EPRI

2024 TECHNICAL UPDATE

# An Electric Vehicle Charging Standards Guidebook for North America

First Edition

# An Electric Vehicle Charging Standards Guidebook for North America

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**3002029530**

Technical Update, April 2024

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# ACKNOWLEDGMENTS

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This report describes research sponsored by EPRI.

EPRI would like to acknowledge the support of the following individuals:

Rich Scholer – Stellantis
Jason D. Harper – Argonne National Lab

This publication is a corporate document that should be cited in the literature in the following manner: *An Electric Vehicle Charging Standards Guidebook for North America: First Edition.* EPRI, Palo Alto, CA: 2024. 3002029530.

# ABSTRACT

This guidebook is designed to support automotive charging design engineers and charging equipment design engineers in navigating the complex set of standards that have developed in North America for electric vehicle charging. Documents from multiple standards development organizations govern and guide electric vehicle charging implementations. Successfully navigating those documents is fundamental to implementing a robust, interoperable charging infrastructure to support electric vehicles. This document focuses on conductive, light-duty vehicle charging standards built around SAE J1772™ (including the new SAE J3400™ document). The document does not include descriptions of wireless charging found in the SAE J2594 series documents or automated connection device standards found in SAE J3105 series documents. It also does not include power export from vehicles. We intend to address power export from vehicles and any industry feedback in a second edition of the document to be released later in 2024.

## Keywords

Electric vehicle
Charger
Supply Equipment
EV Standards

# EXECUTIVE SUMMARY

**Deliverable Number:** 3002029530

**Product Type:** Technical Update

**Product Title:** An Electric Vehicle Charging Standards Guidebook for North America: First Edition

**Primary Audience:** Designers of electric vehicle charging systems and infrastructure.

**Secondary Audience:** Those wanting a deeper understanding of the standards for electric vehicle charging and the operation of electric vehicle chargers.

## KEY RESEARCH QUESTION

Designing electric vehicle charging systems, both vehicle and stationary infrastructure, requires following a complex set of standards and safety documents. This document is targeted to those designers to help them have a better understanding of the complex set of standards documents they must be familiar with in order to design charging systems that are reliable and fully interoperable.

## RESEARCH OVERVIEW

A comprehensive review of the SAE J1772™ Conductive Charging Coupler document was carried out. Details of requirements specified in the standard have been carefully identified and documented. In addition, links to other documents outside SAE J1772™ and required to successfully implement vehicle charging, have been reviewed and described.

## KEY FINDINGS

- Section 2 details methods of energy transfer to an electric vehicle.
- Section 3 provides an overview of the current state of electric vehicle charging standards for North America.
- Section 4 provides an in-depth analysis of the SAE J1772™ standards document's requirements.

## WHY THIS MATTERS

The hope is that this guidebook will enable designers to develop fully interoperable, standards-compliant electric vehicle charging system designs and hardware. Standards compliance provides for the support of reliable and interoperable public charging infrastructure.

## HOW TO APPLY RESULTS

This document is intended as a guide for charging system designers. It is not a substitute for designers having knowledge of and access to other referenced standards documents.

## LEARNING AND ENGAGEMENT OPPORTUNITIES

- EPRI hosts the Infrastructure Working Council (IWC) meeting three times a year in various locations around the US. This group focuses on technical issues and topics related to electric vehicle charging infrastructure. More information about this working group can be found on EPRI's website at: www.epri.com/IWC.

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**PROGRAM:** Electric Transportation (P18)

# ACRONYMS AND ABBREVIATIONS

## Standards Development Organizations, Alliances and Others in the Electric Vehicle Standards Space:

ANSI – American National Standards Institute

CHAdeMO – The Charge de Move Alliance

CharIN e.V. – The Charging Interface Initiative

CISPR – International Special Committee on Radio Interference

DIN – German Institute for Standardization (Deutsches Institut für Normung e. V.)

EVRoaming Alliance

IEC – International Electrotechnical Commission

IEEE – Institute of Electronic and Electrical Engineers

ISO – International Standards Organization

OCA – Open Charge Alliance

OpenADR – The OpenADR Alliance (ADR – automated demand response)

SAE – SAE International

UL – Underwriters Labs

UNCE – United Nations Common European

## List of Abbreviations Used in the Document

Aac – Amps AC

AC – Alternating Current

ACDP – Automatic Connection Device Pantograph

BC – Basic Communication

BEV – Battery Electric Vehicle

DC – Direct Current

EV – Electric Vehicle

EVSE – Electric Vehicle Supply Equipment

HLC – High Level Communications

kW – kilowatt (a unit of power)

LIN – Local Interconnect Network

LIN-CP – Local Interconnect Network over the control pilot

OCPP – Open Charge Point Protocol

PHEV – Plug-in Hybrid Electric Vehicle

PLC – Power Line Communications

WPT – Wireless Power Transfer

Vac – Voltage AC

Vdc – Voltage DC

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# 1 OVERVIEW OF THIS GUIDEBOOK

## Introduction

**In an effort to meaningfully improve the overall interoperability between electric vehicles and charging systems across North America,** this guidebook seeks to provide product designers, system operators, and other interested parties with an in-depth summary of electric vehicle charging standards, the documents that cover these standards and how the documents interact. This guidebook focuses on electric vehicle charging based on use of SAE J1772™ and associated documents. The guidebook does not cover wireless charging, automatic connection device charging or power export from vehicles.

**There is no single standards document that describes electric vehicle (EV) charging.** In fact, there are dozens of documents that cover a broad set of topics related to EV charging, starting with the physical coupler, and building to an external system far removed from the vehicle as illustrated in Figure 1. As with the foundation of a building, the lower layers must function properly to support the higher-level layers. Communication software and protocols are worthless if the connector interface fails to fit mechanically.

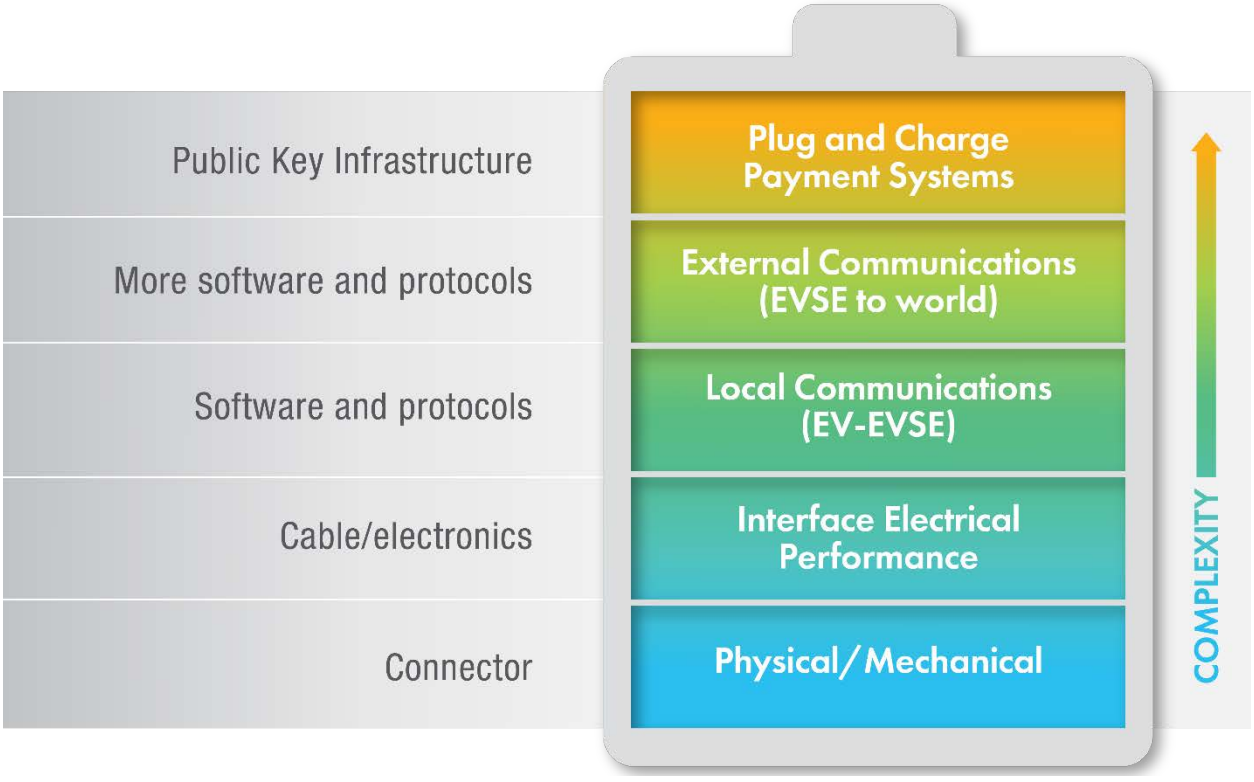



Figure 1. The Layering of Standards for EV Charging

Unfortunately, the standards documents, including SAE J1772™ are not structured in the neat layers introduced in Figure 1. In fact, the existing standards documents cover a complex, intertwined mix of the layers of the charging interface.

A second challenge is identifying the elements of a standard that are required to establish a reliable and interoperable charging infrastructure. Note that the requirements contained in SAE J1772™ are not flagged in any specific way within the document and it is left to the reader to study the narrative in the document to find them.

## Purpose and Scope

The primary focus of this guidebook is the SAE J1772™ Conductive Coupler Standard but includes references to other common charging standards, including the developing SAE J3400™ North American Charging System (a standardized version of Tesla's proprietary coupler).

One of the goals of this guide is to enumerate the full list of **normative (see text box that follows)** requirements of SAE J1772™ in a clear fashion. The word concise is not used here as the initial survey of SAE J1772™ indicated that there are more than 500 normative elements described in the standard.

> **Normative** – an element or requirement of a standard that **must** be implemented/followed to be compliant with the standard. These are requirements stated in a standards document with terms like "shall" or "must". They are mandatory elements of the standard.
>
> The opposite of normative is "informative". Many standards include informative content that might help an implementer better understand the standard or offer options that "may" be implemented. They are elements that do not contribute to compliance with the standard.

## How Can This Guidebook Address Interoperability?

It is a fair question to ask how a standards guidebook can have any influence on interoperability of charging infrastructure. If designers and implementers of charging systems aren't clear on the standards they are following and the normative requirements of those standards, there is little hope for interoperability across dozens of vehicles brands and dozens of charger brands. By having a clear sense of the standards landscape, implementers can have a much better understanding of the requirement they need to meet in product development. There is a real danger that the standards framework, spread over dozens of documents, is so complex, designers will not fully comprehend or implement to the requirements.

## Next Steps

EPRI intends to follow this guidebook with an effort to carry the learnings from developing the document to appropriate stakeholder's group in the electric vehicle charging space. Three primary follow-on activities are intended:

1. Based on the list of normative requirements identified in this guidebook, work with industry stakeholders to prioritize the normative requirements that matter most for interoperability and reliability of charging.

   Answer these questions:

   - What really matters to interoperability?
   - What is causing problems today in real world deployments?

2. Build the normative requirements lists into conformance/interoperability testing protocol documents (these must focus on interoperability).

   Highlights:

   - You test conformance to the standard, but you must do so in a way that ensures interoperability
   - These can support test tool development and be used by test labs to evaluate equipment
   - Might have to prioritize the key normative requirements
   - Tests can be too complex or time consuming to be practical
   - May need two lists: one for EV Requirements; one for EVSE Requirements
   - The documents themselves will need to be "tested" – run lab evaluation of equipment to find errors/shortcomings and correct

3. Working with stakeholders, develop industry accepted practice for equipment testing and certification against the conformance testing protocol documents.

   Highlights:

   - Stakeholder consensus on a path to certification
   - Could be test procedures or "golden" test tools (EV and EVSE)
   - Should be structured to give broad access to testing capability
   - Third party lab capability
   - Low-cost test tools
   - Open-source test tools
   - Stakeholder friction – must address cost, difficulty, delay

## Introduction of SAE J3400™ North American Charging System

During the development of this document, the majority auto manufacturers in the US announced that they would, in 1 to 2 years, be adopting a standardized version of the proprietary coupler used by Tesla. SAE International stood up a task force under the Hybrid EV Committee to develop the SAE J3400™ *North American Charging System* document to support

this goal. SAE J3400™ was published as in information report in December of 2023. Every attempt has been made in this guidebook to include information on this work and the implications of this major change in developing interoperable charging infrastructure.

## A Quick Overview of Electric Vehicle Charging Standards

At a high level, the elements of Figure 1 are covered in multiple standards documents as noted here (this is not an exhaustive list of the applicable standards).

See section 4 of this report for full titles and descriptions of these documents):

- Connector - Physical/Mechanical Interface
  - SAE J1772™
  - IEC 62196
  - SAE J3400™
  - CHAdeMO Standard (maintained by the CHAdeMO Alliance), IEEE 2030.1.1, and IEC 62196
- Cable/Electronics – Interface Electrical Performance
  - SAE J1772™
  - SAE J3400™
  - UL 2251
  - UL 2252
  - UL 2263
  - SAE J2894
  - IEC 61851-1
  - IEC 61851-23
  - CHAdeMO Standard (maintained by the CHAdeMO Alliance) and IEEE 2030.1.1
- Software and Protocols - Local Communications
  - SAE J2847/x; SAE J2836/x
  - DIN 70121
  - DIN 70122
  - ISO 15118-1
  - ISO 15118-2
  - ISO 15118-3
  - ISO 15118-4
  - ISO 15118-5
  - ISO 15118-20
  - ISO 15118-21 through -25 (these are a work in progress)

  - CHAdeMO CAN Protocol (maintained by the CHAdeMO Alliance)
- Software and Protocols - External Communications
  - IEEE 2030.5
  - Open Charge Point Protocol (OCPP - maintained by the Open Charge Alliance[1])
  - OpenADR (maintained by the OpenADR Alliance[2])
- Public Key Infrastructure - Plug and Charge/Payment Systems
  - SAE PKI Activity (EVPKI[3])
  - ISO 15118-2
  - ISO 15118-20

## Other High-Level Resources

EPRI publishes an annual Standards Update[4] for the electric transportation space that includes a comprehensive list of standards.

SAE J2836 "Instructions for Using Plug-In Electric Vehicle (PEV) Communications, Interoperability and Security Documents"[5] is offered as a free resource describing the structure and function of the SAE standards and recommended practices around EV communications.

## Summary of Report Content

Section 2 provides an overview of charging and some additional background information. This describe typical electric system topologies and how they are used to charge electric vehicles.

Section 3 reviews the current charging landscape in North America and includes descriptions of the flow of a charging session and how that connects to other standards documents. This section should give the reader a good overview of the state of charging and existing approaches to charging.

Section 4 provides an in-depth accounting of the normative requirements of SAE J1772Z™. An exhaustive list of requirements is included in the appendix. This section lays the groundwork for supporting prioritization of normative requirements for future compliance and interoperability testing.

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[1] https://openchargealliance.org/

[2] https://www.openadr.org/

[3] https://www.sae-itc.com/programs/evpki

[4] *Electric Transportation Standards Update for 2023*. EPRI, Palo Alto, CA: 2023. 3002026760.

[5] https://www.sae.org/standards/content/j2836_201807/

Section 5 includes a comparison of SAE to ISO/IEC standards and provides an overview of their relationship.

The Appendix contains an exhaustive list of normative requirements from SAE J1772™.

# 2 ENERGY TRANSFER BASICS AND BACKGROUND INFORMATION

## An Overview of Energy Transfer to Electric Vehicles

The main goal of charging is to deliver energy to an electric vehicle from an external power source. This can be done using alternating current (AC) or direct current (DC). For AC power transfer, AC current is used at the vehicle inlet and conversion of AC to DC is done onboard the vehicle. AC is generally limited to a maximum of 80Aac and 240Vac (19.2kW) (Note: SAE J3400™ includes optional use of 277Vac and has a pin design that could operate at higher current levels than the SAE J1772™ AC coupler limits). For DC power transfer, DC current is used at the vehicle inlet and conversion of AC to DC is done external to the vehicle. DC systems are currently available from the 10s of kW level up to > 400kW capacity. DC systems are generally limited to 1000Vdc for light duty vehicles (medium and heavy-duty vehicles standards are considering 1250Vdc to 1500Vdc limits) with a maximum current capability dependent on cable/connector design. For current levels greater than around 300A, liquid cooling of connector/cables is often employed to allow use of smaller/lighter charging cables. The term "energy transfer" is used to acknowledge that power transfer can also be from the vehicle to external loads, often referred to as vehicle to load, where the vehicle acts as a standalone generator – grid forming; or vehicle to grid, where the vehicle provides power interactively with the electric distribution system – grid following.

## What is Not Covered in EV Energy Transfer Standards

**While one may assume that existing standards cover all aspects of the vehicle interface design, that is in fact, not the case.** Many aspects of the interface design and function have been left for manufacturers, vendors, and suppliers to decide, which is a likely contributor to vehicle-to-EVSE interoperability issues. Here's a list of some of the design elements **not** covered in standards:

**Vehicle side of Interface:**

- Shape, size, and operation of charge port door (there are requirements for a keep-out area to allow for finger space)
- Location of port on vehicle
- Inlet construction materials
- Inlet terminal construction and materials (outside basic interface dimensions required for connector mating)
- How inlet pins/sockets are mounted to inlet housing
- Termination, size, length, and routing of wires at the vehicle inlet (there are requirements for wire insulation color of high voltage wiring)

- Active cooling of vehicle side wiring
- On board charger topology, semiconductor choice, packaging, location, power capacity (there are AC input voltage and current limits)
- On board vehicle control and safety system design specifics
- Details of stimuli to wake up a sleeping EV
  - Sleeping – indicates a vehicle state where onboard systems are in a low or no-power state to conserve the vehicle's low voltage battery system
- Conditions for an EV to fall asleep

**Electric Vehicle Supply Equipment (EVSE) (infrastructure side of interface):**

- Connector housing material, color, and shape (there are requirements for the bounds of the connector handle to allow for finger space at vehicle inlet)
- Connector terminal construction and materials (outside basic interface dimensions required for connector mating)
- How connector pins/sockets are mounted to connector housing
- How pins/sockets are terminated to wires at the connector cable interface
- Methods for providing cooling to cable wires and connector pins
- Size, shape, and topology of EVSE
- For DC chargers: charger topology, semiconductor choice, packaging, location, and power capacity (there are AC input voltage and current limits)
- Connector Adapters – to date, only limited efforts have been carried out to develop standards for design and use of charging adapters. UL Solutions released an outline investigation document for adapters, UL 2252, in July of 2023. Industry stakeholders have expressed interest in developing an SAE standard for adapters and there has been discussion of forming a task force to address this.

## Powering EVSE – AC Electric Grid Options

There a several common electric service configurations across North America. These are listed by country below. Note that SAE J1772 and SAE J3400™ vehicles are charged using single phase AC, even when charging from a 3-phase source.

Typical USA Voltages:

- 120/240V split phase (single phase)
- 208V 3-phase (120V phase to neutral)
- 240V 3-phase (139V phase to neutral)

- 480V 3-phase (277V phase to neutral)

Typical Canada Voltages:

- 120/240V split phase (single phase)
- 208V 3-phase (120V phase to neutral)
- 240V 3-phase (139V phase to neutral)
- 480V 3-phase (277V phase to neutral)
- 600V 3-phase (347V phase to neutral)

Typical Mexico Voltages:

- 120/240V split phase (single phase)
- 220V 3-phase (127V phase to neutral)
- 480V 3-phase ((277V phase to neutral)

The figures that follow illustrate typical transformer secondary configurations for AC power in the US (transformer primaries are not shown for simplicity). Figure 2 shows a typical 240V split-phase connection for a residential service. Figure 3 shows a 208V 3-phase AC service typically found at light commercial and industrial sites. Figure 4 shows 240V 3-phase AC found in some buildings. Figure 5 shows 480V 3-phase service found at large industrial sites (usually in conjunction with 208V 3-phase service).

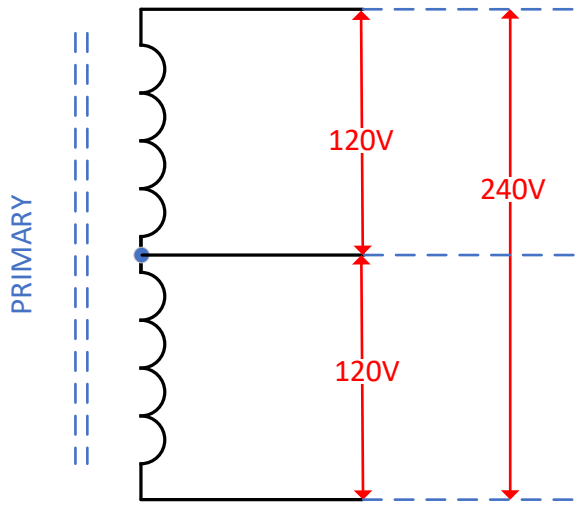



Figure 2. Split-Phase 240Vac Service

The split-phase service illustrated in Figure 2 can serve either AC level 1 charging at 120Vac (EVSE wired from neutral to line) or AC level 2 charging at 240Vac (EVSE wired from line to line).

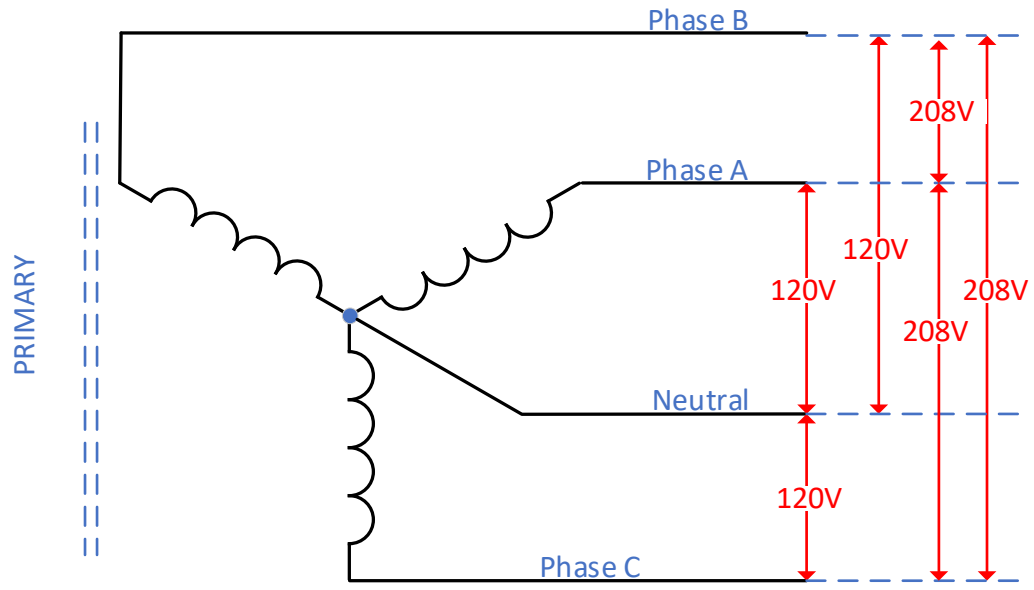



Figure 3. Three-Phase 208Vac Service (Y-Connection)

208Vac, three-phase service as illustrated in Figure 3 is common in light commercial and industrial settings. AC level 1 service can be provided by wiring the EVSE from phase to neutral at 120Vac. AC level 2 charging service can be provided by wiring from phase to phase at 208Vac. Where multiple chargers will be installed at a site, balancing current demand across the three phases is required to avoid overloading a single phase of the service transformer. Typical load centers are constructed so that double pole breakers installed in the panel are distributed across the three phases – phases A and B on first breaker, phases C and A on second breaker and phases B and C on third breaker.

Lower power (sub-50kW) DC chargers may be designed for 208Vac, three-phase service, though in recent years, many designs have moved to use of 480Vac service. A 50kW DC charger will have an AC line current per phase of ~ 139Aac for 208Vac, 3-phase service.

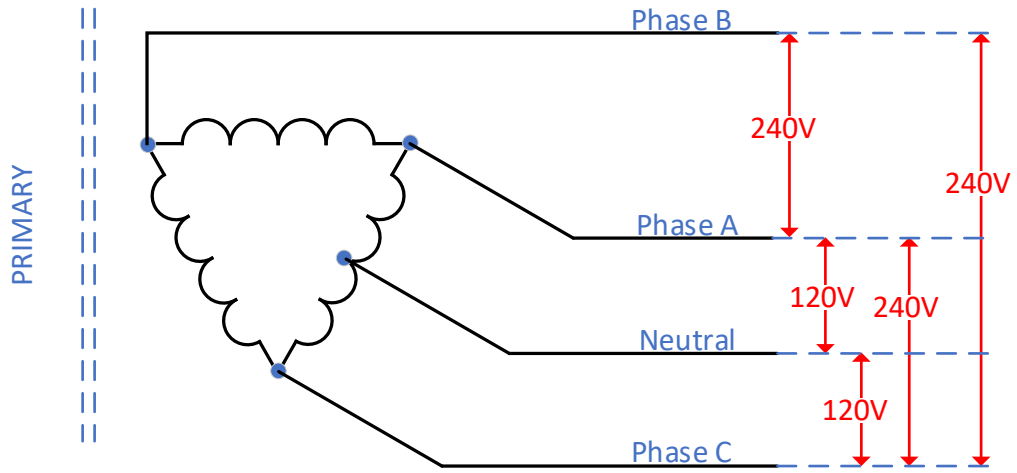



Figure 4. Three-Phase 240Vac Service (Delta-Connection)

A 240Vac, three-phase service is illustrated in Figure 4. This configuration, while not as common as 208Vac, three-phase service, is still used in the US. AC level 1 EVSE can be served from either phase to neutral on the center-tapped phase. AC level 2 EVSE can be served from phase to phase on the center-tapped phase (phase A to phase C in diagram). In general, EVSE should not be installed phase to phase on the untapped phases as the voltage from line to ground will exceed the EVSE's design specification.

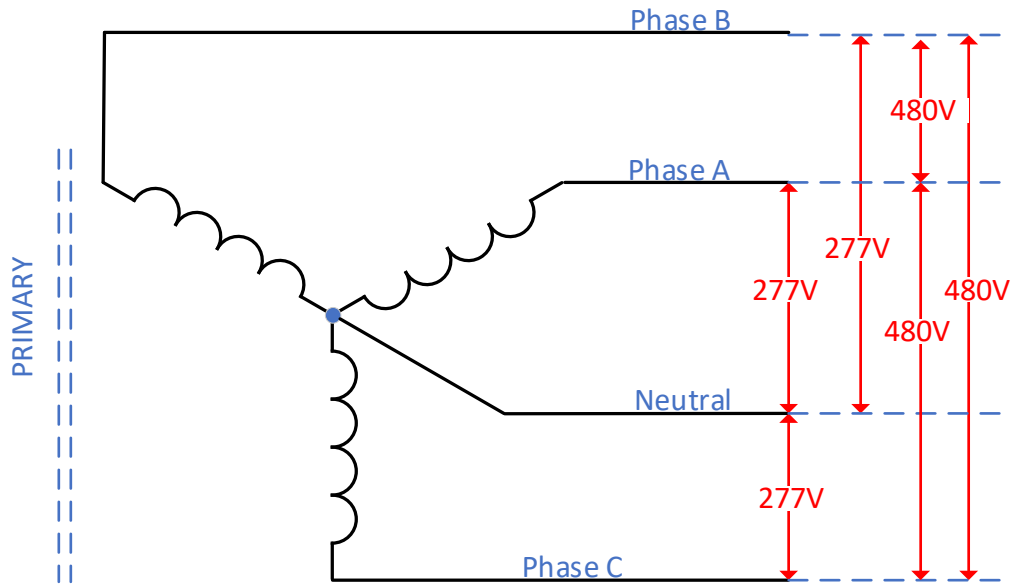



Figure 5. Three-Phase 480Vac Service (Y-Connection)

Most heavy commercial and industrial sites will have at least some 480Vac, three-phase service as illustrated in Figure 5, particularly where large electric loads are used. Most DC chargers are designed to operate from 480Vac, three-phase. A 400kW DC charger will have an AC input per phase current of ~ 481A for 480Vac, 3-phase service.

