NEC ARTICLE 90.2(B)

90.2(B) Not Covered. This Code does not cover:

Installations in ships, watercraft other than floating buildings, railway rolling stock, aircraft, or **automotive vehicles** other than mobile homes and recreational vehicles.
ARTICLE 625
ELECTRIC VEHICLE CHARGING SYSTEMS
Article 625 was entered into the NEC in 1996, covers the charging equipment external to the vehicle. It covers anything installed with either feeders or branch circuits to charge the vehicle. The provisions of this article cover the electrical conductors and equipment external to an electric vehicle that connect an electric vehicle to a supply of electricity by conductive or inductive means, and the installation of equipment and devices related to electric vehicle charging.
<table>
<thead>
<tr>
<th>Level</th>
<th>Voltage</th>
<th>Amperage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1</td>
<td>Rated 110-120 volts</td>
<td>15 or 20 Amps</td>
</tr>
<tr>
<td>Level 2</td>
<td>Rated 208 or 240 Volts</td>
<td>20-100 Amps</td>
</tr>
<tr>
<td>Level 3</td>
<td>Rated 480 Volts</td>
<td>60-400 Amps</td>
</tr>
</tbody>
</table>
LEVEL ONE CHARGERS-LEVITON
LEVITON LEVEL ONE CHARGERS
CHARACTERISTICS

1) 120 volt (1.5 kw) Primarily Residential Household Power

2) Permitted to be cord and plug connected

3) Charge Time—approximately 8-20 hours
LEVEL TWO CAR CHARGERS COMMERICAL

GE WATT STATION
30 AMP/ 208 V

HUBBEL
30 AMP/208 V
# Level Two Car Chargers Characteristics

## Residential
1) 240V Single Phase (6.5-24kW) 30-100A
2) Fixed in Place-Mandatory
3) Charge Time: 4-8 Hours

## Commercial
1) 208 V Three Phase (14kW) 30 Amps
   Fixed in Place-Mandatory
2) Charge Time: 4-8 Hours
**TESLA S CHARGING SCALE**

**LEVEL 2**

### Breaker Rating (Amperage) vs. Miles of Range per Hour of Charge (w/ Twin Charge)

<table>
<thead>
<tr>
<th>Breaker Rating</th>
<th>#3 AWG</th>
<th>#4 AWG</th>
<th>#6 AWG</th>
<th>#8 AWG</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td></td>
<td></td>
<td>62</td>
<td></td>
</tr>
<tr>
<td>90</td>
<td>#3 AWG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>#4 AWG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>#4 AWG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
<td>#6 AWG</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>#8 AWG</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>#8 AWG</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Home Connector Charge Times

<table>
<thead>
<tr>
<th>Your Home's Breaker Rating (Amps)</th>
<th>Approximate Charge Time (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>90</td>
<td>4</td>
</tr>
<tr>
<td>80</td>
<td>4.2</td>
</tr>
<tr>
<td>70</td>
<td>4.7</td>
</tr>
<tr>
<td>60</td>
<td>5</td>
</tr>
<tr>
<td>50</td>
<td>6</td>
</tr>
<tr>
<td>40</td>
<td>7.5</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>
LEVEL 3 CHARGERS
CHAdeMo (CHArge for Moving)
LEVEL THREE CAR CHARGERS
CHAdeMo (CHArge for Moving)
CHARACTERISTICS

1) 480 Volts/30-40 Amps

2) These chargers are rated to charge at 480 volts and 400 amps

3) 50-80% partial charge in a matter of 15-30 minutes or so.

Nissan mentions that constant Level 3 charging of the Leaf would lower the range while consistent Level 2 charging would maintain maximum capacity.
LEVEL THREE CAR CHARGERS
CHAdeMo (CHArge for Moving)
TESLA CHARGING STATIONS

The stations--faster than any other charging stations in existence, according to Tesla--can provide up to 100 kW (in the future, up to 120 kW) of power to EVs, juicing them up in 30 minutes with enough power to drive for three hours.
It’s no five-minute trip to the gas station, but we are getting closer.

Tesla’s superchargers offer power for free for all Tesla S.
CHAdeMo CHARGING STATIONS
Japan 1677 Europe 759 USA 160 Others 12
Supercharging past the halfway point slows down considerably. This is due to the battery technology. The more full the cells become, the slower the charging has to be, because charging is too fast, the cells become damaged.
ARTICLE 625
ELECTRIC VEHICLE CHARGING SYSTEMS

PART I   GENERAL   PRIMARILY DEFINITIONS

PART II   WIRING METHODS   COUPLERS

625.9 (A) Polarization Of Coupler
   (B) Noninterchangeability Not Interchangeable with other Electrical Systems
   (C) Construction and Installation Prevent Inadvertent contact By Persons
   (D) Unintentional Disconnection Positive means of locking
   (E) Grounding Pole Provided Only if Coupler Requires
   (F) Grounding Pole Requirements If provided, shall be First to Make, last to Break
CHARGING COUPLER
ARTICLE 625.9(A)
PRIMARILY MANUFACTURER’S RESPONSIBILITY

Detail dimension of interface geometry is open to public, then any maker can fabricate compatible connector.

