

Peter Claeson, + 46 8 55 55 21 21  
peter.claeson@sis.se

## Electric and hybrid road vehicles – Related standards and drafts

Below is a condensed report about published standards and the status of drafts under development. Global standards within the area are developed by ISO and IEC, and European standards by CEN and CENELEC. The area of responsibility is roughly that ISO deals with the vehicle related items, while IEC deals with all other items. Work on charging of electric vehicles is done in cooperation between ISO and IEC according to a special agreement.

### Global standardisation (ISO and IEC)

#### ISO/TC 22/SC 21 Electrically propelled vehicles (secr: Germany)

**WG 1:** Vehicle operation conditions, vehicle safety and energy storage installation

**WG 2:** Definitions and methods of measurement of vehicle performance and of energy consumption

**WG 3:** Lithium Ion traction batteries

#### ISO standards and drafts\*, including joint ISO/IEC work:

<a href="#">ISO 6469-1:2009, ed.2</a>	Electrically propelled road vehicles – Safety specifications – Part 1: On-board rechargeable energy storage system (RESS)
<a href="#">ISO 6469-2:2009, ed.2</a>	Electrically propelled road vehicles – Safety specifications – Part 2: Vehicle operational safety means and protection against failures
<a href="#">ISO 6469-3:2011, ed.2</a>	Electrically propelled road vehicles – Safety specifications – Part 3: Protection of persons against electric hazards
<a href="#">ISO/DIS 6469-4*</a>	Electrically propelled road vehicles – Safety specifications – Part 4: Post crash electrical safety requirements
<a href="#">ISO/TR 8713</a>	Electric road vehicles – Vocabulary
<a href="#">ISO 8714:2002</a>	Electric road vehicles – Reference energy consumption and range – Test procedures for passenger cars and light commercial vehicles
<a href="#">ISO 8715:2001</a>	Electric road vehicles – Road operating characteristics
<a href="#">ISO/TR 11954:2008</a>	Fuel cell road vehicles – Maximum speed measurement
<a href="#">ISO/TR 11955:2008</a>	Hybrid-electric road vehicles - Guidelines for charge balance measurement
<a href="#">ISO 12405-1:2011</a>	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 1: High power applications
<a href="#">ISO 12405-2:2012</a>	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 1: High energy applications
<a href="#">ISO/DIS 12405-3*</a>	Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 3: Safety performance requirements
<a href="#">ISO/IEC 15118-1:2013</a>	Road vehicles – Vehicle to grid communication interface – Part 1: General information and use-case definition
<a href="#">ISO/IEC FDIS 15118-2*</a>	Road vehicles – Vehicle to grid communication interface – Part 2: Technical protocol description and Open Systems Interconnections (OSI) layer requirements
<a href="#">ISO/IEC DIS 15118-3*</a>	Road vehicles – Vehicle to grid Communication Interface – Part 3: Physical and data link layer requirements
<a href="#">ISO/IEC NP 15118-4*</a> New project, awaiting first WD	Road vehicles – Vehicle to grid communication interface – Part 4: Network and

