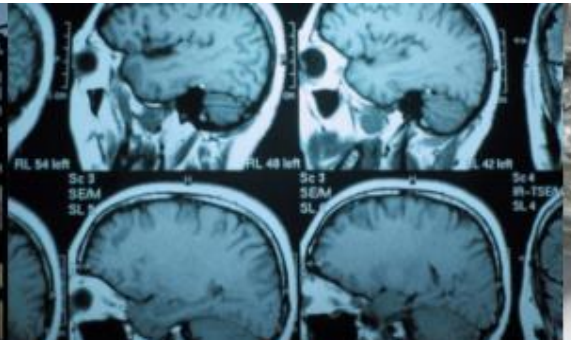
National Electrical Manufacturers Association

National Council on Weights and Measures
Garden Grove, CA
February 10, 2026

Electric Vehicle Power Transfer Systems

Electric Vehicles (EV)
Electric Vehicle Supply Equipment (EVSE)

NEMA
The Association of Electrical and Medical Imaging Equipment Manufacturers


ELECTRIC VEHICLES

Vol. 3 CHICAGO, MAY, 1913 No. 5

BAKER MOTOR VEHICLE COMPANY'S VICTORIA MODEL

EVSE Types

Level 1

In the US, standard outlets are at 120 volts. All Level 1 charging is done at this voltage. Depending on the car and the level of charge on the battery, Level 1 charging can take 8 – 16 hours to charge. Level 1 charging would typically take place in the home. All new EVs will come with a Level 1 charging cord.

Level 2

Level 2 charging uses 208 or 240 volts and is able to fully charge a battery in 4 – 6 hours. This charge time is optimal for overnight or long-length charging. This is the preferred EV charging method for both public and private facilities. They will be typically found in public areas, parking garages and commercial businesses.

DC Fast Charging

DC Fast Charging and can provide 80% of a full charge in fewer than 30 minutes. They are the EV equivalent to the commercial gas station. These units are very expensive and require significant facilities and training. At this time exact voltage and load specifications for DC fast charging have not yet been defined. The vehicle must be properly equipped to accept a DC fast charge.

How Long Does it Take to Charge an EV?

Typical time to fill up an 80-mile battery by charging type

Courtesy of chargepoint

* DC fast charging can get many EV batteries charged to 80 percent in 20-30 minutes

Primary EV Connector Types

- **SAE J1772** – used on Level 1 & 2 AC charging.
- **SAE J3400** – North American Charging Standard (NACS). Tesla configuration. Used on most new Battery Electric Vehicles (BEV).
- **CCS** (Combined Charging System). Used for DC fast charging.

NEC Definitions (Article 100)

Electric Vehicle Connector.

A device that couples to the inlet on the electric vehicle for power transfer, including charging and export, and information exchange.

NEC Definitions (Article 100)

Output Cable to the Electric Vehicle.

An assembly, consisting of a 25 feet maximum length of EV cable and an EV connector (supplying power to the electric vehicle).

CCS Connector
DC Fast Charger (DCFS)

