INTERNATIONAL STANDARD

ISO 13674-2

Second edition
2016-04-01

Road vehicles — Test method for the quantification of on-centre handling —

Part 2: Transition test

Véhicules routiers — Méthode d'essai pour la quantification du centrage —
Partie 2: Essai de la transition

Reference number
ISO 13674-2:2016(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

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

This second edition cancels and replaces the first edition (ISO 13674-2:2006), which has been technically revised.

ISO 13674 consists of the following parts, under the general title *Road vehicles — Test method for the quantification of on-centre handling*:

— *Part 1: Weave test*

— *Part 2: Transition test*

Introduction

The main purpose of this part of ISO 13674 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.

Road vehicles — Test method for the quantification of on-centre handling —

Part 2: Transition test

1 Scope

This part of ISO 13674 specifies a test schedule that addresses a particular aspect of the transition test, the on-centre handling characteristics of a vehicle. It is applicable to passenger cars in accordance with ISO 3833 and to light trucks, N1 category.

NOTE The manoeuvre specified in this test method is not representative of real driving conditions, but is useful for obtaining measures of vehicle on-centre handling behaviour in response to a specific type of steering input under closely controlled test conditions. Other aspects of on-centre handling are addressed in the companion ISO 13674-1.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For 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 15037-1:2006, *Road vehicles — Vehicle dynamics test methods — Part 1: General conditions for passenger cars*

3 Terms, definitions and symbols

For the purposes of this document, the terms, definitions and symbols given in ISO 1176, ISO 2416, ISO 3833, ISO 8855 and the following apply.

3.1
on-centre handling
description of the steering "feel" and steering precision of a vehicle during nominally straight-line driving and in negotiating large radius bends at high speeds but low lateral accelerations

3.2
ordinate threshold
value of a parameter plotted as the ordinate on a graph and defined as the minimum threshold of human perception

3.3
abscissa deadband
horizontal separation between the pair of straight-line fits at ordinate threshold values

3.4
gradient
ratio of change in the ordinate with respect to a unit change in the abscissa, for a straight-line fit to a pair of recorded variables plotted one against the other on Cartesian coordinates

4 Principle

On-centre handling represents that part of the straight-line directional stability characteristics of the vehicle existing at low lateral acceleration levels, typically no greater than 1 m/s^2. On-centre handling is concerned primarily with features that directly influence the driver's steering input, such as steering system and tyre characteristics. Thus, test schedules for the evaluation of on-centre handling behaviour seek to minimize other factors that influence the wider aspects of straight-line directional stability, such as disturbance inputs due to ambient winds and road irregularities.

This part of ISO 13674 defines test schedules that involve driving the vehicle in a nominally straight line at a constant forward speed. During the tests, driver inputs and vehicle responses are measured and recorded. From the recorded signals, characteristic values are calculated.

5 Variables

5.1 Reference system

The variables of motion used to describe vehicle behaviour in a test-specific driving situation shall be related to the intermediate axis system (X, Y, Z) (see ISO 8855).

The location of the origin of the vehicle axis system (X_V, Y_V, Z_V) is the reference point and therefore should be independent of the loading condition. The origin is therefore fixed in the longitudinal plane of symmetry at half-wheelbase and at the same height above ground as the centre of gravity of the vehicle at complete vehicle kerb mass (see ISO 1176).

5.2 Variables to be measured

When using this test method, the following variables shall be measured:

— steering-wheel angle, δ_H;

— steering-wheel torque, M_H;

— yaw velocity, $d\psi / dt$;

— longitudinal velocity, v_x;

— lateral acceleration, a_y (see the NOTE to 6.2).

The following variables should be measured:

— steering-wheel angular velocity, $d\delta_H / dt$;

— roll angle, ψ.

The variables are defined in ISO 8855.

In order to acquire a deeper understanding of the vehicle behaviour, it may be desirable to determine motions of various components within the steering system, especially for vehicles with more than one steering axle.

