

An Electric Vehicle Charging Standards Guidebook for North America

First Edition

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Technical Update, April 2024

EPRI Project Manager

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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.

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EXECUTIVE SUMMARY

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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.

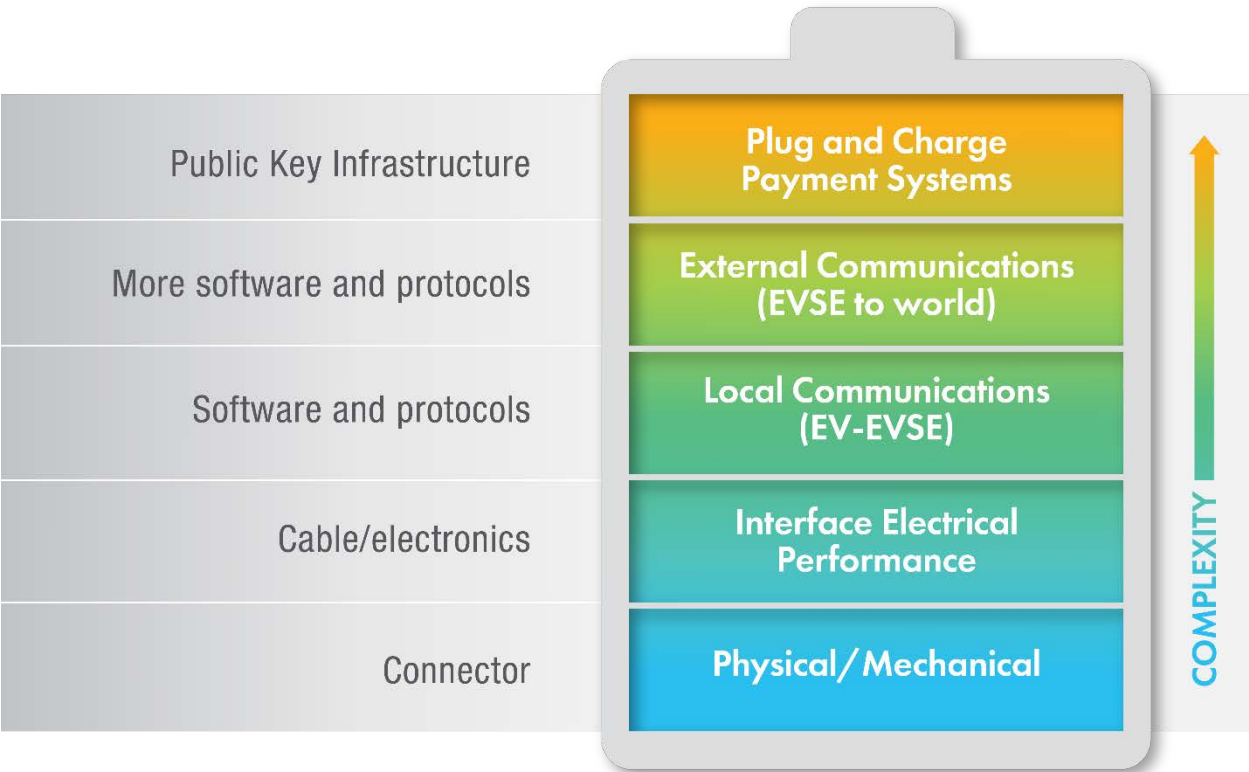


Figure 1. The Layering of Standards for EV Charging

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 an 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 Alliance¹)
 - OpenADR (maintained by the OpenADR Alliance²)
- Public Key Infrastructure - Plug and Charge/Payment Systems
 - SAE PKI Activity (EVPKI³)
 - ISO 15118-2
 - ISO 15118-20

Other High-Level Resources

EPRI publishes an annual Standards Update⁴ 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.

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 are 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).

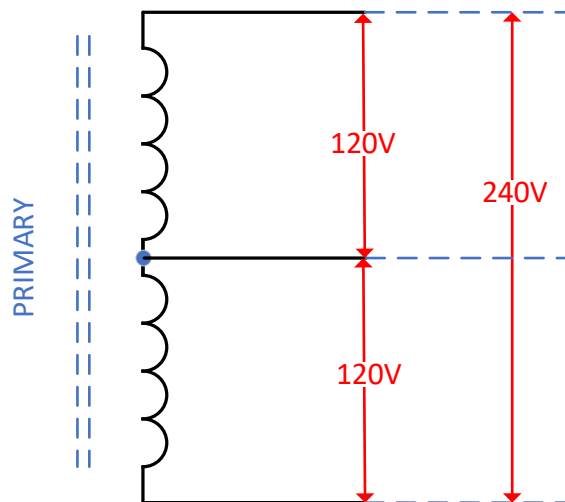


Figure 2. Split-Phase 240Vac Service

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).

