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Heavy commercial vehicles and buses — Emergency braking on a defined path — Test method for trajectory measurement

Véhicules utilitaires lourds et autobus — Freinage d'urgence sur un passage défini — Méthodes d'essai pour la mesure de trajectoire

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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 ISO/TC 22, *Road vehicles*, Subcommittee SC 33, *Vehicle dynamics and chassis components*.

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Introduction

The main purpose of this document is to provide repeatable and discriminatory test results.

The dynamic behaviour of a road vehicle is a very important aspect of active vehicle safety. Any given vehicle, together with its driver and the prevailing environment, constitutes a closed-loop system that is unique. The task of evaluating the dynamic behaviour is, therefore, very difficult since the significant interaction of these driver-vehicle-environment elements are each complex in themselves. A complete and accurate description of the behaviour of the road vehicle requires information obtained from a number of different tests.

Since this test method quantifies only one small part of the complete vehicle handling characteristics, the results of these tests can only be considered significant for a correspondingly small part of the overall dynamic behaviour.

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. Consequently, any application of this test method for regulation purposes will require proven correlation between test results and accident statistics.

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Heavy commercial vehicles and buses — Emergency braking on a defined path — Test method for trajectory measurement

1 Scope

This document describes test methods for determining the deviation of the path travelled by a vehicle during a braking manoeuvre induced by an emergency braking system from a pre-defined desired path. The purpose of this document is the evaluation of the vehicle path during and following the system intervention. The corrective steering actions for keeping the vehicle on the desired path can be applied either by the driver or by a steering machine or by a driver assistance system. By making this document open for either open-loop or closed-loop testing, it is possible to apply the test method for evaluating how well the vehicle can be kept within user-defined lane markings after the system intervention, and also for evaluating the precision of the interaction between the emergency braking system and an active lane keeping system.

This document applies to heavy vehicles equipped with an advanced emergency braking system (AEBS), including commercial vehicles, commercial vehicle combinations, buses and articulated buses as defined in ISO 3833 (trucks and trailers with maximum weight above 3,5 tonnes and buses and articulated buses with maximum weight above 5 tonnes, according to ECE and EC vehicle classification, categories M3, N_2, N3, O3 and O4).

NOTE The test method is intended to evaluate the entire vehicle behaviour, not for defining system requirements for the AEBS, which is done in the respective standards created by ISO/TC 204.

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 15037-2:2002, *Road vehicles — Vehicle dynamics test methods — Part 2: General conditions for heavy vehicles and buses*

ISO 16552:2015, *Heavy commercial vehicles and buses — Stopping distance at straight-line braking with ABS — Open-loop and closed-loop test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8855 and ISO 15037-2 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 http://www.iso.org/obp

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3.1
vehicle reference point
point fixed in the vehicle

Note 1 to entry: For use with this document, the vehicle reference point of the first vehicle unit shall be set to the following:

— $X_V = 0$ at the wheel centre of the first axle;

— $Y_V = 0$ at the centre of the connection line between the tyre contact centres of the first axle;

— $Z_V = 0$ on ground level.

3.2
activation time
t_0
point in time of intervention of the AEBS, given by a trigger signal

3.3
vehicle reference position
X_0, Y_0
lateral and longitudinal position of the reference point of the first vehicle unit at the *activation time* (3.2)

3.4
path deviation
D_{Pn}
shortest distance between the desired vehicle path and the position of the reference point of vehicle unit, n, at a certain point in time, t

4 Principle

This document specifies a method to determine the deviation of the vehicle from a defined path. The driving situation represents an intervention of an advanced emergency braking system during straight-ahead driving or in a curve on an even road surface with a uniform coefficient of friction as specified in ISO 15037-2. It is necessary that the emergency braking system of the test vehicle allows an external input for triggering the system intervention. After the triggering, the AEBS shall remain active until vehicle standstill. The test may be conducted as open-loop or as a closed-loop test. In case of an open-loop test, the steering wheel angle is kept to its initial value. In case of a closed-loop test, the driver (or a steering robot) or a lane keeping assistance system or both attempt to keep the vehicle on the desired path.

If the test is conducted with corrective steering actions by the driver, the results will strongly depend on the driver activities. This should be considered when comparing closed-loop test results. For excluding the driver influence during a closed-loop test, it is recommended to conduct the test with a steering robot which has the capability to be programmed for a desired path via GPS feedback.

NOTE By leaving the test method open for interventions of driver assistance systems other than the emergency braking system, the interactions of the systems can be investigated, e.g. the steering interventions of an active lane keeping assistance system acting during the emergency braking can be compared with the steering actions of a steering robot or a driver.

5 Variables

The variables of motion used to describe the behaviour of the vehicle shall be related to the *reference axis system* (*X, Y, Z)* of the first vehicle unit (see ISO 8855) with the *reference point* as described in 3.1. The variables that shall be determined for compliance with this document are the following:

— longitudinal velocity, v_x;

— steering-wheel angle, δ_H;

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