EV/EVSE
Testing & Certification

THE E-MOBILITY STANDARD LANDSCAPE

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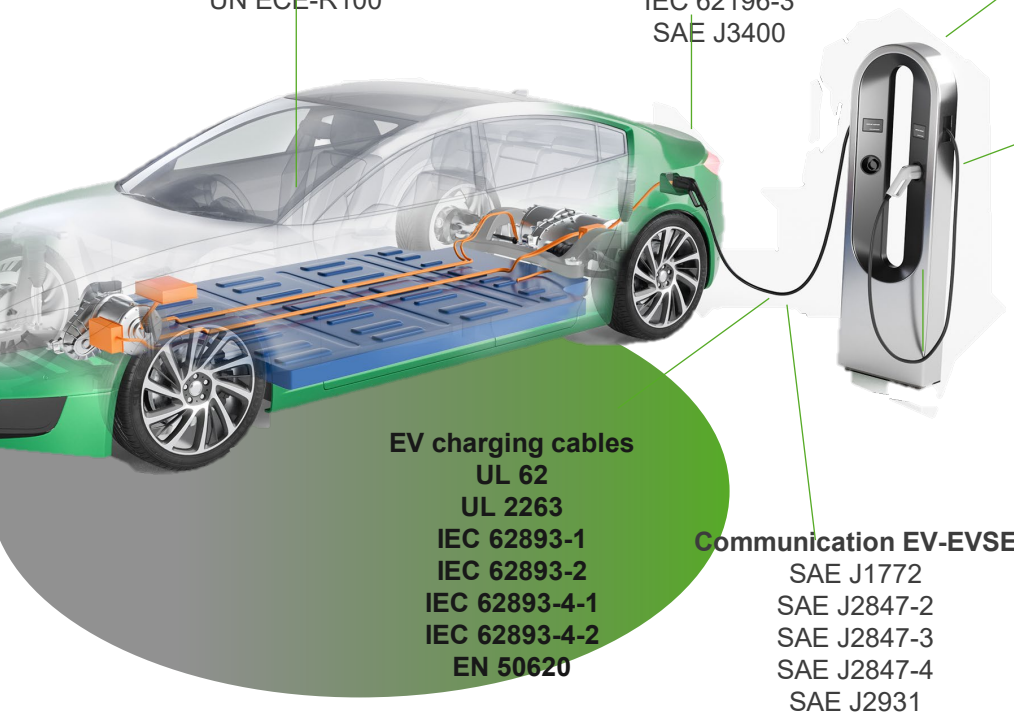
EV Charging Infrastructure

Standards covering aspects of charging infrastructure

Vehicle | Infrastructure | Backend

Onboard
SAE J3072
IEC 61851-21-1 (EMC)
ISO 17409
SAE J2344
UN ECE-R100

Vehicle connectors and inlets
UL 2251
SAE J1772
IEC 62196-1
IEC 62196-3
SAE J3400



EV charging cables
UL 62
UL 2263
IEC 62893-1
IEC 62893-2
IEC 62893-4-1
IEC 62893-4-2
EN 50620

Connectors/inlets/plugs
UL 2251
SAE J1772
IEC 62196-1
IEC 62196-3

EVSE – Safety/ EMC
UL 2202
UL 2594
UL 2231-1/2
IEC 61851-1
IEC 61851-23
IEC 61851-21-2
UL 1741 3rd Ed
UL 9741
SAE J3400

EVSE – Metering
NIST HandBook 44
EN 50470
IEC 62053-41
OIML Guide 22

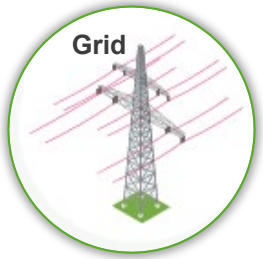
Communication EV-EVSE
SAE J1772
SAE J2847-2
SAE J2847-3
SAE J2847-4
SAE J2931
SAE J3072
DIN 70121
ISO 15118-2/-3
ISO 15118-20
SAE J3400
SAE J3068-2

