

## Scope

Summary of requirements relating to high power ( $\geq 1\text{MW}$ ) charging.

The scope is to be limited to the connector, and any related requirements for the EVSE, the vehicle, communication, and related hardware.

The current regions for focus are the US and EU markets.

## Application

Focus on Class 8 commercial vehicles.

Other potential applications include Class 6/7 trucks, buses and other large commercial vehicles (airplanes, ships, off road equipment, etc.).

## Areas of general agreement:

- J1772 and CCS is not sufficient for high power charging of large electric trucks
- Support for both IEC15118 and DIN70121 would be desirable to allow compatibility with existing infrastructure in North America
- Backwards compatibility of hardware (connector) is desired
- Greater than 1MW power capacity is needed
- DC charging is the correct approach (vs AC)
- Assisted (automated) operation should not be blocked, but is also not required by the content of the standard
- V2X power flow should be supported (bi-directional capability)
- User education should be addressed
- A use-case approach to requirements development is appropriate
- Standardization of certain technical parameters is needed (e.g. charging port location)
- Usage of cord/connection sets should be similar in experience to existing low power solutions
- Contact max temp defined in IEC62196 and UL2251

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## Terms and Definitions

Term	Definition
Assisted charging	Human and hardware supported involvement in the charging process
Automatic charging	Human only initiates the charging process, hardware connects and charges without human support
Automated charging	No human involvement in the charging process
Bi-directional	Power flow to/from the vehicle
Breakdown Manager	Person to accept and manage fueling requests, including after hours
Coach Bus	Similar to transit buses except used for transportation of passengers long distances.
Class 6 Commercial Truck	A vehicle with a Gross Vehicle Weight Rating from 19,501 lbs. GVWR to 26,000 lbs. GVWR
Class 7 Commercial Truck	A vehicle with a Gross Vehicle Weight Rating from 26,001 lbs. GVWR to 33,000 lbs. GVWR
Class 8 Commercial Truck	A vehicle with a Gross Vehicle Weight Rating (GVWR) exceeding 33,001 lbs. (14,969 kg).
Customer	<p>Fleet operator, manager, utilities, cities, infrastructure – other (convenience store), person who uses the equipment (see also user), maintenance manager</p> <p>Alternate definition: person paying for the charging or the charging equipment</p> <p>Alternate 2: Person receiving a service or product</p>
Equipment	Charging equipment (plug, pantograph, dispenser with user interface, rectifier, stationary batteries, switch gears, load management integrating grid with battery, site meter)
Failure	Any time the user does not get the expected outcome on the first try. It isn't okay to wiggle or re-insert the connector
Successful Connection Rate	Performance of the EVSE to provide the customer the defined charge characteristics on the first insertion of the plug
Fleet Manager	Person managing the vehicle fleet, including charging
Grounded System (UL definition)	A charging system that depends on reliable grounding of the circuitry to provide the basis for the Personnel Protection System. The ground connection is considered to be a

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	protective earth connection, and the circuitry and conductors that make up the ground path are suitable for the potential ground fault currents expected for that product rating.
Isolated System (UL definition)	A charging system that depends on reliable isolation of the circuitry from all dead metal parts or circuits that can be contacted by the user. The isolation is monitored as part of the Personnel Protection System. The ground connection is not relied on for safety and is considered a functional or reference ground. The reference ground connection is used by the isolation monitor to monitor the isolation of the system. The functional or reference ground is not expected to carry ground fault current and, based on this, is not expected to be sized in accordance with the device rating.
Maintainer/Maintenance Provider	Person who maintains or services a vehicle or EVSE
Manual Charging	Human connects and initiates the charging process
Charge Port	Location on the vehicle to connect to the charging system.
Port Operators	Managers of a shipping port, also owners/operators of vehicles in/out of shipping ports
Rated	Continuous performance of the charging system
School Bus	Type C school buses typically range between 23,500 lbs. to 29,500 lbs. GVWR, depending on seating capacity.  Type D school buses typically range between 25,000 lbs. to 36,000 lbs. GVWR, depending on seating capacity.
Shuttle Bus	Shuttle buses typically range between 10,050 lbs. GVWR to 19,500 lbs. GVWR.
Site (also Charge Site)	Location for charging featuring one or more stations
Station (also Charge Station)	Individual or multi-side charger for a vehicle
Touch Safe	As defined in UL2251
Transit Bus	A transit bus is a type of bus used on shorter-distance public transport bus services. These are typically two axle 35ft, two axle 40ft or three axle articulated 60ft buses. The curbs weights range from 20,000 to 50,000 lbs. and the fully loaded weights range from 44,000 to 65,000 lbs. according to the American Public Transit Association. Frequent stops and starts, frequent door opening and closing
User (also Operator)	The operator of the vehicle and/or charging system

