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Electrically propelled road vehicles — Magnetic field wireless power transfer — Safety and interoperability requirements

Véhicules routiers électriques — Transmission d'énergie sans fil par champ magnétique — Exigences de sécurité et d'interopérabilité

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, SC 37, *Electrically propelled vehicles*.

This first edition cancels and replaces ISO/PAS 19363:2017, which has been technically revised. The main changes compared to the previous edition are as follows:

— MF-WPT classes and z- classes eliminated;

— compatibility classes introduced;

— reference devices changed to off-board devices and description updated;

— communication and functional requirements deleted.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document prescribes the usage of the wireless power transfer technology to charge electrically propelled road vehicles and has been developed based on ISO/PAS 19363.

Status of technological development:

This document specifies requirements for on-board components of a wireless power transfer systems. It gives guidance in terms of safety and performance and additionally addresses interoperability to off-board components from different manufacturers to, for example support the development of public wireless charging infrastructure. Even if the technology itself is well known, the implementation in a vehicle is new and demands to meet the very specific requirements of the automotive industry. This document is based on limited experience with series development and production. Current and future product developments will continuously prove (and disprove) the applicability of this document to further improve the contents, especially regarding the interoperability between systems from different manufacturers.

Cooperation during document development:

This document has been developed in intense cooperation with IEC/TC 69 WG7, which is establishing the IEC 61980 series. The IEC 61980 series covers the requirements for the off-board components in correspondence to the application of on-board components according to this document. Furthermore, SAE J2954 is standardising wireless power transfer systems in the United States of America. An exchange between the groups was continuously sustained during the document development. Even though there is no complete harmonization at this stage, several contents are comparable.

Electrically propelled road vehicles — Magnetic field wireless power transfer — Safety and interoperability requirements

1 Scope

This document defines the requirements and operation of the on-board vehicle equipment that enables magnetic field wireless power transfer (MF-WPT) for traction battery charging of electric vehicles. It is intended to be used for passenger cars and light duty vehicles.

This document addresses the following aspects for an EV device:

— safety requirements;

— transferred power and power transfer efficiency;

— ground clearance of the EV device;

— functionality with associated off-board systems under various conditions and independent of manufacturer;

— test procedures.

EV devices that fulfil the requirements in this document are intended to operate with supply devices that fulfil the MF-WPT related requirements in the IEC 61980 series.

NOTE 1 Charging of a vehicle in motion is not considered in this edition.

NOTE 2 Bi-directional power transfer is not considered in this edition.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 6469-3:2018, *Electrically propelled road vehicles — Safety specifications — Part 3: Electrical safety*

ISO 20653, *Road vehicles — Degrees of protection (IP code) — Protection of electrical equipment against foreign objects, water and access*

IEC 61980-2, *Electric vehicle wireless power transfer (WPT) Systems — Part 2: specific requirements for communication between electric road vehicle (EV) and infrastructure with respect to wireless power transfer (WPT) systems*

IEC 61980-3, *Electric vehicle wireless power transfer (WPT) systems — Part 3: Specific requirements for the magnetic field power transfer systems*

ICNIRP 2010, *Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz – 100 kHz)*

CISPR 11, *Industrial, scientific and medical equipment — Radio-frequency disturbance characteristics — Limits and methods of measurement*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
alignment
relative position in x- and y-direction of the *secondary device* (3.15) to the *primary device* (3.9) for a given *secondary device ground clearance* (3.16)

Note 1 to entry: The coordinate system conforms with ISO 4130.

3.2
alignment tolerance area
intended *WPT* (3.22) operating area in x- and y-direction for a given *secondary device ground clearance* (3.16)

3.3
centre alignment point
geometrical centre of the *alignment tolerance area* (3.2)

Note 1 to entry: The position of the centre alignment point of an *MF-WPT system* (3.8) depends on the specific centre alignment points of the *primary device* (3.9) and *secondary device* (3.15).

3.4
electrically propelled vehicle
EV
vehicle with one or more electric drive(s) for vehicle propulsion

[SOURCE: ISO 6469-3:2018, 3.15, modified — The abbreviation "EV" has been added.]

