U.S.-India Virtual Standards Workshop
The Future of Electric Vehicles in India
Session I
EV Charging Standards and Protocol

February 18, 2021
Opening Remarks

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EV CHARGING GLOBAL SAFETY REQUIREMENTS

Rich Byczek

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AGENDA

01 Introduction

02 EVSE Types and Related Standards

03 Global Certification Programs

04 Questions
A GLOBAL AUTOMOTIVE AND ELECTRIC VEHICLE FOOTPRINT

North America:
- Detroit, MI
- Grand Rapids, MI
- San Antonio, TX
- Pittsfield, MA

South America:
- Valparaiso, Chile

EMEA:
- Milton Keynes, UK
- Kaufbeuren, Germany
- Kista, Sweden
- Geleen, Netherlands
- Johannesburg, S.A.

APAC:
- Shanghai, China
- Guangzhou, China
- Chongqing, China
- Wuhan, China
- Bangkok, Thailand
- Taipei, Taiwan
- Seoul, South Korea
- Matsuda, Japan

1,100+ TT employees

Temporary Test Centers
- Griesheim, Germany
- Lulea, Sweden
- St. Petersburg, Rus.
- Dubai, UAE

Employees
ELECTRIC VEHICLE TESTING

From battery packs to charge stations

• Battery Testing
• UNECE R100.02
• EVSE Certification
• EV Interoperability
• SAE J1772 / J2953
• CHAdeMO
• ETL Safety Mark
02

EVSE TYPES AND RELATED STANDARDS
WHAT IS EVSE?

**EVSE: Electric Vehicle Supply Equipment**

The US Electrical code (NFPA 70) Article 625 gives the following definition

625.1 Scope – 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

NOTE: While vehicle on-board systems (couplers, DC-AC converters/chargers) may perform some of these functions, they are typically considered as separate from the EVSE.
Charge Stations: AC Power Transfer

UL 2594, 2nd edition 2016, CSA 22.2 #280-13 and NMX-J-677-ANCE-2013
Safety Standard for Electric Vehicle Supply Equipment

NFPA 70
US National Electric Code, article 625

IEC 61851-1, 3rd edition 2017
Electric vehicle conductive charging system – Part 1: General requirements

IEC 62752, 1.1 edition 2018
In-Cable Control and Protection Device for mode 2 charging of electric road vehicles (IC-CPD)
Charge Stations: AC Power Transfer

Wall Mount Charge Station for homeowners – typically mounted in the homeowner or business garage or parking areas and permanently connected for high amperage charging. (US 208-240VAC 1P, elsewhere 220-250VAC 1P/3P). Often Referred as “Level 2” Charge Stations

Municipal Charge Station –. Can be mounted anywhere: parking lots, hotels, etc. May be provided with a variety of options for things such as credit card readers, I/O ports for recording data etc. Typically a “Level 2” type system.
EV CORDSETS: “IC-CPD”

IC-CPD: In-Cable Control and Protection Device
Also called: Mode 2, cordset

- EV Coupler
- EV Output Cable
- IC-CPD (control and Protection circuit)
- Input (Mains) Cable
- Mains Coupler (“plug”)
EV Charger: Offboard DC Power

UL 2202, 2nd edition 2009
Standard for Electric Vehicle (EV) Charging System Equipment

CSA 22.2 #107.1-16, 2016
Power Conversion Equipment, Clause 16

IEC 61851-1, 3rd edition 2017
Electric vehicle conductive charging system – Part 1: General requirements

IEC 61851-23, 1st edition 2014
Electric vehicle conductive charging system – Part 23: D.C. electric vehicle charging station

IEC 61851-25, 1st edition 2020
Electric vehicle conductive charging system – Part 25: DC EV supply equipment where protection relies on electrical separation

FOCUS ON <120VDC, <100ADC
EV Charger: Offboard DC Power
Common Elements: Personnel Protection System

