

Method of test for

Steady state cornering behaviour for road vehicles

[ISO title: Road vehicles — Steady state circular test procedure]

UDC 629.11:656.085.1

NO COPYING WITHOUT BSI PERMISSION EXCEPT AS PERMITTED BY COPYRIGHT LAW

BSI
Documents

AVA

Document Sharing Hub

Committees responsible for this British Standard

This British Standard was published under the direction of the Automobile Standards Committee AUE/-. Its preparation was entrusted to Technical Committee AUE/15 upon which the following bodies were represented:

- Association of Trailer Manufacturers
- Caravan Club
- Department of the Environment (Transport and Road Research Laboratory)
- Department of Transport
- Metropolitan Police
- National Caravan Council Limited
- Royal Automobile Club
- Society of Motor Manufacturers and Traders Limited

This British Standard, having been prepared under the direction of the Automobile Standards Committee, was published under the authority of the Board of BSI and comes into effect on 29 July 1983

© BSI 02-2000

The following BSI references relate to the work on this standard:
Committee reference AUE/15
Draft for comment 78/71656 DC

ISBN 0 580 13356 7

Amendments issued since publication

Amd. No.	Date of issue	Comments

Contents

	Page
Committees responsible	Inside front cover
National foreword	ii
0 Introduction	1
1 Scope and field of application	1
2 References	1
3 Instrumentation	2
4 Test conditions	3
5 Test procedure	3
6 Data analysis	4
7 Data presentation	4
Annex A General data	5
Annex B Presentation of results	6
Annex C Processing of test data	9
Annex D Determination of overall (static) steering ratio	12
Annex E Terminology	12
Figure 1 — Steering wheel angle characteristic	6
Figure 2 — Sideslip characteristic	7
Figure 3 — Vehicle roll characteristic	8
Figure 4 — Steering wheel torque characteristic	9
Table 1	2
Publications referred to	Inside back cover

National foreword

This British Standard has been prepared under the direction of the Automobile Standards Committee and is identical with ISO 4138:1982 *“Road vehicles — Steady state circular test procedure”* prepared by Technical Committee ISO/TC 22, Road vehicles, and published by the International Organization for Standardization (ISO).

Terminology and conventions. The text of the International Standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

Cross-references. There are no British Standards corresponding to ISO 1176, ISO 2416 and ISO 3833 to which references are made in the text. The Technical Committee has reviewed the provisions of these International Standards and has decided that they are acceptable for use in conjunction with this standard.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

0.1 General remarks

The road holding ability of a road vehicle is a most important part of active vehicle safety. Any given vehicle, together with its driver and the prevailing environment, makes a closed-loop system that is unique. The task of evaluating road holding ability is therefore very difficult because of the significant interaction of these driver-vehicle-road elements, each of which is in itself complex. A complete and accurate description of the behaviour of the road vehicle must necessarily involve information obtained from a number of tests of different types.

Because they quantify only one small part of the whole handling field, the results of this test can only be considered significant for a correspondingly small part of the overall vehicle handling behaviour.

Moreover, nothing is known about the relationship between the results of this test and accident avoidance. A very large amount of work is necessary to acquire sufficient and reliable data on the correlation between handling properties in general and accident avoidance.

In addition, up to now, no significant correlation has been found between the vehicle behaviour and the driver's subjective evaluation during the test.

However, some correlation has been found to exist between certain aspects of a skilled driver's subjective evaluation during road driving and the results of the steady state circular test.

Therefore it is not possible to use this procedure and the test results for regulation purposes at the moment. The best that can be expected is that the steady state circular test can be used as one among many other, mostly transient, tests which together can cover the field of vehicle dynamic behaviour.

0.2 Object of the test

This procedure requires the test vehicle to be driven at several constant¹⁾ speeds on a path of known radius. The directional control response characteristics are determined from data obtained while driving the vehicle at successively higher speeds on the constant radius path (or path of sufficient length to attain steady state). This procedure can be conducted in a relatively small area. The procedure can be tailored to existing test track facilities by selecting a circle or path of appropriate radius. Often a constant radius (in plane) road will suffice for a test facility.

The primary object of this test is to measure the steering wheel angle as a function of lateral acceleration and to describe vehicle steering (for example, understeer/oversteer) behaviour for left hand and right hand turns.

Thus it is necessary to measure:

- steering wheel angle;
- lateral acceleration (alternatively, this may be determined from other variables).

NOTE Strictly speaking, test results based on lateral acceleration should not be used for comparison of the performance of different vehicles. This is because lateral acceleration, as precisely defined, is measured at right angles to the vehicle *x*-axis²⁾ and not at right angles to the tangent of the vehicle path.

To overcome this difficulty, lateral acceleration may be corrected for vehicle sideslip angle, which gives the quantity "centripetal acceleration".

However, the extent of this correction is not likely to exceed a few percent and can generally be neglected.

