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

Part 1: Requirements for passenger vehicle rear-end 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 1: Exigences pour cibles d'arrière de véhicules particuliers

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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.

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 vehicle rear-end test targets (see Annex E for examples of existing vehicle rear-end targets). A future part of this document series is intended to address also other configurations (3D targets).

A surrogate vehicle target needs to represent a real vehicle in terms of detectability and movement. It should also provide safety for the subject vehicle and test operators in the event that contact is made between the subject vehicle and the target. Crashworthiness and durability requirements for the vehicle target require that the material and construction of the vehicle target are adapted to fit the purposes.

Test cases usually address both stationary and moving vehicle targets and, as such, the physical construction of the target accommodates a target carrier system capable of mimicking realistic motions. 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.

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

Part 1: Requirements for passenger vehicle rear-end 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 a vehicle target that will allow it to represent a passenger vehicle in terms of size, shape, reflection properties, etc. for testing purposes. The document addresses the detection requirements for a vehicle 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 performance requirements for the target carrier.

This document specifies the properties of the vehicle target for simulation of rear-end scenarios, with overlap greater than 50 %. The specifications of vehicle targets in this document are intended to address current and anticipated test protocols related to safety critical events in which the subject vehicle approaches a stopped, braking or slower moving (target) vehicle from behind and in the forward path of the subject vehicle.

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

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
vehicle target
VT
test device representing a vehicle in the forward path of the subject vehicle used to test active safety systems

Note 1 to entry: This document addresses test devices representing the rear-end of a vehicle.

3.3
target structure
physical structure used to activate sensor systems representing the body of a vehicle

3.4
target carrier
mechanical system used to move the target structure according to a test protocol

Note 1 to entry: It may be self-contained within, or supporting the target structure or external devices connected with cables, beams, or similar structures.

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

3.5
measurement equipment
equipment used to record the position and motions of the vehicle target relative to the subject vehicle to ensure that the test protocol is followed within prescribed tolerances and to 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 Vehicle target specifications

5.1 Vehicle classes and target applicability

The vehicle targets specified in this document refer to passenger cars and in particular the smaller and more common B and C class cars. See Annex A for more information.

The vehicle targets are intended for testing of systems designed to mitigate or avoid collisions in which the subject vehicle approaches a stopped, braking, or slower moving vehicle (target) from behind and in the forward path of the subject vehicle.

The vehicle target should withstand impacts for all rear collision overlap situations.

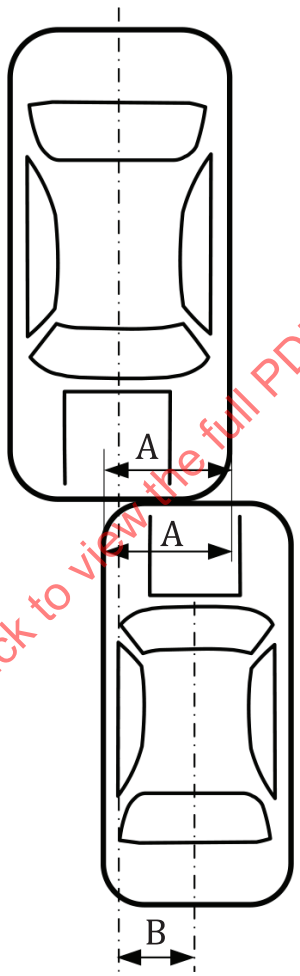
For system tests, the range of potential collision situations of interest includes those having 50 % up to 100 % vehicle target width overlap.

The rear-end target should not be used in offset scenarios where subject vehicle sensors will view the side of the vehicle target.

Figure 1 shows the ISO definition of overlap. It should be noted that the overlap is related to one of the vehicles involved.

NOTE Vehicle width overlap specifications are typically described in a test procedure.

EXAMPLE The Euro NCAP AEB test procedure specifies 100 % vehicle width overlap.



