



SURFACE VEHICLE TECHNICAL INFORMATION REPORT

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Electric Vehicle Charging Adapter Safety and OEM-Qualified Device Designation

RATIONALE

There is concern over safety and reliability of EV charging adapters on the market today that are not all of the same power delivery capability and construction quality. Complementing the UL 2252 testing criteria, more detail is needed to define adapter requirements, specifically on latch/lock and temperature limiting safety features. Vehicle manufacturers have liability concerns and desire a documented process for an OEM-qualified charging adapter. Standardization will pave the way for safer charging if adapters are used and exclude operations where they should not be used.

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Full document details: SAE J3400_1_202504

For more information on this standard, visit https://www.sae.org/standards/content/J3400/1_202504/

Documents



Standard, visit Sharing Hub

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1. SCOPE

This document covers the general physical, electrical, functional, and performance requirements for adapters connected to standards conforming conductive power transfer via handheld conductive coupler capable of transferring either DC or single-phase power using two current-carrying contacts. The focus is on defining the process to evaluate the suitability of adapters for NACS couplers. This edition only covers adapters used between SAE J3400 and SAE J1772.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1772 SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler

SAE J3068 Electric Vehicle Power Transfer System Using a Three-Phase Capable Coupler

SAE J3400 North American Charging System (NACS) for Electric Vehicles

USCAR-2 Performance Standard for Automotive Electrical Connector Systems

2.1.2 ANSI Accredited and UL Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

Available from UL, 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

ANSI/UL 2202 Standard for Electric Vehicle (EV) Charging System Equipment

ANSI/UL 2231-1 Personnel Protection Systems for Electric Vehicle Supply Circuits: General Requirements

ANSI/UL 2231-2 Personnel Protection Systems for Electric Vehicle Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems

ANSI/UL 2594 Electric Vehicle Supply Equipment

2.1.3 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at <https://www.ecfr.gov>.

47 CFR Part 15 Radio Frequency Devices

2.1.4 CSA Group Publications

Copies of these documents are available online at <https://www.csagroup.org/>.

CSA C22.1	Canadian Electrical Code Part 1, Section 86
CSA C22.2 NO. 280	Electric Vehicle Supply Equipment
CSA C22.2 NO. 281.1	Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements
CSA C22.2 NO. 281.2	Standard for Safety for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems
CSA C22.2 NO. 282	Plugs, Receptacles, and Couplers for Electric Vehicles
CSA C22.2 NO. 346	DC Charging Equipment for Electric Vehicles

2.1.5 DIN Publications

Copies of these documents are available online at <https://www.din.de/en/>.

DIN SPEC 70121	Electromobility - Digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging in the Combined Charging System
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2.1.6 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 61851-21-1	Electric vehicle conductive charging system - Part 21-1 Electric vehicle on-board charger EMC requirements for conductive connection to AC/DC supply
IEC 61851-21-2	Electric vehicle conductive charging system - Part 21-2: Electric vehicle requirements for conductive connection to an AC/DC supply - EMC requirements for off board electric vehicle charging systems
IEC 62196-1	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 1: General requirements

2.1.7 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 100 CD	Standards Dictionary: Glossary of Terms and Definitions
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2.1.8 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

- ISO 5474-1 Electrically propelled road vehicles - Functional requirements and safety requirements for power transfer - Part 1: General requirements for conductive power transfer
- ISO 5474-2 Electrically propelled road vehicles - Functional requirements and safety requirements for power transfer - Part 2: AC power transfer
- ISO 5474-3 Electrically propelled road vehicles - Functional requirements and safety requirements for power transfer - Part 3: DC power transfer
- ISO 6469-3 Electrically propelled road vehicles - Safety specifications - Part 3: Electrical safety
- ISO 15118-3 Road vehicles - Vehicle to grid communication interface - Part 3: Physical and data link layer requirements
- ISO 17409 Electrically propelled road vehicles - Conductive power transfer - Safety requirements

2.1.9 NFPA Publications

Available from National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471, Tel: 617-770-3000, www.nfpa.org.

