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## Passenger cars — Validation of vehicle dynamic simulation — Sine with dwell stability control testing

*Voitures particulières — Simulation et validation dynamique des véhicules — Essais de contrôle de la stabilité en sinus avec palier*

ICS: 43.100

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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. [www.iso.org/directives](http://www.iso.org/directives)

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC22/SC9 which will be ISO/TC22/SC33.

## Introduction

The main purpose of this Standard 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 must necessarily involve 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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# Passenger cars — Validation of vehicle dynamics simulation — Sine with dwell stability control testing

## 1 Scope

This International Standard specifies a method for comparing computer simulation results from a vehicle mathematical model to test data measured for an existing vehicle undergoing sine with dwell tests that are typically used to evaluate the performance of an electronic stability control (ESC) system. The comparison is made for the purpose of validating the simulation tool for this type of test when applied to variants of the tested vehicle.

It is applicable to passenger cars as defined in ISO 3833.

NOTE The sine with dwell test method described in this International Standard is based on the test method specified in regulations USA FMVSS 126 “Federal Register Vol. 72, No. 66, April 6, 2007” and UN/ECE Regulation No. 13-H, “Uniform provisions concerning the approval of passenger cars with regard to braking.”

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For these undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1176, *Road vehicles — Masses — Vocabulary and codes*

ISO 2416, *Passenger cars — Mass distribution*

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

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

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

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 1176, ISO 2416, ISO 3833, ISO 8855 and the following apply.

### 3.1 simulation

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

### 3.2 simulation tool

simulation environment including software, model, input data, and hardware in case of hardware in the loop simulation



3.3

**ESC (electronic stability control) system**

control system that intervenes to maintain directional stability of vehicle and responsiveness on steering input

3.4

**sine with dwell test**

test in which the vehicle is steered by a robot using a steering pattern of a sine wave at a frequency of 0.7 Hz with a delay of 500 ms beginning at the second peak amplitude (see Figure 1)

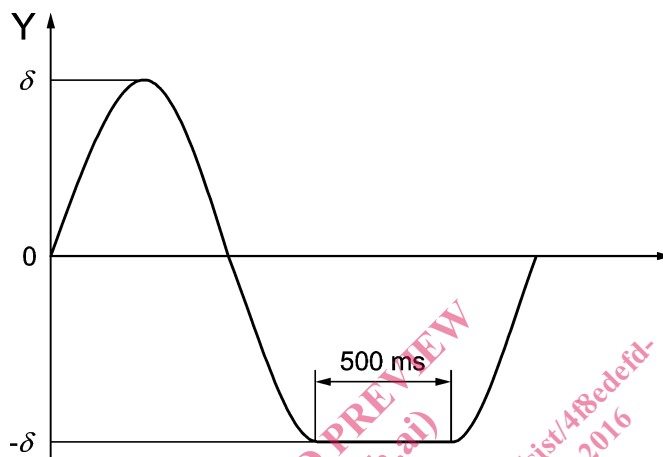


Figure 1: Steering wheel input for a sine with dwell test

3.5

**sine with dwell test series**

series of sine with dwell tests in which the amplitude of the steering pattern is increased with each test

3.6

**BOS (beginning of steer)**

time at which the steering begins for a sine with dwell test

3.7

**COS (completion of steer)**

time at which the steering is completed for a sine with dwell test

3.8

**ESC system performance standard**

published standard, typically issued by a regulatory organization, that defines ESC system performance requirements using a sine with dwell test series; e.g., UN/ECE Regulation No. 13-H, “Uniform provisions concerning the approval of passenger cars with regard to braking” or USA FMVSS 126 “Federal Register Vol. 72, No. 66, April 6, 2007”

**4 Principle**

A sine with dwell test sequence is used to evaluate the behaviour of a vehicle with ESC. In this sequence, the vehicle is subjected to two series of tests that are run using a steering pattern of sine with dwell as shown in Figure 1. One series uses counter-clockwise steering for the first half cycle, and the other series uses clockwise steering for the first half cycle.