Power terminal external diameter: 9 mm
Signal terminal external diameter: 1.6 mm
ARTICLE 625
ELECTRIC VEHICLE
CHARGING SYSTEMS

PART III  EQUIPMENT CONSTRUCTION

625.13  125V 15/20A  EVSE  Permitted to be cord and plug

625.15(A)  Marking.  “For Use with Electric Vehicles”

625.16 Means of Coupling.  Coupling Listed and labeled for the Purpose

625.18 Interlock.  De-energize when uncoupled.  Not required for 120v Single Phase Systems

625.19 Automatic De-Engergization of Equipment    De-energize cable conductors & connector when exposed to strain. Applies to portable 120v equipment.
DE-ENERGIZE CHARGER IF UNCOUPLED FROM VEHICLE
ARTICLE 625
ELECTRIC VEHICLE
CHARGING SYSTEMS

PART IV CONTROL AND PROTECTION

625.21 Overcurrent Protection rated 125%. Considered “Continuous Duty”

625.22 Personnel Protection System-EV supply equipment shall have listed protection against personnel shock

625.23 >60 A/150 V Disconnect-Readily Accessible Lockable in the Open Position-Permanent

625.25 Loss of Primary Source-No back feeding from Vehicle during Utility Outages
DISCONNECT READILY ACCESSIBLE IF OVER 60 A or more than 150 V to Ground
“Circuit breaker used as the disconnecting means shall remain in place with or without the lock installed”
ARTICLE 625
ELECTRIC VEHICLE CHARGING SYSTEMS

PART V  ELECTRIC VEHICLE SUPPLY EQUIPMENT LOCATION

625.29 Indoor Sites. Integral, attached, detached garage enclosed, underground parking structures

625.29(A) Location. Permit direct connection of vehicle
(B) Height No lower than 18”-no higher than 4’
(C) Ventilation Not Required-Listed as non-vented storage batteries for indoor charging
18” Off Ground, No Higher than 4’
ARTICLE 625
ELECTRIC VEHICLE
CHARGING SYSTEMS

PART V Continued.

(D) Mechanical Ventilation (fan) for indoor charging

625.30 Outdoor Sites. Residential Car Ports, driveways curbside, parking structures, parking lots

(A) Location. EVSE located to permit connection

(B) Height. Not less than 24” and not greater 4’
DOES THE DEFINITION OF A SEPARATE STRUCTURE APPLY TO FREE STANDING CHARGERS (COMMERCIAL) OR CHARGERS INSTALLED IN DETACHED GARAGES (RESIDENTIAL)?

SEPARATE STRUCTURE

“That which is built or constructed.”
ARTICLE 250.32
BUILDINGS OR STRUCTURES SUPPLIED BY A FEEDER(S) OR BRANCH CIRCUIT(S)
LEVEL 3 CHARGER WITH GROUND RODS-SEPARATE STRUCTURE
LEVEL THREE CHARGER
OVER 60 Amps/150 v to Ground
SOLAR CAR PORTS

RESIDENTIAL

COMMERCIAL
BOLLARDS
NEW FOR 2011 NEC
**625.2 Definitions: Electric Vehicle**

**Electric Vehicle:** An automotive-type vehicle for on-road use primarily powered by an electric motor that draws current from a rechargeable storage battery, fuel cell, photovoltaic array, or other source of electric current.

Plug-in hybrid electric vehicles (PHEV) are considered electric vehicles.

The definition of an “Electric Vehicle” has been revised to include a “Plug-in Hybrid Electric Vehicle” (PHEV).
625.2 Definitions: PHEV

Plug-in Hybrid Electric Vehicle (PHEV): A type of electric vehicle intended for on-road use with the ability to store and use off-vehicle electrical energy in the rechargeable energy storage system, and having a second source of motive power.

A new definition has been added to Article 625 for “Plug-in Hybrid Electric Vehicle” (PHEV)
625.2 Definitions: RESS

Rechargeable Energy Storage System: Any power source that has the capability to be charged and discharged

Informational Note: Batteries, capacitors, and electro mechanical flywheels are examples of rechargeable energy storage systems

A new definition has been added to Article 625 for “Rechargeable Energy Storage System”
END OF PRESENTATION