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Road vehicles — Test method to evaluate the performance of autonomous emergency braking systems —

Part 2: Car to pedestrian

Véhicules routiers — Méthode d'essai pour évaluer la performance des systèmes automatiques de freinage d'urgence —

Partie 2: Voiture à piéton

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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 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 22733 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

The capacity to avoid or mitigate a collision during -potential accident - is an important part of the performance of an autonomous braking system fitted in a road vehicle. This document is intended to assess performance of an autonomous braking under defined test scenario only.

NOTE Moreover, insufficient knowledge is available concerning the relationship between overall vehicle dynamic properties and accident avoidance. A substantial amount of work is necessary to acquire sufficient and reliable data on the correlation between accident avoidance and vehicle dynamic properties in general and the results of these tests in particular.

Road vehicles — Test method to evaluate the performance of autonomous emergency braking systems —

Part 2:
Car to pedestrian

1 Scope

This document specifies test methods to evaluate performance of the autonomous emergency braking system (AEBS) in car to pedestrian collision situations. Forward collision warning system (FCWS) is part of AEBS when it provides warning before braking intervention.

Vehicle to pedestrian accidents occur when a vehicle under test (VUT) drives in straight line and either a pedestrian walks longitudinal on the same road or the pedestrian is approaching perpendicular the road.

A system requiring a driver intervention is not in scope of this document.

NOTE Depending on accidentology only a part of the scenarios can be used for an evaluation of performance.

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 15037-1:2019, *Road vehicles — Vehicle dynamics test methods — Part 1: General conditions for passenger cars*

ISO 22733-1:2022, *Road vehicles — Test method to evaluate the performance of autonomous emergency braking systems — Part 1: Car-to-car*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8855 and ISO 15037-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
AEB
autonomous emergency braking
braking applied automatically by the vehicle in response to the detection of a likely collision to reduce the vehicle speed and potentially avoid the collision

Note 1 to entry: For a complete definition refer to ISO 22839.

3.2
CPFA-50
car-to-pedestrian farside adult 50 %
collision in which a vehicle travels forwards towards an adult pedestrian crossing its path running from the farside and the frontal structure of the vehicle strikes the pedestrian at 50 % of the vehicle's width when no braking action is applied

[SOURCE: Reference [4], Clause 2]

3.3
CPNA-25
car-to-pedestrian nearside adult 25 %
collision in which a vehicle travels forwards towards an adult pedestrian crossing its path walking from the nearside and the frontal structure of the vehicle strikes the pedestrian at 25 % of the vehicle's width when no braking action is applied

[SOURCE: Reference [4], Clause 2]

3.4
CPNA-75
car-to-pedestrian nearside adult 75 %
collision in which a vehicle travels forwards towards an adult pedestrian crossing its path walking from the nearside and the frontal structure of the vehicle strikes the pedestrian at 75 % of the vehicle's width when no braking action is applied

[SOURCE: Reference [4], Clause 2]

3.5
CPNC-50
car-to-pedestrian nearside child 50 %
collision in which a vehicle travels forwards towards a child pedestrian crossing its path running from behind and obstruction from the nearside and the frontal structure of the vehicle strikes the pedestrian at 50 % of the vehicle's width when no braking action is applied

[SOURCE: Reference [4], Clause 2]

3.6
CPLA-25
car-to-pedestrian longitudinal adult 25 %
collision in which a vehicle travels forwards towards an adult pedestrian walking in the same direction in front of the vehicle where the vehicle strikes the pedestrian at 25 % of the vehicle's width when no braking action is applied or an evasive steering action is initiated after a *forward collision warning (FCW)* (3.8)

[SOURCE: Reference [4], Clause 2]

3.7
CPLA-50
car-to-pedestrian longitudinal adult 50 %
collision in which a vehicle travels forwards towards an adult pedestrian walking in the same direction in front of the vehicle where the vehicle strikes the pedestrian at 50 % of the vehicle's width when no braking action is applied

[SOURCE: Reference [4], Clause 2]

3.8
FCW
forward collision warning
audio-visual warning provided automatically by the vehicle in response to the detection of a likely collision to alert the driver

3.9
PTa
pedestrian target adult
test device representing an adult pedestrian used to test active safety systems

[SOURCE: ISO 19206-2:2018, 3.2, modified — "Adult" has been added to the term and the definition.]

3.10
PTc
pedestrian target child
test device representing a child pedestrian used to test active safety systems

[SOURCE: ISO 19206-2:2018, 3.2, modified — "Child" has been added to the term and the definition.]