EVSE – Power Quality
EN 50160
SAE J2894

Communication
OCPP 1.6
OCPP 2.0.1
OCPP 2.1
IEC 63110 -x
IEC 63119-x

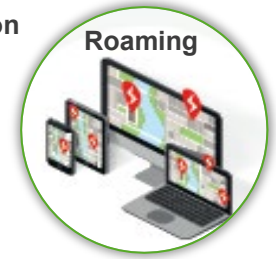
Communication
OSCP
OpenADR
MIDAS

Safety
NEC 625
IEC 60364-7-722
IEC 60364-5-55
IEC 60364-8-82
IEC 61439-7



Communication
OCPI
OICP
OCHP
EMIP

Communication
OCPI
OICP
OCHP
EMIP



Communication
OPCP
OPNC

U.S. interconnection

UL 1741 –SB (IEEE 1527-2018) calls for either
- IEEE 2030.5 (TCP/IP) or
- IEEE 1815 (DNP3) (TCP/IP) or
- SunSpec Modbus (TCP/IP or RS 485)
- UL 1741 incl. Suppl. SB (from April 1st 2023)
- UL 1741 Suppl SA (now until 31st March 2023)
- UL 1741-SC under preparation

EU Interconnection
- EU – EN 50549-1/10
- EU – Reg 2016/631/EU (RfG)
- National Grid code applies to On-Board charger/inverter

The appropriate standard per use case

a) AC basic charging
b) AC Smart charging with high level communication (ISO 15118)
c) DC charging
d) AC bidirectional (charging and discharging)
e) DC bidirectional (charging and discharging)
f) AC Vehicle to load, vehicle to vehicle

AC Basic charging

European Union – other countries

- **IEC 61851-1 Ed. 3 (2017) → Safety and functional aspects, CP, PP in annex A – LVD Directive**
- **IEC 61851-21-2 - EMC Directive**
- **EN 50470 – E-meter- MID directive**
- **IEC 63000(2018) RoHS Directive**
- **EN 50620 – Cables**
- **IEC 62196 – All connectors and plugs**
- **RED directive (e.g. RFID, LTE etc.)**

- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1
- EVReady

(incl level 1 and 2)

North America incl. Mexico

- **UL 2594 – Safety**
- **UL 2231-1/2 – Safety – Protective devices**
- **UL 2251 – Safety - Connector**
- **UL 2263 – Safety – Charging Cable**
- **FCC part 15 – unintentional radiator / intentional radiator (e.g. RFID)**
- **FCC part xx – appropriate for Communication module e.g. LTE etc.)**
- **NIST handbook 44 (e.g. CDFA-DMS-CTEP / NTEP**
- SAE J1772 – 202401 - Functional aspects
- UL 2231-1/-2 – EMC
- EnergyStar

- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1
- SAE J3400

AC Smart charging

European Union – other countries

- **IEC 61851-1 Ed. 3 (2017) → Safety and functional aspects, CP, PP in annex A – LVD Directive**
- **IEC 61851-21-2 - EMC Directive**
- **EN 50470 – E-meter- MID directive**
- **IEC 63000(2018) RoHS Directive**
- **EN 50620 – Cables**
- **IEC 62196 – All connectors and plugs**
- **RED directive (e.g. RFID, LTE etc.)**

- ISO 15118-4/5
- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1

incl. level 1 and 2

North America incl. Mexico

- **UL 2594 – Safety**
- **UL 2231-1/2 – Safety – Protective devices**
- **UL 2251 – Safety - Connector**
- **UL 2263 – Safety – Charging Cable**
- **FCC part xx – appropriate for Communication module e.g. LTE etc.)**
- **NIST handbook 44 (e.g. CDFA-DMS-CTEP / NTEP**
- SAE J1772 – 202401 - Functional aspects
- UL 2231-1/-2 – EMC
- EnergyStar

- ISO 15118-4/5
- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1
- SAE J3400

DC charging

European Union – other countries

- **IEC 61851-1 Ed. 3 (2017) → Safety and functional aspects, CP, PP in annex A – LVD Directive**
- **IEC 61851-23 (ed.2.)**
- **IEC 61851-21-2 - EMC Directive**
- **EN 50470 – E-meter- MID directive**
- **IEC 63000(2018) RoHS Directive**
- **EN 50620 – Cables**
- **IEC 62196 – All connectors and plugs**
- **RED directive (e.g. RFID, LTE etc.)**

