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First edition

Electrically propelled road vehicles — Functional and safety requirements for power transfer between vehicle and external electric circuit —

Part 4: Magnetic field wireless power transfer

PROOF/ÉPREUVE

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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 document 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).

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

This first edition cancels and replaces ISO 19363:2020, which has been technically revised.

The main changes are as follows:

— the Scope has been adjusted to include passenger cars and light commercial vehicles only;

— the terms and definitions have been aligned with the ISO 5474 series and the IEC 61980 series;

— the efficiency requirements for unmatched power levels between on-board and off-board devices have been specified;

— the source for EMC limits and the corresponding test procedure have been updated.

A list of all parts in the ISO 5474 series can be found on the ISO website.

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 specifies requirements for the onboard side of a magnetic field wireless power transfer system for vehicles intended for passenger use and for light duty commercial applications. This document also addresses safety and functionality with off-board systems from different manufacturers.

The systems specified in this document are intended to work with off-board systems that meet the MF-WPT-related requirements of IEC 61980-1, IEC 61980-2 and IEC 61980-3.

Electrically propelled road vehicles — Functional and safety requirements for power transfer between vehicle and external electric circuit —

Part 4:
Magnetic field wireless power transfer

1 Scope

This document defines the requirements and operation of the on-board vehicle equipment that enables magnetic field wireless power transfer (MF-WPT) between supply device and electric vehicles (EV). It is intended to be used for passenger cars and light commercial 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 (interoperability);

— test procedures.

This document does not provide:

— requirements for dynamic (vehicle in motion) applications;

— requirements for reverse WPT;

— requirements for the operation of EV devices specified in this document with supply devices according to IEC 61980-4.

EV devices that fulfil the requirements of this document are intended to operate with supply devices that fulfil the MF-WPT related requirements of IEC 61980-1, IEC 61980-2 and IEC 61980-3.

NOTE IEC 61980-4 specifies requirements for supply devices of power levels above the limits of the reference supply power circuits in this document. Requirements related to dynamic applications of supply devices are specified in IEC 61980-5 and IEC 61980-6.

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 5474-1, *Electrically propelled road vehicles — Functional and safety requirements for power transfer between vehicle and external electric circuit — Part 1: General requirements for conductive power transfer*

ISO 6469-3:2021, *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 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 61980-1, *Electric vehicle wireless power transfer (WPT) systems - Part 1: General requirements*

IEC 61980-2, *Electric vehicle wireless power transfer (WPT) systems - Part 2: Specific requirements for communication between electric road vehicle (EV) and infrastructure*

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

ICNIRP *Guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz – 100 kHz)*, Health Physics 99(6):818-836; 2010

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5474-1 and the following terms and definitions apply.

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

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

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

3.1
alignment
relative position in the x- and y-directions of the *secondary device* (3.14) to the *primary device* (3.9) for a given *secondary device ground clearance* (3.15)

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

3.2
alignment tolerance area
intended *wireless power transfer (WPT)* (3.20) operating area in the x- and y-directions for a given *secondary device ground clearance* (3.15)

3.3
centre alignment point
spatial X, Y centre of the *alignment tolerance area* (3.2)

Note 1 to entry: The centre alignment point is not a fixed point for any single coil. It only has relevance for a primary and secondary device combination and is specific for that combination.

[SOURCE: IEC 61980-3:2022, 3.104]

3.4
EV device
on-board component assembly of *WPT system* (3.21)

Note 1 to entry: See Figure 1.

3.5
EV power circuit
EVPC
on-board component assembly, comprising the *secondary device* (3.14) and *EV power electronics* (3.6), as well as the electrical and mechanical connections

Note 1 to entry: See Figure 1.

3.6
EV power electronics
on-board component that converts the power and frequency from the *secondary device* (3.14) to the DC power output of the *EV power circuit (EVPC)* (3.5)

Note 1 to entry: See Figure 1.

3.7
magnetic field WPT
MF-WPT
transfer of electrical energy from a power source to an electrical load via a magnetic field without galvanic connection

3.8
operational design domain
ODD
specific operating conditions in which the *EV power circuit (EVPC)* (3.5) is designed to properly operate

3.9
primary device
off-board component comprising the primary coil and its compensation network to generate and shape the magnetic field for *wireless power transfer (WPT)* (3.20)

Note 1 to entry: Includes housings, covers and cabling.

Note 2 to entry: See Figure 1.

[SOURCE: IEC 61980-3:2022, 3.124, modified — "MF-WPT" changed to "WPT" and Note 2 to entry added.]

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 *EV power circuit (EVPC)* (3.5) is designed to deliver consistently during a charging cycle

3.12
reference EVPC
EV power circuit (EVPC) (3.5) that serves for conformance testing purposes

[SOURCE: IEC 61980-3:2022, 3.125]

3.13
reference supply power circuit
supply power circuit (3.18) that serves for conformance testing purposes

[SOURCE: IEC 61980-3:2022, 3.126]

3.14
secondary device
on-board component comprising the secondary coil and its compensating network to capture the magnetic field

Note 1 to entry: Includes housings, covers and cabling.