It is desirable to measure:

- sideslip angle. If the whole of the procedure described in Annex C is to be followed, the sideslip angle must be measured directly or calculated from other measured variables (see 3.2.5).

The following variables can also be measured:

- yaw velocity;
- forward velocity;
- steering wheel torque;
- vehicle roll angle.

1 Scope and field of application

This International Standard specifies a procedure for determining the steady state directional control response of passenger cars, as defined in ISO 3833, by measuring the steady state cornering behaviour which is one of the factors composing vehicle dynamics and road holding properties.

The definitions of the technical terms used in this document are given in Annex E.

2 References

- ISO 1176, *Road vehicles — Masses — Vocabulary*³⁾.
- ISO 2416, *Passenger cars — Load distribution*.
- ISO 3833, *Road vehicles — Types — Terms and definitions*.

¹⁾ This may depend on the test procedure to be used (see note in clause 5).

²⁾ As referred to an axis system defined as follows:

A right-hand orthogonal axis system fixed in the vehicle such that its origin is at the centre of gravity of the vehicle. The *x*-axis is in the longitudinal direction, the *y*-axis is in the lateral direction and the *z*-axis is vertical.

³⁾ At present at the stage of draft. (Revision of ISO 1176:1974.)

3 Instrumentation

3.1 Description

Those of the variables listed in 0.2 which are selected for test purposes shall be monitored, using appropriate transducers, and the data shall be recorded on a multi-channel recorder having a time base. The normal operating ranges and recommended maximum errors of the transducer/recording system are as shown in Table 1.

Table 1

Variable	Range	Recommended maximum error of the combined transducer/recorder system
Steering wheel angle	$\pm 360^\circ$ ^a	$\pm 2^\circ$ for angles $\leq 180^\circ$ $\pm 4^\circ$ for angles $> 180^\circ$
Lateral acceleration	$\pm 15 \text{ m/s}^2$	$\pm 0,15 \text{ m/s}^2$
Yaw velocity	$\pm 50^\circ/\text{s}$	$\pm 0,5^\circ/\text{s}$
Forward velocity	0 to 50 m/s	$\pm 0,5 \text{ m/s}$
Sideslip angle	$\pm 15^\circ$	$\pm 0,5^\circ$
Steering wheel torque	$\pm 30 \text{ Nm}$	$\pm 0,3 \text{ Nm}$
Roll angle	$\pm 15^\circ$	$\pm 0,15^\circ$
NOTE These values are tentative and provisional until more experience is available. The minimum overall bandwidth of the entire measurement system including transducers and recorder shall be 3 Hz.		
^a Assuming conventional steering system.		

3.2 Installation

Transducer installation and orientation will vary according to the type of instrumentation used. However, if a transducer does not measure directly the required variable, appropriate corrections for linear and angular displacement shall be made to its signals so as to obtain the required level of accuracy.

3.2.1 Steering wheel angle

A transducer shall be installed, as specified by the manufacturer, to obtain steering wheel angle relative to the sprung mass.

3.2.2 Lateral acceleration

An accelerometer shall be installed as specified by the manufacturer and mounted either:

- on the sprung mass at the whole vehicle centre of gravity and aligned with the vehicle y -axis. In this case it will measure “side acceleration” and its output shall be corrected for the component of gravity on the accelerometer axis due both to the vehicle roll angle and any track surface inclination.
- on the sprung mass at any position and aligned parallel to the vehicle y -axis. In this case, its output shall be corrected for its position relative to the centre of gravity, which will give “side acceleration”, which in turn shall be corrected for the component of gravity on the accelerometer axis due both to vehicle roll angle and any track surface inclination.
- on a reference trolley such as may be used to measure vehicle roll angle and sideslip angle. In this case corrections shall be made both for its position relative to the vehicle centre of gravity and for any track surface inclination.

3.2.3 Yaw velocity

A transducer shall be installed, as specified by the manufacturer, with its axis aligned with or parallel to the vehicle z -axis.

3.2.4 Forward velocity

A velocity transducer shall be installed as specified by the manufacturer. If it is not aligned so as to operate in the x - z plane and parallel to the test track surface, its output shall be corrected for any linear or angular displacement therefrom.

3.2.5 Sideslip angle

A transducer shall be installed, as specified by the manufacturer, so as to measure sideslip angle. If it does not measure the angle in the plane of the track surface, an appropriate correction shall be made. Sideslip angle can be calculated from coincident measurements of other variables, for example, lateral and forward velocity at any point on the vehicle.

The point of the vehicle to which the output of the transducer is referred shall be indicated in Annex A.⁴⁾

3.2.6 Steering wheel torque

A transducer shall be installed, as specified by the manufacturer, so as to measure the torque applied to the steering wheel about its axis of rotation.

⁴⁾ It is recommended that the centre of gravity or the point of intersection between a line connecting the rear wheel centres and the vehicle's longitudinal median plane are used as reference points.