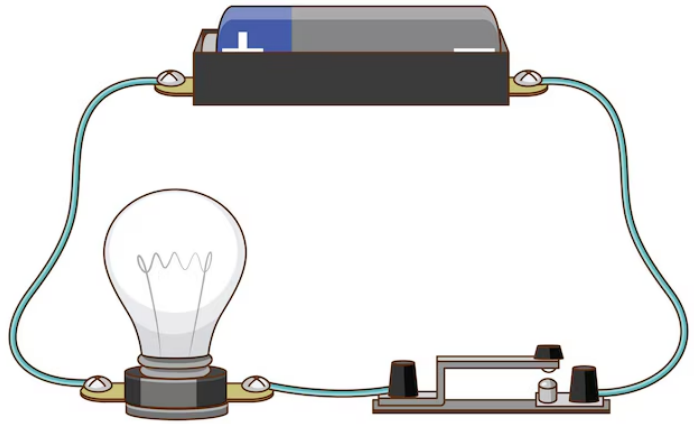
$$E = P * t$$

Energy consumed

time

A 1000 W stove running for 1 hour would consumer 1 kWh of electrical energy

Electric energy is often **transformed** to other types of energy: Mechanical, Chemical, Thermal, Light, etc.



Power

- The **rate of transfer** of electrical energy within an electrical circuit.
- SI unit is the watt (W), with the symbol P.

Power Law

$$P = V * I$$

(Can express in other forms using Ohm's Law)

$$V = I * R \qquad I = \frac{V}{R} \qquad R = \frac{V}{I}$$

$$P = V * I = (I * R) * I = I^2 * R$$

$$P = V * I = V * \left(\frac{V}{R}\right) = \frac{V^2}{R}$$

Evaluating resistive power losses (heat) in cables

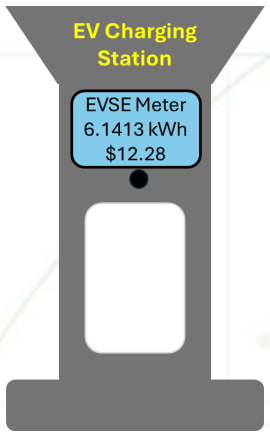
Toaster filaments

Source: https://en.wikipedia.org/wiki/Toaster

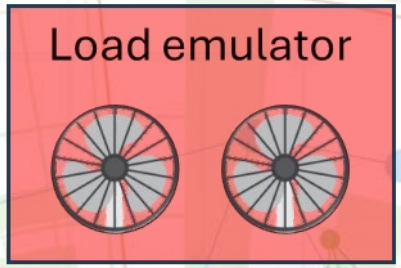
Power Law in Circuits

- Simple circuit example:
  - $V_s = 120$ V
  - $I = 10$ A
  - Calculate P

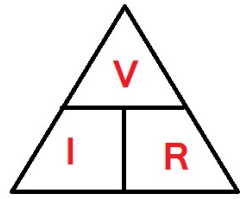
$$P = V * I \ = (120\ \text{V})(10\ \text{A}) \ = 1200\ \text{W}$$



Level 1 Charger



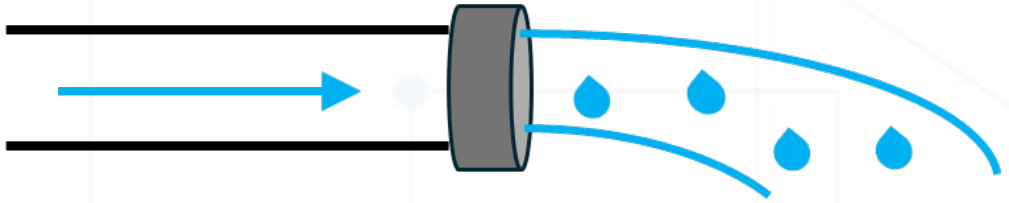
1200 W Hair Dryer



Power (kW) and Energy (kWh)

Power

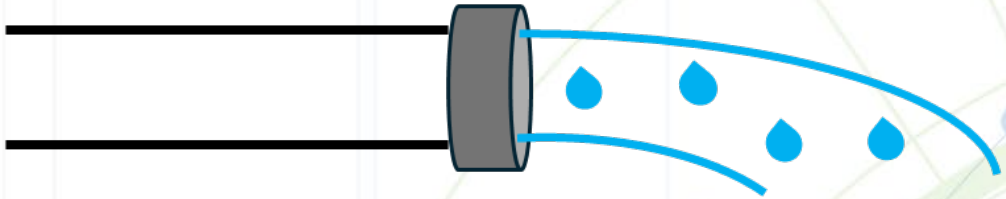
Watts or kilowatts

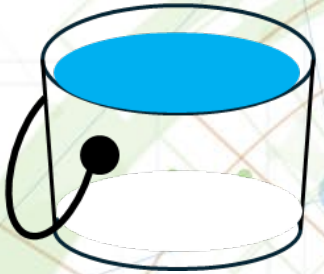


… is like the flow rate of the water

Energy

Watt-hours or kilowatt hours

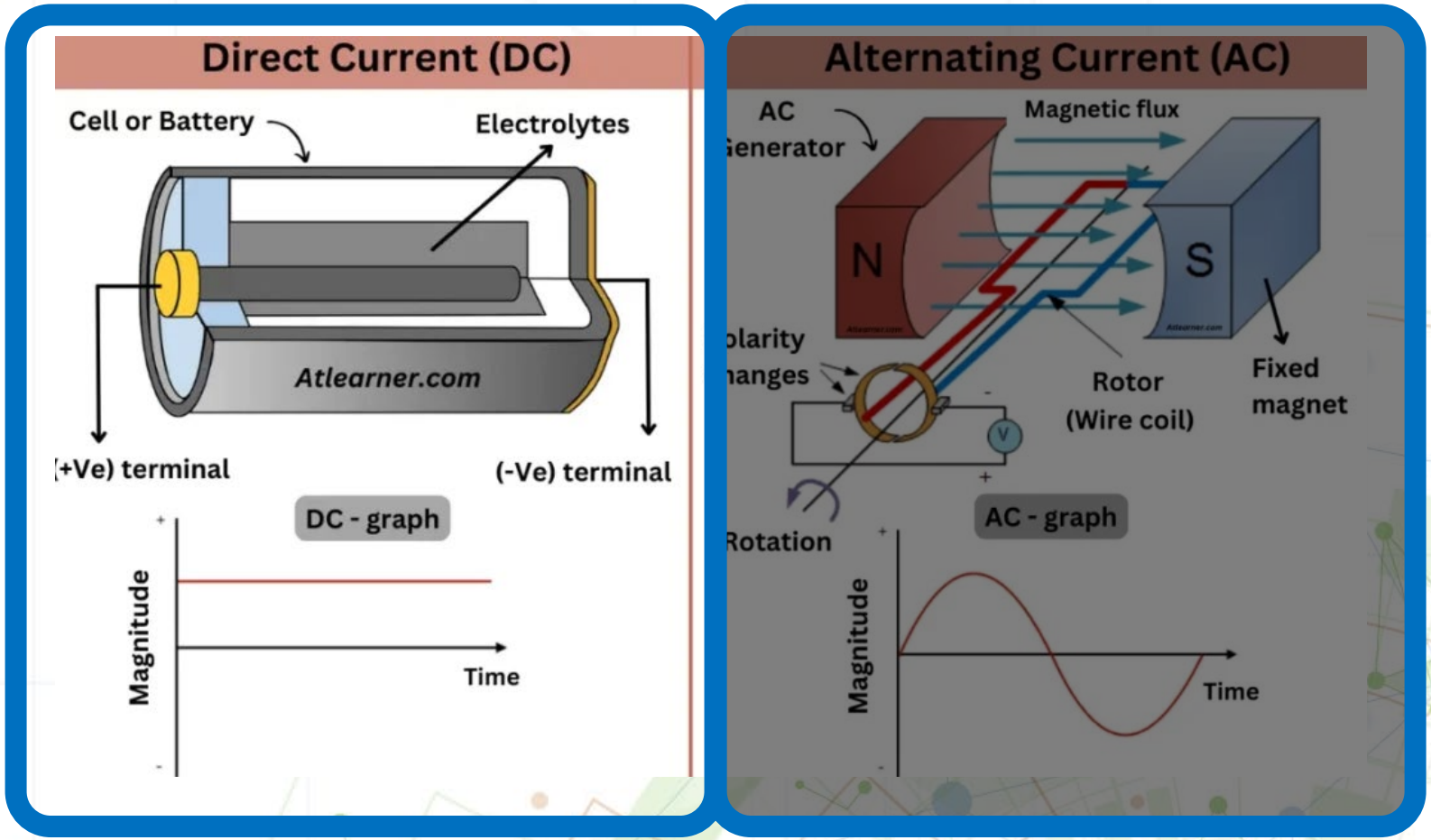




… is like the amount of water that ends up in the bucket

Direct Current (DC)

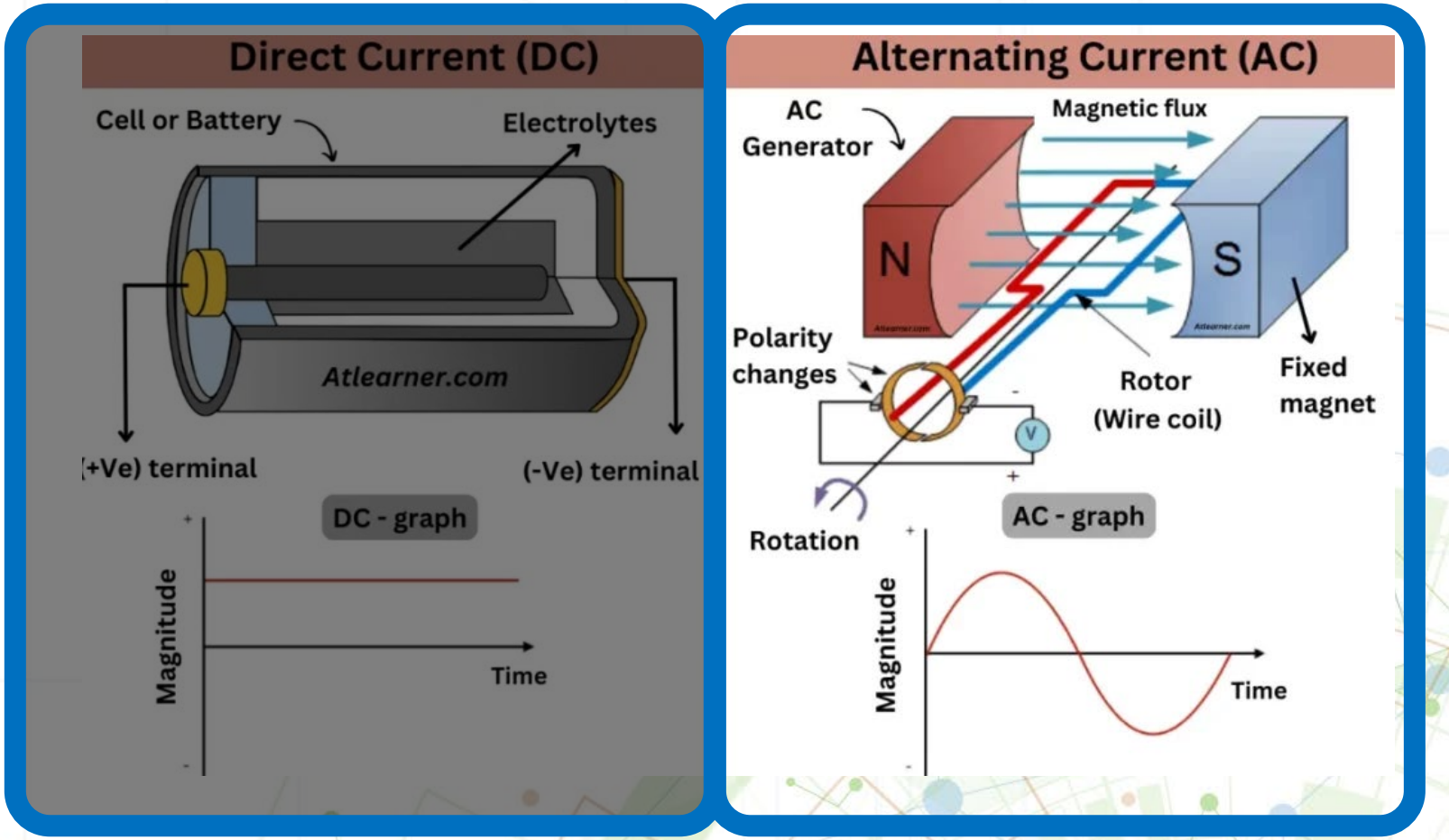
- An electric current that is **uni-directional** (i.e., flow of electrons is always in the same direction)



Source: https://www.centralwires.com/ac-vs-dc-current/

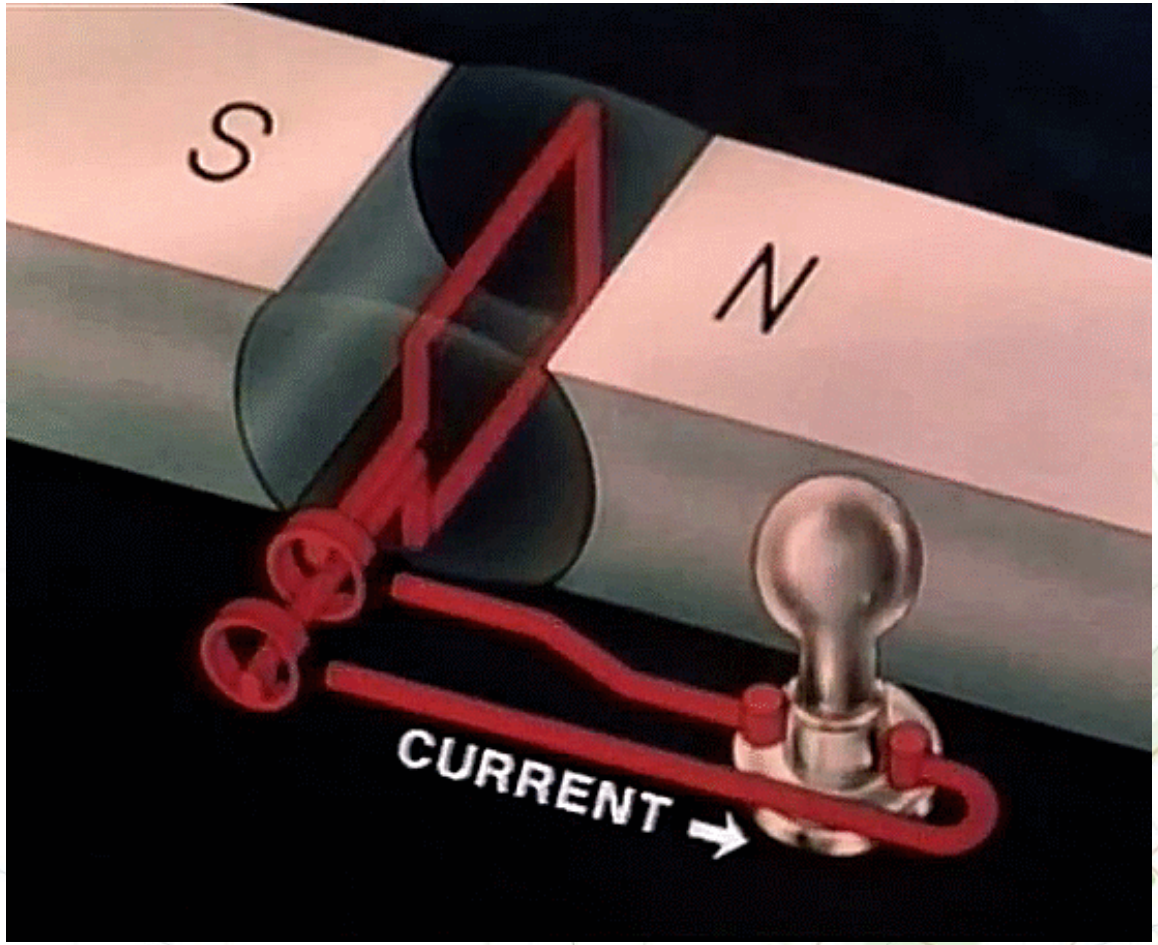
Alternating Current (AC)

- An electric current that is **<u>bi-directional</u>** (i.e., the flow of electrons switches back and forth at regular intervals.



Source: https://www.centralwires.com/ac-vs-dc-current/

AC Animation



Sine wave ac generator, Edison Tech Center, Source: https://www.youtube.com/watch?v=ATFqX2Cl3-w

EVSE Overview

EVSE Components

Timing Device

Embedded Meter

Fixed cord(s)

Power Supply

Cord Connector

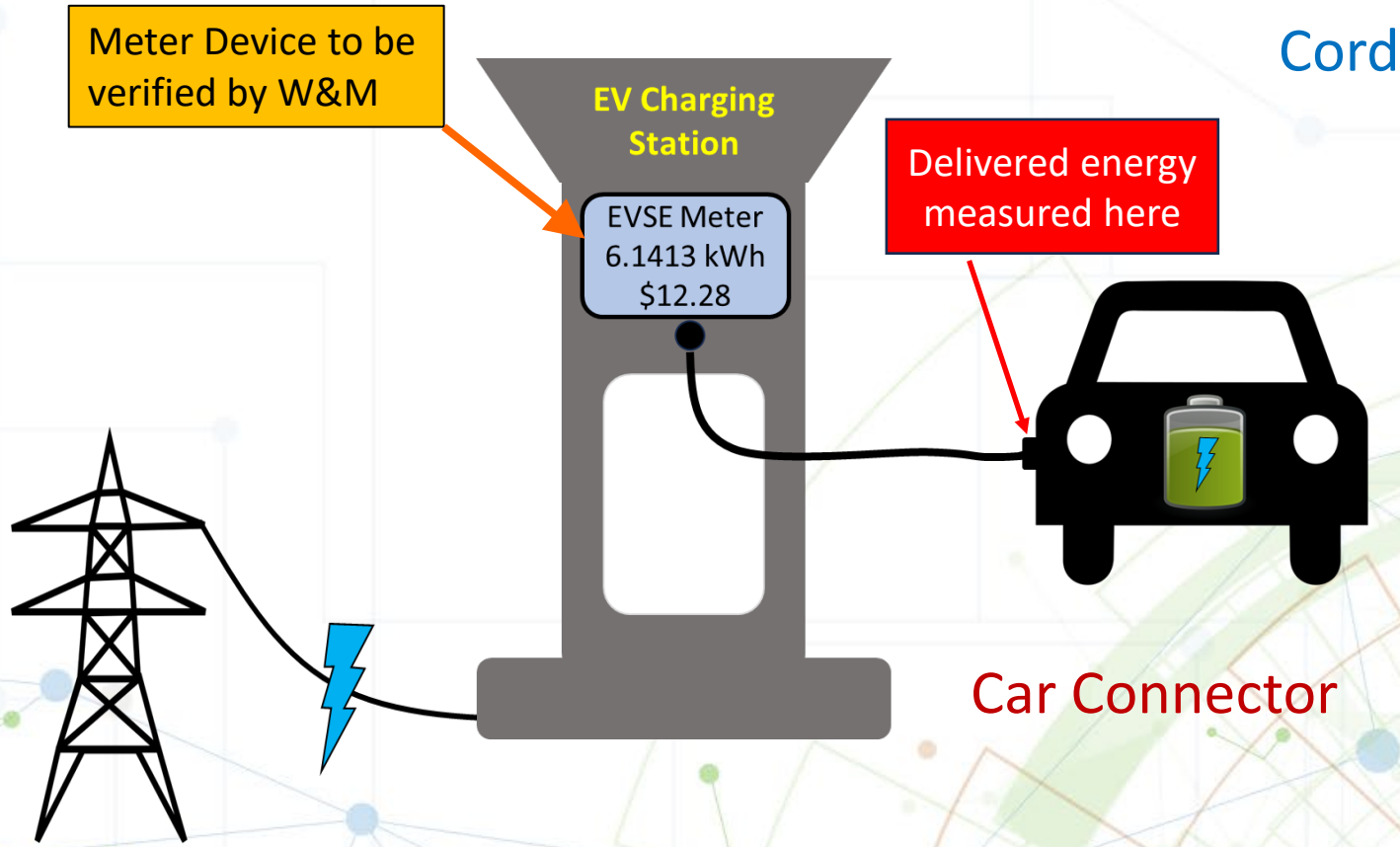
Enclosure

Battery

Power Input

On Board Charger (OBC)

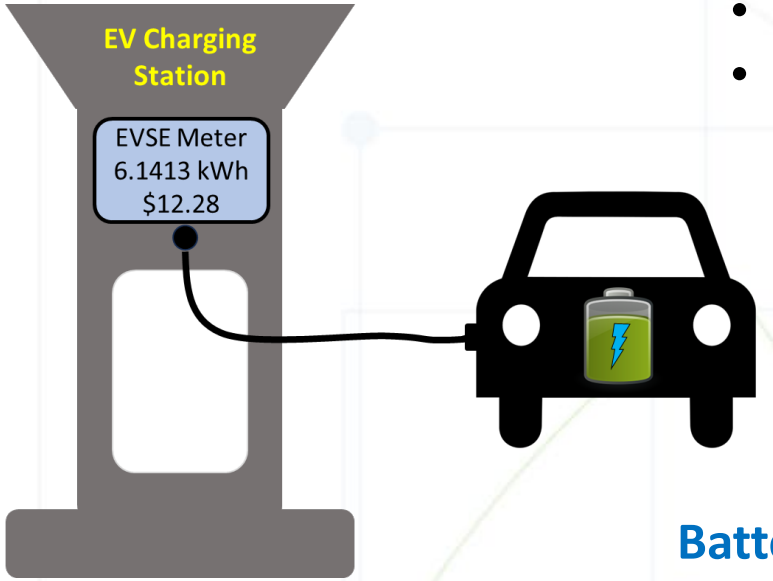
Car Connector



EVSE Specifications

EVSE ratings based on current and power outputs:

- ChargePoint CPF50: 12 kW; up to 50 A/port
- Blink Series 9: 40 kW; 133 A
- Supercharger V3: 250 kW; 301 A
- BTC Power Gen 4: 360 kW; up to 500 A/port