Note 2 to entry: See Figure 1.

[SOURCE: IEC 61980-3:2022, 3.129, modified — Note 2 to entry added.]

3.15
secondary device ground clearance
vertical distance between the ground surface and the lowest point of the *secondary device* (3.14) including the housing

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

3.16
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 60050-351:2013, 351-45-10]

3.17
supply device
off-board component assembly of *WPT system* (3.21)

Note 1 to entry: See Figure 1.

3.18
supply power circuit
off-board component assembly, comprising the *primary device* (3.9) and *supply power electronics* (3.19), as well as the electrical and mechanical connections

Note 1 to entry: See Figure 1.

3.19
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.

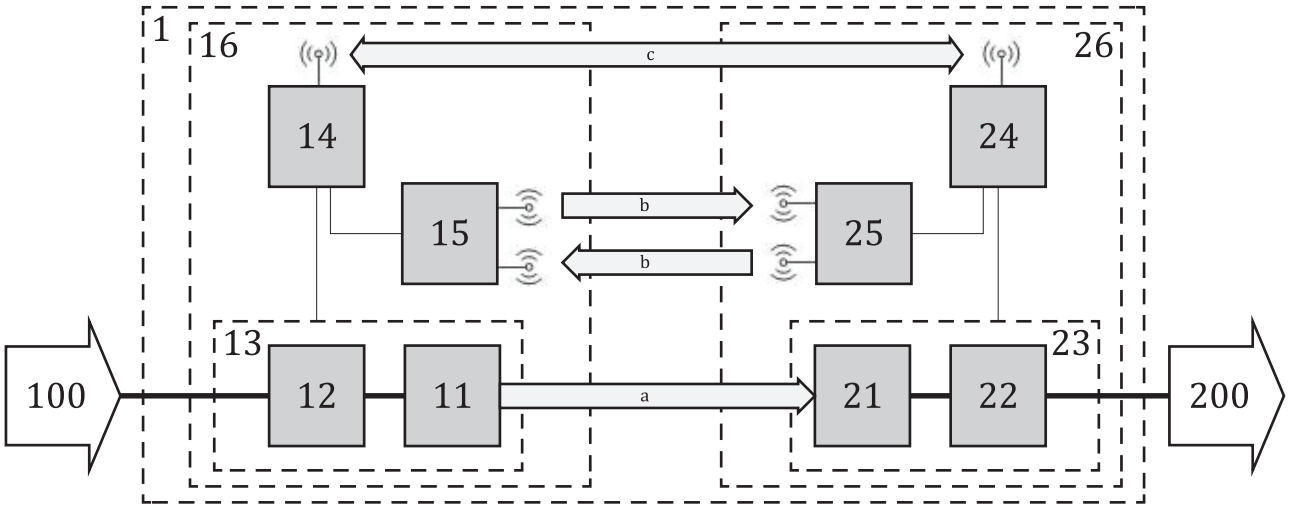
3.20
wireless power transfer
WPT
transfer of electrical energy from a power source to an electrical load without galvanic connection

3.21
MF-WPT system
system comprising all necessary components for *magnetic field wireless power transfer (MF-WPT)* (3.7) 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 does not give an indication on hardware packaging.



Key

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

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

a Wireless power flow.

b Wireless signalling (P2PS).

c Wireless communication.

Figure 1 — Example of system structure

5 Requirements regarding environmental conditions

The requirements given in this document shall be met across the range of environmental conditions as specified by the vehicle manufacturer.

The environmental requirements applicable to a component depend on its mounting position. The component shall withstand and retain its degree of protection under the typical loads and stresses it is subjected to in its intended mounting position.

Components of the EV device installed at the underbody of the EV shall have IP degree IP6K7 and IP6K9K in accordance with ISO 20653.

NOTE See the ISO 16750 series, the ISO 21498 series and the ISO 19453 series 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),

— interoperability.

Requirements regarding system safety and system performance are relevant and applicable to any MF-WPT system (including dedicated single-supplier solutions).

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.

There are two compatibility classes 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 reference supply power circuits as specified in Annex A and Annex B.

— 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. EVPCs of compatibility class A are tested with the reference supply power circuits described in Annexes A and B. EVPCs of compatibility class B are tested with supplier specific supply power circuits.

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

Table 1 — EVPC ODD

Specifications of EVPC		Compatibility class A	Compatibility class B
Frequency range		Operation within 79 kHz – 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 operates in the frequency range of 79 kHz - 90 kHz. The operating frequency during power transfer is set by the supply device according to IEC 61980-2.

7.3 Geometrical operating space

An EVPC shall meet the requirements of 7.4 and 7.5 within its entire geometrical operating space defined by its secondary device ground clearance range and the alignment tolerance area according to Table 1.

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.