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1962.2 Electric Vehicle Charging Requirements

Background:

In 2001, ARB modified the ZEV Regulation and added Section 1962.1 (now renamed 1962.2) to restrict Battery EVs (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) that earn ZEV credit to make use of on-board chargers that connect to the grid with a conductive, rather than inductive, charge coupler. ARB further stipulated that the charge connection for Level II+ power-capable EVs make use of the interface protocol and connection described in SAE Recommended Practice J1772 REV NOV 2001

Current Challenges with 1962.2:

SAE is currently making modifications to J1772 REV NOV2001 and appears to be moving towards a completely different charging coupler made by Yazaki to replace the former Avcon standard. This new Yazaki coupler is attractive because it is much smaller and less expensive than the former Avcon connector. The only apparent drawback is that it will not be able to deliver Level III (fast charge) capability like a future-version Avcon might have. This new Yazaki coupler will, however, be able to deliver much more than the former Level II power limit (6.6 kW), perhaps as much as 16-19 kW. This medium power capability is necessary in order to obtain reasonable charge times with upcoming long-range BEVs. Tesla Motors will be shipping their Roadster in 2008 with a 52 kWhr battery. With the former Level II charge limits of 6.6 kW, charge times for a 52 kWhr battery would become unreasonably long, perhaps as much as 7-8 hours. This charge time duration would extend beyond preferred late-evening low-cost Utility rate schedules, while a medium-power 3-4 hour charge could be scheduled to "fit" better into these upcoming schedules¹. It is assumed that high power capable EVs (50+ kW) would now make use of a separate on-vehicle higher-power inlet standard that is yet to be developed. Overall, the attractiveness of all PHEVs and BEVs making use of an consistent, almost-worldwide² J1772-Yazaki-based low-to-medium power connection standard more than outweighs the loss of potential high power capability with the former Avcon connector. The need for and attractiveness of higher "fast charge" power capability for EVs is not yet proven to be necessary to market BEVs.

ARB has received several comments recently regarding our EV charging requirements. These involve:

¹ A useful and more understandable measure of the charge power capability of an EV is to convert charge power to an equivalent "charging speed". In the case of a Tesla Roadster, medium power charging would provide (18kW/ .25 kWhr/mile) =~ 72 mph, or in other words, it charges up about as fast as you can discharge it on the freeway. A typical PHEV might charge at (1.4 kW/.25 kWhr/mile) =~6 mph. Children with wind-up toy cars will appreciate this way of visualizing charging speed.

² Japan may also adopt the J1772 + Yazaki interface, while Europe might adopt J1772 protocols with a standard power plug.

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- (1) Changing the reference from the soon-to-be obsolete J1772 NOV 2001 Recommend Practice to the new version, and
- (2) Modification of ARB definitions for Level I charging to make them consistent with SAE and/or to modify the regulation to avoid unintended consequences. If modifications are not made, one could interpret the existing regulation language as requiring all 220 VAC charge capable PHEVs to install 3.3 kW onboard chargers, even though this was not the intent of ARB.

Recommended Modifications:

(1) Update the SAE reference from the obsolete SAE J1772 REV NOV 2001 to the new Recommend Practice (J1772 REV ?2009).

(2) Level I definition: Delete the Level I definition in the regulation, and instead specify a charger with power capability that can meet a maximum charge time of 4 hours. This change satisfies the intent of the original regulation while avoiding ambiguity with the use of Level I definitions, and will allow 220 volt capable charge vehicles to have 1.4 kW chargers as long as they meet the 4 hour maximum charge time. The 4 hour charge time requirement can be met with a 1.4 kW charger in a 25 mile PHEV, while a 40 mile PHEV or Type I City EV will require a higher power charger as shown in the table below:

Vehicle	UDDS Range (miles)	Usable Energy (kWhr)	Charge time with charger power of:	
			1.4 kW	3.3 kW
			(hours) ³	
PHEV 10	10	2	1.4	0.4
PHEV 20	20	4	2.9	0.9
PHEV 25	25	5	3.6	1.1
PHEV 40	40	8	5.7	1.7
Type I CityEV	50	10	7.1	2.2
Type I.5 CityEV	75	15	10.7	3.2
Type II EV	100	20	14.3	4.3

(3) Other potential changes to consider:

- Requirement for low power PHEVs and BEVs to make use of the Yazaki connector, whether or not J1772 specifies it.
- Require all BEVs and PHEVs to come equipped with a cordset and compatibility with 120 VAC/60 hz 15 amp circuits.

³ Assumes AC energy consumption of 200 whr/mile and best-case (shortest time) scenario where charge rate is not limited by battery chemistry, cooling limitations, etc.

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Proposed Regulation Language Changes

§ 1962.4-2. Electric Vehicle Charging Requirements

(a) Applicability. This section applies to (1) all battery electric vehicles that qualify for 1.0 or greater ZEV credit under section 1962, and (2) all hybrid electric vehicles that are off-vehicle charge capable ~~capable of being recharged by a battery charger that transfers energy from the electricity grid to the vehicle for purposes of recharging the vehicle traction battery, other than battery electric vehicles and hybrid electric vehicles that are only capable of Level 1 charging.~~

(b) Definitions.

(1) The definitions in section 1962 and 1962.1 apply to this section.

(2) ~~"Level 1 charging" means a charging method that allows an electric vehicle or hybrid electric vehicle to be charged by having its charger connected to the most common grounded receptacle (NEMA 5-15R). A vehicle that is only capable of Level 1 charging is one that is charged by an on-board or off-board charger capable of accepting energy from the existing AC supply network. The maximum power is 12 amps, with a branch circuit rating of 15 amps, and continuous power of 1.44 kilowatts.~~

(c) Requirements. Beginning with the ~~2006~~ 2010 model year, all vehicles identified in subsection (a) must be equipped with a conductive charger inlet port which meets all the specifications contained in Society of Automotive Engineers (SAE) Surface Vehicle Recommended Practice SAE J1772 REV ~~NOV 2004~~ XXX 2009, SAE Electric Vehicle Conductive Charger Coupler, which is incorporated herein by reference. All such vehicles must be equipped with an on-board charger with a minimum output of 3.3 kilovolt amps or an on-board charger with sufficient power capability to restore 95% of ARB certification UDDS range or Equivalent All-Electric Range in 4 hours or less.

Note: Authority cited: Sections 39600, 39601, 43013, 43018, 43101, 43104 and 43105, Health and Safety Code. Reference: Sections 39002, 39003, 39667, 43000, 43009.5, 43013, 43018, 43100, 43101, 43101.5, 43102, 43104, 43105, 43106, 43107, 43204 and 43205.5, Health and Safety Code.