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

Part 9: Requirements for small child targets

National foreword

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ISO/TS 19206-9

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

Part 9: Requirements for small child 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 9: Exigences pour cibles de petits enfants

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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).

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

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Advanced driver assistance systems (ADAS) 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.

The ISO 19206 series addresses the specification of test target objects for traffic scenarios representing vehicles, vulnerable road users and other objects in the path of the subject vehicle. This document addresses the specification of test targets for small children as a supplement to ISO 19206-2, where targets for an adult and a seven-year-old child are specified.

Small child test targets (SCT) represent two different sizes for testing of different functions to evaluate their performance. Current test procedures only address stationary SCT, and consequently this document only addresses the stationary SCT without movement by a target carrier.

The SCT described in this document series can be used for system development or applied in conjunction with existing standards, or standards under development, for assessment of active safety systems and automated driving systems (ADS).

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

Part 9: Requirements for small child targets

1 Scope

This document specifies performance requirements for surrogate small child targets (SCT) used to assess the system detection and activation performance of active safety systems and automated driving systems (ADS). This document specifies the properties of targets that represent two small children in terms of size, shape, reflection properties, etc. for testing purposes. The two targets represent a 9- to 12-month-old infant and a two-year-old toddler.

This document addresses the detection requirements for the targets in terms of sensing technologies commonly in use at the time of publication, and where possible, anticipated future sensing technologies. It also addresses methodologies to verify the target response properties to these sensors.

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

NOTE Related test procedures using small child targets according to this document can be found in ISO 4273 and ISO 23374-1.

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

ISO 17386, *Intelligent transport systems — Manoeuvring aids for low-speed operation (MALSO) — Performance requirements and test procedures*

ISO 19206-2, *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*

3 Terms and definitions

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

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

- IEC Electropedia: available at <https://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
small child target

SCT
test device representing an infant or a toddler used to test active safety systems

Note 1 to entry: "SCT" is an umbrella term and includes the infant target and the toddler target.

3.2.1
infant target

IT
test device representing an infant used to test active safety systems

Note 1 to entry: The infant target is corresponding to the dimensions of a 9- to 12-month-old child.

3.2.2
toddler target

TT
test device representing a toddler used to test active safety systems

3.3
target body
physical structure that resembles an infant or toddler body used to activate sensor systems

3.4
ultrasonic cross section

UCS
ratio between the echo amplitudes of the device under test and a reference pole

Note 1 to entry: The reference pole used in this document is specified in ISO 17386.

4 Symbols and abbreviated terms

LIDAR	light detection and ranging
NIR	near infrared
PMD	photonic mixer device
RCS	radar cross section
SCT	small child target
UCS	ultrasonic cross section
US	ultrasonic

5 Small child target specifications

5.1 General

The SCTs should represent small children that have a certain probability of being located in the path of a vehicle or in the area surrounding a vehicle. Relevant ages for vulnerable targets are an infant (see [5.2](#)) and a two-year-old child (see [5.3](#)).

The sizes and dimensions of small children depend slightly on the region. For the purposes of this document, data from the National Institute of Standards and Technology (NIST, USA)^[9] were used as they provide a broad statistical basis for different age classes. To check the plausibility of the NIST data, child growth data from the World Health Organization^[10] and the Child Anthropometry database CANDAT^{[11],[12]} were compared. The NIST dimensions were found to represent typical children with only slight deviations from the dimensions found in the other sources.

5.2 Infant target dimensions

The infant target (IT) shall represent a 9- to 12-month-old child that is able to crawl and stand upright. The IT dimensions given in [Annex A](#) shall be followed.

5.3 Toddler target dimensions

The toddler target (TT) shall represent a two-year-old child that is able to run and quickly change position. The TT dimensions given in [Annex A](#) shall be followed.

5.4 Postures

The joints at the hips, knees, shoulders and elbows shall be moveable to realize different static postures.

The IT static postures shall include standing, sitting and crawling, with the arms in different positions.

The TT static postures shall include standing, walking and sitting, with the arms in different positions.

Dynamic postures with articulation of the extremities, both for IT and TT, are optional.

The IT and TT may be attached to a movable target carrier. Speed range can be limited to 0 km/h to 5 km/h.

5.5 Repairability

The IT and TT should be easily reassembled or repaired after contact with a test vehicle up to a speed of 30 km/h. Field repairs should be possible with hand tools. After repair, the target body shall be verified according to [6.5](#).

5.6 Environmental conditions

The SCT shall meet all requirements in a temperature range of $-5\text{ }^{\circ}\text{C}$ to $+40\text{ }^{\circ}\text{C}$. The SCT shall not deteriorate under storage temperatures in the range of $-20\text{ }^{\circ}\text{C}$ to $+80\text{ }^{\circ}\text{C}$ when properly stored.

NOTE The specified temperature range recognises that there can be substantial technical challenges to achieving a cost-effective target that meets the requirements at temperatures below $-5\text{ }^{\circ}\text{C}$.

6 Small child target response to sensing technologies

6.1 General

The SCT is intended to be used in standardized ADAS tests for traffic situations with vehicle speeds up to 30 km/h and especially for parking manoeuvres to get comparable test results. According to favoured sensing technologies for low speed manoeuvring, the SCT shall especially provide realistic detection characteristics for cameras and ultrasonic (US) sensors. Light detection and ranging (LIDAR) and radar reflectivity characteristics may be limited to distances up to 10 m.

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](#).

An SCT 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 mono and stereo camera sensors, photonic mixer devices (PMD) and LIDAR. These systems cover visible and near infrared (NIR) light frequency spectra. PMD and LIDAR are more reliant on the infrared reflectivity of the target surface.

6.2.2 Visual requirements

The same requirements as for adult and child targets according to ISO 19206-2 shall apply.

For development testing, alternative colours of clothing of IT and TT can be chosen provided that the requirements of [6.2.3](#) are fulfilled.

6.2.3 Near infrared (NIR) requirements

The same requirements as for adult and child target according to ISO 19206-2 shall apply.

IR reflectivity shall be measured in accordance with ISO 19206-2.

6.2.4 Reference measurements

When technology-specific reference measurements are required, information on the type of sensor used, the environmental conditions during measurement and the date of measurement shall be provided with the description of the SCT. The version of the SCT shall be traceable to manufacturing drawings or supplier specifications. For more information, see [Annex C](#).

6.3 Radar requirements

6.3.1 General

At the time of publication of this document, automotive applications of radar use 24 GHz and 76 GHz to 81 GHz.

6.3.2 Reference measurements

The reference measurement setups for human subjects specified in [Annex C](#) shall be used for verification.

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

6.3.3 Radar cross section (RCS) measurement of small child target

The radar reflective characteristics of the SCT should be comparable to real children of the same size. Recommendations on radar properties are given in [Annex C](#). It is recommended to conduct the measurements with older children and not with infants or toddlers. Use extrapolated data from these measurements to achieve a size-scaled radar cross section (RCS) for the IT and the TT, assuming that the RCS of the IT and the TT is the same, since the size difference is very small. An example of a scaling procedure is shown in [C.3.2](#).

For every radar frequency relevant for the TT, a set of RCS measurements shall be made. The main steps are as follows:

- 1) Measure the toddler reference subjects or RCS standard targets.
- 2) Establish the boundaries.
- 3) Verify that the RCS measurements of the TT are within the boundaries.