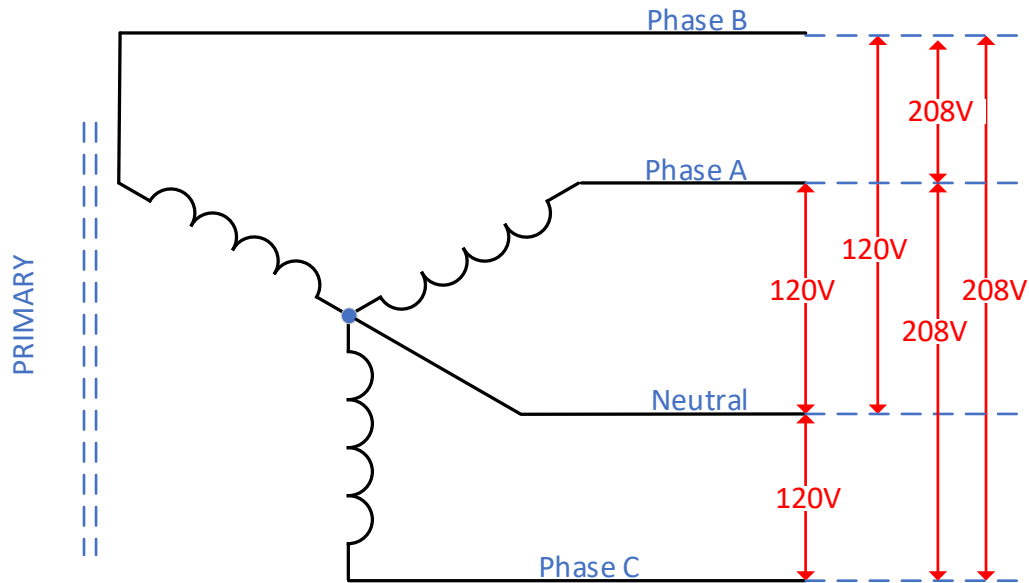


Figure 3. Three-Phase 208Vac Service (Y-Connection)

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 $\sim 139A_{ac}$ for 208Vac, 3-phase service.

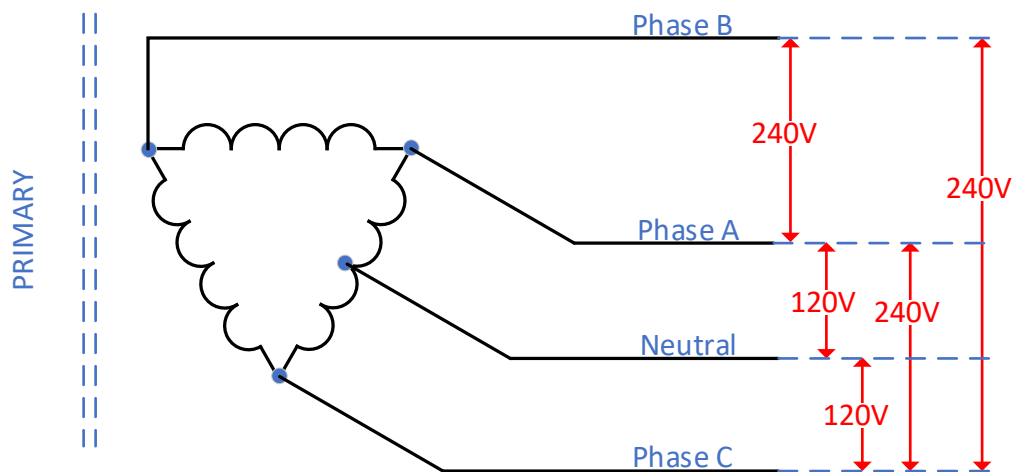


Figure 4. Three-Phase 240Vac Service (Delta-Connection)

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.

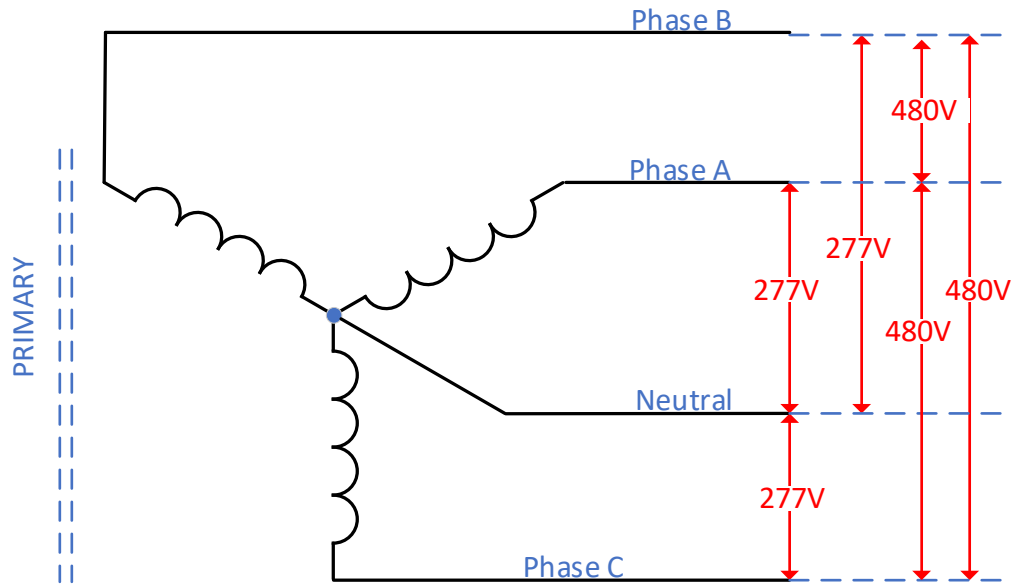


Figure 5. Three-Phase 480Vac Service (Y-Connection)

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)



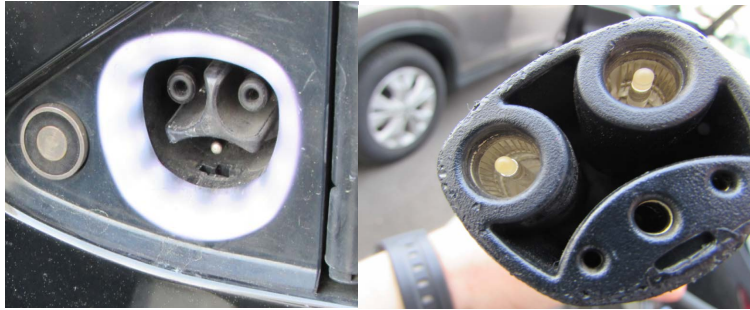
- SAE J1772™ CCS DC (referred to as CCS Type 1 in IEC standards)



- 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
	Tesla Vehicle	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 be 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 requirements⁹. 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.