- NFPA 70 National Electric Code

2.1.10 Normas Mexicanas

Available from Sistema Integral de Normas y Evaluación de la Conformidad (SINEC), Insurgentes Sur 1735, Col. Guadalupe Inn., Delegación Alvaro Obregón, México, D.F. C.P. 01020, Tel: (01)-(55)-2000-3000, www.gob.mx.

- NOM-001-SEDE Instalaciones Electricas (Utilización) Artículo 625
- NMX-J-668/1-ANCE Vehículos eléctricos (VE) - Sistemas de protección personal para circuitos de alimentación - Parte 1: Requisitos generales
- NMX-J-668/2-ANCE Vehículos eléctricos (VE) - Sistemas de protección personal para circuitos de alimentación - Parte 2: Requisitos particulares para dispositivos de protección para utilizarse en sistemas de carga
- NMX-J-677-ANCE Vehículos eléctricos - Equipos de alimentación (AC)
- NMX-J-678-ANCE Vehículos eléctricos - Clavijas, receptáculos y acopladores
- NMX-J-817-ANCE Vehículos eléctricos - Equipos de alimentación (DC)

2.1.11 UL Publications

Available from UL, 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

- UL 1741 Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources
- UL 2251 Plugs, Receptables, and Couplers for Electric Vehicles
- UL 2252 Outline of Investigation for Adapters for use with Electric Vehicle Coupler

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J551-5	Performance Levels and Methods of Measurement of Magnetic and Electric Field Strength from Electric Vehicles, 150 kHz to 30 MHz
SAE J1211	Handbook for Robustness Validation of Automotive Electrical/Electronic Modules
SAE J1715	Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology
SAE J1742	Connections for High Voltage On-Board Vehicle Electrical Wiring Harness - Test Methods and General Performance Requirements
SAE J1812	Function Performance Status Classification for EMC Immunity Testing
SAE J2012	Diagnostic Trouble Code Definitions
SAE J2344	Guidelines for Electric Vehicle Safety
SAE J2836-1	Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
SAE J2836-2	Use Cases for Communication Between Plug-in Vehicles and Off-Board DC Charger
SAE J2836/3	Use Cases for Plug-In Vehicle Communication as a Distributed Energy Resource
SAE J2836/4	Use Cases for Diagnostic Communication for Plug-in Electric Vehicles
SAE J2836/5	Use Cases for Customer Communication for Plug-in Electric Vehicles
SAE J2847-1	Communication for Smart Charging of Plug-in Electric Vehicles Using Smart Energy Profile 2.0
SAE J2847/2	Communication Between Plug-in Vehicles and Off-Board DC Chargers
SAE J2847/3	Communication for Plug-in Vehicle as a Distributed Energy Source
SAE J2847/5	Communication Between Plug-in Vehicles and Customers
SAE J2894-1	Power Quality Requirements for Plug-In Electric Vehicle Chargers
SAE J2894/2	Power Quality Test Procedures for Plug-In Electric Vehicle Chargers
SAE J2931/1	Digital Communications for Plug-in Electric Vehicles
SAE J2931/4	Broadband PLC Communication for Plug-in Electric Vehicles
SAE J2931/7	Security for Plug-In Electric Vehicle Communications

- SAE J2953/1 Plug-in Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)
- SAE J2953/2 Test Procedures for the Plug-in Electric Vehicle (PEV) Interoperability with Electric Vehicle Supply Equipment (EVSE)
- SAE J2953/3 Plug-in Electric Vehicle Communication Interoperability with Electric Vehicle Supply Equipment
- SAE J2953/4 Plug-In Electrical Vehicle Charge Rate Reporting and Test Procedures
- SAE J3072 Interconnection Requirements for Onboard, Grid Support Inverter Systems

2.2.2 ANSI Accredited and UL Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

Available from UL, 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

ANSI/UL 943 Ground-Fault Circuit-Interrupters

2.2.3 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at <https://www.ecfr.gov>.