- DIN 70121/70122
- ISO 15118-4/5
- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1
- CHAdeMO

North America incl. Mexico

- **UL 2202 – Safety**
- **UL 2231-1/2 – Safety – Protective devices**
- **UL 2251 – Safety - Connector**
- **UL 2263 – Safety – Charging Cable**
- **FCC part xx – appropriate for Communication module e.g. LTE etc.)**
- **NIST handbook 44 (e.g. CDFA-DMS-CTEP / NTEP**
- SAE J1772 – 202401 - Functional aspects
- UL 2231-1/-2 – EMC
- EnergyStar

- SAE J2931/1 - ISO 15118-2/4
- SAE J2931/4 – ISO 15118-3/5
- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1
- SAE J3400

DC Bidirectional

European Union – other countries

- **IEC 61851-1 Ed. 3 (2017) → Safety and functional aspects, CP, PP in annex A – LVD Directive**
- **IEC 61851-23 (ed.2.)**
- **IEC 62109 (Inverter part)**
- **IEC 61851-21-2 - EMC Directive**
- **EN 50470 – E-meter- MID directive**
- **IEC 63000(2018) RoHS Directive**
- **EN 50620 – Cables**
- **IEC 62196 – All connectors and plugs**
- **RED directive (e.g. RFID, LTE etc.)**

- ISO 15118-20
- OCPP 1.6 / OCPP 2.0.1 / OCPP 2.1
- OCPI 2.2.1
- CHAdeMO

North America incl. Mexico

- **UL 9741 – Safety**
- **UL 1741 – Grid support Suppl B (IEEE 1547)**
- **UL 2231-1/2 – Safety – Protective devices**
- **UL 2251 – Safety - Connector**
- **UL 2263 – Safety – Charging Cable**
- **FCC part xx – appropriate for Communication module e.g. LTE etc.)**
- **NIST handbook 44 (e.g. CDFA-DMS-CTEP / NTEP**
- SAE J1772 – 202401 - Functional aspects
- UL 2231-1/-2 – EMC
- EnergyStar

- SAE J2847/2 (2023) (ISO 15118-2 negative value, ISO-20 Light (TLS1.2)
- SAE J2836/3 (2024)
- OCPP 1.6 / OCPP 2.0.1/OCPP 2.1
- OCPI 2.2.1
- SAE J3400

AC Bidirectional

European Union – other countries

- **IEC 61851-1 Ed. 3 (2017) → Safety and functional aspects, CP, PP in annex A – LVD Directive**
- **IEC 61851-21-2 - EMC Directive**
- **EN 50470 – E-meter- MID directive**
- **IEC 63000(2018) RoHS Directive**
- **EN 50620 – Cables**
- **IEC 62196 – All connectors and plugs**
- **RED directive (e.g. RFID, LTE etc.)**

- ISO 15118-3/5
- ISO 15118-20
- OCPP 1.6 / OCPP 2.0.1 / OCPP 2.1
- OCPI 2.2.1

incl. level 1 and 2

North America incl. Mexico

- **UL 2594 – Safety**
- **UL 9741 – Safety**
- **UL 1741 – Grid support Suppl C (IEEE 1547)**
- **UL 2231-1/2 – Safety – Protective devices**
- **UL 2251 – Safety - Connector**
- **UL 2263 – Safety – Charging Cable**
- **FCC part xx – appropriate for Communication module e.g. LTE etc.)**
- **NIST handbook 44 (e.g. CDFA-DMS-CTEP / NTEP**
- SAE J1772 – 202401 - Functional aspects
- UL 2231-1/-2 – EMC
- EnergyStar

- SAE J3072 (IEEE 2030.5)
- SAE J2847/3
- OCPP 1.6 / OCPP 2.0.1
- OCPI 2.2.1
- SAE J3400

NEVI and CEC DC Charger

CFR Title 23 – Chapter 1 Subchapter G Part 680—NATIONAL ELECTRIC VEHICLE INFRASTRUCTURE STANDARDS AND REQUIREMENTS

§ 680.106 Installation, operation, and maintenance by qualified technicians of electric vehicle charging infrastructure.