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Vehicle	Class 8 (33,000 lbs. GVWR or more) commercial truck, or bus, maybe class 6-7 (19,501 lbs. GVWR to 26,000 lbs. GVWR)
Vehicle Owner	Holds the legal title to the vehicle, may or may not be the legally responsible party for the operation of the vehicle

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## Acronyms and Abbreviations

Term	Definition
AC	Alternating Current
ADA	American with Disabilities Act
ADR	Automated Demand Response
ATA	American Trucking Association
AV	Autonomous Vehicle
BEV	Battery Electric Vehicle – see also EV
CCS	Combined Charging System
CDL	Commercial Driver’s License
DC	Direct Current
ECS	Electrical Charging Station
ELD	Electronic Logging Device
EMSP	Electronic Mobility Service Provider
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
EVSP	Electric Vehicle Service Provider
FE	Functional Earth Also: Fast Ethernet (AV data communication)
GVWR	Gross Vehicle Weight Rating
HB	Handbook
HEV	Hybrid Electric Vehicle
IBC	International Building Codes
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IP	Intellectual Property Also: Ingress Protection

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ISO	International Organization for Standardization
AHJ	Authority Having Jurisdiction
KAIC	Kilo Amp Interrupt Capacity
MTBF	Mean Time Between Failures
MTTR	Mean Time to Repair
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
NIST	National Institute of Standards and Technology
NRTL	Nationally Recognized Test Lab
OCPP	Open Charge Point Protocol
OE	Original Equipment
OEM	Original Equipment Manufacturer
PHEV	Plug-in Hybrid Electric Vehicle
PLC	Power Line Communication
PM	Preventive Maintenance
PPE	Personal Protective Equipment
QR Code	Quick Response Code
RP	Recommended Practices
SAE	Society of Automotive Engineers
SCCR	Short Circuit Current Rating
SOC	State of Charge
SOH	State of Health
TBD	To Be Determined
V2G	Vehicle to Grid communications and/or power flow
V2I	Vehicle to Infrastructure communications and/or power flow

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V2V	Vehicle to Vehicle communications and/or power flow
V2X	Vehicle to "X" communications and/or power flow
VAC	Volts AC
VDC	Volts DC



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## Requirements:

### Connector (Vehicle, Charger)

Requirement	Options	Decision
Form	<ul style="list-style-type: none"> <li>• Plug</li> <li>• Pantograph</li> <li>• Inductive</li> </ul>	Plug (conductive)
Backwards compatibility	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Consider Both (explore designs for both, defer decision)
Number of Inlets	<ul style="list-style-type: none"> <li>• Single</li> <li>• Multiple</li> </ul>	Single
Maximum DC voltage (continuous rating)	<ul style="list-style-type: none"> <li>• 1000V</li> <li>• 1500V</li> <li>• Higher</li> </ul>	Coupler: 1500 VDC 1000 VDC min, 1500 VDC optional Keying to distinguish (hardware or software)
Maximum Current Design Target (continuous rating)	<ul style="list-style-type: none"> <li>• 1000A</li> <li>• 2000A</li> <li>• Other</li> </ul>	3000A max
Maximum Touch Temperature		see <a href="#">touch safe</a> requirements Defined in IEC 62196 and UL 2251.
Maximum Pin Temperature		to be determined through feedback from designers
Latch on vehicle side of cable/vehicle connector	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes
Communication port(s)	<ul style="list-style-type: none"> <li>• Same as ISO/IEC 15118</li> </ul>	Auxiliary services as supported by ISO/IEC15118 (others may be considered during design)
Reliability of vehicle side	<ul style="list-style-type: none"> <li>• Number of charge cycles <ul style="list-style-type: none"> <li>○ 20,000</li> </ul> </li> <li>• Years <ul style="list-style-type: none"> <li>○ 12+</li> <li>○ Other</li> </ul> </li> <li>• 1<sup>st</sup> pass yield <ul style="list-style-type: none"> <li>○ 99%</li> <li>○ Other</li> </ul> </li> </ul>	Supplied as design target, not explicitly stated in the standard.

