# INTERNATIONAL STANDARD

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Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions —

Part 2:

# iTeh STANDARD PREVIEW estrian targets

Néhicules routiers - Dispositifs d'essai pour véhicules cibles, usagers de la route vulnérables et autres objets, pour l'évaluation de fonctions de sécurité active —

ISO 19206-2:2018

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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 <a href="www.iso.org/directives">www.iso.org/directives</a>).

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A list of all parts in the ISO 19206 series can be found on the ISO website.

# Introduction

ADAS (Advanced Driver Assistance Systems) and Active Safety systems are designed to support decision-making for the driver, extend the driver's awareness of the traffic situation with advanced warnings, improve the behaviour of the vehicle, and even take over vehicle control in an emergency situation. The goal is to completely avoid an accident or at least reduce the severity of an accident.

Testing of active safety systems requires documentation of test materials, test environment, testing procedures, and performance criteria. This document series addresses the specification of test target objects for traffic scenarios representing vehicles, vulnerable road users and other objects in the forward path of the subject vehicle.

This document addresses the specification of pedestrian test targets.

A pedestrian test target needs to resemble the characteristics of a human, yet provide safety for the subject vehicle and test operators in the event that contact is made between the subject vehicle and the pedestrian target. Crashworthiness and durability requirements for the pedestrian target require that the material and construction of the pedestrian target are adapted to fit the purposes.

Pedestrian test targets may need to represent a range of pedestrian sizes to evaluate the performance of an active safety system. Test cases may address both stationary and moving targets and, as such, the physical construction of the target may accommodate a target carrier system capable of mimicking the motions of a human. This document includes requirements on the target carrier system as applicable.

Targets described in this document series may be used for system development or applied in conjunction with existing standards, or standards under development, for assessment of ADAS and active safety functions of vehicles.

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# Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions —

# Part 2:

# Requirements for pedestrian targets

# 1 Scope

This document specifies performance requirements for surrogate targets used to assess the system detection and activation performance of active safety systems.

This document specifies the properties of pedestrian targets that represent an adult or a child in terms of size, shape, reflection properties, etc. for testing purposes. The document addresses the detection requirements for a pedestrian target in terms of sensing technologies commonly in use at the time of publication of this document, and where possible, anticipated future sensing technologies. It also addresses methodologies to verify the target response properties to these sensors, as well as some performance requirements for the target carrier PREVIEW

This document does not address the test procedures in terms of speeds, positions, or timing of events. Performance criteria for the active safety system being evaluated are also not addressed.

A related test procedure using pedestrian targets according to this document can be found in ISO 19237.

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# **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 8855:2011, Road vehicles — Vehicle dynamics and road-holding ability — Vocabulary

ISO 8608, Mechanical vibration — Road surface profiles — Reporting of measured data

# Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8855:2011 and the following apply.

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

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

#### 3.1

### subject vehicle

vehicle with active safety system to be tested

# ISO 19206-2:2018(E)

# 3.2

# pedestrian target

#### PT

test device representing a pedestrian used to test active safety systems

#### 3.3

# target body

physical structure that resembles a human used to activate sensor systems

#### 3.4

# target carrier

mechanical system used to move the target body according to a test protocol

Note 1 to entry: It may be a self-propelled platform or external devices connected with cables, beams, or similar structures.

Note 2 to entry: Target body fixation is included in the target carrier.

#### 3.5

# measurement equipment

equipment used to record the position of the pedestrian target relative to the subject vehicle to ensure that the test protocol is followed within prescribed tolerances and record data documenting the function of the active safety system and allowing its performance to be assessed

# 4 Symbols and abbreviated terms PREVIEW

CCD Charge-Coupled Device (standards.iteh.ai)

FIR Far Infrared

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LIDAR Light Detection: and Rangingi/catalog/standards/sist/e2f37952-c78b-4a54-8942-

34442ce37a23/iso-19206-2-2018

NIR Near Infrared

PMD Photonic Mixer Device

RCS Radar Cross Section

# 5 Pedestrian target specifications

### 5.1 Pedestrian size

The pedestrian targets specified in this document reflect both adults and children. Male and female attributes are not explicitly defined as the systems being tested should not rely on the sex of the pedestrian. References for subsequent requirements are based on sample measurements of different demographics and compiled into categories. The following pedestrian sizes are relevant for this document:

- Adult: 50 %-ile male (walking mode);
- Child: 6-7 year old (running mode).

