PUBLICLY AVAILABLE SPECIFICATION

# ISO/PAS 19363

First edition
2017-01

# 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*

Reference number
ISO/PAS 19363:2017(E)

© ISO 2017



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2017, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

# Contents

Page

**Foreword** ..... **v**
**Introduction** ..... **vi**
**1 Scope** ..... **1**
**2 Normative references** ..... **1**
**3 Terms and definitions** ..... **2**
**4 Environmental conditions** ..... **6**
**5 System description** ..... **6**
**6 MF-WPT interoperability** ..... **7**
6.1 General ..... 7
6.2 Classification of EV power circuits ..... 7
6.2.1 General ..... 7
6.2.2 MF-WPT classes ..... 7
6.2.3 Z classes ..... 7
6.3 Performance requirements ..... 8
6.3.1 General ..... 8
6.3.2 Alignment tolerance requirements ..... 8
6.3.3 Power transfer requirements ..... 8
6.3.4 System efficiency requirements ..... 9
6.4 Frequency ..... 9
6.5 Reference EV devices ..... 9
6.6 Test procedure ..... 9
**7 Functions** ..... **11**
7.1 Communication setup ..... 11
7.2 Service selection ..... 11
7.2.1 General ..... 11
7.2.2 Parameters to be exchanged for interoperability ..... 12
7.3 Fine positioning ..... 12
7.4 Pairing ..... 12
7.5 Final compatibility check ..... 12
7.6 Initial alignment check ..... 12
7.7 Start power transfer ..... 13
7.8 Power saver mode ..... 13
7.8.1 Start power saver mode ..... 13
7.8.2 Terminate power saver mode ..... 13
7.9 Perform power transfer ..... 13
7.10 Stop power transfer ..... 13
7.11 User initiated stop power transfer ..... 14
7.12 Safety monitoring and diagnostics ..... 14
7.12.1 General ..... 14
7.12.2 Alignment monitoring ..... 14
7.12.3 Power transfer monitoring ..... 14
7.12.4 Communication link monitoring ..... 14
7.13 Terminate communication ..... 14
7.14 Terminate safety monitoring and diagnostics ..... 14
7.15 Wake up after power outage ..... 14
7.16 Test procedure ..... 14
**8 Sequence and communication** ..... **14**
8.1 General ..... 14
8.2 Sequence of functions ..... 15
8.2.1 Protocol flow stages and associated messages ..... 15
8.2.2 Basic definitions for error handling ..... 15

© ISO 2017 – All rights reserved

8.3 Communication 15
**9 EMC requirements 15**
**10 Safety requirements 15**
10.1 Protection in case of unintended power transfer 15
10.2 Protection against electrical shock 16
10.3 Protection against overcurrent 16
10.3.1 Overload protection 16
10.3.2 Short-circuit protection 16
10.4 Protection of humans against electromagnetic effects 16
10.4.1 General 16
10.4.2 Protection areas 16
10.4.3 Requirements for protection against exposure to hazardous electromagnetic fields 17
10.4.4 Requirements to protect functionality of active implantable medical devices (AIMDs) 18
10.4.5 Test procedures 18
10.5 Temperature rise and protection against thermal incidents 20
10.5.1 General 20
10.5.2 Protection against burns from heating of foreign objects 20
**11 Owner's manual and marking 20**
11.1 Owner's manual 20
11.2 Marking 20
**Annex A** (informative) **Circular reference EV device proposals for MF-WPT1 21**
**Annex B** (informative) **DD reference EV device proposals for MF-WPT1 26**
**Annex C** (informative) **Circular reference EV device proposals for MF-WPT2 33**
**Annex D** (informative) **DD reference EV device proposals for MF-WPT2 40**
**Annex E** (informative) **Corresponding reference supply devices proposals 50**
**Annex F** (informative) **Coil position in parking spot 58**
**Bibliography 59**

 © ISO 2017 – All rights reserved

# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 on 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 the following URL: www.iso.org/iso/foreword.html.

ISO PAS 19363:2017 was prepared by Technical Committee ISO/TC 22, *Road vehicles,* SC 37, *Electrically propelled vehicles*, in collaboration with IEC/TC 69 *Electric road vehicles and electric industrial trucks,* in accordance with ISO/IEC mode of cooperation 4.