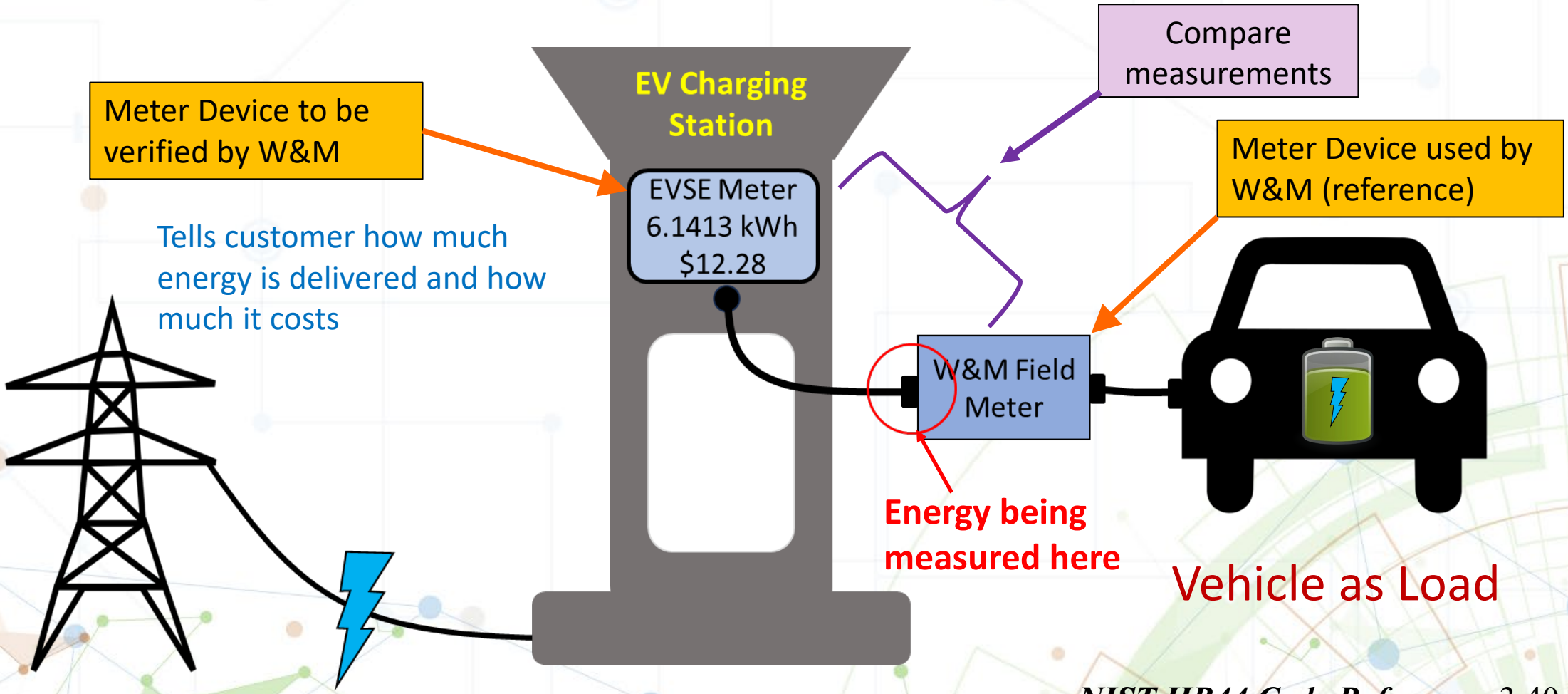
Maximum EV Charging Rate

- 1st gen Nissan Leaf: 6.6 kW
- Ford Mustang Mach E Base: 115 kW
- Kia Kona Electric Base: 100 kW
- Lucid Air Sapphire: 300 kW

Battery Capacity

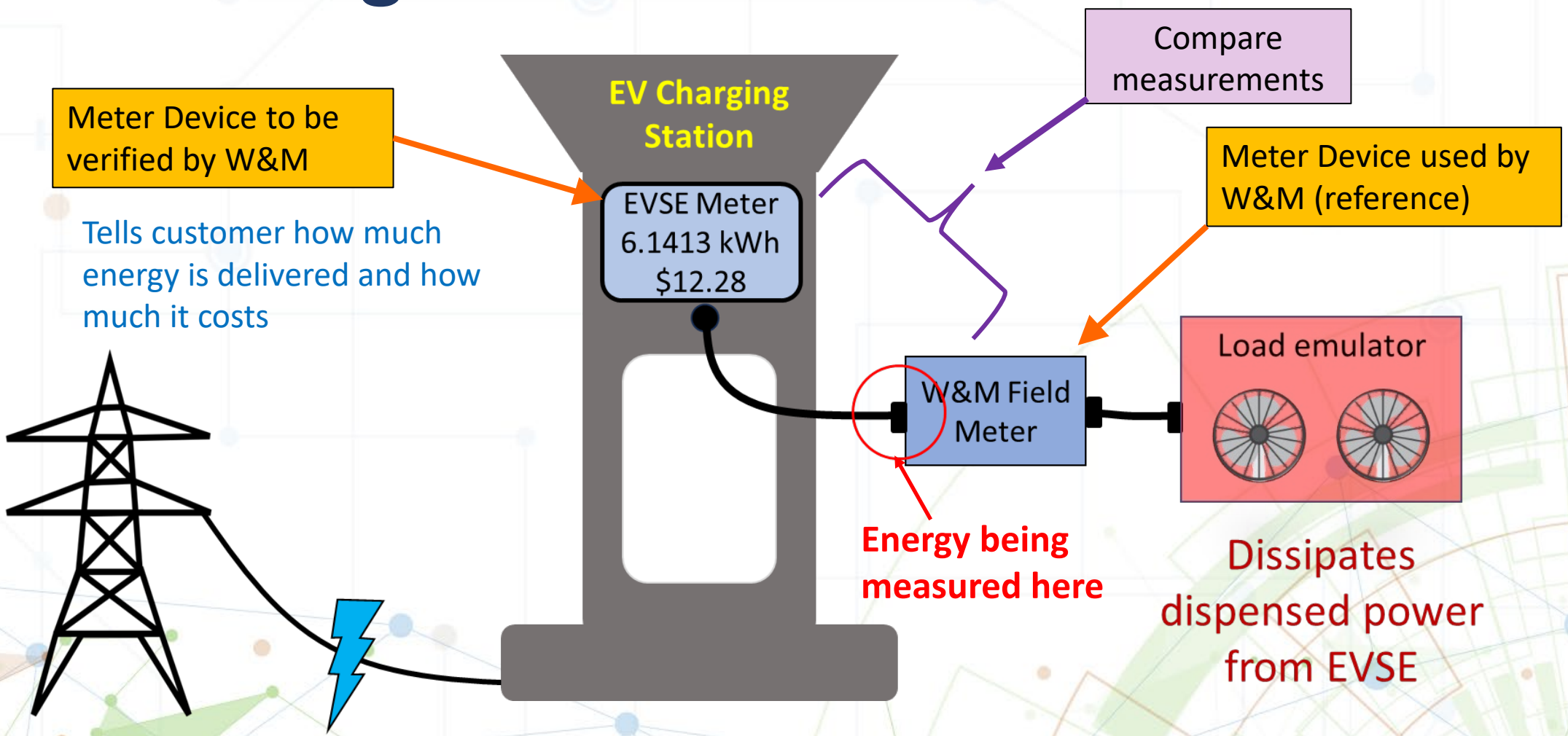
- 1st gen Nissan Leaf: 24 kWh
- Ford Mustang Mach E Base: 73 kWh
- Kia Kona Electric Base: 48.6 kWh
- Lucid Air Sapphire: 118 kWh

EVSE – Man-in-the-Middle



NIST HB44 Code Reference: 3.40: N.3.3

EVSE – Programmable Load



EVSE Charger Types (North America)

Level 1 (AC)

Level 1 equipment provides **slow** charging through a common residential 120 V AC outlet. Power output around 1 kW.

Level 2 (AC)

Level 2 equipment offers **medium** AC charging through 240V (residential) or 208V (commercial) electrical service, and is common for home, workplace, and public charging. Typical power output ranges from 7 kW to 19 kW.

Direct Current Fast Charging (DCFC)

DCFC offers **fast** charging through 400V to 1000V DC. Typical power output ranges between 50 and 350 kW.

J1772

NACS

CCS1

EVSE Charger Types (North America)

	Level 1	Level 2	DC Fast Charging
Voltage	120 V AC	208 - 240 V AC	400 V - 1000 V DC
Typical Power Output	1 kW	7 kW - 19 kW	50 - 350 kW
Estimated Charge Time from Empty*	40 - 50 hours	4 - 10 hours	20 minutes - 1 hour
Estimated Electric Range per Hour of Charging	2 – 5 mi	10 – 20 mi	180 – 240 mi
Typical Locations	Home	Home, Workplace, and Public	Public

* For a 60 kWh battery

Adapted from https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds

EVSE Charger Connectors (North America)

J1772

J1772 plug Source:
https://www.electronicdesign.com/markets/automotive/article/21267879/electronic-design-an-introduction-to-the-sae-j1772-and-ccs-ev-charging-interfaces

CCS1

CCS1 plug Source:
https://www.electrive.com/2024/08/05/phoenix-contact-launches-new-charging-cables-for-north-america/

NACS

NACS plug Source:
https://evsafecharge.com/dc-fast-charging-explained/

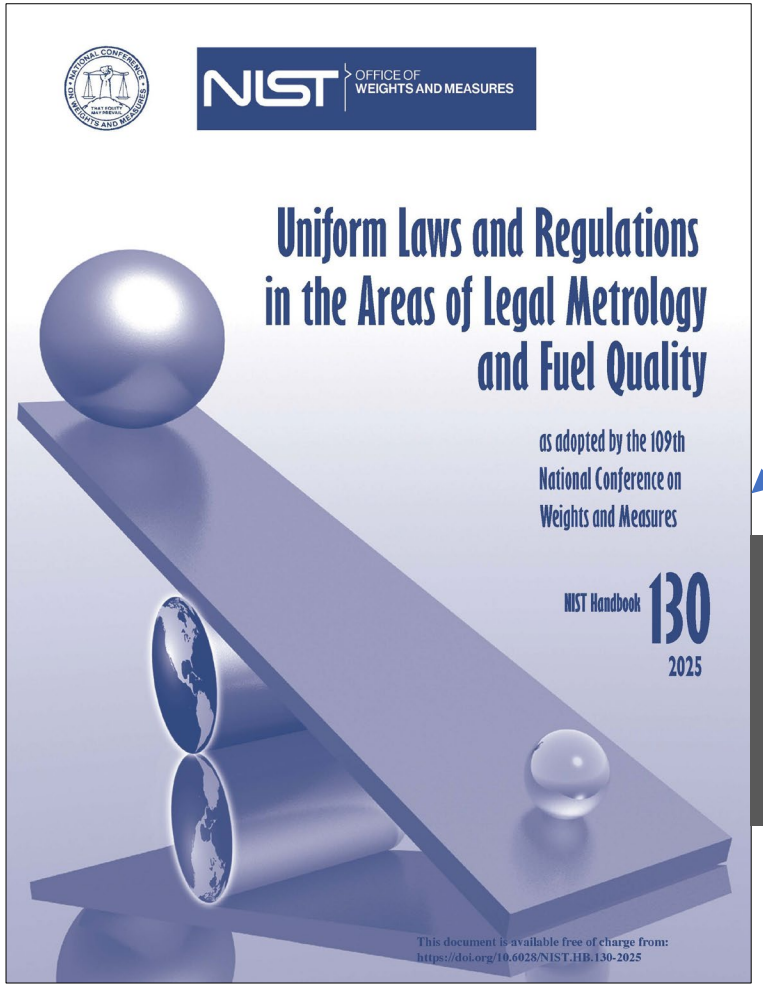
EVSE Charging Factors

Interplay between EV and EVSE parameters will affect time-to-charge and miles added from a charging session

- Vehicle Type (battery size)
- EVSE Rating
- Battery State of Charge (SoC)
- EVSE Usage (ports per station)
- EV and EVSE age
- Temperature
- Other loads (e.g., air conditioning)

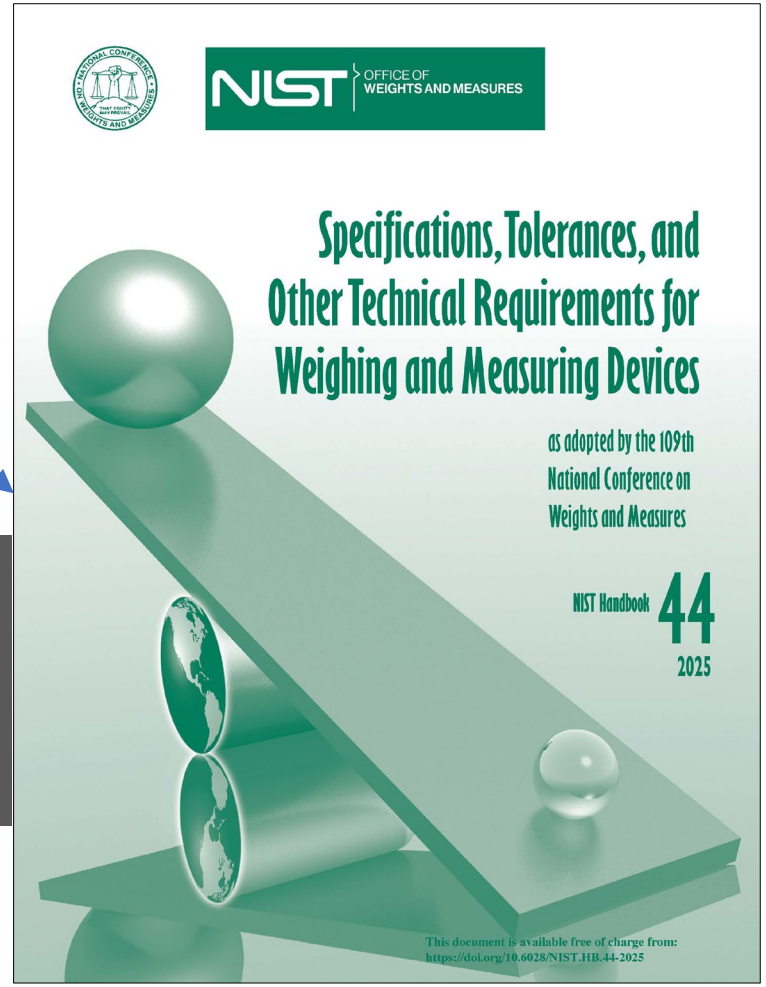
NIST Handbooks

NIST



2025

CA W&M Law supersedes NIST Handbooks



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National Legal Metrology Program

NIST OFFICE OF WEIGHTS AND MEASURES

Electric Vehicle Fueling Systems Inspection Reference Materials

NIST Handbook 130 (2025)

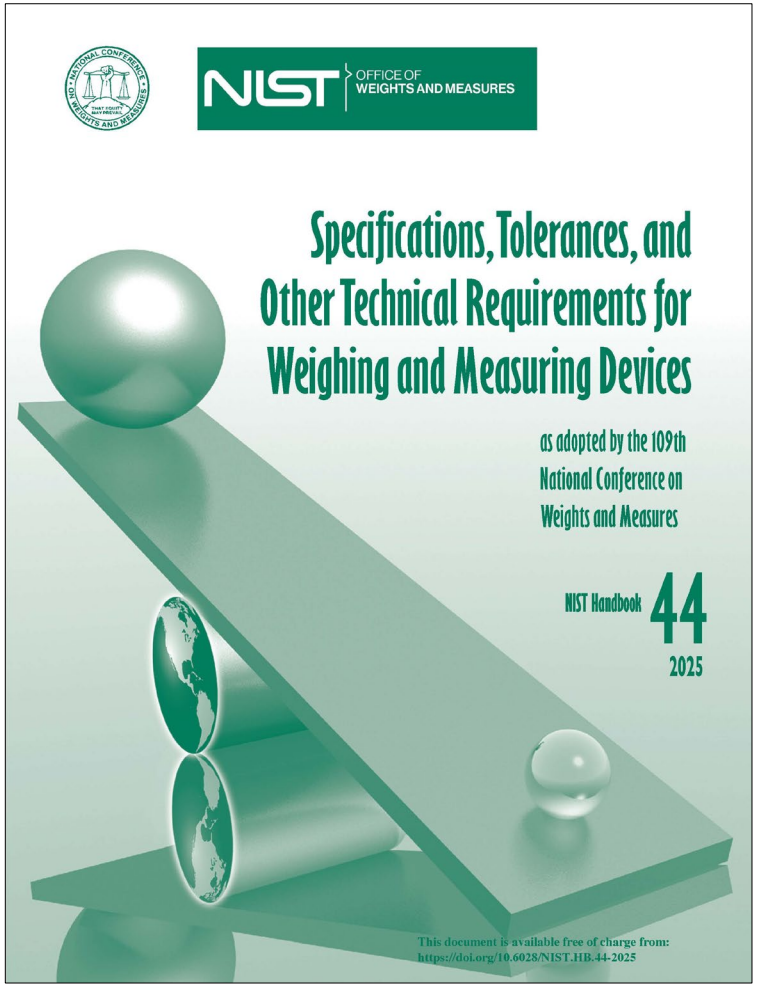
- IV. Uniform Regulations, B. Uniform Regulation for the Method of Sale of Commodities

NIST Handbook 44 (2025)

- Section 1.10. General Code
- Section 3.40. Electric Vehicle Fueling Systems
- Section 5.55. Timing Devices
- Appendix A and Appendix D

EPO 30-Retail Electric Vehicle Fueling Systems

NIST Handbooks



Per Section 1.10. General Code, which of the following is required to be marked on Electric Vehicle Supply Equipment (EVSE)?

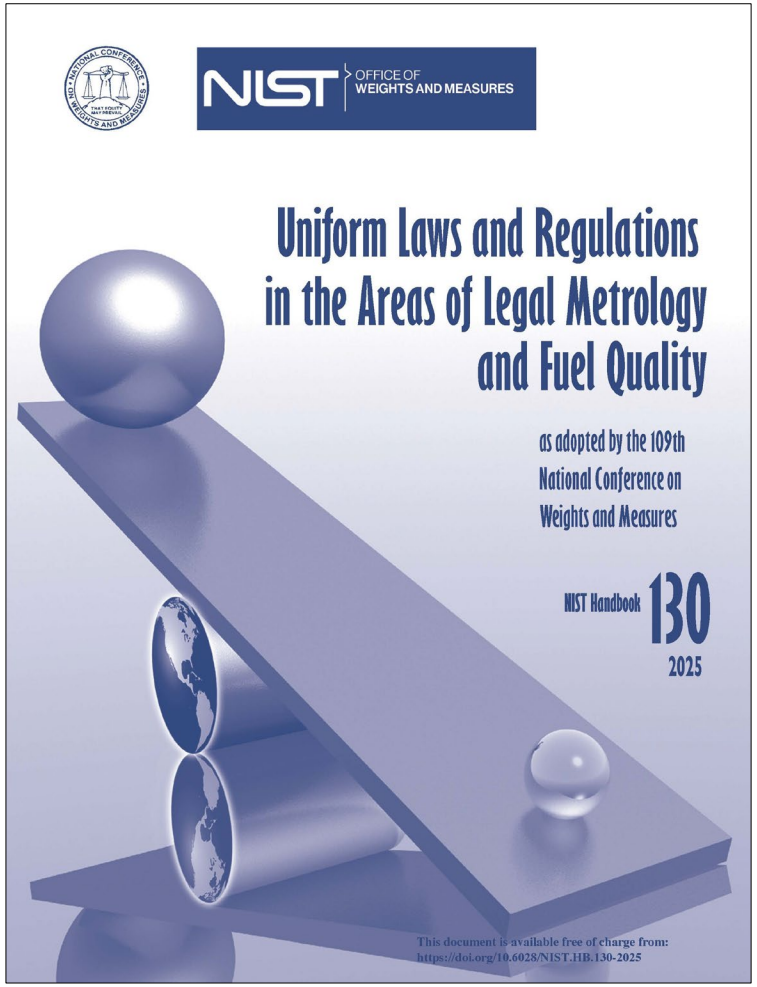
a. Nominal Power

b. Type of Current

c. NRTL Approval

d. Software Version

NIST Handbook 130 Method of Sale (MOS)



IV. Uniform Regulations

B. Uniform Regulation for the Method of Sale of Commodities

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Electric Vehicle Fueling Systems Inspection
NIST Handbook 130 (HB 130) Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel (Added 2013)

2.33.1. Definitions:

2.33.1.1 Electricity Sold as Vehicle Fuel. – Energy transferred to an EV for (mostly) propulsion

2.33.1.2. Electric Vehicle Supply Equipment (EVSE). – The device that measures, delivers, and computes the price of energy delivered to an EV

NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.1. Definitions:

2.33.1.3. Fixed Service. – Service that continuously provides the nominal power that is possible with the equipment as it is installed.

2.33.1.4. Variable Service. – Service that may be controlled resulting in periods of reduced, and/or interrupted transfer of electrical energy.

NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.1. Definitions:

2.33.1.5. Nominal Power. – The “stated” as opposed to the “actual” rate of energy transfer. Identified as kW.

Power (P) = Voltage (V) x Current (I)

Power (P): Power is the rate at which energy is transferred or converted.

Voltage (E): Voltage is the potential difference between two points in a circuit, measured in volts (V).

Current (I): Current is the flow of electrical charge through a circuit, measured in amperes (A).

Terms for Power NIST HB 44 & 130

NIST HB 130:

2.33.1.5. Nominal Power. – The "stated" as opposed to the "actual" rate of energy transfer. Identified as kW. Definition

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

(b)(1) includes the term "nominal power transfer (i.e., nominal rate of electrical energy transfer)" Labeling requirement; fixed service application

(c)(2) includes the term "maximum power transfer" Labeling requirement; variable service application

(e) kilowatt ("kW") capacity Federal labeling requirement for alternative fuels; 16 C.F.R. § 309.

NIST HB 44:

Section 3.40: 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.).

2.33.1.5. Nominal Power. – The "stated" as opposed to the "actual" rate of energy transfer.

Nominal Power (P) = Rated Voltage (E) x Rated Current (I)

Nominal Power (P) = 208 VAC x 30 A

Nominal Power (P) = 6,240 W

Nominal Power (P) = 6.24 kW (6,240 W ÷ 1000)*

*1kW = 1000 W

NATIONAL TYPE EVALUATION PROGRAM

Certificate of Conformance

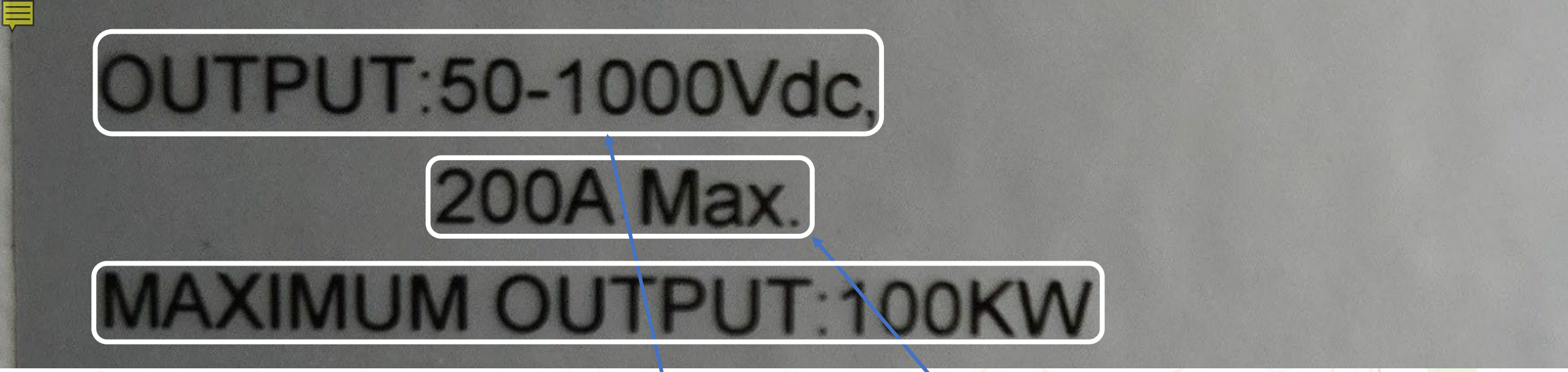
for Weighing and Measuring Devices

For:
Electric Vehicle Fueling System
AC only
Model: CT4000
Software Version: 4.6.0.73 or higher

Submitted By:
ChargePoint, Inc.
240 East Hacienda Ave
Campbell, CA 95008
Tel: 408-718-3781
Contact: Gary Eldridge
Email: gary.eldridge@chargepoint.com
Website: www.chargepoint.com

Standard Features and Options

- Alternating Current (AC) system in kilowatt-hour (kWh)
- 0.0001 kWh registration display
- Minimum Measured Quantity (MMQ): 0.2 kWh
- Voltage Rating: 208/240 VAC (Volts Alternating Current)
- Maximum Current Deliverable (MDA): 30 A (Amperes)



Nominal Power (P) = Rated Voltage (E) x Rated Current (I)

Nominal Power (P) = 1000 Vdc x 200 A

Nominal Power (P) = 200,000 W

Nominal Power (P) = 200 kW (200,000 W ÷ 1000)*

*1kW = 1000 W

California Type Evaluation Program

Certificate of Approval

Weighing and Measuring Devices

For:

Electric Vehicle Fueling Systems (EVFS)
DC Only

Make: Delta Electronics Inc.

