



# EMERGING TECHNOLOGIES

Electric Vehicle Charging  
and Supply Equipment



Early forms of EV charging equipment prior to the J1772

Little or no safety features

Used to charge lead acid batteries



# LEVEL 2 CHARGING

According to the SAE standard, power transfer pins are rated for 80 amps

Commercial EVSE units with a 70 amp 208 volt branch circuit could deliver power at a rate of 11.5kw



# HOME BASED EVSE

The industry seems to be leaning toward EVSE units that require a 40 amp branch circuit

Because EVSE is considered a continuous load, a 40 amp 240 volt unit is limited to power delivery at a rate of 7,680 watts



# DUAL VOLTAGE RATING

40 amps at 208 volts is limited to a power transfer rate of 6,656 watts

Most units will probably be designed for use at 208 and 240 volts

Some early release vehicles will have 3.3kw chargers upgradeable to 6.6kw



# HOME-BASED CHARGING

20 amps at 240 volts could supply  
the 3.3kw charger ( $16a \times 240v = 3840w \text{ max}$ )

EVSE could be built in this configuration  
to accommodate marginal dwelling  
services

Could not supply a 6.6kw charger



# COMMERCIAL CHARGING

EV use proponents have indicated a goal to be able to “fill up” at a commercial charging station in less than 15 min

Approximate charge . . . Rate vs. Time

1.1kw -- 12 to 15 hrs

11kw -- 1 1/2 to 2 hrs

3.3kw -- 6 to 8 hrs

20kw -- 1 hr

6.6kw -- 3 to 4 hrs

40kw -- 40 min.



# LEVEL 2 EVSE POSSIBILITIES

amps	kw - 208v	kw - 240v
20	3.328	3.84
30	4.992	5.76
40	6.656	7.68
50	8.32	9.6
60	9.984	11.52
70	11.648	13.44



# EMERGING TECHNOLOGY

House Bill 2179 passed in 2005

Oregon Revised Statute 455.065

Authority to write administrative rules  
to ensure a path through alternative  
regulatory options



# LEVEL ONE CHARGING

January 2009 the division adopted rules that;

Streamlined product certification,  
Clarified permit requirements, and  
Exempted charging stations from the  
requirement of having to provide a  
grounding electrode system





**Public Charging**

# SPECIAL DEPUTY INSPECTION

Level 1 charging stations are quite simple and exempt from several of the safety provisions of NEC article 625

The division is not equipped to evaluate the more complex level 2 EVSE units



# ALL LEVEL 2 EVSE UNITS

Must be evaluated and listed by a NRTL or Oregon approved field evaluation firm prior to installation

Level 3 fast chargers, reported to be rated at 60/30kw will face even greater challenges as there is no standard at this time for the connector



# COMMERCIAL CHARGING

Land developers and project managers started thinking about making electrical provisions for vehicle charging stations

An electrical contractor speculated that he would have to provide a 1,200 amp service at a parking structure to support 30 – 6.6kw chargers!





6.6kw  
charger in  
California



# FEEDERS AND SERVICES

NEC article 625 contains no provisions for load diversity when calculating EVSE feeders and services

The division started researching charge rate data gathered by users of battery powered vehicles and electric utilities



# EXISTING DATA

Data collected from various industrial and warehouse charging operations for material handling equipment revealed reason to apply a diversity factor

There is no existing data for mass charging of Lithium Ion batteries



# DIVERSITY FACTOR TABLES

Exist in the following NEC articles;

550 Mobile home parks

551 RV parks

555 Boatyards and marinas

626 Electrified truck parking



# ALTERNATE METHOD RULING

Adopted the following demand factor table;

## Demand Factors

<b>Number of EVSE stations</b>	<b>Sum of EVSE station ratings (%)</b>
<b>1-4</b>	<b>100</b>
<b>5-8</b>	<b>90</b>
<b>9-14</b>	<b>80</b>
<b>15-30</b>	<b>70</b>
<b>31-40</b>	<b>60</b>
<b>41 plus</b>	<b>50</b>



# WITHOUT DEMAND FACTOR

30 – 6.6kw units = 198kw

198kw @ 125% = 247.5kw

A 120/208v three phase service could deliver this amount of power at 687 amps, (247,500 / 360.256)