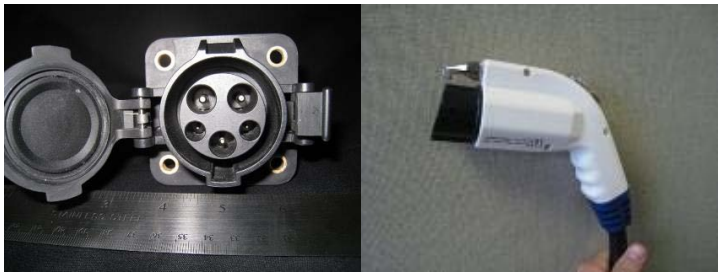
As was noted previously, Tesla's proprietary charging interface does allow for AC charging at 277Vac (from phase to neutral in a 480Vac, three-phase system). This requires the onboard vehicle charging be capable of handling the typical input voltage range of +/- 10% (or a voltage range of 249Vac to 304Vac). While Tesla has designed their vehicles to accept 277Vac, most other vehicle manufacturers have only designed for nominal 208Vac/240Vac service. One advantage of the use of 277Vac is allowing AC charging to be provided in conjunction with a DC fast charger without the need for a separate transformer. As of this writing, the SAE J3400™ task force has included the use of 277Vac as an option. It should be noted that there are deployed Tesla AC chargers that use 277Vac and consumers are already using J1772-to-Tesla coupler adapters to charge their non-Tesla vehicles at these sites (often with mixed success – and another potentially growing source of interoperability issues).

## Types of EV Charging Couplers in Circulation

There are several EV charging interfaces currently deployed on both EVs and EVSEs. Many plug-in hybrid vehicles (PHEVs) have only AC charging capability. Most new generation battery electric vehicle (BEVs) have Combined Charging System (CCS) ports or Proprietary Tesla charging interfaces. Note that SAE J1772™ describes two primary connector form factors – an AC only coupler and a coupler that combines the AC form factor with two additional high power DC pins (referred to as the combined charging system).

Common Conductive Charging Interfaces in Use in North America for Light Duty Vehicles

- SAE J1772™ AC Only (referred to as Type 1 in IEC standards)



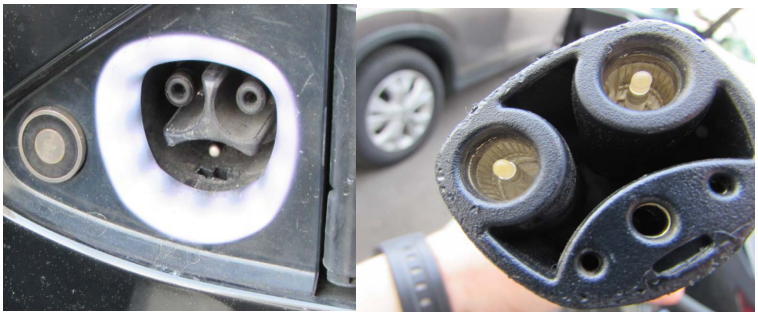
- SAE J1772™ CCS DC (referred to as CCS Type 1 in IEC standards)



- CHAdeMO DC



- Tesla Proprietary (AC/DC)



- SAE J3400™ (work in progress) (AC/DC)

  [No photo available]

Recent announcements indicate that many auto original equipment manufacturers (OEMs) are planning to transition to use of a standardized form of the Tesla coupler being developed in the SAE J3400™ Task Force (part of the SAE Hybrid-EV Committee). The CHAdeMO charging interface continues to be used by Mitsubishi and Nissan for some vehicles in North America.

Note that for CCS, Tesla, and SAE J3400™ vehicles, the same port is used for AC and DC charging – so vehicle side systems can accept either type of voltage, while the infrastructure generally is only either AC or DC capable.

A unique feature of the Tesla and SAE J3400™ couplers is that the same pins are used to transfer AC or DC current to the vehicle inlet. This elevates the need to ensure AC and DC systems never misapply the incorrect voltage type in operation and is being addressed in SAE J3400™.

## What's in the Field Today

Even as charging for North America is moving toward a common connector under SAE J3400™, designers should be aware of what is already deployed in the field, where these vehicles and infrastructure implementations will be present for many years.

These terms, used in these lists are defined in greater detail later in this section:

CAN – controller area network

PLC – power line carrier

PWM – pulse width modulation

**Typical Vehicle Side Capabilities (EV)**

- SAE J1772™ AC Only Form Factor (AC)
- SAE J1772™ Combined Charging System (CCS) Form Factor (AC/DC)

- CHAdeMO (DC)
- Tesla Legacy Proprietary (DC) (some early Tesla vehicles do not support PLC based communications)
- Tesla Proprietary (AC/DC) (with PWM/PLC capability)
- North American Charging System (SAE J3400™) – this is a work in progress and standardizes the Tesla proprietary coupler using existing charging protocols (AC/DC)

**Typical Infrastructure Side Capabilities (EVSE)**

- SAE J1772 AC Form Factor (AC)
- SAE J1772 CCS Form Factor (DC)
- CHAdeMO (DC)
- Tesla Proprietary Legacy (AC - Single wire CAN based) (not compatible with other vehicle brands)
- Tesla Legacy AC (PWM based)
- Tesla Proprietary Legacy DC (DC - Single wire CAN based) (not compatible other vehicle brands)
- Tesla Legacy DC (DC - PLC based)
- North American Charging System (SAE J3400™) (AC)
- North American Charging System (SAE J3400™) (DC)

## Types of EV Charging per SAE J1772™

SAE J1772™ defines several categories of charging based on the line voltage for AC and which pins are used to transfer power for DC.

- AC L1 – AC power transfer using 120Vac power (typically used in the 1kW to 2kW power range)
- AC L2 – AC power transfer using 208Vac/240Vac (SAE J1772™ does not recognize use of 277Vac) (supports up to 20kW power range)
- AC L3 – not defined
- DC L1 – DC charging where DC power is passed over AC pins of the AC form factor SAE J1772™ connector (no known products in the market)
- DC L2 – DC charging where DC power transfer occurs over the DC pins (supports up to 350kW charging)
- DC L3 – not defined

While SAE standards and recommended practices use the definitions noted above, it has become common practice for the public to refer to charging in three categories:

- Level 1 – 120Vac
- Level 2 – 208/240Vac (and 277Vac)
- Level 3 – DC charging (usually as DC "fast" charging)

Consumers generally think of Level 3 as fast charging, but there are products in the market that offer DC charging capability at lower power levels that are more like AC charging (sub 25kW). With no formal definitions for the various levels of DC charging, vendors have used many different terms to distinguish power levels of DC charging (fast, ultra, hyper, super, etc.).

The SAE J3400™ document does not define charging levels, so the consumer definitions may become the de facto descriptors for charging.

## Interoperability of the Various Charging Interfaces and Protocols

As noted previously, there are several charging interfaces available in the market today. While there is a strong industry push to move to a single standard in North America (SAE J3400™ North American Charging System), legacy charging infrastructure and legacy vehicles are likely to be "around" for many years to come.

For a designer or implementer of charging systems, it is useful to understand the basic operation of the various charging system types as it gives insight into applications where adapters, whether passive or active, might be used to bridge different charging interfaces. Note that a section on adapters follows this section and provides a deeper dive on their use and implications.

Table 1 illustrates the matrix of EVSE and EV options related to interface types. In some cases, interoperation between the different interfaces is possible with use of a passive mechanical adapter. For those noted as "not compatible", differences in the functional implementation or communications technology prevent direct interoperability.

Table 2 provides a focused view of AC charging options, while Table 3 focuses on DC charging options. In each table, the left most column represents the coupler type at the vehicle inlet and the top row identifies the coupler type on the infrastructure.

## Table 1. Compatibility of Various Charging Interfaces Found in North America

| | | Infrastructure Connector Type (EVSE) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | SAE J1772 AC | SAE J1772 CCS | CHAdeMO | Legacy Tesla AC Single wire CAN | Legacy Tesla DC Single wire CAN | SAE J3400 NACS AC | SAE J3400 NACS DC |
| EV Inlet Type | SAE J1772 AC ONLY | AC L1, AC L2 | not compatible | not compatible | not compatible | not compatible | AC L1, AC L2 with mechanical adapter | not compatible |
| | SAE J1772 CCS | AC L1, AC L2 | AC L1, AC L2, DC | not compatible | not compatible | not compatible | AC L1, AC L2 with mechanical adapter | DC with mechanical adapter |
| | CHAdeMO | NA | not compatible | DC | NA | not compatible | NA | not compatible |
| | Tesla Vehicle | AC L1, AC L2 with mechanical adapter (1) | DC with mechanical adapter (2) | DC with mechanical adapter (3) | AC | DC | AC (1) | DC (2) |
| | SAE J3400 NACS | AC L1, AC L2 with mechanical adapter | DC with mechanical adapter | not compatible | not compatible | not compatible | AC | DC |

*Table 1 Notes:*

*(1) Tesla vehicle must support PWM control*
*(2) Tesla vehicle must support PLC communication and appropriate protocol*
*(3) Tesla vehicle must support single wire CAN*
*AC L1 - 120Vac power transfer*
*AC L2 - 208/240Vac power transfer*
*DC L2 - DC passes over J1772 DC pins*
*DC L1 - DC charging using AC form factor J1772 connect - DC passes over AC pins is NOT addressed in this chart*

## Table 2. Focus on AC-Only Charging Compatibility

| | | Infrastructure Connector Type (AC EVSE) | | | AC with HLC (Digital Comms)(2) | |
|---|---|---|---|---|---|---|
| | | SAE J1772 AC | Legacy Tesla AC Single wire CAN | SAE J3400 NACS AC | SAE J1772 AC HLC | SAE J3400 NACS AC HLC |
| EV Inlet Type | SAE J1772 AC ONLY | AC L1, AC L2 | not compatible | AC L1, AC L2 with mechanical adapter | AC L1, AC L2 | AC L1, AC L2 with mechanical adapter |
| | SAE J1772 CCS | AC L1, AC L2 | not compatible | AC L1, AC L2 with mechanical adapter | AC L1, AC L2 | AC L1, AC L2 with mechanical adapter |
| | TeslaVehicle | AC L1, AC L2 with mechanical adapter (1) | AC | AC (1) | AC L1, AC L2 with mechanical adapter | AC |
| | SAE J3400 NACS | AC L1, AC L2 with mechanical adapter | not compatible | AC | AC L1, AC L2 with mechanical adapter | AC |

*Table 2 Notes:*

*(1) Tesla vehicle must support PWM charge control*
*(2) Vehicle must support high level communications (ISO/SAE over PLC)*

Table 3. Focus on DC-only Charging Compatibility

| | | Infrastructure Connector Type(DC EVSE) | | | |
|---|---|---|---|---|---|
| | | SAE J1772 CCS | CHAdeMO | Legacy Tesla DC Single wire CAN | SAE J3400 NACS DC |
| EV Inlet Type | SAE J1772 AC ONLY | not compatible | not compatible | not compatible | not compatible |
| | SAE J1772 CCS | DC | not compatible | not compatible | DC with mechanical adapter |
| | CHAdeMO | not compatible | DC | not compatible | not compatible |
| | Tesla Vehicle | DC with mechanical adapter (1) | DC with mechanical adapter (2) | DC | DC (1) |
| | SAE J3400 NACS | DC with mechanical adapter | not compatible | not compatible | DC |

*Table 3 Notes:*

*(1) Tesla vehicle must support PLC communication and appropriate protocol*
*(2) Tesla vehicle must support CHAdeMO CAN*

## Adapters

As indicated in the previous tables, in some cases, adapters can be used to allow vehicles with one type of charging interface to work with infrastructure supporting another type of charging interface. While adapters present many challenges, they are already widely available and used by consumers today. With the anticipated adoption of SAE J3400™ by many auto makers, their use is expected to become even more common in the future.

Work is underway via UL Solutions to address adapter construction standards in UL 2252. SAE has defined a new Task Force, SAE J3400/1, with plans for that Task Force to start meeting in January of 2024. The SAE effort is not likely to produce published documents for many months.

### *Passive Adapters*

Passive adapters electrically couple pins from one standard of coupler to another. They do not alter the electrical signals present from the infrastructure or vehicle. Here the infrastructure communications method must be recognized by the electric vehicle to have successful charge sessions. Passive adapters can take the form of a rigid single piece unit or might be cable based (section of cable between couplers).

## Active Adapters

Active adapters, in addition to coupling pins electrically from one standard of coupler to another, have active electronics that alter electrical signals within the interface. For example, the adapter might have electronics that translate messages received on a CHAdeMO coupler's CAN pins to ISO 15118-2 compatible messages communicated over a PLC interface on the pilot wire. These adapters require a local power source and may contain a battery to support the active electronics.

## Possible Types of Adapters

Table 5 lists some potential EV charging adapters. It is **not** anticipated that all of the adapters noted will be available to consumers. There are a couple of reasons that Tesla legacy interfaces are included separately from SAE J3400™ interfaces: Tesla has used single wire CAN in the past for EV to charger communications; and legacy Tesla couplers have a voltage rating limitation of 500Vdc, where SAE J3400™ couplers will have a 1000Vdc rating. The list of concerns is not exhaustive – EV and EVSE designers should be fully aware of adapters and their potential use and impact in the field. Prioritization of addressing adapter options is expected to be an early component of work in SAE J3400/1.

Table 4. Some Potential Forms of EV Charging Adapters

| Adapter From Infrastructure (EVSE) | To vehicle (EV) | Application | Notes/Concerns |
|---|---|---|---|
| SAE J1772 AC only | SAE J3400 | Using an SAE J1772 AC form factor charger with an SAE J3400 vehicle (AC power transfer). | Adapter current rating must be greater than charger current rating. |
| SAE J1772 AC only | Tesla legacy | Using an SAE J1772 AC charger with a Tesla vehicle (AC power transfer). | Adapter current rating must be greater than charger current rating. |
| SAE J1772 CCS | SAE J3400 | Using an SAE J1772 CCS fast charger with an SAE J3400 vehicle (DC power transfer). | AC pins on CCS inlet of adapter should be floating. DC current rating of adapter should be great than the charger rating. Voltage rating should be 1000Vdc. |

Table 4 (continued). Some Potential Forms of EV Charging Adapters

| Adapter From Infrastructure (EVSE) | To vehicle (EV) | Application | Notes/Concerns |
|---|---|---|---|
| SAE J1772 CCS | CHAdeMO | Using an SAE J1772 CCS fast charger with a CHAdeMO vehicle (DC power transfer). | AC pins on CCS inlet of adapter should be floating. This must be an active adapter unless CHAdeMO vehicle supports PLC communication. |
| SAE J1772 CCS | Tesla legacy | Using an SAE J1772 CCS fast charger with a Tesla vehicle (DC power transfer). | AC pins on CCS inlet of adapter should be floating. DC current rating of adapter should be great than the charger rating. Tesla vehicle must support PLC communication. |
| SAE J3400 | SAE J1772 AC only | Using an SAE J3400 AC charger with an SAE J1772 vehicle (AC power transfer). | |
| SAE J3400 | SAE J1772 CCS for AC use | Using an SAE J3400 AC charger with an SAE J1772 CCS vehicle (AC power transfer). | Adapter could be SAE J1772 AC only form factor at vehicle inlet (recommended option) or could be CCS form factor. If CCS, DC pins on plug side of adapter should be floating. |
| SAE J3400 | SAE J1772 CCS vehicle for DC use | Using an SAE J3400 DC charger with an SAE J1772 CCS vehicle (DC power transfer). | AC pins on vehicle inlet should be floating. |
| SAE J3400 | SAE J1772 CCS vehicle for AC/DC use | Using an SAE J3400 charger with an SAE J1772 CCS vehicle – AC or DC. | This adapter design is problematic as it ties the AC and DC pins together at the SAE J1772 CCS interface. |
| SAE J3400 | CHAdeMO | Using an SAE J3400 DC charger with a CHAdeMO vehicle (DC power transfer) | This must be an active adapter unless CHAdeMO vehicle supports PLC communication. |

Table 4 (continued). Some Potential Forms of EV Charging Adapters

| Adapter From Infrastructure (EVSE) | To vehicle (EV) | Application | Notes/Concerns |
|---|---|---|---|
| Tesla legacy | J1772 AC only | Using a Tesla AC charger with an SAE J1772 AC only form factor vehicle (AC power transfer). | Some Tesla AC chargers may operate at 277Vac. Some Tesla AC chargers may by CAN only. |
| Tesla legacy | SAE J1772 CCS vehicle for AC use | Using a Tesla AC charger with an SAE J1772 CCS vehicle (AC power transfer). | DC pins should be floating on CCS side of adapter. |
| Tesla legacy | SAE J1772 CCS vehicle for DC use | Using a Tesla DC charger with an SAE J1772 CCS vehicle (DC power transfer). | AC pins should be floating on CCS side of adapter. SAE J1772 vehicle may not be compatible with Tesla charger. |
| Tesla legacy | SAE J1772 CCS vehicle for AC/DC use | Allows using a Tesla AC or DC charger with an SAE J1772 CCS vehicle (AC or DC power transfer). | This adapter design is problematic as it ties the AC and DC pins together at the SAE J1772 CCS interface. |
| CHAdeMO | SAE J1772 CCS vehicle | Use of a CHAdeMO DC charger with an SAE J1772 CCS vehicle (DC power transfer). | Limited to 500Vdc. Requires translation of CHAdeMO CAN to PLC communications. |
| CHAdeMO | Tesla Legacy vehicle | Use of a CHAdeMO DC charger with a Tesla vehicle (DC power transfer). | |
| CHAdeMO | SAE J3400 vehicle | Use of a CHAdeMO DC charger with an SAE J3400 vehicle (DC power transfer). | Limited to 500Vdc Requires translation of CHAdeMO CAN to PLC communications. |

Some key safety and operational concerns related to use of adapters:

- The current rating of an adapter may be less than the vehicle or infrastructure's capability. This could lead to situations where the adapter is operated above its current rating leading to overheating.
- The voltage rating of the adapter may be less than the vehicle or infrastructure's capability. This could lead to situations where the adapter is operated beyond its voltage rating leading to arcing.

- Adapters may limit thermal coupling from connector to vehicle inlet, hindering operation where liquid cooled cables are in use. This could lead to overheating or reduced charging rates.
- Adapters may or may not couple the vehicle inlet locking mechanism. For DC charging It is required that the connector/inlet interface be locked where the connector cannot be removed while high voltage is present. EV charging couplers are not designed to interrupt current flow. Adapters should be designed so that the vehicle inlet locking mechanism is coupled to the adapter assembly, preventing unplugging of any portion of the interface during active charging. It should be noted that there are already adapters being sold and in use today for DC charging interfaces that do not couple the locking mechanism from inlet to infrastructure and will allow unplugging of the coupler during active current flow. Unplugging while current is flowing is a potential safety hazard and can lead to damaging both the adapter and EV inlet.
- Adapters add additional connection interfaces which may increase charging losses and add to heating at the vehicle inlet and infrastructure connector.
- SAE J3400™ will use a single pair of pins to transfer power, AC or DC. Other charging standards use independent pin pairs for AC and for DC. How should adapters be built related to managing connection of these pins?
- Users might put multiple adapters in series.

## Requirements Numbering in Standards Documents

Some newer ISO/IEC documents, SAE communications documents, and DIN 70121 include numbered callouts for normative requirements, but the numbering schemes vary.

Example of requirements numbering used in **SAE** communications documents: [V2G-DC-xxx].

V2G is suffix for all requirements.

DC – SAE has number requirements only in SAE J28747/2 which is specific to DC energy transfer.

xxx – number assigned to requirement.

The numbering in SAE is harmonized with DIN 70121 numbering.

Example of requirements numbering used in **DIN 70121** document: [V2G-DC-xxx].

V2G is suffix for all requirements.

DC – DIN 70121 is specific to DC charging.

xxx – number assigned to requirement.

Example of requirements numbering used in **ISO 15118-2, -3** documents: [V2GN-Y01-xxx].

V2G is suffix for all ISO requirements.

N – identifies ISO document -

1 = ISO 15118-1

2 = ISO 15118-2

3 = ISO 15118-3

Y = document section (M=main; annex letter].

xxx – number assigned to requirement.

Example of requirements numbering used in **ISO 15118-20** document: [V2G20-xxxx or V2G20-yyy].

20 = ISO 15118-20 or ISO 15118-2

xxxx – number assigned to requirement in ISO 15118-20.

yyy – number of the requirement taken from ISO 15118-2.

Some ISO/IEC documents also use shortcut identifiers for the ISO/IEC document set for EV energy transfer within the document texts:

| | |
|---|---|
| [IEC-1] | IEC 61851-1 |
| [IEC-21] | IEC 61851-21 |
| [IEC-22] | IEC 61851-22 |
| [IEC-2] | IEC 62196-2 |
| [IEC-3] | IEC/TS 62763 |
| [ISO-0] | ISO 15118-series |
| [ISO-1] | ISO 15118-1 |
| [ISO-2] | ISO 15118-2 |
| [ISO-3] | ISO 15118-3 |

## ISO/IEC Modes, Systems, Types, Cases, and Configurations

ISO and IEC documents use some specific names for various connector configurations as noted following.

IEC 61851-1 describes “Modes” of charging operation:

- Mode 1 – Charging from a receptacle directly (without EVSE); this is not allowed in US.
- Mode 2 – Use of portable EVSE (cord set).
- Mode 3 – AC charging with permanently installed EVSE.
- Mode 4 – DC charging.

IEC 61851-1 also describes “Systems”:

- System A – EVSE with dedicated CAN communication and vehicle coupler configuration AA (CHAdeMO coupler) as specified in IEC 62196-3 or TS 62196-3-1. Details of System A requirements are found in IEC 61851-1 Annex AA.
- System B – EVSE using the vehicle coupler configuration BB (China GB/T 20234-3 coupler) as specified in IEC 62196-1 or IEC TS 62196-3-1. Details of System B requirements are found in IEC 61851-1 Annex BB.
- System C – EVSE using the vehicle coupler configuration EE or FF (CCS Type 1 or CCS Type 2) as specified in IEC 62196-1 or IEC TS 62196-3-1. Details of System C requirements are found in IEC 61851-1 Annex CC.

IEC 62196 describes couplers by “Type”:

- Type 1 – This is the SAE J1772 AC only coupler or SAE J1772 CCS coupler.
- Type 2 – This is the European AC coupler (3-phase capable) or European CCS coupler.
- Type 3 – Pin and sleeve coupler variant used in some European countries.

IEC 61851-1 describes three cases for the cable from EVSE to EV:

- Case A – cable assembly is permanently attached to the EV.
- Case B – cable assembly is detachable at both ends (commonly done in Europe)
- Case C – cable assembly is permanently attached to the EVSE (common method in North America)

SAE J3400™ leaves open the possibility of using the Case B option for EVSE implementation in North America.

IEC 62196 also describes couplers by “Configuration”:

- Configuration AA – CHAdeMO coupler
- Configuration BB – China GB/T 20234-3 coupler
- Configuration EE – Combined Charging System, Type 1 (SAE J1772 CCS) coupler
- Configuration FF – Combined Charging System, Type 2 (European version of CCS) coupler

# 3 THE STANDARDS LANDSCAPE FOR CHARGING

## Charging Standards

Charging standards for EVs have developed across several standards development organizations and industry alliances (though alliance-based documents may not be considered formal standards). The reader should also note that the US tends to follow a market-based standards development philosophy, where industry consensus determines what standards are used in product development and that vendors can choose to develop proprietary approaches to product design. Many of the agencies that offer grant funding for charging infrastructure in the US do add requirements around compliance with specific standards.

Each standards body or alliance generally has a limited area that they work in, as noted here:

- American National Standards Institute (ANSI) – ANSI is charged with oversight of standards development for the US. ANSI certifies standards development organizations and develops some system level standards. ANSI standards are specific to the US, though they may be used by entities outside the US.
- SAE International – Onboard vehicle standards and standards for elements that interact with vehicles. They generally do not develop standards for elements external to the vehicle. Safety aspects of some elements of SAE work for off-board systems are often delegated to UL Solutions. Connectors for EVs and their electrical behavior are covered here. SAE also covers vehicle related communications standards. While SAE is an international standards body, their standards work often has a North American focus.
- International Electrotechnical Commission (IEC) – IEC develops primarily electrical function and electrical safety standards. Electrical safety and testing specifications are often directly combined in the IEC documents. Connectors for EVs and their electrical behavior are covered here. IEC standards are used internationally but often have country specific provisions within a standard.
- International Standards Organization (ISO) – ISO develops vehicle safety standards and communications standards. Testing specifications are often directly combined in the ISO documents. ISO covers vehicle electrical safety and vehicle communications.
- UL Solutions – UL develops product specific safety standards for North America. These are often based on SAE, ISO, and IEC documents in the EV space. Use of UL standards by Canada and Mexico is coordinated through the Council for Harmonization of Electrotechnical Standards of the Nations in the Americas (CANENA). Several of the key UL standards for charging are Tri-national via the CANENA process.

## Standards Enforcement

Installation of electrical hardware is governed by local electric codes. In the U.S., the National Fire Protection Association (NFPA) published NFPA 70 - National Electric Code (NEC). The NEC is widely used by local jurisdictions to regulate installation of electrical hardware and is updated every 3-years (recent editions are 2023, 2020, 2017). Some states allow local jurisdictions to modify or amend the NEC. In the US, the NEC is generally adopted at the state level (noting that not all states use the most recent published version of the NEC)[6]. NFPA 70 requires that charging hardware deployed be "shall be listed"[7]. It is this listing requirement that ties the installation standards to external product standards as listing implies testing and certification by a Nationally Recognized Test Lab (NRTL - as defined and approved by ANSI and/or the Occupational Safety and Health Administration (OSHA)[8]) to appropriate UL Solutions product standards.

UL Solutions develops product safety standards that include rigorous testing requirements[9]. Testing to UL Solutions standards must be carried out by NRTLs, as self-attestation of compliance is not allowed in the U.S.

This leads to one significant difference between SAE standards documents when compared to IEC or ISO standards. SAE generally references appropriate UL Solutions product safety standards related to detailed product testing requirements. These types of testing requirements are embedded in IEC and ISO documents.

Canada and Mexico have similar national electric codes and safety listing requirements.

Many other countries that directly employ IEC and ISO standards follow the "Conformite Europeenne" process, or CE marking process. Here vendors are required to perform and attest to the testing procedures contained directly in the IEC and ISO documents as pertains to their equipment. This testing can be done by the vendor or by a third-party testing entity.

The U.S. does not have a rigorous system of compliance certification beyond the items noted above. Some standards, developed or backed by an industry alliance, may have their own certification process. An example is the Open Charge Alliance (OCA) that authors Open Charge Point Protocol (OCPP) documents. OCA offers testing tools and a certification process for compliance to OCPP through various international testing labs.

Currently, there are no formal compliance certifications for EV charging related to SAE or ISO/IEC documents. The CHAdeMO Alliance does have a certification process for CHAdeMO DC power transfer products.

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[6] https://www.nfpa.org/education-and-research/electrical/nec-enforcement-maps

[7] NFPA 70, Article 625.6

[8] https://www.osha.gov/nationally-recognized-testing-laboratory-program/current-list-of-nrtls

[9] https://www.ul.com/insights/electric-vehicle-onboard-equipment-and-charging-infrastructure-standards

## Understanding What Standards Apply and Where

It is critical for a charging designer to understand what standards apply across a charging system. Two figures are provided following, based on a simple functional diagrams of charging interfaces, that detail relevant standards for North America. Figure 6 describes standards for AC charging, while Figure 7 describes standards for DC charging.

Electric Vehicle Supply Equipment (EVSE) represents the interface between the electric grid and the vehicle. For AC charging, the EVSE is a safety device and switch for the AC power – the power electronics used to convert AC to DC are on-board the vehicle. For DC charging, the EVSE contains the power electronics that convert AC to DC.