UL 2231-1, 2\textsuperscript{nd} Edition 2012, CSA C22.2 \#281.1 and NMX-J688/1-ANCE
Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements

UL 2231-2, 2\textsuperscript{nd} Edition 2012, CSA C22.2 \#281.2 and NMX-J688/2-ANCE
Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems

IEC VARIOUS:

“RCD”: Residual Current Device
“GM”: Ground Monitor
“CCID”: Charge Current Interrupt Device
“GFI/GFCI”: Ground Fault Circuit Interrupt Device
Common Elements: Vehicle Coupler

UL 2251, 4th Edition 2017, CSA C22.2 #282 and NMX-J678-ANCE
Safety for Plugs, Receptacles and Couplers for Electric Vehicles

IEC 62196-1 Ed.3 (2014)
Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 1: General requirements

IEC 62196-2 Ed.2 (2016)
Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability requirements for AC pin and contact-tube accessories

IEC 62196-3 Ed. 1 (2014)
Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles – Part 3: Dimensional compatibility and interchangeability

IEC 62196-6, ED1 (draft) 2021
Electric vehicle conductive charging system – Part 23:
D.C. electric vehicle charging station
FOCUS ON <120VDC, <100ADC
EV Charger: EV Couplers
Battery chargers intended for charging batteries in a household end use application outside the scope of the IEC 60335 series of standards are within the scope of this standard.

Battery chargers not intended for normal household use, but which nevertheless may be a source of danger to the public, such as battery chargers intended for use in garages, shops, light industry and on farms, are within the scope of this standard.
GLOBAL CERTIFICATION PROGRAMS
How do I know whether product has been certified?

• Each NRTL uses its own unique, registered certification mark(s) to designate conformance

• Each NRTL must register its certification mark(s) w/the US Patent & Trademark Office

• The manufacturer physically places the mark on the products

• An NRTL must ensure that its mark is applied to each unit, or if not feasible, to the smallest package containing each unit

• The presence of a safety mark also means the product is ‘listed’ in the NRTL’s “directory” – public record.

• And, is part of an on-going follow-up program that ensures the products continuously comply with the applicable standards
CB Scheme?

- The CB Scheme is an international program (under IECEE) for the exchange and acceptance of product safety test results among participating laboratories and certification organizations around the world.
- The CB Scheme offers manufacturers a simplified way of obtaining multiple national safety certifications for their products — providing entry into over 45 countries.
- “ELVH” Category covers the EVSE-specific IEC standards.
EVSE CERTIFICATION – CB SCHEME

How can I get a CB Scheme Certification

• Each member country has one or more NCB (National Certification Body)
• Each NCB overseas one or more CBTL: Certification Body Testing Laboratories.
• Each NCB and CBTL is accredited/approved by the IECEE to issue test reports and certificates.
What about the rest of the world?

- NRTL or CE mark may be accepted in some countries
- “Mode 2” cord sets must have the appropriate plugs and couplers.
- IECEE CB SCHEME:
  - Provides a global “PASSPORT”
  - Ease of attaining local “VISA” (country-specific marks of conformity)
  - For EVSE: not harmonized to US/CAN, Japan, China
  - Safety AND EMC Requirements Covered
US / CAN NRTL Program: non Harmonized to the 250V/50Hz world

CB Scheme provides a path for the rest of the world, based on existing IEC standards

Micromobility products can use “Off The Shelf” chargers. Ride share and public access will require further development. BATTERY SWAP to be discussed.

Heavy truck not discussed here: in-house charging infrastructure vs public access charging.

Protocols and Interoperability are separate from safety requirements. To be discussed.
THANK YOU!