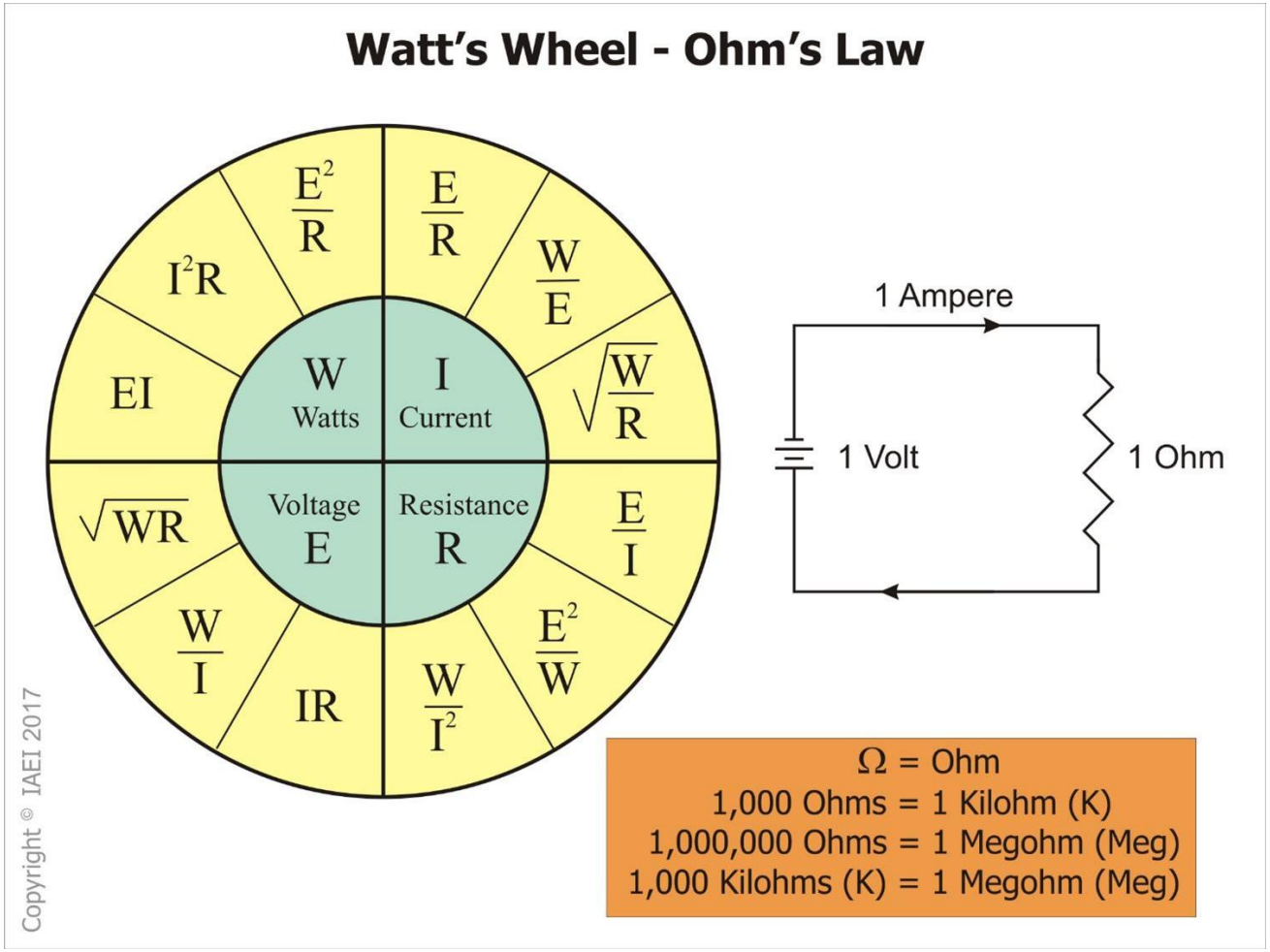
OHM'S LAW

- Mathematical Relationship between Resistance, Voltage and Current
- Resistance (R) – measured in Ohms
- Voltage (E) – measured in Volts
- Current (I) – measured in Amperes

ALSO

- Power (W or VA) – measured in Watts or Volt-Amps

WATT'S WHEEL


Watt's Wheel - Ohm's Law
W
Watts
I
Current
Voltage
E
Resistance
R
$\frac{E^2}{R}$
$\frac{E}{R}$
$\frac{W}{E}$
$\sqrt{\frac{W}{R}}$
$\frac{E}{I}$
$\frac{E^2}{W}$
$\frac{W}{I^2}$
IR
$\frac{W}{I}$
$\sqrt{WR}$
EI
I^2R
1 Ampere
1 Volt
1 Ohm
Ω = Ohm
1,000 Ohms = 1 Kilohm (K)
1,000,000 Ohms = 1 Megohm (Meg)
1,000 Kilohms (K) = 1 Megohm (Meg)
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Power Formula

