

# TECHNICAL SPECIFICATION



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**Electric vehicle wireless power transfer (WPT) systems –  
Part 3: Specific requirements for the magnetic field wireless power transfer  
systems**

IEC TS 61980-3:2019

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC VEHICLE WIRELESS POWER TRANSFER (WPT) SYSTEMS –****Part 3: Specific requirements for the magnetic field wireless power transfer systems**

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- the subject is still under technical development or where, for any other reason, there is the future but no immediate possibility of an agreement on an International Standard.

Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

IEC TS 61980-3, which is a Technical Specification, has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

The text of this Technical Specification is based on the following documents:

Draft TS	Report on voting
69/554A/DTS	69/616B/RVDTS

Full information on the voting for the approval of this Technical Specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61980 series, published under the general title *Electric vehicle wireless power transfer (WPT) systems*, can be found on the IEC website.

This part is to be used in conjunction with IEC 61980-1:2015.

The clauses of the particular requirements in this document supplement or modify the corresponding clauses in IEC 61980-1:2015. Where the text indicates an "addition" to or a "replacement" of the relevant requirement, test specification or explanation of IEC 61980-1:2015, these changes are made to the relevant text of IEC 61980-1:2015, which then becomes part of the standard. Where no change is necessary, the words "Clause xx of IEC 61980-1:2015 is applicable" are used. Additional items to those of IEC 61980-1:2015 are numbered starting 101. Additional annexes are lettered from AA onwards.

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## INTRODUCTION

The IEC 61980 series is published in separate parts according to the following structure:

- IEC 61980-1 covers general requirements for electric road vehicle (EV) wireless power transfer (WPT) systems including general background and definitions. (e.g. efficiency, electrical safety, EMC);
- IEC TS 61980-2 covers specific requirements for communication between electric road vehicle (EV) and wireless power transfer (WPT) systems including general background and definitions.
- IEC TS 61980-3 covers specific requirements for electric road vehicle (EV) magnetic field wireless power transfer (MF-WPT) systems including general background and definitions (e.g. efficiency, electrical safety, EMC).

The requirements described in IEC 61980-1 are general. The technical requirements for the various wireless power transfer (WPT) technologies are very different; they are specified in the technology specific parts of the IEC 61980 series. A list of possible WPT technologies is listed in IEC 61980-1. The requirements for magnetic field wireless power transfer systems (MF-WPT) are described in this document. Further parts of the IEC 61980 series will describe other technologies such as power transfer via electric field (EF-WPT) or via electromagnetic field wireless power transfer systems (EF-WPT) or electromagnetic field-WPT systems, also named microwave-WPT systems (MW-WPT).

Reference to "technology specific parts" always refers to each parts of the IEC 61980 series. The structure of the "technology specific parts" follows the structure of IEC 61980-1.

WPT systems are still under development. For this reason, there is the future but not immediate possibility of an agreement to publish an International Standard. The committee has decided, by following the procedure set out in ISO/IEC Directives part 1:2018, 2.3, that the publication of a Technical Specification is appropriate. The reason for publishing the Technical Specification is a high market need for a first basic technical description.

IEC TS 61980-2, also published as a Technical Specification for the same reason as IEC TS 61980-3, deals with communication and for this reason has an independent structure. The numbering of the clauses does not follow the numbering of the other parts of the IEC 61980 series.

The electric road vehicles (EV) requirements of the MF-WPT system are covered by ISO PAS 19363.

# ELECTRIC VEHICLE WIRELESS POWER TRANSFER (WPT) SYSTEMS –

## Part 3: Specific requirements for the magnetic field wireless power transfer systems

### 1 Scope

This part of IEC 61980, which is a Technical Specification, applies to the equipment for the magnetic field wireless power transfer (MF-WPT) of electric power from the supply network to electric road vehicles for purposes of supplying electric energy to the RESS (rechargeable energy storage system) and/or other on-board electrical systems. The MF-WPT system operates at standard supply voltages ratings per IEC 60038 up to 1 000 V AC and up to 1 500 V DC. The power transfer takes place while the electric vehicle (EV) is stationary.

This document also applies to MF-WPT equipment supplied from on-site storage systems (e.g. buffer batteries) at standard supply voltages ratings per IEC 60038 up to 1 000 V AC and up to 1 500 V DC.

The aspects covered in this document include

- the characteristics and operating conditions,
- the required level of electrical safety,
- requirements for basic communication for safety and process matters if required by a MF-WPT system,
- requirements for positioning to assure efficient and safe MF-WPT power transfer, and
- specific EMC requirements for MF-WPT systems.

The following aspects are under consideration for future documents:

- requirements for two- and three-wheel vehicles,
- requirements for MF-WPT systems supplying power to EVs in motion, and
- requirements for bidirectional power transfer.