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- Bureau of Indian Standards (BIS) Sectional Committee ETD-51
  - National Mirror Committee for IEC TC-69, TC-23H, JWG-11, JWG-1
  - EV Charging Standards work has gathered momentum.
- Specific Uses cases in the Tropical Region
  - High Power Charging Stations (Pathway)
  - Light EV Charge Point (all localities)
  - Park Bay Charge Point (Destination)
  - Battery Swap Standard
  - Unified payment mechanism (UPI, FASTag)
### Four Specific Use Cases

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<td>Plug-in Connection</td>
<td>50 kW to 250 kW</td>
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<td>Normal Power</td>
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<td>Park-Bay Charge Point</td>
<td>Type-2</td>
<td>CCS &amp; Chademo</td>
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<td>Light EV Charge Point</td>
<td>IEC-DC &amp; Indian-Combined</td>
<td>1-phase, &lt;7 kW</td>
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**Diagram:**

- 1. Light EV Park-Bay
- 2. Park-Bay Charge Point
- 3. Highway Charging Station
- 4. Depot Charging Station
Directions for Indian Charging Standards

1. Light EV AC Charge Point - Draft Indian Standard prepared & circulated in BIS Committee.
   - Only small change required to Connection Standard
3. Light EV DC Charge Point drafts ready
4. Pantograph for Charging from 200 kW to 1MW
   - A draft IEC standard is being studied for adoption in India
   - Indian Standard for Charging Stations prepared, It is being studied for use in eBus Charging.
   - Upto 180 kW can be delivered with one gun; so upto 350kW can be charged using plug in connectors
   - Pantograph for Charging from 200 kW to 1MW
Light EV can be charged anywhere
- Charge points in stores, roadside, apartments
- Ubiquitous AC Charge Points
- Dense network of DC Charge Points

Innovations are expected
- Battery Swapping
- Fast Charging battery
- Primary cells like Aluminium Air

Full conversion to eMobility is possible
Light EV AC Charge Point
1Φ power supply
Charge EV in the Parking itself

Charging Rate depends on the onboard charger. A small onboard charger = slow charging

Fast Charge a FAME car in parking lot with DC Unit
Examples are from Europe - cable can be detached. System proposed for Car Parks.
High Power Charging Stations
MoP/ DHI

EV to Grid Communication

Device & Charging Protocol Standards
1. 17017 Part-1
2. 17017 Part-21-1
3. 17017 Part-21-2
4. 17017 Part-2-1
5. 17017 Part-2-2
6. 17017 Part-2-3
7. Draft 17017 Part-23
8. Draft 17017 Part-24

Standards have been developed.

Highway Charging Station
Plug-in Connection
CCS & Chademo

50 kW to 250 kW

5. 15118 Part-5
6. 15118 Part-6

1. 15118 Part-1
2. 15118 Part-2
3. 15118 Part-3
4. 15118 Part-4

Standards have been developed.
Per-trip Fast Charge eBus @ Depot.
EV CHARGING PROTOCOL OPTIONS
COMMUNICATION AND CONTROL
FROM WATTS TO MW+ MULTIPORE
ELECTRIC VEHICLE CHARGING

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Lee Slezak program manager

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OVERVIEW-SCOPE

- ANL/DOE recent work is focused on charging as many vehicles per site as possible using existing electrical distribution infrastructure (up to MW level)

- Vehicle electrification covers LEVs (hundreds of Watts) to light duty EVs (kW) to medium duty (delivery, many kW) to heavy duty-bus/truck; 20kW->200kW->2MW

- Smart Charging is required to proactively manage available electrical resources.

- Protocols, standards and interoperable solutions enable a more useful/optimized national approach to charging infrastructure planning/operation (resiliency)

- Commercial charging transactions are covered by Weights and Measures (AHJ)
AC DISTRIBUTION VS DC DISTRIBUTION; ‘SMART CHARGING’

- **AC charging** in general seldom uses vehicle-EVSE communication.

- **DC Charging couplers** require vehicle-EVSE communication to control power delivered. This communication can access vehicle state of charge that can be used to conduct ‘flow control’ to allocate charging capacity based on estimated charging completion time.