16 CFR § 309.17 Labels

2.2.4 CSA Group Publications

Copies of these documents are available online at <https://www.csagroup.org/>.

CSA C22.2 NO. 0 General requirements - Canadian Electrical Code, Part II

2.2.5 DIN Publications

Copies of these documents are available online at <https://www.din.de/en/>.

DIN SPEC 70122 Electromobility - Conformance tests for digital communication between a d.c. EV charging station and an electric vehicle for control of d.c. charging in the Combined Charging System

2.2.6 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

CISPR 12 Vehicles, boats and internal combustion engines - Radio disturbance characteristics - Limits and methods of measurement for the protection of off-board receivers

CISPR 16-1-2 Specification for radio disturbance and immunity measuring apparatus and methods - Part 1-2: Radio disturbance and immunity measuring apparatus - Coupling devices for conducted disturbance measurements

IEC 60479-1 Effects of current on human beings and livestock - Part 1: General aspects

IEC 60479-2 Effects of current on human beings and livestock - Part 2: Special aspects

IEC 60529 Degrees of protection provided by enclosures (IP Code)

IEC 60664-1	Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests
IEC 61000-4-3	Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test
IEC 61032	Protection of persons and equipment by enclosures - Probes for verification
IEC 61140	Protection against electric shock - Common aspects for installation and equipment
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
IEC 61300-2-7	Fibre optic interconnecting devices and passive components - Basic test and measurement procedures - Part 2-7: Tests - Bending moment
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
IEC 61851-1	Electric vehicle conductive charging system - Part 1: General requirements
IEC 61851-23	Electric vehicle conductive charging system - Part 23: DC electric vehicle supply equipment
IEC 61851-24	Electric vehicle conductive charging system - Part 24: Digital communication between a DC EV charging station and an electric vehicle for control of DC charging
IEC 62196-2	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 2: Dimensional compatibility and interchangeability requirements for AC pin and contact-tube accessories
IEC 62196-3	Plugs, socket-outlets, vehicle connectors and vehicle inlets - Conductive charging of electric vehicles - Part 3: Dimensional compatibility and interchangeability requirements for DC and AC/DC pin and contact-tube vehicle couplers
IEC TS 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
IEC 62477-1	Safety requirements for power electronic converter systems and equipment - Part 1: General

2.2.7 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 1547	IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces
IEEE 2030.5	IEEE Standard for Smart Energy Profile Application Protocol

2.2.8 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

ISO 10303-21	Industrial automation systems and integration - Product data representation and exchange - Part 21: Implementation methods: Clear text encoding of the exchange structure
ISO 11451-2	Road vehicles - Vehicle test methods for electrical disturbances from narrowband radiated electromagnetic energy - Part 2: Off-vehicle radiation sources
ISO 15118-1	Road vehicles - Vehicle to grid communication interface - Part 1: General information and use-case definition
ISO 15118-2	Road vehicles - Vehicle-to-Grid Communication Interface - Part 2: Network and application protocol requirements
ISO 15118-4	Road vehicles - Vehicle to grid communication interface - Part 4: Network and application protocol conformance test
ISO 15118-5	Road vehicles - Vehicle to grid communication interface - Part 5: Physical layer and data link layer conformance test
ISO 15118-20	Road vehicles - Vehicle to grid communication interface - Part 20: 2nd generation network layer and application layer requirements
ISO 17987-1	Road vehicles - Local Interconnect Network (LIN) - Part 1: General information and use case definition
ISO 17987-2	Road vehicles - Local Interconnect Network (LIN) - Part 2: Transport protocol and network layer services
ISO 17987-3	Road vehicles - Local Interconnect Network (LIN) - Part 3: Protocol specification
ISO 17987-4	Road vehicles - Local Interconnect Network (LIN) - Part 4: Electrical physical layer (EPL) specification 12 V/24 V
ISO/TR 17987-5	Road vehicles - Local Interconnect Network (LIN) - Part 5: Application programmers interface (API)
ISO 17987-6	Road vehicles - Local Interconnect Network (LIN) - Part 6: Protocol conformance test specification
ISO 17987-7	Road vehicles - Local Interconnect Network (LIN) - Part 7: Electrical Physical Layer (EPL) conformance test specification
ISO 20653	Road vehicles - Degrees of protection (IP code) - Protection of electrical equipment against foreign objects, water and access
ISO 26262	Road vehicles - Functional safety

2.2.9 NEMA Publications

Available from National Electrical Manufacturers Association, 1300 North 17th Street, Suite 900, Arlington, VA 22209, Tel: 703-841-3200, www.nema.org.

