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## Standards



The design, manufacture, and operation of EV and PHEV charging systems and their infrastructure has given rise to several key standards that end-users should be aware of. Safety is the most important factor that is driving the adoption of these standards. Among the agencies involved in developing these standards are: the National Fire Protection Agency (NFPA), the Society of Automotive Engineers (SAE), and Underwriters Laboratories (UL). A brief summary of these standards is in order:

#### NFPA 70 (National Electrical Code)

Article 625 of the NEC (National Electrical Code) specifies the requirements for the external equipment and wiring necessary for the purpose of charging an electric vehicle (EV or PHEV) connected to the premises supply of electricity. The standard defines the coupling equipment requirements between the electric vehicle and the premises supply power. The standard also requires that the vehicle charging coupler be polarized, non-interchangeable with wiring devices in other electrical systems, constructed so as to guard against electric shock, provided with a means to prevent unintentional disconnection, and properly grounded. The standard also addresses the rating of power supply equipment, ventilation requirements and signage for batteries, the means of coupling (i.e., either conductive or inductive), the type of wire and cable used for charging, overcurrent protection, the personnel protection system used to guard against shock hazards, means of disconnection, bi-directional power flow, and the location and mounting height of the charging/coupling equipment. The key requirements of Article 625 include the following[1]:

- Wiring methods, including electric vehicle coupler design, construction, and functionality
- Electric Vehicle Supply Equipment (EVSE) coupler requirements, including polarization, non-interchangeability, construction and installation, unintentional disconnection, and grounding pole requirements
- EVSE construction requirements, including rating, markings, means of coupling, cable, interlock, and

#### SAE Electrified Vehicle Standards

The following is a list of standards published by the Society of Automotive Engineers (SAE) that pertain to electrified vehicle safety<sup>2</sup>:

- **J1772 Electric Vehicle Conductive Charge Coupler**  
This document covers the general physical, electrical, and performance requirements for the electric vehicle conductive charge system and coupler for use in North America. The intent of this document is to define a common electric vehicle conductive charging system architecture, including operational requirements and the functional and dimensional requirements for the vehicle inlet and mating connector.
- **J1773 Electric Vehicle Inductively Coupled Charging**  
This document establishes the minimum interface compatibility requirements for electric vehicle (EV) inductively coupled charging for North America. This part of the specification is applicable to manually connected inductive charging for Levels 1 and 2 power transfer. Requirements for Level 3 compatibility are contained in Appendix B.
- **J1776 (2005) Recommended Practice for Electric and Hybrid Electric Vehicle Battery Systems Crash Integrity Testing**  
The purpose of this document is to define test methods and performance criteria that evaluate battery system spillage, battery retention, and electrical system isolation in electric and hybrid electric

automatic de-energization of the charger cable

- EVSE control and protection, including overcurrent protection, disconnecting means, loss of primary source, and interactive systems
- EVSE location requirements, including hazardous (classified) locations, indoor sites and ventilation requirements for indoor installations (where applicable), and outdoor site requirements

vehicles during specified crash tests.

- **J2293 Energy Transfer System for Electric Vehicles**  
This document establishes requirements for EV and the off-board EVSE used to transfer electrical energy to an EV from an electric utility power system (utility) in North America.

<sup>1</sup> Morrow, Kevin; Karner, Donald; Francfort, James. U.S. Department of Energy Vehicle Technologies Program – Advanced Vehicle Testing Activity: Plug-in Hybrid Electric Vehicle Charging Infrastructure Review, Idaho National Laboratory, Battelle Energy Alliance, November 2008

<sup>2</sup> SAE web page, <http://www.sae.org/standardsdev/>