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Requirement	Options	Decision
Reliability of charger side	<ul style="list-style-type: none"> <li>• Number of charge cycles               <ul style="list-style-type: none"> <li>○ 20,000</li> <li>○ Same as off vehicle stationary fuel pump</li> </ul> </li> <li>• Years               <ul style="list-style-type: none"> <li>○ Cable replacement (2)</li> <li>○ Other</li> </ul> </li> <li>• 1<sup>st</sup> pass yield               <ul style="list-style-type: none"> <li>○ 99%</li> <li>○ Other</li> </ul> </li> <li>• Other</li> </ul>	Supplied as design target, not explicitly stated in the standard.
EMI Requirements		FCC Class A
Corrosion Resistance	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Design Target: similar to other commercial vehicle exterior components and/or stationary fuel pumps.
Automated Charging System Compatibility	<ul style="list-style-type: none"> <li>• Connection should not limit future automated systems</li> </ul>	May also consider contacts as conductive connection in addition to assumed pins.
Environmental and Safety considerations – Vehicle side	<ul style="list-style-type: none"> <li>• UL62</li> <li>• UL87 – hazardous env.</li> <li>• IP56</li> <li>• IP67 – protection reading</li> <li>• Noise</li> <li>• <a href="#">Touch safe</a></li> <li>• No PPE required by user</li> </ul>	Yes

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Requirement	Options	Decision
Environmental considerations – Charger side	<ul style="list-style-type: none"> <li>• UL62</li> <li>• UL87 – hazardous env.</li> <li>• IP56</li> <li>• IP67 – protection reading</li> <li>• Noise</li> <li>• UL certification               <ul style="list-style-type: none"> <li>○ Perhaps with exclusion for UL1741?</li> <li>○ CE in Europe</li> <li>○ CSA in Canada</li> </ul> </li> <li>• NEC 625 applies               <ul style="list-style-type: none"> <li>○ May need addition or modification?</li> </ul> </li> <li>• NIST Handbook 44 and 130 applies when charging consumers for power</li> <li>• <a href="#">Touch safe</a></li> <li>• Cable breakaway (?)</li> <li>• No PPE required by user</li> </ul>	Yes

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**Vehicle**

Requirement	Options	Decision
Vehicle Immobilized during charging	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes
Vehicle electrical system is functional during charging	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes
Cap on port is watertight (IP 6/7)	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Recommended port to be IP 6/7.
Fiducial Markings (visual markings to enable automated charging)	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Optional (not required)
Ramp up/down rates	<ul style="list-style-type: none"> <li>• Vehicle control?</li> <li>• Mandated?</li> <li>• Other</li> </ul>	SAE J2884 is sufficient for specs of the project  IEC 61851 can be used for EU use and UL 2202 is the N. American equivalent
User override switch	<ul style="list-style-type: none"> <li>• On handle</li> </ul>	Must be a switch on the handle to request end of charge session, the switch is to be interpreted by software.

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## Charger

Requirement	Options	Decision
Indicate connection was made	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes
Unit of sale indicated for public stations	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes
Isolation	<ul style="list-style-type: none"> <li>• Reference IEC 61851</li> <li>• Functional earth</li> <li>• From UL 16:               <p><b>Isolation</b></p> <p>16.1) A device intended for use on an isolated system shall comply with 16.2. A device intended for use on a grounded system need not comply with these requirements, but rather shall comply with Grounding, 14.</p> <ul style="list-style-type: none"> <li>• 16.2) No protective earth ground is required. A functional earth, or reference earth, conductor used to monitor the isolation of the vehicle frame from the source voltage is required. The conductor shall be suitably sized for the application.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Language to left</li> </ul> <p>Refer to standards being updated by SAE, IEC</p>
Computer Network – if down, must still charge	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes
Ramp up/down rates	<ul style="list-style-type: none"> <li>• Vehicle control?</li> <li>• Mandated?</li> <li>• Other</li> </ul>	See Discussion on <a href="#">Vehicle Requirements</a> . Charger must complement.
OSHA Compatibility/ similar national health & safety requirements	<ul style="list-style-type: none"> <li>• Yes</li> <li>• No</li> </ul>	Yes, must meet OSHA guidelines and follow <a href="#">NIOSH Lifting Equation</a>
Automated Connection	<ul style="list-style-type: none"> <li>• If above thresholds for voltage, current</li> </ul>	Not required Connection systems designed to accommodate manual or automated solution
UL and/or NRTL Certification	<ul style="list-style-type: none"> <li>• Required</li> </ul>	Yes

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Requirement	Options	Decision
Charger handle/Cable	<ul style="list-style-type: none"> <li>• Weight (15 lbs. max)</li> <li>• Size</li> <li>• Cable length</li> </ul>	<ul style="list-style-type: none"> <li>• Need to meet OSHA guidelines</li> <li>• Weight less important</li> </ul>
Insertion forces	<ul style="list-style-type: none"> <li>• Per IEC 62196 - The force to insert and withdraw a vehicle connector shall be less than 100 N. Means to facilitate the insertion and withdrawal of the vehicle connector from the vehicle inlet may be provided. If a vehicle coupler is equipped with an assist device to reduce this force (e.g. mechanical assist device), the operating force of assist device shall be less than 100 N</li> </ul>	<ul style="list-style-type: none"> <li>• 100N, as is the current CCS plug</li> </ul>
User override switch	<ul style="list-style-type: none"> <li>• On handle</li> </ul>	<ul style="list-style-type: none"> <li>• Must be a switch on the handle to request end of charge session, the switch is to be interpreted by software.</li> </ul>
ADA Compliance	Regards to plug and screen heights etc.	Yes