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.

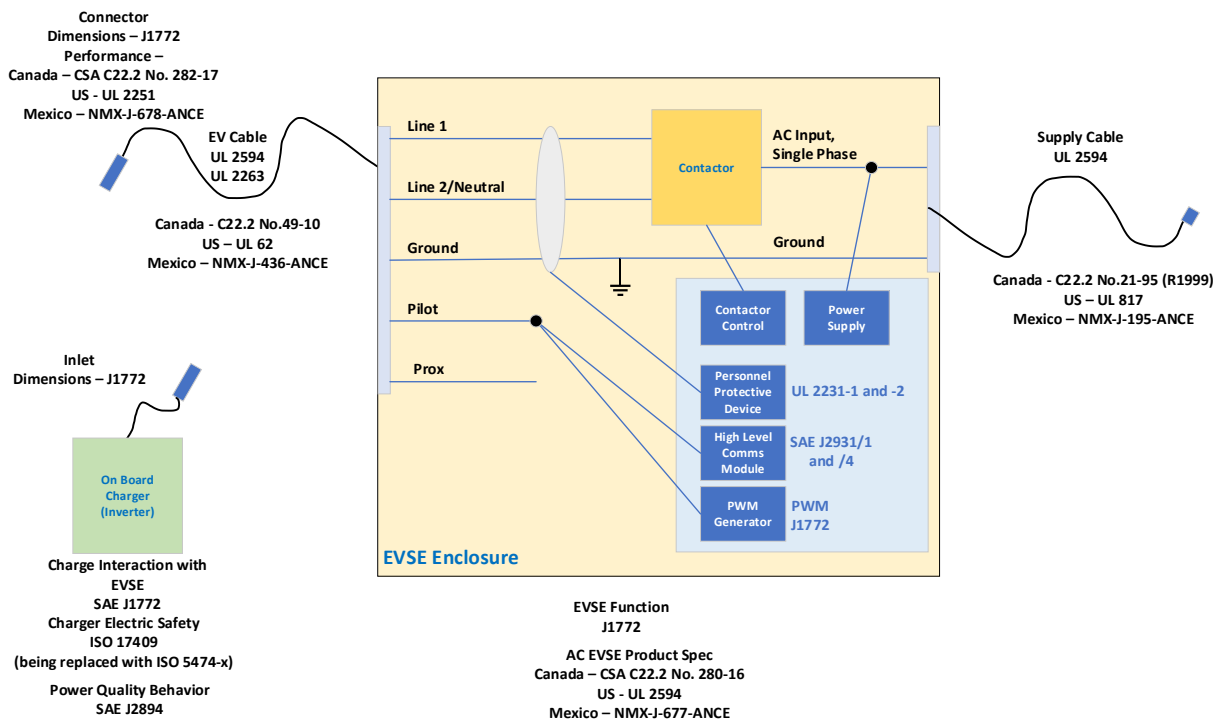


Figure 6. AC Charging Standards - Functional Diagram

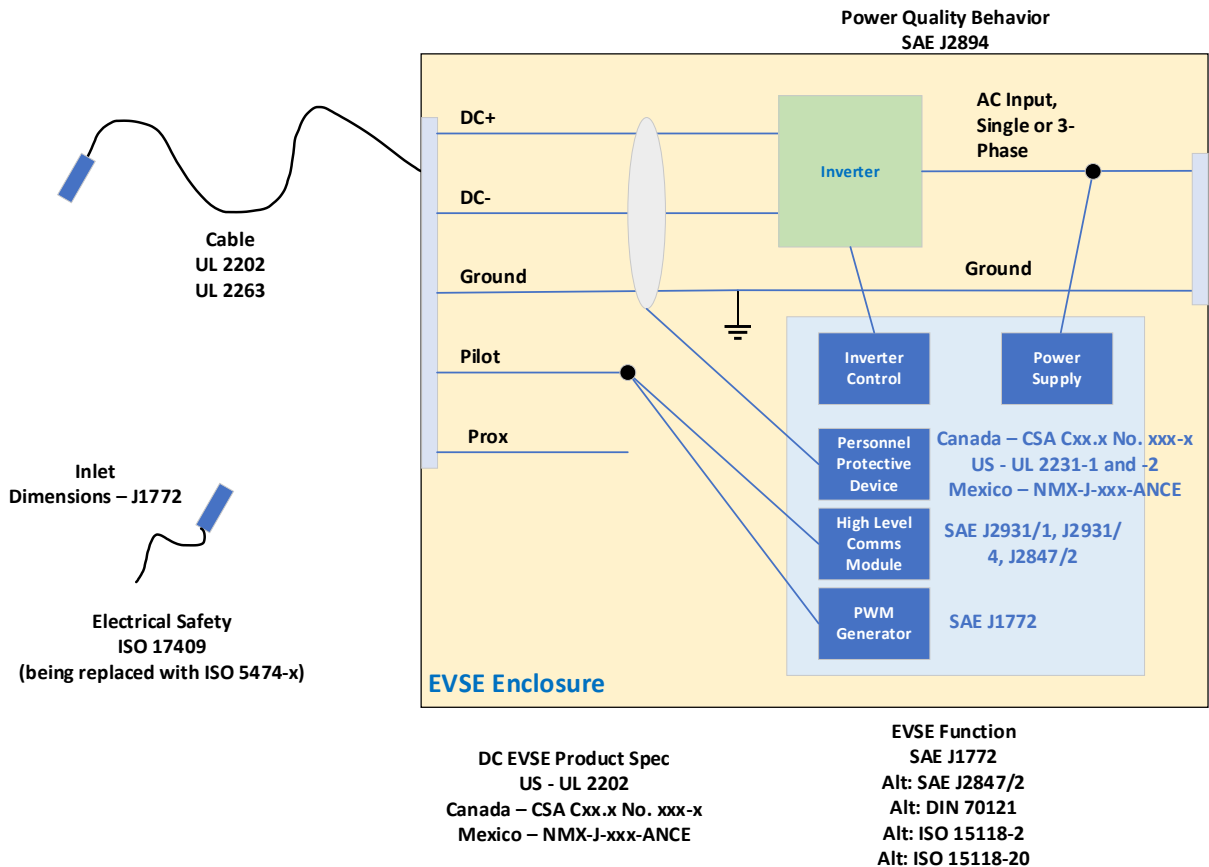


Figure 7. DC Charging Standards - Functional Diagram

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.

