

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Measurement procedures of magnetic field levels generated by electronic and electrical equipment in the automotive environment with respect to human exposure –**

**Part 1: Low-frequency magnetic fields**

IEC 62764-1:2022

**Procédures de mesure de l'exposition humaine aux niveaux de champs magnétiques générés par les accessoires électroniques et électriques dans l'environnement automobile –**

**Partie 1: Champs magnétiques à basse fréquence**



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**Partie 1: Champs magnétiques à basse fréquence**

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**MEASUREMENT PROCEDURES OF MAGNETIC FIELD LEVELS  
GENERATED BY ELECTRONIC AND ELECTRICAL EQUIPMENT IN THE  
AUTOMOTIVE ENVIRONMENT WITH RESPECT TO HUMAN EXPOSURE –**

**Part 1: Low-frequency magnetic fields**

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IEC 62764-1 has been prepared by IEC technical committee 106: Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure. It is an International Standard.

This first edition cancels and replaces IEC TS 62764-1 published in 2019.

The text of this International Standard is based on the following documents:

Draft	Report on voting
106/575/FDIS	106/579/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/standardsdev/publications](http://www.iec.ch/standardsdev/publications).

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## INTRODUCTION

This document specifies a methodology for determining the exposure to multiple magnetic field sources for passenger cars and light commercial vehicles including standardized operating conditions and measurement volumes and/or surfaces.

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# MEASUREMENT PROCEDURES OF MAGNETIC FIELD LEVELS GENERATED BY ELECTRONIC AND ELECTRICAL EQUIPMENT IN THE AUTOMOTIVE ENVIRONMENT WITH RESPECT TO HUMAN EXPOSURE –

## Part 1: Low-frequency magnetic fields

### 1 Scope

This part of IEC 62764 applies to the assessment of human exposure to low-frequency magnetic fields generated by automotive vehicles. For plug-in vehicles, this includes the electric vehicle supply equipment (EVSE) and associated cables provided by the car manufacturer. This excludes the charging station.

This document specifies the measurement procedure for the evaluation of magnetic field exposures generated by electronic and electrical equipment (excluding intentionally transmitting radio frequency antennas) in selected automotive environments, for passenger cars and commercial vehicles of categories M1 and N1 as defined in ECE/TRANS/WP.29/78/Rev.3 [1]<sup>1</sup>, with respect to human exposure. It provides standardized operating conditions and defines recommended measurements to assess compliance with the applicable exposure requirements.

This document covers the frequency range 1 Hz to 100 kHz and is applicable to any type of engine and/or internal energy source.

This document does not include procedures for assessment of human exposure to electromagnetic fields generated by wireless power transfer (WPT) equipment operating in automotive environments. Exposure assessment procedures for WPT equipment are covered by IEC PAS 63184 [2]. Magnetic field transients shorter than 200 ms occurring when electrical functions are activated are not considered in this document.

Abnormal operation of the vehicle or its equipment is not taken into consideration.

### 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 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*

IEC 62311:2019, *Assessment of electronic and electrical equipment related to human exposure restrictions for electromagnetic fields (0 Hz to 300 GHz)*

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<sup>1</sup> Numbers in square brackets refer to the Bibliography.

### 3 Terms, definitions and abbreviated terms

#### 3.1 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>

##### 3.1.1

##### **applicable requirement**

particular requirement regarding human exposure to low-frequency magnetic fields against which the vehicle is to be assessed using the methods outlined in this document

Note 1 to entry: Examples of such requirements can be found in [3] to [9].

##### 3.1.2

##### **dynamometer**

device allowing a vehicle to rotate all its wheels with a given torque while stationary

##### 3.1.3

##### **magnetic field exposure**

specific metric that is used to quantify human exposure to low-frequency magnetic fields in the applicable requirement

Note 1 to entry: Examples of such metrics can be found in [3] to [9].

##### 3.1.4

##### **powertrain**

main system that generates power and delivers it to the road surface

#### 3.2 Abbreviated terms

EV	electric vehicle
EVSE	electric vehicle supply equipment
HEV	hybrid electric vehicle
ICEV	internal combustion engine vehicle
SOC	state of charge (indicated to the driver)
WPT	wireless power transfer

### 4 Measurement procedure

#### 4.1 Measurement phases

The measurement procedure is divided into four parts regarding the operational vehicle use:

- 1) vehicle in stationary mode;
- 2) vehicle in driving mode;
- 3) vehicle in dynamic mode;
- 4) vehicle in plug-in charging mode.

These four parts are described in detail in Clause 6.

## 4.2 Measuring conditions

The measurements cover only sources of persistent magnetic field exposure. Continuous occurring sources, or repetitive transient sources such as fan and wipers, are included. Magnetic field transients shorter than 200 ms occurring when electrical functions are activated are not considered in this document due to the difficulty of performing reliable and repeatable measurements.