This standard does not apply to

- safety aspects related to maintenance, and
- trolley buses, rail vehicles and vehicles designed primarily for use off-road.

NOTE The terms used in this document are specifically for MF-WPT.

### 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.

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

IEC 60947-2, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 61008-1, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

IEC TS 61980-2:2019, *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 62423, *Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses*

DIN 7405:1963, *Wire staple 24/6 for office-staplers*

EN 10130, *Cold rolled low carbon steel flat products for cold forming – Technical delivery conditions*

ICNIRP Guidelines 1998, *ICNIRP guidelines for limiting exposure to time-varying electric, magnetic and electromagnetic fields (up to 300 GHz)*, International commission on non-ionizing radiation protection, published in: *Health Physics* 74(4):494-522; 1998

ICNIRP Guidelines 2010, *ICNIRP guidelines for limiting exposure to time-varying electric and magnetic fields (1 Hz – 100 kHz)*, International commission on non-ionizing radiation protection, published in: *Health Physics* 99(6):818-836; 2010

UL 2251, Standard for plugs, receptacles, and couplers for electric vehicles

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### 3 Terms and definitions

[IEC TS 61980-3:2019](#)

For the purposes of this document, the terms and definitions given in IEC 61980-1 and the following apply.

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

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

*Additional terms and definitions:*

#### 3.101

##### **primary coil**

component of the primary device according IEC 61980-1 comprising one or more electrical windings generating a magnetic field for wireless power transfer (MF-WPT)

#### 3.102

##### **secondary coil**

component of the secondary device according IEC 61980-1 comprising one or more electrical windings generating a magnetic field for wireless power transfer (MF-WPT)

#### 3.103

##### **system frequency**

frequency range over which the system is designed to transfer power

Note 1 to entry: The bandwidth is a frequency range above and below the nominal frequency, and need not be centred at the nominal frequency. Spurious harmonics are not included in the bandwidth.

**3.104****EV device**

on-board component assembly, comprising the secondary device, the EV power electronics and the on-board communication controller, as well as the mechanical connections between the assemblies

**3.105****complete power**

power level which is the lower of the declared primary device input power according to the specifications listed in 6.3, or of the output power limit specified by the manufacturer for the EV device

**3.106****primary device**

off-board component that generates and shapes the magnetic field for power transfer

**3.107****secondary device**

on-board component that captures the magnetic field

**3.108****secondary device ground clearance**

vertical distance between the ground surface and the lowest point of the secondary device

Note 1 to entry: The lower surface may not be planar and may not be parallel to the ground surface..

**3.109****plug and cable connected supply device**

supply device that can be connected to, or disconnected from, the socket-outlet of AC or DC supply network by the use of a plug

**3.110****MF-WPT input power class**

power class of a supply device of MF-WPT systems defined from the perspective of the maximum power drawn from the supply network in order to drive the supply device

**3.111****reference supply power circuit**

supply power circuit that serves for conformance testing purposes

**3.112****reference EVPC**

on-board component which implements the communication with the SECC

**3.113****EV communication controller****electrical vehicle communication controller**

on-board component which implements the communication with the SECC

**3.114****EV power circuit****EVPC**

on-board component assembly that includes the secondary device and EV power electronics, as well as the mechanical connections between the components

**3.115****EV power electronics**

on-board component, that converts the power and frequency needed for the output from the EVPC

EXAMPLE Impedance matching network (IMN), filter, rectifier, impedance converter..

### 3.116

#### supply device

off-board component assembly comprising the primary device, the supply power electronics and the supply device communication controller, as well as the mechanical connections between the components necessary for wireless power transfer

### 3.117

#### supply power circuit

off-board component assembly comprising the supply power electronics and primary device, as well as the mechanical connections between the components

### 3.118

#### supply equipment communication controller

#### SECC

off-board component that implements the communication with the EVCC(s)

### 3.119

#### supply power electronics

off-board electronics, including all housings and covers, that supply the electric power to the primary device

EXAMPLE PFC converter, DC-AC inverter, filter, impedance matching network..

### 3.120

#### MF-WPT system

system comprising the supply device and the EV device to perform MF-WPT

Note 1 to entry: See also Figure 303.

IEC TS 61980-3:2019

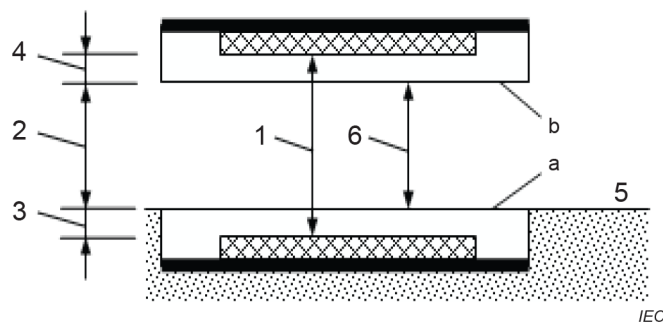
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### 3.121

#### flush mounted

mounting of a primary device in such a manner that the top of the covering primary device is flush with the road surface

SEE Figure 101.