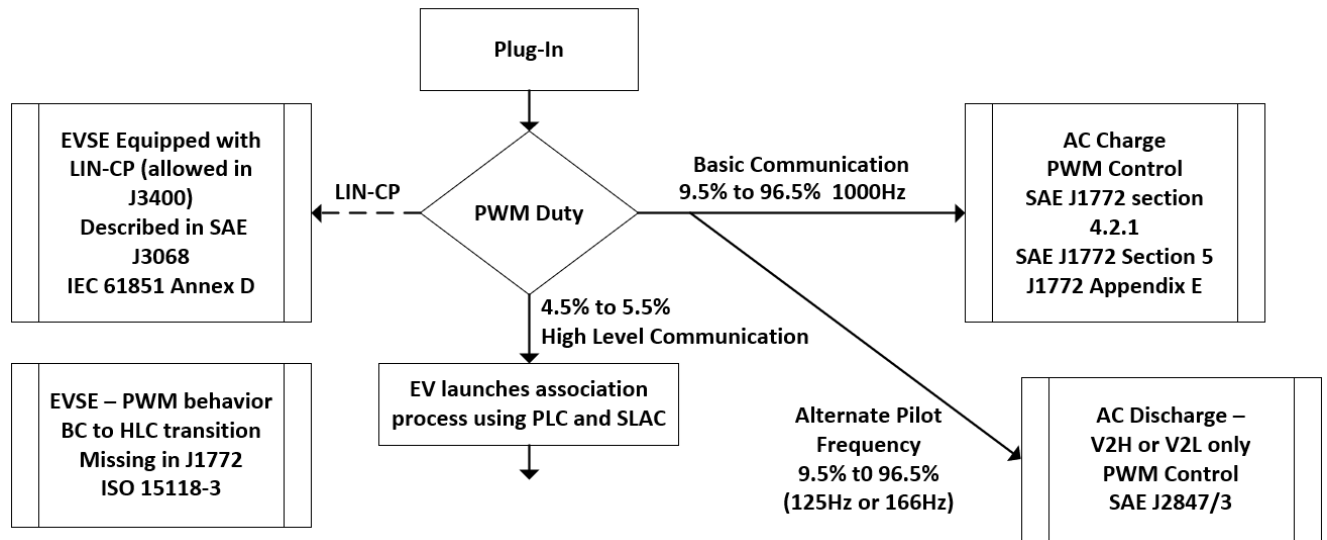


Figure 8. DC Charging Standards - Functional Diagram 1

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.

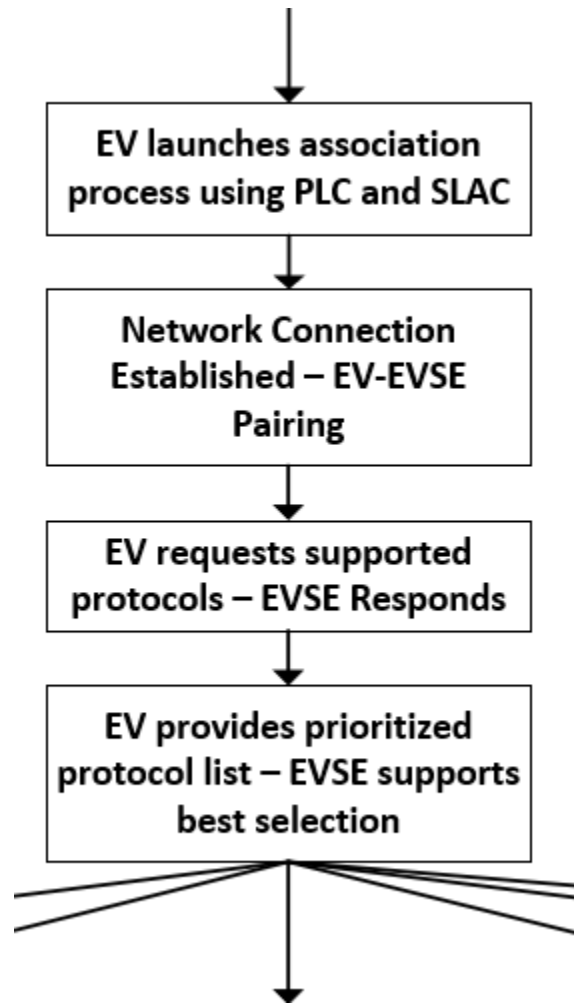


Figure 9. Establishing Digital Communications

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”