- Managed AC charging distribution system are based on maximum load at each location (covered by NEC part 625.42 for managed loads).

- DC distribution systems can more ‘directly’ manage local PV/storage generated charging energy, split between a few or many vehicles (DER).
ACTIVE LOAD MANAGEMENT EXPANDS RESOURCE FROM 30 TO 160 EVSE

Powerflex Systems; **UL916 safety certified** (AC charging)  
[https://www.powerflex.com/turnkey-solutions/](https://www.powerflex.com/turnkey-solutions/)

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**30 EVSE@32A WITHOUT ALM**

- (10) 32A Level 2 Charging Stations
- Existing Distribution Board 208Y/120V
- 112 kW PanelBoard
- 40 ft Conduit

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**160 EVSE@32A WITH ALM**

- (80) 32A Level 2 Charging Stations
- Existing Distribution Board 208Y/120V
- 112 kW PanelBoard
- 45 ft Conduit

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**71 EVs without Adaptive Charging**

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**71 EVs with Adaptive Charging:**

- 44% LESS Power Capacity Required

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Not a single car had to stay later to receive the same amount of energy as the chart above.
MW+ MULTI-PORT EV CHARGING SYSTEM LABELED SEGMENTS

From Source to Load (grid-to battery)

1) Utility Interconnection
2) AC/DC Power Conversion
3) DC Distribution, w/DER Elements
4) DC Dispenser Electronics, Cables, Couplers, Micro-siting
5) Vehicle Inlet, Battery-BMS, Safety
BACK OF THE ENVELOPE- CLASS 4 DELIVERY VEHICLE ENERGY CONSUMPTION AND CHARGING SPEED/DURATION

• ~5kW AC charging rate, 12-15hr recharge(60kWhr), ~ 1kWhr/mile
• Compared to Bollinger Deliver-E vehicle with 70kWhr, 105, 140, 175, 210 kWhr battery translates 70-210 mile range
• Basic recharge rate/duration: 20kW=20 miles/charging hour, 3.5-10.5hrs; 100kW=100 miles/charging hours; <1hr-2.1hrs
BACK OF THE ENVELOPE- CHARGING CLASS 8 LINE HAUL TRACTORS

https://www.trucks.com/2019/09/05/everything-we-know-about-the-tesla-semi-truck/

• Class 8 trucks loaded to 80,000lb GVW consume ~2kWhr/mile (or more)
• Replacing 400 miles range (800kWhr) in 30 minutes requires (2C) 1.6MW
• Shorter route vehicles have smaller battery capacity, shorter recharge time
• Overnight charging (8hrs) requires {average} 100kW for 800kWhr
TA Petro Ontario California truck stop ~600 parking spots (on left); again as many on right. Electrifying up to 1200 parking/charging spots is both an opportunity and a challenge.
BALANCING ACT; SCALING, FINANCING, EXPANDABILITY, INTEROPERABILITY

- Multi-port MD/HD electric bus and MD/HD truck charging source-to-destination (utility interconnection to battery terminal), up to 1MW or above
- More realistically multiple vehicles at a single location, addressing utility interconnection **pad mounted transformer 2.5MVA limitations**.
- At the 1MW-2.5MW level, ignoring losses this equates to simultaneous charging of

  - 1 to 2.5 charging ports at **1MW** each
  - 2 to 5 charging ports at **500kW** each
  - 10 to 25 charging ports at **100kW** each
  - 50 to 125 charging ports at **20kW** each

- One can do the math on oversubscription of 4-10x for sharing DC sources (10’s at MW level to hundreds at the 100kW/20kW per port from one 480vac/2.5MW AC-DC conversion feed (**1500vdc*1666A=2.5MW** DCaaS DC bus distribution feed)
LEV MULTI-PORT DC DISTRIBUTION (600W) SMART CHARGING