- Watts = Voltage x Amperes (P=EI)
- VA (Volt Amperes) or W (Watts)
- Often referred to as the “Power Formula”
- 1,000 Watts referred to as 1 kW or 1 kVA
- 1 kW consumed in one hour is 1 kilo-watt hour (kWh)
- kWh is commonly used to measure and bill for electricity consumption

Determining Ampacity and Conductor Sizing

- Ampacity (I) = Power (W or VA) divided by Voltage (V)
- I = P/E
- Conductor and equipment sizes are based on ampacity
- Conductor sizing is also dependent on conductor material (CU or AL), insulation type, ambient temperature

Conductor Sizing Example – Level 2 Charger

Given: 7,200 VA (W) Level 2 EVSE at 240 volts

Amperage = 7,200 VA (W) divided by 240 volts

7,200/240 = 30A

EVSE loads are continuous @ 125% (>3 hours)

30A x 125% = 37.5A

Conductor sized according to 37.5A and any other adjustment factors

Fuse or circuit breaker would be sized at 40A

National Electrical Code

Article 625: Electric Vehicle Power Transfer Systems

- General
- Equipment Construction
- Installation
- Wireless Power Transfer Equipment

NEC Definitions (Article 100)

Electric Vehicle Supply Equipment (EVSE).

The conductors, connectors, attachment plugs, and all other fittings, devices, or apparatus installed for the purpose of **transferring energy** between the building wiring and the electric vehicle.

NEC 625.6 Listed

All EVSE equipment covered by the scope of Article 625 shall be **listed** (e.g., UL).

UL Product iQ Category Codes:

FFTG: Electric Vehicle Charging System Equipment

FFSO: Electric Vehicle Cable

FFWA: Electric Vehicle Supply Equipment

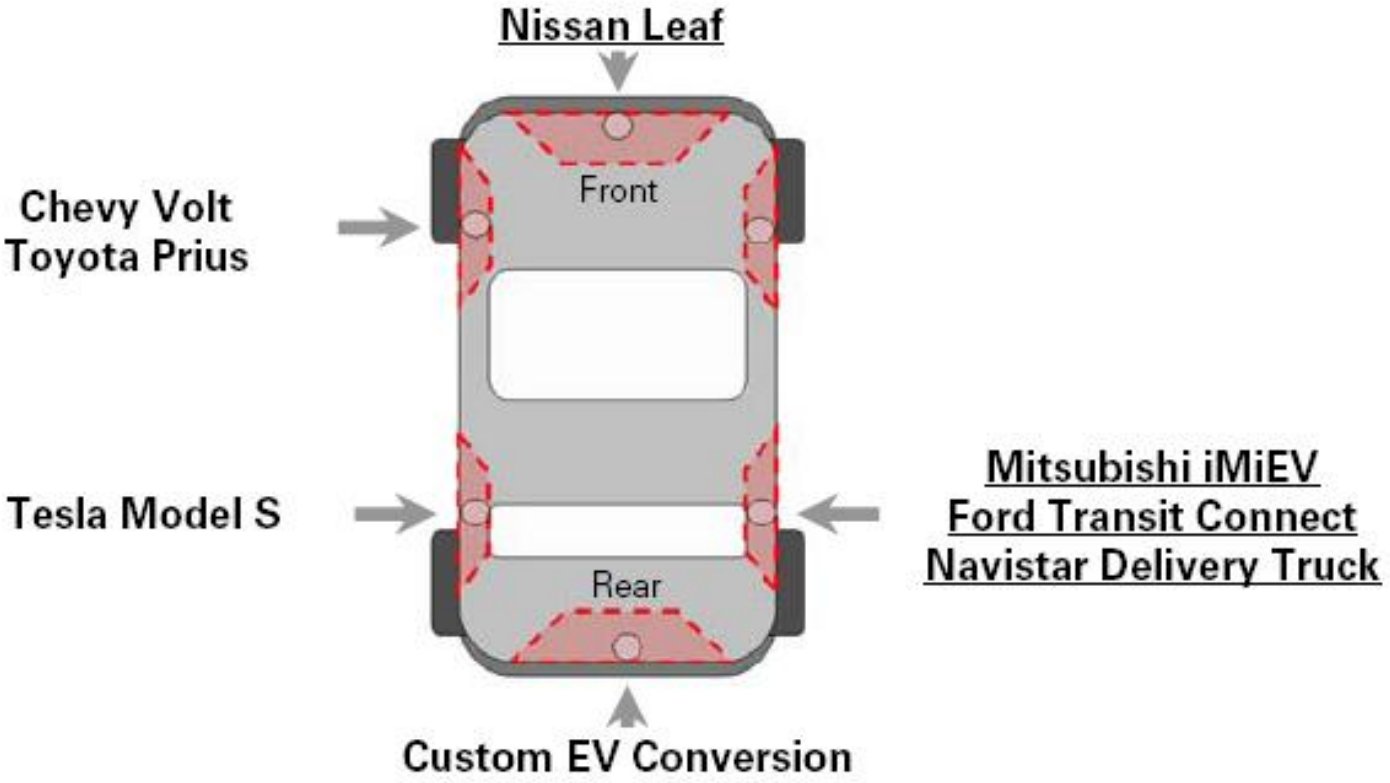
FFYA: Electric Vehicle Wireless Power Transfer Equipment