© ISO 2017 – All rights reserved

# Introduction

This document is an intermediate specification, published prior to the development of a full International Standard. This document prescribes the usage of the wireless power transfer technology to charge electrically propelled road vehicles. 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. The main purpose of this document is to respond to the upcoming market needs starting with determination of basic safety requirements and documentation for the first findings for vehicle usage.

This document will be transformed into an International Standard as soon as consolidated technical experiences are available. When transferring this document into an IS, technical changes are possible to adopt the document to the latest level of knowledge.


© ISO 2017 – All rights reserved

# 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:

— transferred power;

— ground clearance;

— interoperability requirements among differently classified EV devices and associated off-vehicle systems;

— performance requirements under various conditions, including among different manufacturers and classifications;

— safety requirements;

— test procedures.

EV devices according to this document are intended to operate with off-board systems currently under development in the IEC 61980 series.

NOTE 1 This edition covers stationary applications.

NOTE 2 Bidirectional 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, *Electrically propelled road vehicles — Safety specifications — Part 3: Protection of persons against electric shock*

ISO 14117, *Active implantable medical devices — Electromagnetic compatibility — EMC test protocols for implantable cardiac pacemakers, implantable cardioverter defibrillators and cardiac resynchronization devices*

ISO 15118-8, *Road vehicles — Vehicle to grid communication interface — Part 8: Physical layer and data link layer requirements for wireless communication*

ISO 16750-3, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 3: Mechanical loads*

ISO 16750-4, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 4: Climatic loads*

© ISO 2017 – All rights reserved

ISO 16750-5, *Road vehicles — Environmental conditions and testing for electrical and electronic equipment — Part 5: Chemical loads*

IEC 61786-1, *Measurement of DC magnetic, AC magnetic and AC electric fields from 1 Hz to 100 kHz with regard to exposure of human beings - Part 1: Requirements for measuring instruments*

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

ICNIRP 1998, *Guidelines for limiting exposure to time varying electric and magnetic fields (up to 300 kHZ)*

## 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:

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

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

**3.1**
**alignment**
relative position of primary to *secondary device* (3.27)

**3.2**
**alignment check**
confirmation that the primary and *secondary devices* (3.27) are properly positioned relative to each other

Note 1 to entry: Proper positioning is done to assure sufficient system functionality [e.g. *system efficiency* (3.35), EMF/EMC limits, safety requirements, etc.].

**3.3**
**basic insulation**
insulation of hazardous-live-parts which provides basic protection

**3.4**
**battery system**
(battery) energy storage device that includes cells or cell assemblies or battery pack(s), as well as electrical circuits and electronics

EXAMPLE BCU, contactors.

**3.5**
**double insulation**
insulation comprising both *basic insulation* (3.3) and *supplementary insulation* (3.30)

**3.6**
**electric shock**
physiological effect resulting from an electric current through a human body

**3.7**
**electric vehicle/electric road vehicle**
**EV**
any vehicle propelled by an electric motor drawing current from a *battery system* (3.4) intended primarily for use on public roads


© ISO 2017 – All rights reserved

**3.8**
**EV communication controller**
**EVCC**
embedded system, within the vehicle, that implements the communication between the vehicle and the SECC in order to support specific functions

Note 1 to entry: Such specific functions could be, for example, controlling input and output channels, encryption, or data transfer between vehicle and SECC.

**3.9**
**EV device**
on-board component assembly, comprising the *secondary device* (3.27), the *EV power electronics* (3.12) and the *EV communication controller* (3.8), as well as the mechanical connections between the components necessary for wireless power transfer

**3.10**
**EV power circuit**
**EVPC**
electrical component assembly that includes the *secondary device* (3.27) and *EV power electronics* (3.12), as well as the mechanical connections between the components

Note 1 to entry: EVPC is here defined specifically for *MF-WPT systems* (3.19).

**3.11**
**EVPC power class**
power class of an EVPC defined according to the *MF-WPT input power class* (3.18) of the supply device it is designed to operate

Note 1 to entry: The power delivered to the *EV device* (3.9) will be less than that maximum MF-WPT input power to the *MF-WPT system* (3.19) due to losses, for example, in the *supply power electronics* (3.34) and eddy currents in the MF-WPT shield or the vehicle underbody.