Models: EVHU503UKBA07EG
EVHU104UPAB07EG
EVHU104UHAA28EG
EVHU104UHAA29EG
EIDS-U200TSUUAE1
EIDS-U200TSUUAE2

Submitted By:

EVgo Services LLC
for Delta Electronics Inc.
11835 W. Olympic Blvd. Ste 900E
Los Angeles, CA 90064

Contact: Jeremy Whaling
Tel: (310) 954-2900
Email: jeremy.whaling@evgo.com
Web site: www.evgo.com

Standard Features and Options

Standard Features:

- Direct Current (DC) system in kilowatt-hour (kWh)
- Accuracy Class 2.0 for DC with 1% accuracy tolerance or better
- Maximum Rate of Energy Transfer: 50kW, 100kW and 200kW DC
- Maximum Deliverable Amperes (MDA): 125 amperes (A), 200A, and 400A
- Minimum Measured Quantity (MMQ): 0.5 kWh
- Voltage Rating: 150 - 950V (200kW models), 150 - 1000V (50kW and 100kW models)

NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.2. Method of Sale. – All electrical energy kept, offered, or exposed for sale and sold at retail as a vehicle fuel shall be in units in terms of the kilowatt-hour (kWh).

In addition to the fee assessed for the quantity of electrical energy sold, fees may be assessed for other services; such fees may be based on time measurement and/or a fixed fee.

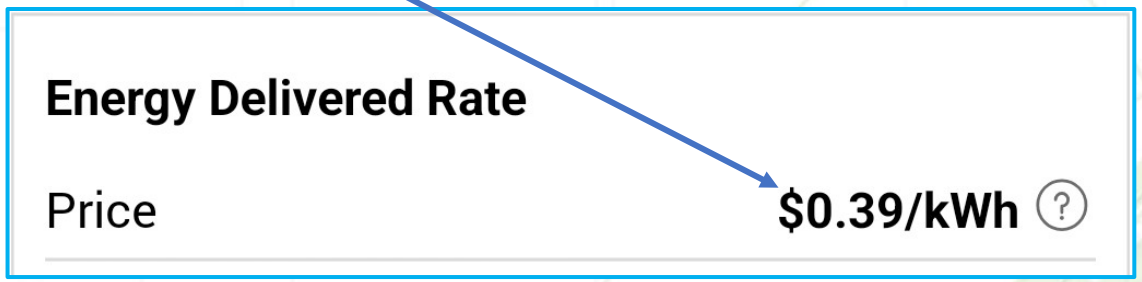
NIST HB 130 Method of Sale

2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

(a) A computing EVSE shall display the unit price:

- in whole cents (e.g., $0.12)
- or tenths of one cent (e.g., $0.119)
- on the basis of price per kilowatt-hour ($/kWh)



In cases where the electrical energy is unlimited or free of charge, this fact shall be clearly indicated in place of the unit price.

NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

(b) For fixed service applications, the following information shall be conspicuously displayed or posted on the face of the device:

1) the level of EV service expressed as the nominal power transfer (i.e., nominal rate of electrical energy transfer), and

2) the type of electrical energy transfer (e.g., AC, DC, wireless).

Electric Vehicle Fueling Systems Inspection
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

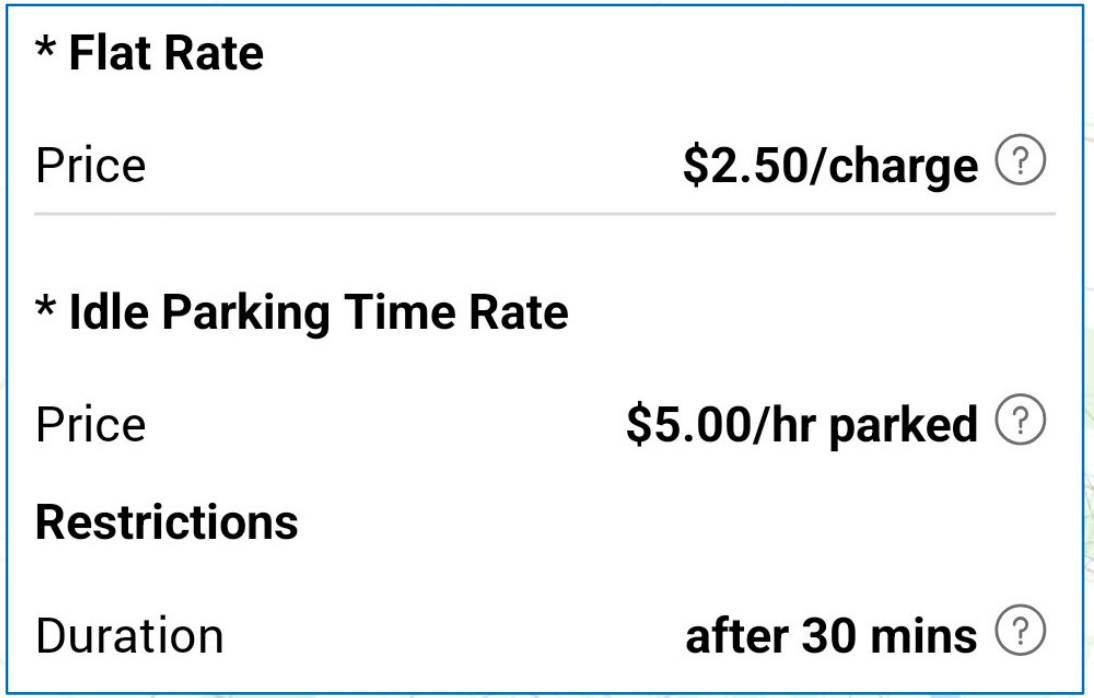
(c) For variable service applications, the following information shall be conspicuously displayed or posted on the face of the device:

1) the type of delivery (i.e., variable);
2) the minimum and maximum power transfer that can occur during a transaction, including whether service can be reduced to zero;
3) the condition under which variations in electrical energy transfer will occur; and
4) the type of electrical energy transfer (e.g., AC, DC, wireless).

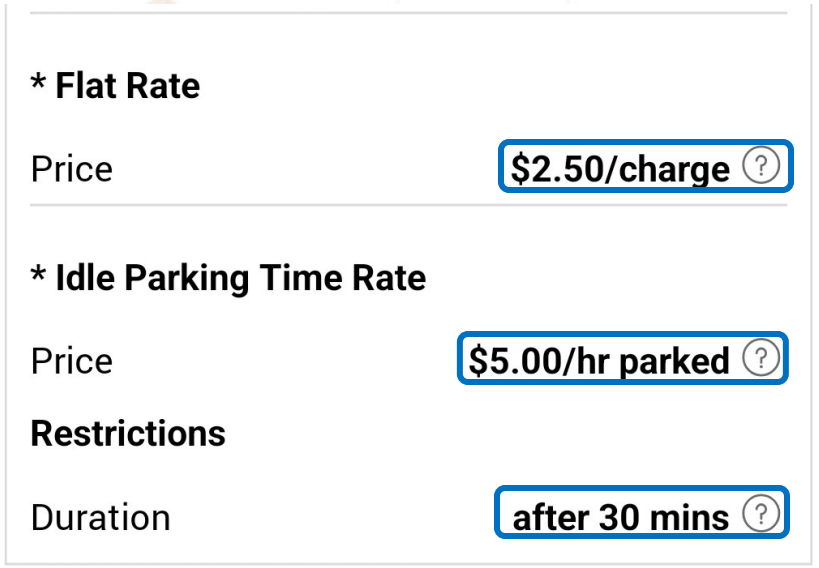
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

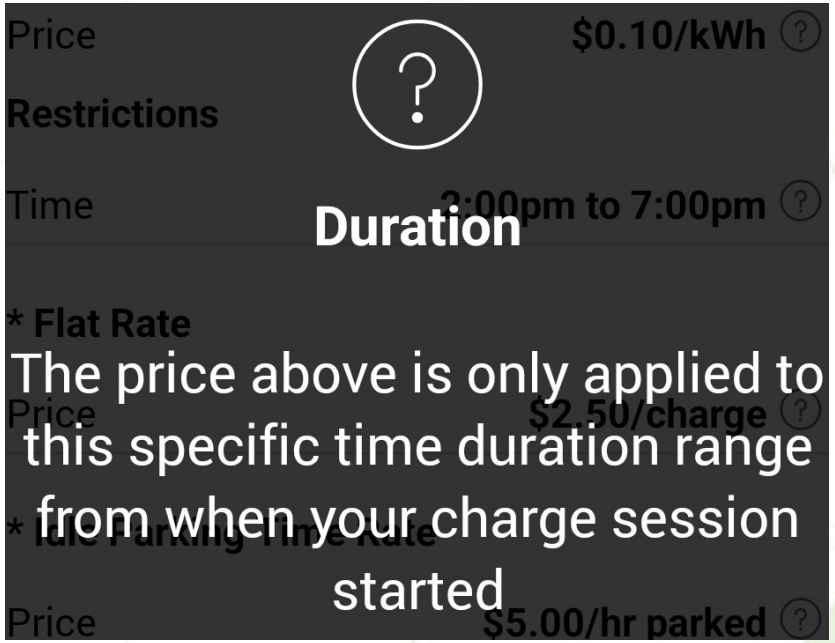
2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

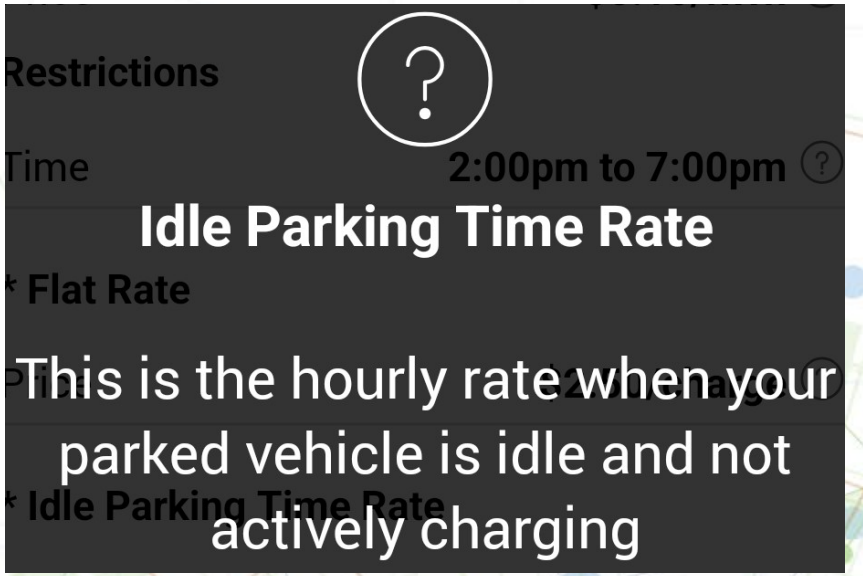
(d) Where fees will be assessed for other services in direct connection with the fueling of the vehicle, such as fees based on time measurement and/or a fixed fee, the additional fees shall be displayed.



NIST HB 130, IV. UR, B. MOS
2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.
(d) Fees for Other Services







Electric Vehicle Fueling Systems Inspection
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

(e) The EVSE shall be labeled in accordance with Labeling Requirements for Alternative Fuels and Alternative Fueled Vehicles, 16 C.F.R. § 309.

16 C.F.R. § 309.10 Alternative vehicle fuel rating (b)

16 C.F.R. § 309.15 Posting of non-liquid alternative vehicle fuel rating (f)

Electric Vehicle Fueling Systems Inspection
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling (e).

16 C.F.R. § 309.10 Alternative vehicle fuel rating (b):

If you are a manufacturer of electric vehicle fuel dispensing systems, you must determine the fuel rating of the electric charge delivered by the electric vehicle fuel dispensing system before you transfer such systems.

To determine the fuel rating of the electric vehicle fuel dispensing system… you must disclose: kilowatt ("kW") capacity, voltage, whether the voltage is alternating current ("ac") or direct current ("dc"), amperage, and whether the system is conductive or inductive.

Electric Vehicle Fueling Systems Inspection
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling (e).

16 C.F.R. § 309.15 Posting of non-liquid alternative vehicle fuel rating (f)

Example of information to be included:

"Electricity",

"XX kW",

"XXX vac/XX amps"

"Inductive"

NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

(f) The EVSE shall be listed and labeled* in accordance with the National Electric Code® (NEC) NFPA 70, Article 625 Electric Vehicle Charging Systems (www.nfpa.org).

*by a recognized testing agency

National Fire Protection Association

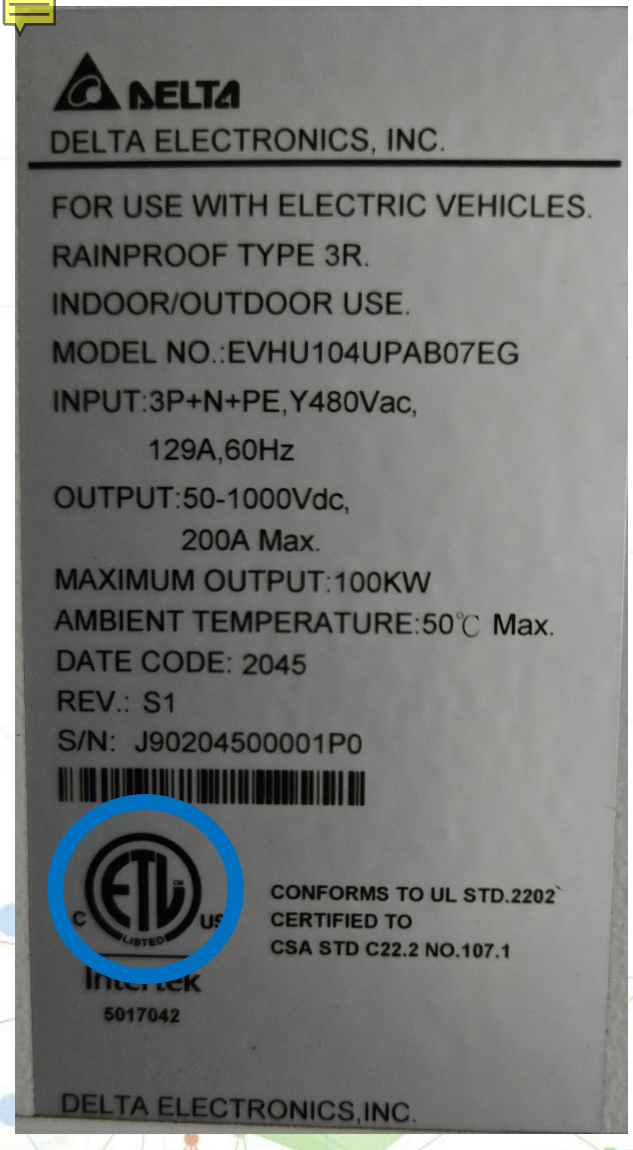
- US-based international standards organization
  - Founded 1896, headquarters in MA, ~50,000 members world-wide
- Develops voluntary consensus standards focused on fire, electrical and life safety
- NFPA 70 (aka National Electric Code (NEC))
  - Benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards
  - NEC often adopted by state and local jurisdictions, becoming part of their building codes
  - Properly installed EVSE should meet all NEC requirements

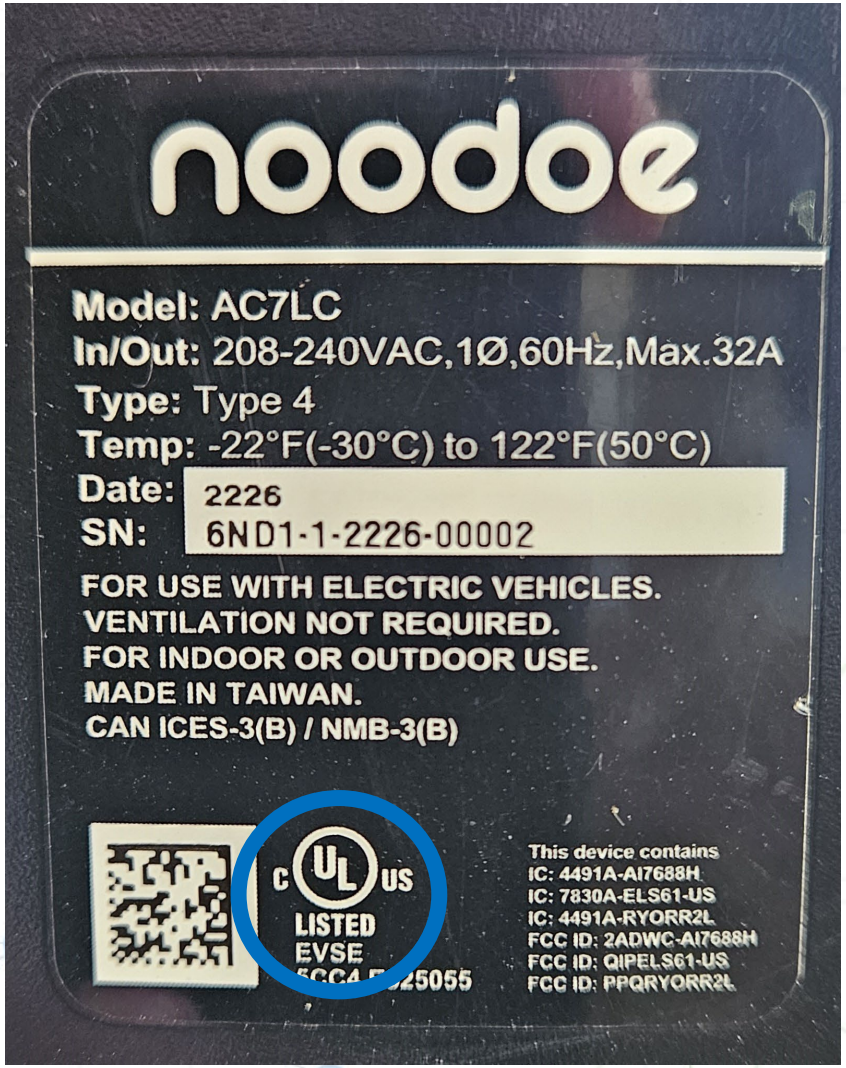
https://www.osha.gov/dts/otpca/nrtl/index.html

Nationally Recognized Testing Laboratories

Occupational Safety and Health Administration

- OSHA requires 38 different types of products and devices to be approved
- NRTL is an OSHA recognition program for testing facilities
- NRTL-approved products are recognized by OSHA as safe for use in the workplace.
  - It is not an endorsement of products by OSHA
- After certifying a product, the NRTL authorizes manufacturers to apply the NRTL's registered certification mark
  - Do not rely on website claims, manuals, or marketing information
- Approved devices will have NRTL logo on a label or nameplate affixed to the device. (small devices may have logo on packaging)
- NEC requires EV charging stations be NRTL certified before they can be installed


DELTA
DELTA ELECTRONICS, INC.
FOR USE WITH ELECTRIC VEHICLES.
RAINPROOF TYPE 3R.
INDOOR/OUTDOOR USE.
MODEL NO.:EVHU104UPAB07EG
INPUT:3P+N+PE,Y480Vac,
129A,60Hz
OUTPUT:50-1000Vdc,
200A Max.
MAXIMUM OUTPUT:100KW
AMBIENT TEMPERATURE:50℃ Max.
DATE CODE: 2045
REV.: S1
S/N: J90204500001P0
CONFORMS TO UL STD.2202
CERTIFIED TO
CSA STD C22.2 NO.107.1
5017042
DELTA ELECTRONICS,INC.


noodoe
Model: AC7LC
In/Out: 208-240VAC,1Ø,60Hz,Max.32A
Type: Type 4
Temp: -22°F(-30°C) to 122°F(50°C)
Date: 2226
SN: 6ND1-1-2226-00002
FOR USE WITH ELECTRIC VEHICLES.
VENTILATION NOT REQUIRED.
FOR INDOOR OR OUTDOOR USE.
MADE IN TAIWAN.
CAN ICES-3(B) / NMB-3(B)
LISTED
EVSE
This device contains
IC: 4491A-AI7688H
IC: 7830A-ELS61-US
IC: 4491A-RYORR2L
FCC ID: 2ADWC-AI7688H
FCC ID: QIPELS61-US
FCC ID: PPQRYORR2L

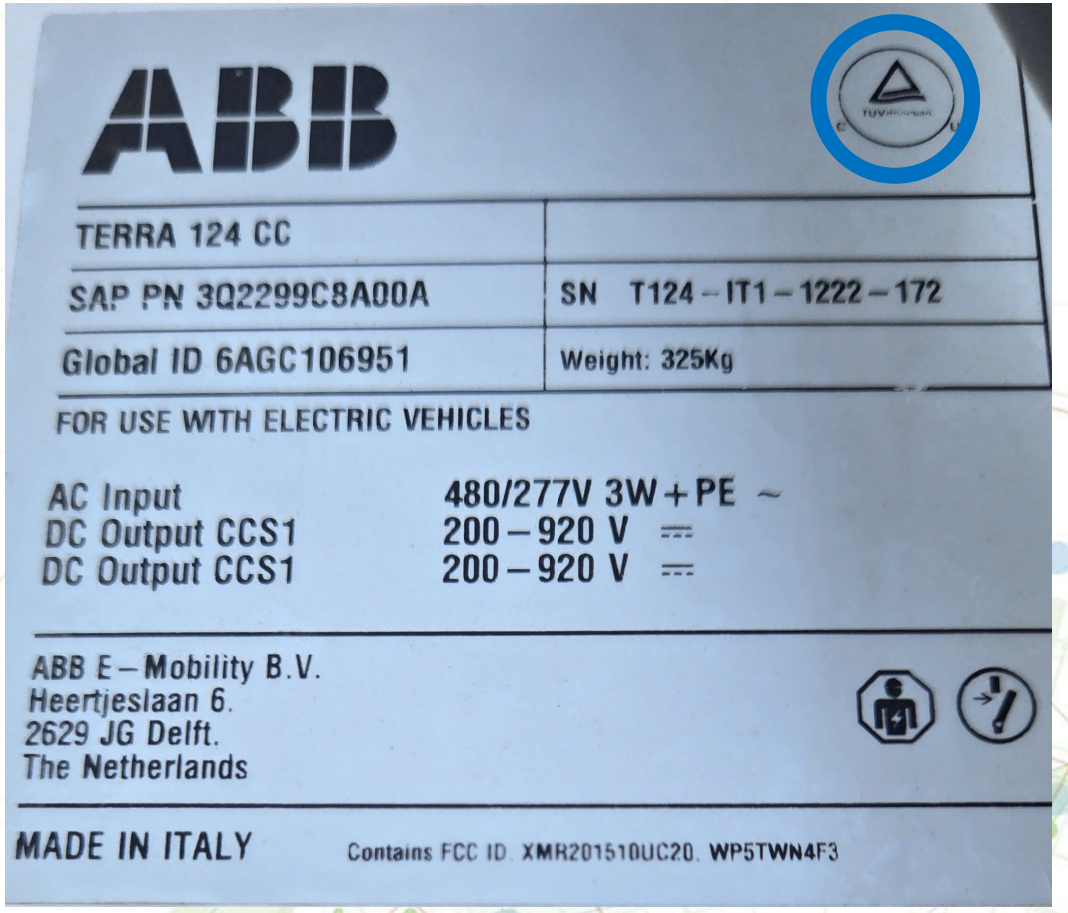


ABB
TERRA 124 CC
SAP PN 3Q2299C8A00A
SN T124-IT1-1222-172
Global ID 6AGC106951
Weight: 325Kg
FOR USE WITH ELECTRIC VEHICLES
AC Input 480/277V 3W+PE ~
DC Output CCS1 200-920 V ⎓
DC Output CCS1 200-920 V ⎓
ABB E-Mobility B.V.
Heertjeslaan 6.
2629 JG Delft.
The Netherlands
MADE IN ITALY
Contains FCC ID XMR201510UC20, WP5TWN4F3

Electric Vehicle Fueling Systems Inspection
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

2.33.4. Street Sign Prices and Other Advertisements

Same as labeling requirements with the exceptions of (e) and (f) in 2.33.3. Retail Electric Vehicle Supply Equipment (EVSE) Labeling.