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**Other Requirements for the Standard**

Requirement	Options	Decision
Cybersecurity	<ul style="list-style-type: none"> <li>• Over-air updates</li> <li>• 3<sup>rd</sup> party security evaluation</li> <li>• Internal components segmented with trust boundaries</li> <li>• Encrypted communications</li> <li>• Secured vehicle/driver &amp; credit card information</li> <li>• Unique key per station for encryption</li> <li>• Intrusion detection, mitigation, and response</li> <li>• Anti-tampering physical security</li> <li>• Vulnerability scanning</li> </ul>	All elements listed, to be included as references (list to be provided by DOE/DOT)
Cybersecurity Policy Controls	<p>Privacy Controls</p> <ul style="list-style-type: none"> <li>• It shall not be required for the vehicle to 'call ahead' and inform the charge station prior to physical connection</li> <li>• Controls to ensure anonymity of vehicle (cargo issues)</li> </ul> <p>Inventory/device controls</p> <ul style="list-style-type: none"> <li>• Manufacturer maintain component and firmware information for vulnerability monitoring and remediation</li> </ul> <p>Threat and Risk Assessment</p> <ul style="list-style-type: none"> <li>• Ongoing Third-Party Independent Security Testing</li> <li>• PEN testing</li> <li>• Network and device vulnerability scans</li> </ul> <p>Vulnerability Disclosure Program (VDP)</p> <p>Secure Coding Practice</p> <p>Incident Response Plan</p>	All elements listed, to be included as references (list to be provided by DOE/DOT)
Communications	<ul style="list-style-type: none"> <li>• Signal when a connection is made</li> <li>• Temperature of port, connector</li> <li>• Interoperability of communication for DC base charging and PnC</li> </ul>	As supported by ISO/IEC 15118

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Requirement	Options	Decision
Maintenance	<ul style="list-style-type: none"><li>• By qualified individual per manufacturer definitions</li></ul>	Yes
Metering/Certification (See also RP)		as dictated by local <a href="#">AHJ</a>
Safety Markings		TBD



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### Recommended Practices

Type	Options
Charge Port Location on Vehicle	<ul style="list-style-type: none"> <li>• Convenient for a human on the ground</li> <li>• Compliant with relevant OSHA requirements.</li> <li>• On the tractor, not the trailer.</li> <li>• Behind the front axle.</li> <li>• In front of the most forward rear axle.</li> <li>• On the driver's side of the vehicle.</li> <li>• Port height is the most important dimension</li> </ul>
Power flow from vehicle to grid with intelligent controls	<ul style="list-style-type: none"> <li>• ISO 15118 supports power transfer protocols</li> </ul>
Cable and connector	<ul style="list-style-type: none"> <li>• Must be serviceable</li> <li>• IEC62196 language below:</li> </ul> <p><b>Rewirable accessory:</b> accessory so constructed that the cable or wiring can be replaced. It can be either a user-serviceable accessory or a field-serviceable accessory</p> <p><b>Non-rewirable accessory:</b> accessory so constructed that the cable or wiring cannot be separated from the accessory without making it permanently useless</p> <p style="padding-left: 40px;">Note to entry: A plug which is integrally molded to the cable is an example of non-rewirable accessory.</p> <p><b>User-serviceable accessory:</b> accessory so constructed that it can be rewired, or parts can be replaced, using commonly available tools and without having to replace individual parts of the accessory</p> <p style="padding-left: 40px;">Note to entry: An ordinary plug, which can be disassembled and wired using a common screwdriver, is an example of user-serviceable accessory.</p> <p><b>Field-serviceable accessory:</b> accessory constructed so that it can only be rewired, repaired or replaced by manufacturer's authorized personnel or skilled person according to national regulation</p>
Safety Training video	<ul style="list-style-type: none"> <li>• Recommended practice available on-site for operators in form of QR code or short video</li> </ul>
Charger current rating	<ul style="list-style-type: none"> <li>• All EVSE manufacturers shall consider utility transformer short circuit current rating</li> </ul>
ADA Compliance (charger related)	<ul style="list-style-type: none"> <li>• Adhere to <a href="#">AHJ</a> for site related issues</li> </ul>