- DCFC charging port must be capable of charging any CCS-compliant vehicle and each DCFC charging port must have at least one permanently attached CCS Type 1 connector
- DCFC charging ports must support output voltages between 250 volts DC and 920 volts DC. DCFCs located along and designed to serve users of designated AFCs must have a continuous power delivery rating of at least 150 kilowatt (kW)
- Equipment certification; certified by an OSHA recognized NRTL. Chargers should be certified to the appropriate Underwriters Laboratories (UL) standards for EV charging system equipment. (AC Level 2 chargers require ENERGY STAR certification)

§ 680.108 Interoperability of electric vehicle charging infrastructure.

- ***Charger-to-EV communication***. Chargers must conform to ISO 15118–3 and must have hardware capable of implementing both ISO 15118–2 and ISO 15118–20. By February 28, 2024, charger software must conform to ISO 15118–2 and be capable of Plug and Charge. Conformance testing for charger software and hardware should follow ISO 15118–4 and ISO 15118–5, respectively.
- ***Charger-to-Charger-Network Communication.*** Chargers must conform to Open Charge Point Protocol (OCPP) 1.6J or higher. By February 28, 2024, chargers must conform to OCPP 2.0.1.
- ***Charging-Network-to-Charging-Network Communication.*** By February 28, 2024, charging networks must be capable of communicating with other charging networks in accordance with Open Charge Point Interface (OCPI) 2.2.1.

NEVI and CEC DC Charger

§ 680.114 Charging network connectivity of electric vehicle charging infrastructure.

- ***Charger-to-charger-network communication -***
- Chargers must communicate with a charging network via a secure communication method. See § 680.108 for more information about OCPP requirements.
- Chargers must have the ability to receive and implement secure, remote software updates and conduct real-time protocol translation, encryption and decryption, authentication, and authorization in their communication with charging networks → **OCPP security profile**
- Charging networks must perform and chargers must support remote charger monitoring, diagnostics, control, and smart charge management.→ **OCPP profile**
- Chargers and charging networks must securely measure, communicate, store, and report energy and power dispensed, real-time charging-port status, real-time price to the customer, and historical charging-port uptime
- ***Charging-network-to-charging-network communication.*** A charging network must be capable of communicating with other charging networks to enable an EV driver to use a single method of identification to charge at Charging Stations that are a part of multiple charging networks. See § 680.108 for more information about OCPI requirements.
- ***Charging-network-to-grid communication.*** Charging networks must be capable of secure communication with electric utilities, other energy providers, or local energy management systems.
- ***Disrupted network connectivity.*** Chargers must remain functional if communication with the charging network is temporarily disrupted, such that they initiate and complete charging sessions, providing the minimum required power level defined in § 680.106(d).

https://www.ecfr.gov/current/title-23/chapter-I/subchapter-G/part-680

NEVI and CEC DC Charger

DC fast charger installations must be:
- New, stub-out/make-ready, or replacement.
- DC Fast Chargers are eligible for replacement only if their power output is below 40kW.
- Non-DC Fast Chargers are not eligible for replacement under the Golden State Priority Project.

DC fast chargers must:
- Be new equipment, installed for first time.
- Use Combined Charging System (CCS) connectors and/or CCS adapters that are fully integrated into the charger such that they cannot be removed from the site.
  - North American Charging Standard (NACS) and CHAdeMO connectors may be installed but will not be considered when determining the maximum rebate amount for the installation.
- Be networked, meeting the following criteria:
  - Equipment must be networked via Wi-Fi, ethernet or cellular connection.
  - Equipment must connect to a back-end network and be capable of "over-the-air" updates.
  - Equipment must be capable of utilization data collection.
  - Equipment must include a minimum five-year networking agreement, eligible toward total approved costs.
- Be capable of at least a 150-kW guaranteed power output simultaneously at each charging port.
- Must be capable of using an implementation of the Open Charge Point Protocol (OCPP) version 1.6 or later. The product specification sheet must state it is capable of using OCPP.