# 5.2 Dimensions of the targets

Annex A and Table A.1 provides the dimensional requirements for walking postures of a 50 %-ile male adult and running postures of a 6-7 year old child.

# 5.3 Safety considerations

Drivers of the subject vehicle shall not be exposed to any substantial risk of personal injury resulting from impact of the PT by the SV. The pedestrian target and its components should not cause more than cosmetic damage to the subject vehicle when struck at a relative velocity of 60 km/h. The conditions specified by the test procedure application shall be taken into consideration.

NOTE Test procedures for specific applications typically indicate what measures are taken to reduce the risk of injury and vehicle damage. These measures can include instructions to disable subject vehicle systems such as supplementary occupant restraints, seatbelt pre-tensioners, vulnerable user protection systems, etc.

EXAMPLE The Euro NCAP AEB VRU test procedure specifies that if a vehicle is equipped with a deployable pedestrian/VRU protection system, this system must be deactivated before the testing commences.

# 5.4 Repairability

The pedestrian target should be easily reassembled or repaired after contacts up to a relative speed of 60 km/h. Field repairs should be possible with hand tools. After repair, the target body and/or target carrier system shall be checked according to <u>6.5</u>.

NOTE This requirement does not apply to disposable targets.

### 5.5 Environmental conditions

The pedestrian target shall fulfil all requirements in a temperature range of -5 °C to +40 °C. The pedestrian target shall not deteriorate under storage temperatures in the range of -20 °C to +80 °C when properly stored.

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NOTE The specified temperature range recognises that there could be substantial technical challenges achieving a cost-effective target fulfilling the requirements at lower temperatures than -5 °C.

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**5.6 Postures and articulation**<sub>4442ce37a23/iso-19206-2-2018</sub>

# 5.6.1 General

Pedestrian target postures can be of static (non-articulated) or articulated type. Articulated targets equipped with moving legs, and optionally with moving arms, shall demonstrate that the motions are consistent with standard gait phases (see Figure 1).

The posture of the adult PT shall show an inclination of about 5° from upright (85° from horizontal), see <u>Annex A</u>, <u>Table A.1</u> and <u>Figure A.1</u> a).

The posture of a running child PT is approximately 12° from upright (78° from horizontal), see <u>Annex A</u>, <u>Table A.1</u> and <u>Figure A.2</u> a).

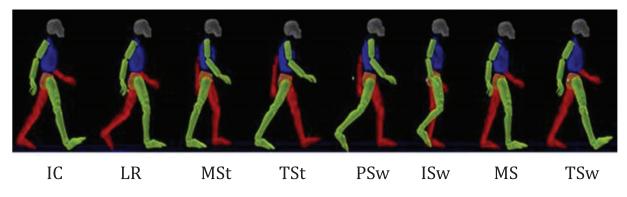


Figure 1 — Gait phases

# 5.6.2 Static posture

A static adult PT shall represent the walking phase MS. The lateral centre of mass of the target structure shall lie in-between the feet. The static child PT shall represent an appropriate running phase corresponding to LR.

# 5.6.3 Articulation posture

For articulated PTs, leg movement shall be realized in a manner that realistically represents that of a real pedestrian. Articulation properties as described in <u>Annex D</u> shall be followed.

Since real pedestrians may or may not exhibit arm motion, such arm motion is optional for articulated PTs. If implemented, they shall also be realized in a manner that realistically represents that of a real pedestrian.

# 6 Pedestrian target response to sensing technologies

## 6.1 General

Requirements related to sensing technologies commonly in use at the time of publication of this document are given in 6.2, 6.3 and 6.4.