2013-10-17

	application protocol conformance test
<a href="#">ISO/IEC NP 15118-5*</a> New project, awaiting first WD	Road vehicles – Vehicle to grid communication interface – Part 5: Physical layer and data link layer conformance test
<a href="#">ISO/IEC NP 15118-6*</a> New project, awaiting first WD	Road vehicles – Vehicle to grid communication interface – Part 6: General information and use-case definition for wireless communication
<a href="#">ISO/IEC NP 15118-7*</a> New project, awaiting first WD	Road vehicles – Vehicle to grid communication interface – Part 7: Network and application protocol requirements for wireless communication
<a href="#">ISO/IEC NP 15118-8*</a> New project, awaiting first WD	Road vehicles – Vehicle to grid communication interface – Part 8: Physical layer and data link layer requirements for wireless communication
<a href="#">ISO/IEC PAS 16898:2012</a>	Electrically propelled road vehicles – Dimensions and designation of secondary lithium-ion cells
<a href="#">ISO/DIS 17409*</a>	Electrically propelled road vehicles – Connection to an external electric power supply – Safety requirements
<a href="#">ISO/NP 18300*</a>	Electrically propelled road vehicles – Specifications for lithium-ion cell and battery coupled with other types of battery and capacitor
<a href="#">ISO/AWI PAS 19295*</a>	Electrically propelled road vehicles – Specification of voltage sub-classes for voltage class B
<a href="#">ISO/NP 19363*</a> New Project proposal	Electrically propelled road vehicles – Inductive wireless connection to an external electric power supply – Interoperability and Safety requirements
<a href="#">ISO/NP 19453*</a> New Project proposal	Environmental conditions and testing for electrical and electronic equipment for drive system of electric propulsion vehicles
<a href="#">ISO 23273:2013</a>	Fuel cell road vehicles – Safety specifications – Protection against hydrogen hazards for vehicles fuelled with compressed hydrogen
<a href="#">ISO 23274-1:2013</a>	Hybrid-electric road vehicles – Exhaust emissions and fuel consumption measurements – Part 1: Non-externally chargeable vehicles
<a href="#">ISO 23274-2:2012</a>	Hybrid-electric road vehicles – Exhaust emissions and fuel consumption measurements – Part 2: Externally chargeable vehicles
<a href="#">ISO 23828:2008</a>	Fuel cell road vehicles – Energy consumption measurement – Part 1: Vehicles fuelled with compressed hydrogen
<a href="#">ISO/DIS 23828*</a> Draft under development (ed. 2)	Fuel cell road vehicles – Energy consumption measurement – Part 1: Vehicles fuelled with compressed hydrogen
<a href="#">ISO/IEC CD 62752*</a>	In-cable control and protective device for mode 2 charging of electric road vehicles (IC-RCD)

## IEC/TC 69 Electric road vehicles and electric industrial trucks (secr: France)

### Active Working Groups :

**WG 2:** Motors and motor controllers

**WG 4:** Power supplies and chargers

### IEC standards and drafts\*, incl. TC 21 (batteries) and SC 23H (connectors):

<a href="#">IEC 61851-1:2010, 2<sup>nd</sup> ed.</a> <a href="#">Status of revision*</a>	Electric vehicle conductive charging system – Part 1: General requirements
<a href="#">IEC 61851-21:2001</a> <a href="#">Status of revision*</a>	Electric vehicle conductive charging system – Part 21: Electric vehicle requirements for conductive connection to an a.c./d.c. supply
<a href="#">IEC 61851-21-1*</a>	Electric vehicle conductive charging system – Part 21-1: Electric vehicle onboard charger EMC requirements for conductive connection to a.c./d.c. supply
<a href="#">IEC 61851-21-2*</a>	Electric vehicle conductive charging system – Part 21-2: EMC requirements for OFF board electric vehicle charging systems
<a href="#">IEC 61851-22:2001</a> <a href="#">Status of revision*</a>	Electric vehicle conductive charging system – Part 22: AC electric vehicle charging station