NOTE The rotation of the tyres can produce low-frequency magnetic fields (typically below 50 Hz, depending on the speed of the vehicle) in and surrounding the vehicle, due to the static magnetization of the tyres [10], [11]. This can only contribute to measurements inside the vehicle (since no measurements are performed around the vehicle in dynamic mode).

The measurements shall be performed in the vehicle's standard modes of operation, generating reasonably foreseeable levels of magnetic field exposure in measuring volumes that are representative of the occupant (Annex B) and bystander locations.

## 4.3 Test site

Measurements shall be performed in an area having ambient magnetic field exposure values of less than 10 % of the values given in the requirements in the measurement volumes.

The ambient magnetic field exposure shall be measured without the vehicle, but in conditions that are representative of the vehicle test. This measurement can be performed before each test or periodically in accordance with the laboratory's quality management processes.

A dynamometer (or roller bench) may be used if it rotates all the wheels of the vehicle. It shall be set to simulate the outdoor dynamics of the vehicle including at least its steady-state torque in driving mode and its inertial mass during dynamic mode.

If an outdoor track is used, the slope gradient of the section of the track used for the tests shall be in the range  $\pm 2$  %.

NOTE In the case of a dynamometer, the ambient magnetic field exposure can depend on the torque and/or speed of the dynamometer.

## 4.4 Vehicle set-up

The following configuration is recommended within the passenger compartment, where practicable:

- all seats except the rearmost seats, if adjustable, centre-positioned horizontally and at the lowest position vertically;
- the rearmost seats, if horizontally adjustable, in their rearmost position;
- the headrests fully retracted;
- all seat backs except for the rearmost seats, if adjustable, approximately 15° back from the vertical;
- all seat backs of the rearmost seats, if adjustable, fully tilted backwards;
- the steering wheel centre-positioned vertically and horizontally.

## 4.5 Measurement locations

### 4.5.1 General

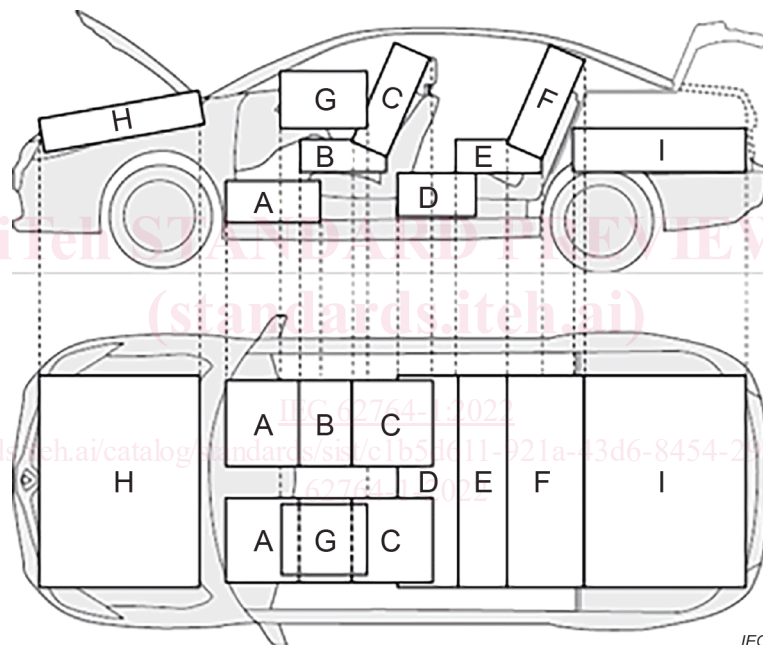
Measurements are performed in all regions of the vehicle that are accessible by the driver and passengers, and in the immediate vicinity of the vehicle for bystanders. These include the driver and passenger area (cabin), the cargo storage area, the engine and/or the electric powertrain areas, and the areas around the outside of the vehicle.

The measurement distance between the surface of any part of the vehicle and the centre of the probe shall be 20 cm (see Annex A), except for the surfaces of the seats where the distance of 6,5 cm shall be used. These distances (see Annex E) ensure an acceptable measurement uncertainty for a 100 cm<sup>2</sup> probe (see Annex C).

#### 4.5.2 Inside the vehicle

Measurements shall be performed throughout the volumes accessible in normal vehicle use cases by parts of the human body to which the applicable exposure requirements apply. These volumes shall be defined by the car manufacturer depending on the specific vehicle. For example, in the passenger compartment, occupants are assumed to be seated in positions where restraint systems are provided. An example of test volumes taking account of all body parts is illustrated in Figure 1.

Measurements are not required where the components are mounted (no components or parts shall be removed to perform the measurements).



**Figure 1 – Example of test volumes taking account of all body parts for a left-hand drive vehicle**

In the example shown in Figure 1, the following apply.

- For individual seats, the occupants are represented by three volumes corresponding to (A) the feet, (B) the legs, and (C) the trunk and head. For bench seats, the occupants are represented by three common volumes: D, E and F.
- The volume G represents the arms and hands on the steering wheel (which can be on the left-hand side or right-hand side of the vehicle or both, or in the centre).