A PT intended for use with a specific set of sensing technologies needs only to meet the requirements of those technologies.

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# 6.2 Optical requirements

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#### 6.2.1 General

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Sensors operating on optical principles include CCD and CMOS camera sensors, stereo camera sensors, Photonic Mixer Devices (PMD) and Light Detection and Ranging (LIDAR). These systems cover visible and near infrared (NIR) light frequency spectra. PMD and LIDAR are more reliant on infrared reflectivity of the target surface.

#### **6.2.2** Reference measurements

When technology specific measurements are required, information of the type of sensor used, environmental conditions during measurements, and date of measurement shall be provided with the description of the pedestrian target. The version of the pedestrian target and the target carrier shall be traceable to manufacturing drawings or supplier specifications. For more information, see Annex C.

# 6.2.3 Colours and clothing

Skin surface parts shall be non-reflective and skin-coloured. Hair may be represented by a hairpiece or integrated in the head design by other means.

For camera-based systems it is recommended to use a long-sleeved t-shirt and trousers in different, non-reflective, colours. A black t-shirt and blue jeans are recommended. Clothing shall be loose fitting, but fluttering shall be avoided. Features necessary for the optical recognition as specified in <u>Annex B</u> shall be followed.

# 6.3 Radar requirements

#### 6.3.1 General

At the time of publication of this document, automotive applications of radar are using 24 GHz and 76 GHz – 81 GHz.

#### **6.3.2** Reference measurements

Annex C provides the required reference measurement setups for human subjects to be used for verification.

When technology specific measurements are required, information of the type of sensor used, environmental conditions during measurements, and date of measurement shall be provided with the description of the reference subject(s). The version of the pedestrian target and the target carrier shall be traceable to manufacturing drawings or supplier specifications.

#### 6.3.3 Radar cross section measurement of PT

The radar reflective characteristics of the pedestrian targets, including the target carrier, should be comparable to a real pedestrian of the same size. Recommendations on radar properties are given in Annex B and Annex C.

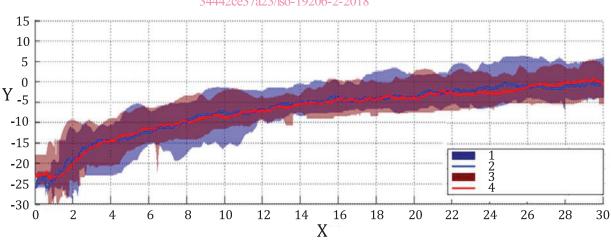
For every radar frequency relevant for the pedestrian target, a set of RCS (radar cross section) measurements shall be made. The main steps are as follows:

- 1) Measurement of pedestrian reference subjects or RCS standard targets;
- 2) Establishment of boundaries;
- 3) Verification that the pedestrian target RCS measurements are within the boundaries.

An example of the results of this process is illustrated in Figure 2.

The following scenario is described in C.3.3:

 Static PT approached by moving vehicle or moving fixture, to check for inconsistencies at different distances and different PT orientation angles.



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# Key

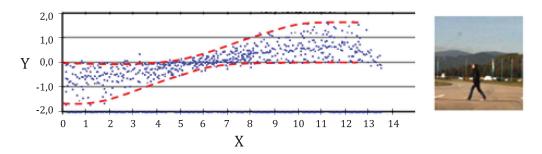
- 1 min-max with clothes
- 2 mean value with clothes
- 3 min-max nearly without clothes
- 4 mean value nearly without clothes
- X distance (m)
- Y RCS (dBsm)

Figure 2 — Radar cross-section measurement, example for adult pedestrians at 76 GHz

# 6.3.4 Micro-Doppler effect for articulated PT

Articulation of the PT legs will result in a micro-Doppler effect on the radar reflective characteristics. The micro-Doppler spread shall be comparable to that of a real pedestrian. In order to ensure a micro-Doppler effect comparable to human beings the articulation of the legs shall provide the characteristics of <u>D.2</u>

Example of micro-Doppler effect is shown in Figure 3.