NEVI and CEC DC Charger

- Be ISO-15118 'Hardware Ready' via self-attestation on the product specification sheet which includes:
  - Powerline carrier (PLC) based high-level communication as specified in ISO 15118-3.
  - Secure management and storage of keys and certificates.
  - Transport Layer Security (TLS) version 1.2; additional support for TLS 1.3 or subsequent versions recommended to prepare for future updates to the ISO 15188 standard.
  - Remotely receiving updates to activate or enable ISO 15188 use cases.
  - Connecting to a back-end network.
- Not require a subscription or membership to dispense energy.
- If payment is required, the charger must comply with all relevant laws and regulations pertaining to payment accessibility.
- Be certified by a Nationally Recognized Testing Laboratory Program (NRTL) to either UL 2202 or UL 9741.
- Be ENERGY STAR certified.
  - DC Chargers capable of an output greater than 350kW are out of scope of the ENERGY STAR EVSE Specification.
    - Please contact evse@energystar.gov to request an out-of-scope evaluation.
- Have Open Charge Alliance (OCA) OCPP certification completed or in progress through one of the below options:
  - OCPP 1.6 certification which at minimum, includes both a subset (core) certificate and a security certificate.
  - OCPP 2.0.1 certification proof of payment.
  - OCPP 2.0.1 test tool report showing compliance with both Core and Advanced Security certification profiles.
- Be registered on the CALeVIP 2.0 Equipment Eligibility webpage as eligible for the Golden State Priority Project.
  - To list eligible equipment, manufacturers must submit a completed online equipment form to CSE.

NEVI and CEC DC Charger

Effective January 1, 2025, DC fast chargers must also be:
- Certified by Open Charger Alliance (OCA) for OCPP 2.0

https://calevip.org/calevip-eligible-equipment

Certifications – DC EVSE

Subject	By	Reference
UL 2202 UL 2594	NRTL's	**https://www.osha.gov/nationally-recognized-testing-laboratory-program/current-list-of-nrtls**
OCPP 1.6 OCPP 2.0.1	OCA recognized laboratories	**https://openchargealliance.org/testing-laboratories/**
EnergyStar	EPA recognized labs and Certification bodies	**https://www.energystar.gov/partner-resources/partner-list/epa-recognized-cbs-and-laboratories**
FCC requirements	FCC authorized test firms and Telecommunication Certification Bodies (TCB)	https://apps.fcc.gov/oetcf/eas/reports/TestFirmSearch.cfm https://apps.fcc.gov/oetcf/tcb/reports/TCBSearch.cfm
NIST Handbook 44 Section 3.40	California DMS	CDFA - DMS - California Type Evaluation Program (CTEP)

Certifications – DC EVSE

Subject	By	Reference
IEC 61851-1 and IEC 61851-23	IEC CB	https://www.iecee.org/certification
CharIN EVSE Basic Certification	CharIN recognized laboratories	**https://www.charin.global/technology/charin-conformance-testing/**
CharIN EVSE extended (soon)	CharIN recognized laboratories	**https://www.charin.global/technology/charin-conformance-testing/**
ISO 15118 -4 and -5	DEKRA	
SAE J1772	DEKRA	

Conformance & Interoperability testing & certification

completed | ongoing | open

CCS Basic v1.1.x 30.07.2021

Requirements	DC EVSE	AC EVSE 40TC open
Test Cases	DC EVSE 207 TC*	AC EVSE

CharIN is responsible for fixing the Implementation baseline to ensure a competitive CCS charging system in SYNC with directives and homologation requirements

EVSE products can be **tested** and **certified** for **CCS Basic DC EVSE v1.1.6**

CCS Basic v1.2 is being evaluated

CCS Extended 21.09.2022 (Start)

Requirements	DC EVSE	AC EVSE	AC EV	AC EVSE
Test Cases	DC EVSE	AC EVSE	AC EVSE	AC EVSE

CharIN is responsible for fixing the Implementation baseline to ensure a competitive CCS charging system in SYNC with directives and homologation requirements

On basis of ISO 15118 incl. PnC

EVSE products can be **validated** and **certified** for **CCS Extended by end of 2024**

EV products can be **validated** and **certified** for **CCS Extended by ???**

*Test cases implemented in CCTS

Thank you,

for taking care of

SAFETY