Street signs and other advertisements do not need to include the information specified in (e) and (f) in 2.33.3.

Mobile apps included

Electric Vehicle Fueling Systems Inspection
NIST HB 130 Method of Sale
2.33. Retail Sales of Electricity Sold as Vehicle Fuel

What unit of measure must electrical energy for vehicle fuel be sold by?

a. Amps
b. Volts
c. Kilowatt Hour
d. Kilowatt

NIST Handbook 44, Appendix A, 4. Inspection of Commercial Equipment

4.1. Inspection Versus Testing

- Inspection:
  - loosely used to include everything that the official (or serviceperson) does in connection with commercial equipment
  - useful to limit the scope primarily to examinations made to determine compliance with design, maintenance, and user requirements
- Testing:
  - limited to those operations that determine the accuracy or performance of the equipment under examination

4.2. Necessity for Inspection

- Specification and user requirements are as important as tolerance requirements and should be enforced

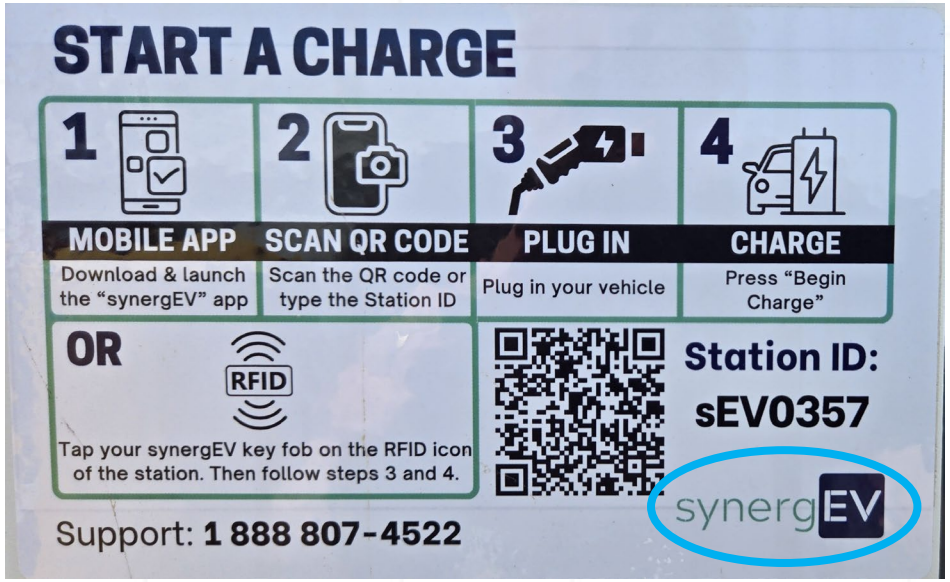
NIST Handbook 44, Appendix A, 4. Inspection of Commercial Equipment

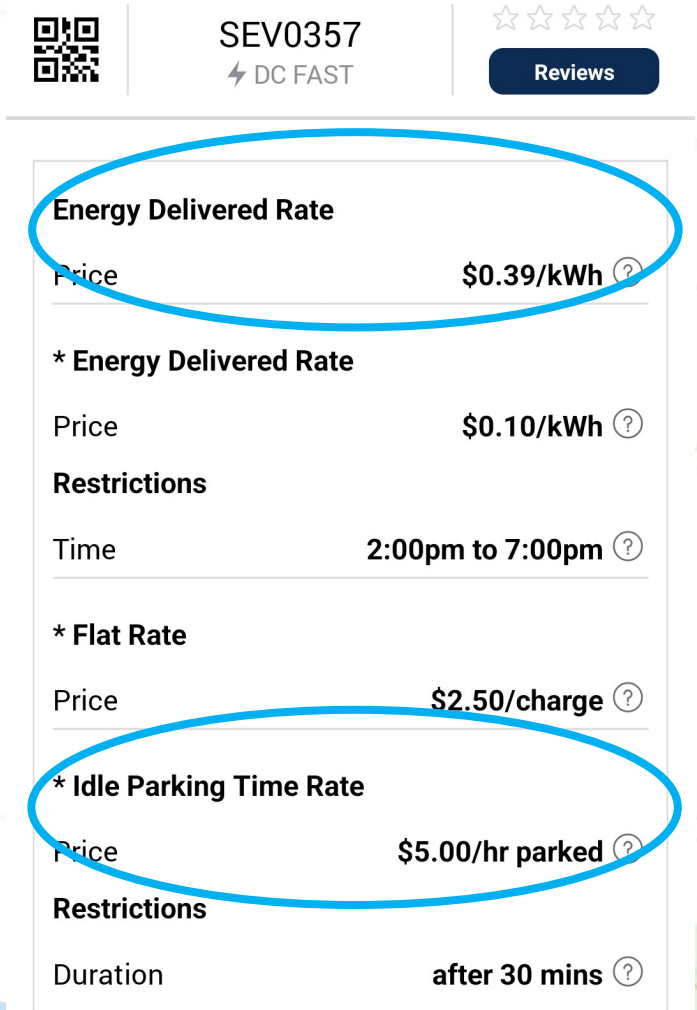
4.7. Accurate and Correct Equipment.

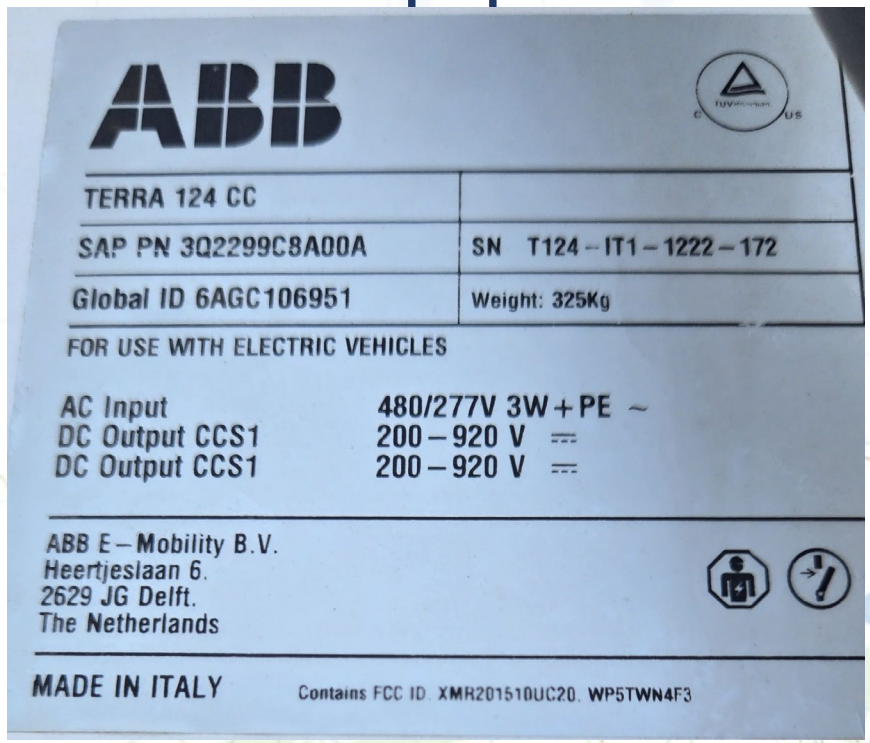
Accurate: equipment performance – that is, indications and recorded representations, as determined by tests made with suitable standards – conforms to the standard within the applicable tolerances and other performance requirements.

Correct: equipment is accurate and meets all applicable specification and user requirements

NIST HB 44, Appendix A, 4. Inspection of Commercial Equipment







synergEV app (POS)

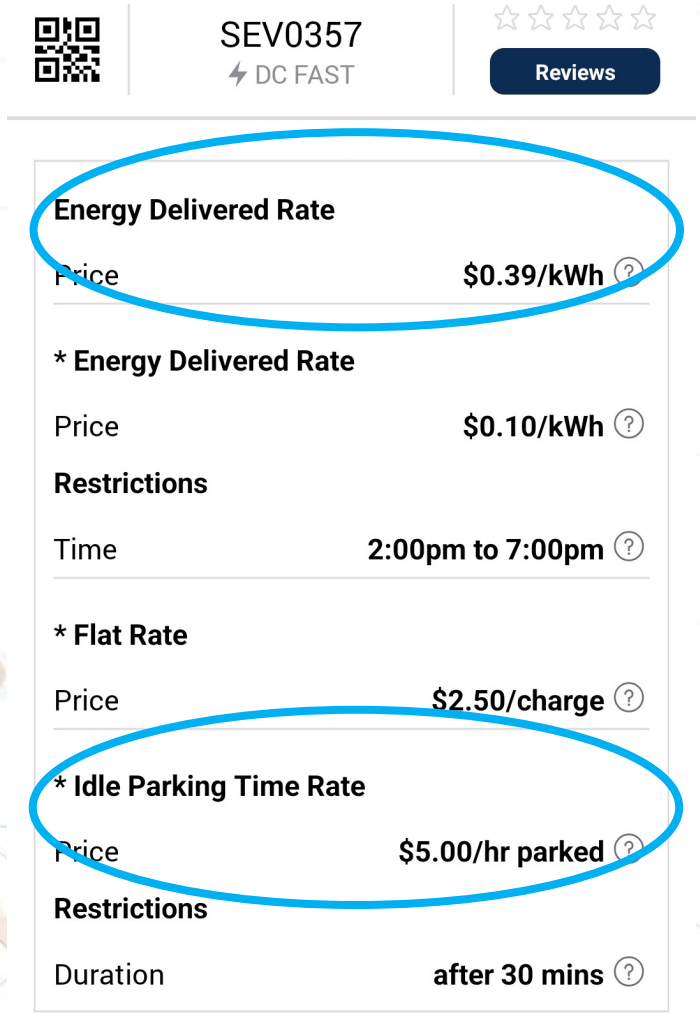
no CTEP or NTEP CC

NTEP CC: 23-045A1

CTEP CC: 5922(a)-25

No timing function

NIST Handbook 44,Appendix D, Definitions



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.

EPO 30-Retail Electric Vehicle Fueling Systems

- Organized in nine sections
- Designed as guide to inspection and testing
  - Regulators
  - Service Agents
- Refers to relevant handbook requirements

EPO 30-Retail Electric Vehicle Fueling Systems

1. Scope
2. Safety Notes
3. Equipment List
4. Definitions
5. Inspection
6. Pretest Determinations
7. Test Notes
8. Test
9. Post-Test Tasks

EPO 30-Retail Electric Vehicle Fueling Systems

1. Scope

- NIST Handbook 44
  - 1.10. General
  - 3.40. EVFS
  - 5.55. Timing*

Electric Vehicle Supply Equipment (EVSE) is defined in both NIST HB 44 and 130 and is the acronym cited throughout Section 3.40.

The acronym “EVSE” is used in this presentation and has the same meaning as the terms “electric vehicle fueling system” or “electric vehicle charger”.

*Applies to EVSE that assess fees for time-related services

EPO 30-Retail Electric Vehicle Fueling Systems

2. Safety
   - PPE
   - Hazards
     - Device
     - Site Conditions

EPO 30 Safety Reminders and Guidelines

- **NIST OWM DOES NOT make official safety-related recommendations or hazard mitigations**
- **EPO authors are not safety professionals**
- Safety should be **foremost** in the Inspector's and Serviceperson's mind
- NIST OWM EPOs contain safety reminders and guidelines
  - Within individual EPOs
  - EPO Annex 1 – Safety Considerations and Glossary of Key Safety Phrases
    - Link: https://www.nist.gov/system/files/documents/2025/03/10/EPO_Annex01-Final-20250310.pdf

EPO 30 Safety Reminders and Guidelines

- It takes vigilance and preparation to be safe
- Read and be familiar with NIST Safety Annex 1
- Read and be familiar with EPO Safety Reminders
- Be aware of all safety regulations and policies at the inspection site
  - Including local, state, federal, OSHA, employer, and site owner safety regulations and policies
- Evaluate potential safety hazards prior to an inspection. Meet with site safety personnel.
- Follow your employer's safety policies

EPO 30 Safety Reminders and Guidelines

- EPOs contain general and specific safety reminders
- Not intended to cover all possible safety precautions
- EPO 30 contains four safety reminder blocks
- EVSE installation, repair, and inspection warrants extra attention to electrical safety issues
  - Loose or exposed wiring
  - Frayed, worn, or damaged cords
  - Avoid standing on wet surfaces

EPO 30 Safety Reminders and Guidelines

Safety Reminder Locations

- Section 2. Safety Notes.
- Section 3.3. Optional Equipment.
- Section 7.2. Steps in the Test of an EVSE.
- Section 7.6. Use of Adjustments.

SAFETY REMINDER!!!

- **Assess the overall safety condition of the EVSE.**
- **Report loose, exposed, frayed, or worn EVSE 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 EVSE for the field examination process.**
- **Identify the EVSE's power capacity, voltage, type of current, amperage, and system's power transfer method, and verify compatibility with the test standard.**
- **For EVSEs 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 EVSE is available for conduct of the test.**
- **Do not leave an activated dispenser unattended!**
- **Ground the test equipment.**

EPO 30-Retail Electric Vehicle Fueling Systems

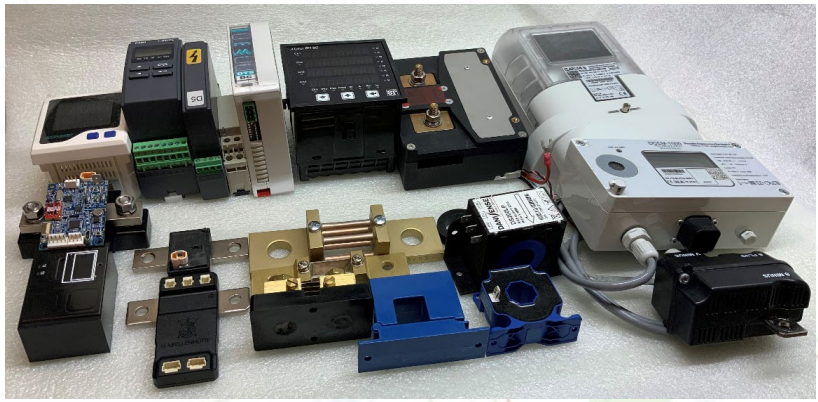
3. Equipment

- Test Standards
  - Suitable
  - Traceable
- Other Equipment

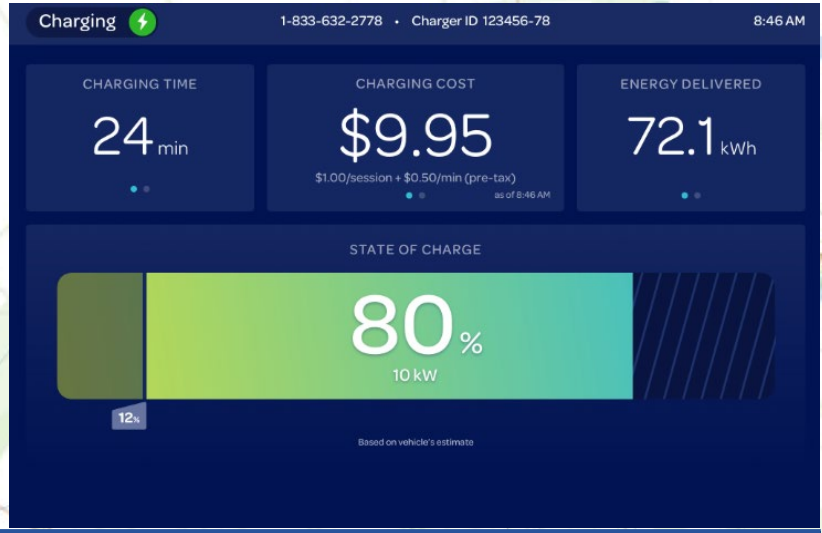
EVSE Embedded Meter (legal device)

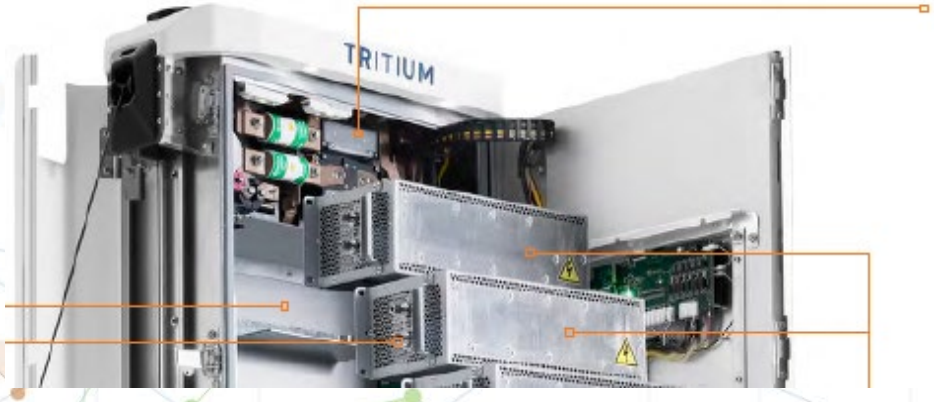
- Embedded in the EVSE to measure the energy delivered for which the customer is billed.
- Needs to be compliant with NIST Handbook 44 specifications and tolerance requirements.
- Subject to regulatory oversight (testing and inspections) by the state W&M programs.

Embedded Meters



Credit: Ted Bohn, ANL





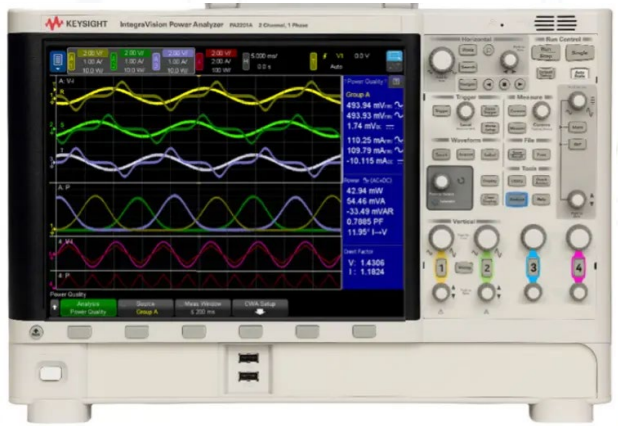
DC Meter Close-up

Electrical Test Equipment

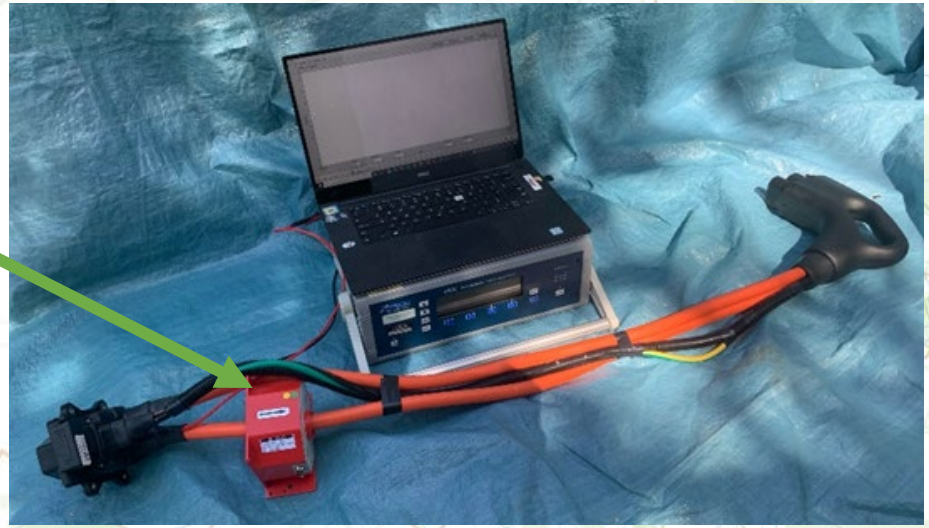
- Can use more traditional electrical test equipment (multimeters, power analyzers, and appropriate sensors (DCCT)
- Completely acceptable test equipment solution, with a computer, appropriate software, and a calibrated multimeter.
  - Need to be SI-traceable.
  - Error and uncertainty (accuracy specification) must be known

Benchtop Multimeter

Power Analyzer



DC Current Transducer (DCCT)



All-in-one EVSE Test Equipment

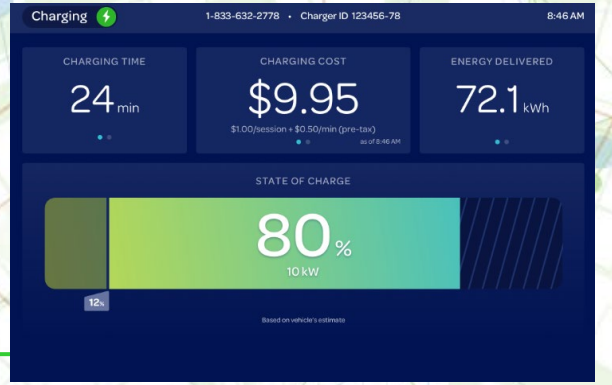
- Programmable test equipment with integrated ability to measure voltage, current, and energy. Enables users to set up test routines to evaluate compliance with NIST Handbook 44.
- Manufacturers include Comemso, TESCO and Tunkia. Fluke set to release EVSE test equipment in 2025.
- These are the devices W&M officials are probably most familiar with.
  - Need to be SI-traceable.
  - Error and uncertainty (accuracy specification) must be known

Check standard or field reference

Device under test

Field Meter for State Labs

EVSE Meter (i.e. LM Device)



Test Equipment Compatibility and Suitability

Suitability – Is the **test equipment** capable of performing the measurement task accurately and reliably?

- Size
- Capacity (Voltage, Current, Energy ratings)
- Range, resolution, accuracy
- Safety
- Ease of use
- Retains calibrations
- Traceability
- Compatibility

Compatibility – Is the **test equipment** capable of integrating with the EVSE?

- Hardware
- Software
- Network connectivity

Calibration Scale

Common physical quantities that are transferred and measured

SOURCE	FLOW METER	RECEIVER
Mass artifact		Weighing Scale
Fluids	Flow meter	**Volume Prover**
Electric charge	**Electric meter**	Battery
Light	**Photometer**	Solar panel/battery

Choice of what **'carries the calibration scale'** depends on the physical quantity, stability of an artifact, convenience, and accuracy

Which SI Unit is Electrical Energy Traceable to?