- LEV (bicycle, scooter, 3 wheeler) batteries are ~1000Whr or less
- DC charging can share common resource (PV/battery) to many LEVs
- 48v DC/DC converters as low as $30 for 480 watts; 15 vehicles=7kW

Magnetic base power w/data coupler (60v/40A) [LEON] Legacy golf cart plugs (48v)
https://www.rosenberger.com/product/ropd/
FREEWIRE BOOST CHARGER - INTEGRATED LOCAL STORAGE, 27KW INPUT
DUAL 60KW (120KW SINGLE) OUTPUT


Low voltage AC power input  AC power converted to DC  Integrated battery discharges  2 high-efficiency DC converters  Dual connectors for simultaneous fast charging

AC Grid Service

240 or 208 Vac, Up to 27kW

160 kWh Li-Ion Battery Pack

CCS Port

120 kW Max (1 Port) or 2 at 60 kW simultaneous

CHAdEMO Port
MW MULTI PORT ELECTRIC TRUCK-BUS CHARGING COUPLERS

• SAE-IEC Combination Charging System (CCS) DC couplers (w/liquid cooled cables) can deliver up to 1000v/500A (.5MW) today

• The CharIN ‘Mega Charging System’ (MCS) coupler is under development; target capability of 1500v(max)/3000A(max){4.5MW}; prototype couplers under development. Lab prototypes have run at full 3000A. PLC vs CAN communication noise immunity testing.

• SAE J3105(-1, -2, -3) Overhead Pantograph; 600kW-MW+ mechanized couplers
GRADIENT OF EV CHARGING COUPLERS WITH POWER LEVELS/VEHICLES

- **Light duty vehicles**, some school buses use **AC SAE J1772 Level 2** (208/240vac-80A) chargers; 30A/7kW nominal; 80A/19.2kW max.

- **Medium Duty (commercial) vehicles** can use **SAE J3068** AC; 3-phase; 63A/480v(53kW)
  
  Advanced versions on J3068 can handle 120A/480v(99kW), or **Tesla** at 160A(120kW dc)
  
  Higher voltage **SAE J3068-DC6** can push 320A(2x160A) up to 1000vdc (600vdc today)

- **Light-Medium Duty vehicles;** can use **J1772-CCS** 1000vdc/350A-500A (up to 500kW)

- **Medium/Heavy Duty bus** (port/drayage trucks) can use **SAE J3105 (/1, 2, 3) <600kW**

- **Medium/Heavy Duty trucks** can use **CharIN MCS;** under 1000vdc/1000A (1MW) today, potential for 1500v/3000A (4.5MW) in the future
SELECT REFERENCES TO RELEVANT ROADMAPS/STANDARDS

• ABB Solar fed EV Charging stations for eRickshaws (50kW)

• 2012 Era ANSI EVSP Roadmap on standard; summaries of activities
  https://share.ansi.org/evsp/ANSI_EVSP_Roadmap_Standards_Compendium.xls

• IEEE P2030.10; DC Microgrids for Rural/Remote Electricity Access (w/EVs)
  https://www.slideshare.net/e4sv/kuching-2g34-off-grid-dc-microgrid-che-hang-seng

  ▪ Tesla India manufacturing; charging subsidies
    https://www.reuters.com/article/tesla-india-electric-idUSKBN2AD0MJ
An Overview of SAE International Standards Activities Related to Hybrid / Electric Vehicles

Keith Wilson
Technical Program Manager,
Ground Vehicle Standards
02/18/2021
Global Ground Vehicle Standards Structure

- 145,000+ SAE members worldwide
- Representatives from 100 Countries
- 8,375 GV Standards Published
- 1,817 GV Standards Maintained
- 491 GV WIP Standards
- 564 GV Technical Committees
- 8,800 GV Committee Members
- 2,900 Companies
- Representatives from 50 Countries
SAE EV / Hybrid Vehicle Steering Committee