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Type	Options
Cybersecurity	<ul style="list-style-type: none"> <li>• Periodic re-assessment of security</li> <li>• Remote vulnerability scans</li> <li>• Disable JTAG interfaces</li> <li>• Others as reference, to be provided in list from DOE/DOT</li> </ul>
Cybersecurity – Best Practices for Key Management	<ul style="list-style-type: none"> <li>• Secure Key Management (unique keys per device)</li> <li>• Hardware Security Module (HSM) for secure key storage</li> <li>• PKI structure (CRLs, etc.)</li> </ul>
Cybersecurity – Secure hardware design	<ul style="list-style-type: none"> <li>• Well defined trust boundaries (internal segmentation) between vehicle, EVSE, provider, and grid operation/communication</li> <li>• Disable diagnostics (e.g. JTAG fuses) once deployed</li> <li>• Secure bootloaders with digitally signed firmware</li> </ul>
Cybersecurity – Firmware design and implementation	<ul style="list-style-type: none"> <li>• Static code analysis scans</li> <li>• Fuzz testing</li> <li>• Vulnerability scans as part of development process</li> </ul>
Site Planning	<ul style="list-style-type: none"> <li>• See appendix C</li> </ul>
Charger to fleet management software link	<ul style="list-style-type: none"> <li>• Open communication standards are recommended, and preferred by customers, but not required.</li> <li>• Strongly recommended</li> <li>• Important for maintenance</li> </ul>
Replacement schedule of cables	as defined by EVSE manufacturers
Inspection of connection and charger	<ul style="list-style-type: none"> <li>• By User</li> <li>• By Site maintenance</li> <li>• Definition of failure mechanisms and what to inspect and when is needed</li> </ul>
Environmental	Maximum leakage amount (TBD) if liquid cooled, depends on fluid medium used, EVSE to provide MSDS for fluid

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Appendix A – Standards for Manual Bus/Truck Charging (up to 1.5MW)

6 MANUAL BUS/TRUCK CHARGING (up to 1,5 MW, I<sub>MAX</sub> ≥ XXX) STAND XX.XX.2019 – V 1.0

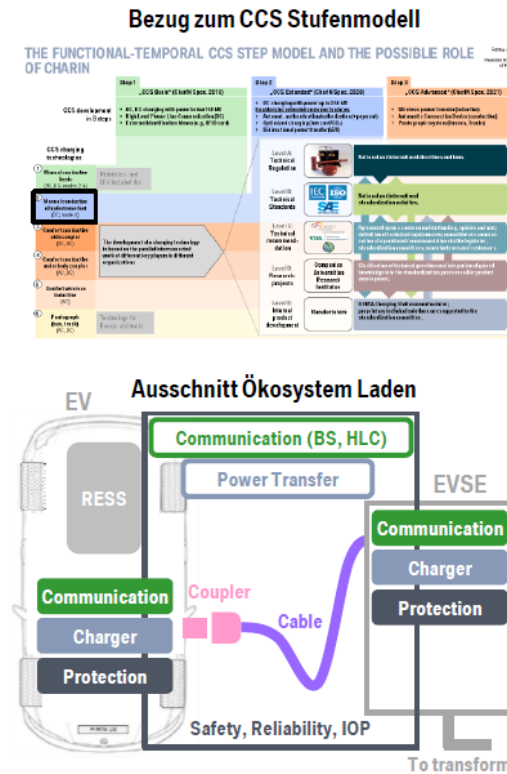
BMW, Liertz  
Fokus auf Schnittstelle EV/EVSE: Ladetechnologie Nr.6,  
27.11.2018, V 1.0