Physical quantity being measured: Electrical Energy [kWh]

Relevant SI Base Unit: Ampere [A] , Second [s]

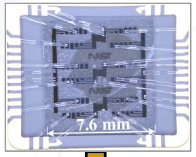
Energy [kWh] = Power [kW] x time [h]

Power [W] = Current [A] x Voltage [V]

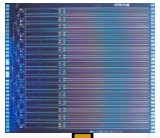
SI $Joule = \mathrm{W\ s}$ $W = \frac{Joules}{s}$ $A = \frac{Coulomb}{s}$ $V = \frac{Joules}{Coulomb}$

Traceability – NIST Primary Electrical Standards

Primary Resistance Standard



Primary Volt Standard



Current accessed indirectly through a voltage measurement

Standard Resistor

Current

Voltage

Calibrated Current Transducer

Calibrated voltmeter

(I)

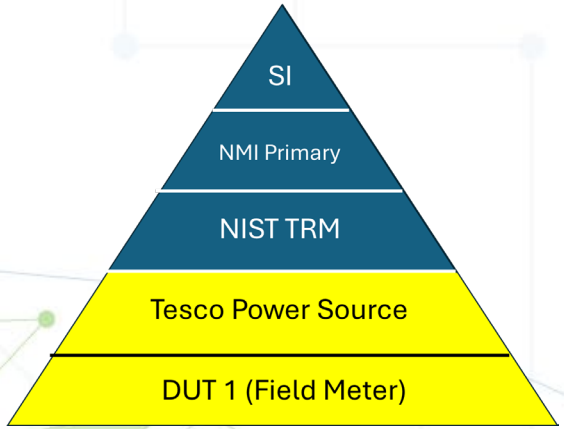
(V)

Intermediary power/energy
Transfer Reference Meter (TRM)

Calibrated DC Power

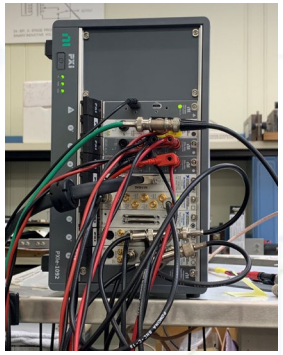
CA Traceability Scheme

1. In Step #1, NIST TRM is used to calibrate the TESCO power source (TPS), assuming it has embedded meter. Traceability to SI is through TPS.
2. In Step #2, the TPS is used to directly calibrate field meters.



Step #1

Traceability



Energy

NIST TRM

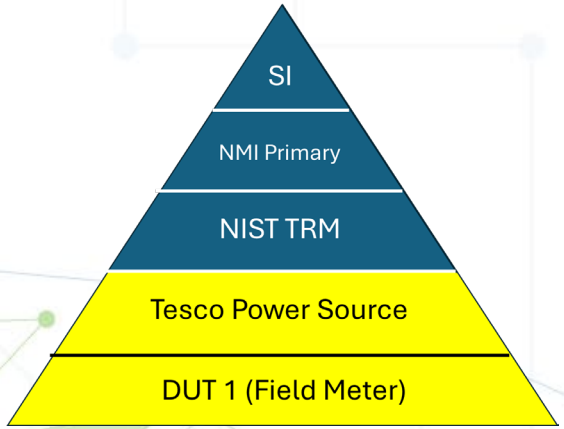
u = 0.01 %

CA TESCO power source

u_c (TPS) =[u^2 (TRM) + u^2 (Repeatability)]$^{1/2}$

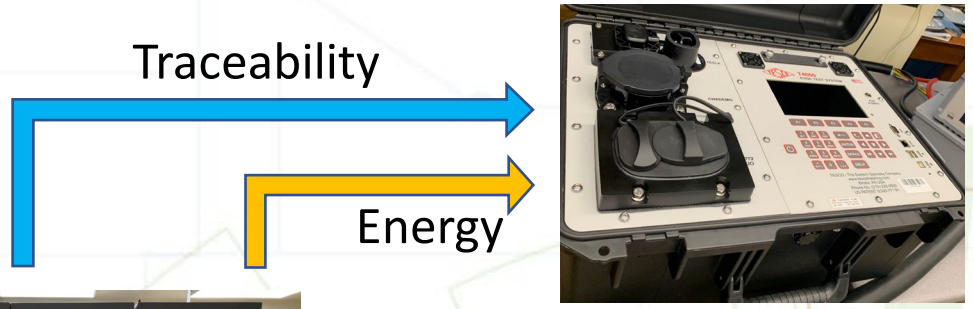
CA Traceability Scheme

1. In Step #1, NIST TRM is used to calibrate the TESCO power source (TPS), assuming it has embedded meter. Traceability to SI is through TPS.
2. In Step #2, the TPS is used to directly calibrate field meters.



Step #2

u_c (DUT1) =[u^2 (TPS) + u^2 (repeatability)]$^{1/2}$



CA TESCO power source

Field Meter under Test (DUT1)

EPO 30-Retail Electric Vehicle Fueling Systems

4. Definitions

4.1. Control Pilot (CP) Signal*

4.2. interference test**

4.3. maximum current deliverable (MCD)

4.4. maximum deliverable amperage (MDA)

4.5. Proximity Pilot (PP) Signal.*

*EPO Only **EPO only, item on 2026 S&T Agenda

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.2. General Considerations.

5.2.1. Selection and Suitability.

Code Reference: 1.10: G-S.3., G-S.5.4., G-UR.1.1., G-UR.1.2., 3.40: S.3.4.

- Design
  - permanence
  - repeatability

EPO 30-Retail Electric Vehicle Fueling Systems

5.2.1. Selection and Suitability.

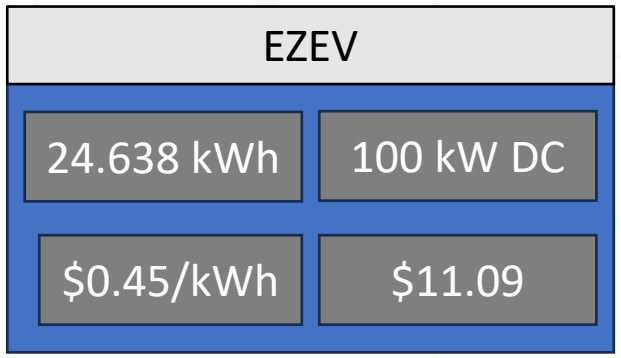
Code Reference: 1.10: G-S.3., G-S.5.4., G-UR.1.1., G-UR.1.2., 3.40: S.3.4.

- Design
  - environment
  - computing capability
  - rate of flow
  - the character, number, size, and location of its indicating or recording elements
  - value of its smallest unit and unit prices
  - data storage and retrieval

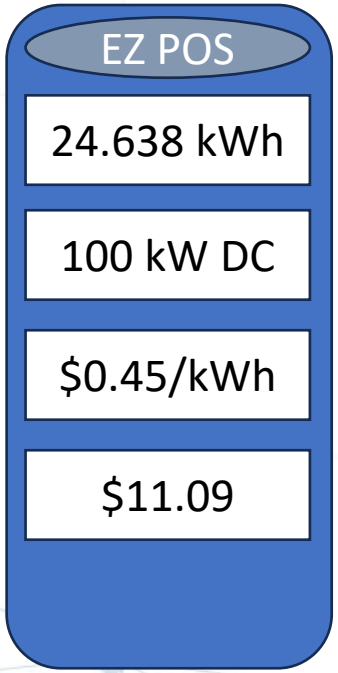
EPO 30-Retail Electric Vehicle Fueling Systems

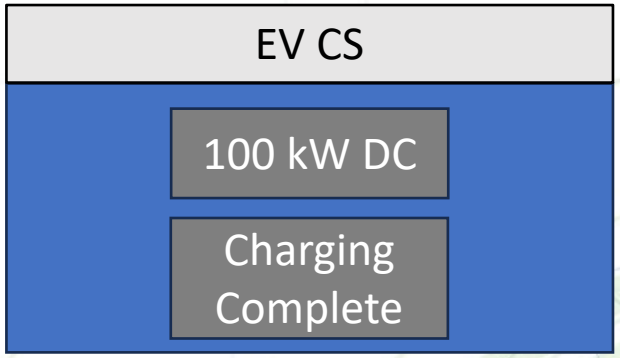
5.2.1. Selection and Suitability.

Design: computing capability, the character, number, size, and location of its indicating or recording elements

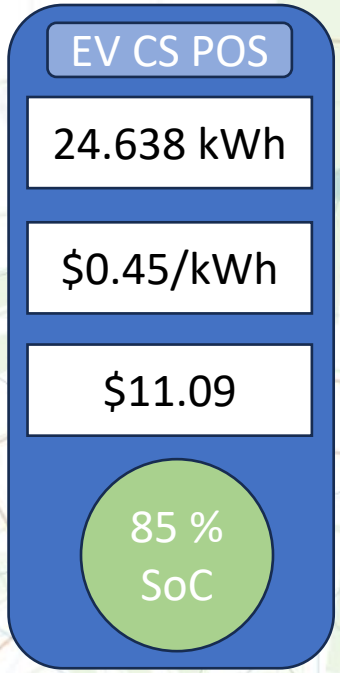


EVSE Display



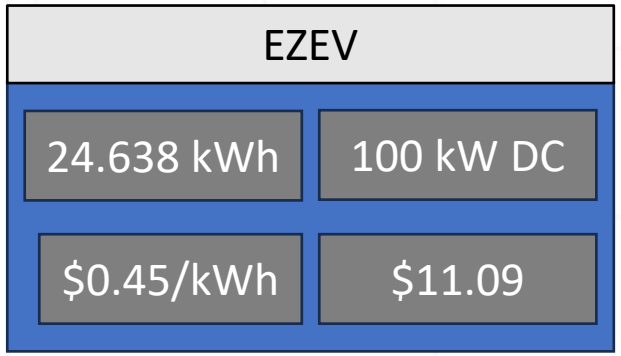


EVSE Display

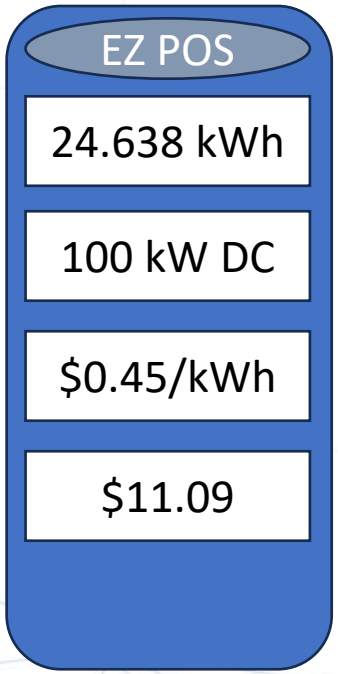


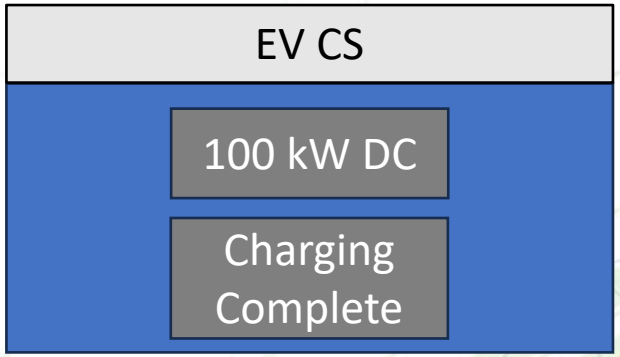
EPO 30-Retail Electric Vehicle Fueling Systems

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, 3.32, 3.37, 3.39, and 3.40]

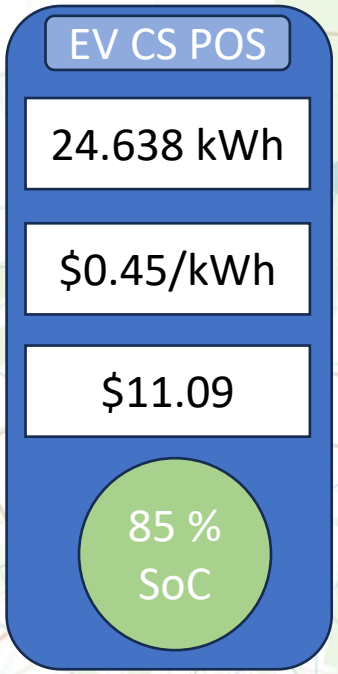


EVSE Display





EVSE Display



EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.2. General Considerations.

5.2.2. Installation.

Code Reference: 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.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.2. General Considerations.

What does G-UR.3.3 pertain to?

a. The position of the required marking information
b. Accessibility for inspection
c. Assistance in testing
d. The position of primary indications

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.2. General Considerations.

5.2.4. Use and Maintenance.

Code Reference: 1.10: G-UR.3.1., G-UR.4.1., G-UR.4.2., 3.40: UR.3.5.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.2. General Considerations.

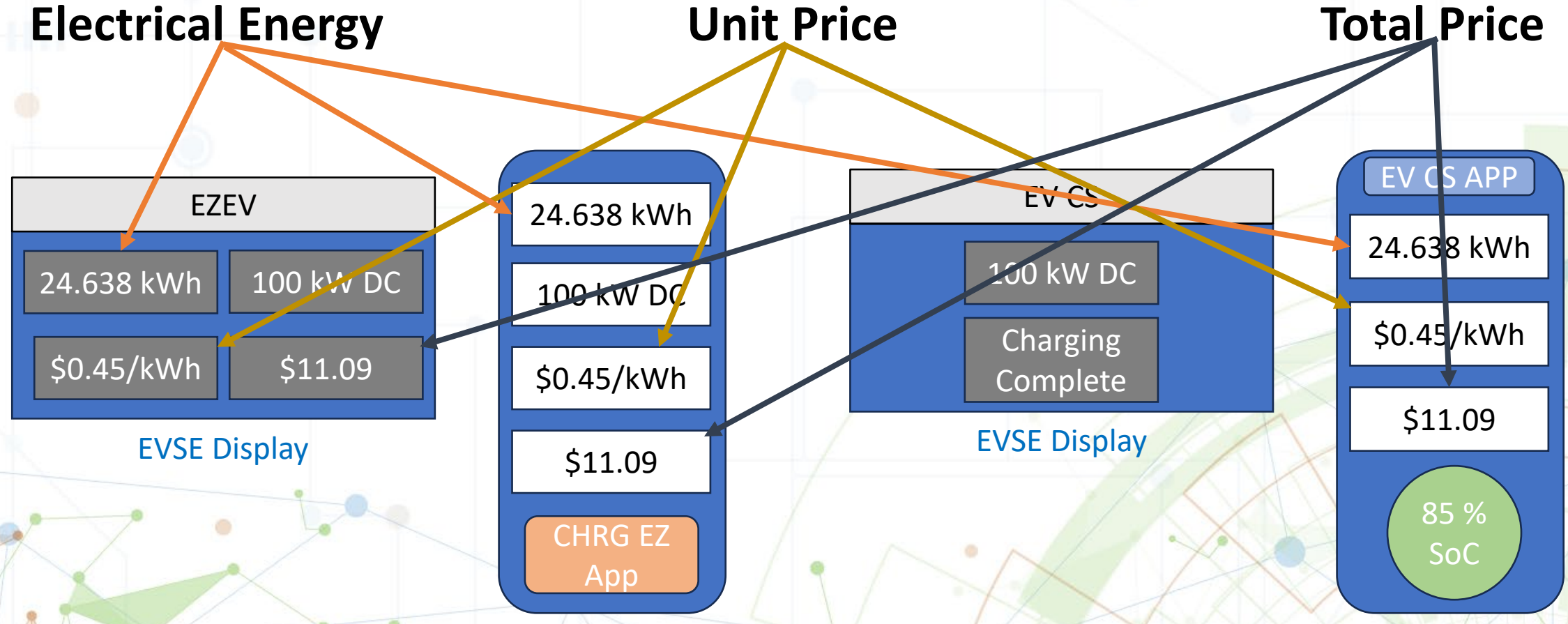
5.2.5. Computing Capability.

Code Reference: 3.40: S.1.1., UR.1.1.

- An EVSE shall be of the computing type and shall indicate the electrical energy, the unit price, and the total price of each transaction.

EPO 30-Retail Electric Vehicle Fueling Systems

S.1.1. and UR.1.1.



EPO 30-Retail Electric Vehicle Fueling Systems

S.1.1. and UR.1.1.

- Electrical Energy
- Unit Price?
- Total Price?

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3. Indicating and Recording Elements.

5.3.1. Design.

Code Reference: 1.10: G-S.5.1., G-S.5.2.2., 3.40: S.1.2., S.1.2.1., S.2.4.4., 5.55: S.3.

S.1.2. EVSE Indicating Elements

EPO 30-Retail Electric Vehicle Fueling Systems

S.1.2. EVSE Indicating Elements

- shall include an indicating element that accumulates continuously and displays, for a minimum of 15 seconds the correct measurement results relative to quantity and total price
  - at activation by the user
  - at the start of the transaction
  - at the end of the transaction

EPO 30-Retail Electric Vehicle Fueling Systems

- Electrical Energy
- Unit Price?
- Total Price?

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3. Indicating and Recording Elements.

5.3.2. Units.

5.3.2.1. Units – EVSEs.

Code Reference: 3.40: S.1.3.1., S.1.3.2.

5.3.2.2. Units – Integral Time-Based Systems.

Code Reference: 5.55: S.1.1.2., S.1.1.3.

EPO 30-Retail Electric Vehicle Fueling Systems

5.3.2.1. Units – EVSEs.

Code Reference: 3.40: S.1.3.1., S.1.3.2.

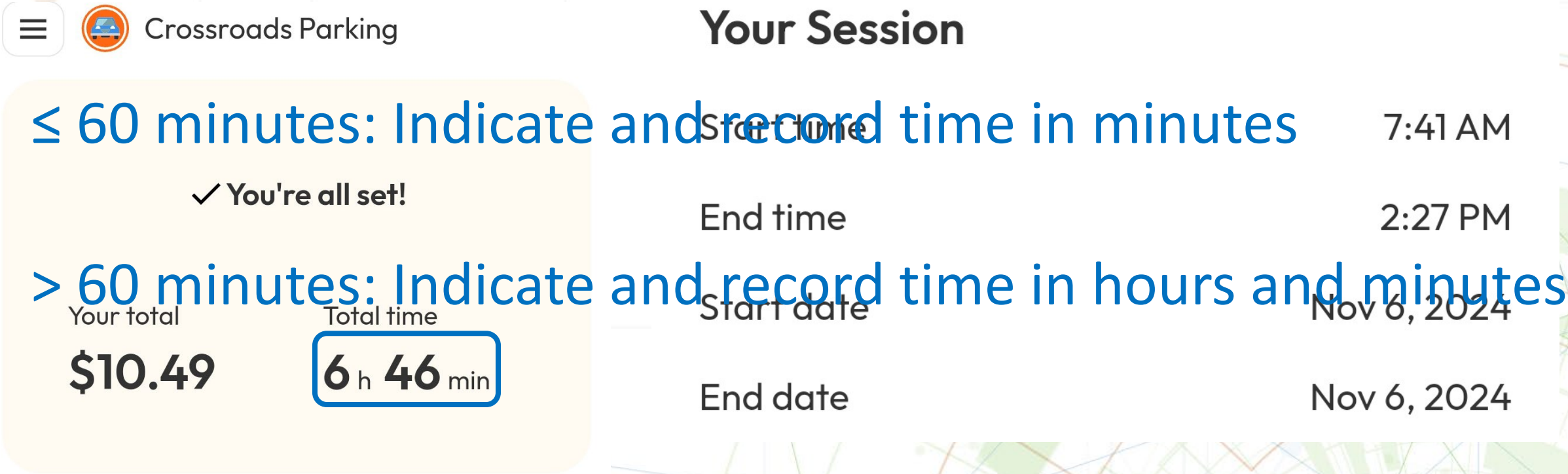
For AC systems, the value of the unit of indicated delivery shall not exceed 0.0001 kWh.

For DC systems, the value of the unit of indicated delivery shall not exceed 0.001 kWh.

EPO 30-Retail Electric Vehicle Fueling Systems

5.3.2.2. Units – Integral Time-Based Systems.

Code Reference: 5.55: S.1.1.2. Units:



≤ 60 minutes: Indicate and record time in minutes

> 60 minutes: Indicate and record time in hours and minutes

EPO 30-Retail Electric Vehicle Fueling Systems

5.3.2.2. Units – Integral Time-Based Systems.

Code Reference: 5.55: S.1.1.3.

Smallest Units, EVSE:

An EVSE shall have a time interval of 1 minute for time-based fees such as parking.

57 min ✓

57 m ✓

5 m 16 s ?

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3. Indicating and Recording Elements.

5.3.3. Readability.

Code Reference: 1.10: G-S.5., G-S.6. (1/1/77), G-S.7., 3.40: S.1.3.3., UR.3.4., 5.55: S.2.

0.0001 kWh Unit of Measure	
Acceptable Zero Display	Unacceptable Zero Display
0.0000 kWh	0

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3. Indicating and Recording Elements.

5.3.5. Indication of delivery.

Code Reference: 3.40: S.2.7.*

The initial zero and final quantity must automatically be displayed.*

*DC EVSE exempt until 1/1/2023 if placed in service prior to 1/1/2022

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3. Indicating and Recording Elements.

5.3.7. Money-Value Divisions.

Code Reference: 3.40: S.2.5.2

All indicated money value and quantity divisions of any auxiliary element shall be identical to those of the primary element.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3. Indicating and Recording Elements.

5.3.8. Unit Price and Product Identity.

Code Reference: 3.40: S.2.4.1., S.2.4.3., UR.1.1., UR.3.1., 5.55: UR.1.

The rates for energy and other fees, must be clearly, prominently, and conspicuously displayed

EPO 30-Retail Electric Vehicle Fueling Systems

5.3.8. Unit Price and Product Identity.

Code Reference: 3.40: 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.

EPO 30-Retail Electric Vehicle Fueling Systems

5.3.8. Unit Price and Product Identity.

Code Reference: 3.40: 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.