**3.12**
**EV power electronics**
on-board electronics, including all housings and covers, that convert the AC power from the *secondary device* (3.27) to DC power having suitable voltages and currents provided to the *battery system* (3.4) or the traction-battery

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

**3.13**
**fine positioning**
relative movement of the *secondary device* (3.27) in relation to the *primary device* (3.23) with the goal of reaching *optimal alignment* (3.20)

**3.14**
**foreign object**
object that is not an attached part of the vehicle or the *MF-WPT system* (3.19)

**3.15**
**grid**
electric power source that is not part of the vehicle for supplying electric energy to an EV using a *supply power circuit* (3.33)

**3.16**
**Magnetic Field Wireless Power Transfer**
**MF-WPT**
wireless transfer of energy from a power source to an electrical load via a magnetic field

© ISO 2017 – All rights reserved

**3.17**
**message**
data in a specified format

EXAMPLE A message contains data in a specified format that describes for example, a request or a reply.

Note 1 to entry: A message contains zero or more parameters.

**3.18**
**MF-WPT input power class**
power class of a supply device of *MF-WPT systems* (3.19) defined from the perspective of the maximum power drawn from the *grid* (3.15) in order to drive the supply device

Note 1 to entry: IEC 61980-3 will specify the MF-WPT input power classes, current status of discussions: for MF-WPT1 the maximum input power is ≤3,7 kW, for MF-WPT2 the maximum input power is >3,7 kW and ≤7,7 kW, for MF-WPT3 the maximum input power is >7,7 kW and ≤11 kW, for MF-WPT4 the maximum input power is >11 kW and ≤22 kW, for MF-WPT5 the maximum input power is >22 kW. For this document, MF-WPT1 to MF-WPT4 are under consideration.

**3.19**
**MF-WPT system**
system consisting of *primary device* (3.23), *supply power electronics* (3.34), *supply equipment communication controller* (3.32), (the supply device), *secondary device* (3.27), *EV power electronics* (3.12) and electric vehicle communication controller [the *EV device* (3.9)], including wiring, housing and covers used to transfer energy using magnetic fields

Note 1 to entry: See also Figure 1.

**3.20**
**optimal alignment**
*alignment* (3.1) with the most efficient power transfer

**3.21**
**pairing**
process by which an EV is correlated with the unique dedicated *primary device* (3.23) at which it is located and from which power will be transferred

**3.22**
**power saver mode**
mode in which the EV either turns *EV device* (3.9) components off or into a mode with reduced power consumption

**3.23**
**primary device**
device external to the EV that is the source of the MF-WPT, including all housings and covers

Note 1 to entry: When the EV is receiving power, the primary device acts as the source of the power to be transferred.

**3.24**
**protection area**
volume in and around the vehicle that has homogeneous protection target requirements

**3.25**
**reference level**
levels of field strength or power density derived from the basic restrictions using worst case assumptions about exposure

Note 1 to entry: If the reference levels are met, then the basic restrictions will be complied with, but if the reference levels are exceeded, that does not necessarily mean that the basic restriction will not be met.


© ISO 2017 – All rights reserved

**3.26**
**reinforced insulation**
insulation of hazardous live parts which provides a degree of protection against *electric shock* (3.6) equivalent to *double insulation* (3.5)

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as *basic insulation* (3.3) or *supplementary insulation* (3.30).

**3.27**
**secondary device**
device mounted on the EV, including all housings and covers, that captures the magnetic field sourced by the *primary device* (3.23)

Note 1 to entry: When the EV is receiving power, the *secondary device* (3.28) transfers the power from the primary to the EV.

**3.28**
**secondary device ground clearance**
vertical distance between the ground surface and the lowest point of the *secondary device* (3.28)

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

**3.29**
**steady state**
state of a system at which all state and output variables remain constant in time while all input variables are constant

**3.30**
**supplementary insulation**
independent insulation applied in addition to *basic insulation* (3.3) for fault protection

**3.31**
**supply device**
off-board component assembly comprising the *primary device* (3.23), the *supply power electronics* (3.34) and the supply device communication controller, as well as the mechanical connections between the components necessary for wireless power transfer

**3.32**
**supply equipment communication controller**
**SECC**
entity which implements the communication to one or multiple *EVCCs* (3.8)

Note 1 to entry: Functions of an SECC control input and output channels, data encryption, or data transfer between vehicle and SECC.