- Started – 2005
- Current Committee Membership
  - > 1100 Individual Participants
  - > 500 Companies
    - OEM’s
    - Suppliers
    - Government
    - Academia
- 10 EV / Hybrid Vehicle Subcommittees
- 4 Fuel Cell Standards Subcommittees
- 66 SAE EV, Hybrid, Fuel Cell Vehicle Standards Published to Date
65 SAE EV, Hybrid, Fuel Cell Vehicle Standards:

**Fuel Cell Fueling**: J2600, J2601, J2601/1, J2601/2, J2601/3, J2601/4, J2719, J2719/1, J2799, J1766, J2578, J2579

**Fuel Cell Systems**: J2579, J2594, J3089

**Fuel Cell Testing**: J2615, J2616, J2617

**Energy Transfer Systems**: J2293, J2293/1, J3072

**EV, Hybrid, Fuel Cell Vehicle**: J1766, J2344, J2910, J2990, J2990/1, J3108, J2578, 3108

**EV, Hybrid, Fuel Cell Vehicle Crash Safety**: J3040, J1766, J2990, J2990/2

**EV Charging & Grid Communications**: J1772, J1773, J2293, J2836, J2841, J2847, J2894, J2931, J2954, J3068, J3105, J3105-1, J3105-2, J3105-3, J2799

**EV, Hybrid, Fuel Cell Vehicle Economy, Range / Power**: J2991, J1798, J2758, J2946, J2572, J2907, J2908, J1634, J1711, J2711

**EV Charging Safety**: J1718, J2953/1, J2953/2, J2953/3

**EV, Hybrid, Fuel Cell Vehicle Terminology**: J1715, J2574, J2760

* * Blue Font Denotes WIP

[Links]
SAE EV, Hybrid, Fuel Cell Vehicle Standards Focused on Vehicle Safety

**J2990 & J2990/1:**
- Emergency Response Guides (Immobilize, Disable, Warnings)
- Vehicle Type Identification (Badging)
- High Voltage Shutdown (Disconnects, Battery & Converter Cables)
- Tow & Inspection Guides (Recovery, Isolation, Inspection, Diagnostics)
- Hazard Communication

**J2990** - Hybrid and EV First and Second Responder Recommended Practice

**J2990/1** - Gaseous Hydrogen and Fuel Cell Vehicle First and Second Responder Recommended Practice

**J3108** - xEV Labels to Assist First and Second Responders, and Others (high voltage safety info.)

**J2344** - Guidelines for Electric Vehicle Safety (EV, HEV, PHEV and FCV high voltage systems)

**J2578** - Recommended Practice for General Fuel Cell Vehicle Safety (fuel cell system, storage & high voltage)

**J1766** - Recommended Practice for Electric, Fuel Cell and Hybrid Electric Vehicle Crash Integrity Testing

**J2910** - Recommended Practice for Design & Testing Hybrid Electric/Electric Trucks/Buses for Electrical Safety
SAE J1772 Revision 8

Manual AC & DC conductive connection for low and high power levels

Auto OEMs supported moving to higher power levels for charging (8th revision)

SAE J1772 Task Force has raised the voltage and current limit of the SAE Combo Connector

- Current limit from 200A to 350A
- Voltage limit from 500Vdc to 1000Vdc
- = 350kW Max Power

Publication completed: October 2017
SAE J3105 Overhead & Portal Charging

• Automated charging connection at high power- SAE J-3105
  • Document will standardize the interface between the infrastructure and the bus
  • Targeted towards in-route DC charging, for example to recharge at transit bus during a short stop
  • DC Power Levels (Voltage Range: 250-1,000 DC Volts) up to 1MW

• DC Power Levels
• Power Configurations
• Connection Points
• Communications
• Safety
• Alignment Protocol
SAE J3068 AC Depot Conductive Charging