Key

A overlap

B offset

Figure 1 — Overlap and offset definition (approximately 60 % overlap frontal collision shown) (Source: ISO 6813)

5.2 Reference dimensional measurements

Reference measurements for the vehicle target should come from a representative sample of vehicles from the B/C class that were manufactured within five years prior to the publication date of this document.

General dimensions of the vehicle fleet are given in Annex A.

5.3 Safety considerations

Drivers of the subject vehicle shall not be exposed to any substantial risk of personal injury. The vehicle 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 US NHTSA test procedure for crash imminent brake system performance evaluation specifies that the subject vehicle airbags be disabled. The Euro NCAP AEB 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 vehicle target should be easily reassembled or repaired after minor contacts. Field repairs should be possible to perform with hand tools. After repair or reassembly, the vehicle target shall be checked according to 6.5.

5.5 Environmental conditions

The vehicle target shall fulfil all requirements in an ambient temperature range of −5 °C to +40 °C. The vehicle target shall not deteriorate under storage temperatures in the range of −40 °C to +80 °C when properly stored.

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

6 Vehicle 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 listed in 6.2, 6.3 and 6.4. A vehicle target 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 vehicle models. The version of the vehicle target and the target carrier shall be traceable to manufacturing drawings or supplier specifications.

General dimensions of the vehicle fleet are given in Annex A.

6.2.3 Stability of dimensions for optical recognition

Target surface shall not flutter or vibrate unrealistically due to aerodynamic effects for a speed up to 50 km/h and a side wind of up to 10 m/s. Local fluttering should not exceed 10 mm perpendicularly from the reference surface. Distortion of the vehicle shape should not exceed 10 mm in any direction.

6.2.4 Viewing angles

Viewing angles for which target should be valid, at a distance of 10 m:

— Horizontal ±5°;

— Vertical up to 10° from above if used with vehicles having high sensor positioning (e.g. commercial vehicles, SUVs).

6.2.5 Features related to optical requirements

For camera based systems, lighter colours of vehicle targets shall be used. Silver or grey is recommended. Contrast to background should be considered.

Features representing the rear lights, reflectors, and registration plate are required.

General requirements for the size and position of these features are available in e.g. 407/2011/EC, UN-ECE R3, UN-ECE R48, FMVSS 108.

Features necessary for the optical recognition as specified in Annex B shall be followed.

6.3 Radar requirements

6.3.1 Reference measurements of radar properties

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

Reference measurements for the vehicle target should come from a representative sample of vehicles from the B/C class that were manufactured within five years prior to the publication date of this document.

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 vehicle models. The version of the vehicle target and the target carrier shall be traceable to manufacturing drawings or supplier specifications.

6.3.3 Radar cross section, static measurements and requirements

Requirements for the measurement of radar cross section are given in Annex C, C.3.

6.3.4 Radar recognition features of vehicle target

Features necessary for radar recognition as specified in Annex B shall be followed.

6.3.5 Stability of dimensions for radar recognition

Target surface shall not flutter or vibrate due to aerodynamic effects more than a normal car for a speed up to 50 km/h and a side wind of up to 10 m/s. Local fluttering should not cause radar signature to vary, including micro-doppler effects.

6.4 Thermal requirements for Far Infrared vision systems

The vehicle target is defined as possessing the optical characteristics according to 6.2 with features added to provide response to thermal sensing. Inclusion of passive thermal sensor requirements is optional.

6.4.1 General

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 µm to 14 µm. 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 measured subjects and/or target. The version of the target and the target carrier shall be traceable to manufacturing drawings or supplier specifications.

6.4.3 Thermal characteristics

Vehicle targets commonly in use at the time of publication of this document do not feature vehicle-specific FIR characteristics. Developers of vehicle targets that incorporate such characteristics should ensure that the characteristics are comparable to typical vehicles represented by the target.

Characterization of these properties should follow the main steps below:

1) Measurement of reference vehicles;

2) Establishment of boundaries;

3) Verification that the vehicle target FIR measurements are within the specified boundaries.

6.5 Calibration

The vehicle 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 vehicle target functionality, see Annex D.