#### Key

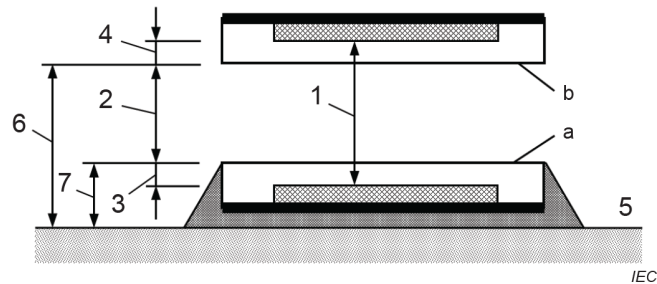
- a primary device
- b secondary device
- 1 operational air gap
- 2 mechanical air gap
- 3 covering primary device
- 4 covering secondary device
- 5 top of road surface
- 6 secondary device ground clearance

Figure 101 – Flush mounted

**3.122**  
**surface mounted**

mounting of a primary device in such a manner it protrudes above ground up to certain mounting height

SEE Figure 102.



**Key**

- a primary device
- b secondary device
- 1 operational air gap
- 2 mechanical air gap
- 3 covering primary device
- 4 covering secondary device
- 5 top of road surface
- 6 secondary device ground clearance
- 7 mounting height

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**Figure 102 – Surface mounted**

**3.123**  
**fundamental mutual inductance**

$M_0$

mutual inductance  $M$  divided by the primary number of coil turns and divided by the secondary number of coil turns

Note 1 to entry: The mutual inductance  $M$  describes the magnetic interaction and characteristic between the primary and the secondary coil system.

Note 2 to entry: The value for the fundamental mutual inductance is defined by the geometric coil and ferrite design and the positioning parameters  $x$ ,  $y$ ,  $z$  describing the position from the secondary coil system against the primary coil system. A specific value of the fundamental mutual inductance is valid for a specific position  $x$ ,  $y$ ,  $z$ .

**3.124**  
**gauge device**

test device which is intended to verify that a reference primary coils is functioning as designed, but may be used for testing and development of product devices

**3.125**  
**product primary device**

primary device intending to prove standard conformance

Note 1 to entry: In symbols, the product primary device is identified by the subscript "P", whereas the reference primary device is identified by the subscript "R".

**3.126**  
**product secondary device**

secondary device intending to prove standard conformance

## 4 Abbreviations

Clause 4 of IEC 61980-1:2015 is applicable except as follows.

*Replacement of the title of Clause 4 of IEC 61980-1:2015:*

## 4 Symbols and abbreviated terms

*Addition:*

Re	real of the reflected impedance
Im	real and imaginary part of the reflected impedance
$C_{TD}$	calibration factor of the gauge device as provided by the gauge device manufacturer
$U_{i2}$	induced voltage in gauge device, generated by the primary excitation $I_1 \times w_1$
$\omega$	$2\pi f$ ; $f = 85$ kHz (nominal frequency)
$w_2$	number of turns of the gauge device
$\Phi_{1 \rightarrow 2}$	magnetic flux the gauge device is exposed to, excited primary coil
$M_0$	fundamental mutual inductance with $w_1 = 1$ , $w_2 = 1$
$I_1$	primary coil current
$I_1 \times w_1$	primary coil specific ampere turns
$Z_2$	impedance presented to the secondary device coil by the secondary device electronics and load
$P_{b,out}$	output power of secondary device measured at the RESS (traction battery or adjustable load)
$U_{b,out}$	output voltage of secondary device measured at the RESS (traction battery or adjustable load)

## 5 General

Clause 5 of IEC 61980-1:2015 is applicable except as follows.

*Addition:*

Unless otherwise specified, all tests shall be carried out in a draft-free location and at an ambient temperature of  $20 \text{ °C} \pm 5 \text{ °C}$ .

IEC TS 61980-3 applies to equipment that is designed to be used at an altitude up to 2 000 m.

For equipment designed to be used at altitudes above 2 000 m, it is necessary to take into account the reduction of the dielectric strength and the cooling effect of the air. Electrical equipment intended to operate under these conditions is not covered by IEC TS 61980-3 and should be designed or used in accordance with an agreement between manufacturer and user.

## 6 Classification

Clause 6 of IEC 61980-1:2015 is applicable except as follows;