EPO 30-Retail Electric Vehicle Fueling Systems

5.3.8. Unit Price and Product Identity.

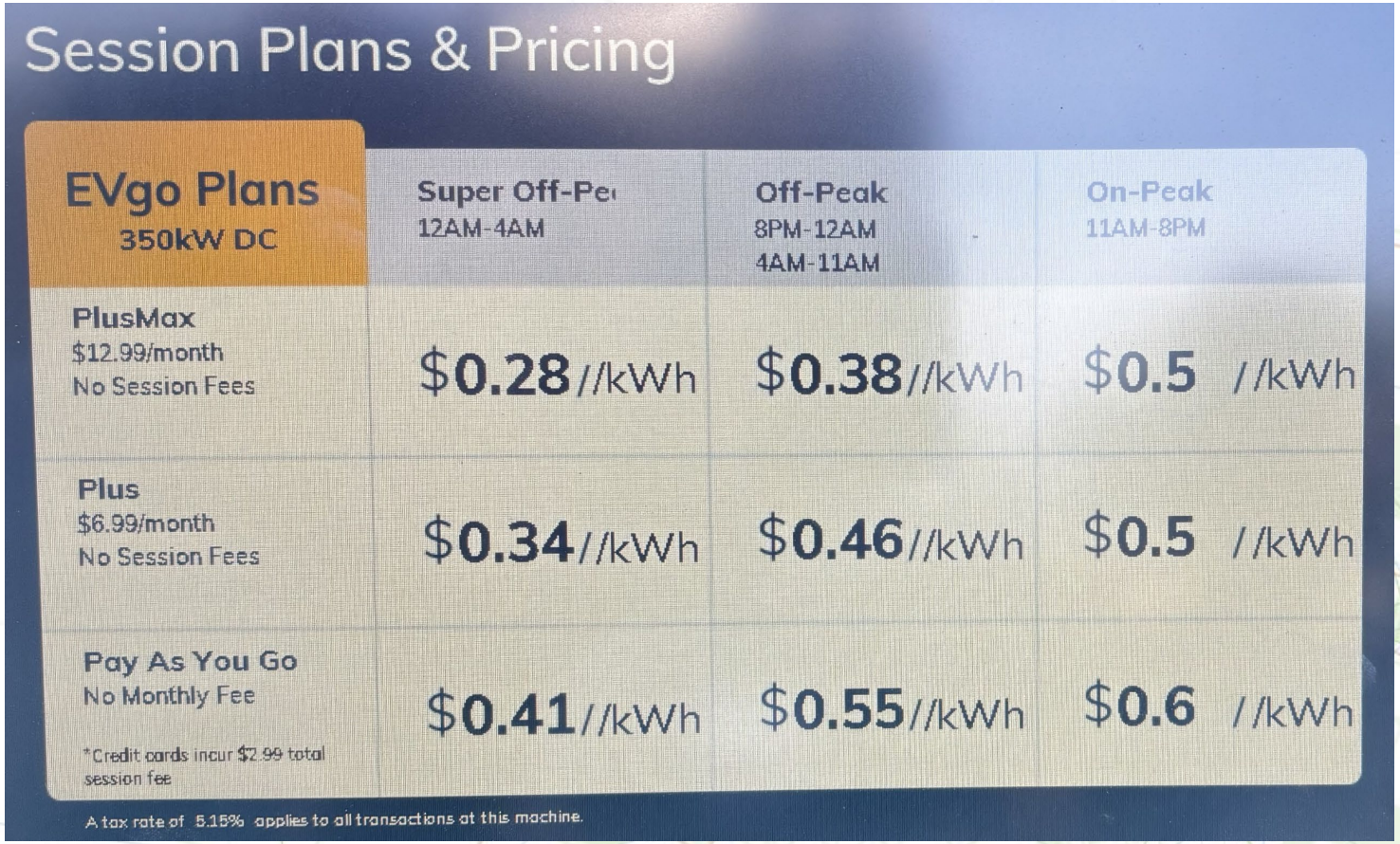
Code Reference: 3.40: S.2.4.3. Selection of Unit Price.

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.

5.3.8. Unit Price and Product Identity.

Code Reference: 3.40: S.2.4.3. Selection of Unit Price.

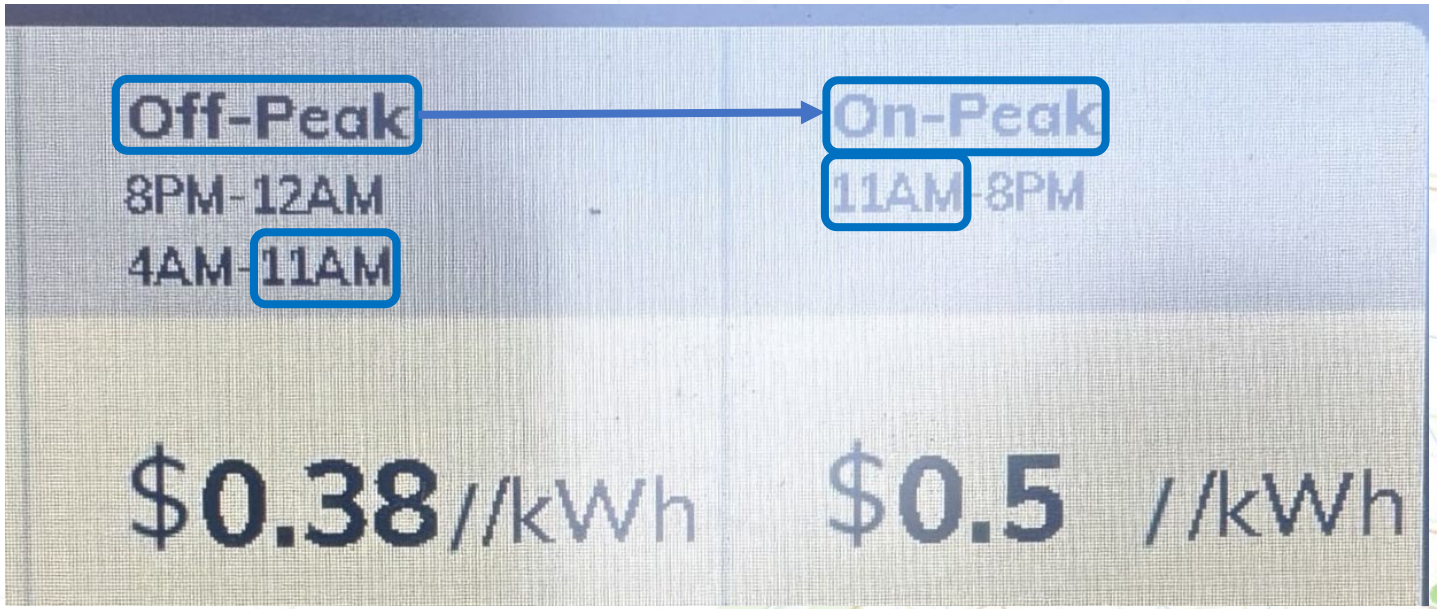
Except when the conditions for variable price structure have been approved by the customer prior to the sale, a system shall not permit a change to the unit price during delivery of electrical energy.



5.3.8. Unit Price and Product Identity.

Code Reference: 3.40: S.2.4.3. Selection of Unit Price.

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.



EPO 30-Retail Electric Vehicle Fueling Systems

5.3.8. Unit Price and Product Identity.

Code Reference: 3.40: UR.3.1., 5.55: UR.1.

An EVSE used in direct sales shall display:

- the unit price of EV fuel,
- and if time-based fees are accessed, the $ per unit(s)of time

5.3.8. Unit Price and Product Identity. 3.40:

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.

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.

5.3.8. Unit Price and Product Identity. 3.40:

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.

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.

EPO 30-Retail Electric Vehicle Fueling Systems

- Unit Price?

UR.3.1. requires that “The unit price…shall be conspicuously displayed…on the face of the retail EVSE used in direct sale.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

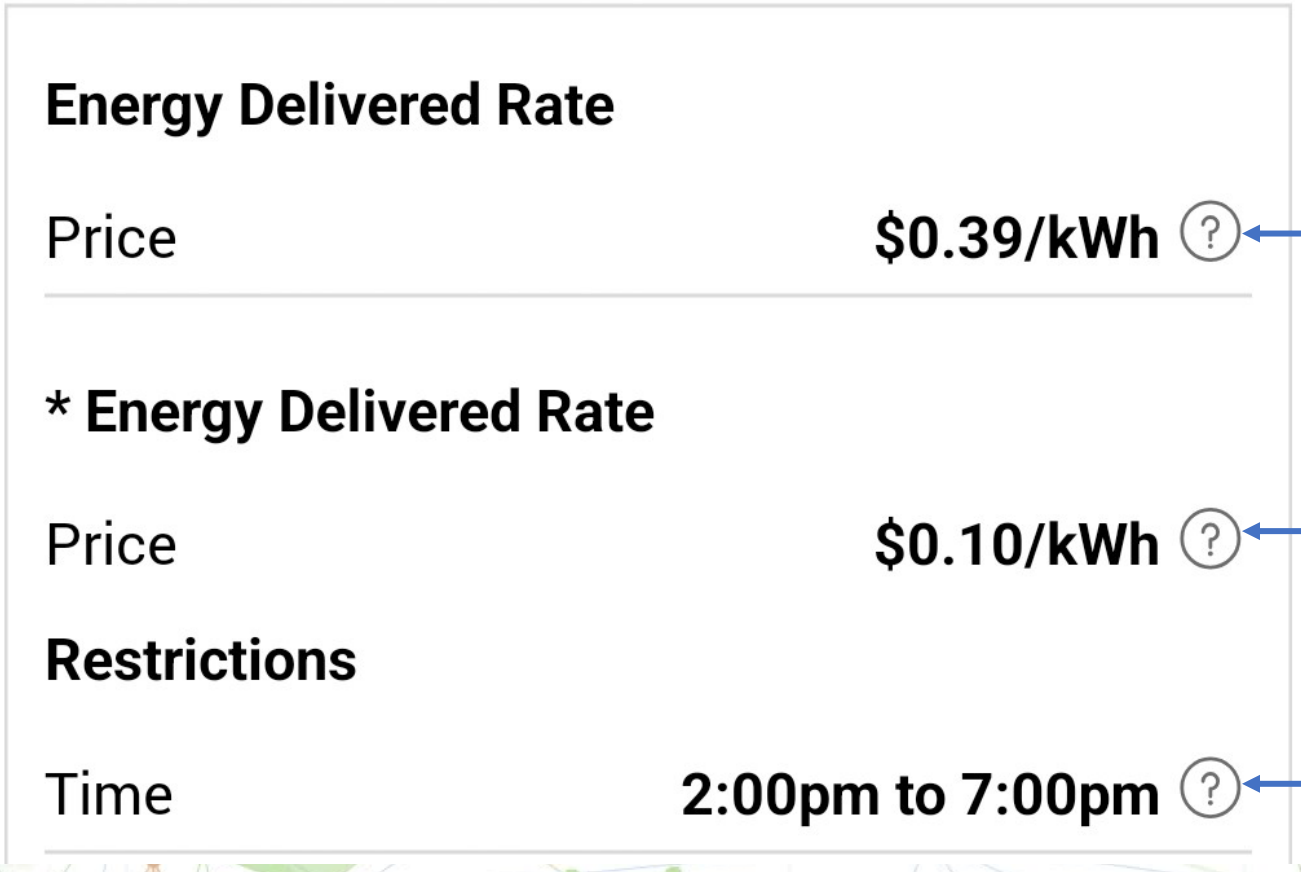
5.3.9. Multiple Unit Price Dispensers.

Code Reference: 1.10: G-S.5.3.1., 3.40: S.1.1., S.2.4.3., UR.3.1., 5.55: UR.1.

A device capable of charging multiple unit prices over a single transaction and/or for time-based services shall indicate the 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.

NIST HB 44
3.40: S.2.4.3. Selection of Unit Price.



Present Rate

Future Rate

Variable Rate Condition

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3.10. Advancement and Return to Zero.

Code Reference: 3.40: S.2.1., S.2.2., UR.3.2., UR.3.5., 5.55: S.1.1.4.

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.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3.13. Recorded Representations.

5.3.13.1. General.

Code Reference: 1.10: G-S.5.6., 3.40: S.2.6., 5.55: S.1.4.1.

5.3.13. Recorded Representations. 3.40: S.2.6.

5.55: S.1.4.1. – refers to 3.40. (S.2.6.(e))

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
d. the maximum rate of energy transfer (i.e., maximum power) and type of current
e. any additional separate charges included in the transaction (e.g., charges for parking time) including:
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.

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

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.3.14. Automatic Timeout, Pay-At-EVSE.

Code Reference: 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.

EPO 30-Retail Electric Vehicle Fueling Systems

5.3. Indicating and Recording Elements.

What is the maximum value of the unit of indicated delivery for an AC EVSE?

a. 0.00001 kWh

b. 0.0001 kWh

c. 0.001 kWh

d. 0.01 kWh

EPO 30-Retail Electric Vehicle Fueling Systems

5.3. Indicating and Recording Elements.

What is the maximum time interval value for EVSE that access time-related fees?

a. 1 second

b. 1 minute

c. 5 minutes

d. 30 minutes

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.4. Provision for Sealing.

Code Reference: 1.10: G-S.8. (1/1/90), 3.40: S.3.3., Table S.3.3., 5.55: S.4.

Sealing information included in NTEP & CTEP CC's

Sealing: The Siemens VC3-K03-02-1 has a meter that uses a category 1 physical seal, preventing the separation of the housing and access to the internal components.

EPO 30-Retail Electric Vehicle Fueling Systems

5.4. Provision for Sealing. (con't)

Table S.3.3. Categories of Device and Methods of Sealing	
Categories of Device	**Method of Sealing**
Category 1: No remote configuration capability.	physical seal or two event counters: one for calibration parameters and one for configuration parameters.
Category 2: Remote configuration capability but access is controlled by physical hardware.	hardware sealed using a physical seal or an event counter for calibration parameters and an event counter for configuration parameters.
Category 3: Remote configuration capability access may be unlimited or controlled through a software switch (e.g., password).	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.

EPO 30-Retail Electric Vehicle Fueling Systems

5.4. Provision for Sealing.

5.4.1. Physical Means of Security.

5.4.1.1. Accessibility of the Adjusting Mechanism

Code Reference: 3.40: S.3.3., 5.55: S.4.

When applicable, the adjusting mechanism shall be readily accessible for purposes of affixing a security seal.

EPO 30-Retail Electric Vehicle Fueling Systems

5.4.2. Audit Trails.

5.4.2.2. Audit Trail Information.

If the system is equipped with event counters, note parameters (calibration/configuration) 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.

EPO 30-Retail Electric Vehicle Fueling Systems

5.4.2. Audit Trails.

5.4.2.3. Event Logger. (con't)

- shall include:
  - event counter (000 to 999),
  - the parameter ID,
  - the date and time of the change, and
  - the new value of the parameter, and
  - 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.

EPO 30-Retail Electric Vehicle Fueling Systems

5.4.4. Multiple Elements - Common Seal.

Code Reference: 1.10: G-S.8.1. (1/1/10)

For multiple measuring elements with a single provision for sealing, a change to the adjustment of any measuring element must be individually identified.

5.4.5. Metrologically Significant Software Updates.

Code Reference: 1.10: G-S.9.

A metrologically-significant software change is a sealable event.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.6. Measuring Elements.

5.6.1. Security Seals.

Presence of Security Seals.

Code Reference: 1.10: G-UR.4.5., 3.40: S.3.1., S.3.3., 5.55: S.4.

Check for the presence of security seals on the device. Document missing seals on the official report and apply new ones as needed.

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.5. Marking.

5.5.1. General Markings:

Code Reference: 1.10: G-S.1.

5.5.1.1. Identification – General.

Code Reference: G-S.1.

EPO 30-Retail Electric Vehicle Fueling Systems

General-Code Reference: G-S.1.

- Name or ID of manufacturer
- Model designation
- Nonrepetitive serial number
- Software version or revision identifier: software-based devices and not-built-for-purpose software-based devices.
- NTEP CC Number

EPO 30-Retail Electric Vehicle Fueling Systems

General-Code Reference: G-S.1.

- Name or ID of manufacturer
- Model designation

Prefaced by “Model”, Type”, or “Pattern” NR 1/1/03

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.5.1.4. Device-Specific EVSE Additional Identification and Marking Information

Code Reference: 3.40: S.5.2.

- Voltage rating.

  Also required by MOS 2.33.3.(e)

  Code Reference: 3.40: S.5.2.(a)
- Maximum current deliverable (MCD).

  Code Reference: 3.40: S.5.2.(b)

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.5.1.4. Device-Specific EVSE Additional Identification and Marking Information.

- Type(s) of current (AC/DC). ← Also required by MOS 2.33.3.(c) & (e)

  Code Reference: 3.40: S.5.2.(c)
- Minimum measured quantity (MMQ).

  Code Reference: 3.40: S.5.2.(d)
- Temperature limits, if narrower than – 40 °F to 185 °F.

  Code Reference: 3.40: S.5.2.(e)

EPO 30-Retail Electric Vehicle Fueling Systems

5.5.1.4. Device-Specif itional Identification and Marking Informa

Accuracy Class C systems p into service prior to 2025: Cod 3:40: S.5

The informa nust le to a n accessing a device or sy charging f pro l via the indicating ele the infor be visible prior to the start of th action.

*A DC EVSE placed in s subject to the tolerances of T.2.2.(a) is a Class 5 EVSE s Class 5 (exempt until 1/1/28).

EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

5.5.2. Location of Marking Information, Not-Built-For Purpose, Software-Based Devices.

Code Reference: 1.10: G-S.1.1. (1/1/04)

5.5.3. Visibility of required markings after installation.

Code Reference: 1.10: G-UR.2.1.1.

5.5.4. Location of Marking Information, Retail EVSE.

Code Reference: 3.40: S.5.1.

EPO 30-Retail Electric Vehicle Fueling Systems

5.5.4. Location of Marking Information, Retail EVSE.

Code Reference: 3.40: S.5.1.

Marking information required in G-S.1. Identification shall appear as follows:

(a) within 60 cm (24 in) to 150 cm (60 in) from ground level; and

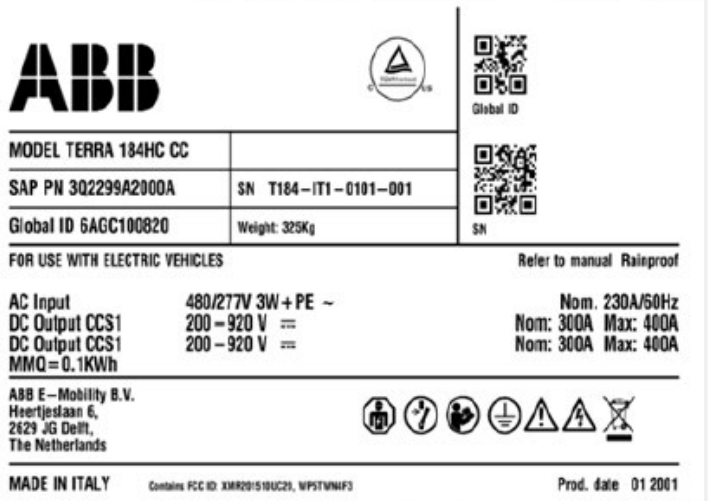
(b) on a portion of the EVSE that cannot be readily removed or interchanged (e.g., not on a service access panel).

5.5.4. Location of Marking Information, Retail EVSE.

Identification: The required EVFS identification label is located on the right side of the charger towards the back (*Figure 1*).

NTEP CC's are a good source to help locate the required markings on a device.

This is from CC 23-045



5.5.4. Location of Marking Information, Retail EVSE.

Identification: The required EVFS identification label is located on the right side of the charger towards the back (*Figure 1*).

5.5.4. Location of Marking Information, Retail EVSE.

ABB

Global ID

MODEL TERRA 184HC CC	
SAP PN 3Q2299A2000A	SN T184–IT1–0101–001
Global ID 6AGC100820	Weight: 325Kg

SN

FOR USE WITH ELECTRIC VEHICLES — Refer to manual Raineproof

AC Input	480/277V 3W+PE ~	Nom. 230A/60Hz
DC Output CCS1	200–920 V ⎓	Nom: 300A Max: 400A
DC Output CCS1	200–920 V ⎓	Nom: 300A Max: 400A
MMQ=0.1KWh		

ABB E–Mobility B.V.
Heertjeslaan 6,
2629 JG Delft,
The Netherlands

MADE IN ITALY Contains FCC ID: XMR201510UC2S, WPSTWN4F3 Prod. date 01 2001

EPO 30-Retail Electric Vehicle Fueling Systems

What information is required to be labeled/marked by both MOS 2.33.3. in NIST Handbook 130 and S.5.2. in Section 3.40. of NIST SHandbook 44?

a. Nominal Power/MMQ
b. Voltage/Type of current (AC/DC)
c. Amperage/Maximum Current Deliverable (MCD)
d. Maximum Deliverable Amperage (MDA)/Minimum Measured Quantity (MMQ)

EPO 30-Retail Electric Vehicle Fueling Systems

5.5.5. Responsibility, Money-Operated Devices, Unattended EVSE.

Code Reference: 1.10: G-UR.3.4., 3.40: UR.2.5

5.5.6. Limitation on Use.

Code Reference: 3.40: S.5.2., UR.2.1., UR.2.3.

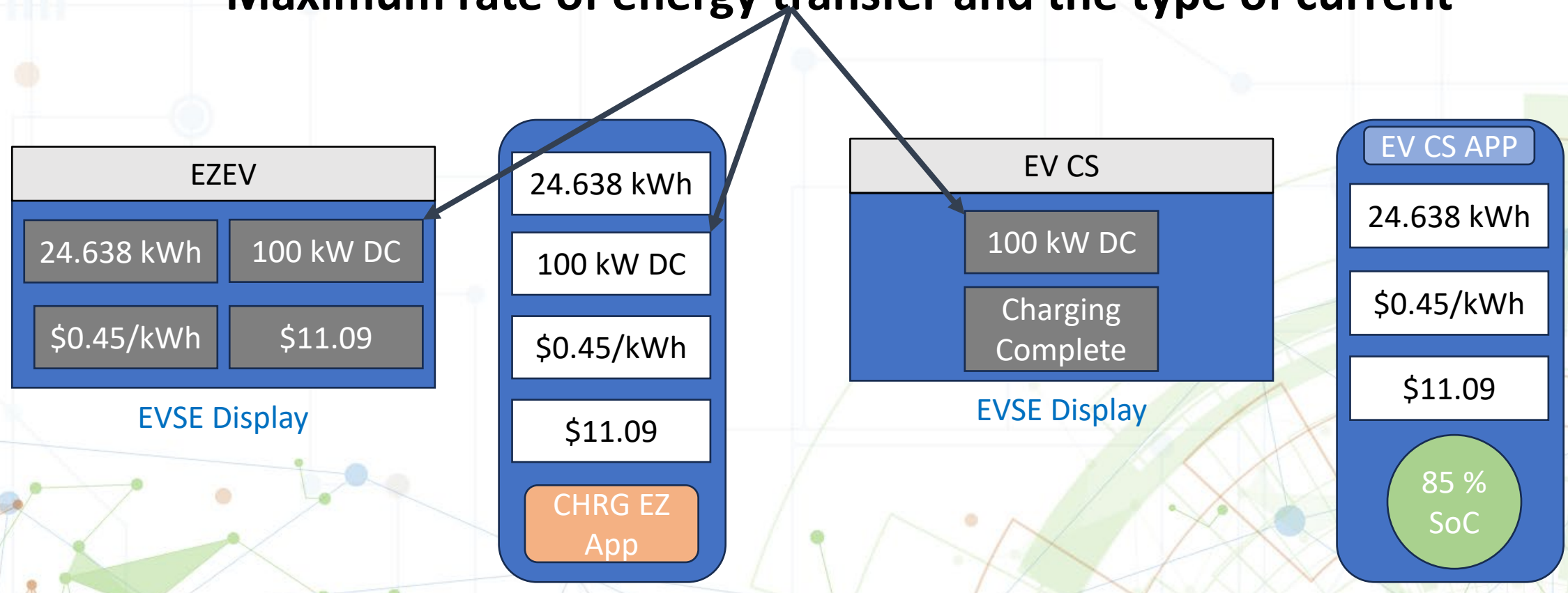
5.5.7. Equipment Capacity.

Code Reference: 3.40: S.2.4.2. - Requires display of "maximum power" and current type with unit price

EPO 30-Retail Electric Vehicle Fueling Systems

S.2.4.2.

Maximum rate of energy transfer and the type of current



EPO 30-Retail Electric Vehicle Fueling Systems

5. Inspection

- 5.7. Connection Cord.

  Length and Protection.

  Code Reference: 3.40: UR.1.2.

- 5.8. Facilitation of Fraud.

  Facilitation of Fraud, General.

  Code Reference: 1.10: G-S.2.

- 5.9. Totalizers for EVSE Systems.

  Code Reference: 3.40: S.7.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.1. Test Methods.