7 Motion and positioning during test for VT including target carrier system

7.1 General requirements

The target carrier system shall be capable of positioning the target within tolerances required by the test procedure application. Repeatable test performance requires that subject and vehicle 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 section are the minimum requirements for the vehicle target. Requirements and recommendations for measurement equipment are given in Annex C.

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

— All visible parts of the target carrier system should be 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;

— The target carrier system and resulting motion of the vehicle target shall minimally affect target characteristics (radar, optical signature, etc.);

— The target carrier shall accelerate and decelerate in a smooth manner, except for actions intended to avoid impact or damage.

The positioning requirements in 7.2, 7.3, and 7.4 are with reference to a coordinate system oriented with the vehicle target. The longitudinal axis is parallel with the direction of travel.

7.2 Longitudinal positioning

7.2.1 Speed range for operation

Maximum speed shall be at least 50 km/h (13,9 m/s). The speed control accuracy shall be ±1 km/h (±0,3 m/s).

7.2.2 Accelerations

Deceleration/braking of 6 m/s^2 is required. Acceleration of at least 1 m/s^2 is recommended.

7.3 Lateral positioning

7.3.1 General

The vehicle target shall be able to meet the lateral positioning requirements in 7.3.2 and 7.3.3 while operating in the speed range defined in 7.2.1 over a smooth road surface no rougher than road class A as defined in ISO 8608.

7.3.2 Yaw angle

The vehicle target shall be capable of maintaining a straight line path within ±2° of the direction of travel.

7.3.3 Lateral position

During straight line manoeuvres, when using a self-propelled target carrier, the vehicle target shall be able to maintain a straight line within ±0,1 m.

During straight line manoeuvres, when using a tow system, the vehicle target shall be able to follow the path of the towed vehicle with a maximum deviation of ±0,1 m.

7.4 Vertical positioning

7.4.1 General

The vehicle target shall be able to meet the vertical positioning requirements in 7.4.2 and 7.4.3 while operating in the speed range defined in 7.2.1 over a smooth road surface no rougher than road class A as defined in ISO 8608.

7.4.2 Pitch angle

For straight line motions at constant speed, the pitch angle of the VT shall not exceed ±2°.

7.4.3 Vertical motions

The vehicle target average surface should not vibrate or bounce more than 25 mm when operating in the speed range defined in 7.2.1 over a smooth road surface.

Annex A
(informative)

Vehicle classes

The vehicle targets specified in this document reflect passenger cars and, in particular, the smaller and more common B and C class cars. References for requirements in the document are based on a sample of vehicles from the relevant class. The criteria apply to the target structure, connected target carrier system components, and installed instrumentation. The vehicle classes referred to in the document are given in Table A.1.

Table A.1 — Vehicle classes

Vehicle class			Example vehicles[c]
EU[a]	US[b]	Euro NCAP	
A - Mini car	MiniCompact Car	City Car	Ford Ka®, Smart Fortwo®, Toyota Aygo®, Volkswagen Up®
B - Small car	Subcompact Car	Supermini	Ford Fiesta®, Volkswagen Polo®, Opel Corsa®, Peugeot 207®
C - Medium car	Compact Car	Small Family Car	Ford Focus®, Volkswagen Golf®, Opel Astra®, Volvo V40®
D - Large car	Midsize Car	Large Family Car	Ford Mondeo®, Hyundai Sonata®, Opel Insignia®, Alfa Romeo 159®, Mercedes C-Class®, BMW 3 Series®, Volvo S60®
E - Executive car	Full Size Car	Executive Car	Lexus GS®, BMW 5 Series®, Jaguar XF®, Volvo S80®
J - Sports utility car	Mid-size SUV Full-size SUV	Small Off-Road 4×4 Large Off-Road 4×4	Ford Escape®, Honda CR-V®, Jeep Liberty®, Kia Sportage® Jeep Grand Cherokee®, Volkswagen Touareg®, Volvo XC90®
M - Multi purpose car	MPV Minivan Cargo van	Small MPV Large MPV	Citroën C3 Picasso®, Ford B-Max®, Renault Kangoo® VW Touran®, Ford C-Max, Renault Scenic® Ford Galaxy®, Peugeot 807®, SEAT Alhambra®

[a] The EU vehicle classes are as referred to in Case No COMP/M.1406.