3.5
EV device
on-board component assembly of *WPT system* (3.23)

Note 1 to entry: See Figure 1.

3.6
EV power circuit
EVPC
on-board component assembly, comprising the *secondary device* (3.15) and *EV power electronics* (3.7), as well as the electrical and mechanical connections

Note 1 to entry: See Figure 1.

3.7
EV power electronics
on-board component that converts the power and frequency from the *secondary device* (3.15) to the DC power output of the *EVPC* (3.6)

Note 1 to entry: See Figure 1.

3.8
magnetic field WPT system
MF-WPT system
WPT system (3.23) using magnetic field

3.9
primary device
off-board component that generates and shapes the magnetic field for *WPT* (3.22)

Note 1 to entry: See Figure 1.

3.10
protection area
volume in and around the vehicle that has uniform requirements with regard to effects of exposure to electromagnetic fields

3.11
rated output power
maximum power the *EVPC* (3.6) is designed to deliver consistently during a charging cycle

3.12
rechargeable energy storage system
RESS
rechargeable system that stores energy for delivery of electric energy for the electric drive

EXAMPLE Battery, capacitor, flywheel.

[SOURCE: ISO 6469-1:2019, 3.22]

3.13
reference EVPC
EVPC (3.6) that serves for testing purposes

3.14
reference supply power circuit
supply power circuit (3.19) that serves for testing purposes

3.15
secondary device
on-board component that captures the magnetic field

Note 1 to entry: See Figure 1.

3.16
secondary device ground clearance
vertical distance between the ground surface and the lowest point of the *secondary device* (3.15) including the housing

Note 1 to entry: Note to entry: The lower surface does not need to be planar or parallel to the ground surface

3.17
steady state
state of a system at which all state and output variables remain constant in time while all input variables are constant

[SOURCE: IEC 60050-351:2006, 351-24-09]

3.18
supply device
off-board component assembly of *WPT system* (3.23)

Note 1 to entry: See Figure 1.

3.19
supply power circuit
off-board component assembly, comprising the *primary device* (3.9) and *supply power electronics* (3.20), as well as the electrical and mechanical connections

Note 1 to entry: See Figure 1.

3.20
supply power electronics
off-board component that converts the power and frequency from the supply network to the power and frequency needed by the *primary device* (3.9)

Note 1 to entry: See Figure 1.

3.21
voltage class B
classification of an electric component or circuit with a maximum working voltage of (>30 and ≤1 000) V AC (rms) or (>60 and ≤1 500) V DC, respectively

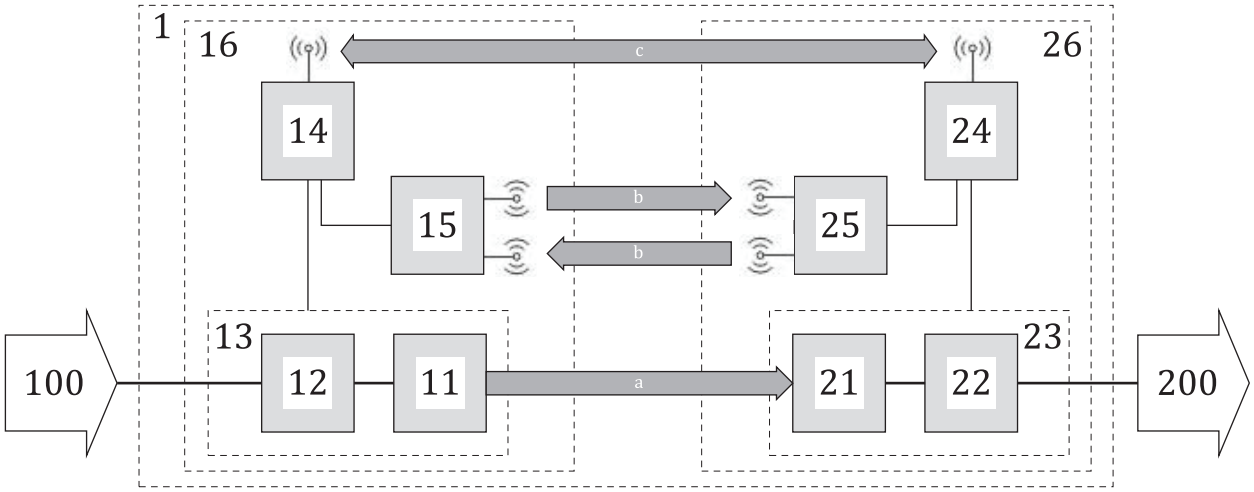
3.22
wireless power transfer
WPT
transfer of electrical energy from a power source to an electrical load without galvanic connection