6 Measuring equipment

6.1 Description

The measuring equipment shall be in accordance with ISO 15037-1.

Typical operating ranges and recommended maximum errors of the combined transducer and recording system are shown in Table 1.

NOTE It is advisable that care be taken to ensure that friction or inertia added to the system by steering robot or steering transducers does not improperly influence the measurement of steering-wheel torque.

Table 1 — Variables, typical operating ranges and recommended maximum errors

Variable	Typical operating range[a]	Recommended maximum error of the combined transducer and recorder system[b]
Steering-wheel angle	±50°	±0,1°
Steering-wheel torque	±10 Nm	±0,1 Nm
Yaw velocity	±10 °/s	±0,1 °/s
Longitudinal velocity	0 – 50 m/s	±0,5 m/s
Lateral acceleration	±5 m/s^2	±0,1 m/s^2
Steering-wheel angular velocity	±100 °/s	±1 °/s
Roll angle	±5°	±0,05°

Transcribers for measuring some of the listed variables are not widely available and are not in general use. Many such instruments are developed by users. If any system error exceeds the recommended maximum value, this and the actual maximum error shall be stated in the test report (ISO 15037-1:2006, Annex A).

[a] These transducer ranges are appropriate for the standard test conditions and may not be suitable for non-standard test conditions.

[b] The values for maximum errors are provisional until more experience and data are available.

6.2 Transducer installations

The transducers shall be installed according to the manufacturers' instructions, where such instructions exist, so that the variables corresponding to the terms and definitions of ISO 8855 can be determined.

If a transducer does not measure a variable directly, appropriate transformations into the specified reference system shall be carried out.

NOTE Lateral acceleration, as defined, is measured in the intermediate XY plane. However, for the purpose of this test procedure, measurement of "sideways" acceleration in the vehicle X_vY_v plane (i.e. corrupted by vehicle roll) is typically adequate, provided that the roll angle versus lateral acceleration characteristic for the vehicle is known and an appropriate correction in respect of roll angle can be made to the "sideways" acceleration.

6.3 Data processing

See ISO 15037-1:2006, 4.3.

7 Test conditions

7.1 General

General comments relating to test conditions are given in ISO 15037-1:2006, Clause 5.

7.2 Test track

The test track requirements shall be in accordance with those of ISO 15037-1:2006, 5.2. In addition, the lateral gradient of the test surface should not exceed 1 %.

7.3 Wind velocity

During a test, the ambient wind velocity shall not exceed 5 m/s when measured at a height above ground of not less than 1 m. Ideally, the maximum ambient wind velocity should not exceed 1,5 m/s. If this cannot be achieved, then conditions of significant "gusting" should be avoided, i.e. testing should be avoided in conditions where changes in wind velocity exceed a range of 1,5 m/s. In the event that the ambient velocity exceeds 1,5 m/s or the range of "gusting" exceeds 1,5 m/s, or both, the vehicle should be tested in a direction such that the ambient wind is a tail wind. For each test, the climatic conditions shall be recorded in the test report (see ISO 15037-1:2006, Annex B).

Where measurement of wind velocity is not possible, estimation by use of the Beaufort scale is suggested (see Table 2).

Table 2 — Estimation scale for wind intensity for observer without measuring instrument (Beaufort scale)

Wind intensity (Beaufort scale)	0	1	2	3	4
Name	calm	light air	light breeze	gentle breeze	moderate breeze
Velocity in m/s	0 – 0,2	0,3 – 1,5	1,6 – 3,3	3,4 – 5,4	5,5 – 7,9
Identification sign	smoke rises vertically in a straight line	wind direction indicated only by smoke	leaves rustle, wind felt in face	leaves and thin twigs move	moves twigs and thin branches, dust rises

7.4 Test vehicle

7.4.1 General data

Refer to ISO 15037-1:2006, 5.4.1. Special attention should be paid to the condition of the tyres, axle alignments and the steering system to ensure that the vehicle does not lead or pull when operating on a level surface.