Measurements shall be performed over the engine and/or the electric powertrain in H and/or I only in stationary and charging modes if the measurement is required, and if people are permitted to access these areas while the engine is running and/or the electric powertrain is active. The bottom of H can be a smooth envelope above all contained components. Volumes B, C, E and F can also take into account the positions of babies and infants.

NOTE These test volumes are examples defined with consideration of all body parts (including potential exposure of extremities in volumes A, D, G, H and I), but it is possible that some standards or regulations do not apply to the whole body.

Measurement in the areas of the driver's position can be achieved by different means including the use of a dynamometer. Appropriate safety measures shall be employed to avoid accidents due to operation of the dynamometer during measurements.

#### **4.5.3 Outside the vehicle**

Measurements shall be performed around the outside of the vehicle in all areas accessible to parts of the human body identified in the applicable requirements.

### **5 Measurement technique**

#### **5.1 Measuring equipment**

The measuring equipment shall include a probe covering the frequency range from 1 Hz to 100 kHz. The probe shall comply with the requirements of IEC 61786-1, including that the area of the probe shall be at most 100 cm<sup>2</sup>.

#### **5.2 Measurement of the magnetic field exposure**

For each volume specified in 4.5.2, the measurement of the magnetic field exposure shall be performed as follows:

- 1) scan the entire volume to determine the location of the maximum magnetic field exposure;
- 2) retain the maximum magnetic field exposure.

To scan the measurement volumes, the probe shall be moved sufficiently slowly to ensure that the spatial maximum is correctly located, especially when measuring sources between 1 Hz and 10 Hz.

The positioning of the probe and the means used to scan the volume shall be defined by the laboratory depending on the probe and their measurement facilities, manually or automatically.

### **6 Measurement procedure**

#### **6.1 Vehicle in stationary mode**

##### **6.1.1 General**

In this step, measurements are performed with the vehicle stationary.

For ICEVs, EVs and HEVs, these measurements are not required if all the relevant vehicle functions can be tested simultaneously in driving mode.

##### **6.1.2 Phase 1: vehicle preparation and set-up**

The following conditions shall be applied.

- For ICEVs: idle (engine running) with transmission disengaged (neutral) for both manual and automatic gearboxes.
- For EVs: ready to drive.
- For HEVs: ready to drive and/or idle (engine running).
- Vehicle parking brake enabled only if all functions can still be activated, otherwise utilize appropriate means to restrain the vehicle.
- Start/stop function (if present) disabled (with engine continuously running).
- Seats and steering wheel set as defined in 4.4.
- Doors closed.

- Front and rear openings of vehicle (e.g. cargo storage area, hood) closed except when measuring in associated volumes (e.g. H or I).
- Switch on the items of electrical equipment that are considered in 4.2.
- Where a range of settings are available (blower motor, heating), the reasonably foreseeable use mode of operation shall be used.

NOTE As noted in IEC 62311:2019, 5.3, "For practical reasons it is acceptable to perform the assessment with the equipment being operated with settings that produce the maximum exposure levels (e.g., maximum rated load, maximum rated power consumption, maximum speed or other), consistent with reasonably foreseeable use. The equipment is operated for a sufficient period to ensure that the conditions of operation are stable."

CAUTION: The engine fan or other equipment can start automatically without any warning.

### 6.1.3 Phase 2: vehicle measurement

Perform the measurement of magnetic field exposure in all volumes defined in 4.5 that are required by the applicable regulation being assessed.

NOTE Examples of such regulations can be found in [3] to [9].

During the measurements, the SOC shall be kept above 20 % of the maximum SOC for vehicles having an electric powertrain.

## 6.2 Vehicle in driving mode

### 6.2.1 General

In this step, measurements are performed when the vehicle is operated at a constant speed.

### 6.2.2 Phase 1: vehicle preparation and set-up

The following conditions shall be applied.

- Seats and steering wheel set as defined in 4.4.
- Switch on the items of electrical equipment that are considered in 4.2.
- Where a range of settings are available (blower motor, heating), the reasonably foreseeable use mode of operation shall be used. See NOTE in 6.1.2.

### 6.2.3 Phase 2: vehicle measurement (at constant speed)

For ICEVs and EVs, drive the vehicle at a constant speed of  $(40 \pm 8)$  km/h as indicated to the driver: a cruise control regulator can be used.

For HEVs, drive the vehicle:

- either in single mode (e.g. serial hybrid) with both the electrical and the internal combustion propulsion systems functioning to operate the vehicle at  $(40 \pm 8)$  km/h. The value of the engine speed shall be recorded in the test report;
- or in two separate modes (e.g. parallel hybrid): internal combustion engine operating alone, electric propulsion system operating alone.

In all cases, if the vehicle cannot reach  $(40 \pm 8)$  km/h, the maximum speed shall be chosen and recorded in the test report.

During driving mode, the vehicle functions activated in stationary mode shall also be activated simultaneously when possible.

Perform the measurement of magnetic field exposure in all volumes defined in 4.5.