
**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

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

Partie 2: Exigences pour cibles de piétons

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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 voluntary nature of standards, 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.

This document was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 33, *Vehicle dynamics and chassis components*.

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

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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.

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.

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

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

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

3.1

subject vehicle

SV

vehicle with active safety system to be tested

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

CCD Charge-Coupled Device

FIR Far Infrared

LIDAR Light Detection and Ranging

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 [6.5](#).

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 $+40\text{ °C}$. The pedestrian target shall not deteriorate under storage temperatures in the range of -20 °C to $+80\text{ °C}$ when properly stored.

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 .

5.6 Postures and articulation

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 [Annex A, Table A.1](#) and [Figure A.1 a](#)).

The posture of a running child PT is approximately 12° from upright (78° from horizontal), see [Annex A, Table A.1](#) and [Figure A.2 a](#)).

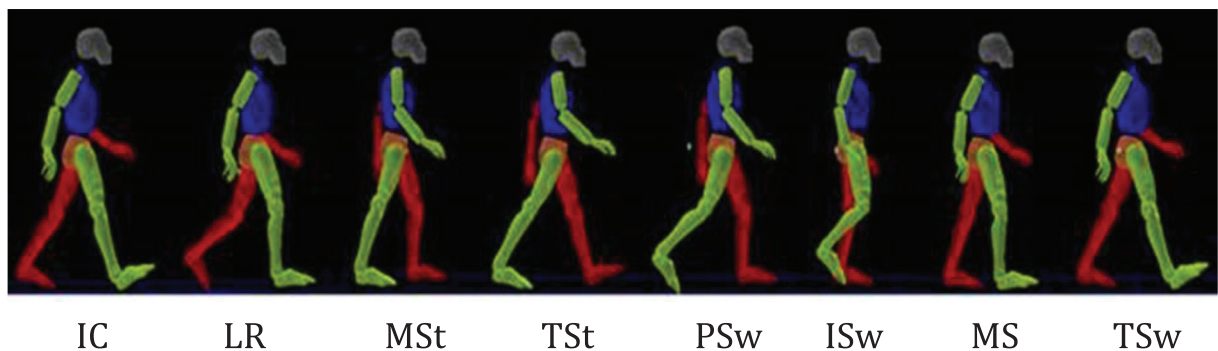


Figure 1 — Gait phases

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 [Annex D](#) 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.

6.2 Optical requirements

6.2.1 General

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 [Annex B](#) 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](#).

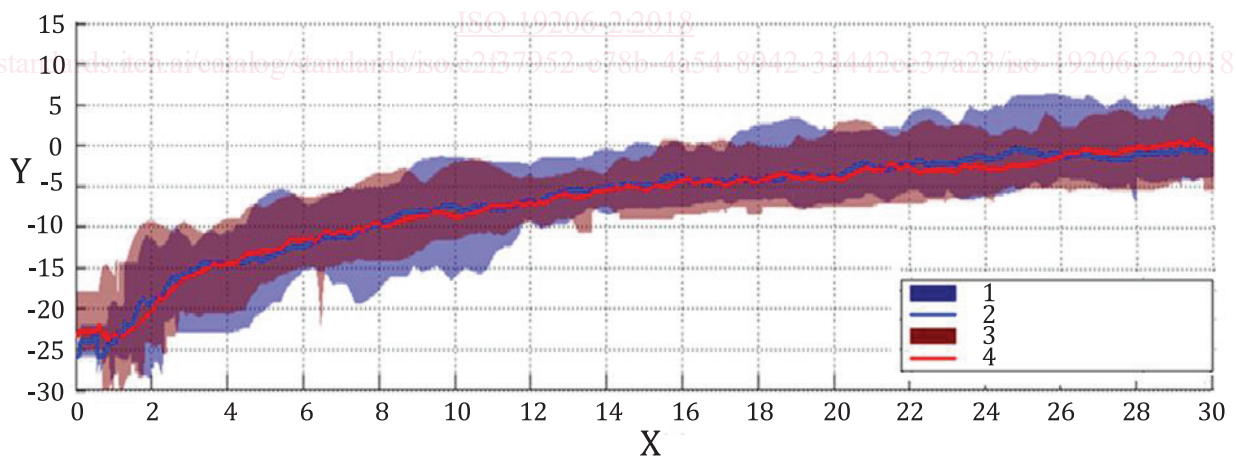
For every radar frequency relevant for the pedestrian target, a set of RCS (radar cross section) measurements shall be made. The main steps are as follows:

- 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.



Key

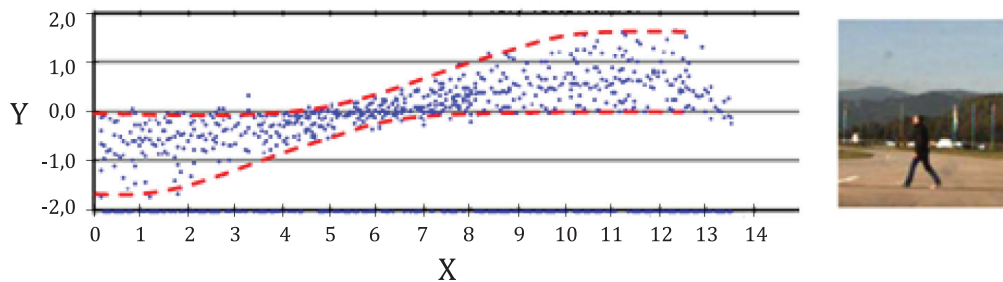
- 1 min-max with clothes
- 2 mean value with clothes
- 3 min-max nearly without clothes
- 4 mean value nearly without clothes
- X distance (m)
- Y RCS (dBsm)

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 [D.2](#)

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

6.4.1 General

Inclusion of passive thermal sensor requirements is optional.

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 μm . Imaging is provided by means of an appropriate camera. 19206-2-2018

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 human-specific 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.