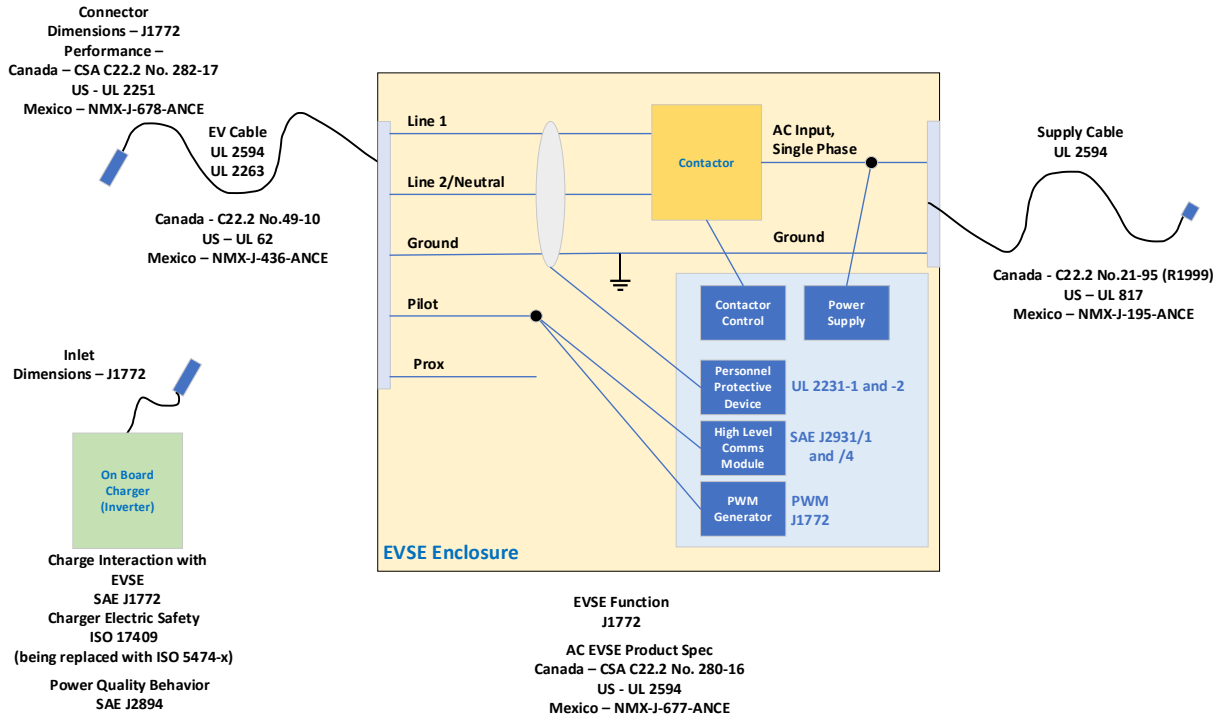



Figure 6. AC Charging Standards - Functional Diagram

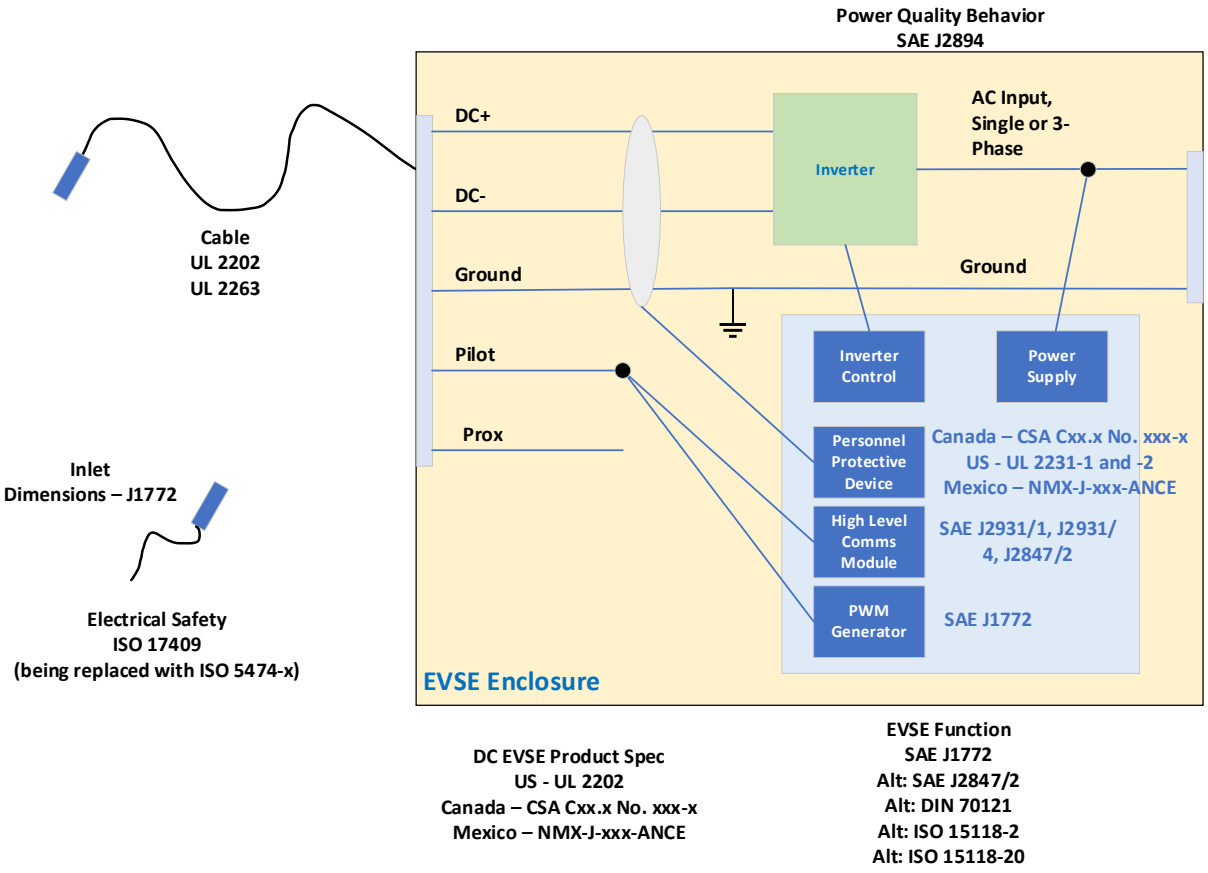



Figure 7. DC Charging Standards - Functional Diagram

## How Charging is Controlled

The various charging protocol standards in SAE and ISO/IEC allow for three main types of charging control: one based on use of the pilot wire and a pulse width modulation (PWM) signal, referred to as basic communications (BC) (or PWM control); another based on use of Local Interconnect Network (LIN) over the control pilot; and a third option based on the use of digital communications, referred to as high-level communications (HLC) or digital control. LIN based communications are described in SAE J3068 and in an annex of IEC 61851-1 and are included as an option in SAE J3400™.

BC is used for initiating the charging sequence and can be used for AC charging. For AC charging, BC uses the PWM signal duty cycle to communicate to the vehicle the maximum current it is allowed to draw while charging.

HLC is required for DC charging but is optional for AC charging. For the AC charging case, Table 4 illustrates the matrix of EVSE and EV charging support for PWM and HLC and how they interact in terms of interoperability of charging. For the HLC only case, two notes: 1) the vehicle would still require use of a 5% PWM signal for proper operation; and 2) it should be noted that

the authors are not aware of any vehicle or infrastructure that limits operation to HLC only for AC charging.

Table 5. Compatibility of AC Charging Infrastructure (EVSE) with Electric Vehicles (EV)

| | EVSE | | |
|---|---|---|---|
| **EV** | **BC only** | **BC/HLC** | **HLC only** |
| **PWM only** | BC | BC | not compatible |
| **PWM/HLC** | BC | either | HLC |
| **HLC only** | not compatible | HLC | HLC |

## Charge Session Flow Mapped to Standards

When a vehicle is plugged in, there is a process needed to determine the type of power transfer that is to occur and the direction of power flow. The primary factor is to determine if basic communication (BC - PWM control) or high-level communication (HLC) is available. By default, if only BC is available, this indicates that the charging will occur using AC for power transfer. The following discussion describes the session flow and what standards provide details for each path. This charging flow for SAE J1772™ is applicable to SAE J3400™, as SAE J3400™ is basing the interface operation on that used in SAE J1772™.

The first decision point is at plug-in, illustrated in Figure 8, where one of four paths must be followed:

- Use BC (pilot duty-cycle based)
  - AC charging - 1000Hz pilot, 9.5% to 96.5% duty cycle charging
  - AC discharging - 125Hz or 166Hz pilot, 9.5% to 96.5% duty cycle for V2H
- or Use HLC (nominal 5% duty cycle)
- or Use LIN-CP (as defined in SAE J3400™).

It should be noted that some Tesla legacy proprietary charging systems used single-wire CAN over the control pilot – referenced as SW-CAN-CP. A limited description of SW-CAN-CP is included in SAE J3400™. These chargers will not function with vehicles that rely on PWM operation.

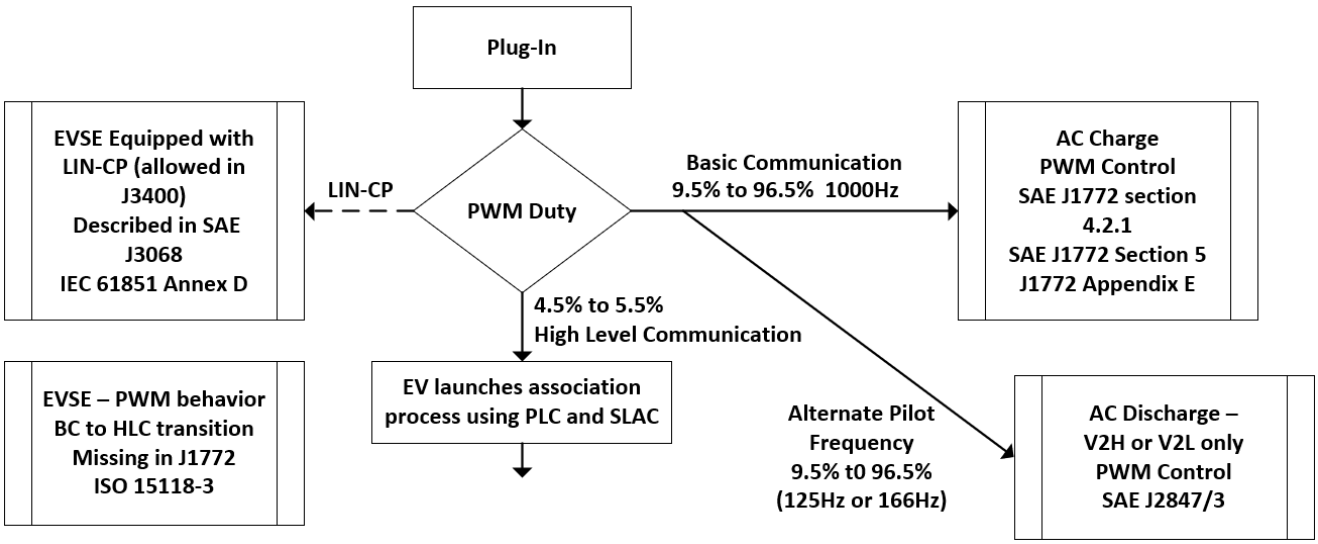



Figure 8. DC Charging Standards - Functional Diagram 1

SAE J1772 contains detailed timings for operation using BC for AC charging in Appendix E.

Operation using LIN-CP is described in SAE J3068 and Annex D of IEC 61851-1 and is referenced by SAE J3400™.

SAE J3400™ provides a brief description of SW-CAN-CP, to support interoperability but does not propose to use SW-CAN-CP for new products.

For AC charging, HLC is optional, while HLC is required for DC charging. AC charging requires guidance on how BC and HLC are coordinated – a topic that is currently lacking in the SAE J1772™ document but is covered in detail in ISO 15118-3 and SAE J3400™ (section 9.1).

DC charging assumes that both the EVSE and EV are equipped with PLC interfaces (HomePlug GreenPHY) and that both devices support HLC. For DC charging, SAE J1772™ section 6.2.3 notes that a 5% pilot duty cycle indicates the need for digital communication (which is required for DC charging) but does not specify any related timings. Section 6.4.8.1 of SAE J1772 provides limited guidance on the BC to HLC transition for DC charging as part of a charging session restart routine. As noted previously, SAE J3400™ details the use of HLC in section 9.1.

ISO 15118-3 provides detailed requirements for the BC to HLC transition, outlined here:

- Allows for and describes requirements for EVSE to indicate it is transitioning from HLC to BC (moving from 5% duty cycle to a nominal duty cycle that sets maximum current) [V2G3-M06-05 through -06] ISO 15118-3 section 6.4.2.1.
- Specifies timing for AC charging session where timing for establishing HLC after EVSE asserts 5% duty cycle including number of retries allowed. [V2G3-M06-07 through -09] ISO 15118-3 section 6.4.2.1.

- Provides restrictions and conditions for transition from HLC to BC. [V2G3-M06-13 through -15] ISO 15118.3 section 6.4.3.2.

If high level communication is being indicated by the EVSE through its PWM duty cycle (5%), then the system must establish the digital communication link from EVSE to EV as illustrated in Figure 9. In each case, once the protocol to be used has been decided, the EV must query the EVSE (Service Discovery) to find out what services are potentially provided by that EVSE as shown in Figure 10.

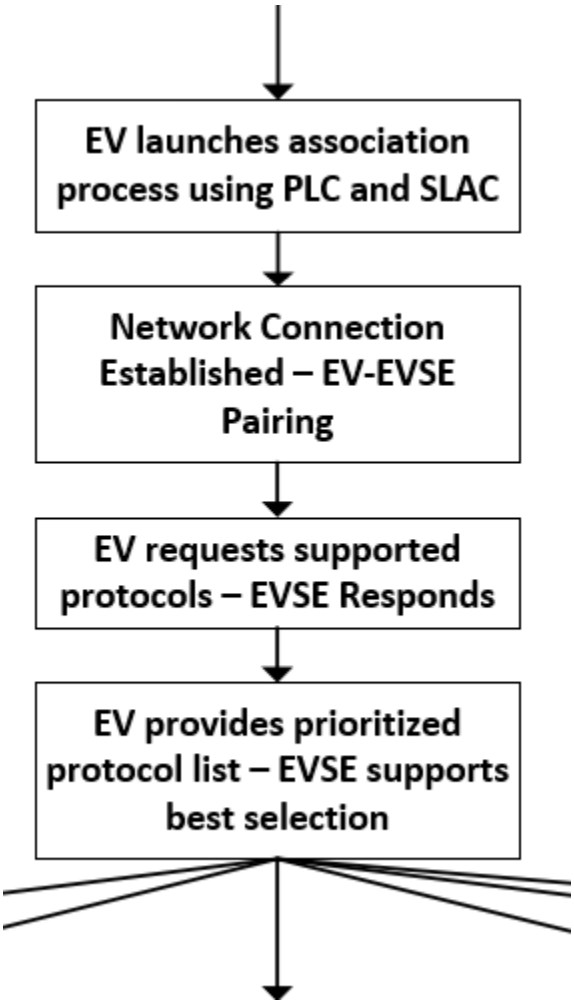



Figure 9. Establishing Digital Communications

The available protocols are presented as part of a namespace message that describes the protocol:

- DIN 70121 - namespace “din:70121:2012 with version x.x”
- SAE J2847/2 – namespace “sae:2847:2:2022 with version x.x”
- SAE J2847/3 – J3072 – namespace “ieee:std:2030.5:ns”

- ISO 15118-2 – namespace “iso:15118:2:yyyy with version x.x”
  - Where yyyy is a year reference
- ISO 15118-20 – namespace “iso:15118:20:2022 with version x.x”

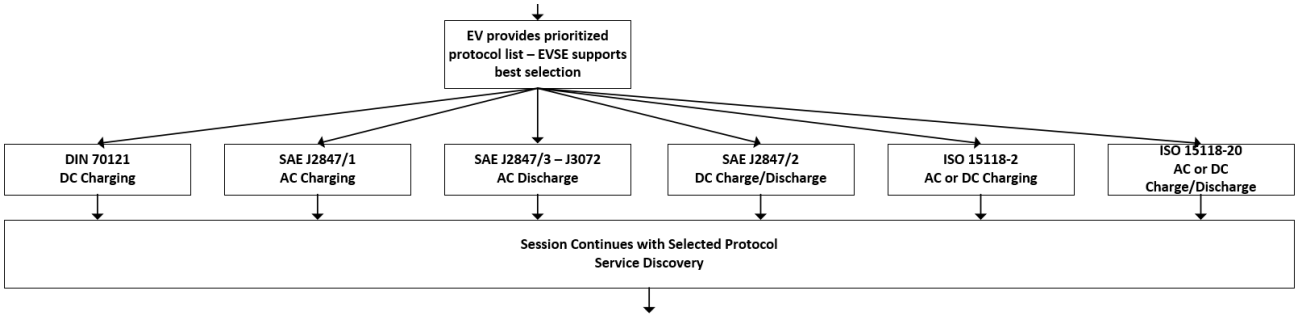



Figure 10. Once a protocol is selected, the EV must discover what services are available from the EVSE.

Note that some protocols support multiple operations and forms of energy transfer while others may only support one type of energy transfer.

For AC charging, there are three options, two of which have seen only limited use:

- ISO 15118-2 would be the dominant protocol option for AC charging control.
- SAE J2847/1, which is based on use of the Smart Energy Profile (IEEE 2030.5) has seen only limited use in pilot demonstrations,
- ISO 15118-20.

For AC discharging, there are two options:

- SAE J2847/3 – J3072 is used for export of AC power from the vehicle where U.S. grid codes must be met. A companion UL document (UL 1741 supplement C) is a work in progress.
- ISO 15118-20 – supports power export but not U.S. grid codes. An effort is underway to address U.S. grid codes in an addendum this ISO document.

For DC charging, there are three primary paths have been followed by charging implementers related to protocols and one developing option:

- DC charge control using DIN 70121. Supported by DIN 70122. Many legacy vehicles use DIN 70121 for DC charging.
- DC charge control using SAE J2847/2 and associated documents. This approach is nearly identical to DIN 70121 due to harmonization work. An update to SAE J2847/2 was published in September of 2023 that included addressing alignment with ISO 15118-2.
- DC charge control using ISO 15118-2 and associated documents. Supported by ISO 15118-4 and -5.

- DC charge control using ISO 15118-20 and associated documents (developing). Supported by ISO 15118-21 through -25 (works in progress).

DIN 70121 is the oldest of these documents and was used as the basis for DC charging control found in SAE J2847/2 and ISO 15118-2. DIN 70121 offers only the basic features needed to implement a DC charging session. While considerable work has been conducted to harmonize SAE J2847/2 and ISO 15118-2 there are still some differences in signal naming and functions available. One key feature of ISO 15118-2 not covered in SAE J2847/2 is Plug & Charge capability. Plug & Charge is a specific feature within ISO 15118 that simplifies the process of EV charging by allowing for automatic authentication and billing without the need for physical cards or smartphone apps.

For DC discharging, there are two options:

- SAE J2847/2,
- ISO 15118-2,
- ISO 15118-20 (work in progress).

## The Protocol Options

Each optional protocol path flow is detailed following.

### *DIN 70121*

DIN 70121 was the earliest of the DC protocols to support the CCS type of coupler. It is focused on DC charge control only and does not provide features beyond basic charging session management. It was used as the basis for the DC charging protocols found in SAE J2847/2 and ISO 15118-2/IEC 61851-1/IEC 61851-23.

Note: Reference numbers in [brackets] are those used in the DIN 70121 document.

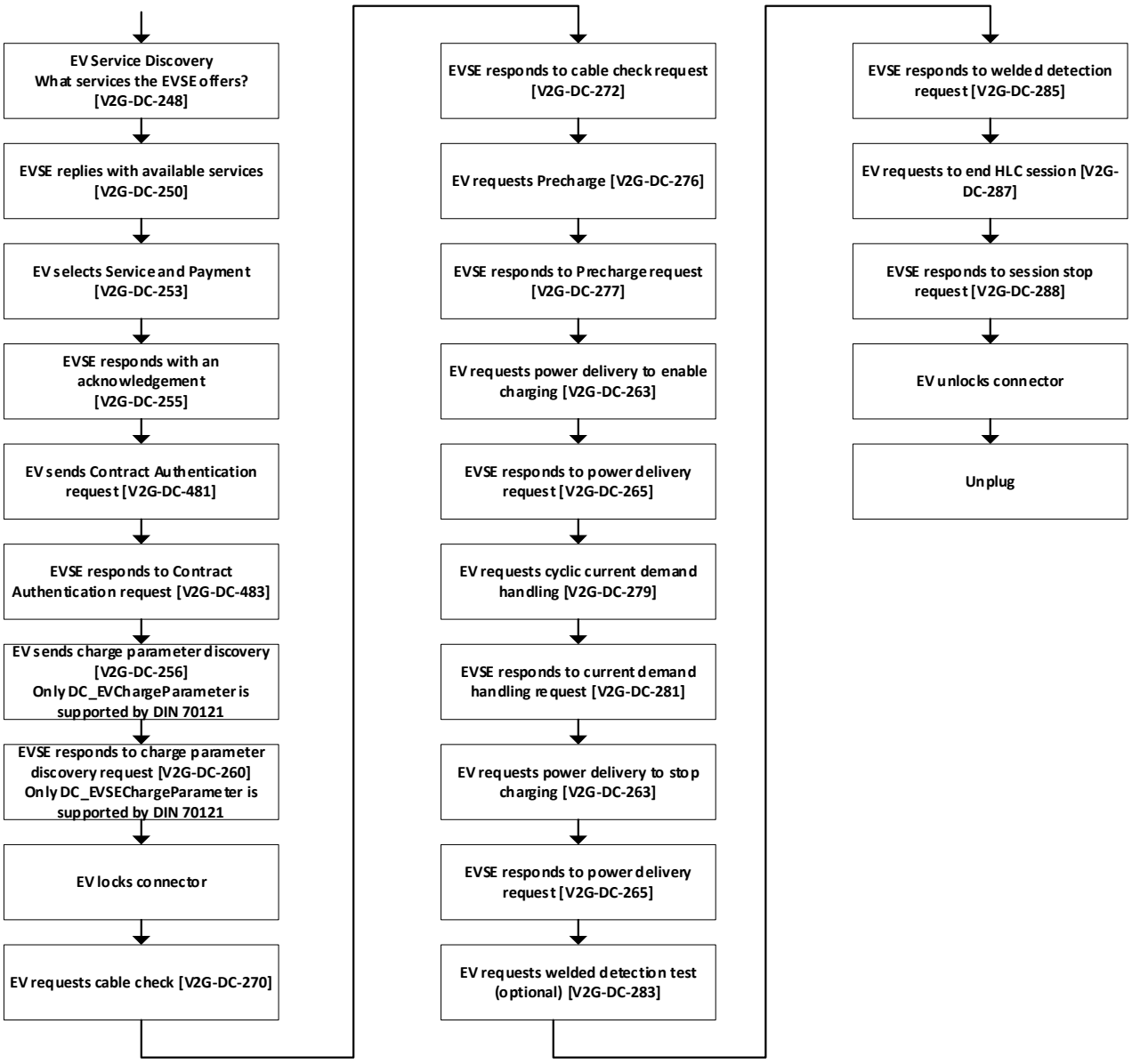



Figure 11. Session Flow for DIN 70121

## SAE J2847/1

To date, little interest has been shown by stakeholders for use of the Smart Energy Profile (IEEE 2030.5) for control of EV charging. For this reason, this option has not been detailed.

## SAE J2847/2

SAE J2847/2 is harmonized with DIN 70121. It supports a broader set of situations than DIN 70121 (for instance, restart of a session without unplugging). In normal operation, the session flow is identical to DIN 70121. Figure 12 illustrates a normal session flow for SAE J2847/2.

Note: Reference numbers in [brackets] are those used in the SAE J2847/2 document.

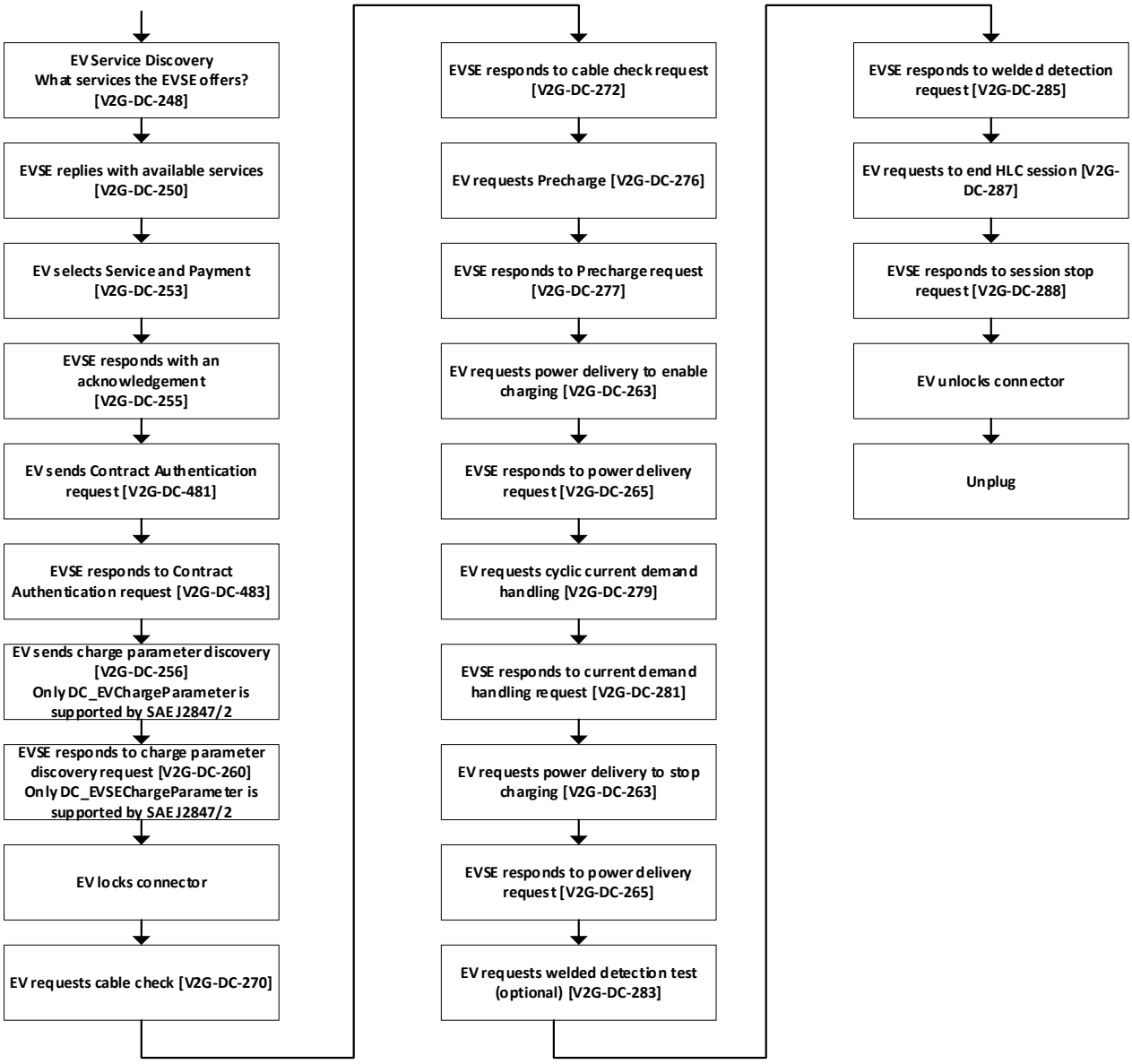



Figure 12. Session Flow for SAE J2847/2

## SAE J2847/3 – J3072

SAE J2847/3 supports AC export of power from the vehicle. This document is used in conjunction with SAE J3072 to implement AC export. As these documents are a work in progress, no detailed flow diagram is provided.

## *ISO 15118-2*

ISO 15118-2 is based on the underpinnings of DIN 70121 but offers additional features and capabilities. Figure 13 illustrates a normal session flow for ISO 15118-2.

Note: Reference numbers in [brackets] are those used in the ISO 15118-2 document.

