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Heavy commercial vehicles and buses — Vehicle dynamics simulation and validation — Steady-state circular driving behavior

Véhicules utilitaires lourds et autobus — Simulation et validation dynamique des véhicules — Tenue de route en régime permanent sur trajectoire circulaire

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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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For an explanation of 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 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.*

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.

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Introduction

The main purpose of this document is to provide a repeatable and discriminatory method for comparing simulation results to measured test data from a physical vehicle for a specific type of test.

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 interactions of these driver–vehicle–environment elements are each complex in themselves. A complete and accurate description of the behaviour of the road vehicle involves information obtained from a number of different tests.

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

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Heavy commercial vehicles and buses — Vehicle dynamics simulation and validation — Steady-state circular driving behavior

1 Scope

This document specifies a method for comparing simulation results from a vehicle model to measured test data for an existing vehicle according to steady-state circular driving tests as specified in ISO 14792. The comparison is made for the purpose of validating the vehicle model for this type of test.

This document applies to heavy vehicles, including commercial vehicles, commercial vehicle combinations, buses and articulated buses as defined in ISO 3833 (trucks and trailers with a maximum weight above 3,5 tonnes and buses and articulated buses with a maximum weight above 5 tonnes, according to ECE and EC vehicle classification, categories M3, N2, N3, O3 and O4).

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 14792, *Road vehicles — Heavy commercial vehicles and buses — Steady-state circular tests*

ISO 3833, *Road vehicles — Types — Terms and definitions*

ISO 8855, *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 19364, *Passenger cars — Vehicle dynamic simulation and validation — Steady-state circular driving behaviour*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 3833, ISO 8855, ISO 15037-2, ISO 19364 and the following apply.

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

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

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

3.1
simulation
calculation of motion variables of a vehicle from equations in a mathematical model of the vehicle system

3.2
vehicle configuration
fundamental vehicle characteristic influencing the vehicle dynamics

EXAMPLE Number of axles, axle types, number and type of the vehicle units.

Note 1 to entry: An example of axle types can be independent suspension or rigid axle.

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3.3
basic vehicle parameters
parameters not subject to model fitting, which are directly and accurately measurable on the test vehicle

EXAMPLE Masses and dimensions.

3.4
estimated vehicle parameters
parameters that may be used for model fitting, which are typically hard to be determined

EXAMPLE Mass moment of inertia and tyre characteristics.

3.5
vehicle model validity range
basic vehicle parameters (3.3) which may be changed if the type of vehicle combination and tyre type are maintained

Note 1 to entry: For example, when wheel base is modified some of the estimated parameters may need to be updated accordingly.

4 Principle

The open-loop test methods defined in ISO 14792 are used to determine the steady-state circular driving behaviour of heavy commercial vehicles and buses as defined in ISO 3833.

Within this document, the purpose of the test is to demonstrate that a vehicle model can predict the vehicle behaviour within specified tolerances. The vehicle model is used to simulate a specific existing vehicle which is also tested physically, using one of the steady-state test methods specified in ISO 14792 for both test and simulation. For single vehicle units, alternatively consider a test with constant vehicle velocity and slowly increasing steer or a test with constant turning radius and slowly increasing vehicle velocity. Measurement results are used to define reference curves and tolerance boundaries, and the respective simulation results are overlaid to analyse the deviation between physical testing and simulation.

The validation process shall be repeated when changing the vehicle configuration, resulting in a fundamental change of the structure of the vehicle model, for example when simulating a three-axle vehicle instead of a two-axle vehicle or when simulating a vehicle combination instead of a single vehicle unit. For one vehicle configuration, it is recommended to repeat the process of comparing simulation and measurement results at least once for a change in basic vehicle parameters, for example for a different loading condition or a different wheelbase, to validate the robustness of the vehicle model.

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). For the purpose of this document, the reference point shall be the centre of gravity of the first vehicle unit. This provision overrides the similar provision of ISO 15037-2. Measurement requirements shall be taken from ISO 14792 and ISO 15037-2. The variables that shall be determined for compliance with this document are:

— longitudinal velocity, v_x;

— steering-wheel angle, δ_H;

— lateral acceleration, a_y;

— roll angle of first vehicle unit, φ.

It is recommended that the following variables are also determined:

— steering-wheel torque, M_H;

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