Depot Charging - 3 Phase AC (J-3068) targeted towards charging at commercial and industrial locations or other places where three-phase AC power is available and preferred such as at commercial and industrial locations (160A 480VAC 3ø = 133kW)

Defines a conductive power transfer method including the digital communication system. It also covers the functional and dimensional requirements for the vehicle inlet, supply equipment outlet, and mating housings and contacts.
## SAE J2954 Wireless Power Transfer for Light-Duty Plug-In/Electric Vehicles

### SAE J2954 Standard Development
- Inductive Charging Interoperability
- Automated Charging
- Power Transfer Communications
- Smart Grid Interoperability
- Automatic Shutdown Capability
- Autonomous Parking / Charging

### SAE J2954 Published
October 2020

### Key aspects:
- Static applications (currently)
- Efficiencies of over 85% (Aligned)
- Air gaps up to 25 cm
- Safety Limits
- Validation Tests

### Charging Locations:
- Residential
- Public
- On-Road
- Static (parking lots, curb side)
SAE J2954 Task Force Testing Protocols

SAE Standard will Define:
- Performance
- Safety
- Testing Methodologies
- Charge Levels
- Location & Alignment
- Communications

SAE J2954 WPT Power Classes

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<td>7.7 kW</td>
<td>11 kW</td>
<td>22 kW</td>
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Safety Limits
- EMF Limits with AAMI
- EMC Limits
- Positions / Orientations
- Efficiency Power Transfer
- SAE J1211
- ISO 16750
- USCAR 37
- Object Detection
- Temperature Test
- Automatic Shutdown
# SAE Plug-In Electric Vehicle Grid Communication Standards

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- Series of Standards defining Use Cases, Information Messages and Communication formats
## SAE Grid Communication Standards

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Establishes the requirements for digital communication between Plug-In Vehicles (PEV), the Electric Vehicle Supply Equipment (EVSE) and the utility or service provider.
Battery Standards Steering Committee and Technical Committees

- Started – 2009
- Committee Membership
  - >290 Individual Participants
  - >160 Companies
    - OEM's
    - Suppliers
    - Government
    - Academia
- 23 Subcommittees

NEW COMMITTEES
- 24) Electric Vehicle Battery Service
- 20) International Battery Interface

COMPONENTS & MATERIALS
- 23) Battery Systems Adhesives-Sealants-Heat Transfer Materials
- 21) Battery Thermal Management
- 19) Battery Systems Connectors
- 14) Battery Materials Testing

LIFE MANAGEMENT
- 10) Battery Recycling
- 15) Secondary Use
- 18) Battery Field Discharge & Disconnect

SUPPORT
- 4) Battery Transport
- 12) Battery Testing Equipment
- 13) Battery Terminology
- 3) Battery Labeling

PRODUCT SPECIFIC
- 2) Battery Standards Testing
- 1) Battery Safety
- 16) Start-Stop Battery
- 17) Capacitive Energy Storage
- 5) Battery Size Standardization
- 9) Battery Standards Future Energy Storage Systems
- 6) Starter Battery
- 8) Battery Standards Electronic Fuel Gauge

INDUSTRY SPECIFIC
- 11) Small Task Oriented Vehicle Batteries
- 7) Truck Batteries
- 22) Bus Battery

Global Ground Vehicle Standards
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# 45 SAE Battery Standards Committee Documents

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* Green Font Denotes WIP
This committee will initially focus on low-speed personal mobility devices and the technology and systems that support them that are not normally subject to the United States Federal Motor Vehicle Safety Standards or similar regulations. These may be device-propelled or have propulsion assistance.

Emerging and innovative mobility vehicles and devices, sometimes referred to as micro-mobility, are proliferating in cities around the world.

These technologies have the potential to expand mobility options for a variety of people.

Recent formation of the SAE Micromobility Battery Committee which will focus specifically on battery and charging needs.
Questions?

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Thank you!

Remember to register for our next EV webinar sessions on February 23rd and 25th