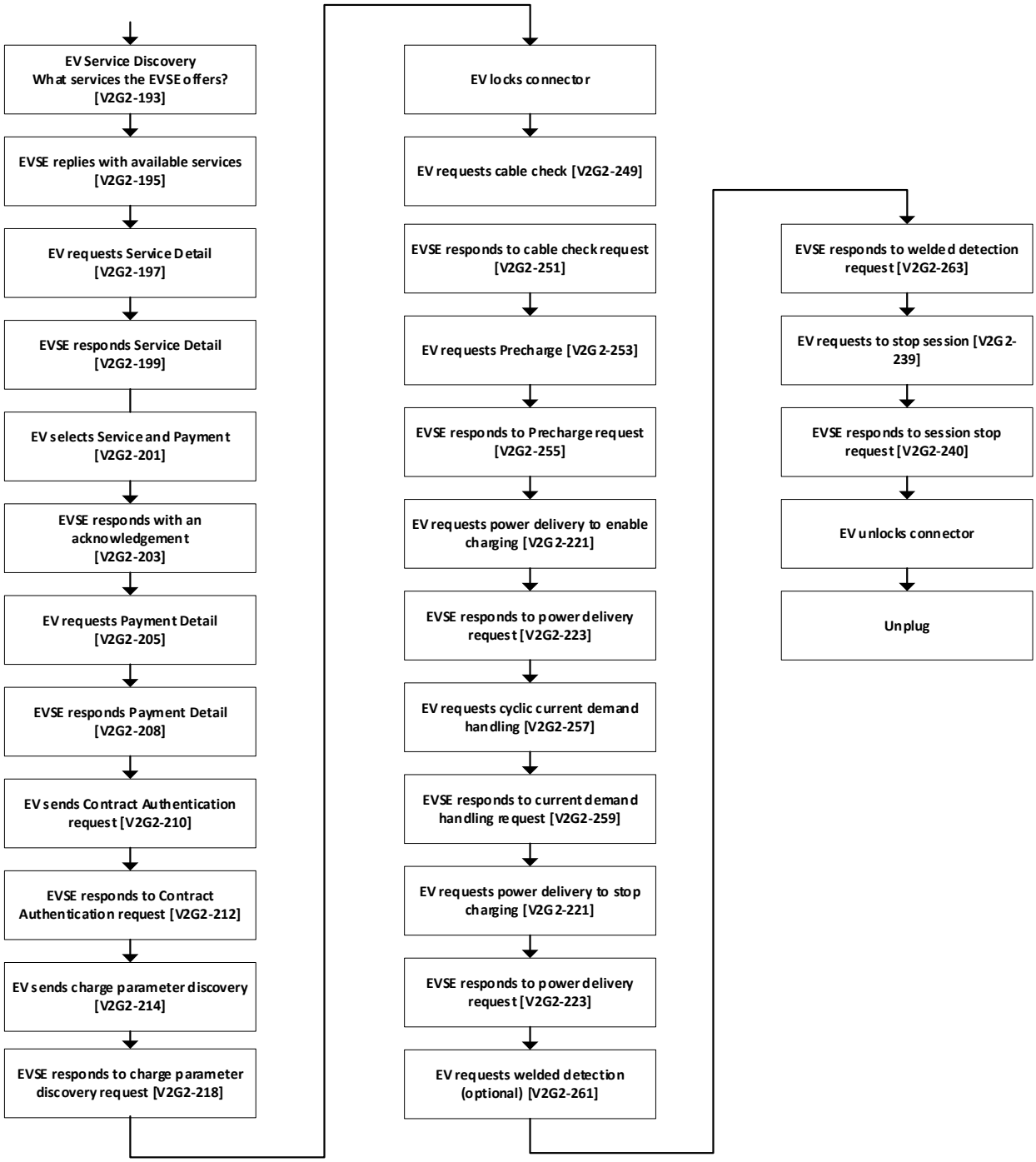



Figure 13. Session Flow for SAE ISO-15118-2

## *ISO 15118-20*

ISO 15118-20 was published in 2020 and is new protocol designed to offer a broad set of functionalities to support EV charging. It is not backward compatible with ISO 15118-2.

Note: Reference numbers in [brackets] are those used in the ISO 15118-20 document.

Unlike the protocols previously listed, ISO 15180-20 has multiple namespaces that cover the various forms of charging support:

- AC charging namespace “urn:iso:std:iso:15118:-20:AC” [V2G20-1039]
- DC charging namespace “urn:iso:std:iso:15118:-20:DC” [V2G20-2132]
- Automatic Connection Device Pantograph (ACDP) namespace “urn:iso:std:iso:15118:-20:DC” [V2G20-4107]
- Wireless Power Transfer (WPT) namespace “urn:iso:std:iso:15118:-20:DC” [V2G20-5126]

Figure 14 illustrates a sample session flow for a DC charging session using ISO 15118-20. Not all steps shown are mandatory. ISO 15118-20 section 8.6.6 describes message sequence requirements.

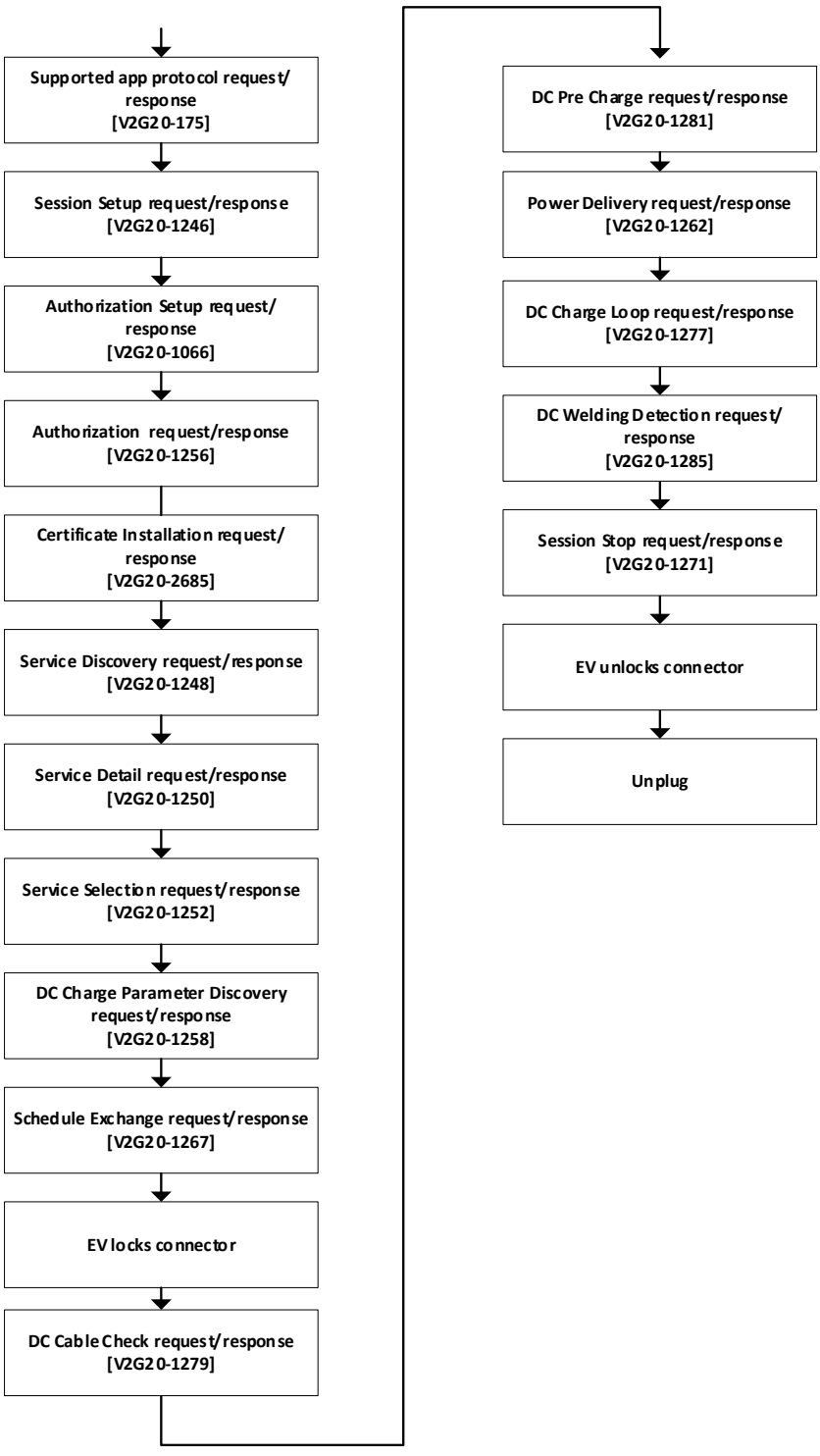



Figure 14. Session Flow for SAE ISO-15118-20

## Charge Session Timing

The following sections details where specific information on timing requirements can be found for various forms of charging. Note that for both SAE and ISO/IEC systems, timing diagrams and protocol details are contained in separate documents.

### *SAE J1772™ – AC Power Transfer Using Basic Communication*

For AC charging using BC, SAE J1772 sections 4 and 5 provide functional requirements and Appendix E provides timing requirements.

For AC discharging using BC, SAE J2847/3 provides requirements (where pilot operates at a frequency other than 1000Hz). SAE J1772 does not contain detailed timing requirements for this type of power export. Additional requirements have been added in SAE J3400™ to address the gaps found in SAE J1772.

### *SAE J1772™ – AC Power Transfer Using High Level Communication*

For AC charging using HLC, SAE J1772 currently lacks detailed timing requirements. AC charging with HLC is covered in SAE J2847/1.

For AC discharging using HLC, SAE J1772 currently lacks detailed timing requirements. AC discharging with HLC is covered in SAE J3072 and SAE J2847/3. Additional requirements have been added in SAE J3400™ to address the gaps found in SAE J1772.

### *SAE J1772™ – DC Power Transfer Using High Level Communication*

For DC charging (which must use HLC), SAE J1772 section 6 contains functional requirements and SAE J1772 Appendix F provides timing requirements. A new version of SAE J1772 was published in early 2024 with major revisions to timing diagrams to better harmonize with ISO/IEC work.

For DC discharging (which also requires HLC), SAE J1772 lacks detailed timing requirements. DC discharging is covered in SAE J2847/2.

### *IEC 61851-1 – AC Power Transfer Using Basic Communication*

For AC charging using BC, IEC 61851-1 Annex A provides functional and timing requirements.

IEC 61851-1 does not support power export via basic communications.

### *IEC 61851-1 – AC Power Transfer Using High Level Communication*

For AC charging using HLC, IEC 61851-1 provides functional requirements and ISO 15118-3 section 7 provides timing requirements.

AC discharging (referred to as bidirectional power transfer (BPT) in ISO/IEC documents) using HLC is not included in IEC 61851-1. ISO 15118-1 includes use case descriptions for BPT. The

published edition of ISO 15118-2 (edition 1, 2014) does not include BPT. It is anticipated that ISO 15118-2 edition 2 (still listed as "under development" by ISO) will include BPT. ISO 15118-20 provides protocol support for BPT.

### *IEC 61851-1 – DC Power Transfer Using High Level Communication*

For DC charging (which must use HLC), IEC 61851-23 Annex CC provides details timing requirements.

For DC discharging (which also requires HLC), IEC 61851-23 contains an informative Annex DD that describe "bidirectional power transfer" or BPT. ISO 15118-20 provides protocol support for BPT.

## Support Tools and Resources

For engineers looking to implement HLC or learn more about a specific protocol or implementation, there are some open-source resources available. Packet data of HLC charging sessions can be recorded and logged and then viewed for post analysis. A very common program used to analyze packet capture data is Wireshark[10]. HLC packet capture files (.pcap format) contain all the communication between an EV and EVSE, but the payloads are EXI encoded, requiring a codec to decode the packets. One of the most popular HLC codecs is the OpenV2G codec[11]. Engineers at ChargePoint have created an open-source Wireshark plugin (wireshark-v2g[12]) that utilizes the OpenV2G codec to decode the EXI packets of an HLC session. The Everest project[13] is an activity under the Linux Energy Foundation[14] with the goal of becoming the open-source operating system for charge stations. The Everest repository logfiles[15], contains packet capture files from a wide assortment of Electric Vehicles and different HLC protocols. This is a valuable resource to analyze how a successful HLC session is performed for different HLC protocols.

## Consideration of SAE J3400™

The Task Force's intent for SAE J3400™ is to use existing electrical behavior and protocols wherever possible in developing this standard for charging. Operation of the pilot and proximity wires is expected to closely follow SAE J1772™. Protocols for high level communication will be used as in SAE J1772™.

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[10] https://www.wireshark.org/

[11] https://github.com/Martin-P/OpenV2G

[12] https://github.com/ChargePoint/wireshark-v2g

[13] https://github.com/EVerest

[14] https://lfenergy.org/projects/everest/

[15] https://github.com/EVerest/logfiles

There are several key differences between the SAE J1772™ interface and the developing SAE J3400™ charging interface that may result in some minor changes to the charging interface implementation. These are enumerated in the follow sections.

## A Single Pair of Power Pins are Used for AC and DC Power Transfer

Having a single set of pins to deliver power to the EV offers the opportunity to have a more compact coupler design. It also means that the same electrical pin ratings are available for both AC and DC charging. Where SAE J1772™ limits AC voltage to 240Vac and 80Aac current, because the SAE J3400™ coupler uses the same, large, high-power pins for AC transfer, this opens the possibility of using higher voltages and higher current levels for AC charging. The published SAE J3400™ information report includes 277Vac power transfer. It has been proposed that higher voltages could be accommodated using high level communications to arbitrate available voltage.

A key safety concern, where a single pair of pins are used for both AC and DC transfer, is that the interface needs to be designed to ensure that the EV battery's DC terminals are never connected directly to the AC power source. As an added layer of distinction between AC and DC charging, it has been proposed that AC charging only be carried out when the pilot PWM signal duty cycle is in the 9.5% to 96.5% range even when high level communications are being used to manage a charge session.

## SAE J3400™Has No User Operated Latch Mechanism

The SAE J3400™ coupler has no user operated latch mechanism on the connector housing. Two terms must be defined for this discussion – latch and lock.

Latch – a mechanism that holds the connector in place at the vehicle inlet via a mechanical tooth. For SAE J1772™, the latch is part of the connector (infrastructure side of interface) and can be manually operated using a pushbutton lever integrated into the SAE J1772™ coupler. This latch mechanism in SAE J1772™ is tied to the operation of switch S3 which is part of the proximity detection circuit and the vehicle inlet controls locking of the latch tooth. SAE J3400™ does not have an equivalent to the SAE J1772™ latch mechanical pushbutton.

Lock – a device that prevents the connector from being removed from the vehicle inlet. In SAE J1772™, a pin on the vehicle inlet is used to capture the latch tooth described above, disabling a user's ability to manually unseat the connector. For SAE J1772™, locking is optional for AC charging and mandatory for DC charging. In SAE J3400™, a mechanical pall controlled by the vehicle is moved into a recess in the connector housing, locking the connector to the vehicle inlet. SAE J3400™ requires locking for all types of energy transfer and, in essence, the latch and lock are one in the same mechanism and controlled by the vehicle inlet.

Lack of a finger operated latch also impacts the function of the proximity wire, where S3 in SAE J1772™ allows sensing of the finger operated latch position (see Figure 15). J3400 uses a fixed value of resistance (R6 – see Figure 16) to load the proximity wire as it has no switch tied to the proximity circuit. The value of R6 is the same for SAE J1772™ and SAE J3400™.

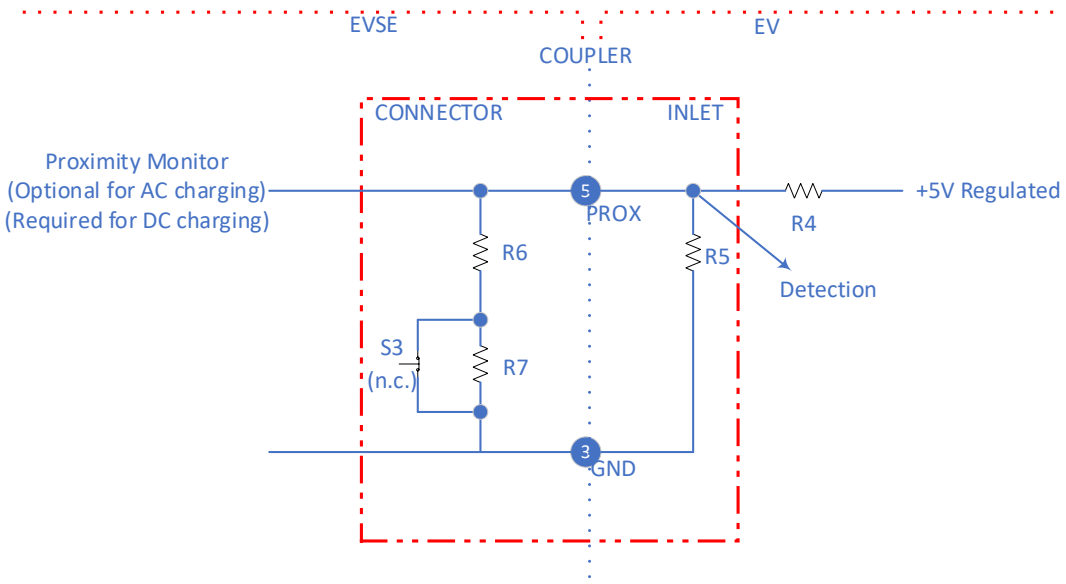



Figure 15. SAE J1772™ Proximity Circuit

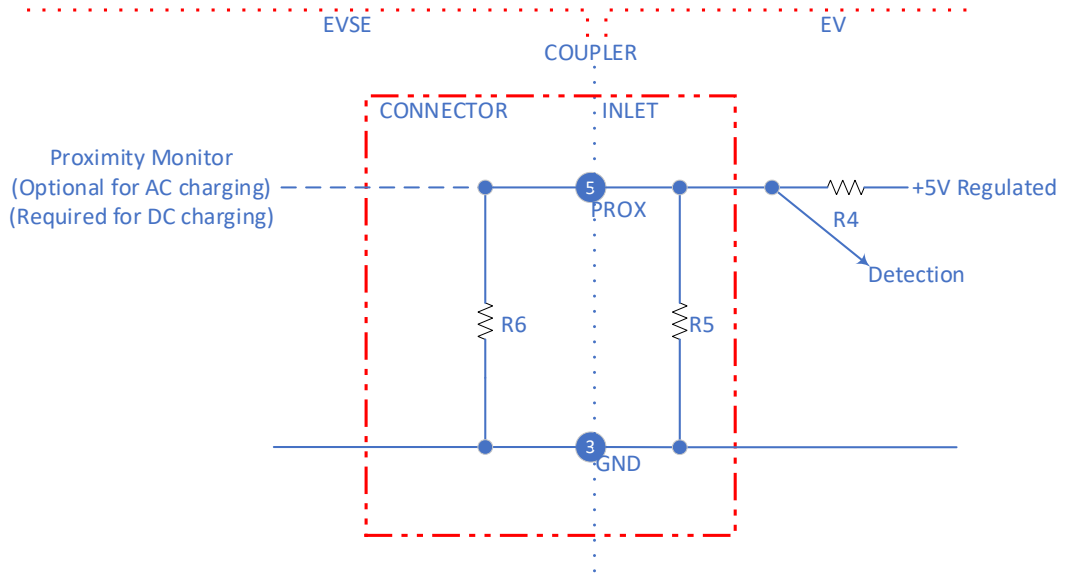



Figure 16. SAE J3400™ Proximity Circuit

## *SAE J3400™Allows Use of Alternate Communication Means*

The SAE J3400™ document allows for use of Local Interconnect Network (LIN) over the control pilot, referred to as LIN-CP, and uses SAE J3068 as the normative reference for the implementation. LIN-CP replaces use of the PWM signal or high-level communications on the pilot wire. IEC also includes refence to LIN-CP in IEC 61851-1 appendix D. J3068 is harmonized with the IEC document implementation.

Tesla has, in the past, used single wire CAN over the pilot wire, SW-CAN-CP. This is referenced in SAE J3400™ but is not detailed with the assumption this would not be used for new designs.

## *SAE J3400™ Allows for "Bring Your Own Cable"*

For AC charging, the SAE J3400™ document allows for use of a removable cable at the charger. This solution has been used in Europe, but not North America. It would allow for an AC charger to be used with multiple cable types, where the charging consumer brings a cable suitable for their own vehicle.

# 4 SAE J1772™ – AN INDEPTH REQUIREMENTS ANALYSIS

## Outline of the SAE J1772™ Document

The SAE J1772™ document divides charging requirements into three sections – chapter 4 of the document details requirements that apply to both AC and DC charging, referred to as "General requirements". Chapter 5 of the document addresses requirements specific to AC charging while chapter 6 addresses DC charging.

Key topics (with SAE J1772™ section numbers):

- General Requirements (apply to both AC and DC charging)
  - Electrical Ratings (4.1)
  - Charging Control (4.2)
  - Digital Data Transfer (4.3)
  - Charging Sequence/Timing (4.4)
  - Additional Requirements (4.5)
  - Electric Vehicle/Plug-in Hybrid Electric Vehicle (EV/PHEV) requirements (4.6)
  - Electric Vehicle Supply Equipment (EVSE) Requirements (4.7)
  - Charge Coupler Requirements (4.8)
  - Vehicle Inlet Requirements (4.9)
  - Connector Requirements (4.10)
- AC Charging
  - Electrical Ratings (5.1)
  - Charging Control (5.2)
  - Charging Sequence/Timing (5.3)
  - EV/PHEV Requirements (5.4)
  - EVSE Requirements (5.5)
  - Charge Coupler Requirements (5.6)
  - Vehicle Inlet Requirements (5.7)
  - Connector Requirements (5.8)
- DC Charging
  - Electrical Ratings (6.1)
  - Charging Control (6.2)
  - Charging Sequence/Timing (6.3)
  - EV/PHEV Requirements (6.4)

  - EVSE Requirements (6.5)
  - Charge Coupler Requirements (6.6)
  - Vehicle Inlet (6.7)
  - Vehicle Connector (6.8)
- Charge Coupler Dimensions
  - Non-lockable AC coupler (Appendix A) – Note: this section is not recommended for new designs
  - Charge coupler (lockable) (Appendix B)
  - DC Level 2 Coupler (CCS) (Appendix C)
  - Lock function zone (Appendix D)
- Detailed Timing Requirements and Sequence Diagrams
  - AC charging (Appendix E)
  - DC charging (Appendix F)
- High Level Communications Message List (Appendix G)

## Detailed Normative Requirements Analysis of SAE J1772™

The SAE J1772™ document is written in narrative fashion which makes tallying normative requirements difficult. To support charging designers, a review of SAE J1772™ document was conducted noting each normative requirement (typically where statements using "shall" are found in the document). A total of 582 normative requirements were noted in the review and are fully enumerated in Appendix B of this document.

The requirements have been tagged to enable better analysis and understanding under several headings:

- Device: EVSE Requirement or EV/PHEV Requirement
  - Some requirements apply to both the EVSE and the EV/PHEV (tagged as Joint).
  - Some requirements apply only to the EVSE
  - Some requirements apply only to the EV/PHEV
- Mode: AC Charging or DC Charging
  - Some requirements apply to all forms of charging (tagged as AC/DC)
  - Some requirements apply only to AC charging
  - Some requirements apply only to DC charging
- Category: General, or Electrical, or Basic Communications, or High-Level Communications
  - General requirements that fall outside the other categories
  - Electrical items pertain to requirements related to electrical properties of the charging interface, EVSE or EV/PHEV

- Basic communications pertain to the use of the Pilot and Proximity wires for charging control
- High-level communications pertain to the use of digital communications (using power line carrier technology for the SAE and ISO/IEC standards)

It should be recognized that there is some overlap across the categories (for instance an electrical parameter that leads to a specific digital message).

An accompanying Excel spreadsheet will be release with this document that includes a tabular listing of the full complement of normative requirements outline in this document's appendix. The Excel sheet also breaks out requirements into for main categories as noted in Table 6.

Table 6. SAE J1772™ Normative Requirements Categorized

| Electric Vehicle AC Charging | | Number of Requirements |
|---|---|---|
| 1 | Basic Communications | 35 |
| 2 | General | 35 |
| 3 | Electrical | 48 |
| 4 | High level communications | 3 |
| | Total | 121 |
| Electric Vehicle DC Charging | | |
| 5 | Basic Communications | 36 |
| 6 | General | 47 |
| 7 | Electrical | 69 |
| 8 | High level communications | 59 |
| | Total | 211 |
| Electric Vehicle Supply Equipment AC Charging | | |
| 9 | Basic Communications | 61 |
| 10 | General | 11 |
| 11 | Electrical | 35 |
| 12 | High level communications | 2 |
| | Total | 109 |

Table 6 (continued). SAE J1772™ Normative Requirements Categorized

| Electric Vehicle AC Charging | | Number of Requirements |
|---|---|---|
| Electric Vehicle Supply Equipment DC Charging | | |
| 13 | Basic Communications | 68 |
| 14 | General | 42 |
| 15 | Electrical | 162 |
| 16 | High level communications | 72 |
| | Total | 344 |

## What Documents Will You Need to Implement SAE J1772™?

As part of the exercise of enumerating the normative requirements, links to external documents were noted. In some cases, it is clear that the external document would need to be obtained and studied by an implementer. In other cases, the reference may be to a process or procedure used from the external document, where having the source document may not be a necessity to complete a system design. For each document, the authors have tried to indicate what an implementer will need to know from the referenced document.

SAE J1772™ has a total of 91 textual references to external documents, but some of the references are redundant. This can be sorted down to a total of 51 external, unique references as denoted in Table 7.