Single phase loads are more efficiently served by a three phase service

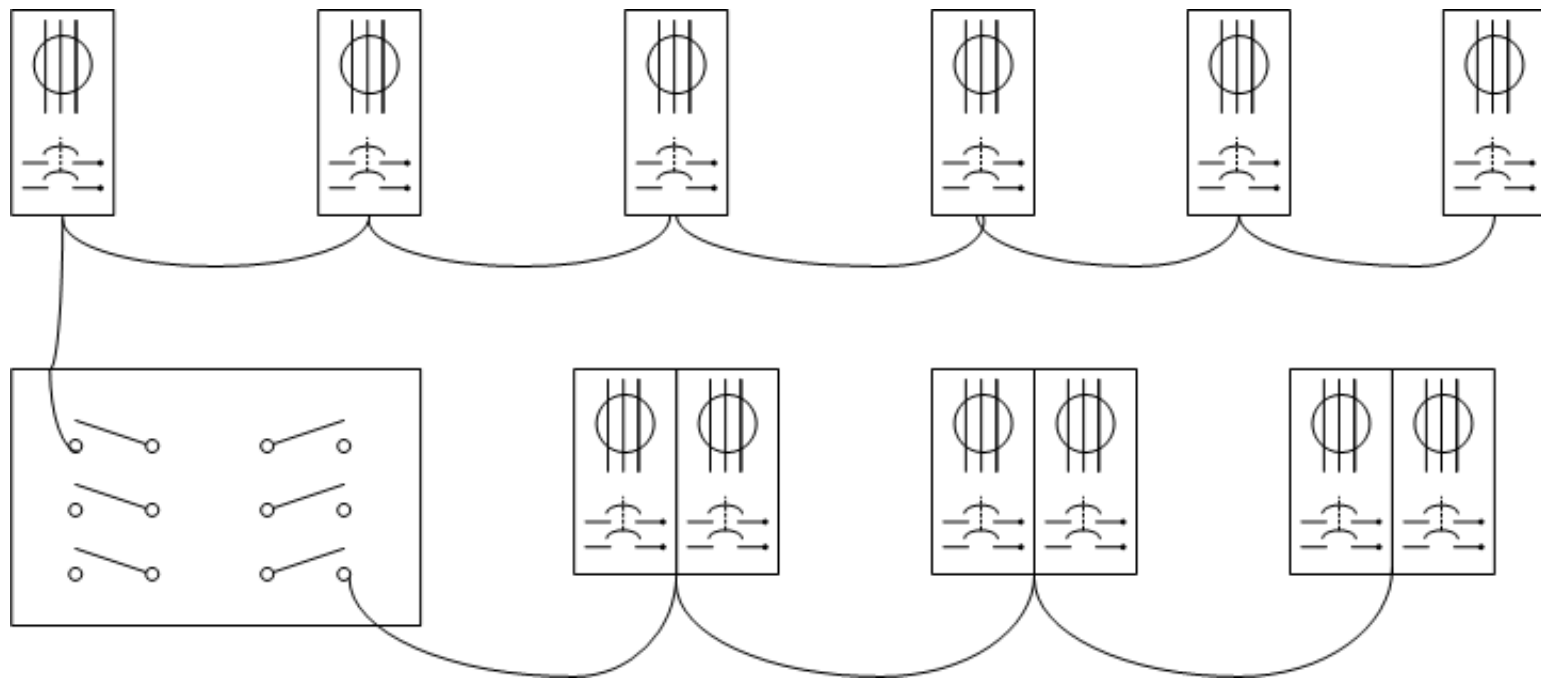


# REALITY QUESTION

Are these 30 – 6.6kw charging stations likely to operate simultaneously at maximum load for more than three hours?



# SERVICE CALCULATION



Five EVSE feeders and a house panel feeder



# EXAMPLES OF USE

Five feeders, each one serves  
6 – 6.6kw EVSE units;

Each feeder can be taken at 90% (see handout)  
 $6.6\text{kw} \times \text{six units} = 39.6\text{kw}$  divided by 208 volt =  
190amps @ 90% = 171 amps. Feeder conductor  
size could be 2/0 copper with 175amp breakers

Without the demand factor table these feeders  
would have to be at least 250mcm conductors  
protected at 250 amps!



# WITH DEMAND FACTOR

30 – 6.6kw EVSE units;

30 – 6.6kw units = 198kw

$118.8\text{kw} / 360.256 + 79.2\text{kw} / 208 = 720$  amps

720 @ 70% = 504 amps

A 120/208v three phase service could deliver this amount of power at 504 amps, (see handout)

687 amps to 504 amps is a huge reduction!



# OTHER CALCULATIONS

may result in more dramatic reductions than this example

Remember that the code contains provisions that are considered necessary for safety.

Attention to proper wire size and overcurrent protection will assure safety but may not result in an installation that is efficient, convenient, or adequate for future expansion