2013-10-17

<a href="#">IEC 61851-23*</a>	Electric vehicle conductive charging system – Part 23: DC electric vehicle charging station
<a href="#">IEC 61851-24*</a>	Electric vehicles conductive charging system – Part 24: Digital communication between a dc EV charging station and an electric vehicle for control of d.c. charging
<a href="#">IEC 61980-1*</a>	Electric vehicle wireless power transfer systems (WPT) - Part 1: General requirements
<a href="#">IEC 61980-2*</a>	Electric equipment for the supply of energy to electric road vehicles using an inductive coupling - Part 2: Manual connection system using a paddle
<a href="#">IEC 61980-3*</a>	Electric vehicle wireless power transfer (WPT) systems - Part 3: Specific requirements for the magnetic field power transfer systems
<a href="#">IEC 61981*</a>	On board electric power equipment for electric road vehicles
<a href="#">IEC 61982:2012</a>	Secondary batteries (except lithium) for the propulsion of electric road vehicles – Performance and endurance tests
<a href="#">IEC 62196-1:2011</a> <a href="#">Status of revision*</a>	Plugs, socket-outlets, vehicle couplers and vehicle inlets - Conductive charging of electric vehicles - Part 1: Charging of electric vehicles up to 250 A a.c. and 400 A d.c.
<a href="#">IEC 62196-2:2011</a> <a href="#">Status of revision*</a>	Plugs, socket-outlets and vehicle couplers – Conductive charging of electricity vehicles – Part 2: Dimensional interchangeability requirements for a.c. pin and contact-tube accessories
<a href="#">IEC 62196-3*</a>	Plugs, socket-outlets, and vehicle couplers - Conductive charging of electric vehicles - Part 3: Dimensional compatibility and interchangeability requirements for dedicated d.c. and combined a.c./d.c. pin and contact-tube vehicle couplers
<a href="#">PNW 23H-298</a> Preliminary work item	Plugs, socket-outlets, and vehicle couplers - conductive charging of electric vehicles - Part 4: Dimensional compatibility and interchangeability requirements for a.c., d.c. and a.c. /d.c. vehicle couplers for Class II or Class III light electric vehicles (LEV)
<a href="#">IEC 62576*</a>	Electric double-layer capacitors for use in hybrid electric vehicles - Test methods for electrical characteristics
<a href="#">IEC PNW 69-243*</a> Preliminary work item	Electric Double-Layer Capacitors for automotive applications - Test Methods for Electrical Characteristics, Life-Time and Durability, Environmental Performance and Safety
<a href="#">IEC 62831*</a>	User identification in Electric vehicle Service Equipment using a smartcard
<a href="#">IEC 62840*</a>	Electric vehicle battery exchange infrastructure safety requirements
<a href="#">IEC PNW 69-260*</a> Preliminary work item	Electric vehicle battery swap system - Part 1: System description and general requirements
<a href="#">IEC/TR 60783</a>	Wiring and connectors for electric road vehicles
<a href="#">IEC/TR 60784</a>	Instrumentation for electric road vehicles
<a href="#">IEC/TR 60785</a>	Rotating machines for electric road vehicles
<a href="#">IEC/TR 60786</a>	Controllers for electric road vehicles
<a href="#">IEC 62576:2009</a>	Electric double-layer capacitors for use in hybrid electric vehicles - Test methods for electrical characteristics
<a href="#">IEC 62660-1:2010</a>	Secondary batteries for the propulsion of electric road vehicles - Performance testing for lithium-ion cells and batteries
<a href="#">IEC 62660-2:2010</a>	Secondary batteries for the propulsion of electric road vehicles - Reliability and abuse testing for lithium-ion cells

## European standardisation (EN)

The European standards below are published. Most of these are ISO or IEC standards adopted as EN:s.

New activities started in spring 2010 to review the needs of additional European standards as a response to European market needs and the EC Directive and Mandate, in the field of electric vehicles and charging infrastructure. CEN, CENELEC and ETSI are involved.

2013-10-17

**EN standards (CEN):**

<a href="#">EN 12736:2001</a>	Electrically propelled road vehicles - Airborne acoustical noise of vehicle during charging with on-board chargers - Determination of sound power level
<a href="#">EN 13444-1:2001</a>	Electrically propelled road vehicles - Measurement of emissions of hybrid vehicles - Part 1: Thermal electric hybrid vehicles
<a href="#">EN 13447:2001</a>	Electrically propelled road vehicles - Terminology
<a href="#">EN 1821-1:1996</a>	Electrically propelled road vehicles - Measurement of road operating ability - Part 1: Pure electric vehicles
<a href="#">EN 1821-2:1999</a>	Electrically propelled road vehicles - Measurement of road operating ability - Part 2: Thermal electric hybrid vehicles
<a href="#">EN 1986-1:1997</a>	Electrically propelled road vehicles - Measurement of energy performances - Part 1: Pure electric vehicles
<a href="#">EN 1986-2:2001</a>	Electrically propelled road vehicles - Measurement of energy performances - Part 2: Thermal electric hybrid vehicles
<a href="#">EN 1987-1:1997</a>	Electrically propelled road vehicles - Specific requirements for safety - Part 1: On board energy storage
<a href="#">EN 1987-2:1997</a>	Electrically propelled road vehicles - Specific requirements for safety - Part 2: Functional safety means and protection against failures
<a href="#">EN 1987-3:1998</a>	Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards

**EN standards (CENELEC):**

<a href="#">EN 61851-1:2001</a> <a href="#">EN 61851-1:2011</a>	Electric vehicle conductive charging system - Part 1: General requirements	<a href="#">2006/95/EC*</a>
<a href="#">EN 61851-21:2002</a>	Electric vehicle conductive charging system - Part 21: Electric vehicle requirements for conductive connection to an a.c/d.c. supply	<a href="#">2006/95/EC*</a>
<a href="#">EN 61851-22:2002</a>	Electric vehicle conductive charging system - Part 22: AC electric vehicle charging station	<a href="#">2006/95/EC<sup>1</sup></a>
<a href="#">CLC/TS 50457-1:2008</a>	Conductive charging for electric vehicles - Part 1: D.C. charging station	
<a href="#">CLC/TS 50457-2:2008</a>	Conductive charging for electric vehicles - Part 2: Communication protocol between off-board charger and electric vehicle	