Charging System Specifications

		Documents	Content	Eosys	1	2	Responsible
Standardization	X	1. Directive 2014/96/EU	Altern. fuel infrastructure	EVSE		?	
	X	2. FprEN Final Draft 17186 Ed.1	Electricity fuel labelling	EV-EVSE			
	X	3. DIN SPEC 70121:2014	DC PLC	EV-EVSE			
	X X	4. ISO 15118-1:2013 Ed.1	AC/DC PLC general	EV-EVSE			
	X X	5. ISO 15118-2:2014 Ed.1	AC/DC network, application	EV-EVSE			
	X X	6. ISO 15118-3:2015 Ed.1	AC/DC physical, data link	EV-EVSE			
	X X	7. IEC 61851-1:2017 Ed.3	PWM <b>Prio 1: Ed.4 mitentwickeln</b>	EV-EVSE			
	X X	8. IEC 61851-21-2:2017 Ed.1	Off-board charger EMC	EVSE			
	X X	9. IEC 61851-23:2014 + COR1:2016 Ed.1	DC charging	EV-EVSE			
	X X	10. IEC 62196-1:2014 Ed.3	AC/DC general	EV-EVSE			
	X X	11. IEC CD 62196-3 Amd.1 Ed.1	DC Combo 1/2	EV-EVSE			
	X X	12. IEC/TS CD 62196-3-1 Ed.1	DC Combo 1/2, therm. manag.	EV-EVSE			
	X X	13. ISO 17409:2015 Ed.1	AC/DC electr. Safety	EV			
	X X	14. ISO 6469-3:2011 Ed.1	AC/DC electr. Safety	EV			
	X X	15. IEC FDIS 62893-1 Ed.1	AC/DC general	EV-EVSE			
	X X	16. IEC CD 62893-4-1 Ed.1	DC	EVSE			
	X X	17. IEC WD 62893-4-2 Ed.1	DC, therm. manag.	EVSE			
CharIN	X	18. SAE J1772:2017 V7 revised	AC/DC, Type 1, Combo 1	EV-EVSE			
	X	19. SAE J2836/2:2011 V1 issued	DC PLC use cases	EV-EVSE			
	X	20. SAE J2847/2:2015 V3 revised	DC PLC (layer 3-7)	EV-EVSE			
	X	21. SAE J2931/1:2014 V3 revised	DC PLC (layer 3-6)	EV-EVSE			
	X	22. SAE J2931/4:2014 V2 revised	DC PLC (layer 1-2)	EV-EVSE			
	X	23. SAE J2931/7:2018 V2 revised	DC PLC (TLS)	EV-EVSE			
	X	24. SAE J2953/1:2013 V1 issued	AC/DC (IOP CP and Prox)	EV-EVSE			
	X	25. DIN 70121 Amendment	DC PLC (EIM, 80kW)	EV-EVSE			
	X X	26. IEC 61851-1 Amendment	AC/DC charging, PWM	EV-EVSE			
	X X	27. IEC 61851-23 Amendment	DC charging	EV-EVSE			
	X X	28. CCS 1.0 technical requirements spec. v X.Y	General specification, closing gaps in standards	EV-EVSE			
	X X	29. CCS design guide	General specification	EV-EVSE			
	X	30. Guideline DC CCS 1.0 (DIN Spec)	DC PLC guideline	EV-EVSE			
	X X	31. CCS DC power classes	DC charging specification	EV-EVSE			

X: Documents applicable for this market.

Link through V-model



1 Availability: available (published, e.g. on CharIN website) not available (not yet published)






2 Quality: satisfactory specification small amendments needed severe amendments needed

Charging System Test Specifications






Documents	1	2	Responsible
32. DIN SPEC 70122:2018			
33. ISO 15118-4:2018 Ed.1			
34. ISO 15118-5:2018 Ed.1			
7. IEC 61851-1:2017 Ed.3			
8. IEC 61851-21-2:2017 Ed.1			
35. DIN VDE V 0122-2-300:2016			
10. IEC 62196-1:2014 Ed.3			
11. IEC CD 62196-3 Amd.1 Ed.1			
12. IEC CD2 62196-3-1 Ed.1			
13. ISO 17409:2015 Ed.1			
14. ISO 6469-3:2011 Ed.1			
15. IEC FDIS 62893-1 Ed.1			
36. IEC FDIS 62893-2 Ed.1			
17. IEC WD 62893-4-2 Ed.1			
20. SAE J2847/2:2015 V3 revised ?			
21. SAE J2931/1:2014 V3 revised ?			
22. SAE J2931/4:2014 V2 revised ?			
23. SAE J2931/7:2018 V2 revised ?			
37. SAE J2953/2:2014 V1 issued			
38. SAE J2953/3:2016 V1 WIP			
39. CCTS TestSpecs DIN 70122			
40. CCTS TestSpecs IEC 61851-1			
41. SLAM TestSpecs IEC 61851-1			
42. CCTS TestSpecs IEC 61851-23			
43. SLAM TestSpecs ISO 17409			
44. SLAM TestSpecs lessons learned			

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## Appendix B – CharIN e.V. to Standards Committee Correlation Matrix