Table 7. Summary of External References in SAE J1772™

| # | Document | Usage Related to SAE J1772™ |
|---|---|---|
| 1 | Canadian Electrical Code - Part 1, Section 86 | If equipment will be deployed in Canada, designer should be familiar with Canadian EVSE installation requirements |
| 2 | UNECE Regulation No. 100 *Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train* | This is in a note giving the origin of vehicle isolation requirements |
| 3 | FCC Part 15 Telecommunications – Federal Communications Commission (FCC) - Radio Frequency Devices | Designer will need to study this document as compliance with FCC Parts 15A and 15B is required |
| 4 | IEC 60479-1 Effects of current on human beings and livestock - Part 1: General aspects | Designer should be familiar with human body impedance model, startle reaction, current path, touch current boundaries, Figure 22, Table 13 requirements, and touch thresholds in this document |

Table 7 (continued).Summary of External References in SAE J1772™

| # | Document | Usage Related to SAE J1772™ |
|---|---|---|
| 5 | IEC 60479-2 Effects of current on human beings and livestock - Part 2: Special aspects | Designer should be familiar with touch current boundaries, Figure 23, and perception and pain threshold requirements in this document |
| 6 | IEC 60664 *Insulation coordination for equipment within low-voltage systems - ALL PARTS* | Designer should be familiar with this document (EVSE design is required to be compliant with all relevant parts) |
| 7 | IEC 61000-4-3 Electromagnetic compatibility (EMC) - Part 4-3 : Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test | Designer will need to be familiar with this document |
| 8 | IEC 61000-4-6 Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields | Designer will need to be familiar with this document |
| 9 | IEC 61032 Corrigendum 1 - Protection of persons and equipment by enclosures - Probes for verification | Designer should be familiar with contact touch safety test probe 18 |
| 10 | IEC 61140 Protection against electric shock - Common aspects for installation and equipment | Designer should be familiar with sections 5.2, 5.3.3.2, 5.3.3.3, 5.3.3.4, 5.3.3.5, 7.3, 7.4, and touch thresholds |
| 11 | IEC 61300-2-4 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-4: Tests - Fibre or cable retention | Designer should be familiar with test procedure as defined in this document |
| 12 | IEC 61300-2-6 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-6: Tests - Tensile strength of coupling mechanism | Designer should be familiar with test procedure as defined in this document |
| 13 | IEC 61300-2-7 Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-7: Tests - Bending moment | Designer should be familiar with test procedure as defined in this document |

Table 7 (continued).Summary of External References in SAE J1772™

| # | Document | Usage Related to SAE J1772™ |
|---|---|---|
| 14 | IEC 61558-2-6 Safety of transformers, reactors, power supply units and combinations thereof - Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers for general applications | Designer should be aware that safety isolation transformers are defined as being compliant with this document |
| 15 | IEC 61851-21-1 *Electric vehicle conductive charging system - Part 21-1 Electric vehicle on-board charger EMC requirements for conductive connection to AC/DC supply* | Use of this document is listed as "market dependent" |
| 16 | IEC 61851-21-2 *Electric vehicle requirements for conductive connection to an AC/DC supply - EMC requirements for off board electric vehicle charging systems* | Use of this document is listed as "market dependent" |
| 17 | IEC 61851-23 Electric vehicle conductive charging system - Part 23: DC electric vehicle charging station | Designer should be familiar with output isolation requirements and section 6.3.1.112.2 in this document |
| 18 | IEC 62196-2 Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility and interchangeability requirements for a.c. pin and contact-tube accessories | Designer should be familiar with coupler lock zone requirements of this document |
| 19 | IEC 62196-3 Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3: Dimensional compatibility requirements for DC and AC/DC pin and contact-tube vehicle couplers | Designer should be familiar with configuration EE as defined in this document |
| 20 | IEC 62196-3-1 Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3-1: Vehicle connector, vehicle inlet and cable assembly for DC charging intended to be used with a thermal management system | Designer should be familiar with coupler current limit specifications of this document |
| 21 | IEC 62477-1 Safety requirements for power electronic converter systems and equipment - Part 1: General | Designer should be familiar with sections 4.4.3.2 (basic insulation), section 4.4.5.4, section 4.4.4.2, section 4.4.4.4, section 4.4.4.7, section 4.4.5.3, and extra low voltage definition in this document |
| 22 | ISO 6469-2 Electrically propelled road vehicles — Safety specifications — Part 2: Vehicle operational safety | This is a in note giving the origin of vehicle isolation requirements |

Table 7 (continued).Summary of External References in SAE J1772™

| # | Document | Usage Related to SAE J1772™ |
|---|---|---|
| 23 | ISO 6469-3 *Electrically propelled road vehicles - Safety specifications - Part 3: Electrical safety* | Designer will need to understand definition of "voltage Class B", touch energy provisions, and implementing basic protection and fault protection |
| 24 | ISO 11452-1 Road vehicles — Component test methods for electrical disturbances from narrowband radiated electromagnetic energy — Part 1: General principles and terminology | Designer will need to know required frequency step size for testing |
| 25 | ISO 15118-1 Road vehicles -- Vehicle to grid communication interface -- Part 1: General information and use-case definition | The SAE J1772™ document does not give clear guidance on how these documents would be used and does not reference DIN 70121 which is being used by many vendors for DC charge management. See chapter xx of this document for more discussion of this topic. |
| 26 | ISO 15118-2 Road vehicles - Vehicle-to-Grid Communication Interface - Part 2: Technical protocol description and Open Systems Interconnections (OSI) layer requirements | |
| 27 | ISO 15118-3 Road vehicles -- Vehicle to grid communication interface -- Part 3: Physical and data link layer requirements | |
| 28 | ISO 17409 Electrically propelled road vehicles — Conductive power transfer — Safety requirements | Designer should be familiar with y-capacitance requirements in this document, touch energy provisions, and section 9.2 |
| 29 | ISO 20653 Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access | Designer should be familiar with IPXXC and IP ratings as defined in this document |
| 30 | NFPA 70 National Electric Code | Designer should be familiar with the NEC. This reference is a bit vague as the whole code would not need to be studied specific to EVSE |
| 31 | NFPA 70 Article 625 | Designer should be familiar with the NEC article 625 which covers EVSE installation and power conductor requirements |
| 32 | SAE J1211 Handbook for Robustness Validation of Automotive Electrical/Electronic Modules | Designer should be familiar with this document as compliance is required |
| 33 | SAE J1812 Function Performance Status Classification for EMC Immunity Testing | Designer will need to know the test levels required |

Table 7 (continued).Summary of External References in SAE J1772™

| # | Document | Usage Related to SAE J1772™ |
|---|---|---|
| 34 | SAE J2847/1 Communication for Smart Charging of Plug-in Electric Vehicles using Smart Energy Profile 2.0 | The references are for digital communications related to utility charging control using SAE J2847/1 via the Smart Energy Profile (IEEE 2030.5). The requirement is related to using the lessor current limit of digital and PWM controls. Designer would not need to be familiar with these documents if they are not implementing digital control via J2847/1. |
| 35 | SAE J2931/1 Digital Communications for Plug-in Electric Vehicles | |
| 36 | SAE J2931/4 Broadband PLC Communication for Plug-in Electric Vehicles | |
| 37 | SAE J2953/1 Plug-In Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE) | |
| 38 | SAE J2953/2 Test Procedures for the Plug-In Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE) | |
| 39 | SAE J2344 Guidelines for Electric Vehicle Safety | This is a note giving the origin of vehicle isolation requirements |
| 40 | SAE J2847/2 Communication Between Plug-in Vehicles and Off-Board DC Chargers | The SAE J1772™ document does not give clear guidance on how these documents would be used and does not reference DIN 70121 which is being used by many vendors for DC charge management. See chapter 5 of this document for more discussion of this topic. |
| 41 | SAE J2931/1 Digital Communications for Plug-in Electric Vehicles | |
| 42 | SAE J2931/4 Broadband PLC Communication for Plug-in Electric Vehicles | |
| 43 | SAE J2953/1 Plug-In Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE) | |
| 44 | SAE J2953/2 Test Procedures for the Plug-In Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE) | |
| 45 | SAE USCAR2 | Designer should be familiar with resistance to automotive lubricants, solvents, and fuels per this document |
| 46 | UL 1439 Standard for Tests for Sharpness of Edges on Equipment | Designer will need to be familiar with this document |
| 47 | UL 2202 Standard for Electric Vehicle (EV) Charging System Equipment | Designer should be familiar with this document as it is the main DC EVSE product specification |
| 48 | UL 2231-1 | Designer will need to be familiar with this document |
| 49 | UL 2231-2 | Designer will need to be familiar with this document |

Table 7 (continued).Summary of External References in SAE J1772™

| # | Document | Usage Related to SAE J1772™ |
|---|---|---|
| 50 | UL 2251 *Standard for Plugs, Receptacles, and Couplers for Electric Vehicles* | Designer will need to be familiar with this document as it is the main product definition document for couplers |
| 51 | UL 2594 *Standard for Electric Vehicle Supply Equipment* | Designer should be familiar with this document as it is the main AC EVSE product specification |

The following paragraphs list the externally referenced documents in order of appearance in SAE J1772™ (subdivided by EVSE and EV/PEHV side requirements for AC or DC charging) along with the numbered J1772 requirements developed in this document. The numbering of the requirements is taken from the list in Appendix A.

EVSE Related External Document References

**EVSE Joint Requirements (AC/DC)**

J1772-113, J1772-118, J1772-120, J1772-122: reference ISO 6469-3: Designer will need to understand definition of “voltage Class B”.

J1772-122: references *IEC 60664*: As EVSE design is required to be compliant with all relevant parts, designer will likely need to study this document.

J1772-136: references *FCC CFR Title 47, Part 15*: Designer will need to study this document as compliance with FCC Parts 15A and 15B is required.

J1772-136: references *IEC 61851-21-1*: Use of this document is listed as “market dependent”.

J1772-136: references *IEC 61851-21-2*: Use of this document is listed as “market dependent”.

J1772-137, J1772-138, J1772-139: reference *FCC CFR Title 47, Part 15*: Designer will need to study this document as compliance with FCC Parts 15 is required.

J1772-139: references SAE J1812 for test levels. Designer will need to know the test levels required.

J1772-139: references IEC 61000-4-6 immunity testing. Designer will need to be familiar with this document.

J1772-139: references IEC 61000-4-3 immunity testing. Designer will need to be familiar with this document.

J1772-139: references ISO 11452-1 for frequency step size. Designer will need to know required frequency step size for testing.

J1772-140, J1772-141, J1772-142, J1772-143, J1772-144, J1772-145, J1772-146: reference UL 2231-2. Designer will need to be familiar with this document.

J1772-147: references National Electric Code (NFPA 70) and Canadian Electrical Code - Part 1, Section 86 requires compliance with requirements. Designer will need to be familiar with these codes.

J1772-149, J1772-221, J1772-222: reference UL 2231. Designer will need to be familiar with two documents – UL 2231-1 and UL 2231-2.

J1772-153: references National Electric Code (NFPA 70) article 625. Designer should be familiar with the NEC article 625 which covers EVSE installation.

J1772-153, J1772-159, J1772-161, J1772-162, J1772-163, J1772-181, J1772-183, J1772-184, J1772-188, J1772-321: references *UL 2251*. Designer will need to be familiar with this document as it is the main product definition document for connectors.

J1772-164: references SAE USCAR2. Designer should be familiar with resistance to automotive lubricants, solvents, and fuels per this document.

J1772-182: references UL 1439 Standard for Tests for Sharpness of Edges on Equipment. Designer will need to be familiar with this document.

J1772-192: references IEC 62196-3-1. Noted that maximum current limit is nominal and subject to change with reference to this IEC document. Designer should be familiar with coupler current limit specifications of this document.

**EVSE AC Charging**

J1772-148, J1772-151: references *UL 2594*. Designer should be familiar with this document as it is the main AC EVSE product specification.

J1772-151: references National Electric Code (NFPA 70) article 625. Designer should be familiar with the NEC article 625 which covers EVSE installation.

J1772-190: references National Electric Code (NFPA 70). Designer should be familiar with the NEC. This reference is a bit vague as the whole code would not need to be studied specific to EVSE.

**EVSE DC Charging**

J1772-200: references SAE J2847/2, J2931/1, J2931/4, J2953/1, J2953/2 series of documents and ISO 15118-1, ISO 15118-2, ISO 15118-3 series of documents. The J1772 document does not give clear guidance on how these documents would be used and does not reference DIN 70121 which is being used by many vendors for DC charge management. See *Chapter 5 CHARGE SESSION CONTROL USING HIGH LEVEL COMMUNICATIONS* in this document for more discussion of this topic.

J1772-220, J1772-235: references UL 2202. Designer should be familiar with this document as it is the main DC EVSE product specification.

J1772-222, J1772-275: references IEC 61851-23. Designer should be familiar with output isolation requirements and section 6.3.1.112.2 in this document.

J1772-226, J1772-227, J1772-228, J1772-229, J1772-249: references IEC 60479-1. Designer should be familiar with human body impedance model, startle reaction, current path, touch current boundaries, Figure 22, and Table 13 requirements in this document.

J1772-229, J1772-249: references IEC 60479-2. Designer should be familiar with touch current boundaries and Figure 23 requirements in this document.

J1772-229: references ISO 17409. Designer should be familiar with y-capacitance requirements in this document.

J1772-232, J1772-238, J1772-239, J1772-242, J1772-243, J1772-244, J1772-245, J1772-247, J1772-248, J1772-275, J1772-282: references IEC 62477-1. Designer should be familiar with sections 4.4.3.2 (basic insulation), section 4.4.5.4, section 4.4.4.2, section 4.4.4.4, section 4.4.4.7, section 4.4.5.3, and extra low voltage definition in this document.

J1772-237: references IEC 61558-2-6. Designer should be aware that safety isolation transformers are defined as being compliant with this document.

J1772-246, J1772-250, J1772-251, J1772-252: references IEC 61140. Designer should be familiar with sections 5.2, 5.3.3.2, 5.3.3.3, 5.3.3.4, 5.3.3.5, 7.3, and 7.4.

J1772-261: references ISO 6469-3. Designer should be familiar with touch energy provisions.

J1772-261, J1772-283: references ISO 17409. Designer should be familiar with touch energy provisions and section 9.2.

J1772-273: references ISO 20653. Designer should be familiar with IPXXC rating as defined in this document.

J1772-303: references SAE J2847/2. Designer should be familiar with Vehicle Maximum Current Limit message definition.

J1772-315: references IEC 61300-2-6. Designer should be familiar with test procedure as defined in this document.

J1772-316: references IEC 61300-2-7. Designer should be familiar with test procedure as defined in this document.

J1772-317: references IEC 61300-2-4. Designer should be familiar with test procedure as defined in this document.

J1772-321: references National Electric Code (NFPA 70) article 625. Designer should be familiar with power conductor requirements of this article.

J1772-329: references IEC 62196-2. Designer should be familiar with coupler lock zone requirements of this document.

Vehicle Related External Document References

**EV/PHEV Joint Requirements (AC/DC)**

J1772-114, J1772-121, J1772-123, J1772-124: reference *ISO 6469-3*: Designer will need to understand definition of "voltage Class B" and implementing basic protection and fault protection.

J1772-123: references *IEC 60664*. Designer should be familiar with this document.

J1772-124: references IEC 61032. Designer should be familiar with contact touch safety test probe 18.

J1772-124, J1772-127, J1772-128, J1772-129, J1772-130, J1772-131, J1772-132: references ISO 20653. Designer should be familiar with IP rating specification.

J1772-127, J1771-128, J1772-129, J1772-130, J1772-131, J1772-132: references IEC 61140. Designer should be familiar with touch thresholds.

J1772-127, J1771-128, J1772-129, J1772-130, J1772-131, J1772-132: references IEC 60479-1. Designer should be familiar with touch thresholds.

J1772-127, J1771-128, J1772-129, J1772-130, J1772-131, J1772-132: references IEC 60479-2. Designer should be familiar with perception and pain thresholds.

J1772-133: references SAE J1211. Designer should be familiar with this document as compliance is required.

J1772-152: references National Electric Code (NFPA 70) article 625. Designer should be familiar with power coupler requirements of this article.

J1772-152, J1772-159, J1772-161, J1772-162, J1772-163, J1772-172, J1772-173, J1772-177, J1772-178, J1772-188, J1772-189: references *UL 2251*. Designer will need to be familiar with this document as it is the main product definition document for couplers.

J1772-164: references SAE USCAR2. Designer should be familiar with resistance to automotive lubricants, solvents, and fuels per this document.

J1772-174: references UL 1439. Designer will need to be familiar with this document.

J1772-192: references IEC 62196-3-1. Noted that maximum current limit is nominal and subject to change with reference to this IEC document. Designer should be familiar with coupler current limit specifications of this document.

J1772-329: references IEC 62196-2. Designer should be familiar with coupler lock zone requirements of this document.

**EV/PHEV AC Charging**

J1772-187: references SAE J2847/1, J2931/1, J2931/4, J2953/1, and J2953/2. The references are for digital communications related to utility charging control using SAE J2847/1 via the Smart Energy Profile (IEEE 2030.5). The requirement is related to using the lessor current limit of digital and PWM controls. Designer would not need to be familiar with these documents if they are not implementing digital control via J2847/1.

**EV/PHEV DC Charging**

J1772-200: references SAE J2847/2, J2931/1, J2931/4, J2953/1, J2953/2 series of documents and ISO 15118-1, ISO 15118-2, ISO 15118-3 series of documents. The J1772 document does not give clear guidance on how these documents would be used and does not reference DIN 70121 which is being used by many vendors for DC charge management. See *Chapter 5 CHARGE SESSION CONTROL USING HIGH LEVEL COMMUNICATIONS* of this document for more discussion of this topic.

J1772-223: references UL 2231. Designer will need to be familiar with two documents – UL 2231-1 and UL 2231-2.

J1772-223: references ECE R100. This is a note giving the origin of vehicle isolation requirements.

J1772-223: references ISO 6469-2. This is a note giving the origin of vehicle isolation requirements.

J1772-223: references SAE J2344. This is a note giving the origin of vehicle isolation requirements.

# 5 SAE AND ISO/IEC STANDARDS

One of the challenges facing charging designers is the blending of SAE and IEC/ISO standards. Where SAE J1772™'s normative references are to other SAE documents, it is not always clear how specifics found in other standards should be applied. The SAE J3400™ document provides more guidance on this standards "blending". Table 8 provides an overview of where key topics are located across the standards space. Considerable work has been done to harmonize the SAE, ISO, and IEC standards work.

Table 8. Comparison of SAE and IEC/ISO Charging Standards Documents

| Topic | SAE | IEC/ISO (ISO 15118-2) | IEC/ISO (ISO 15118-20) |
|---|---|---|---|
| Coupler general requirements | SAE J1772/SAE J3400 | IEC 62196-1 | IEC 62196-1 |
| AC Coupler requirements | SAE J1772/SAE J3400 | IEC 62196-2 | IEC 62196-2 |
| DC coupler requirements | SAE J1772/SAE J3400 | IEC 62196-3 | IEC 62196-3 |
| DC coupler with active cooling | | IEC 62196-3-1 | IEC 62196-3-1 |
| AC Basic electrical behavior | SAE J1772/SAE J3400 | IEC 61851-1 | IEC 61851-1 |
| DC Basic electrical behavior | SAE J1772/SAE J3400 | IEC 61851-23 | IEC 61851-23 |
| AC charging timing requirements | SAE J1772/SAE J3400/ SAE J2847/1 | IEC 61851-1 | IEC 61851-1 |
| DC charging timing requirements | SAE J1772/SAE J3400/ SAE J2847/2 | IEC 61851-23 | IEC 61851-23 |
| Use cases for Smart Charging | SAE J2836/1 | ISO 15118-1 | ISO 15118-1 |
| Use cases for DC Charging | SAE J2836/2 | ISO 15118-1 | ISO 15118-1 |
| Use cases for Distributed Energy Resources | SAE J2836/3 | | |
| Use cases for Diagnostics | SAE J2836/4 | | |
| Use cases for Customer | SAE J2836/5 | | |
| Use cases for Wireless power transfer | SAE J2836/6 | ISO 15118-6 | ISO 15118-6 |

Table 8 (continued). Comparison of SAE and IEC/ISO Charging Standards Documents

| Topic | SAE | IEC/ISO (ISO 15118-2) | IEC/ISO (ISO 15118-20) |
|---|---|---|---|
| Plug and Charge | | ISO 15118-2 | ISO 15118-20 |
| Communication for AC Smart Charging | SAE J2847/1 | ISO 15118-2 | ISO 15118-20 |
| Communication for DC Charging | SAE J2847/2 | ISO 15118-2 | ISO 15118-20 |
| Communication for DC Export | SAE J2847/2 | | ISO 15118-20 |
| Communication for Distributed Energy Resources – AC export | SAE J2847/3/SAE J3072 | | ISO 15118-20 |
| Communication for Diagnostics | SAE J2847/4 | | |
| Communication for Customer Interaction | SAE J2847/5 | | ISO 15118-20 |
| Communications for Wireless power transfer | SAE J2847/6 | ISO 15118-7 | ISO 15118-20 |
| Protocol Requirements | SAE J2931/1 | ISO 15118-2 | ISO 15118-2 |
| Physical Layer Requirements | SAE J2931/4 | ISO 15118-3 | ISO 15118-3 |
| Wireless Protocol Requirements | SAE J2931/1 | ISO 15118-7 | ISO 15118-7 |
| Wireless Physical Layer Requirements | SAE J2931/6 | ISO 15118-8 | ISO 15118-8 |
| Interoperability | SAE J2953/1 | | |
| Interoperability Test Procedures | SAE J2953/2 | | |
| Interoperability Test Cases | SAE J2953/3 | | |
| Charge Rate Reporting | SAE J2953/4 | | |
| Power Quality Requirements | SAE J2894/1 | | |
| Power Quality Test Procedures | SAE J2894/2 | | |

Table 8 (continued). Comparison of SAE and IEC/ISO Charging Standards Documents

| Topic | SAE | IEC/ISO (ISO 15118-2) | IEC/ISO (ISO 15118-20) |
|---|---|---|---|
| Automatic Connection Device | SAE J3105 | | ISO 15118-20 |
| Protocol test cases Network/App | | ISO 15118-4 | ISO 15118-21 |
| Protocol test cases Physical/Data | | ISO 15118-5 | ISO 15118-22 |
| Adapters | SAE J3400/1 | IEC PT 62196-7 | IEC PT 62196-7 |