**SAE standards and drafts**

Updated, but may not be fully complete

\*: under revision

**Hybrid EV Committee, Fuel cell standards Committee etc**

Document	Title
<a href="#">J1654:2012</a>	High Voltage Primary Cable
<a href="#">J1673:2012</a>	High Voltage Automotive Wiring Assembly Design
<a href="#">J1711:2010</a>	Recommended Practice for Measuring the Exhaust Emissions and Fuel Economy of Hybrid-Electric Vehicles
<a href="#">J1715:2008</a>	Hybrid Electric Vehicle (HEV) & Electric Vehicle (EV) Terminology
<a href="#">J1742:2010</a>	Connections for High Voltage On-Board Road Vehicle Electrical Wiring
<a href="#">J1766:2005</a>	Recommended Practice for Electric and Hybrid Electric Vehicle Battery Systems Crash Integrity Testing

<sup>1</sup> Quoted in LVD, Low Voltage Directive

2013-10-17

<a href="#">J1772:2012</a>	SAE Electric Vehicle Conductive Charge Coupler
<a href="#">J1773:2009</a>	SAE Electric Vehicle Inductively Coupled Charging
<a href="#">J2183:2012</a>	60 V and 600 V Single Core Cables – Test Methods, Dimensions and Requirements (= ISO 6722)
<a href="#">J2289:2008</a>	Electric Driver Battery Pack System: Functional Guidelines
<a href="#">J2344:2010</a>	Guidelines for Electric Vehicle Safety
<a href="#">J2464:2009</a>	Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing
<a href="#">J2501:2012</a>	Round, Screened and Unscreened, 60 V and 600 V Multicore Sheathed Cables – Basic and High Performance Test Methods and Requirements (= ISO 14572)
<a href="#">J2578:2009</a>	Recommended Practice for General Fuel Cell Vehicle Safety
<a href="#">J2698:2008</a>	Primary Single Phase Nominal 120 VAC Wiring Distribution Assembly Design - Truck and Bus
<a href="#">J2836/1:2010</a>	Use Cases for Communication between Plug-in Vehicles and the Utility Grid
<a href="#">J2836/2:2011</a>	Use Cases for Communication between Plug-in Vehicles and Off-Board DC Charger
<a href="#">J2836/3:2013</a>	PEV Communicating as a Distributed Energy Resource
<a href="#">J2836/4*</a>	Use Cases for Diagnostic Communication for Plug-in Vehicles
<a href="#">J2836/5*</a>	Use Cases for Communication between Plug-in Vehicles and their customers
<a href="#">J2836/6</a>	Use Cases for Wireless Charging Communication for Plug-in Electric Vehicles
<a href="#">J2841:2010</a>	Utility Factor Definition for Plug-In Hybrid Electric Vehicles Using Travel Survey Data
<a href="#">J2847/1:2011</a>	Communication between Plug-in Vehicles and the Utility Grid
<a href="#">J2847/2:2012</a>	Communication between Plug-in Vehicles and Off-Board DC Chargers
<a href="#">J2847/3*</a>	Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow
<a href="#">J2929:2013</a>	Electric and Hybrid Vehicle Propulsion Battery System Safety Standard - Lithium-based Rechargeable Cells

## UL Safety Standards (Underwriters Laboratories)

Updated, but may not be fully complete.

Document	Title
<a href="#">UL 1564:2007</a>	Industrial battery chargers
<a href="#">UL1642:2012</a>	Safety of Lithium-Ion Batteries – Testing
<a href="#">UL 2202:2009</a>	Electric Vehicle (EV) Charging System Equipment
<a href="#">UL 2231-1:2012</a>	Personnel Protection Systems for EV Supply Circuits: Part 1: General Requirements
<a href="#">UL 2231-2:2012</a>	Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems
<a href="#">UL 2251:2013</a>	Plugs, Receptacles and Couplers for Electric Vehicles
<a href="#">UL 2580:2011</a>	Batteries for use in Electric Vehicles
<a href="#">UL 2594:2013</a>	Electric Vehicle Supply Circuit