[b] The US classes are defined in Federal Regulations 40 CFR 600.315-82.

[c] The trade names of these products are examples of suitable products available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

Some general dimensions of the vehicle fleet are given below.

Average width of the entire vehicle fleet and for the C class:

— Average width, A to M class: 1 751 mm;

— Average width, C class: 1 741 mm.

Range of vehicle widths for the entire fleet:

— Minimum width, A class: 1 397 mm;

— Maximum width, M class: 1 970 mm;

— Minimum width, C class: 1 701 mm;

— Maximum width, C class: 1 775 mm.

Annex B
(normative)

Sensor-specific recognition properties

B.1 General

The vehicle target (VT) shall be able to represent the attributes of a reference vehicle in relation to the sensors used in the subject vehicle (SV). For system testing with a certain detection technology in the SV, the VT shall be equipped with the relevant corresponding features given below.

B.2 Visual and near infrared properties

B.2.1 Overall visual properties

The following requirements and recommendations apply, to enable a proper recognition with regard to visual detection:

— The visual difference between the passenger car target and a real representative car of the B and C class should be as small as possible;

— The contours of the target should be representative of real cars of the B and C class;

— The target should demonstrate a high level of vertical symmetry;

— The chassis paint should be plain (no texturing);

— The colour and the texture should not blend in with the background;

— The representation of wheels and tire shapes shall be visible from both behind and from each side;

— A free space between chassis and road of approximately 170 mm is required and a realistic shadow shall be visible;

— A realistic representation of the rear window is required.

B.2.2 License plate

— The VT shall include a visual representation of a license plate;

— The license plate shall be representative of the region for which the VT is intended, with respect to size, colour, position and reflectivity;

— Where feasible the VT should be equipped with a real license plate. A license plate shall not be mounted behind a transparent plastic foil;

— In case of using foil/sticker material, its size and position shall be equal to size and position of a standard registration plate for the region of sale for the subject vehicle (e.g. 520 mm × 110 mm in Europe, 305 mm × 152 mm (12 in × 6 in) in North America).

B.2.3 Lighting and retroreflectors

— The passenger car target shall include a visual representation of rear retroreflectors and rear lighting;

— The retroreflectors and lighting shall be representative of the region for which the VT is intended, with respect to size, colour, placement and reflectivity;

— Functional rear lights and brake lights can optionally be implemented;

— Optionally, a reflective foil colour “red” can be used (meeting the specifications of UN R104 or FMVSS 108);

— Optionally, pictures of rear lights can be printed to reflective foil (meeting the specifications of UN R104 or FMVSS 108).

B.2.4 Near infrared properties

With regard to NIR detection (for a wavelength of around 850 to 910 nm), the following requirements shall be fulfilled in addition to the ones in B.2.1 to B.2.3:

— A homogeneous visible surface without specular reflections is required;

— The target surface shall consist of material with reflectivity in the relevant IR band of about 50 % (substitute value for real car, based on measurements);

— The VT shall have properties similar to a real car with respect to IR reflectivity of the license plate/tail reflector.

B.3 Radar properties

B.3.1 General

The difference between the passenger car target and a real car concerning radar reflectivity should be as small as possible.

Two separate radar reflectors with different characteristics are needed.

B.3.2 Reflector representing the rear bumper

The following requirements shall be fulfilled:

— The total radar cross section shall be approximately 30 m^2;

— The vertical position shall be approximately 350 mm above ground;

— The longitudinal position shall be at the rear end of the passenger car target.

The following recommendations also apply:

— The rear bumper should have a semi-circular shape with radius of 5 m;

— The reflector should consist of about 1,5 m wide homogeneous base (e.g. metal bar) with 20 m^2 radar cross section and 10 m^2 radar cross section centred (e.g. triple mirror) due to a radar intensity maximum in vertical middle.