# A APPENDIX – COMPREHENSIVE LIST OF SAE J1772™ REQUIREMENTS

SAE J1772 Requirements Roughly in Order of Appearance in the J1772 Document

Based on J1772-version 8

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-001 | EVSE, state A defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 1, Note 1 | |
| J1772-002 | EV/PHEV, state A defined | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.2, Table 1, Note 1 | |
| J1772-003 | EVSE, state B1 defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 1, Note 1 | |
| J1772-004 | EV/PHEV, state B1 defined | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.2, Table 1, Note 1 | |
| J1772-005 | EVSE, state B2 defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 1, Note 2,3 | |
| J1772-006 | EV/PHEV, state B2 defined | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.2, Table 1, Note 2,3 | |
| J1772-007 | EVSE, state C defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 1, Note 2 | |
| J1772-008 | EV/PHEV, state C defined | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.2, Table 1, Note 2 | |
| J1772-009 | EVSE, condition for Control Pilot transition from static to PWM | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 1, Note 3 | |
| J1772-010 | EVSE, recovery from state F – optional EVSE self-recovery. Maximum number of retries and timing | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 1, Note 6 | |
| J1772-011 | EVSE, generator (PWM) open circuit voltage high (Voch) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-012 | EVSE, generator (PWM) open circuit voltage high (Voch) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-013 | EVSE, generator (PWM) open circuit voltage high (Voch) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-014 | EVSE, generator (PWM) open circuit voltage low (Vocl) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-015 | EVSE, generator (PWM) open circuit voltage low (Vocl) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-016 | EVSE, generator (PWM) open circuit voltage low (Vocl) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-017 | EVSE, generator (PWM) frequency (Fo) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-018 | EVSE, generator (PWM) frequency (Fo) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-019 | EVSE, generator (PWM) frequency (Fo) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-020 | EVSE, generator (PWM) pulse width (Pwo) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 2, Reference Figure 1 | |
| J1772-021 | EVSE, generator (PWM) pulse width (Pwo) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 2, Reference Figure 1 | |
| J1772-022 | EVSE, generator (PWM) pulse width (Pwo) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 2, Reference Figure 1 | |
| J1772-023 | EVSE, generator (PWM) rise time (Trg) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 3, Reference Figure 1 | |
| J1772-024 | EVSE, generator (PWM) rise time (Trg) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 3, Reference Figure 1 | |
| J1772-025 | EVSE, generator (PWM) rise time (Trg) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 3, Reference Figure 1 | |
| J1772-026 | EVSE, generator (PWM) fall time (Tfg) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 3, Reference Figure 1 | |
| J1772-027 | EVSE, generator (PWM) fall time (Tfg) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 3, Reference Figure 1 | |
| J1772-028 | EVSE, generator (PWM) fall time (Tfg) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with Note 1 and 3, Reference Figure 1 | |
| J1772-029 | EVSE, generator (PWM) settling time (Tsg) nominal value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with note 1 and 4, | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | Reference Figure 1 | |
| J1772-030 | EVSE, generator (PWM) settling time (Tsg) max value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with note 1 and 4, Reference Figure 1 | |
| J1772-031 | EVSE, generator (PWM) settling time (Tsg) min value | AC/DC | EVSE | Basic Communications | Section 4.2.1.2, Table 4 with note 1 and 4, Reference Figure 1 | |
| J1772-032 | EVSE, output components, equivalent source resistance, R1 nominal value | AC/DC | EVSE | Electrical | Section 4.2.1.2, Table 4 with Note 1 and 5, Reference Figure 1 | |
| J1772-033 | EVSE, output components, equivalent source resistance, R1 max value | AC/DC | EVSE | Electrical | Section 4.2.1.2, Table 4 with Note 1 and 5, Reference Figure 1 | |
| J1772-034 | EVSE, output components, equivalent source resistance, R1 min value | AC/DC | EVSE | Electrical | Section 4.2.1.2, Table 4 with Note 1 and 5, Reference Figure 1 | |
| J1772-035 | EVSE, output components, total equivalent EVSE capacitance without cable, C1 min value | AC/DC | EVSE | Electrical | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-036 | EVSE, output components, total equivalent EVSE capacitance including cable, C1 + Cc max value | AC/DC | EVSE | Electrical | Section 4.2.1.2, Table 4, Note 1, Reference Figure 1 | |
| J1772-037 | EV/PHEV, equivalent load resistance - State B1 and B2, R2B nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Note 1 and 2, Reference Figure 2 | |
| J1772-038 | EV/PHEV, equivalent load resistance - State B1 and B2, R2B max value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Note 1 and 2, Reference Figure 2 | |
| J1772-039 | EV/PHEV, equivalent load resistance - State B1 and B2, R2B min value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Note 1 and 2, Reference Figure 2 | |
| J1772-040 | EV/PHEV, equivalent load resistance - State C, R2C nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Notes 1, 2 and 3, Reference Figure 2 | |
| J1772-041 | EV/PHEV, equivalent load resistance - State C, R2C max value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Notes 1, 2 and 3, Reference Figure 2 | |
| J1772-042 | EV/PHEV, equivalent load resistance - State C, R2C min value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Notes 1, 2 and | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | 3, Reference Figure 2 | |
| J1772-043 | EV/PHEV, equivalent load resistance - State D, R2D nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Notes 1, 2 and 4, Reference Figure 2 | |
| J1772-044 | EV/PHEV, equivalent load resistance - State D, R2D max value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Notes 1, 2 and 4, Reference Figure 2 | |
| J1772-045 | EV/PHEV, equivalent load resistance - State D, R2D min value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5 with Notes 1, 2 and 4, Reference Figure 2 | |
| J1772-046 | EV/PHEV, total equivalent capacitance, C2 max value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5, Note 1, Reference Figure 2 | |
| J1772-047 | EV/PHEV, equivalent diode voltage drop, Vd nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5, Note 1 and 5, Reference Figure 2 | |
| J1772-048 | EV/PHEV, equivalent diode voltage drop, Vd max value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5, Note 1 and 5, Reference Figure 2 | |
| J1772-049 | EV/PHEV, equivalent diode voltage drop, Vd min value | AC/DC | EV/PHEV | Electrical | Section 4.2.1.2, Table 5, Note 1 and 5, Reference Figure 2 | |
| J1772-050 | EVSE, response if it turns off oscillator from state C or D | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.2, Appendix E.2 examples, transition note 14 | |
| J1772-051 | EV/PHEV, response to state C or D to oscillator off | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.2, Appendix E.2 examples, transition note 14 | |
| J1772-052 | EVSE, contactor state based on oscillator | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.3 with Figure 3 | |
| J1772-053 | EV/PHEV, ready accept energy indication | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.4 with Figure 1 | |
| J1772-054 | EVSE, indoor ventilation required, EVSE to signal | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.5 and Tables 1 and 2 | |
| J1772-055 | EVSE, indication of available continuous current | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.6 and Table 6 and Figure 3 | |
| J1772-056 | EV/PHEV, maximum current draw | AC/DC | EV/PHEV | Electrical | Section 4.2.1.3.6 and Table 6 and Figure 3 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-057 | EVSE, control pilot tolerance | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7 and Table 6 | |
| J1772-058 | EVSE, duty cycle 0% (state E or F defined) | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7, Table 6, Note 1 and 7 | |
| J1772-059 | EV/PHEV, duty cycle < 3% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6, Note 7 | |
| J1772-060 | EVSE, duty cycle 5% (digital comms needed) defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7, Table 6, Note 2 | |
| J1772-061 | EV/PHEV, duty cycle 4.5% to 5.5% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6, Note 2 | |
| J1772-062 | EV/PHEV, duty cycle > 7%, < 8% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6, Note 3 and 7 | |
| J1772-063 | EV/PHEV, duty cycle from 9.5% inclusive to < 10% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6, Note 4 | |
| J1772-064 | EVSE, duty cycle greater than or equal to 10% to less than or equal to 20% defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7, Table 6 | |
| J1772-065 | EV/PHEV, duty cycle greater than or equal to 10% to less than or equal to 20% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6 | |
| J1772-066 | EVSE, duty cycle greater than 20% to less than or equal to 85% defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7, Table 6 | |
| J1772-067 | EV/PHEV, duty cycle greater than 20% to less than or equal to 85% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6 | |
| J1772-068 | EVSE, duty cycle greater than 85% to less than or equal to 96% defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7, Table 6 | |
| J1772-069 | EV/PHEV, duty cycle greater than 85% to less than or equal to 96% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6 | |
| J1772-070 | EV/PHEV, duty cycle greater than 96% to less than or equal to 96.5% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6, Note 5 | |
| J1772-071 | EVSE, duty cycle equals 100% defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.7, Table 6, Note 6 and 7 | |
| J1772-072 | EV/PHEV, duty cycle 100% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7, Table 6, Note 6 and 7 | |
| J1772-073 | EV/PHEV, use of duty cycle | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.3.7 | |
| J1772-074 | EVSE, loss of control pilot behavior | AC/DC | EVSE | Basic Communications | Section 4.2.1.3.8 | |
| J1772-075 | EVSE, Control pilot tolerance defined | AC/DC | EVSE | Basic Communications | Section 4.2.1.4 | |
| J1772-076 | EV/PHEV, control pilot tolerance defined | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.4 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-077 | EV/PHEV, duty cycle 3-7% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.4.1 | |
| J1772-078 | EV/PHEV, duty cycle between 8% and less than 10% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.4.2 | |
| J1772-079 | EV/PHEV, duty cycle less than or equal to 85% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.4.3 | |
| J1772-080 | EV/PHEV, duty cycle greater than 85% behavior | AC/DC | EV/PHEV | Basic Communications | Section 4.2.1.4.4 | |
| J1772-081 | EV/PHEV, coupler insertion detection defined | AC/DC | EV/PHEV | Electrical | Section 4.2.2, Table 7, Figure 4 | |
| J1772-082 | EV/PHEV, detection location requirement for unintentional motion | AC/DC | EV/PHEV | General | Section 4.2.2 | |
| J1772-083 | EV/PHEV, resistor R5 required for AC and DC charging | AC/DC | EV/PHEV | Electrical | Section 4.2.2.1, Figure 4, Note 1 | |
| J1772-084 | EVSE, DC, monitor proximity detection circuit | DC | EVSE | Electrical | Section 4.2.2.1, Figure 4, Note 1 | |
| J1772-085 | EV/PHEV, proximity detection circuit vehicle +5Vdc nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 3, Figure 4 | |
| J1772-086 | EV/PHEV, proximity detection circuit vehicle +5Vdc max value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 3, Figure 4 | |
| J1772-087 | EV/PHEV, proximity detection circuit vehicle +5Vdc min value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 3, Figure 4 | |
| J1772-088 | EV/PHEV, proximity detection circuit equivalent load resistance, R4 nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-089 | EV/PHEV, proximity detection circuit equivalent load resistance, R4 max value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-090 | EV/PHEV, proximity detection circuit equivalent load resistance, R4 min value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-091 | EV/PHEV, proximity detection circuit equivalent load resistance, R5 nominal value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-092 | EV/PHEV, proximity detection circuit equivalent load resistance, R5 max value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-093 | EV/PHEV, proximity detection circuit equivalent load resistance, R5 min value | AC/DC | EV/PHEV | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-094 | EVSE, proximity detection circuit equivalent load resistance, R6 nominal value | AC/DC | EVSE | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-095 | EVSE, proximity detection circuit equivalent load resistance, R6 max value | AC/DC | EVSE | Electrical | Section 4.2.2.2, Table 7 with | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | Note 1 and 2, Figure 4 | |
| J1772-096 | EVSE, proximity detection circuit equivalent load resistance, R6 min value | AC/DC | EVSE | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-097 | EVSE, proximity detection circuit equivalent load resistance, R7 nominal value | AC/DC | EVSE | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-098 | EVSE, proximity detection circuit equivalent load resistance, R7 max value | AC/DC | EVSE | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-099 | EVSE, proximity detection circuit equivalent load resistance, R7 min value | AC/DC | EVSE | Electrical | Section 4.2.2.2, Table 7 with Note 1 and 2, Figure 4 | |
| J1772-100 | EV/PHEV, charge status indicator requirement | AC/DC | EV/PHEV | General | Section 4.2.2.3 | |
| J1772-101 | EVSE, digital communications required at 5% duty cycle of pilot signal before charging | AC/DC | EVSE | High Level Communications | Section 4.3 | |
| J1772-102 | EV/PHEV, digital communications required at 5% duty cycle of pilot signal before charging | AC/DC | EV/PHEV | High Level Communications | Section 4.3 | |
| J1772-103 | EVSE, alternative measures in addition to basic insulation | AC/DC | EVSE | Electrical | Section 4.5.1 | |
| J1772-104 | EV/PHEV, alternative measures in addition to basic insulation | AC/DC | EV/PHEV | Electrical | Section 4.5.1 | |
| J1772-105 | EVSE, insulation requirements, basic, double, reinforced | AC/DC | EVSE | Electrical | Section 4.5.2.1, paragraph 2, section 4.5.2.2.4 | |
| J1772-106 | EV/PHEV, insulation requirements, basic, double, reinforced | AC/DC | EV/PHEV | Electrical | Section 4.5.2.1, paragraph 2, section 4.5.2.2.4 | |
| J1772-107 | EVSE, insulation requirements, access to live parts, barriers, enclosures | AC/DC | EVSE | Electrical | Section 4.5.2.1, paragraph 4, section 4.5.2.2.2 | |
| J1772-108 | EV/PHEV, insulation requirements, access to live parts, barriers, enclosures | AC/DC | EV/PHEV | Electrical | Section 4.5.2.1, paragraph 4, section 4.5.2.2.2 | |
| J1772-109 | EVSE, live parts of cables without protective enclosures or behind protective barriers | AC/DC | EVSE | Electrical | Section 4.5.2.1, paragraph 5 | |
| J1772-110 | EV/PHEV, live parts of cables without protective enclosures or behind protective barriers | AC/DC | EV/PHEV | Electrical | Section 4.5.2.1, paragraph 5 | |
| J1772-111 | EVSE, protective barrier requirements | AC/DC | EVSE | General | Section 4.5.2.2.1, paragraph 1 | |
| J1772-112 | EV/PHEV, protective barrier requirements | AC/DC | EV/PHEV | General | Section 4.5.2.2.1, paragraph 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-113 | EVSE, protective barrier requirements - tools | AC/DC | EVSE | General | Section 4.5.2.2.1, paragraph 2 - external reference | ISO 6469-3 class B defined |
| J1772-114 | EV/PHEV, protective barrier requirements - tools | AC/DC | EV/PHEV | General | Section 4.5.2.2.1, paragraph 2 - external reference | ISO 6469-3 class B defined |
| J1772-115 | EVSE, protective barrier requirements - degree of protection | AC/DC | EVSE | General | Section 4.5.2.2.2, paragraph 1 | |
| J1772-116 | EV/PHEV, protective barrier requirements - degree of protection | AC/DC | EV/PHEV | General | Section 4.5.2.2.2, paragraph 1 | |
| J1772-117 | EV/PHEV, protective barrier requirements - degree of protection - passenger and load compartments | AC/DC | EV/PHEV | General | Section 4.5.2.2.2, paragraph 2 | |
| J1772-118 | EVSE, mated connector requirements | AC/DC | EVSE | Electrical | Section 4.5.2.2.3, paragraph 1 - external reference | ISO 6469-3 class B defined |
| J1772-119 | EV/PHEV, unmated inlet requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.2.2.3, paragraph 2, Section 4.5.3 | |
| J1772-120 | EVSE, Class B connector requirements | AC/DC | EVSE | Electrical | Section 4.5.2.2.3, paragraph 3 - a, b, c - external reference | ISO 6469-3 class B defined |
| J1772-121 | EV/PHEV, Class B connector requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.2.2.3, paragraph 3 - a, b, c - external reference | ISO 6469-3 class B defined |
| J1772-122 | EVSE, Class B wiring requirements | AC/DC | EVSE | Electrical | Section 4.5.2.2.4 - external reference | IEC 60664 Shall be compliant with applicable portions; ISO 6469-3 class B defined |
| J1772-123 | EV/PHEV, Class B wiring requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.2.2.4 - external reference | IEC 60664 Shall be compliant with applicable portions; ISO 6469-3 class B defined |
| J1772-124 | EV/PHEV, unmated inlet requirements, response times for requirements in 4.5.3.3 | AC/DC | EV/PHEV | Electrical | Section 4.5.3.1 - external reference | ISO 6469-3 implementing basic and fault protection, IEC 61032 contact touch safety test probe 18, ISO 20653 IP rating |
| J1772-125 | EV/PHEV, unmated inlet requirements, unlatching-unlocking behavior | AC/DC | EV/PHEV | General | Section 4.5.3.1 | |
| J1772-126 | EV/PHEV, unmated inlet requirements, no latch or lock timing requirements | AC/DC | EV/PHEV | General | Section 4.5.3.1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-127 | EV/PHEV, unmated inlet requirements, normal operation, degree of protection | AC/DC | EV/PHEV | General | Section 4.5.3.2 - external reference | ISO 20653 IPXXD, IEC 61140 and IEC 60479-1 touch thresholds, IEC 60479-2 perception and pain thresholds |
| J1772-128 | EV/PHEV, unmated inlet requirements, normal operation, non IPXXD voltage requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.3.2 - external reference | ISO 20653 IPXXD, IEC 61140 and IEC 60479-1 touch thresholds, IEC 60479-2 perception and pain thresholds |
| J1772-129 | EV/PHEV, unmated inlet requirements, normal operation, non IPXXD current requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.3.2 - external reference | ISO 20653 IPXXD according, IEC 60479 series taken into consideration, IEC 61140 and IEC 60479-1 touch thresholds, IEC 60479-2 perception and pain thresholds |
| J1772-130 | EV/PHEV, unmated inlet requirements, single fault condition, degree of protection | AC/DC | EV/PHEV | General | Section 4.5.3.3 - external reference | ISO 20653 IPXXD according, IEC 60479 series under consideration, IEC 61140 and IEC 60479-1 touch thresholds |
| J1772-131 | EV/PHEV, unmated inlet requirements, single fault condition, voltage requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.3.3 - external reference | ISO 20653 IPXXD according, IEC 60479 series under consideration, IEC 61140 and IEC 60479-1 touch thresholds |
| J1772-132 | EV/PHEV, unmated inlet requirements, single fault condition, non-IPXXD current requirements | AC/DC | EV/PHEV | Electrical | Section 4.5.3.3 - external reference | ISO 20653 IPXXD according, IEC 60479 series under consideration, IEC 61140 and IEC 60479-1 touch thresholds |
| J1772-133 | EV/PHEV, charging system module requirements | AC/DC | EV/PHEV | General | Section 4.6.1 - external reference | SAE J1211 compliance required |
| J1772-134 | EV/PHEV, vehicle movement with coupler mated requirement | AC/DC | EV/PHEV | General | Section 4.6.2 | |
| J1772-135 | EV/PHEV, control pilot continuity requirement | AC/DC | EV/PHEV | Electrical | Section 4.6.3 | |
| J1772-136 | EVSE, electromagnetic emissions requirements | AC/DC | EVSE | Electrical | Section 4.7.1.1 - external reference | FCC CFR Title 47, Part 15 - requires compliance with FCC Parts 15A and 15B, may apply IEC 61851-21-1 and IEC 61851-21-2 |
| J1772-137 | EVSE, conducted emissions requirements | AC/DC | EVSE | Electrical | Section 4.7.1.1.1 - external reference | FCC CFR Title 47, Part 15 - *requires compliance with FCC Parts 15* |
| J1772-138 | EVSE, radiated emissions requirements | AC/DC | EVSE | Electrical | Section 4.7.1.1.2 - external reference | FCC CFR Title 47, Part 15 - *requires* |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | | *compliance with FCC Parts 15* |
| J1772-139 | EVSE, electromagnetic immunity requirements | AC/DC | EVSE | Electrical | Section 4.7.1.2 - external reference | UL 2231-2 requires compliance with electromagnetic immunity requirements, SAE J1812 test levels, IEC 61000-4-6 and IEC 61000-4-3 immunity testing, ISO 11452-1 frequency step size |
| J1772-140 | EVSE, electrostatic discharge requirements | AC/DC | EVSE | Electrical | Section 4.7.1.3 - external reference | UL 2231-2 requires compliance with electromagnetic discharge requirements |
| J1772-141 | EVSE, harmonic distortion immunity requirements | AC/DC | EVSE | Electrical | Section 4.7.1.4 - external reference | UL 2231-2 requires compliance with harmonic distortion immunity requirements |
| J1772-142 | EVSE, electrical fast transient immunity requirements | AC/DC | EVSE | Electrical | Section 4.7.1.5 - external reference | UL 2231-2 requires compliance with electrical fast transient immunity requirements |
| J1772-143 | EVSE, voltage dips, short interruptions and voltage variations immunity requirements | AC/DC | EVSE | Electrical | Section 4.7.1.6 - external reference | Requires compliance with voltage dips, short interruptions and voltage variations immunity requirements of UL 2231-2 |
| J1772-144 | EVSE, magnetic field immunity requirements | AC/DC | EVSE | Electrical | Section 4.7.1.7 - external reference | UL 2231-2 requires compliance with magnetic field immunity requirements |
| J1772-145 | EVSE, capacitor switching transient immunity requirements | AC/DC | EVSE | Electrical | Section 4.7.1.8 - external reference | UL 2231-2 requires compliance with capacitor switching transient immunity requirements |
| J1772-146 | EVSE, voltage surge requirement | AC/DC | EVSE | Electrical | Section 4.7.1.9 - external reference | UL 2231-2 requires compliance with voltage surge requirements |
| J1772-147 | EVSE, installation | AC/DC | EVSE | General | Section 4.7.2 - external reference | National Electric Code (NFPA 70) and Canadian Electrical Code - Part 1, Section 86 requires compliance with requirements |
| J1772-148 | EVSE, general product standards | AC | EVSE | General | Section 4.7.3 - external reference | UL 2594 requires compliance with requirements |
| J1772-149 | EVSE, personnel protection | AC/DC | EVSE | Electrical | Section 4.7.4 - external reference | UL 2231 Requires compliance personnel |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | | protection device requirements |
| J1772-150 | EVSE, AC, AC present indicator requirement | AC | EVSE | General | Section 4.7.5 | |
| J1772-151 | EVSE, AC, AC conductor cord requirements | AC | EVSE | Electrical | Section 4.7.6 - external reference | National Electric Code (NFPA 70) article 625 and UL 2594 requires compliance with conductor cord requirements |
| J1772-152 | EV/PHEV, coupler requirements | AC/DC | EV/PHEV | General | Section 4.8 - external reference | National Electric Code (NFPA 70) article 625 and UL 2251 requires compliance with requirements |
| J1772-153 | EVSE, coupler requirements | AC/DC | EVSE | General | Section 4.8 - external reference | National Electric Code (NFPA 70) article 625 and UL 2251 *requires compliance with requirements* |
| J1772-154 | Joint, coupler ease of use requirements | AC/DC | Joint | General | Section 4.8.1.1 | |
| J1772-155 | Joint, coupler indexing requirement | AC/DC | Joint | General | Section 4.8.1.2 | |
| J1772-156 | Joint, coupler tactile feel requirement | AC/DC | Joint | General | Section 4.8.1.3 | |
| J1772-157 | Joint, coupler latching requirement | AC/DC | Joint | General | Section 4.8.1.4 - references 4.2.2 | |
| J1772-158 | Joint, coupler S3 switch behavior while coupler is locked requirement | AC/DC | Joint | Electrical | Section 4.8.1.5 | |
| J1772-159 | Joint, coupler surface temperature requirement | AC/DC | Joint | General | Section 4.8.2.1 - external reference | UL 2251 requires compliance with surface temperature test |
| J1772-160 | Joint, coupler design life | AC/DC | Joint | General | Section 4.8.3.1 - references 4.8.9 | |
| J1772-161 | Joint, coupler temperature range requirements | AC/DC | Joint | General | Section 4.8.4.1 - external reference | UL 2251 requires compliance with surface temperature test |
| J1772-162 | Joint, coupler temperature rise requirements | AC/DC | Joint | General | Section 4.8.4.2 - external reference | UL 2251 requires compliance with temperature rise requirement |
| J1772-163 | Joint, coupler insulation resistance | AC/DC | Joint | Electrical | Section 4.8.4.3 - external reference | UL 2251 requires compliance with insulation resistance requirement |
| J1772-164 | Joint, coupler fluid resistance | AC/DC | Joint | General | Section 4.8.4.4 - external reference | SAE USCAR2 requires coupler to meet requirements resistance to automotive lubricants, solvents and fuels as specified |
| J1772-165 | EV/PHEV, inlet physical configuration requirement | AC/DC | EV/PHEV | General | Section 4.8.5 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-166 | Joint, connector and inlet compatibility requirements | AC/DC | Joint | General | Section 4.8.5 | |
| J1772-167 | Joint, coupler contact sequence requirement | AC/DC | Joint | Electrical | Section 4.8.6 | |
| J1772-168 | EV/PHEV, inlet physical dimension requirements | AC/DC | EV/PHEV | General | Section 4.9.1 | |
| J1772-169 | EV/PHEV, inlet installation | AC/DC | EV/PHEV | General | Section 4.9.2 | |
| J1772-170 | EV/PHEV, connector alignment | AC/DC | EV/PHEV | General | Section 4.9.3 | |
| J1772-171 | EV/PHEV, inlet contact isolation | AC/DC | EV/PHEV | Electrical | Section 4.9.4 | |
| J1772-172 | EV/PHEV, inlet exposure of contacts | AC/DC | EV/PHEV | Electrical | Section 4.9.5 - external reference | UL 2251 requires compliance with live parts requirements |
| J1772-173 | EV/PHEV, inlet exposure of contacts for reverse power flow | AC/DC | EV/PHEV | Electrical | Section 4.9.5 - external reference | UL 2251 requires compliance with live parts requirements |
| J1772-174 | EV/PHEV, inlet sharp edges | AC/DC | EV/PHEV | General | Section 4.9.6 - external reference | UL 1439 sharp edges as defined |
| J1772-175 | EV/PHEV, inlet environmental considerations | AC/DC | EV/PHEV | General | Section 4.9.7 - references 4.7.10 | |
| J1772-176 | EV/PHEV, inlet mechanical requirements | AC/DC | EV/PHEV | General | Section 4.9.8 | |
| J1772-177 | EV/PHEV, inlet sealing requirements, unmated | AC/DC | EV/PHEV | General | Section 4.9.9, a - external reference | UL 2251 requires compliance with UL 50 type 3S |
| J1772-178 | EV/PHEV, inlet sealing requirements, mated | AC/DC | EV/PHEV | General | Section 4.9.9, b - external reference | UL 2251 requires compliance with UL 50 type 3S |
| J1772-179 | EV/PHEV, inlet sealing requirements, egress of fluids | AC/DC | EV/PHEV | General | Section 4.9.9, c | |
| J1772-180 | EVSE, connector physical dimensions | AC/DC | EVSE | General | Section 4.10.1 | |
| J1772-181 | EVSE, connector exposure of contacts | AC/DC | EVSE | Electrical | Section 4.10.2 - external reference | UL 2251 requires compliance with live parts requirements |
| J1772-182 | EVSE, connector sharp edges | AC/DC | EVSE | General | Section 4.10.3 - external reference | UL 1439 sharp edges as defined |
| J1772-183 | EVSE, connector impact resistance | AC/DC | EVSE | General | Section 4.10.4 - external reference | UL 2251 requires compliance with connector drop test requirements |
| J1772-184 | EVSE, connector vehicle drive-over | AC/DC | EVSE | General | Section 4.10.5 - external reference | UL 2251 requires compliance with connector drive-over test requirements |
| J1772-185 | Joint, AC, coupler contact functions | AC | Joint | Electrical | Section 5, Figure 6, and Table 8 | |
| J1772-186 | Joint, AC, electrical ratings | AC | Joint | Electrical | Section 5.1 Table 9 | |
| J1772-187 | EV/PHEV, AC, Fall back AC charging current limit when digital | AC | EV/PHEV | High Level Communications | Section 5.2.3 - external references | SAE J2847/1, J2931/1, J2931/4, J2953/1, and J2953/2 digital data |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | communications and PWM do not agree | | | | | transfer as specified |
| J1772-188 | Joint, AC, coupler contact size requirements | AC | Joint | Electrical | Section 5.6 and Table 11 - external reference | UL 2251 Table 11 references ground path current test |
| J1772-189 | EV/PHEV, AC, inlet requirements | AC | EV/PHEV | Electrical | Section 5.7, Table 11, references Appendix A, sheet A1 - external reference | UL 2251 Table 11 references ground path current test |
| J1772-190 | EVSE, AC, coupler requirements | AC | EVSE | Electrical | Section 5.8, references Appendix A, sheets A2-A5 or Appendix B, sheets B1-B3 - external reference | NFPA 70 (NEC) and UL 2251; |
| J1772-191 | Joint, DC, coupler contact functions | DC | Joint | Electrical | Section 6, Figure 11, and Table 12 | |
| J1772-192 | Joint, DC, couple electric ratings | DC | Joint | Electrical | Section 6.1, Table 13 - external reference | IEC 62196-3-1 current limit specification |
| J1772-193 | EVSE, DC, charging shutdown from control pilot | DC | EVSE | Basic Communications | Section 6.2.1.1 | |
| J1772-194 | EV/PHEV, DC, emergency shutdown from control pilot | DC | EV/PHEV | Basic Communications | Section 6.2.1.2 | |
| J1772-195 | EVSE, DC, proximity detection | DC | EVSE | Basic Communications | Section 6.2.2.1, Figure 13 | |
| J1772-196 | EVSE, DC, proximity input impedance | DC | EVSE | Electrical | Section 6.2.2.2, Table 8 | |
| J1772-197 | EVSE, DC, proximity voltage latch state | DC | EVSE | Electrical | Section 6.2.2.3, Table 8 | |
| J1772-198 | EVSE, DC, proximity voltage - S3 | DC | EVSE | Electrical | Section 6.2.2.4, Table 8 | |
| J1772-199 | EVSE, DC, proximity voltage leads to EVSE trigger of emergency shutdown | DC | EVSE | Electrical | Section 6.2.2.5, Table 8, Appendix F | |
| J1772-200 | Joint, DC, digital data transfer for DC charging, pilot duty | DC | Joint | High Level Communications | Section 6.2.3 - external reference | SAE J2847/2, J2931/1, J2931/4, J2953/1, J2953/2, ISO 15118-1, ISO 15118-2, ISO 15118-3 |
| J1772-201 | EV/PHEV, DC, lock function diagnostic | DC | EV/PHEV | General | Section 6.4.1, Table 27 | |
| J1772-202 | EV/PHEV, DC, charging lock diagnostic timing with S2 | DC | EV/PHEV | General | Section 6.4.1, Table 27 | |
| J1772-203 | EV/PHEV, DC, manual release, exposure to high voltage or arcing | DC | EV/PHEV | Electrical | Section 6.4.2 | |
| J1772-204 | EV/PHEV, DC, timing of isolation monitoring disabling | DC | EV/PHEV | Electrical | Section 6.4.3, Appendix F | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-205 | EV/PHEV, DC, charging max Y capacitance | DC | EV/PHEV | Electrical | Section 6.4.4 | |
| J1772-206 | EV/PHEV, DC, charging loss of communications | DC | EV/PHEV | High Level Communications | Section 6.4.5, Appendix F | |
| J1772-207 | EV/PHEV, DC, contact temperature monitoring | DC | EV/PHEV | General | Section 6.4.6 | |
| J1772-208 | EV/PHEV, DC, closing of contactor during charging | DC | EV/PHEV | Electrical | Section 6.4.7 | |
| J1772-209 | EV/PHEV, DC, action before contactor closing | DC | EV/PHEV | High Level Communications | Section 6.4.7, references 6.4.8, Appendix F.1.8, Appendix F.1.13 | |
| J1772-210 | EV/PHEV, DC, restart sequence | DC | EV/PHEV | High Level Communications | Section 6.4.8.1, Figure 14 | |