7.4.2 Tyres

For general information regarding tyres used for test purposes, see ISO 15037-1:2006, 5.4.2. In addition, the following recommendations are offered for guidance.

Since tyre characteristics can have a profound effect upon the vehicle behaviour being measured in this procedure, it is recommended that only tyres with known characteristics be used if possible. Failing this, original equipment rather than replacement market tyres should be used.

For similar reasons, caution should be exercised if worn tyres are to be used. For example, it is known that some tyre characteristics, which affect vehicle on-centre handling, change significantly during the early wear life (up to several thousand kilometres) of the tyre, but continue to change throughout the life of the tyre. In any event, tyres without a known history should be avoided.

All wheel/tyre assemblies should be balanced before use. Assemblies exhibiting large run-out or imbalance (detectable as vibration at roadwheel rotational frequency) should be avoided.

7.4.3 Operating components

See ISO 15037-1:2006, 5.4.3.

7.4.4 Loading conditions of the vehicle

See ISO 15037-1:2006, 5.4.4.

8 Test procedure

8.1 Warm-up

See ISO 15037-1:2006, 6.1.

8.2 Initial driving condition

The initial driving condition is that described in ISO 15037-1:2006, 6.2 for the steady-state straight-ahead run condition (with the time intervals as defined in ISO 15037-1:2006, Figure 2). The allowable variations for yaw velocity should be adopted rather than those for lateral acceleration.

An additional requirement is that, for a time interval starting no later than time t_1 and ending at time t_2, the steering wheel shall be subject to zero steer torque input. The recommended method to achieve this is to drive the vehicle under free steering control (i.e. hands free) during this specified time interval.

At time t_0, the steering input specified in 8.3 shall be applied. The transducer signals shall be recorded throughout the initial driving condition and for the duration of the test to ensure that the required data are not affected by the instrumentation system. It is recommended that the steady-state straight-ahead condition be re-established as described in ISO 15037-1:2006, 6.2 and data recorded for a further 1 s after the test run.

See ISO 15037-1:2006, 6.2 for guidance on selection of the appropriate transmission gear for performing the test.

NOTE This test procedure is not suitable for any vehicle that, under free steering control, is not able to remain within the limits of yaw velocity variation given in ISO 15037-1:2006, 6.2.2 for the time interval t_1 to t_2. Any such vehicle and its tyres should be examined for causes of excessive lateral deviation.

8.3 Transition test procedure

The transition test is an open-loop procedure and is conducted from an initial straight-line path. The vehicle is driven at a nominally constant longitudinal velocity. The standard test velocity is 100 km/h. Other longitudinal velocities may be used; these should be decremented or incremented by 20 km/h from the standard velocity. Details shall be recorded in the test report (see ISO 15037-1:2006, Annex B, under *Test method specific data*).

Whereas the weave test (see ISO 13674-1) examines the outer edge of the response hysteresis loop, this test examines the transition from straight line running to the edge of the hysteresis loop.

Continuing from the initial driving condition specified in 8.2, the steering wheel shall be subjected to a ramp input (that is one that increases in amplitude with a nominally constant angular velocity). To ensure a smooth transition of the vehicle path from the straight-ahead condition onto a curve of diminishing radius, the steering input shall be applied with an angular velocity that increases smoothly from zero up to the nominally constant value. Commencing at time t_0, the steering input shall be applied for a minimum duration of 3 s, and at an angular velocity not exceeding 5 °/s, until the lateral acceleration achieved by the vehicle reaches a minimum of 1,5 m/s^2. The test shall be performed a sufficient number of times in each turn direction (see 9.2), using, nominally, the same steer input profile.

NOTE For improved repeatability, a steering robot may be used if steering velocity is to exceed 1,5 °/s.

Details of the steering input, angular velocity and duration of application shall be recorded in the test report (see ISO 15037-1:2006, Annex B, under *Test method specific data*).