# Key

- X time (s)
- Y relative velocity (m/s)

Figure 3 — Example of micro-Doppler effect with boundaries for a crossing pedestrian target

# 6.4 Thermal requirements for Far IR vision systems (standards.iteh.ai)

#### 6.4.1 General

Inclusion of passive thermal sensor requirements is optional, e2f37952-c78b-4a54-8942-

Far Infrared (FIR) vision systems can provide information to active safety systems in conditions of low light or otherwise limited visibility. A thermal camera detects FIR electromagnetic radiation with a wavelength in the range of 8 to 14  $\mu$ m. Imaging is provided by means of an appropriate camera.

## **6.4.2** Reference measurements

When technology specific measurements are required, information of the type of sensor used, environmental conditions during measurements, and date of measurement shall be provided with the description of the reference subject(s). The version of the pedestrian target and the target carrier system shall be traceable to manufacturing drawings or supplier specifications.

# 6.4.3 Thermal characteristics

Pedestrian targets commonly in use at the time of publication of this document do not feature humanspecific FIR characteristics. Developers of pedestrian targets that incorporate such characteristics should ensure that the characteristics of the pedestrian targets are comparable to a real pedestrian of the same size.

Characterization of these properties should follow the same main steps as described in clause 6.3.3:

- 1) Measurement of pedestrian reference subjects;
- 2) Establishment of boundaries;
- 3) Verification that the pedestrian target FIR measurements are within the boundaries.

### 6.5 Calibration and verification

The pedestrian target manufacturer shall provide a certificate detailing which test information has been used to verify the product performance and which sensor technologies it conforms to.

Calibration shall be based on representative characteristics of the applied detection technology as described in 6.2, 6.3 and 6.4, and the related Annexes.

For field verification of PT functionality, see Annex E.

# 7 Functional requirements for PT including target carrier system

# 7.1 General requirements

The target carrier system shall be capable of positioning the target within tolerances required by the different test procedures. Repeatable test performance requires that subject vehicle and pedestrian target relative speed and position shall be consistent between test repetitions. Unless more stringent requirements are needed by a specific test procedure, the positioning requirements outlined in this clause are the minimum requirements for the pedestrian target. Recommendations for measurement equipment are given in  $\underbrace{\text{Annex } C}$ .

The following requirements and recommendations apply to the target carrier system:

- All visible parts of the target carrier system should be transparent or coloured to minimize the
  contrast with background, e.g. grey, to approximate the test area road surface. In case of a uniform
  background the colour shade of the background can be used;
- Visible parts of the target carrier system should be non-reflective to light sources, e.g. headlamps during low natural light conditions;
- The target carrier system and resulting motion of the pedestrian target shall minimally affect target characteristics (radar, optical signature, etc). Design measures, e.g., radar absorbing material, shall be used at the PT mounting to ensure that the PT carrier provides minimal radar reflections;
- No deformations of target structure shall occur that influence the sensor response;
- The shoes of the dummy should not be more than 25 mm above the road surface;
- The articulated PT shall not appear to levitate or move its legs without moving forward or otherwise move or lean unnaturally with respect to its speed of travel. See <u>Annex D</u> for more specific information;
- The mounting of the pedestrian target body on the target carrier system (see <u>Annex F</u> for an example interface specification) shall be secure and not permit the target body and target carrier system to separate during any positioning sequence, within the limits specified in <u>7.2</u> through <u>7.4</u>;
- An unlocking system may be needed to release the PT immediately before or upon impact to prevent/ reduce severe damage by the collision;
- The target carrier shall accelerate and decelerate in a smooth manner, except for actions intended to avoid impact or damage. The PT shall not show unnatural changes of posture or movement during acceleration or deceleration.

The positioning requirements in 7.2 through 7.4 are with reference to a coordinate system oriented with the dummy. The longitudinal axis is parallel with the direction of travel. The face of the dummy is oriented in the direction of travel.