CharIn Focus Groups						
Applicable Standards		Charging Connection 	Charging Communication 	Charging Infrastructure 	Grid Integration 	Conformance Test   Interoperability 
<b>US National Standards</b>						
NFPA70/NEC 625	Electrical conductors and equipment external to an electric vehicle that connect an electric	X		X		
UL 2202	Standard for Electric Vehicle (EV) Charging System Equipment.	X		X		
UL 2231	Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits.	X		X		
UL 2251	Standard for Plugs, Receptacles, and Couplers for Electric Vehicles.	X		X		
UL 2900	Standard for Software Cybersecurity for Network-Connectable Products (2 parts)					
UL 62 / UL 2263	This standard specifies the requirements for flexible cords, elevator cables, electric vehicle	X				
UL 87	<i>(hazardous locations) Standard for Power-Operated Dispensing Devices for Petroleum</i>					
SAE J1772	(Surface Vehicle) Electric Vehicle Conductive Charge Coupler - covers the general physical,	X	X	X		
SAE J2847-1	(Recommended Practice) Communication between plug-in vehicles and utility grid -		X	X	X	
SAE J3061	Provides an engineering process to design and build cybersecurity into vehicle systems in a		X	X	X	
SAE J3068	A North American recommended practice published and maintained by SAE International.	X		X		
<b>International Standards</b>						
DIN 70121	Digital communication between a DC EV charging station and an electric vehicle for control of DC	X	X	X		
ISO 17409	Electrically propelled road vehicles -- Connection to an external electric power supply -- Safety	X	X	X		
ISO 21434 (draft)	Define a structured process to ensure cybersecurity is designed.		X	X	X	
ISO/ IEC 61851	One of the International Electrotechnical Commission's group of standards for electric road	X	X	X	X	
ISO/IEC 15118	Road vehicles -- Vehicle to grid communication interface is an international standard defining a		X		X	
EN 50620	This standard specifies design, dimensions and test requirements for halogen-free cables with	X				
ISO/IEC 62196	Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric	X		X		

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<b>CharIN Focus Groups</b>					
<b>Applicable Standards</b>	<b>Charging Connection</b> 	<b>Charging Communication</b> 	<b>Charging Infrastructure</b> 	<b>Grid Integration</b> 	<b>Conformance Test   Interoperability</b> 
<b>Reference</b>					
HB 130 – NIST	Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality.				
HB 44 – NIST	Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.				
IBC	(The International Building Code) the foundation of the complete Family of International Codes®. It is an essential tool to preserve public health and safety that provides safeguards from hazards associated with the built environment. It addresses design and installation of innovative materials that meet or exceed public health and safety goals.				
NIST 800.160 – (Special Publications)	Volume 2: Systems Security Engineering: Cyber Resiliency Considerations for the Engineering of Trustworthy Secure Systems  Volume 1: Systems Security Engineering: Considerations for a Multidisciplinary Approach in the Engineering of Trustworthy Secure Systems				
NIST SP1800	NIST Special Publication (SP) 1800 series documents present practical, usable, cybersecurity solutions to the cybersecurity community. These solutions demonstrate how to apply standards-based approaches and best practices. An 1800 document can map capabilities to the Cybersecurity Framework and outline steps needed for another entity or organization to recreate an example solution.				
OCPI 2.1	An independent international protocol to support: 1. Bilateral roaming and roaming via a central system 2. The use of differentiated rates per charge station, and if desired also per user 3. The supply of correct data on charge points (location, availability, rates, type of energy, available facilities near the station, etc.) and 4. Remote and ad hoc use of the charge station				
OPEN ADR 2.0b	Based on formal industry standard. Test tool, test plan & certification program. Backed by industry alliance. Conforms to NIST Smart Grid Interoperability Framework. Expanded architecture to include pricing, telemetry and other services.				
SB 454	CA standard for public charges, payment, signage.				

## **Appendix C - Site Planning to Facilitate Permitting**

- Charge posts:
  - Behind the curb vs. In asphalt
  - Charge cord length
- Traffic Flow
- Landlord requirements/needs
  - Future expansion
  - Stall reduction
- Stall requirements
- Parking lot requirements
- Equipment clearance requirements
- Grading
- Underground Utilities
- Existing easements, setbacks, and right-of-ways
- Lighting
- Landscaping/Green space requirements
- Equipment screening requirements
- ADA requirements
- All charger installations must be in compliance with all applicable local codes and regulations
  - NFPA requirements / Fire Department
  - Building / Electrical
  - Consider emergency shutoff capabilities

## Appendix D: Referenced Standards and Regulations

**DIN 70121** - Digital communication between a DC EV charging station and an electric vehicle for control of DC charging in the Combined Charging System

**EN50620** - This standard specifies design, dimensions and test requirements for halogen-free cables with extruded insulation and sheath having a voltage rating of up to and including 450/750 V for flexible applications under severe condition for the power supply between the electricity supply point or the charging station and the vehicle.

**HB 44 – NIST** - Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices.

**HB130 – NIST** - Uniform Laws and Regulations in the Areas of Legal Metrology and Engine Fuel Quality.

**IBC** - (The International Building Code) the foundation of the complete Family of International Codes®. It is an essential tool to preserve public health and safety that provides safeguards from hazards associated with the built environment. It addresses design and installation of innovative materials that meet or exceed public health and safety goals.