B.3.3 Reflector representing the rear axle

The following requirements shall be fulfilled:

— The total radar cross section shall be approximately 20 m^2;

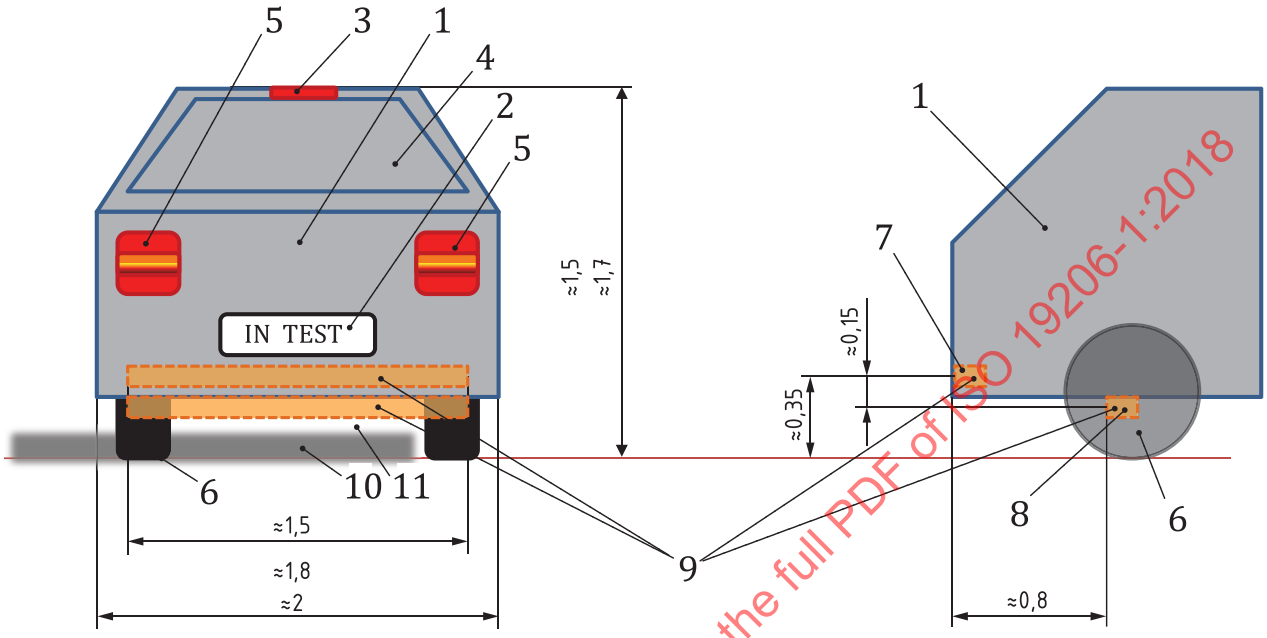
— The vertical position shall be approximately 200 mm above ground;

— The longitudinal position shall be approximately 800 mm from the rear end of the passenger car target;

— The space underneath the rear section of the passenger car target (line of sight from radar sensor to reflectors) shall be free from radar-reflective objects.

The following recommendation also apply:

— The reflector should consist of about 1,5 m wide homogeneous base (e.g. metal bar) with homogeneously spread reflectors (e.g. triple mirrors).



Key

1 homogeneous, plain coloured chassis, material with 50 % IR reflectivity at approximately 850 nm wavelength
2 visual representation of a license plate, or real license plate
3 third brake light, retro-reflective or functional
4 realistic representation of rear window
5 rear lights and brake lights, retro-reflective or functional
6 tire shape visible from behind and from side
7 rear bumper: RCS approximately 30 m^2; recommended homogeneous base 20 m^2 and 10 m^2 centred
8 rear axle: RCS approximately 20 m^2, homogeneously spread over vehicle width
9 radar reflectors for rear bumper and rear axle
10 characteristic shadow visible
11 free space visible

Figure B.1 — Illustration of visual, near infrared and radar properties

Annex C
(normative)

Vehicle target measurements and measurement equipment

C.1 Measurement of position, speed, acceleration of the vehicle target

Relevant parameters like position, speed and acceleration of the vehicle target shall be possible to measure continuously.

