A View of the Standards and Certification Landscape for Electric Vehicles

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A Global Leader Since 1919 In:

Standards

- Develops standards for the U.S. and Canada and participates internationally
- Over 3,000 standards and codes in 54 technology/product areas
- 1,300 technical committees; 9,000 engaged, dedicated volunteer members
- Provides standards-based training across a range of industries

Testing & Certification

- Tests and certifies products for North America and internationally
- Special Inspections and Field Evaluations
- **CSA marks appear on billions of qualified products worldwide**

Consumer Product Evaluation

- Conducts energy efficiency and performance evaluation services
- Helps streamline the entire product development cycle
- Works closely with manufacturers, importers, distributors and major retailers

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Standards and EV Adoption

CSA Group

- Regulations, Codes, and Standards (RCS) can help drive mass adoption
  - Improved Safety
  - Interchangeability/compatibility
  - Customer acceptance
- Address new technology issues
  - Retrofit of buses to electric
  - Second-use batteries
  - Wireless and DC fast charging

CSA Group Vision:

"A better, safer, more sustainable world, where standards work for people and business"

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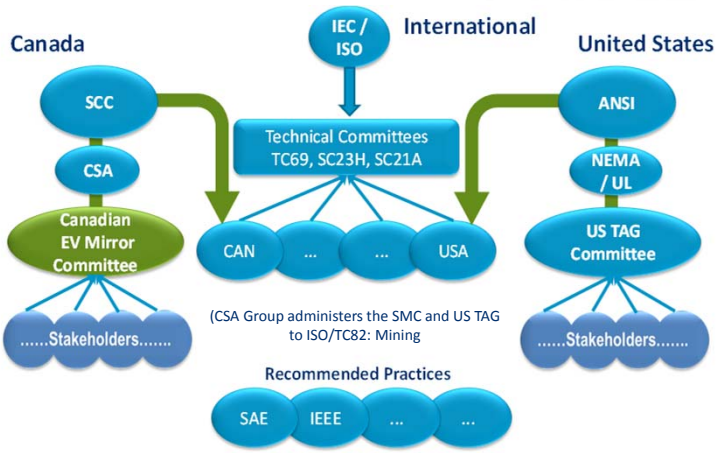
Standards Development Process



Gain value from participation in technical committees:
- **Have a voice in standard development**
- **Early access to draft standards**

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Types of Compliance Requirements

- **Direct regulations** – Mandated by law in a given jurisdiction
- **Indirect regulations –** Required to meet codes which are adopted into local or regional law, such as the US National or Canadian Electrical Codes
- **Customer requirements –** Required to ensure supplier quality and bolster liability protection
- **Industry Norms/historical practices –** Promote the general safety position of the sector as a whole
- **Corporate policy –** Ensure conservative approach to safety

Involving an Accredited certification partner early in the design process can help create and execute a successful compliance plan.

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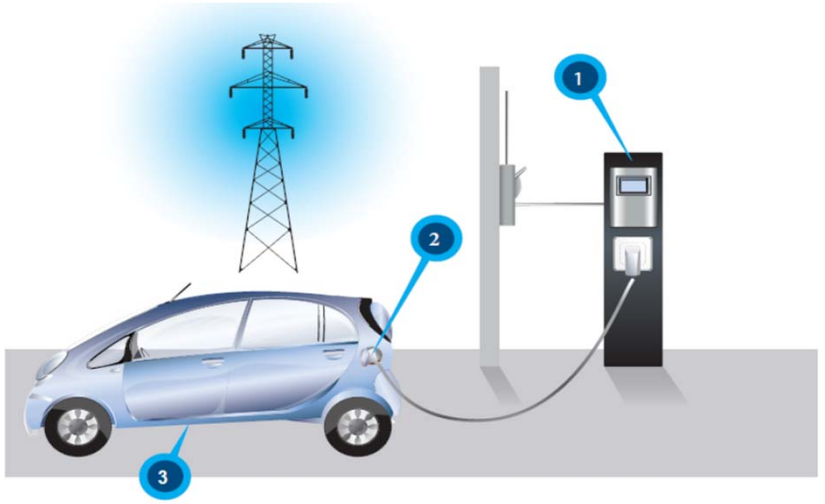
Standards for the EV System



1 Electric Vehicle Supply Equipment 2 Plugs, Receptacles and Couplers 3 Battery Pack

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Standards for the EV System - Vehicle

- Limited Federal reg's in North America
  - 49 CFR 571.305 - Standard No. 305; Electric-powered vehicles: electrolyte spillage and electrical shock protection
- Industry recommended practices
  - SAE, USABC
- Emerging Technologies
  - Communications: V2V, V2G
  - Cyber Security
  - Interoperability
  - First responder safety
  - Autonomous vehicles