-Test methods approved by the Director (NIST HB 44, Appendix A, Section 3. Testing Apparatus) can be utilized. The procedures in EPO 30 may need to be modified.

6.2. Overview of the EVSE and EV Communications that Facilitate a Charging Session.

-Provides a general description of EV to EVSE communications

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.3. Pretest Determination Notes

Before testing the EVSE, verify the following.

1) The system is safe, legal, and, with respect to the installation, suitable for commercial use.
2) The jurisdiction permits the sale of electrical energy as a vehicle fuel.

EPO 30-Retail Electric Vehicle Fueling Systems

6.3. Pretest Determination Notes (con't)

3) If charges are also assessed for time related services, verify these additional fees are:

i. associated with an electric vehicle (EV) charging session;

ii. calculated based on a recognized unit of time; and

iii. separate from fees assessed for the sale of electricity that is based on a recognized unit of electrical energy.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.3. Pretest Determination Notes (con't)

4) If specific rate rules apply, they are:

- properly interpreted,
- itemized in printed and/or electronically recorded representations and/or posted,
- accurately calculated, and
- where applicable, coordinated with other agencies that overlap as parking authorities.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.4. Tolerances.

6.4.1. Acceptance/Maintenance Tolerances.

Code Reference: 1.10: G-T.1., G-T.2.

6.4.2. Application.

Code Reference: 1.10: G-T.3., 3.40: T.1., T.4.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.4. Tolerances.

6.4.3. Basic Values.

Code Reference: 3.40: T.2., T.2.1., T.2.2., 5.55: T.1.3., Table T.1.3.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.4. Tolerances (AC Systems). 3.40: T.2.1.

(a) Acceptance Tolerance: 1.0 %; and

(b) Maintenance Tolerance: 2.0 %

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determi

6.4. Tolerance

40: T.2.2.

(a) Acceptan intenanc rance of 5%

All DC EVSEs placed vice nuary 1, 202 empt from T.2.2. EVSE Accuracy Test Toler r DC Sy l January 1 For those Class 5 DC Systems, the tolera T.2.2.(a) e ry 1, 20 the tolerances of T.2.2.(b) will apply.

(b) DC EVSE bject to

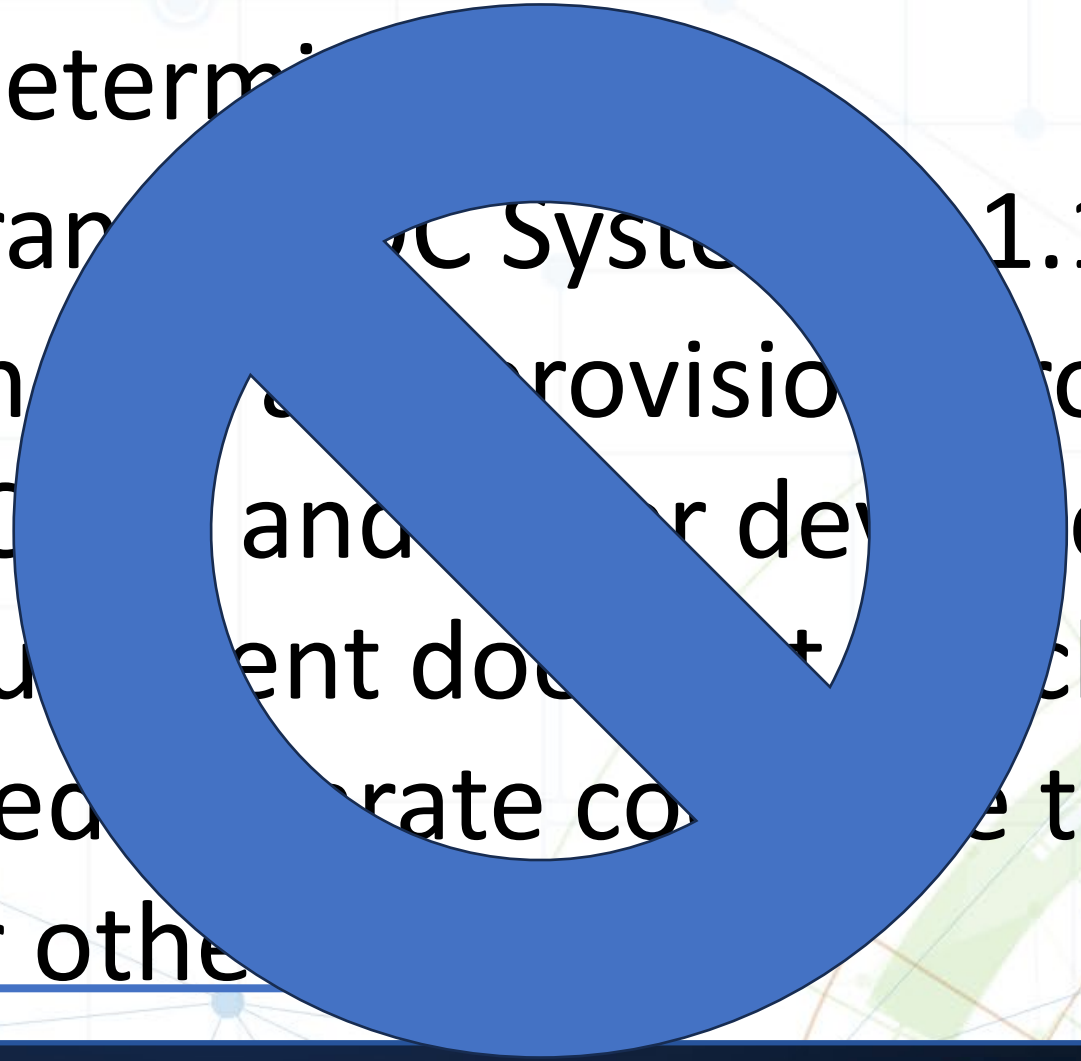
(1) Accepta , and

(2) Maintenanc 2.0 %.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determi

6.4. Toleran C Syste 1.10: G-A.3. Requirem rovisio om the General C and r de codes apply when equ ent doc clearly in an established rate co e to special design or othe



EPO 30-Retail Electric Vehicle Fueling Systems

Special and Unclassi ment

APPLYING NIST HANDBOO OR APPLICATIONS

By Tina G. But ST OWM

When an ins or that a de does not fall under or is dequa overe a specific code, paragraph G allows t to draw upon other device to find re nts that best fit the device and

https://www.nist.gov/document/special

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.4.4. Repeatability.

Code Reference: 1.10: G-S.5.4., 3.40: N.4., T.3.

- Minimum of three consecutive tests
- Same load, test duration, etc.
- Conducted under reasonably static conditions

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.2.5. Digital Indications and Representations, Timing Devices.

Code Reference: 5.55: T.2.

To the tolerances that would otherwise be applied add an amount one-half the minimum value that can be indicated or recorded.

EPO 30-Retail Electric Vehicle Fueling Systems

6.4.5. Digital Indications and Representations, Timing Devices, Code Reference: 5.55: T.1.3., T.2.

Example: In addition to fees assessed for electrical energy, an EVSE assesses a fee for parking. The EVSE has a digital indication of the time elapsed and a time interval of 1 minute.

What is the tolerance on an elapsed time of 25 minutes for:

a. Overregistration
b. Underregistration

EPO 30-Retail Electric Vehicle Fueling Systems

6.4.5. Digital Indications and Representations, Timing Devices, Code

Reference: 5.55: T.1.3., T.2.

Table T.1.3. Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges for Parking		
Maintenance and Acceptance Tolerances		
Nominal Time Capacity	**On Overregistration**	**On Underregistration**
30 minutes or less	No tolerance	10 seconds per minute, but not less than 2 minutes
Over 30 minutes to and including 1 hour	No tolerance	5 minutes plus 4 seconds per minute over 30 minutes
Over 1 hour	No tolerance	7 minutes plus 2 minutes per hour over 1 hour

T.2. Tests Involving Digital Indications or Representations. – To the tolerances that would otherwise be applied, there shall be added an amount equal to one-half the minimum value that can be indicated or recorded.

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval for Overregistration:

0 + 1/2(1 m) =

T.2.: one half the minimum value indicated or recorded

Table T.1.3.
Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges for Parking

Maintenance and Acceptance Tolerances		
Nominal Time Capacity	**On Overregistration**	**On Underregistration**
30 minutes or less	No tolerance	10 seconds per minute, but not less than 2 minutes

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval for Overregistration:

$$0 + 1/2(1\ m) =$$

$$0 + 0.5\ m =$$

$$0.5\ m \times 60\ s/m =$$

$$30\ s$$

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval for overregistration:

$$0 + 1/2(1\ m) = 0 + 0.5\ m = 0.5\ m \times 60\ s/m = 30\ s$$

EVSE Time Registration: 25 minutes	
Test Standard Timepiece Value MM:SS (1 s intervals)	
Maximum Error: 30 s	Minimum Error: 0 s
24:30	25:00

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval for underregistration:

10* s/m x 25 m =

*no less than 2 minutes

Table T.1.3. Maintenance and Acceptance Tolerances for Parking Meters and Other Timing Devices Used to Assess Charges for Parking		
Maintenance and Acceptance Tolerances		
Nominal Time Capacity	**On Overregistration**	**On Underregistration**
30 minutes or less	No tolerance	10 seconds per minute, but not less than 2 minutes

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval for underregistration:

10 s/m x 25 m =

250 s

250 s ÷ 60 s/m =

4 m 10 s

4 m 10 s + 30 s = 4 m 40 s

T.2.: one half the minimum value indicated or recorded

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval for underregistration:

4 m 40 s

EVSE Time Registration: 25 minutes	
Test Standard Timepiece Value MM:SS (1 s intervals)	
Maximum Error: 4 m 40 s	Minimum Error: 0 s
29:40	25:00

EPO 30-Retail Electric Vehicle Fueling Systems

What is the tolerance on an elapsed time of 25 minutes with a 1-minute interval:

- 30 s to + 4 m 40 s

EVSE Time Registration: 25 minutes	
Test Standard Timepiece Value MM:SS (1 s intervals)	
Max Over Error: 30 s	Max Under Error: 4 m 40 s
24:30	29:40

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

How much time must elapse on an EVSE with digital indications that accesses fees for parking services, before the tolerance applied exceeds the minimum tolerance for underregistration (T.1.3.) of 2 minutes?

a. 10 minutes
b. 11 minutes
c. 12 minutes
d. 13 minutes

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

How much time must elapse on an EVSE with digital indications that accesses fees for parking services, before the tolerance applied exceeds the minimum tolerance for underregistration (T.1.3) of 2 minutes?

a. 10 minutes
b. 11 minutes
c. 12 minutes
d. 13 minutes

Time Elapsed (Minutes)	Tol Underregistration 10 sec/min (T.1.3)	Tol Digital Indications 30 sec (T.2)	Total Tol
1	10 sec*	30 sec	2 min 30 sec
2	20 sec*	30 sec	2 min 30 sec
3	30 sec*	30 sec	2 min 30 sec
4	40 sec*	30 sec	2 min 30 sec
5	50 sec*	30 sec	2 min 30 sec
6	60 sec*	30 sec	2 min 30 sec
7	1 min 10 sec*	30 sec	2 min 30 sec
8	1 min 20 sec*	30 sec	2 min 30 sec
9	1 min 30 sec*	30 sec	2 min 30 sec
10	1 min 40 sec*	30 sec	2 min 30 sec
11	1 min 50 sec*	30 sec	2 min 30 sec
12	2 min	30 sec	2 min 30 sec
13	2 min 10 sec	30 sec	2 min 40 sec
14	2 min 20 sec	30 sec	2 min 50 sec
minimum of 2 minutes			

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

What is the acceptance tolerance value applied to an AC EVSE?

a. 0.5 %
b. 1 %
c. 2 %
d. 5 %

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

What tolerance value is applied to a DC EVSE placed in service prior to 1/1/25 and marked Class 5?

a. 0.5 %

b. 1 %

c. 2 %

d. 5 %

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.5. Statement of Rates.

Code Reference: 5.55: UR.1., UR.1.(a)

Where time fees are assessed in association with the electrical energy charging session the pricing for time rates are clearly, prominently, and conspicuously displayed.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.6. Test Load.

Code Reference: 1.10: G-A.3., 3.40: N.2., N.3.1., N.3.3.

Identify the test site conditions under which testing will be conducted on an EVSE.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.6. Test Load. (con't)

When conducting any tests on an EVSE, verify that the test standard(s) is appropriate for the EVSE under test based on the EVSE's power capacity, voltage, type of current, amperage, and system's power transfer method, and whether the system includes an integral timing device. Determine that the prescribed load can be met if an electric vehicle is used as the test load for a DC system.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7 Test Draft Size.

The marked MMQ determines the minimum test draft. As a minimum, a “light load test,” “midrange load test,” and a “full load test” shall be conducted on an AC EVSE. As a minimum, a “light load test,” and a second test at a point above the “light load” up to but not exceeding a “full load” shall be conducted on a DC EVSE.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7. Test Draft Size

Code Reference: 1.10: G-A.3., 3.40: N.1., N.3.1., N.3.3.

Test drafts shall be equal to at least the minimum measured quantity (MMQ).

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7. Test Draft Size

Code Reference: 1.10: G-A.3., 3.40: N.1., N.3.1., N.3.3.

The MMQ for an AC system shall be ≤ 0.5 kWh.

The MMQ for an DC system shall be ≤ 1.0 kWh.

The MMQ must be marked on the device and is included on the NTEP CC.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7 Test Draft Size.(con't)

N.3.1. Testing of an AC EVSE. – Accuracy tests shall be performed at the following current levels:

(a) A point between 4 A and 10 A;

(b) A point between 40 % and 60 % of the MDA; and

(c) A point between 70 % and 100 % of the MDA.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7 Test Draft Size.(con't)

N.3.3. Performance Verification in the Field of a DC EVSE. – Accuracy tests shall be performed at any voltage and the following current levels:

(a) A point between 10 % and 20 % of the MDA, but not less than 30 A; and

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7 Test Draft Size.(con't)

N.3.3. Performance Verification in the Field of a DC EVSE. – Accuracy tests shall be performed at any voltage and the following current levels:

(b) A point between 25 % and 100 % of the MDA (test at the maximum power level possible using the test load and test standard available)

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.7 Test Draft Size. (con't)

N.3.3. Performance Verification in the Field of a DC EVSE.

Note: The test points (a) and (b) above must not be at the same current level; the current levels should be separated to the extent that the test load and test standard will allow.

For DC systems, if an electric vehicle is used as the test load, the load presented by the vehicle shall be sufficient for field verification if it is greater than 40 % of the MDA and no less than 30 A.

EPO 30-Retail Electric Vehicle Fueling Systems

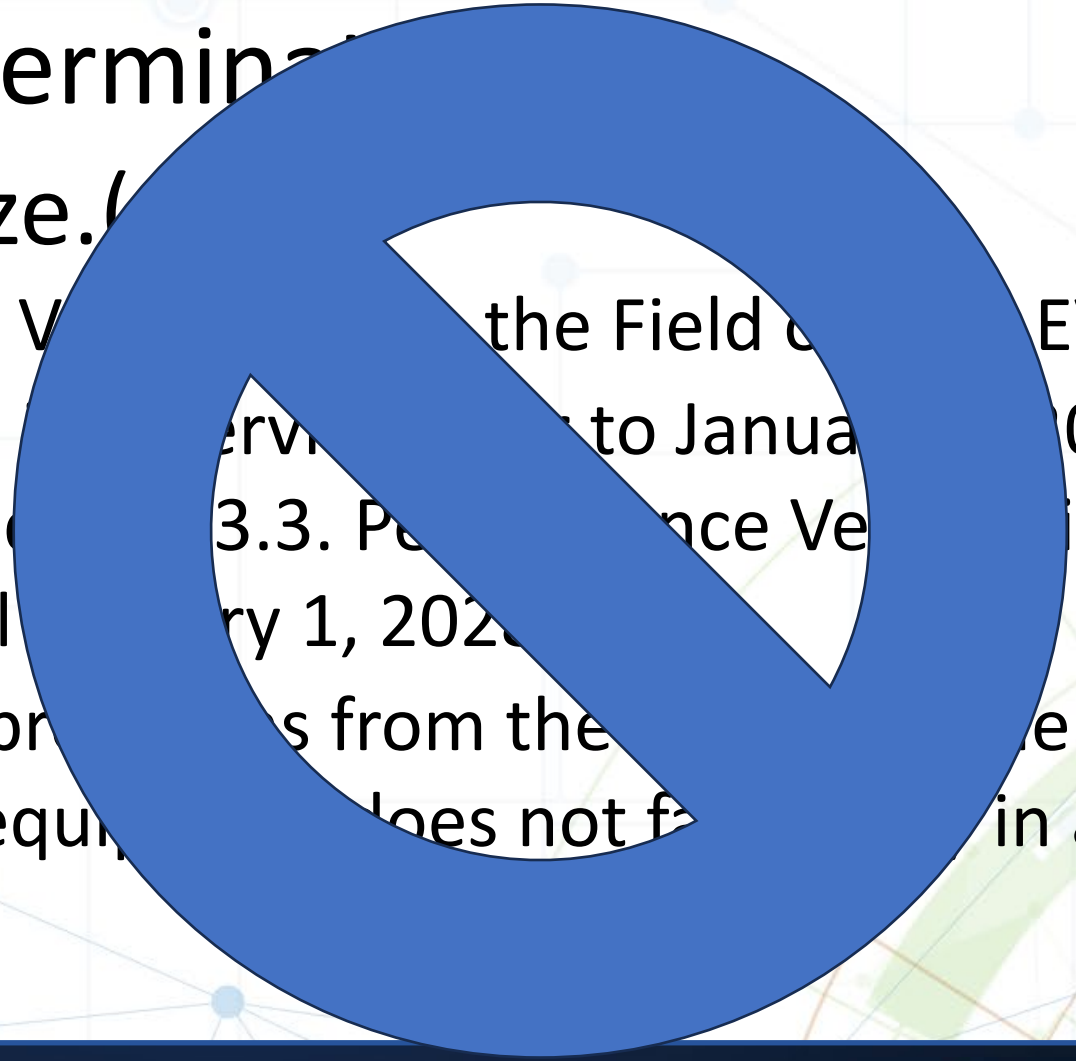
6. Pretest Determina

6.7 Test Draft Size.(

N.3.3. Performance V the Field EVSE.

All DC EVSEs placed erv to Janua 025 are exempt from the tests as specifie 3.3. P nce Ve ion in the Field of a DC EVSE (3.40) until ry 1, 202

Requirements and pr s from the e and other device codes apply when equi oes not f in an established separate code.



EPO 30-Retail Electric Vehicle Fueling Systems

Which of the following current levels would be acceptable when conducting a full load test on an AC EVSE?

a. 10 % of the MDA

b. 35 % of the MDA

c. 60 % of the MDA

d. 85 % of the MDA

EPO 30-Retail Electric Vehicle Fueling Systems

Which of the following current levels would be acceptable when conducting a full load test on a DC EVSE (circle all that apply)?

a. 10 % of the MDA

b. 35 % of the MDA

c. 60 % of the MDA

d. 85 % of the MDA

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.8. Duration of the Test.

Determine the duration of the test time for a test load 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.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.8. Duration of the Test.

6.8.1. Electrical Energy Equation for Use to Establish the Duration of the EVSE Test.

The time will vary to complete the delivery of the required minimum test draft and the steps necessary to verify and document the indicated and recorded transaction information over the specified operating range of an EVSE.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations

6.8. Duration of the Test.

6.8.1. Electrical Energy Equation for Use to Establish the Duration of the EVSE Test.

To calculate the approximate time for the delivery of the required minimum quantity of electrical energy for each level of charging specified for the test of an EVSE for compliance with the Notes paragraphs in Section 3.40. of NIST HB 44, the Power Formula, $P = V \times I$, is used.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

To calculate the test duration, use the following steps:

1. Determine the MDA* and the percentage of the test load at which the test will be conducted

(*Based on communication between the EVSE and the test standard and associated equipment)

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration
    2. Verify the MDA does not exceed the Maximum Current Deliverable (MCD)
    3. Determine the test load by multiplying the MDA determined in step 1 by the test load percentage

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

4. Using the formula for Power ($P = V \times I$) determine the power in Watts (W) to be supplied to the test equipment where:

P is power expressed in Watts (W);

V is voltage expressed in Volts (V); and

I is current expressed in Amps (A)

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration
    5. Convert Power from Watts (*W*) to kilowatts (*kW*)
    6. Divide the minimum measured quantity (MMQ) by the power, now in *kW* to determine the test duration in hours (*h*)

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration
    7. Convert hours (*h)* to minutes (*m)* by multiplying by 60.
    8. Convert minutes (m) to seconds (s) by multiplying by 60.