FFTN: Electric Vehicle Bi-Directional Charging Systems

NEC 625.42 – Load Management

- 625.42 (A) Energy Management System (EMS). Allows the total load on a service or feeder to be as allowed by the set point on the EMS. Systems so managed must be marked.
- 625.42 (B) EVSE with Adjustable Settings. An ampere adjusting means with restricted access is permitted. Must be marked on the nameplate.

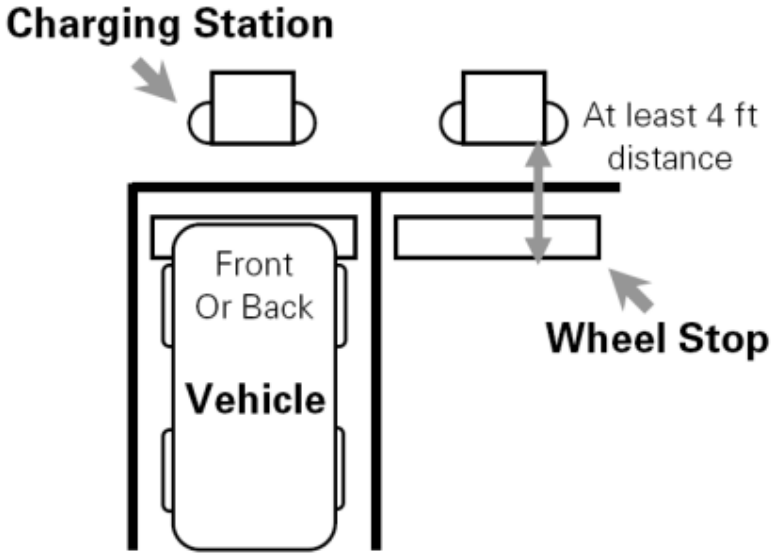
EV System – Charging Inlet Placement

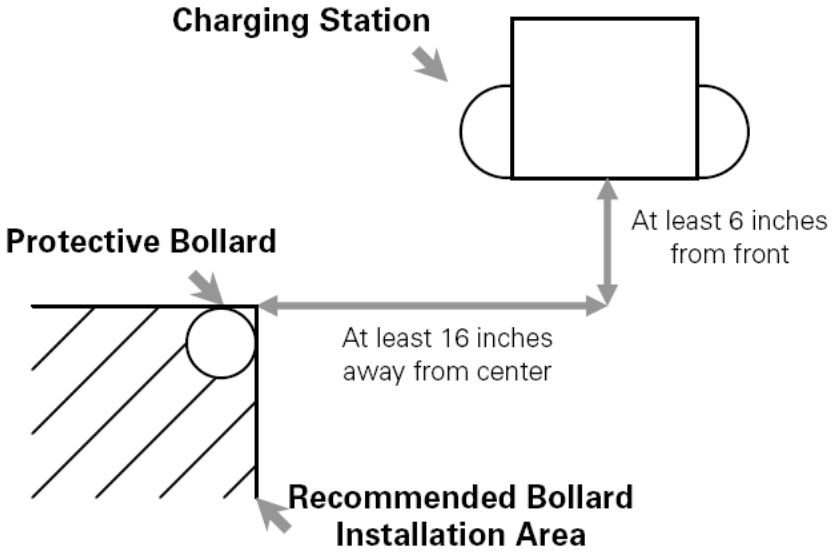


North America Recommendation
Install Toward Front And Driver Side


RESERVED
FOR
ELECTRIC VEHICLES
ONLY
CHARGING STATION
EXIT
RESERVED
FOR
ELECTRIC VEHIC
EV CHARGING STATION

EV System – EVSE Placement Regulated by Fire Codes

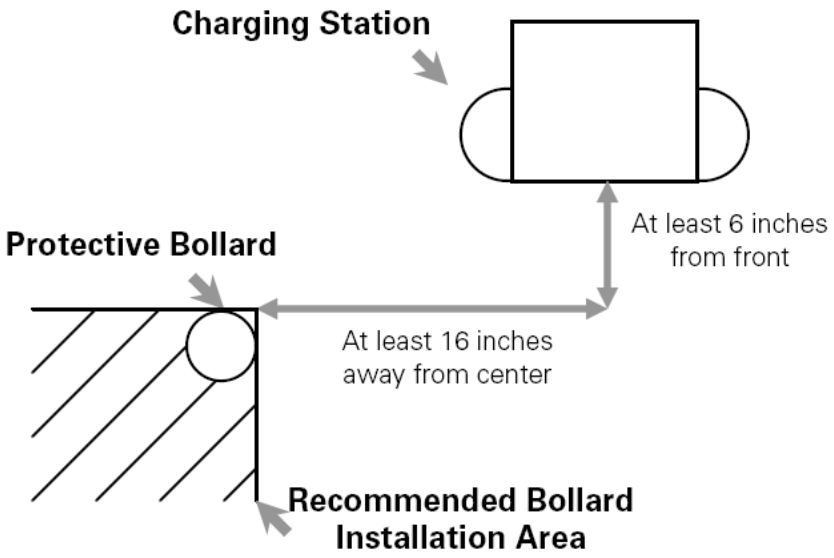




Protecting The Charging Station Is Important
Local Jurisdiction Requirements May Vary