**3.33**
**supply power circuit**
off-board component assembly comprising the *supply power electronics* (3.34) and *primary device* (3.23), as well as the mechanical connections between the components

**3.34**
**supply power electronics**
off-board electronics, including all housings and covers, that supply the electric power to the *primary device* (3.23)

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

**3.35**
**system efficiency**
efficiency from AC or DC power supply (input of the supply device) to the output of the *EV device* (3.9)

Note 1 to entry: It is of no importance whether the output is connected to a device or directly to a battery.

© ISO 2017 – All rights reserved

**3.36**
**voltage class B**
classification of an electric component or circuit with a maximum working voltage of >30 V and ≤1,000 V AC (rms) or >60 V DC and ≤1,500 V DC, respectively

## 4 Environmental conditions

Potential environmental stresses and related tests and requirements for electronic systems/components mounted in specific locations on/in the vehicle are described in ISO 16750.

The environmental requirements applicable to a particular EV device shall be identified and agreed between the customer and supplier and the compliance testing for these requirements shall be performed in accordance with the following ISO standards:

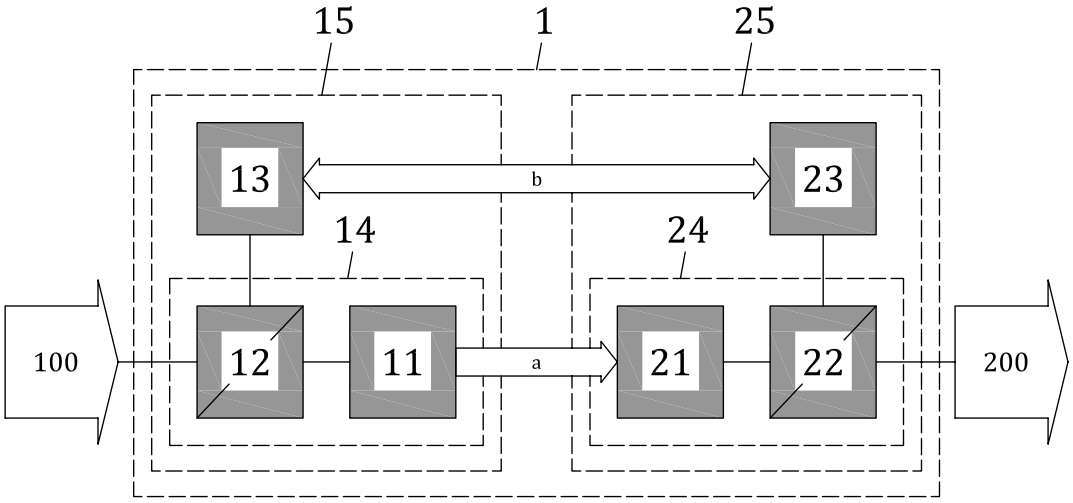
— mechanical loads according to ISO 16750-3, test procedure type VI, vehicle body;

— climate loads according to ISO 16750-4;

— chemical loads according to ISO 16750-5.

## 5 System description

Figure 1 shows an example for the structure of an MF-WPT system.




**Key**

| | | | |
|---|---|---|---|
| 1 | MF-WPT system | 22 | EV power electronics |
| 11 | primary device | 23 | EV communication controller (EVCC) |
| 12 | supply power electronics | 24 | EV power circuit (EVPC) |
| 13 | supply equipment communication controller (SECC) | 25 | EV device |
| 14 | supply power circuit | 200 | battery |
| 15 | supply device | a | Wireless power flow. |
| 100 | grid | b | Communication. |
| 21 | secondary device | | |

NOTE The numbering convention adopted is based on system blocks being assigned a number with the supply device blocks having numbers of the form “1X” and the EV device blocks of the form “2X”. The second digit identifies equivalent functionality in the supply and EV sub-systems.

**Figure 1 — MF-WPT system**


© ISO 2017 – All rights reserved