| J1772-211 | EVSE, DC, successful restart pilot behavior | DC | EVSE | Basic Communications | Section 6.4.8.1 | |
| J1772-212 | EV/PHEV, DC, behavior after EVSE generated pause of charging | DC | EV/PHEV | General | Section 6.4.8.1 | |
| J1772-213 | EV/PHEV, DC, current draw limit for DC+ to DC- | DC | EV/PHEV | Electrical | Section 6.4.9 | |
| J1772-214 | EV/PHEV, DC, maximum voltage for contactor closure | DC | EV/PHEV | Electrical | Section 6.4.9 | |
| J1772-215 | EV/PHEV, DC, voltage measurement | DC | EV/PHEV | General | Section 6.4.9 | |
| J1772-216 | EV/PHEV, DC, limitation on use of EVSE voltage measurement | DC | EV/PHEV | Electrical | Section 6.4.9 | |
| J1772-217 | EV/PHEV, DC, contactor behavior for DC reverse polarity | DC | EV/PHEV | Electrical | Section 6.4.9 | |
| J1772-218 | EV/PHEV, DC, monitoring of protective conductor (ground) during charge initiation | DC | EV/PHEV | Electrical | Section 6.4.10, Figure 4 | |
| J1772-219 | EV/PHEV, DC, monitoring of protective conductor (ground) during energy transfer | DC | EV/PHEV | Electrical | Section 6.4.10, Figure 4 | |
| J1772-220 | EVSE, DC, charging product standards | DC | EVSE | General | Section 6.5.3 - external reference | UL 2202 requires compliance |
| J1772-221 | EVSE, DC, charging personnel protection | DC | EVSE | Electrical | Section 6.5.4 - external reference | UL 2231 requires compliance |
| J1772-222 | EVSE, DC, charging output isolation | DC | EVSE | Electrical | Section 6.5.4 - external reference | IEC 61851-23, UL 2231 |
| J1772-223 | EV/PHEV, DC, charging output isolation | DC | EV/PHEV | Electrical | Section 6.5.4 - external reference | UL 2231 personnel protection; ECE R100, ISO 6469-2, SAE J2344 origin of vehicle isolation requirements |
| J1772-224 | EVSE, DC, electric shock hazard mitigation | DC | EVSE | Electrical | Section 6.5.4.1, reference 6.5.4.2, 6.5.4.3, 6.5.4.4, 6.5.4.5 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-225 | EVSE, DC, hazardous live parts | DC | EVSE | Electrical | Section 6.5.4.1.1 | |
| J1772-226 | EVSE, DC, hazardous voltage disconnection | DC | EVSE | Electrical | Section 6.5.4.1.1 | |
| J1772-227 | EVSE, DC, protection against electric shock | DC | EVSE | Electrical | Section 6.5.4.1.2 - external reference | IEC 60479-1 body impedance |
| J1772-228 | EVSE, DC, protective measures to prevent startle reaction | DC | EVSE | Electrical | Section 6.5.4.1.3 - external reference | IEC 60479-1 startle reaction |
| J1772-229 | EVSE, DC, current path requirement | DC | EVSE | Electrical | Section 6.5.4.1.3 - external reference | IEC 60479-1 current paths |
| J1772-230 | EVSE, DC, touch current limitations | DC | EVSE | Electrical | Section 6.5.4.1.3 | |
| J1772-231 | EVSE, DC, additional protection in case of failure of basic protection | DC | EVSE | Electrical | Section 6.5.4.1.3 - external reference | IEC 60479-1, IEC 60479-2 touch current boundaries; ISO 17409 y-capacitance limit |
| J1772-232 | EVSE, DC, basic protection | DC | EVSE | Electrical | Section 6.5.4.2.1, references 6.5.4.2.2 through 6.5.4.2.5 | |
| J1772-233 | EVSE, DC, protection by basic insulation | DC | EVSE | Electrical | 6.5.4.2.2 - external reference | IEC 62477-1 section 4.4.3.2 - basic insulation |
| J1772-234 | EVSE, DC, basic insulation requirements | DC | EVSE | Electrical | 6.5.4.2.2 | |
| J1772-235 | EVSE, DC, basic insulation voltage withstand | DC | EVSE | Electrical | 6.5.4.2.2 | |
| J1772-236 | EVSE, DC, enclosure/barrier requirement | DC | EVSE | Electrical | Section 6.5.4.2.3, references 6.5.4.5.4 and 4.5.2.2.2 - external reference | UL 2202 packaging requirements |
| J1772-237 | EVSE, DC, voltage limit definitions | DC | EVSE | Electrical | Section 6.5.4.2.4, Table 14, Table 15, Figure 16 | |
| J1772-238 | EVSE, DC, safety isolation by transformer or battery | DC | EVSE | Electrical | Section 6.5.4.2.4, e) 1) - external reference | IEC 61558-2-6 |
| J1772-239 | EVSE, DC, protection by touch current | DC | EVSE | Electrical | Section 6.5.4.2.5, references section 6.5.4.1.3 - external reference | IEC 62477-1 section 4.4.5.4 |
| J1772-240 | EVSE, DC, fault protection means | DC | EVSE | Electrical | Section 6.5.4.3.1, references 6.5.4.3.2, 6.5.4.3.4, 6.5.4.3.6 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-241 | EVSE, DC, equipotential bonding requirements | DC | EVSE | Electrical | Section 6.5.4.3.2 - external reference | IEC 62477-1 section 4.4.4.2 |
| J1772-242 | EVSE, DC, continuity between enclosure and protective circuit | DC | EVSE | Electrical | Section 6.5.4.3.3 | |
| J1772-243 | EVSE, DC, automatic supply disconnection | DC | EVSE | Electrical | Section 6.5.4.3.4 - external reference | IEC 62477-1 section 4.4.4.4 |
| J1772-244 | EVSE, DC, supplementary insulation | DC | EVSE | Electrical | Section 6.5.4.3.5 - external reference | IEC 62477-1 section 4.4.4.7 |
| J1772-245 | EVSE, DC, protective screening requirements | DC | EVSE | Electrical | Section 6.5.4.3.6 paragraph 1 - external reference | IEC 62477-1 section 4.4.4.7 |
| J1772-246 | EVSE, DC, protective screening connection | DC | EVSE | Electrical | Section 6.5.4.3.6 paragraph 2 - external reference | IEC 62477-1 section 4.4.4.2 |
| J1772-247 | EVSE, DC, protective screening bonding requirements | DC | EVSE | Electrical | Section 6.5.4.3.6 paragraph 3 - external reference | IEC 61140 sections 5.3.3.3, 5.3.3.4, 5.3.3.5 |
| J1772-248 | EVSE, DC, enhanced protection, reinforced insulation | DC | EVSE | Electrical | Section 6.5.4.4.2 - external reference | IEC 62477-1 section 4.4.5.3, UL 2202 insulation requirements |
| J1772-249 | EVSE, DC, enhanced protection, separation of circuits, DC to EVSE | DC | EVSE | Electrical | Section 6.5.4.4.3 paragraph 1 - external reference | IEC 62477-1 section 4.4.5.3 |
| J1772-250 | EVSE, DC, enhanced protection, separation of circuits, touch current limits | DC | EVSE | Electrical | Section 6.5.4.4.3 paragraph 2, references 6.5.4.1.3 - external reference | IEC 60479-1 Figure 22 and Table 13, IEC 60479-2 Figure 23 |
| J1772-251 | EVSE, DC, isolated DC EVSE requirements, DC output design, absence of fault | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 1, Note 1 - external reference | IEC 61140 section 5.2 |
| J1772-252 | EVSE, DC, isolated DC EVSE requirements, DC output design, fault present, class 1 portion, AC input to DC output | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 2-bullet 1, Notes 2-4, 6.5.4.5.5 - external reference | IEC 61140 sections 7.3, 7.4 |
| J1772-253 | EVSE, DC, isolated DC EVSE requirements, DC output design, fault present, class 1 portion, equipotential bonding, conductive parts | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 2-bullet 2, Notes 2-4, 6.5.4.5.1 - external reference | IEC 61140 section 5.3.3.2 |
| J1772-254 | EVSE, DC, isolated DC EVSE requirements, DC output design, fault present, class 1 portion, protective shielding | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 2-bullet 3 references 6.5.4.5.5 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-255 | EVSE, DC, isolated DC EVSE requirements, DC output design, fault present, class 2 portion, double/reinforced insulation | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 2-bullet 4 references 6.5.4.5.5 | |
| J1772-256 | EVSE, DC, isolated DC EVSE requirements, DC output design, fault present, class 2 portion, protective separation DC output and SELV/PELV | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 2-bullet 5, Note 6, references 6.5.4.5.5, 6.5.4.1.2 | |
| J1772-257 | EVSE, DC, isolated DC EVSE requirements, DC output design, additional protection, separation between AC input and DC output | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 3-bullet 1, Note 3, Note 4, reference 6.5.4.5.5 | |
| J1772-258 | EVSE, DC, isolated DC EVSE requirements, DC output design, additional protection, continuous continuity checking | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 3-bullet 2, Note 3, Note 5, references F.1.4.1 | |
| J1772-259 | EVSE, DC, isolated DC EVSE requirements, DC output design, additional protection, error shutdown on asymmetric/symmetric insulation fault | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 3-bullet 3, Note 3, references 6.5.4.5.1 | |
| J1772-260 | EVSE, DC, isolated DC EVSE requirements, DC output design, additional protection, multiple DC output protection | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 3-bullet 4, Note 3, Note 7, references 6.5.4.5.1 | |
| J1772-261 | EVSE, DC, isolated DC EVSE requirements, DC output design, additional protection, touch current limitation | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 3-bullet 5, Note 3, references 6.5.4.1.3 | |
| J1772-262 | EVSE, DC, isolated DC EVSE requirements, DC output design, additional protection, limitation of Y-capacitance | DC | EVSE | Electrical | Section 6.5.4.5.1 Table 16-column 3-bullet 6, Note 3, Note 8, references 6.5.4.5.1 - external reference | ISO 6469-3, ISO 17409 touch energy provisions |
| J1772-263 | EVSE, DC, isolated DC EVSE requirements, DC output design, requirements for supplying more than one vehicle simultaneously, independent protection | DC | EVSE | Electrical | Section 6.5.4.5.1 paragraph 2 | |
| J1772-264 | EVSE, DC, isolated DC EVSE requirements, DC output design, requirements for supplying more than one vehicle simultaneously, EVSE output requirements | DC | EVSE | Electrical | Section 6.5.4.5.1 paragraph 3 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-265 | EVSE, DC, isolated DC EVSE requirements, DC output design, requirements for supplying more than one vehicle simultaneously, output isolation | DC | EVSE | Electrical | Section 6.5.4.5.1 paragraph 4, Note 1, Note 2, references 6.5.4.5.2 | |
| J1772-266 | EVSE, DC, equipotential bonding of DC EVSE output requirements, protective conductor | DC | EVSE | Electrical | Section 6.5.4.5.2 paragraph 1, references 6.5.4 | |
| J1772-267 | EVSE, DC, equipotential bonding of DC EVSE output requirements, protective conductor to EV/PHEV | DC | EVSE | Electrical | Section 6.5.4.5.2 paragraph 2 | |
| J1772-268 | EVSE, DC, equipotential bonding of DC EVSE output requirements, AC input protective conductor terminal | DC | EVSE | Electrical | Section 6.5.4.5.2 paragraph 3 | |
| J1772-269 | EVSE, DC, equipotential bonding of DC EVSE output requirements, user manual content requirements | DC | EVSE | General | Section 6.5.4.5.2 paragraph 4 - external reference | IEC 60479-1 Figure 22 |
| J1772-270 | EVSE, DC, output isolation, touch current limit | DC | EVSE | Electrical | Section 6.5.4.5.3, paragraph 1 | |
| J1772-271 | EVSE, DC, output isolation, insulation monitoring device requirements | DC | EVSE | Electrical | Section 6.5.4.5.3, paragraph 2 | |
| J1772-272 | EVSE, DC, output isolation, insulation monitoring device reaction time requirements | DC | EVSE | Electrical | Section 6.5.4.5.3, paragraph 3, references 6.5.4.6 | |
| J1772-273 | EVSE, DC, output isolation, use of Y-capacitance stored energy limitation not allowed | DC | EVSE | Electrical | Section 6.5.4.5.3, paragraph 4 | |
| J1772-274 | EVSE, DC, hazardous live parts, enclosure protection | DC | EVSE | General | Section 6.5.4.5.4 - external reference | ISO 20653 IPXXC rating |
| J1772-275 | EVSE, DC, insulation barriers, DC output insulation | DC | EVSE | Electrical | Section 6.5.4.5.5 paragraph 1 | |
| J1772-276 | EVSE, DC, insulation barriers, insulation barrier requirements | DC | EVSE | Electrical | Section 6.5.4.5.5 paragraph 2, Table 17, matrix of requirements, references 6.5.4.1.2 - external references | IEC 62477 section 4.4.5.4, IEC 61851-23 section 6.3.1.112.2 |
| J1772-277 | EVSE, DC, insulation barriers, DC output live part separation | DC | EVSE | Electrical | Section 6.5.4.5.5 paragraph 4 | |
| J1772-278 | EVSE, DC, AC input stored energy | DC | EVSE | Electrical | Section 6.5.4.5.6 | |
| J1772-279 | EVSE, DC, disconnection from vehicle | DC | EVSE | Electrical | Section 6.5.4.5.7 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-280 | EVSE, DC, supply network grounding, conductor requirements | DC | EVSE | Electrical | Section 6.5.4.5.8 paragraph 2 (bullets 1 and 2), references 6.5.4.5.9 | |
| J1772-281 | EVSE, DC, supply network grounding, protective conductor switching forbidden | DC | EVSE | Electrical | Section 6.5.4.5.8 paragraph 3 | |
| J1772-282 | EVSE, DC, supply network grounding, Class II EVSE requirements | DC | EVSE | Electrical | Section 6.5.4.5.8 paragraph 4 | |
| J1772-283 | EVSE, DC, EVSE to EV/PHEV signaling requirements | DC | EVSE | Electrical | Section 6.5.4.5.9 - external reference | IEC 62477-1 extra low voltage definition |
| J1772-284 | EVSE, DC, insulation monitoring during charging | DC | EVSE | Electrical | Section 6.5.4.6, Note 1, Note 2, references F.1.8 - external reference | ISO 17409 section 9.2 requirements for insulation monitoring system - non-interference with IMD |
| J1772-285 | EVSE, DC, isolation state reporting | DC | EVSE | High Level Communications | Section 6.5.4.7, references Appendix F | |
| J1772-286 | EVSE, DC, isolation state reporting, invalid state | DC | EVSE | Electrical | Section 6.5.4.7.1, references 6.5.4 | |
| J1772-287 | EVSE, DC, isolation state reporting, valid state | DC | EVSE | Electrical | Section 6.5.4.7.2, references 6.5.4 | |
| J1772-288 | EVSE, DC, isolation state reporting, warning state, unbalance state | DC | EVSE | Electrical | Section 6.5.4.7.3 | |
| J1772-289 | EVSE, DC, isolation state reporting, fault state, isolation fault | DC | EVSE | High Level Communications | Section 6.5.4.7.4 first sentence, Table 18 | |
| J1772-290 | EVSE, DC, isolation state reporting, fault state, isolation fault reporting | DC | EVSE | High Level Communications | Section 6.5.4.7.4 second sentence, references 6.5.4.7.1 | |
| J1772-291 | EVSE, DC, isolation state reporting, fault state, EVSE that measure total isolation resistance | DC | EVSE | Electrical | Section 6.5.4.7.4 paragraph 3 (NOTE), | |
| J1772-292 | EVSE, DC, maximum output Y capacitance | DC | EVSE | Electrical | Section 6.5.5 | |
| J1772-293 | EVSE, DC, AC present indicator | DC | EVSE | General | Section 6.5.6 - reference 4.7.5 | |
| J1772-294 | EVSE, DC, Conductor cord requirements | DC | EVSE | Electrical | Section 6.5.7 - reference 4.7.6 | |
| J1772-295 | EVSE, DC, charging diagnostics using high voltage or energy | DC | EVSE | Electrical | Section 6.5.8 | |
| J1772-296 | EVSE, DC, verify latch function (S3) | DC | EVSE | General | Section 6.5.9 | |
| J1772-297 | EVSE, DC, output current measurement accuracy | DC | EVSE | Electrical | Section 6.5.10 | |
| J1772-298 | EVSE, DC, output voltage measurement accuracy | DC | EVSE | Electrical | Section 6.5.11 | |
| J1772-299 | EVSE, DC, output current regulation | DC | EVSE | Electrical | Section 6.5.12 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-300 | EVSE, DC, output descending current slew rate | DC | EVSE | Electrical | Section 6.5.13 - reference Appendix F.1.10, Appendix F.1.11 | |
| J1772-301 | EVSE, DC, output current ripple | DC | EVSE | Electrical | Section 6.5.14, Table 19 | |
| J1772-302 | EVSE, DC, output voltage no load regulation | DC | EVSE | Electrical | Section 6.5.15 | |
| J1772-303 | EVSE, DC, output voltage transient | DC | EVSE | Electrical | Section 6.5.16, Table 20 | |
| J1772-304 | EVSE, DC, output current overshoot | DC | EVSE | Electrical | Section 6.5.17, reference 6.5.12, 6.5.29.8 - external reference | SAE J2847/2 message definition |
| J1772-305 | EVSE, DC, output inrush current | DC | EVSE | Electrical | Section 6.5.18, references Appendix F.1.10 | |
| J1772-306 | EVSE, DC, output short circuit test | DC | EVSE | Electrical | Section 6.5.19, references Appendix F | |
| J1772-307 | EVSE, DC, loss of communications shutdown | DC | EVSE | High Level Communications | Section 6.5.20 - reference Appendix F | |
| J1772-308 | EVSE, DC, connector contact area temperature monitor | DC | EVSE | General | Section 6.5.21 | |
| J1772-309 | EVSE, DC, prevention of unintended reverse power flow | DC | EVSE | Electrical | Section 6.5.22 | |
| J1772-310 | EVSE, DC, user initiated charge termination | DC | EVSE | High Level Communications | Section 6.5.23 | |
| J1772-311 | EVSE, DC, available current PWM slew rate changes | DC | EVSE | General | Section 6.5.24 | |
| J1772-312 | EVSE, DC, output voltage overshoot time | DC | EVSE | Electrical | Section 6.5.25 | |
| J1772-313 | EVSE, DC, voltage deviation during pre-charge | DC | EVSE | Electrical | Section 6.5.26 | |
| J1772-314 | EVSE, DC, max voltage slew rate in normal operation | DC | EVSE | Electrical | Section 6.5.27 | |
| J1772-315 | EVSE, DC, coupler requirements - contact size | DC | EVSE | Electrical | Section 6.6, Table 13, Appendix B (B-1 - B-3), Appendix D (sheet D1) - reference 4.7 | |
| J1772-316 | EVSE, DC, coupler requirements - axial force | DC | EVSE | General | Section 6.6.1, Section 6.6.1.1 - external reference | IEC 61300-2-6 testing as per this document |
| J1772-317 | EVSE, DC, coupler requirements - torque | DC | EVSE | General | Section 6.6.1, Section 6.6.1.2 - external reference | IEC 61300-2-7 testing as per this document |
| J1772-318 | EVSE, DC, coupler requirements - cable retention | DC | EVSE | General | Section 6.6.1, Section 6.6.1.3 - external reference | IEC 61300-2-4 testing as per this document |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-319 | EV/PHEV DC inlet | DC | EV/PHEV | General | Section 6.7, references Appendix D (Sheet D1) | |
| J1772-320 | EV/PHEV DC level 1 inlet contacts | DC | EV/PHEV | Electrical | Section 6.7.1, Table 13, references Appendix A (Sheet A1) | |
| J1772-321 | EV/PHEV DC level 2 inlet contacts | DC | EV/PHEV | Electrical | Section 6.7.2, Table 13, references Appendix C (Sheet C1, Sheet C2) | |
| J1772-322 | EVSE, DC, connector | DC | EVSE | Electrical | Section 6.8 - external reference | NFPA 70 (NEC) article 625 for power conductors and UL 2251 Table 15.1 for ground conductor |
| J1772-323 | EVSE, DC, level 1 contacts | DC | EVSE | Electrical | Section 6.8.1, Table 13, references Appendix A (Sheet A2), Appendix B (sheets B-1 through B3) | |
| J1772-324 | EVSE, DC, level 2 contacts | DC | EVSE | Electrical | Section 6.8.2, Table 13, references Appendix C (Sheet C3, Sheet C4) | |
| J1772-325 | EVSE contact area temperature monitor | DC | EVSE | General | Section 6.8.3 | |
| J1772-326 | Coupler dimensions, non-lockable | AC | Joint | General | Appendix A | |
| J1772-327 | Coupler dimensions, lockable | AC | Joint | General | Appendix B | |
| J1772-328 | EVSE, DC, level 2 coupler dimensions | DC | EVSE | General | Appendix C | |
| J1772-329 | Coupler lock zone definition | DC | Joint | General | Appendix D - external reference | IEC 62196-2 |
| J1772-330 | EV/PHEV, AC, timing start up sequence requirements, charge controller activation | AC | EV/PHEV | Basic Communications | Appendix E.1 - a | |
| J1772-331 | EV/PHEV, AC, timing start up sequence requirements, drive interlock activation | AC | EV/PHEV | Basic Communications | Appendix E.1 - a | |
| J1772-332 | EVSE, AC, timing start up sequence requirements, verification of EV/PHEV connection | AC | EVSE | Basic Communications | Appendix E.1 - b | |
| J1772-333 | EVSE, AC, timing start up sequence requirements, ready to supply energy | AC | EVSE | Basic Communications | Appendix E.1 - c | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-334 | EV/PHEV, AC, timing start up sequence requirements, EV/PHEV, available current, 10% to 96% duty cycle PWM | AC | EV/PHEV | Basic Communications | Appendix E.1 - d.a | |
| J1772-335 | EV/PHEV, AC, timing start up sequence requirements, available current, 3% to 7% duty cycle PWM | AC | EV/PHEV | Basic Communications | Appendix E.1 - d.b | |
| J1772-336 | EV/PHEV, AC, timing start up sequence requirements, available current, digital link failure | AC | EV/PHEV | High Level Communications | Appendix E.1 - d.c | |
| J1772-337 | EVSE, AC, timing start up sequence requirements, available current, digital link failure | AC | EVSE | High Level Communications | Appendix E.1 - d.c | |
| J1772-338 | EVSE, AC, timing start up sequence requirements, EVSE ground conductor continuity to EV/PHEV | AC | EVSE | Electrical | Appendix E.1 - e | |
| J1772-339 | EVSE, AC, timing start up sequence requirements, pilot circuit diode detection | AC | EVSE | Electrical | Appendix E.1 - f, Table 4 | |
| J1772-340 | EV/PHEV, AC, timing start up sequence requirements, EV/PHEV, ready to accept energy | AC | EV/PHEV | Basic Communications | Appendix E.1 - g | |
| J1772-341 | EVSE, AC, timing start up sequence requirements, ventilation required condition 1 (indoor) | AC | EVSE | Basic Communications | Appendix E.1 - h.a | |
| J1772-342 | EVSE, AC, timing start up sequence requirements, ventilation required condition 2 (outdoor) | AC | EVSE | Basic Communications | Appendix E.1 - h.b | |
| J1772-343 | EVSE, AC, timing start up sequence requirements, ventilation required condition 3 (not supported) | AC | EVSE | Basic Communications | Appendix E.1 - h.c | |
| J1772-344 | EV/PHEV, AC, timing start up sequence requirements, pilot monitoring | AC | EV/PHEV | Basic Communications | Appendix E.1 - j | |
| J1772-345 | EVSE, AC, timing start up sequence requirements, pilot monitoring | AC | EVSE | Basic Communications | Appendix E.1 - j | |
| J1772-346 | EVSE, AC, timing start up sequence requirements, loss of pilot | AC | EVSE | Basic Communications | Appendix E.1 - j | |
| J1772-347 | EVSE, AC, timing start up sequence requirements, pilot out of allowable range | AC | EVSE | Basic Communications | Appendix E.1 - j | |
| J1772-348 | EVSE, AC, response time specification, delay to pilot oscillator turn on | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 1, Table 15, Table 16 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-349 | EVSE, AC, response time specification, delay from disconnect to contactor open | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 2, Table 15, Table 16 | |
| J1772-350 | EV/PHEV, AC, response time specification, delay to open battery contactor | AC | EV/PHEV | Basic Communications | Appendix E.2, Table 26, Transition 3, Table 15, Table 16 | |
| J1772-351 | EVSE, AC, response time specification, EVSE, maximum restart attempts | AC | EVSE | Basic Communications | Appendix E.2 , Transition 3, corresponding Note 3 | |
| J1772-352 | EVSE, AC, response time specification, delay until oscillator is turned of from EV/PHEV disconnect | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 4, Table 15, Table 16 | |
| J1772-353 | EVSE, AC, response time specification, oscillator turn off | AC | EVSE | Basic Communications | Appendix E.2, Transition 4, corresponding Note 4 | |
| J1772-354 | EVSE, AC, response time specification, delay until contactor closes in response to S2 close | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 5, Table 15, Table 16 | |
| J1772-355 | EVSE, AC, response time specification, delay until contactor opens in response to S2 open | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 6, Table 15, Table 16 | |
| J1772-356 | EV/PHEV, AC, response time specification, charge current reduction requirement | AC | EV/PHEV | Basic Communications | Appendix E.2, Table 26, Transition 7, Table 15, Table 16 | |
| J1772-357 | EV/PHEV, AC, response time specification, invalid pilot response | AC | EV/PHEV | Basic Communications | Appendix E.2, Transition 7, corresponding Note 7 | |
| J1772-358 | EVSE, AC, response time specification, invalid pilot | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 8, Table 15, Table 16 | |
| J1772-359 | EVSE, AC, response time specification, transition to State E or F, contactor opening timing | AC | EVSE | Basic Communications | Appendix E.2, Transition 8, corresponding Note 8 | |
| J1772-360 | EV/PHEV, AC, response time specification, pilot frequency out of range | AC | EV/PHEV | Basic Communications | Appendix E.2, Table 26, Transition 9, Table 15, Table 16 | |
| J1772-361 | EV/PHEV, AC, response time specification, response to invalid pilot frequency | AC | EV/PHEV | Basic Communications | Appendix E.2, Transition 9, corresponding Note 9 | |
| J1772-362 | EVSE, AC, response time specification, delay from external load management | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 10, | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | signal until EVSE modifies pilot | | | | Table 15, Table 16 | |
| J1772-363 | EV/PHEV, AC, response time specification, response to change in pilot duty cycle | AC | EV/PHEV | Basic Communications | Appendix E.2, Table 26, Transition 11, Table 15, Table 16 | |
| J1772-364 | EV/PHEV, AC, response time specification, maximum response time | AC | EV/PHEV | Basic Communications | Appendix E.2, Transition 11, corresponding Note 11 | |
| J1772-365 | EVSE, AC, response time specification, response to change of ventilation request | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 12, Table 15, Table 16 | |
| J1772-366 | EVSE, AC, response time specification, response to ventilation change | AC | EVSE | Basic Communications | Appendix E.2, Transition 12, corresponding Note 12 | |
| J1772-367 | EV/PHEV, AC, response time specification, response to proximity circuit pressing of S3 | AC | EV/PHEV | Basic Communications | Appendix E.2, Table 26, Transition 13, Table 15, Table 16 | |
| J1772-368 | EVSE, AC, response time specification, transition from not ready to supply energy to read to supply energy | AC | EVSE | Basic Communications | Appendix E.2, Table 26, Transition 14, Table 15, Table 16 | |
| J1772-369 | DC, timing sequence requirements, charge session defined | DC | Joint | High Level Communications | Appendix F.1 | |
| J1772-370 | EV/PHEV, DC, timing sequence requirements, connector locking | DC | EV/PHEV | High Level Communications | Appendix F.1.1, paragraph 2 | |
| J1772-371 | EV/PHEV, DC, timing sequence requirements, connector unlocking | DC | EV/PHEV | High Level Communications | Appendix F.1.1, paragraph 2 | |
| J1772-372 | EV/PHEV, DC, timing sequence requirements, precharge process | DC | EV/PHEV | High Level Communications | Appendix F.1.1, paragraph 4 | |
| J1772-373 | DC, timing sequence requirements, EVSE - EV/PHEV, transition to energy transfer phase | DC | Joint | High Level Communications | Appendix F.1.1, paragraph 5 | |
| J1772-374 | DC, timing sequence requirements, monitoring voltage and current | DC | Joint | High Level Communications | Appendix F.1.2 paragraph 1 | |
| J1772-375 | EVSE, DC, timing sequence requirements, energy transfer status | DC | EVSE | High Level Communications | Appendix F.1.2 paragraph 2 | |
| J1772-376 | EVSE, DC, timing sequence requirements, signal when at max output capacity to EV/PHEV | DC | EVSE | High Level Communications | Appendix F.1.2 paragraph 2 | |
| J1772-377 | EV/PHEV, DC, timing sequence requirements, communication of expected charge completion time to EVSE | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 2 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-378 | EV/PHEV, DC, timing sequence requirements, energy transfer request limitations | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 3 | |
| J1772-379 | EV/PHEV, DC, timing sequence requirements, behavior at bulk threshold | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 3 | |
| J1772-380 | EV/PHEV, DC, charging timing sequence requirements, limitation of energy transfer requests | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 3 | |
| J1772-381 | EV/PHEV, DC, timing sequence requirements, control of charge level | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 4 | |
| J1772-382 | EV/PHEV, DC, charging timing sequence requirements, completion of charge, unique signal | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 4 | |
| J1772-383 | EV/PHEV, DC, timing sequence requirements, completion of charge, reduction of energy transfer request | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 4 | |
| J1772-384 | EV/PHEV, DC, timing sequence requirements, transition to Normal Shutdown | DC | EV/PHEV | High Level Communications | Appendix F.1.2 paragraph 5 | |
| J1772-385 | EV/PHEV, DC, timing sequence requirements, charge current request setting | DC | EV/PHEV | High Level Communications | Appendix F.1.3 paragraph 1 | |
| J1772-386 | EV/PHEV, DC, timing sequence requirements, charge complete indication | DC | EV/PHEV | High Level Communications | Appendix F.1.3 paragraph 1 | |
| J1772-387 | EV/PHEV, DC, timing sequence requirements, onboard charge contactor opening | DC | EV/PHEV | High Level Communications | Appendix F.1.3 paragraph 1 | |
| J1772-388 | EV/PHEV, DC, timing sequence requirements, normal shutdown state | DC | EV/PHEV | High Level Communications | Appendix F.1.3 paragraph 3 | |
| J1772-389 | EV/PHEV, DC, timing sequence requirements, charge coupler lock state | DC | EV/PHEV | High Level Communications | Appendix F.1.3 paragraph 4 | |
| J1772-390 | DC, timing sequence requirements, loss of communications | DC | Joint | High Level Communications | Appendix F.1.4.3 | |
| J1772-391 | EV/PHEV, DC, timing sequence requirements, connector unlock at reception of SessionStopRes message | DC | EV/PHEV | High Level Communications | Appendix F.1.6.1-a, external reference | IEC 62196-3 |
| J1772-392 | EV/PHEV, DC, timing sequence requirements, connector unlock leaving State C2/D2 emergency shutdown | DC | EV/PHEV | Basic Communications | Appendix F.1.6.1-b, F.1.11 | |
| J1772-393 | EV/PHEV, DC, timing sequence requirements, connector unlock leaving State C2/D2 emergency shutdown, voltage > 60Vdc | DC | EV/PHEV | Basic Communications | Appendix F.1.6.1 paragraph 3 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-394 | EVSE, DC, timing sequence requirements, response after execution of shutdown, reinitiation limit | DC | EVSE | High Level Communications | Appendix F.1.6.3 paragraph 1 | |
| J1772-395 | EVSE, DC, timing sequence requirements, EVSE, behavior for EV/PHEV induced B2 -> C2 transition | DC | EVSE | Basic Communications | Appendix F.1.6.3 paragraph 2 | |
| J1772-396 | EVSE, DC, normal startup, output voltage limit at ► t0 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 1 (► t0) | |
| J1772-397 | EVSE, DC, normal startup, change to state B, disable IMD circuit, disable output, open disconnect at t0 | DC | EVSE | General | Appendix F.1.8, Figure 34, Table 27 paragraph 2 (t0), bullet 3 | |
| J1772-398 | EVSE, DC, normal startup, limit on error shutdown at t0 ► t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 3 (t0 ► t3) | |
| J1772-399 | EVSE, DC, normal startup, error shutdown on voltage at t0 ► t4 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 4 (t0 ► t4), bullet 1 | |
| J1772-400 | EV/PHEV, DC, normal startup, lock fail response at t0 ► t4 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 4 (t0 ► t4), bullet 2 | |
| J1772-401 | EVSE, DC, normal startup, disabled output equivalent circuit at t0 ► t4 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 4 (t0 ► t4), bullet 3 | |
| J1772-402 | EVSE, DC, normal startup, no overvoltage protection, t0 ► t10 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 5 (t0 ► t10) | |
| J1772-403 | EVSE, DC, normal startup, pilot behavior at t1 | DC | EVSE | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 6 (t1), bullet 1 | |
| J1772-404 | EVSE, DC, normal startup, pilot 5% duty behavior at t1 | DC | EVSE | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 6 (t1), bullet 2 | |
| J1772-405 | EV/PHEV, DC, normal startup, establish data link, t1 ► t2 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 7 (t1 ► t2), bullet 1 | |
| J1772-406 | EVSE, DC, normal startup, wants to terminate communication session, t1 ► t2 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 7 (t1 ► t2), bullet 4 | |
| J1772-407 | EV/PHEV, DC, normal startup, wants to terminate communications session, t1 ► t2 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 7 (t1 ► t2), bullet 5 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-408 | EV/PHEV, DC, normal startup, receives FAILED message, t1 ► t2 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 7 (t1 ► t2), bullet 6 | |
| J1772-409 | EV/PHEV, DC, normal startup, parameters in first message <3a>, t2 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 8 (t2) | |
| J1772-410 | EVSE, DC, normal startup, compatibility check, t2 ► t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 9 (t2 ► t3), bullet 1 | |
| J1772-411 | EVSE, DC, normal startup, voltage present at output message <3b>, t2 ► t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 9 (t2 ► t3), bullet 2 | |
| J1772-412 | EVSE, DC, normal startup, message <3b> content, t2 ►t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 9 (t2 ► t3), bullet 3 | |