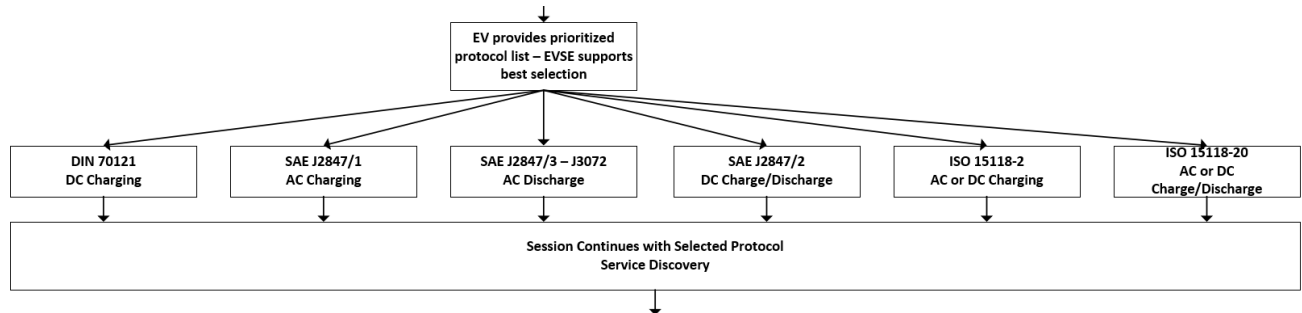


Figure 10. Once a protocol is selected, the EV must discover what services are available from the EVSE.

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.

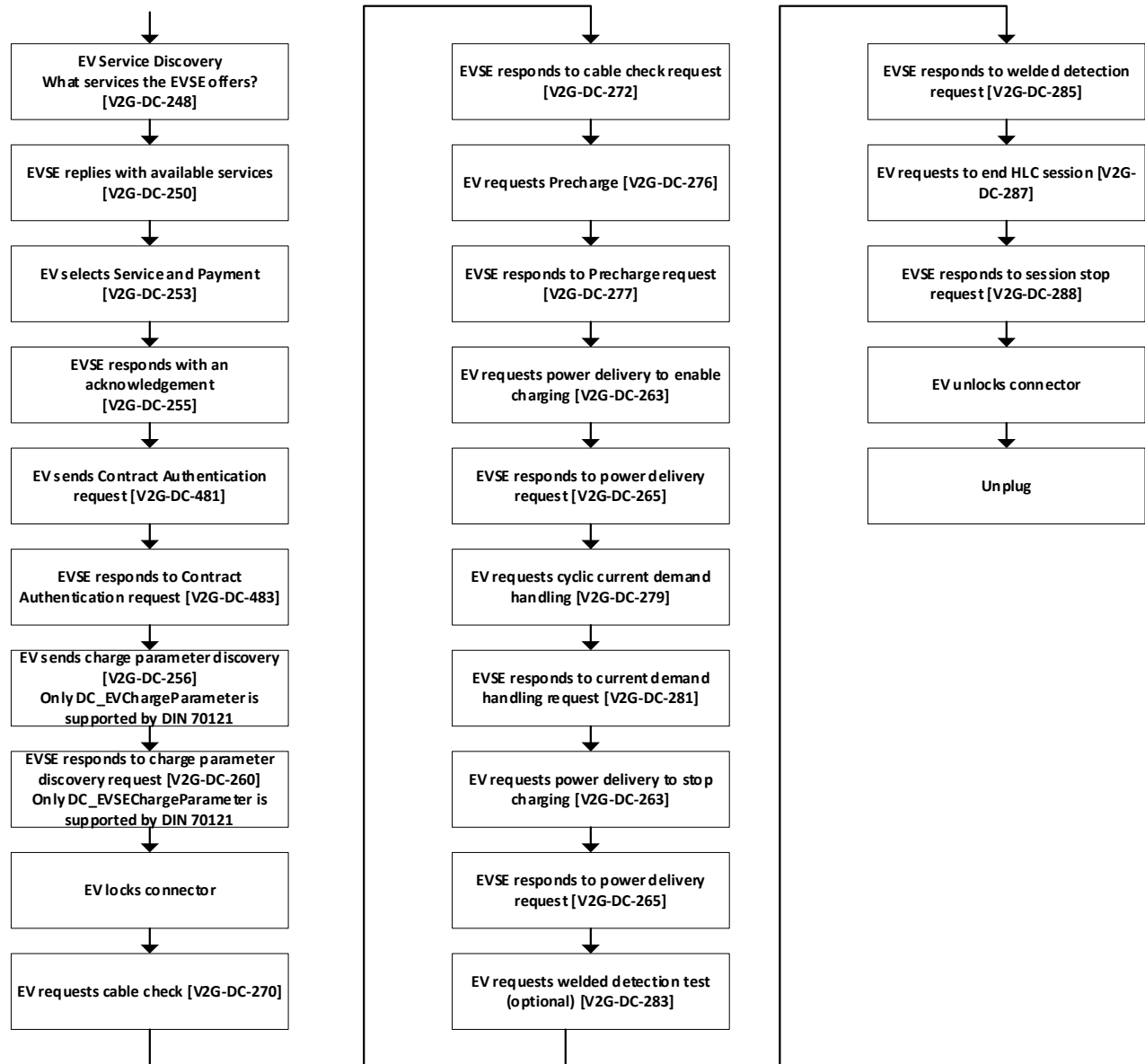


Figure 11. Session Flow for DIN 70121

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.