For test situations where timing is critical, e.g. for determining the exact positions of SV and VT, a timing accuracy within 15 ms is required to ensure synchronisation of the SV and VT instrumentation.

Table C.1 lists the recommended instrumentation needed to conduct field verification tests and confirm positioning performance. Any formal testing of active safety system will follow protocols with prescribed instrumentation.

Sensors placed in the target are susceptible to damage in the event of a collision. Sensors can be placed within the target carrier if their relative position to the centre of the rear bumper of the target is stable with ± 10 mm variations during operation.

Table C.1 — Recommended measurement equipment specifications

Recorded Data	Range	Resolution	Accuracy
Vehicle target longitudinal speed	0,1 - 100 km/h	0,1 km/h	±0,25 % of full scale
Vehicle target longitudinal acceleration	±20 m/s^2	0,02 m/s^2	±0,01 % of full scale
Longitudinal and lateral position of subject vehicle and vehicle target	±200 m from a reference position on track	0,05 m	±0,05 m absolute

C.2 Measurement of IR reflectivity

C.2.1 Equipment and calibration

Measurement of the IR reflectivity is carried out using a spectrometer for wavelength range 800 nm to 900 nm.

Before the start of the measurement the device shall be calibrated with a reflection standard, reflectance 99 %. The calibration should be verified by reflectance standards with reflectivity of e.g. 50 % or 20 %.

C.2.2 Measurement setup

The measurement of the target should be conducted with a special attachment to the measurement sensor, which ensures a defined distance and angles (90° and 45°) between sensor and target depicted in Figure C.1.

The measurement shall be performed at three different points of the measuring object and shall be recorded.

The resulting IR reflectivity value corresponds to the average of the three reflectivity measurements.

Figure C.1 — Measurement sensor attachments, 90° and 45°

C.3 Measurement of radar reflectivity

For a selected radar-based sensor system, a set of radar cross section measurements shall be made for distances between 10 m and 100 m and plotted as shown in Figure C.2. The measurements shall be made for the configurations in Table C.2.

Table C.2 — Radar cross section measurements

Vehicle class	100 % overlap	50 % overlap
A	±5° Horizontal	
B	±10° Horizontal	±5° Horizontal
C	±10° Horizontal	±5° Horizontal

The reference vehicles shall be stationary with no operating equipment. Values in Table C.2 are with respect to the reference vehicles.

NOTE Overlap definitions are given in ISO 6813. See Also Figure 1.

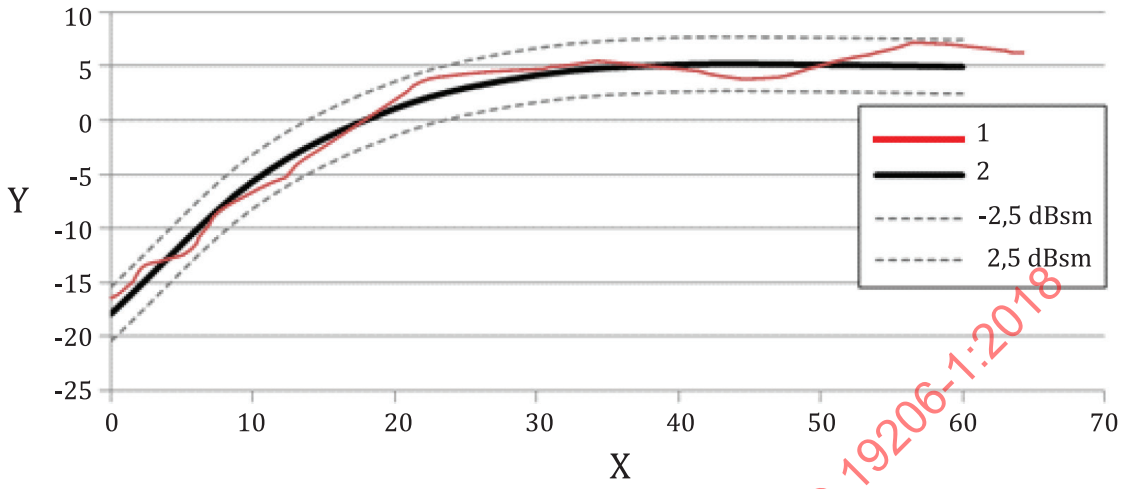
The main steps are as follows:

1) Measurement of reference vehicle;

2) Establishment of boundaries;

3) Verification that the vehicle target RCS measurements are within the boundaries.

Reference measurements from the vehicle class and the vehicle target are plotted as in Figure C.2 with average and ±2,5 dBsm corridors identified for the sample reference vehicles.



Key

1 RCS for VT
2 sample reference average RCS
X target distance (m)
Y RCS (dBsm)

Figure C.2 — Radar cross-section corridor, example

Annex D
(informative)

Field verification of vehicle target properties

D.1 General

To assist with the testing process, field verification measurements with the subject vehicle's equipment could be made using the following procedure. The evaluation can be made with the subject vehicle or a reference vehicle having the same sensing and detection technology as the SV.

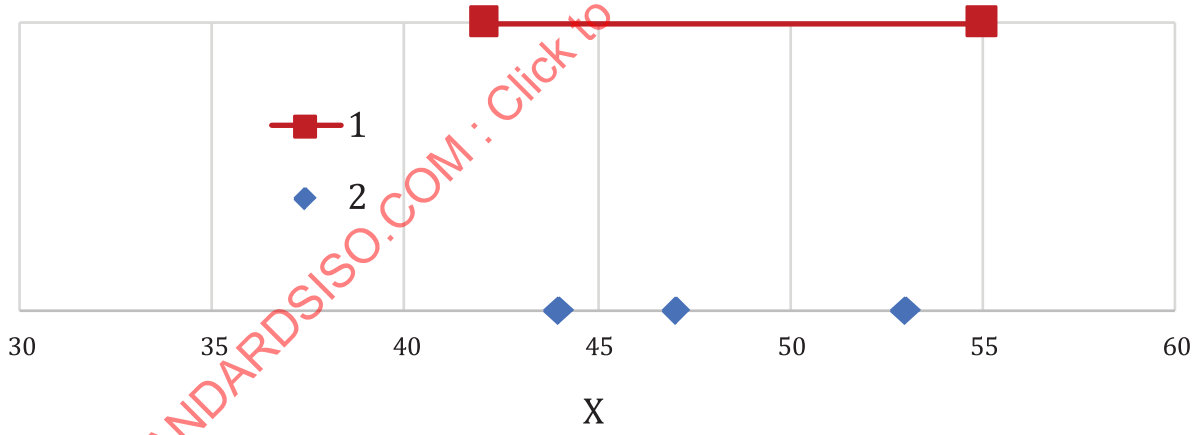
D.2 Field verification procedure using collision warning feature

In a dry, well-lit environment (in excess of 2 000 lux), the vehicle is driven towards the stationary VT 3 times at the lowest speed sufficient to activate the sensing system. The distance when the first warning signal appears to the driver, X_{warn}, is recorded.

The resulting test data will be used to create a verification interval in which the quality of the target can be assessed during the test series.

Subsequent tests of the vehicle and target under the same field verification test procedure should provide warning activations within the interval defined by $X_{warn} \pm SD(X_{warn})$.

An example of the verification interval and verification test results is shown in Figure D.1.



Key

1 verification interval
2 test data
X warning distance (m)

Figure D.1 — Field verification data (example values)

D.3 Field verification procedure at lowest activation speed

Perform at least 3 runs towards the stationary VT at the lowest test speed the system is supposed to activate the brakes. Use the same principle as in D.2 and Figure D.1 to verify that the VT is functional.