**ISO/IEC 61851** - One of the International Electrotechnical Commission's group of standards for electric road vehicles and electric industrial trucks, and is the responsibility of IEC Technical Committee 69 (TC69).

**ISO/IEC 62196** – Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive charging of electric vehicles, is a series of international standards that define requirements and tests for plugs, socket-outlets, vehicle connectors and vehicle inlets for conductive charging of electric vehicles and is maintained by the technical subcommittee SC 23H of the International Electrotechnical Commission (IEC). Covers requirements for AC and DC charging and includes the requirements for the CHAdeMO connector and CCS.

**ISO/IEC 15118** - Road vehicles -- Vehicle to grid communication interface is an international standard defining a vehicle to grid (V2G) communication interface for bi-directional charging/discharging of electric vehicles.

**ISO 17409** - Electrically propelled road vehicles -- Connection to an external electric power supply -- Safety requirements

**ISO 21434 (draft)** – The purpose of this standard is to: Define a structured process to ensure cybersecurity is designed.

**NEC Article 625** – This article covers 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.

**NFPA 70/National Electric Code** - The latest comprehensive regulations for electrical wiring, overcurrent protection, grounding, and installation of equipment.

**NIST 800.160** – (Special Publications)

**Volume 2:** Systems Security Engineering: Cyber Resiliency Considerations for the Engineering of Trustworthy Secure Systems

**Volume 1:** Systems Security Engineering: Considerations for a Multidisciplinary Approach in the Engineering of Trustworthy Secure Systems

**NIST SP1800** - NIST Special Publication (SP) 1800 series documents present practical, usable, cybersecurity solutions to the cybersecurity community. These solutions demonstrate how to

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apply standards-based approaches and best practices. An 1800 document can map capabilities to the Cybersecurity Framework and outline steps needed for another entity or organization to recreate an example solution.

**NFPA 70E** - Requirements for safe work practices to protect personnel by reducing exposure to major electrical hazards. Originally developed at OSHA's request, NFPA 70E helps companies and employees avoid workplace injuries and fatalities due to shock, electrocution, arc flash, and arc blast, and assists in complying with OSHA 1910 Subpart S and OSHA 1926 Subpart K.

**OCPI 2.1** - An independent international protocol to support:

1. Bilateral roaming and roaming via a central system
2. The use of differentiated rates per charge station, and if desired also per user
3. The supply of correct data on charge points (location, availability, rates, type of energy, available facilities near the station, etc.) and
4. Remote and ad hoc use of the charge station

**OPEN ADR 2.0b** - Based on formal industry standard. Test tool, test plan & certification program. Backed by industry alliance. Conforms to NIST Smart Grid Interoperability Framework. Expanded architecture to include pricing, telemetry and other services.

**SAE J1772** – Electric Vehicle Conductive Charge Coupler - covers the general physical, electrical, communication protocol, and performance requirements for the electric vehicle conductive charge system and coupler. This standard specifies a common electric vehicle conductive charging system architecture including operational requirements and the functional and dimensional requirements for the vehicle inlet and mating connector.

**SAE J2847-1** – (Recommended Practice) Communication between plug-in vehicles and utility grid - establishes requirements and specifications for communication messages between plug-in electric vehicles and the electric power grid, for energy transfer and other related applications.

**SAE J3061** - Provides an engineering process to design and build cybersecurity into vehicle systems in a comprehensive and systematic way, to monitor for and respond to incidents in the field, and to address vulnerabilities in service and operation. J3061 is unique in describing a process framework for cybersecurity that an organization can tailor against its other development processes.

**SAE J3068** - A North American recommended practice published and maintained by SAE International. J3068 defines electrical connectors and a control protocol for 3-phase AC electric vehicle charging.

**SB454** – CA standard for public charges, payment, signage.

**UL62** - This standard specifies the requirements for flexible cords, elevator cables, electric vehicle cables, electric vehicle cables, and hoistway cables rated 600 V maximum. To be replaced by UL2263 for EV Cables

**UL 87** - (hazardous locations) Standard for Power-Operated Dispensing Devices for Petroleum Products.

**UL 2202** - Standard for Electric Vehicle (EV) Charging System Equipment.

**UL 2231** - Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits.

**UL 2251** - Standard for Plugs, Receptacles, and Couplers for Electric Vehicles.

**UL 2900** - Standard for Software Cybersecurity for Network-Connectable Products (2 parts)



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**Local Ordinances** - laws usually found in a code of laws for a political division smaller than a state or nation, i.e., a local government such as a municipality, county, parish, prefecture, etc.

**References**

**CDL Requirements** - These requirements vary from state to state.

**ADA** - Title III prohibits discrimination on the basis of disability in the activities of places including commercial facilities (privately owned, nonresidential facilities such as factories, warehouses, or office buildings).