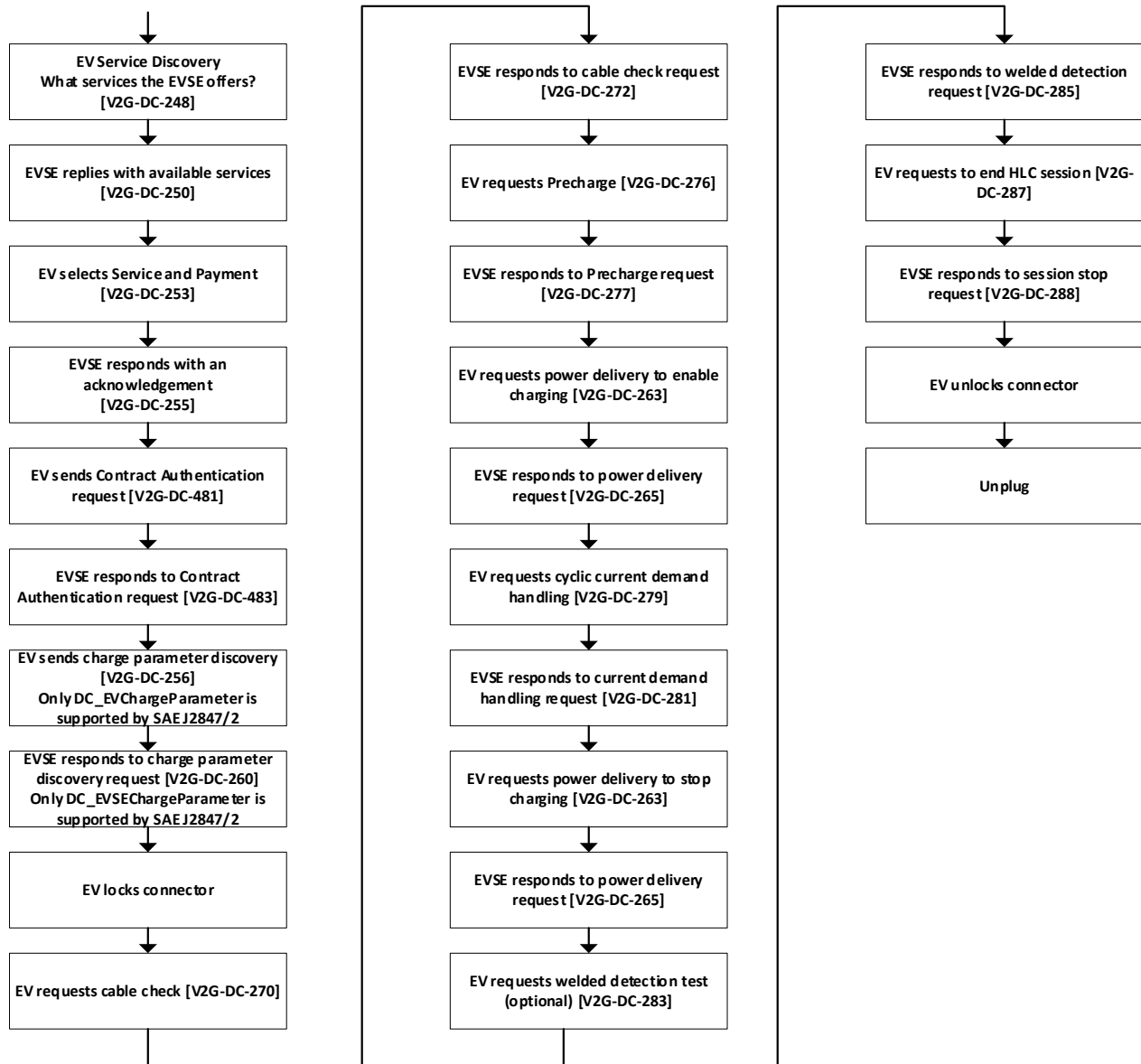


Figure 12. Session Flow for SAE J2847/2

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.