3.23
WPT system
system comprising all necessary components for *WPT* (3.22) and control

4 System structure

To establish a general baseline for the requirements defined in this document, in IEC 61980-2 and in IEC 61980-3, the MF-WPT system is structured into functional entities. Figure 1 shows this structure of functional entities in an exemplary architecture.

NOTE Figure 1 is not meant to give an indication on hardware packaging.



Key

1	MF-WPT system		
11	primary device	21	secondary device
12	supply power electronics	22	EV power electronics
13	supply power circuit	23	EV power circuit
14	supply equipment communication controller (SECC)	24	EV communication controller (EVCC)
15	supply device P2PS controller	25	EV device P2PS controller
16	supply device	26	EV device
100	supply network	200	RESS

NOTE The functional elements 14, 15, 24, and 25 are addressed in IEC 61980-2.

a Wireless power flow.

b Wireless P2PS interface.

c Wireless communication interface.

Figure 1 — Example of system structure

5 Requirements regarding environmental conditions

Components of the EV device installed at the underbody of the EV shall have IP degree IP6K7 and IP6K9K according to ISO 20653.

The environmental requirements applicable to a particular EV device shall be identified and agreed between the vehicle manufacturer and the supplier. The EV device shall withstand and retain its degree of protection under the typical mechanical loads and stresses the EV device is subjected to in its intended mounting position.

NOTE ISO 16750 (all parts) and ISO 21498 (all parts) contain information for guidance.

6 Classification

This document specifies requirements that address the following aspects of MF-WPT systems:

— system safety (Clause 10),

— system performance (Clause 7), and

— interoperability.

Requirements regarding system safety and system performance are relevant and applicable for safe operation of any MF-WPT system (including dedicated single-supplier solutions) while still assuring some base level of performance.

The interoperability requirements supplement the safety and performance requirements in order to allow for interoperability of a supply device and an EV device provided by independent suppliers.

Two compatibility classes have been specified to accommodate these design considerations:

— Compatibility class A: EV devices of this class are intended for interoperable application and are required to meet a set of safety and performance requirements. Cross-supplier interoperability is tested with the normative reference supply power circuits as specified in this document.

— Compatibility class B: EV devices of this class are not intended for interoperable application but still are required to meet the set of safety requirements; performance requirements may be different than those of compatibility class A. EV devices of this class are tested with supplier-specified supply power circuits.

7 MF-WPT power transfer requirements

7.1 General

Unless otherwise specified the requirements in Clause 7 refer to EVPCs of both compatibility classes.

Conformance to the requirements in 7.2 to 7.6 is tested according to 7.7, whereas EVPCs of compatibility class A are tested with the normative reference supply power circuits described in Annexes A and B, and EVPCs of compatibility class B are tested with supplier specific supply power circuits.

The supplier shall specify the rated conditions of an EVPC according to Table 1.

Table 1 — EPVC rated conditions

Specifications of EVPC		Compatibility class A	Compatibility class B
Frequency range		Operation within 79 – 90 kHz	
Secondary device ground clearance range		EVPC specific within 100 mm – 250 mm	EVPC specific
Alignment tolerance area	x-direction	±75 mm	EVPC specific
	y-direction	±100 mm	EVPC specific
Centre alignment point(s)		EVPC specific	
Output voltage range		EVPC specific within voltage classes A and B according to ISO 6469-3.	
Rated output power		EVPC specific up to 11,1 kW	EVPC specific

NOTE 1 Typically, the output voltage range of the EVPC is aligned with the voltage range of the RESS.

