

Passenger cars — Stopping distance at straight-line braking with ABS — Open-loop test method

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National foreword

This British Standard is the UK implementation of ISO 21994:2007.

The UK participation in its preparation was entrusted to Technical Committee AUE/15, Safety related to vehicles.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Passenger cars — Stopping distance at straight-line braking with ABS — Open- loop test method

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 21994 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 9, *Vehicle dynamics and road-holding ability*.

Introduction

The stopping distance of a road vehicle is an important part of vehicle performance and active vehicle safety. Any given vehicle, together with its driver and the prevailing environment, constitutes a unique closed-loop system. The task of determining the stopping distance is therefore very difficult, since there is a significant interaction between these driver-vehicle-environment elements, each of which is complex in itself.

Test conditions and tyres have a strong influence on test results. Therefore, only vehicle stopping distances obtained under comparable test and tyre conditions are comparable to one another.

Passenger cars — Stopping distance at straight-line braking with ABS — Open-loop test method

1 Scope

This International Standard specifies an open-loop test method to determine the stopping distance of a vehicle during a straight-line braking manoeuvre, with the Anti-lock Braking System (ABS) fully engaged. This International Standard applies to passenger cars as defined in ISO 3833 and light trucks.

This International Standard specifies a reference method and is especially designed to ensure high repeatability.

2 Normative references

The following referenced documents are indispensable for the application 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 3833, *Road vehicles — Types — Terms and definitions*

ISO/TR 8349, *Road vehicles — Measurement of road surface friction*

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

ISO 15037-1:2006, *Road vehicles — Vehicle dynamics test methods — Part 1: General conditions for passenger cars*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8855 and the general conditions given in ISO 15037-1 shall apply. For specific terms see Annex C.

4 Principle

This International Standard specifies a method to determine the braking distances characterizing the deceleration build-up phase at the beginning of a braking manoeuvre and at full braking until the vehicle comes to a standstill.

The driving situation represents an emergency or panic braking phase (pushing the brake pedal with a very high activation speed) during straight-ahead driving on an even and dry road surface with a high coefficient of friction.

Using this International Standard, three results become available:

- stopping distance from initial brake pedal contact until vehicle comes to a standstill (s_{A100});
- ABS-braking distance describing the distance travelled under full ABS-controlled braking from 90 km/h until vehicle comes to a standstill (s_{L90}); and
- estimation of the build-up distance from initial brake pedal contact until a velocity reduction of 10 km/h is achieved (s_{F10}).

Apart from the technical equipment and especially the braking characteristics of the vehicle, the distance travelled after the first pedal contact very strongly depends on the individual pedal actuation of the driver. To minimize this influence, this International Standard specifies rules for brake pedal actuation.

To achieve reproducible, reliable and comparable measurement results, a multitude of further test conditions shall be observed.

Measurement results can only be compared if measurements took place under identical conditions. In particular, this means:

- same track (see also Annex C); and
- very similar weather and ambient conditions (wind, temperature, etc.).

5 Variables

5.1 Reference system

The reference system specified in ISO 15037-1 shall apply.

5.2 Variables to be measured

The following variables shall be measured:

- longitudinal velocity: (v_X);
- time of brake pedal actuation: (t_0);
- longitudinal distance: (s);
- brake pedal actuation force: (F_P).

The variable longitudinal velocity is defined in ISO 8855.

6 Measuring equipment

6.1 Description

All variables shall be measured by means of appropriate transducers, and their time histories shall be recorded by a multi-channel recording system. Alternatively, data measured may be recorded and processed directly in a calculation unit of the measuring system without the possibility to access time histories. Typical operating ranges, and recommended maximum errors of the transducer and recording system, are given in Table 1. If initial longitudinal velocities different from 100 km/h are chosen, the following operating ranges shall be changed accordingly, but maximum errors shall be unchanged.

Table 1 — Variables, their typical operating ranges and recommended maximum errors — Additions and exceptions to ISO 15037-1

Variable	Typical operating range	Recommended maximum error of the combined transducer and recorder system
Initial longitudinal velocity ^a	102 km/h – 98 km/h	± 0,5 km/h
Longitudinal velocity ^b	93 km/h – 5 km/h	± 0,5 km/h
Longitudinal distance	100 m	± 1 % (≤ 50 m) ± 0,50 m (> 50 m)
Brake force trigger	≤ 10 N (triggering point)	± 5 N
Brake pedal actuation force ^c	0 N – 1 000 N (max. 1 500 N)	± 2 %
^a Determined in averaging interval 0,2 s-0 s before brake pedal contact. ^b Deviations of the measured velocity are normally found in the transition area from steady state driving to full braking. ^c It is recommended to use a lateral force compensated brake force transducer.		

The trigger signal for brake pedal contact shall be activated at a pedal force of 10 N or less. The time delay of the trigger signal shall be 5 ms or less. If the pedal force transducer does not fulfil this specification, it is recommended to use a contact switch on the brake pedal's step pad.

To monitor test preparation (run-in) and test conditions, the following measuring devices are required:

- brake (disc/drum or pad/lining) temperature sensor; and
- device for measuring and displaying vehicle deceleration (run-in).

6.2 Transducer installation

The requirements of 4.2 of ISO 15037-1:2006 shall apply. In addition, it shall be ensured that transient vehicle pitch angle changes during braking do not affect the measurement of the velocity and distance variables for the chosen transducer system.

6.3 Calibration

All transducers shall be calibrated according to the manufacturer's instructions. The transducer manufacturer's recommended application software and firmware version shall be used. If parts of the measuring system used can be adjusted, such calibration shall be performed immediately before the beginning of the tests.

For a detailed procedure of calibration, see Annex E.

6.4 Data processing

The recording system and data processing requirements contained in 4.3 of ISO 15037-1:2006 shall apply.

7 Test conditions

7.1 General test conditions

The test conditions shall be in accordance with Clause 5 of ISO 15037-1:2006, unless otherwise specified in this International Standard.