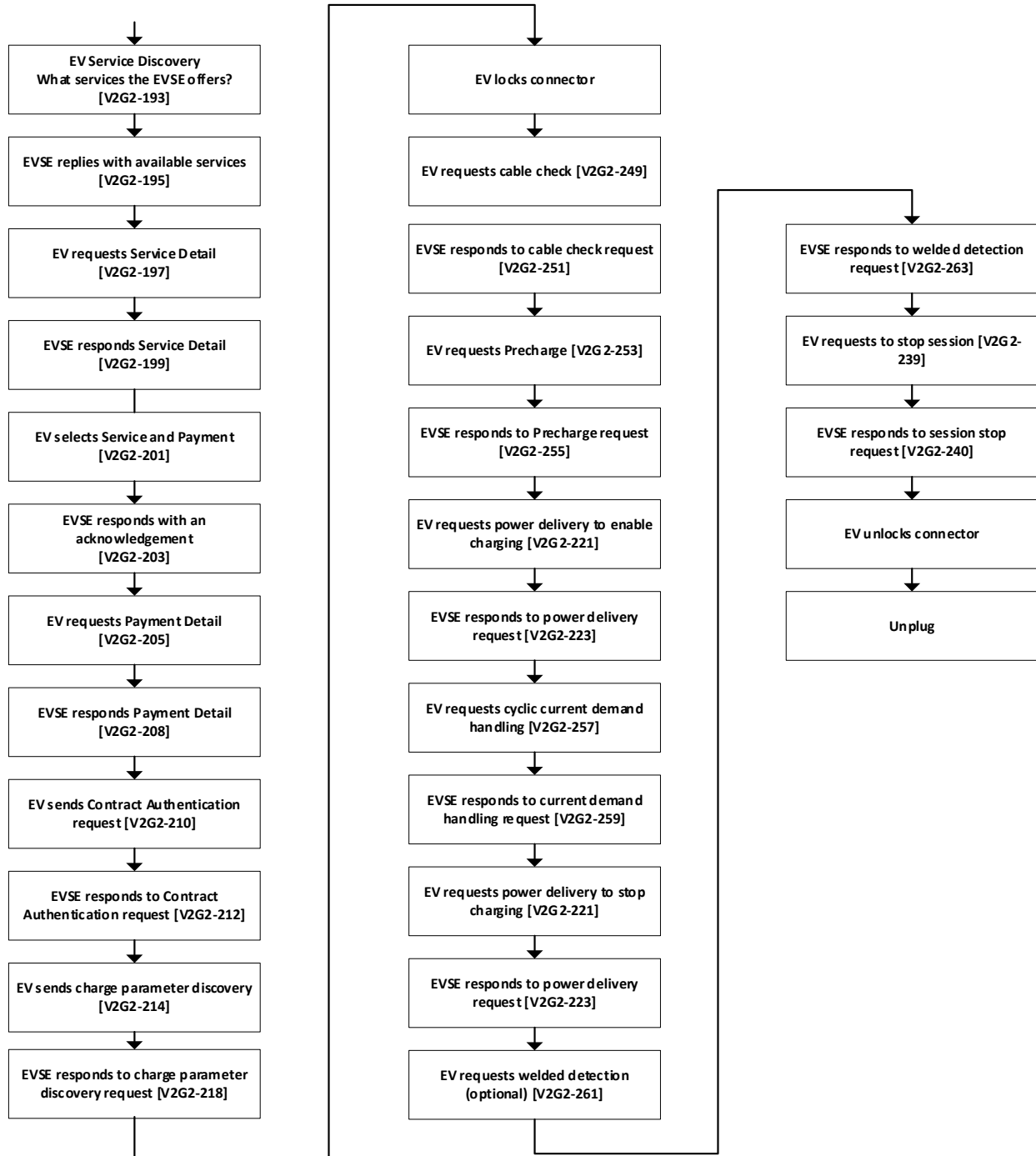


Figure 13. Session Flow for SAE ISO-15118-2

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.

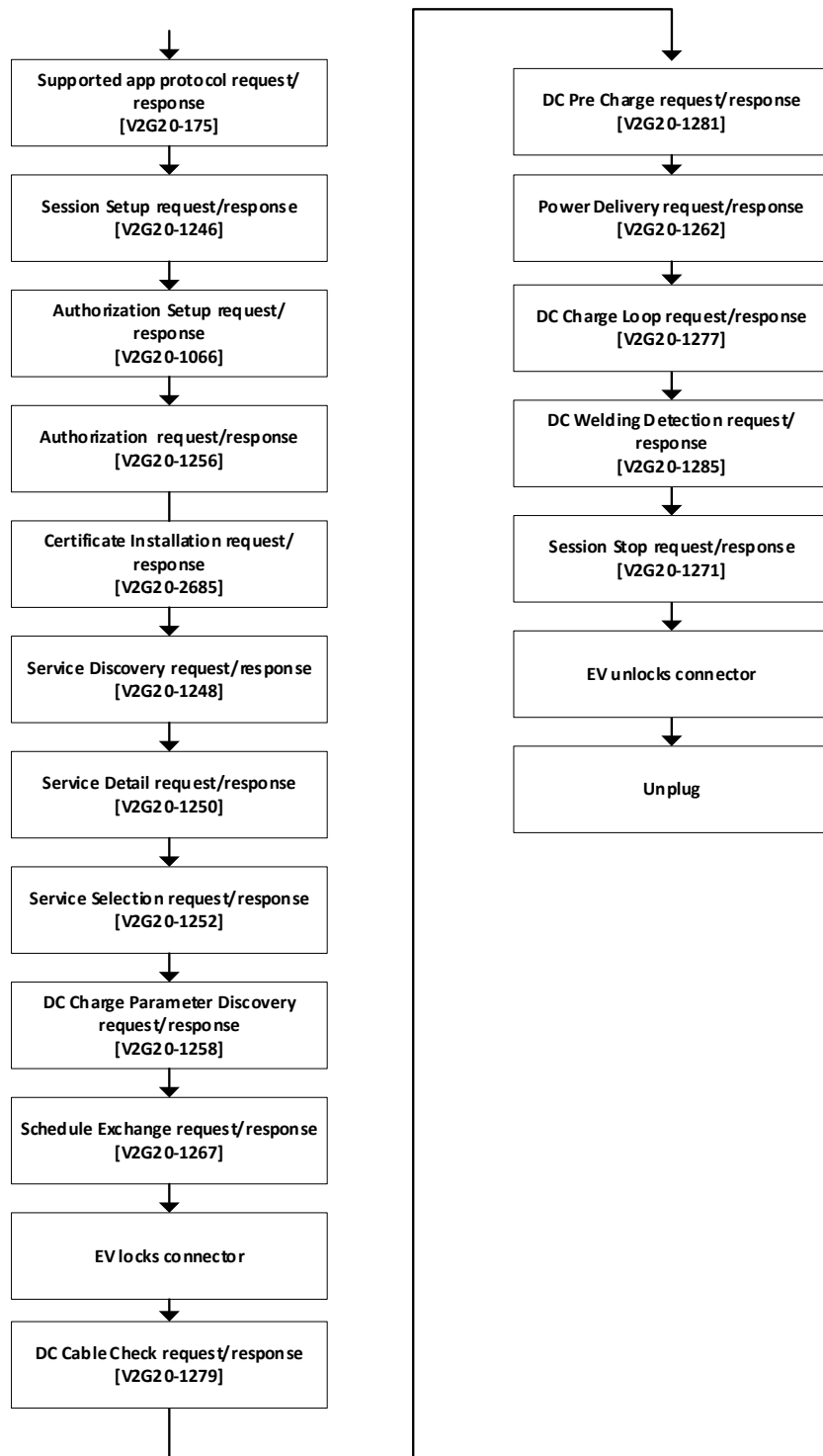


Figure 14. Session Flow for SAE ISO-15118-20

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 Wireshark¹⁰. 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 codec¹¹. Engineers at ChargePoint have created an open-source Wireshark plugin (wireshark-v2g¹²) that utilizes the OpenV2G codec to decode the EXI packets of an HLC session. The Everest project¹³ is an activity under the Linux Energy Foundation¹⁴ with the goal of becoming the open-source operating system for charge stations. The Everest repository logfiles¹⁵, 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™.