Sample Documents	
SAE J2344	Guidelines for Electric Vehicle Safety
SAE J1715	HEV & EV Terminology
UN ECE 324 Reg 100 Revision 2	Requirements for the electric power train
GB/T 18384 series	Chinese EV/HEV safety specification
India AIS 049	Type Approval of Electric Vehicles
Emerging Technologies	
SAE J3016	Levels of Driving Automation
SAE J2990	Hybrid and EV First and Second Responder Recommended Practice
SAE J2931/1	Digital Communications for PEV
SAE J2931/7	Security for PEV Communications
SAE J3061	Best practices for Cybersecurity
ISO 15118 Series	Road vehicles -- Vehicle to grid communication interface

Safety of vehicles is traditionally handled by the OEM, but growing connection/communication with the grid may require a more robust certification paradigm

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Standards for the EV System - EVSE

- Three primary types
  - Level 1, Level 2, and DC Fast Charge
- Local codes will generally require certification and a safety mark
- Emerging Technologies
  - Communications: with vehicle and home networks
  - Wireless Charging

Sample Documents	
CSA Group, UL, ANCE NMX-J-677-ANCE-2013/C22.2 No. 280–13/UL 2594	Electric vehicle supply equipment (harmonized for North America)
CSA Group, UL, ANCE NMX-J-668/2-ANCE/C22.2 No. 281.2-12/UL 2231-2	Standard for safety for personnel protection systems for EV supply circuits (harmonized for NA)
IEC 61851 series	Electric vehicle conductive charging system
GB/T 18487 Series, 2015	EV Conductive Charging system (China)
Emerging Technologies	
CAN/CSA-E61980-1; SAE J2954; UL2750; IEC 61980 series	Wireless Charging Standards
GB/T 27930-2015	Communication protocols between off-board conductive charger and BMS for EV

Build-out of a robust charging infrastructure requires the safety and commonality which standards help encourage

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Standards for the EV System – Plugs

- Standardization of plugs, receptacles, and connectors is critical to customer acceptance
  - Ability to charge at different locations
  - Ability to purchase multiple cars with common chargers
- Local codes will generally require certification and safety mark

Sample Documents	
CSA Group, UL, ANCE NMX-J-678-ANCE/C22.2 No. 282–13/UL 2251	Plugs, receptacles, and couplers for electric vehicles
SAE J1772	SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler
IEC 62196-3	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of EV's
UL 2251	Standard for Plugs, Receptacles, and Couplers for Electric Vehicles
GB/T 20234 Series - 2015	Connection set for conductive charging of electric vehicles (China)

Is evolution to standardized connection points inevitable?

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Standards for the EV System - Battery

- The battery is both an enabling technology and the primary source of hazards associated with EV's
- Pressure to increase performance:
  - Increase range & enable new styles
  - Reduce cost, weight, charging time
- Emerging Technologies
  - Secondary use for ES
  - Stranded energy
  - Grid connection
  - Recycling
  - EDLC – "Ultracapacitors"
  - Retrofit bus applications

Sample Documents	
CAN/CSA-E62660 Series (IEC 62660 adoption)	Secondary lithium-ion cells for the propulsion of electric road vehicles
SAE J2929	Electric and Hybrid Vehicle Propulsion Battery System Safety Standard
SAE J2464	EV Battery Abuse Testing
USABC	Testing Manuals
GB/T 18384.1-2015	Electrically propelled road vehicles. Safety spec's (China)
AIS 048	Safety Requirements for Traction Batteries – Electrical & Mechanical Abuse Tests (India)
Emerging Technologies	
SAE J2997	Stds for Battery secondary use
SAE J2974	Technical Information Report on Automotive Battery Recycling
IEC 62576	Electric double-layer capacitors for use in hybrid electric vehicles

NAATBatt and SAE specifically working to address E-Bus safety due to potential impact of major failure to the public and the industry

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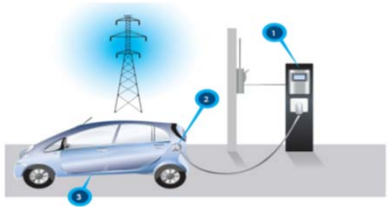
Conclusion

- The RCS landscape is incredibly complex – get involved!
  - Technical Committees
  - Professional organizations
- Certification is often a component issue, but safety is a systems issue
- An experienced certification provider such as CSA Group can help to navigate the global compliance maze



Thank you!

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