SURFACE VEHICLE RECOMMENDED PRACTICE

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Energy Transfer System for Electric Vehicles - Part 1: Functional Requirements and System Architectures

RATIONALE

This stabilized Recommended Practice documents for reference the historical state of energy transfer systems and communications for electric vehicles as they existed in 2008, as defined in SAE J1772 (per published version 11-1-2001) for conductive charging and SAE J1773 (per published version 11-1-1999) for inductive charging.

SAE J1772 continues to be updated to reflect the latest in conductive charging technology. See the latest available version of J1772.

SAE J1773 remains unchanged for inductive charging.

Documentation for the now-emerging “wireless” inductive charging systems will be published when available.

Grid power quality for supplying charging systems is covered in SAE document series J2894.

For state-of-the-art documentation on charging communications, refer to the SAE documents in the series J2836, J2847, J2931, and J2953.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE Hybrid - EV Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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FOREWORD

This SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances.

The ability of Electric Vehicles (EVs) to correctly operate with the off-board electrical supply equipment used to charge them is a major concern for the producers and consumers of such vehicles. This concern stems from the cost of developing an electric “fueling” infrastructure. If EVs are to gain wide acceptance, this infrastructure must, at the least, provide consumers with the same level of convenience that is available for today’s fossil-fueled vehicles. Ideally, there would be a single set of physical and functional requirements for the interaction between an EV and the off-board equipment. Designing to those requirements would allow any EV to charge with any off-board equipment, regardless of the producer of the vehicle or off-board equipment. This would be similar to today’s internal combustion engine vehicles and gasoline pumps for unleaded fuels.

Today, there are two electrical energy coupling methods under consideration for EVs. One *conductively* transfers electrical energy (AC or DC) through metallic contacts. The other *inductively* transfers electrical energy through a separable transformer. These couplings are detailed in SAE J1772 and SAE J1773, respectively. Each of these physical coupling methods includes a means to communicate data that is necessary to control the transfer of energy to the vehicle. Unfortunately, these coupling methods are not physically compatible. Therefore, inoperability between EVs and equipment using different methods is not possible.

While inoperability between conductively and inductively coupled systems is not physically possible, each coupling method performs the same basic functions. When the combination of the EV and the off-board equipment is considered as a complete energy transfer system, there is no reason for the system's functional requirements to differ due to the physical coupling method. The only variation as a result of coupling method is the location (on-board or off-board) where specific functions are accomplished. Defining standards for certain functions of the total system and standards for the communication of data that pass between the EV and the off-board equipment will insure interoperability of equipment with common coupling methods. Different coupling methods will require a different system architecture, not different functional requirements.

Control of the charging of an EV's storage battery is specific to the type of battery and the configuration of the vehicle. Also, energy may be brought on-board a vehicle for purposes other than charging of the battery. These other purposes are specific to the needs of a particular vehicle. From these facts it follows that the EV should be in control of the transfer of energy from the off-board equipment. This way, EVs can have significantly different needs without forcing functional differences into the off-board equipment. It also establishes the EV (and its producer) as responsible to properly charge batteries, and allows charging requirements to evolve with developing battery technologies and EV experience.

This document will define a set of functional requirements for an Energy Transfer System (ETS) for Electric Vehicles, independent of energy coupling method. It will also serve as an "umbrella" document by reference of other SAE documents written or modified to accommodate this application. It will define three different physical system architectures that correspond to:

a. Conductive AC coupling

b. Inductive coupling

c. Conductive DC coupling

Requirements will be included and detailed only to the level that will insure functional interoperability for systems with common physical architectures. When designing systems, there will be additional requirements to consider that do not affect interoperability and are not included here. If requirements are found that affect functional interoperablity, they should be considered for subsequent inclusion under the SAE J2293 umbrella.

This document has been jointly developed by the Electric Power Research Institute-National Electric Vehicle Infrastructure Working Council (EPRI-IWC), Charging Controls and Communication Committee and the SAE Electric Vehicle Charging Controls Task Force. The efforts of all who participated are greatly appreciated.

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