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™.

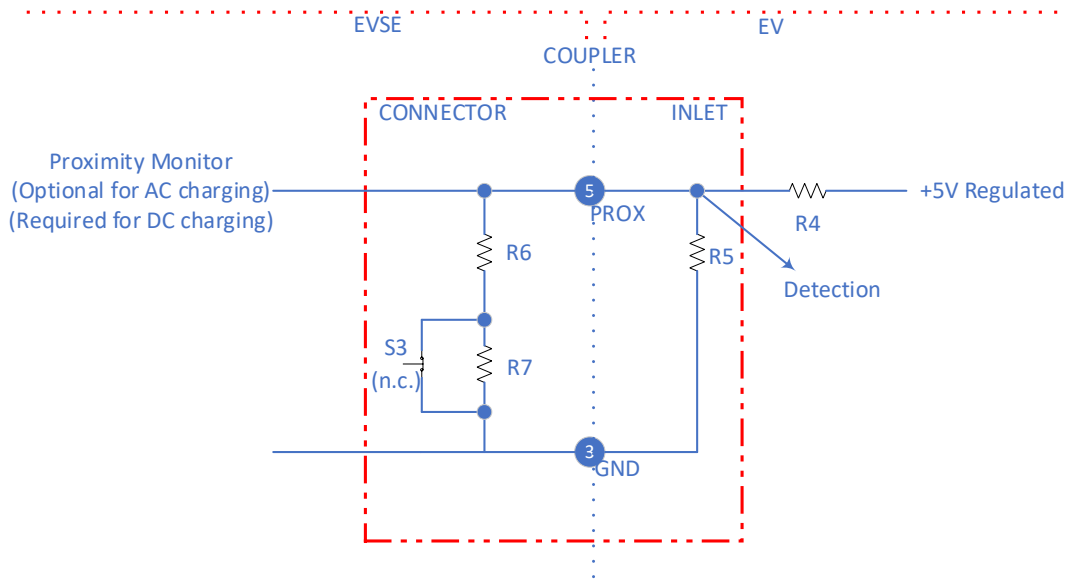


Figure 15. SAE J1772™ Proximity Circuit

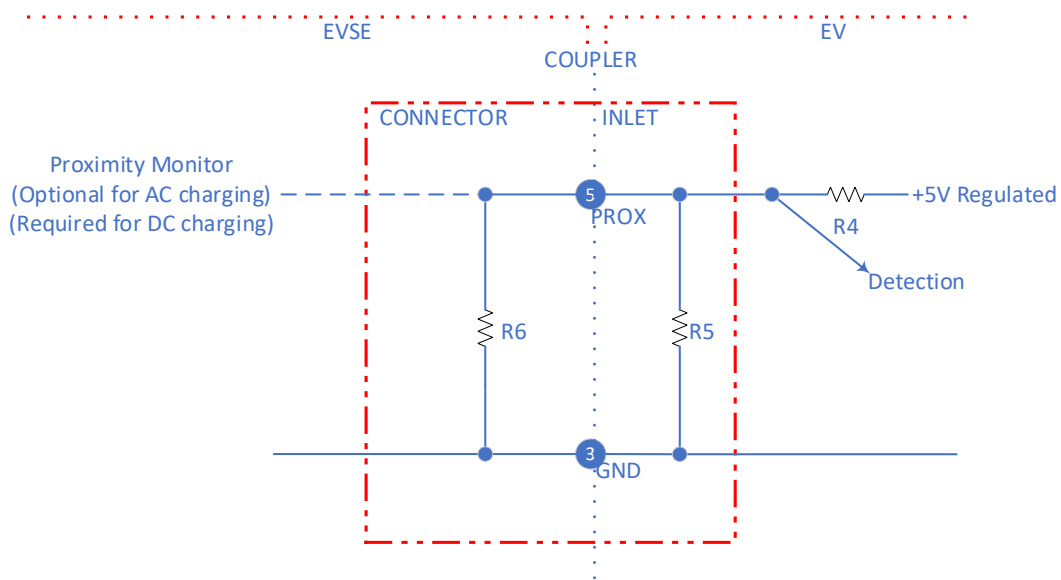


Figure 16. SAE J3400™ Proximity Circuit

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 reference 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 <i>Uniform provisions concerning the approval of vehicles with regard to specific requirements for the electric power train</i>	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 <i>Insulation coordination for equipment within low-voltage systems - ALL PARTS</i>	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 <i>Electric vehicle conductive charging system - Part 21-1 Electric vehicle on-board charger EMC requirements for conductive connection to AC/DC supply</i>	Use of this document is listed as “market dependent”
16	IEC 61851-21-2 <i>Electric vehicle requirements for conductive connection to an AC/DC supply - EMC requirements for off board electric vehicle charging systems</i>	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 <i>Electrically propelled road vehicles - Safety specifications - Part 3: Electrical safety</i>	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 <i>Standard for Plugs, Receptacles, and Couplers for Electric Vehicles</i>	Designer will need to be familiar with this document as it is the main product definition document for couplers
51	UL 2594 <i>Standard for Electric Vehicle Supply Equipment</i>	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
						<i>compliance with FCC Parts 15</i>
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 <i>requires compliance with requirements</i>
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 off 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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