Note: Bollard not required by NEC

EVSE Installation



Bollard Protection – No Signage

Note: Bollard not required by the NEC


VCU


EV
ELECTRIC
VEHICLE
CHARGING
STATION
EV
ELECTRIC
VEHICLE
CHARGING
STATION


ELECTRIC VEHICLE PARKING ONLY
ELECTRIC VEHICLE PARKING ONLY
ELECTRIC VEHICLE PARKING ONLY


E V
ELECTRIC VEHICLE CHARGING STATION
E V
ELECTRIC VEHICLE CHARGING STATION


EV


E.V.
NO PARKING
WHOLE FOODS MARKET

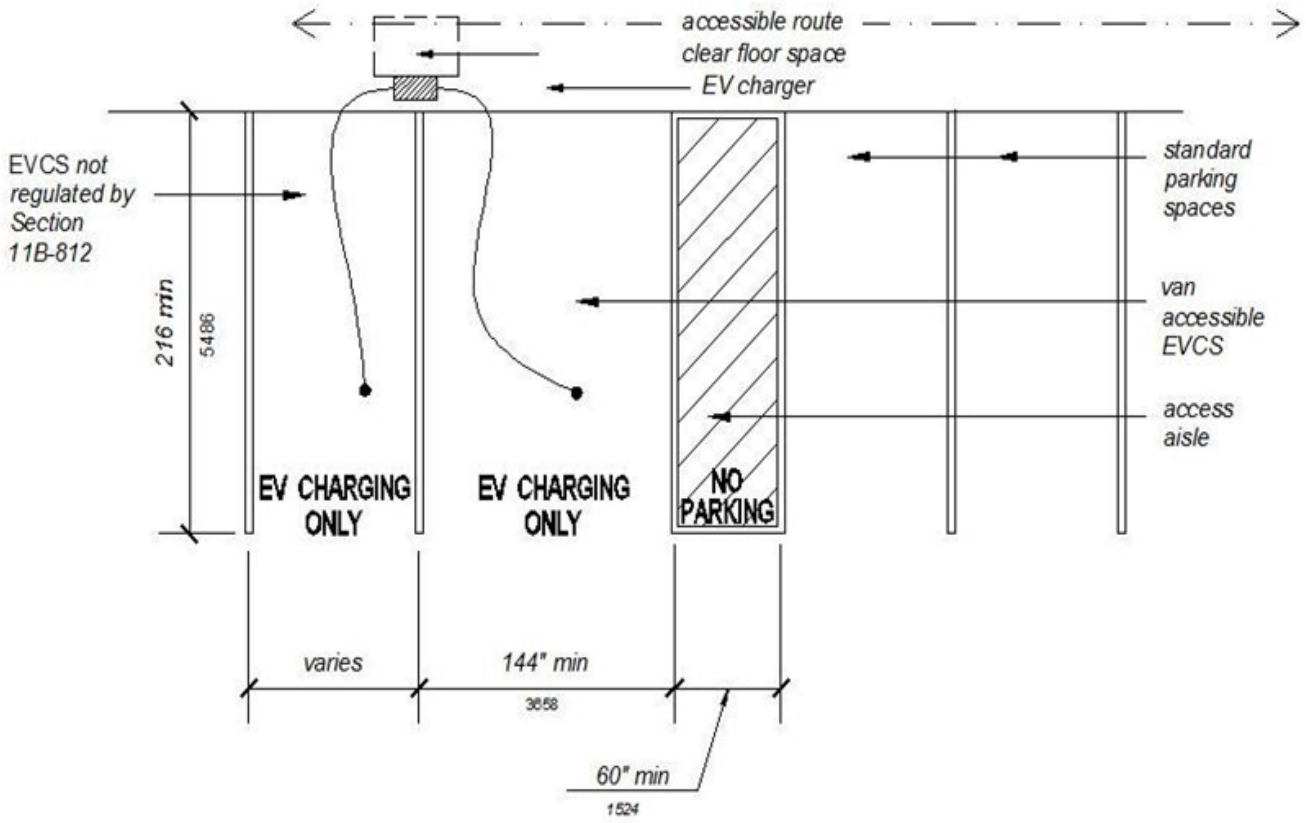
Electrical Safety

- NEC 110.26 – requires working clearances (depth, width, height) around electrical equipment that may need maintenance or testing access to live parts.
- NFPA 70E – **"Electrical Safety in the Workplace".** Safety guidelines for electrical workers. Generally speaking, electrical circuits should never be accessed while energized. Use disconnecting means provided.
- Safety protocols should be followed (OSHA).

2025 CALGreen Updates – Multifamily Dwellings

- 100 % of dwelling units to have access to EV charging
- EV chargers for individual units to be served from dwelling unit electric service panel
- 25% of common area & guest parking to be provided with Level 2 chargers

ADA Accessibility



SUMMARY

- EV and EVSE technology has been evolving for more than 100-years and will continue to evolve into the next century.
- The rapid electrification of transportation will significantly increase the prominence and importance of EVSE-related standards.
- EVSE installations in compliance with the NEC and manufacturer's installation instructions ensure safety from shock, electrocution, and fire.