3.11
TTC
time to collision
remaining time before the *vehicle under test (VUT)* (3.15) strikes the pedestrian target (PT), assuming that the VUT and PT would continue to travel with the speed it is travelling

3.12
$\boldsymbol{T_{AEB}}$
time where the *autonomous emergency braking (AEB)* (3.1) system activates

Note 1 to entry: Activation time is determined by identifying the last data point where the filtered acceleration signal is below -1,0 m/s^2, and then going back to the point in time where the acceleration first crossed -0,3 m/s^2.

3.13
$\boldsymbol{T_{FCW}}$
time where the audible warning of the *forward collision warning (FCW)* (3.8) starts

Note 1 to entry: The starting point is determined by audible recognition or video analysis.

3.14
$\boldsymbol{T_{impact}}$
speed at which the profiled line around the front end of the *vehicle under test (VUT)* (3.15) coincides with the square box around the *pedestrian target adult (PTa)* (3.9), *pedestrian target child (PTc)* (3.10) as shown in the Figure 1

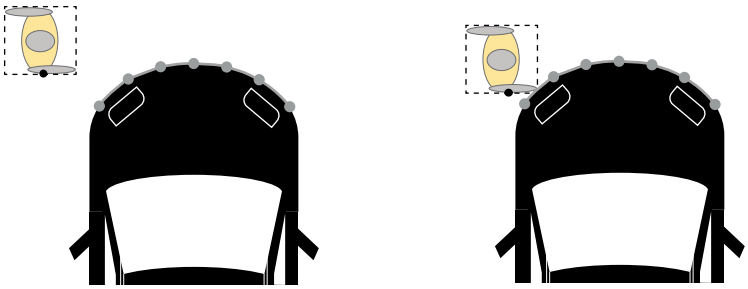


Figure 1 — Definition of impact

3.15
VUT
vehicle under test
vehicle tested according to this document with a pre-crash collision mitigation or avoidance system on board

3.16
vehicle width
widest point of the vehicle ignoring the rear-view mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lamps, flexible mud-guards and the deflected part of the tyre side-walls immediately above the point of contact with the ground

4 Reference system and variables

4.1 Coordinate system

For VUT and PT use the convention specified in ISO 8855 in which the x-axis points towards the front of the vehicle, the y-axis towards the left and the z-axis upwards (right hand system), with the origin at the most forward point on the centreline of the VUT for dynamic data measurements as shown in Figure 2.

Viewed from the origin, roll, pitch and yaw rotate clockwise around the x, y and z axes respectively. Longitudinal refers to the component of the measurement along the x-axis, lateral refers the component along the y-axis and vertical refers the component along the z-axis.

This reference system should be used for both left (LHD) and right-hand drive (RHD) vehicles tested.

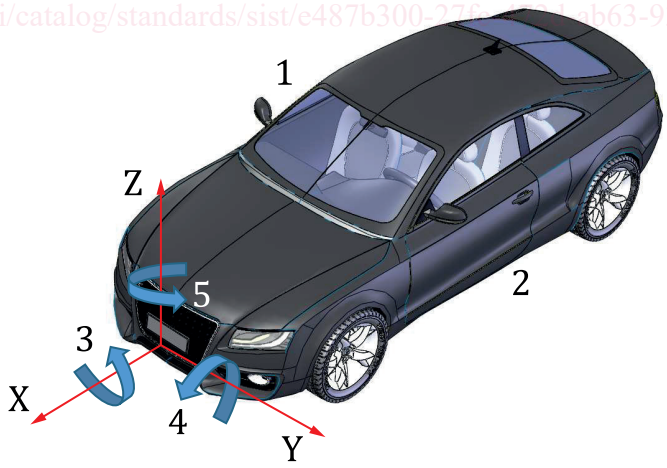
The nearside is swapped as per LHD and RHD vehicles. Figure 2 shows the near and farside of the vehicle for an LHD vehicle.

The reference earth frame according to ISO 8855:2011, 2.8 is defined as:

— X_E axis: intended straight line path projected on the ground to front;

— Y_E axis: perpendicular to X axis on the ground to left;

— Z_E axis: perpendicular to the ground to the top.



Key

X	longitudinal(X)	Y	lateral(Y)
Z	vertical(Z)	1	NEAR SIDE
2	FAR SIDE	3	roll (φ)
4	pitch (θ)	5	yaw (Ψ)

Figure 2 — Coordinate system and notation (LHD and RHD), nearside and farside for LHD vehicle