NOTE 2 7.3 gives additional information for the determination of centre alignment point(s).

7.2 Frequency

MF-WPT for EVs is allowed to operate in the frequency range of 79 - 90 kHz. The operating frequency during power transfer is set by the supply device based on negotiations with the EV device.

7.3 Geometrical operating space

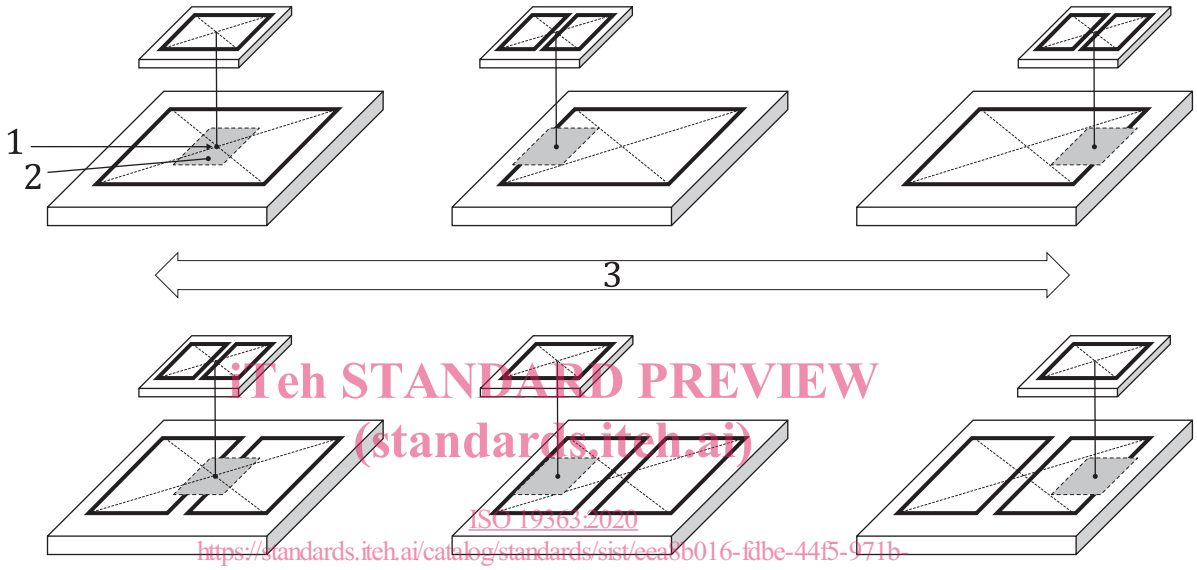
An EVPC shall meet the requirements of 7.4 and 7.5 within its geometrical operating space defined by its secondary device ground clearance range and the alignment tolerance area according to Table 2.

EVPCs of compatibility class B may have a specific alignment tolerance area that deviates from the values in Table 2.

Table 2 — Alignment tolerance area

Axis	Alignment tolerance area [mm]
x	±75
y	±100

In case of MF-WPT between a primary device and a secondary device of different topologies, several centre alignment points can exist. Examples are shown in Figure 2.



Key

1 centre alignment point of the EVPC
2 alignment tolerance area
3 direction of travel

Figure 2 — Example for centre alignment points between different coil topologies

The centre alignment points of supply power circuits are determined according to IEC 61980-3.

The centre alignment point(s) of the EVPC shall be specified with respect to the centre alignment points provided by the supply power circuit.

The requirements in this document apply to all centre alignment points specified for an EVPC.

The vehicle manufacturer may specify only one centre alignment point for alignment with a primary device of a different topology.

NOTE The selection of a single point can be due to a variety of reasons, for example the influence of the EV on the distribution of the magnetic field or the position of the EV within a parking spot.

7.4 Requirements for output power

An EVPC shall be able to deliver power up to its rated output power when operated with a supply power circuit.

An EVPC shall support the maximum ramp up rate of the supply power circuit. The maximum ramp up rate of supply circuits for EVPCs of compatibility class A is specified in IEC 61980-3.