| J1772-413 | EVSE, DC, normal startup, message <3b> additional content, t2 ►t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 9 (t2 ► t3), bullet 4 | |
| J1772-414 | EVSE, DC, normal startup, message content for DIN 70121 message <3b> content, t2 ► t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 10 (t2 ► t3), bullet 1 | |
| J1772-415 | EV/PHEV, DC, normal startup, ChargeParameterDiscovery response content, t2 ► t3 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 10 (t2 ► t3), bullet 3 | |
| J1772-416 | EVSE, DC, normal startup, EV/PHEV changes pilot state to C/D, t2 ► t3 | DC | EVSE | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 10 (t2 ► t3), bullet 5 | |
| J1772-417 | EVSE, DC, normal startup, emergency shutdown when EV/PHEV changes pilot state to B, t2 ► t3 | DC | EVSE | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 10 (t2 ► t3), bullet 5 | |
| J1772-418 | EVSE, DC, normal startup, wants to terminate communication, t2 ► t4 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 11 (t2 ► t4), bullet 1 | |
| J1772-419 | EV/PHEV, DC, normal startup, terminating communication, t2 ► t4 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 11 (t2 ► t4), bullet 2 | |
| J1772-420 | EVSE, DC, normal startup, DC output < 60Vdc message <3b> content, at t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 12 (t3), bullet 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-421 | EVSE, DC, normal startup, DC output not < 60Vdc error shutdown, at t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 12 (t3), Note 3 | |
| J1772-422 | EVSE, DC, normal startup, maximum negotiated value message <3b> content, at t3 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 12 (t3), bullet 2 | |
| J1772-423 | EV/PHEV, DC, normal startup, not compatible error shutdown, at t3 ► t4 | DC | EV/PHEV | General | Appendix F.1.8, Figure 34, Table 27 paragraph 13 (t3 ► t4), bullet 1 | |
| J1772-424 | EV/PHEV, DC, normal startup, connector lock, at t3 ► t4 | DC | EV/PHEV | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 13 (t3 ► t4), bullet 2 | |
| J1772-425 | EV/PHEV, DC, normal startup, connector lock fail, at t3 ► t4 | DC | EV/PHEV | General | Appendix F.1.8, Figure 34, Table 27 paragraph 13 (t3 ► t4), bullet 3 | |
| J1772-426 | EV/PHEV, DC, normal startup, IMD behavior, at t3 ► t4 | DC | EV/PHEV | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 13 (t3 ► t4), bullet 4 | |
| J1772-427 | EVSE, DC, normal startup, DC output voltage error - error shutdown, at t3 ► | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 14 (t3 ►) | |
| J1772-428 | EV/PHEV, DC, normal startup, IMD disabled - pilot state change, at t4 | DC | EV/PHEV | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 15 (t4), bullet 1 | |
| J1772-429 | EVSE, DC, normal startup, EVSE, output enable at state change, at t4 | DC | EVSE | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 15 (t4), bullet 2 | |
| J1772-430 | EV/PHEV, DC, normal startup, cable check request, at t4 ► t5 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 16 (t4 ► t5), bullet 1 | |
| J1772-431 | EVSE, DC, normal startup, check of pilot state, at t4 ► t5 | DC | EVSE | Basic Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 16 (t4 ► t5), bullet 2 | |
| J1772-432 | EVSE, DC, normal startup, IMD check at t4 ► t6 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 17 (t4 ► t6), bullet 1 | |
| J1772-433 | EVSE, DC, normal startup, insulation state check, at t4 ► t6 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 17 (t4 ► t6), bullet 2 | |
| J1772-434 | EVSE, DC, normal startup, communications pause - disable output, at t4 ► t10 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | (t4 ► t10), bullet 1 | |
| J1772-435 | EVSE, DC, normal startup, first message before communications pause, at t4 ► t10 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 1, a or b | |
| J1772-436 | EVSE, DC, normal startup, wants to terminate communications during cable-check or precharge, at t4 ► t10 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 2 | |
| J1772-437 | EVSE, DC, normal startup, normal shutdown sequence, at t4 ► t10 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 2, a | |
| J1772-438 | EV/PHEV, DC, normal startup, response to terminate communications entering normal shutdown, at t4 ► t10 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 2, b | |
| J1772-439 | EV/PHEV, DC, normal startup, wants to terminate communications during cable-check or precharge - charge contactors open, at t4 ► t10 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 3 | |
| J1772-440 | EV/PHEV, DC, normal startup, wants to terminate communications during cable-check or precharge if charge contactor is closed, at t4 ► t10 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 3 | |
| J1772-441 | EV/PHEV, DC, normal startup, response to EVSE shutdown message - charge contactor not yet closed, at t4 ► t10 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 4 | |
| J1772-442 | EV/PHEV, DC, normal startup, response to EVSE shutdown message - charge contactor already closed, at t4 ► t10 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 18 (t4 ► t10), bullet 4 | |
| J1772-443 | EVSE, DC, normal startup, cable check message, t6 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 19 (t6), bullet 1 | |
| J1772-444 | EVSE, DC, normal startup, cable check error - error shutdown, t6 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 19 (t6), bullet 2 | |
| J1772-445 | EV/PHEV, DC, normal startup, start precharge phase, t7 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 21 (t7) | |
| J1772-446 | EVSE, DC, normal startup, start precharge phase, t7 ► t9 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 22 (t7 ► t9), bullet 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-447 | EV/PHEV, DC normal startup, start precharge phase, t7 ► t9 | DC | EV/PHEV | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 22 (t7 ► t9), bullet 1 | |
| J1772-448 | EVSE, DC, normal startup, voltage control, t7 ► t9 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 22 (t7 ► t9), bullet 2 | |
| J1772-449 | EV/PHEV, DC, normal startup, voltage verification before contactor closure, t9 | DC | EV/PHEV | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 25 (t9) | |
| J1772-450 | EV/PHEV, DC normal startup, request pre-charge disable, t9 ► t10 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 26 (t9 ► t10) | |
| J1772-451 | EVSE, DC, normal startup, message after disabling pre-charge, t10 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 27 (t10), bullet 1 | |
| J1772-452 | EVSE, DC, normal startup, start overvoltage protection, t10 | DC | EVSE | Electrical | Appendix F.1.8, Figure 34, Table 27 paragraph 27 (t10), bullet 2 | |
| J1772-453 | EV/PHEV, DC, normal startup, set parameter EVTargetCurrent in message <7a>, t11 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 28 (t11), bullet 1 | |
| J1772-454 | EV/PHEV, DC, normal startup, set voltage and current limits per negotiated limits, t11 | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 28 (t11), bullet 2 | |
| J1772-455 | EVSE, DC, normal startup, adapt DC output per EV/PHEV request, t11 ► t12 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 29 (t11 ► t12), bullet 1 | |
| J1772-456 | EVSE, DC, normal startup, respond with present voltage/current, limits, and status, t11 ► t12 | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 29 (t11 ► t12), bullet 2 | |
| J1772-457 | EVSE, DC, normal startup, continuously monitor isolation, t11 ► | DC | EVSE | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 30 (t11 ►) | |
| J1772-458 | EV/PHEV, DC, normal startup, adapts voltage and current per energy transfer strategy, t12 ► | DC | EV/PHEV | High Level Communications | Appendix F.1.8, Figure 34, Table 27 paragraph 32(t12 ►) | |
| J1772-459 | EV/PHEV, DC, normal shutdown, wants to stop/pause communications session - non-critical, t100 | DC | EV/PHEV | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 2 (t100) | |
| J1772-460 | EVSE, DC, normal shutdown, wants to stop/pause communications session - non-critical, ramp down current and messages, t100 ► t101 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 3 (t100 ► t101) | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-461 | EVSE, DC, normal shutdown, wants to stop/pause communications session - < 5A, t100 ► t102 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 5 (t100 ► t102) | |
| J1772-462 | DC, normal shutdown, EV/PHEV or EVSE wants to stop/pause communications session - disable output - DIN 70121:2014, t102 | DC | Joint | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 6 (t102), bullet 1 | |
| J1772-463 | DC, normal shutdown, EV/PHEV or EVSE wants to stop/pause communications session - disable output - ISO 15118-2:2014, t102 | DC | Joint | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 6 (t102), bullet 2 | |
| J1772-464 | EVSE, DC, normal shutdown, response to PowerDeliveryReq <8a> message - dc output, t102 ► t103 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 7 (t102 ► t103), bullet 1 | |
| J1772-465 | EVSE, DC, normal shutdown, response to PowerDeliveryReq <8a> message - overvoltage protection, t102 ► t103 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 7 (t102 ► t103), bullet 2 | |
| J1772-466 | EV/PHEV, DC, normal shutdown, contactor reclose forbidden, t102 ► t105 | DC | EV/PHEV | Electrical | Appendix F.1.9, Figure 35, Table 28 paragraph 8 (t102 ► t105) | |
| J1772-467 | EVSE, DC, normal shutdown, output disable, t103 | DC | EVSE | Electrical | Appendix F.1.9, Figure 35, Table 28 paragraph 9 (t103), bullet 1 | |
| J1772-468 | EVSE, DC, normal shutdown, IMD disable, t103 | DC | EVSE | Electrical | Appendix F.1.9, Figure 35, Table 28 paragraph 9 (t103), bullet 2 | |
| J1772-469 | EVSE, DC, normal shutdown, disabled output electric properties, t103 ► t110 | DC | EVSE | Electrical | Appendix F.1.9, Figure 35, Table 28 paragraph 10 (t103 ► t110) | |
| J1772-470 | EVSE, DC, normal shutdown, communicate present current - disable output, t104 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 11 (t104), bullet 1 | |
| J1772-471 | EVSE, DC, normal shutdown, missing message error shutdown, t104 ► t107 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 11 (t104 ► t107) | |
| J1772-472 | EV/PHEV, DC, normal shutdown, response to PowerDeliveryRes <8a> message, t105 | DC | EV/PHEV | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 12 (t105) | |
| J1772-473 | EVSE, DC, normal shutdown, check state change prior to first WeldingDetectionRes <9b> message, t105 ► t106 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 13 (t105 ► t106), bullet 3 | |
| J1772-474 | EV/PHEV, DC, normal shutdown, open charge contactors, t106 | DC | EV/PHEV | Electrical | Appendix F.1.9, Figure 35, Table | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | 28 paragraph 14 (t106), bullet 2 | |
| J1772-475 | EV/PHEV, DC, normal shutdown,SessionStopReq after charge contactors open, t107 | DC | EV/PHEV | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 15 (t107), bullet 1 | |
| J1772-476 | EVSE, DC, normal shutdown, reduce output voltage ≤ 60 V DC, t107 ► t108 | DC | EVSE | Electrical | Appendix F.1.9, Figure 35, Table 28 paragraph 16 (t107 ► t108) | |
| J1772-477 | EVSE, DC, normal shutdown, send SessionStopRes message, t108 | DC | EVSE | High Level Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 17 (t108), bullet 1 | |
| J1772-478 | EVSE, DC, normal shutdown, turn off control pilot oscillator - ISO 15118-2:2014, t108 | DC | EVSE | Basic Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 17 (t108), bullet 2 | |
| J1772-479 | EV/PHEV, DC, normal shutdown, connector unlock, t108 ► t110 | DC | EV/PHEV | General | Appendix F.1.9, Figure 35, Table 28 paragraph 18 (t108 ► t110), bullet 1 | |
| J1772-480 | EVSE, DC, normal shutdown, re-initiation restart, t108 ► t110 | DC | EVSE | General | Appendix F.1.9, Figure 35, Table 28 paragraph 18 (t108 ► t110), bullet 4 | |
| J1772-481 | EVSE, DC, normal shutdown, control pilot oscillator state - DIN 70121:2014, t109 | DC | EVSE | Basic Communications | Appendix F.1.9, Figure 35, Table 28 paragraph 19 (t109) | |
| J1772-482 | EVSE, DC, error and emergency handling | DC | EVSE | General | Appendix F.1.10, paragraph 1 | |
| J1772-483 | EV/PHEV, DC, error and emergency handling, | DC | EV/PHEV | General | Appendix F.1.10, paragraph 1 | |
| J1772-484 | EV/PHEV, DC, error and emergency handling, contactor reclose forbidden, t200 | DC | EV/PHEV | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 2, bullet 3 | |
| J1772-485 | EVSE, DC, error and emergency handling, IMD state, t201 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 4 (t201) | |
| J1772-486 | EVSE, DC, error and emergency handling, reduce output current, t201 ► t202 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 5 (t201 ► t202) | |
| J1772-487 | EVSE, DC, error and emergency handling, reduce output voltage, t201 ► t206 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 6 (t201 ► t206) | |
| J1772-488 | EVSE, DC, error and emergency handling, output current limit, t202 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 7 (t202), bullet 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-489 | EVSE, DC, error and emergency handling, overvoltage protection state, disable output, open contactors, t202 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 7 (t202), bullet 2 | |
| J1772-490 | EVSE, DC, error and emergency handling, EVSE initiated error shutdown message, open contactors, t202 | DC | EVSE | High Level Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 7 (t202), bullet 3 | |
| J1772-491 | EVSE, DC, error and emergency handling, EV/PHEV initiated error shutdown message, open contactors, t202 | DC | EVSE | High Level Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 7 (t202), bullet 4 | |
| J1772-492 | EVSE, DC, error and emergency handling, control pilot state, t202 ► t203 | DC | EVSE | Basic Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 8 (t202 ► t203) | |
| J1772-493 | EVSE, DC, error and emergency handling, disabled output electric properties, t202 ► t207 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 9 (t202 ► t207) | |
| J1772-494 | EVSE, DC, error and emergency handling, control pilot oscillator state, t203 | DC | EVSE | Basic Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 10 (t203), bullet 1 | |
| J1772-495 | EVSE, DC, error and emergency handling, trigger emergency shutdown - control pilot not off, t203 | DC | EVSE | Basic Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 10 (t203), bullet 2 | |
| J1772-496 | EV/PHEV, DC, error and emergency handling, trigger emergency shutdown - control pilot not off, t203 | DC | EV/PHEV | Basic Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 10 (t203), bullet 2 | |
| J1772-497 | EV/PHEV, DC, error and emergency handling, contactor response to control pilot turn off, t203 ► t204 | DC | EV/PHEV | Basic Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 11 (t203 ► t204) | |
| J1772-498 | EV/PHEV, DC, error and emergency handling, contactor opening, t204 | DC | EV/PHEV | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 12 (t204) | |
| J1772-499 | EV/PHEV, DC, error and emergency handling, control pilot state, t205 | DC | EV/PHEV | Basic Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 13 (t205), bullet 1 | |
| J1772-500 | EVSE, DC, error and emergency handling, output voltage limit, t206 | DC | EVSE | Electrical | Appendix F.1.10.1, Figure 36, Table 30, paragraph 14 (t206), bullet 1 | |
| J1772-501 | EVSE, DC, error and emergency handling, EV/PHEV initiated | DC | EVSE | High Level Communications | Appendix F.1.10.1, Figure 36, Table 30, | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | shutdown message requirement, t206 | | | | paragraph 14 (t206), bullet 2 | |
| J1772-502 | EV/PHEV, DC, error and emergency handling, connector unlock, t206 ▶ t207 | DC | EV/PHEV | High Level Communications | Appendix F.1.10.1, Figure 36, Table 30, paragraph 15 (t206 ▶ t207), bullet 1 | |
| J1772-503 | EVSE, DC, error and emergency handling, re-initiation restart, t206 ▶ t207 | DC | EVSE | General | Appendix F.1.10.1, Figure 36, Table 30, paragraph 15 (t206 ▶ t207), bullet 2 | |
| J1772-504 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, current reduction at output if > 5 A DC, t300 ▶ t301 | DC | EVSE | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 3 (t300 ▶ t301) | |
| J1772-505 | EV/PHEV, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, contactor reclose forbidden, t300 ▶ t303 | DC | EV/PHEV | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 4 (t300 ▶ t303) | |
| J1772-506 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, overvoltage protection state, t301 | DC | EVSE | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 5 (t301), bullet 1 | |
| J1772-507 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, IMD state, t301 | DC | EVSE | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 5 (t301), bullet 2 | |
| J1772-508 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, output electrical properties, t301 ▶ t307 | DC | EVSE | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 6 (t301 ▶ t307) | |
| J1772-509 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, output status messages communicated, t302 | DC | EVSE | High Level Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 7 (t302) | |
| J1772-510 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, error shutdown on missing message, t302 ▶ t305 | DC | EVSE | High Level Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 8 (t302 ▶ t305) | |
| J1772-511 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, control pilot state change on message, t303 | DC | EVSE | Basic Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 9 (t303), bullet 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-512 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, check control pilot state, t303 ► t304 | DC | EVSE | Basic Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 10 (t303 ► t304), bullet 3 | |
| J1772-513 | EV/PHEV, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, open contactors, t304 | DC | EV/PHEV | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 11 (t304), bullet 2 | |
| J1772-514 | EV/PHEV, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, message after open contactors, t305 | DC | EV/PHEV | High Level Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 12 (t305), bullet 1 | |
| J1772-515 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, reduce output voltage ≤ 60 V DC, t305 ► t306 | DC | EVSE | Electrical | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 13 (t305 ► t306) | |
| J1772-516 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, message requirement, t306 | DC | EVSE | High Level Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 14 (t306), bullet 1 | |
| J1772-517 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, control pilot oscillator state, t306 | DC | EVSE | Basic Communications | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 14 (t306), bullet 2 | |
| J1772-518 | EV/PHEV, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, unlock connector, t306 ► t307 | DC | EV/PHEV | General | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 15 (t306 ► t307), bullet 1 | |
| J1772-519 | EVSE, DC, EV/PHEV initiated error shutdown during energy transfer using DIN 70121:2014, reinitiation of session process, t306 ► t307 | DC | EVSE | General | Appendix F.1.10.1.1, Figure 37, Table 31, paragraph 15 (t306 ► t307), bullet 2 | |
| J1772-520 | EVSE, DC, Emergency shutdown executed by EVSE or EV/PHEV, basic signaling of emergency shutdown | DC | EVSE | Basic Communications | Appendix F.1.11, paragraph 1 | |
| J1772-521 | EV/PHEV, DC, Emergency shutdown executed by EVSE or EV/PHEV, basic signaling of emergency shutdown | DC | EV/PHEV | Basic Communications | Appendix F.1.11, paragraph 1 | |
| J1772-522 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, open S2, t400 ► t401 | DC | EV/PHEV | Basic Communications | Appendix F.1.11.1, Figure 38, Table 32, paragraph 3 (t400 ► t401), bullet 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-523 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, emergency shutdown at loss of electrical conductivity, t400 ► t401 | DC | EV/PHEV | Basic Communications | Appendix F.1.11.1, Figure 38, Table 32, paragraph 3 (t400 ► t401), bullet 2 | |
| J1772-524 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, response to control pilot state, t400 ► t401 | DC | EV/PHEV | Basic Communications | Appendix F.1.11.1, Figure 38, Table 32, paragraph 3 (t400 ► t401), bullet 3 | |
| J1772-525 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, unexpected control pilot state change, t400 ► t401 | DC | EV/PHEV | Basic Communications | Appendix F.1.11.1, Figure 38, Table 32, paragraph 3 (t400 ► t401), bullet 4 | |
| J1772-526 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, open S2, t401 ► t402 | DC | EV/PHEV | Basic Communications | Appendix F.1.11.1, Figure 38, Table 32, paragraph 5 (t401 ► t402) | |
| J1772-527 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, response to emergency condition, t401 ► t403 | DC | EV/PHEV | Electrical | Appendix F.1.11.1, Figure 38, Table 32, paragraph 7 (t401 ► t402) | |
| J1772-528 | EV/PHEV, DC, Emergency shutdown executed by the EV/PHEV, "EVReady" = 'False' message, t401 ► t405 | DC | EV/PHEV | High Level Communications | Appendix F.1.11.1, Figure 38, Table 32, paragraph 8 (t401 ► t405) | |
| J1772-529 | EVSE, DC, Emergency shutdown executed by the EVSE, use of digital communications during an emergency condition forbidden, t500 | DC | EVSE | High Level Communications | Appendix F.1.11.2, Figure 39, Table 33, paragraph 2 (t500), Note 1 | |
| J1772-530 | EVSE, DC, Emergency shutdown executed by the EVSE, emergency shutdown trigger timing, t500 ► t501 | DC | EVSE | General | Appendix F.1.11.2, Figure 39, Table 33, paragraph 3 (t500 ► t501), bullet 1 | |
| J1772-531 | EVSE, DC, Emergency shutdown executed by the EVSE, emergency shutdown internal fault, t500 ► t501 | DC | EVSE | General | Appendix F.1.11.2, Figure 39, Table 33, paragraph 3 (t500 ► t501), bullet 2 | |
| J1772-532 | EVSE, DC, Emergency shutdown executed by the EVSE, control pilot oscillator shutdown timing, t501 ► t502 | DC | EVSE | Basic Communications | Appendix F.1.11.2, Figure 39, Table 33, paragraph 5 (t501 ► t502) | |
| J1772-533 | EVSE, DC, Emergency shutdown executed by the EVSE, reduce output current, disable output, t501 ► t503 | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, paragraph 6 (t501 ► t503) | |
| J1772-534 | EVSE, DC, Emergency shutdown executed by the | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | EVSE, reduce output voltage, t501 ► t506 | | | | paragraph 7 (t501 ► t506) | |
| J1772-535 | EVSE, DC, Emergency shutdown executed by the EVSE, disable IMD, t502 | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, paragraph 8 (t502), bullet 2 | |
| J1772-536 | EVSE, DC, Emergency shutdown executed by the EVSE, EV/PHEV state change (C/D to B), t502 ► t504 | DC | EVSE | Basic Communications | Appendix F.1.11.2, Figure 39, Table 33, paragraph 9 (t502 ► t504) | |
| J1772-537 | EVSE, DC, Emergency shutdown executed by the EVSE, response required, t502 ► t507 | DC | EVSE | High Level Communications | Appendix F.1.11.2, Figure 39, Table 33, paragraph 10 (t502 ► t507) | |
| J1772-538 | EVSE, DC, Emergency shutdown executed by the EVSE, overvoltage protection state, t503 | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, paragraph 11 (t503), bullet 2 | |
| J1772-539 | EVSE, DC, Emergency shutdown executed by the EVSE, EVSE disable output, open disconnection device, t503 | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, paragraph 11 (t503), bullet 2 | |
| J1772-540 | EVSE, DC, Emergency shutdown executed by the EVSE, disabled output characteristic, t503 ► t507 | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, paragraph 12 (t503 ► t507) | |
| J1772-541 | EVSE, DC, Emergency shutdown executed by the EVSE, re-initiation requirement, t506 ► t507 | DC | EVSE | Electrical | Appendix F.1.11.2, Figure 39, Table 33, paragraph 16 (t503 ► t507) | |
| J1772-542 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, forbidden to trigger error shutdown, t600 ► t603 | DC | EVSE | General | Appendix F.1.12.1, Figure 40, Table 34, paragraph 3 (t600 ► t603) | |
| J1772-543 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, lock fail message, t600 ► t604 | DC | EV/PHEV | General | Appendix F.1.12.1, Figure 40, Table 34, paragraph 4 (t600 ► t604) | |
| J1772-544 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, disabled output characteristic, t600 ► t608 | DC | EVSE | General | Appendix F.1.12.1, Figure 40, Table 34, paragraph 5 (t600 ► t608) | |
| J1772-545 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, control pilot state, t601 | DC | EVSE | Basic Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 6 (t601), bullet 1 | |
| J1772-546 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, EVSE, control pilot duty cycle, t601 | DC | EVSE | Basic Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 6 (t601), bullet 2 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-547 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, establish data link, t601 ► t602 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 7 (t601 ► t602), bullet 1 | |
| J1772-548 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, send current and voltage parameters, t602 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 8 (t602) | |
| J1772-549 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, compatibility check, t602 ► t603 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 9 (t602 ► t603), bullet 1 | |
| J1772-550 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, output voltage check, t602 ► t603 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 9 (t602 ► t603), bullet 2 | |
| J1772-551 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, messages to support compatibility check, t602 ► t603 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 9 (t602 ► t603), bullet 3 | |
| J1772-552 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, required status message, t602 ► t603 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 9 (t602 ► t603), bullet 4 | |
| J1772-553 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, tolerate control pilot state changes, t602 ► t603 | DC | EVSE | Basic Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 10 (t602 ► t603), bullet 2 | |
| J1772-554 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, compatibility check results message, t603 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 11 (t603), bullet 1 | |
| J1772-555 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, EV/PHEV, conditions to trigger and error shutdown, t603 | DC | EVSE | General | Appendix F.1.12.1, Figure 40, Table 34, paragraph 11 (t603), Note 2 | |
| J1772-556 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, forbidden messages, t603 ► t604 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 12 (t603 ► t604), bullet 2 | |
| J1772-557 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, state change forbidden, t603 ► t607 | DC | EV/PHEV | Basic Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 13 (t603 ► t607) | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| J1772-558 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, condition for trigger of error shutdown, t603 ► | DC | EVSE | Electrical | Appendix F.1.12.1, Figure 40, Table 34, paragraph 14 (t603 ►) | |
| J1772-559 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, required messages, t604 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 15 (t604), bullet 1 | |
| J1772-560 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, error shutdown on lock fail, t604 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 15 (t604), bullet 2 | |
| J1772-561 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, required messages, t605 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 16 (t605) | |
| J1772-562 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, required messages, t606 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 17 (t606) | |
| J1772-563 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, required messages, t607 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 18 (t607), bullet 1 | |
| J1772-564 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, control pilot state, t607 | DC | EVSE | Basic Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 18 (t607), bullet 2 | |
| J1772-565 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, stop communication, t607 ► t608 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 19 (t607 ► t608), bullet 2 | |
| J1772-566 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, stop communication, t607 ► t608 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 19 (t607 ► t608), bullet 2 | |
| J1772-567 | EV/PHEV, DC, Pause triggered by the EVSE using ISO 15118-2:2014, ending pause, t607 ► t608 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 19 (t607 ► t608), bullet 3 | |
| J1772-568 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, ending pause, t607 ► t608 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 19 (t607 ► t608), bullet 3 | |
| J1772-569 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, connector un-mating response, t607 ► t608 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 19 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | | | | | (t607 ► t608), bullet 4 | |
| J1772-570 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, control pilot state, t608 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 20 (t608), bullet 1 | |
| J1772-571 | EVSE, DC, Pause triggered by the EVSE using ISO 15118-2:2014, continue to normal start up sequence, t608 | DC | EVSE | High Level Communications | Appendix F.1.12.1, Figure 40, Table 34, paragraph 20 (t608), bullet 2 | |
| J1772-572 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, output voltage limit, ► t700 | DC | EVSE | Electrical | Appendix F.1.12.2, Figure 41, Table 35, paragraph 1 (► t700) | |
| J1772-573 | EV/PHEV, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, connector lock, t700 | DC | EV/PHEV | General | Appendix F.1.12.2, Figure 41, Table 35, paragraph 2 (t700), bullet 2 | |
| J1772-574 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, control pilot state change - disable IMD, output, and open disconnection device, t700 | DC | EVSE | Basic Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 2 (t700), bullet 3 | |
| J1772-575 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, error shutdown forbidden, t700 ► t703 | DC | EVSE | High Level Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 3 (t700 ► t703) | |
| J1772-576 | EV/PHEV, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, failed connector lock, t700 ► t704 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 4 (t700 ► t704), bullet 1 | |
| J1772-577 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, disable output characteristics, t700 ► t704 | DC | EVSE | Electrical | Appendix F.1.12.2, Figure 41, Table 35, paragraph 4 (t700 ► t704), bullet 2 | |
| J1772-578 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, overvoltage protection forbidden, t700 ► t718 | DC | EVSE | Electrical | Appendix F.1.12.2, Figure 41, Table 35, paragraph 5 (t700 ► t718), bullet 2 | |
| J1772-579 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118- | DC | EVSE | Basic Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 6 (t701), bullet 1 | |

| # | Description | Mode | Device | Category | J1772 | External Ref |
|---|---|---|---|---|---|---|
| | 2:2014, control pilot state, t701 | | | | | |
| J1772-580 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, control pilot duty cycle, t701 | DC | EVSE | Basic Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 6 (t701), bullet 2 | |
| J1772-581 | EVSE, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, establish data link, t701 ▶ t702 | DC | EVSE | High Level Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 6 (t701 ▶ t702), bullet 1 | |
| J1772-582 | EV/PHEV, DC, Pause after pre-charge and before energy transfer triggered by the EVSE using ISO 15118-2:2014, required messages, t702 | DC | EV/PHEV | High Level Communications | Appendix F.1.12.2, Figure 41, Table 35, paragraph 7 (t702) | |

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