EPO 30-Retail Electric Vehicle Fueling Systems

6.Pretest Determinations-Test Duration Example

An EVSE has a:

Voltage Rating = 208 VAC

Maximum Current Deliverable (MCD) = 30 A

Maximum Deliverable Amperes (MDA) = 30 A

Minimum Measured Quantity (MMQ) = 0.2 kWh

Test Load = 75% of the MDA (“Full Load”)

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

To calculate the test duration use the following steps:

1. MDA = 30 A*

   At a test load = 75%*

   MCD = MDA = 30 A

*Based on communication between the EVSE and the test standard and associated equipment

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

3. Test Load (I) = 30 A x 75 %

   Test Load (I) = 30 A x 0.75 (75 ÷ 100)

   Test Load (I) = 22.5 A

4. P = V x I

   P = 208 V x 22.5 A

   P = 4,680 W

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

5. Convert Power (P) to kW (1 kW = 1,000 W)

   P = 4,680 W ÷ 1000 = 4.68 kW

6. Test Duration (h) = MMQ ÷ P (kW)

   Test Duration (h) = 0.2 kWh ÷ 4.68 kW

   Test Duration (h) = 0.042735 h

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration
   7. Convert Test Duration from hours (h) to minutes (m) to seconds (s)

      Test Duration = 0.042735 h x 60 m/h

      Test Duration = 2.5641 m (0.5641 m x 60 s/m)

      Test Duration ≈ 2 m 34 s

EPO 30-Retail Electric Vehicle Fueling Systems

6.Pretest Determinations-Test Duration Example

An EVSE has a:

Voltage Rating = 1000 VDC

Maximum Current Deliverable (MCD) = 350 A

Maximum Deliverable Amperes (MDA) = 300 A

Minimum Measured Quantity (MMQ) = 0.5 kWh

Test Load = 50% of the MDA

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

To calculate the test duration use the following steps:

1. MDA = 300 A*

   At a test load = 50%*

2. MCD = 350 A > MDA = 300 A

*Based on communication between the EFVS and the test standard and associated equipment

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

3. Test Load (I) = 300 A x 50 %

   Test Load (I) = 300 A x 0.5

   Test Load (I) = 150 A

4. P = V x I

   P = 1000 V x 150 A

   P = 150,000 W

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration

5. Convert Power (P) to kW (1 kW = 1,000 W)

   P = 150,000 W x (1 kW ÷ 1000 W)

   P = 150,000 W ÷ 1000 W = 150 kW

6. Test Duration (h) = MMQ ÷ P (kW)

   Test Duration (h) = 0.5 kWh ÷ 150 kW

   Test Duration (h) = 0.0033333 h

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration
    7. Convert Test Duration from hours (h) to minutes (m)

        Test Duration = 0.003333 h x 60 m/h

        Test Duration = 0.2 m x 60 s/m

        Test Duration = 12 s

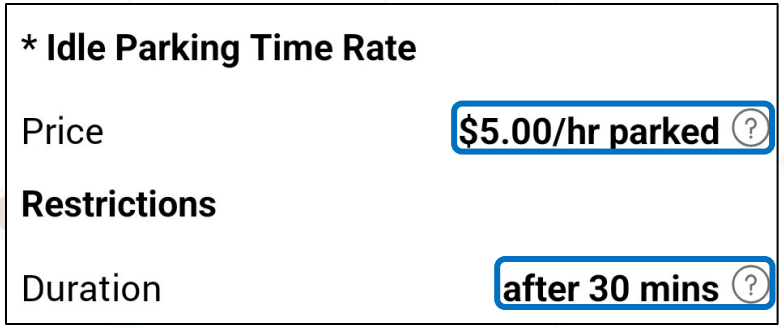
EPO 30-Retail Electric Vehicle Fueling Systems

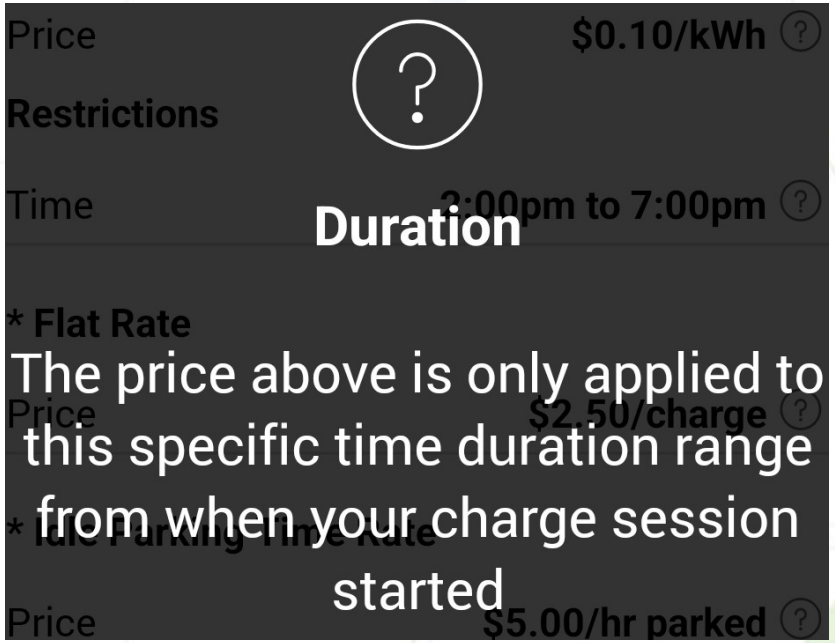
6. Pretest Determinations-Test Duration, Timing Device

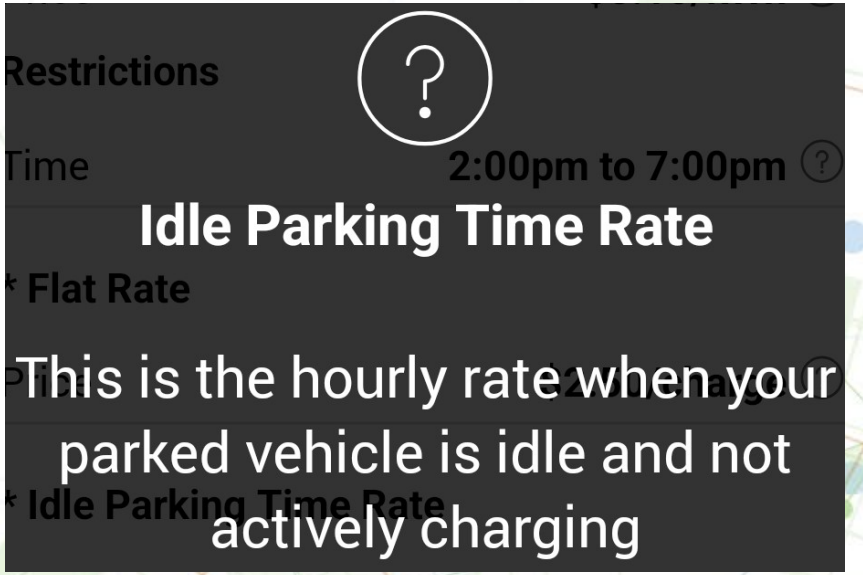
The test duration to determine the accuracy of charges for time-based services should be representative of a transaction where fees are assessed for electrical energy and time-related services.

EPO 30-Retail Electric Vehicle Fueling Systems

6. Pretest Determinations-Test Duration, Timing Device







EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.1. Totalizers.

Code Reference: 3.40: S.7.

To determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.2. Steps in the Test of an EVSE.

7.2.1. EVSE and Test Standard Connection Process.

a. Configure the test standard based on the EVSE's parameters:

i. type of current (AC/DC),

ii. voltage, and

iii. power transfer method (cable/wireless)

EPO 30-Retail Electric Vehicle Fueling Systems

7.2. Steps in the Test of an EVSE.

7.2.1. EVSE and Test Standard Connection Process.

b. After connecting to the EVSE coupler, test procedures will be initiated using the test standard's user interface. 3.40: N.2.

c. Utilize the authorization/activation method that has been identified to initiate the EV charging transaction session.

EPO 30-Retail Electric Vehicle Fueling Systems

7.2.1. EVSE and Test Standard Connection Process.

d. Determine the MDA from the digital communication message communicated from the EVSE to the test standard. 3.40: N.3.1., N.3.3.

e. Automatic Timeout - Pay-At-EVSE

If the time limit for deauthorizing the device is programmable, it shall not accept an entry greater than 2 minutes.

Code Reference: *3.40: S.2.8. (1/1/20)*

EPO 30-Retail Electric Vehicle Fueling Systems

7.2.1. EVSE and Test Standard Connection Process.

f. Verify that the EVSE is displaying the correct quantity and total price for at least 15 seconds:
   i. When the EVSE is activated and,
   ii. At the start of the transaction
   3.40: S.1.2.

g. Determine proper operation of totalizers, read and record the totalizer indications before and after all test drafts. 3.40: S.7.

EPO 30-Retail Electric Vehicle Fueling Systems

7.2.2. After Each Test

a. Review recorded representations (printed or electronic*) for:

   i. appropriate abbreviations, e.g., kWh

   ii. itemized timing charges (when applicable)

   iii. properly calculated money-values (to the nearest 1-cent) and agreement for all indicated or recorded values

   iv. All required information is included

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.

*The customer may be given the option to choose the form of the receipt.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.2.2. After Each Test

Review recorded representations (printed or electronic*) for:

v. For EVSE that assess fees for time services separate from fees for the sale of electrical energy (by the kWh), duplicate receipts are permissible

The word “duplicate” or “copy” is included on the receipt. 5.55: S.1.4.1.

*The customer may be given the option to choose the form of the receipt.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.2.2. After Each Test

b. Verify, after a delivery is completed, that the quantity and total price are displayed for at least 15 seconds.

Code Reference: 3.40: S.1.2.

c. Record the totalizer value

Code Reference: 3.40: S.7.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.4. Confirm Results.

Code Reference: 1.10: G-S.5.4., 3.40: N.3., N.4., T.3.

Repeat tests when results are at, near, or exceeding the applicable tolerance limit.

If necessary, conduct a “Repeatability Test” as described under the “Test” section of this EPO.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.5. Display of Quantity and Total Price After Delivery.

Code Reference: 3.40: S.1.2., S.1.2.1.

Electrical energy sold shall be clearly identified and separate from other time-based fees indicated by the EVSE.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.5. Display of Quantity and Total Price After Delivery.

Code Reference: 3.40: S.1.2., S.1.2.1.

A system with a single indicating element for two or more EVSEs shall provide a means to indicate clearly which EVSE is associated with the displayed information.

EPO 30-Retail Electric Vehicle Fueling Systems

7. Test Notes

7.6. Use of Adjustments.

Code Reference: 1.10: G-UR.4.1., G-UR.4.2., G-UR.4.3.

Equipment is properly maintained, errors are not predominantly in favor of the device owner or operator, and adjustments are made to bring performance errors as close to zero value as possible.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

Code Reference: 1.10: G-UR.3., 3.40: S.5.2., UR.2.

For this and subsequent tests, verify that conditions of use do not exceed marked or manufacturer-specified limitations.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

Code Reference: 1.10: G-UR.3., 3.40: S.5.2., UR.2. Communication between the EVSE and the test standard equipment determines the MDA available from the EVSE at the time of the test.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.1. At the beginning of the first delivery, start with an initial zero condition.
Code Reference: 3.40: S.2.1., S.2.7*., UR.3.2.

*DC EVSE exempt until /1, 202 if placed in service prior to /1, 202

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.2. If the result of the first test is at or near the tolerance limit, repeat this test.
Code Reference: 1.10: G-S.5.4., 3.40: N.2., N.4., T.3.

If necessary, conduct a Repeatability Test.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.3. General, Test Notes, and Load Test Tolerances.

Code Reference: 1.10: G-A.3., 3.40: N.1., N.3.*, T.1., T.2. T.2.1. T.2.2.*

*DC EVSE exempt until [redacted] if placed in service prior to [redacted]

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(1) Connect the EVSE to the test standard.

(2) Verify the EVSE and test standard are communicating properly.

(3) Determine the MDA from the EVSE.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(4) For AC EVSEs set the test load to a value at a current level between 4 A and 10 A.

For DC EVSEs set the test load to a current level between 10 % and 20 % of the MDA, but not less than 30 A.*

*DC EVSE exempt until 1/ /20 8 if placed in service prior to 1/ /20 5

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(5) Start energy measurement on the test standard.

(6) Start a charging transaction on the EVSE.

(7) The EVSE will cycle through various charging levels to achieve an active charging status.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(8) Continue the measurement for an accumulated energy of not less than the MMQ.

(9) The EVSE will cycle through various charging levels to return to an inactive charging status.

(10) Verify that the transaction on the EVSE has completed.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(11) Record the energy delivered as displayed on the EVSE.

(12) Record the price per kWh.

(13) Record the total price of the transaction.

(14) Record the energy delivered as displayed on the test standard.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(15) Verify the resulting energy indications and recorded representations are within applicable tolerances and meet requirements for agreement of indications.

Code Reference: 1.10: G-S.5.2.2., 3.40: S.2.4.4.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(16) Calculate the energy measurement error as follows:

$$\% \text{ Energy Error} = \left(\frac{\text{EVSE Indicated Energy} - \text{Test Standard Indicated Energy}}{\text{Test Standard Indicated Energy}} \right) \text{x } 100$$

EPO 30-Retail Electric Vehicle Fueling Systems

For example, if an EVSE indicates 0.5141 kWh and the test standard registers 0.5037 kWh, the error is calculated as shown here:

$$\% \text{ Energy Error} = \left(\frac{0.5141 \text{ kWh} - 0.5037 \text{ kWh}}{0.5037 \text{ kWh}}\right) \text{x } 100$$

$$\% \text{ Energy Error} = \left(\frac{0.0104 \text{ kWh}}{0.5037 \text{ kWh}}\right) \text{x } 100$$

$$\% \text{ Energy Error} = (.0206472) \text{ x } 100$$

$$\% \text{ Energy Error} = +2.06$$

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1. Accuracy Test.

8.1.4. Light Load Test.

(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:

$$Indicated\ Energy \times Energy\ Unit\ Price = Total\ Energy\ Price^{*}$$

*rounded to the nearest $0.01

EPO 30-Retail Electric Vehicle Fueling Systems

For example, if the EVSE indicated 0.5141 kWh of energy and the unit price of the energy was $0.39/kWh the total price is calculated as follows:

$$0.5141\ kWh \times \$0.39/kWh = Total\ Energy\ Price$$

$$\$0.9041 = Total\ Energy\ Price$$

$$\$0.90 = Total\ Energy\ Price$$

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.1.5. Midrange Load Test (**Only required on AC Systems**)
Repeat the steps specified for the Light Load Test, with the exception of step 4.

(4) For AC EVSEs, set the test load to a value at a current level between 40 % and 60 % of the MDA.

For DC EVSEs set the test load to a current level between 25 % and 100 % of the MDA.

EPO 30-Retail Electric Vehicle Fueling Systems

8.1.6. Full Load Test

Repeat the steps specified for the Light and Midrange Load Tests, with the exception of step 4.

(4) For AC EVSEs, set the test load to a value at a current level between 70 % and 100 % of the MDA.

For DC EVSEs set the test load to a current level between 25 % and 100 %* of the MDA.**

*If a Midrange Load Test (MLT) was conducted, set the value of the current level to a value greater than that verified during the MLT.

**DC EVSE exempt until 1/1/2028 if placed in service prior to 1/1/2025

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.2. Time Test/8.3. Interference Test.

Code Reference: 5.55: N.1., N.2., N.3., T.1.3., Table T.1.3.

If the EVSE assesses charges for time-based services in addition to those charged for electrical energy, conduct a time/interference test representative of a typical transaction where the EVSE is metering time.

EPO 30-Retail Electric Vehicle Fueling Systems

8.2. Time Test/8.3. Interference Test. (con't)

Code Reference: 5.55: N.1., N.2., N.3., T.1.3., Table T.1.3.

- Establish the time interval for the test based on the rate structure applied by the EVSE.
- Activate the EVSE and at the end of the test interval record the time registration error.

If the result of this test is at, near, or exceeds the tolerance limit, repeat the test.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

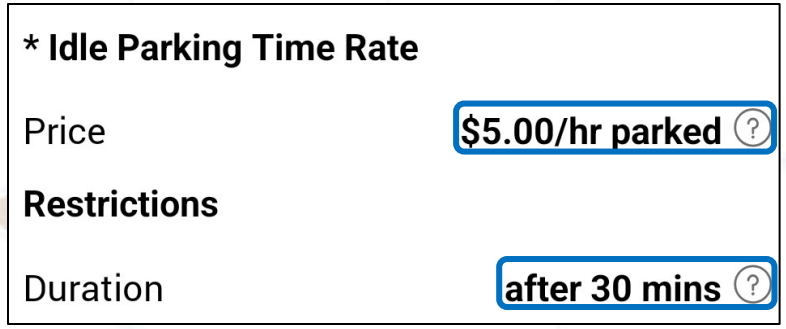
8.2. Time Test/8.3. Interference Test. (con't)

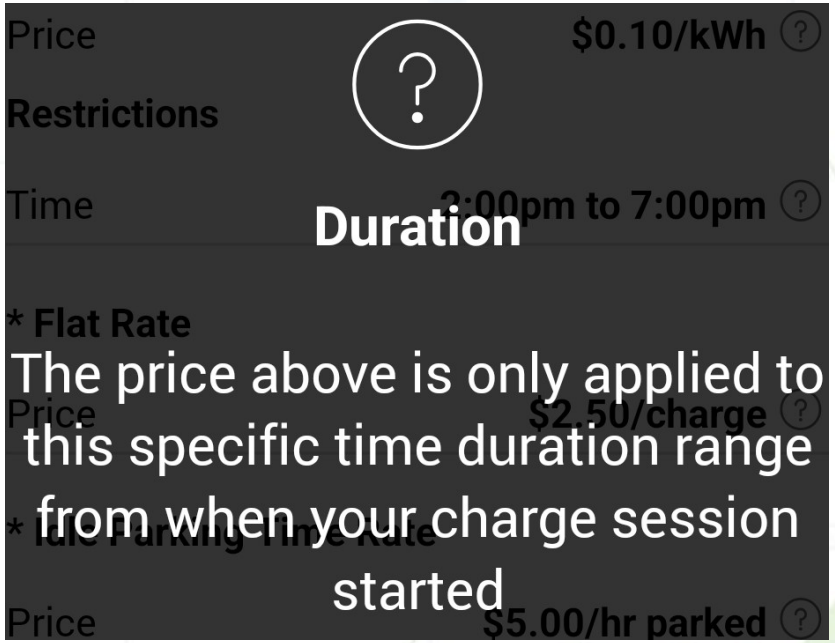
Code Reference: 3.40: S.1.1., S.2.6., UR.3.3., 5.55: S.1.4.1., S.1.4.1.1., S.1.4.2., S.3.

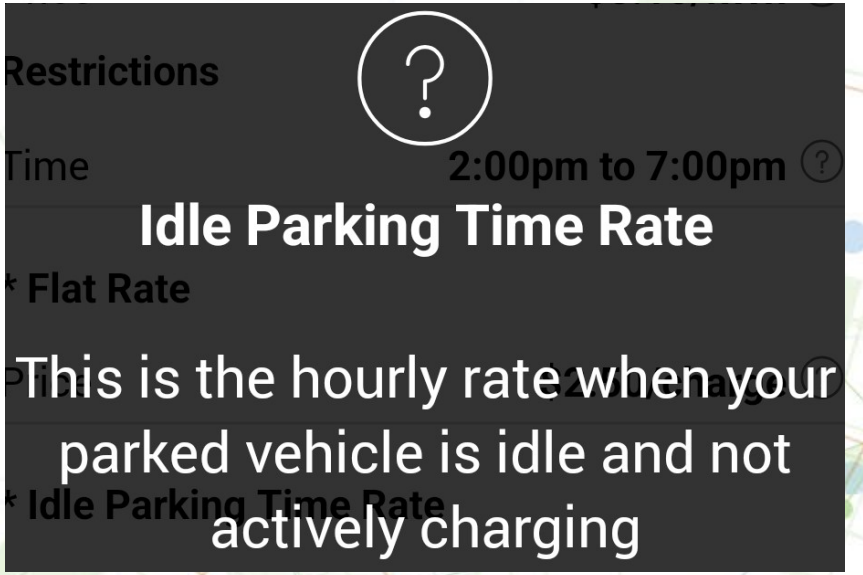
Determine if the rate calculations displayed and on the recorded representation (where applicable) are in agreement, accurate and mathematically correct.

EPO 30-Retail Electric Vehicle Fueling Systems

8.2. Time Test/8.3. Interference Test







EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.4. Repeatability Test.

Code Reference: 3.40: N.4., T.3.

If necessary, conduct a repeatability test. A repeatability test must include at least three consecutive test loads.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.4. Repeatability Test. (con't)

Code Reference: 3.40: N.4., T.3.

Tests must be conducted under approximately the same conditions (e.g., rate of energy transfer, test duration, draft size, temperature, etc.).

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.5. Money-Value Computations and Recorded Representations.

Code Reference: 1.10: G-S-5.2.2., G-S.5.5., 3.40: S.2.5.1., S.2.4.3.

Verify indicated and recorded money-value computations agree and mathematically correct for fixed price sales transactions and, when offered, for a selectable variable pricing sales transaction.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.6. RFI Test.

Code Reference: 1.10: G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.

A system shall meet performance requirements when associated and nonassociated equipment is operated in a customary manner and location.

EPO 30-Retail Electric Vehicle Fueling Systems

8.6. RFI Test. (con't)

Code Reference: 1.10: G-N.2., G-UR.1.2., G-UR.3.2., G-UR.4.2.

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, Radio Frequency Interference (RFI)

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.7. Zero-Set-Back Interlock.

Code Reference: 3.40: S.2.1., S.2.2., 5.55: S.5.

8.7.1. Check the effectiveness of the zero-setback interlock.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.7. Zero-Set-Back Interlock. (con't)

Code Reference: 3.40: S.2.1., S.2.2., 5.55: S.5.

8.7.2. On equipment activated with a single remote controller, activate one EVSE and check all others operated by the same controller to make certain they will not operate without activating the individual EVSE starting mechanism.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test.

Code Reference: 3.40: S.2.3., S.2.3.1, S.2.3.2., S.2.6., S.3.4.

8.8.1. At the time of power loss, the transaction shall either:

(1) terminate; or

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test. (con't)

8.8.1. At the time of the power loss, the transaction shall either:

(2) continue without additional authorization after restoration of power if the EVSE is able to determine it is connected to the same vehicle before and after the power outage.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test. (con't)

(2)…In this case, the information needed to complete the transaction in progress at the time of the power loss shall be available at the EVSE, console, internet, or toll-free phone access.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test. (con't)

(2)…There must also be a clear indication on the receipt provided to the customer of the interruption, including:

- the date and time of the interruption;
- other information required by S.2.6. EVSE Recorded Representations.

Code Reference: 3.40: S.2.3.3.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test. (con't)

8.8.2. 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.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test. (con't)

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.

EPO 30-Retail Electric Vehicle Fueling Systems

8. Test

8.8. Power Loss Test. (con't)

As a minimum, this test should be conducted on a system or device put into service or in response to specific complaints. NIST recommends that, prior to conducting this test, you check with your supervisor to verify your jurisdiction's or organization's policy regarding this test.

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.1. Security Means.

Code Reference: 1.10: G-S.8. (1/1/90), G S.8.1. (1/1/10), G-S.8.2., G-S.9., 3.40: S.3.3. Table S.3.3., 5.55: S.4.

Verify proper sealing of the device (physical seal, event counters, or event logs)

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.1. Security Means, con't.

Code Reference: 1.10: G-S.8. (1/1/90), G S.8.1. (1/1/10), G-S.8.2., G-S.9., 3.40: S.3.3. Table 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.

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.1. Security Means, con't.

Code Reference: 1.10: G-S.8. (1/1/90), G S.8.1. (1/1/10), G-S.8.2., G-S.9., 3.40: S.3.3. Table S.3.3., 5.55: S.4.

A metrologically-significant software change is a sealable event.

Note event counter information on the test report form for future reference.

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.1. Security Means, con't.

Code Reference: 1.10: G-S.8. (1/1/90), G S.8.1. (1/1/10), G-S.8.2., G-S.9., 3.40: S.3.3. Table S.3.3., 5.55: S.4.

If equipped with an event logger, obtain a copy of the event log for future reference.

Examine these records for any signs of misuse of adjustments.

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.2. Record Total Quantity.

Code Reference: 1.10: G-UR.4.1., G-UR.4.2., 3.40: S.7.

Note the final totalizer reading and record the total quantity of electricity dispensed and (where time-based fees are also assessed) the total time during the test on the official test report. Verify totalizers are working correctly.

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.3. Review/Analyze Results.

Code Reference: 1.10: G-UR.4.1., G-UR.4.3.

After all equipment at a location has been tested, review the results to determine compliance with requirements for equipment maintenance and use of adjustments.

EPO 30-Retail Electric Vehicle Fueling Systems

9. Post-Test Tasks

9.4. 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.

Supporting Slides

NIST HB44: Test Conditions

	Voltage	Low Load		% MDA	
		Current	% MDA	Medium Load	High Load
AC EVSE		4 A < I < 10 A		40 % - 60 %	70 % - 100 %
DC EVSE Type Evaluation	350 V ≤ VDC ≤ 450 V	≥ 30 A	10 % - 20 %	40 % - 60 %	70 % - 100 %
	700 V ≤ VDC ≤ 900 V	≥ 30 A	10 % - 20 %	40 % - 60 %	70 % - 100 %
DC EVSE Field Test with Programmable Load	Unspecified	≥ 30 A	10 % - 20 %	25 % - 100 %	
	~~Maximum possible~~	~~≥ 30 A~~	~~10 % - 20 %~~	~~40 % - 60 %~~	~~70 % - 100 %~~
DC EVSE Field Test with Vehicle as Load	Unspecified	≥ 30 A	> 40 % MDA Test at load presented by vehicle		

EPO 30 Safety Reminders and Guidelines

- EPO 30 Section 2. Safety Notes.

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.**

EPO 30 Safety Reminders and Guidelines

- EPO 30 Section 6.7. Test Methods.

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.**

EPO 30 Safety Reminders and Guidelines

- EPO 30 Section 7.6. Use of Adjustments. (Just before Section 8. Test.)

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 EVSE 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.**