ANSI C84.1	Electric Power Systems and Equipment - Voltage Ratings (60 Hz)
NEMA WD 6	Wiring Devices

2.2.10 UL Publications

Available from UL, 333 Pfingsten Road, Northbrook, IL 60062-2096, Tel: 847-272-8800, www.ul.com.

UL 50	Standard for Enclosures for Electrical Equipment
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 231	Power Outlets
UL 2263	Electric Vehicle Cable
UL 2278	Outline of Investigation for Megawatt Charging Configured Electric Vehicle Couplers

3. DEFINITIONS

3.1 ADAPTER

An auxiliary component which is designed to allow the safe coupling of a *connector* and *inlet* of disparate types. Disparate types include *connectors* and *inlets* that do not mechanically mate with one another. An *adapter* includes sections to accommodate each (SAE J1772/SAE J3400) *connector* and vehicle *inlet* type that is being mated with the *adapter*. These sections and functions are shown in [Figure 1](#).

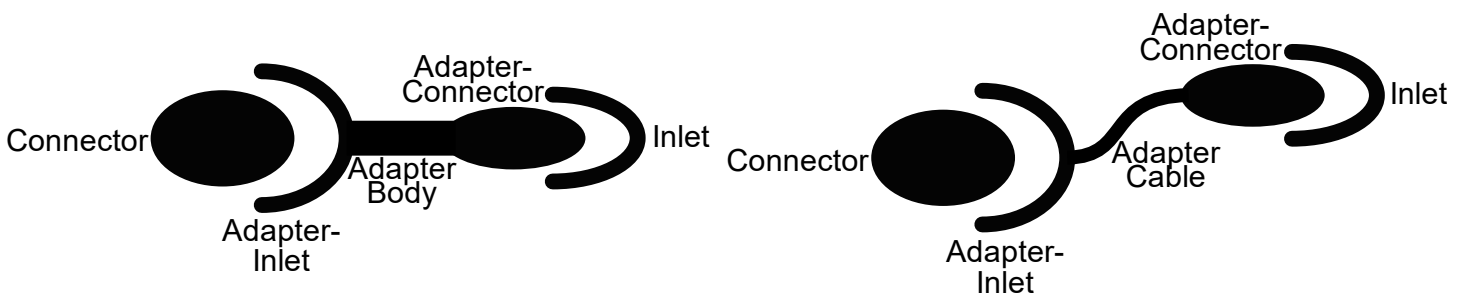


Figure 1 - Adapter parts; rigid adapter (left), non-rigid adapter (right)

3.2 ADAPTER-CONNECTOR

The portion of the *adapter* that mates with the vehicle *inlet*.

3.3 ADAPTER-INLET

The portion of the *adapter* that mates with the vehicle *connector*.

3.4 ADAPTER, CAPTIVE

An *adapter* which is distributed as part of an *EVSE* and is not intended to be removable from the *connector* by the user. A *captive adapter* is retained as part of the *EVSE* system, with selectable mode operation by the *EVSE* controls such that the user cannot manually remove the *adapter* from the *EVSE* or charging *connector*.

NOTE: *Captive adapters* are a separate class of device that are tied to the requirements of the known and defined ratings of the *EVSE* that it is permanently associated.

3.5 CABLE ASSEMBLY, EV

A portable *cable assembly* consisting of a length of *EV* cable, a vehicle *connector* on one end, and a *universal AC plug* (only as defined in [3.30](#)) on the other.