BS ISO 14793:2011

BSI Standards Publication

Road vehicles — Heavy commercial vehicles and buses — Lateral transient response test methods

bsi.

...making excellence a habit.™

Document Sharing Hub

National foreword

This British Standard is the UK implementation of ISO 14793:2011. It supersedes BS ISO 14793:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/15, Safety related to vehicles.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© BSI 2011

ISBN 978 0 580 72782 5

ICS 43.080.01; 43.080.20

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 March 2011.

Amendments issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 14793:2011

INTERNATIONAL STANDARD

ISO 14793

Second edition
2011-02-15

Road vehicles — Heavy commercial vehicles and buses — Lateral transient response test methods

Véhicules routiers — Véhicules utilitaires lourds et autobus — Méthodes d'essai de réponse transitoire latérale

Reference number
ISO 14793:2011(E)

Documents
Document Sharing Hub

© ISO 2011

Full document details: BS ISO 14793:2011

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

COPYRIGHT PROTECTED DOCUMENT

© ISO 2011

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

© ISO 2011 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 14793:2011

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Normative references 1
3 Terms and definitions 1
4 Principle 2
5 Reference system 2
6 Variables 3
7 Measuring equipment 3
7.1 Description 3
7.2 Transducer installation 3
7.3 Data processing 3
8 Test conditions 7
8.1 General 7
8.2 Test track 7
8.3 Weather conditions 7
8.4 Test vehicle 8
8.5 Warm-up 9
8.6 Test speed 9
8.7 Lateral acceleration 9
8.8 Average longitudinal acceleration 10
9 Step input 10
9.1 Test procedure 10
9.2 Data analysis 10
9.3 Data presentation 11
10 Sinusoidal input — One period (see ISO/TR 8725) 12
10.1 Test procedure 12
10.2 Data analysis 12
10.3 Data presentation 13
11 Random input (see ISO/TR 8726) 13
11.1 Test procedure 13
11.2 Data analysis 14
11.3 Data presentation 14
12 Pulse input 15
12.1 Test procedure 15
12.2 Data analysis 15
12.3 Data presentation 15
13 Continuous sinusoidal input 16
13.1 Test procedure 16
13.2 Data analysis 16
13.3 Data presentation 17
Annex A (normative) **Test report — General data** 18
Annex B (normative) **Test report — Presentation of results** 24
Bibliography 29

Documents
Document Sharing Hub

© ISO 2011 – All rights reserved

Full document details: BS ISO 14793:2011

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 14793 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 9, *Vehicle dynamics and road-holding ability*.

This second edition cancels and replaces the first edition (ISO 14793:2003), which has been technically revised.

© ISO 2011 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14793:2011

Introduction

The main purpose of this International 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 is each complex in itself. 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.

© ISO 2011 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14793:2011

Documents
Document Sharing Hub

Full document details: BS ISO 14793:2011

INTERNATIONAL STANDARD ISO 14793:2011(E)

Road vehicles — Heavy commercial vehicles and buses — Lateral transient response test methods

1 Scope

This International Standard specifies test methods for determining the transient response behaviour of heavy commercial vehicles, heavy commercial vehicle combinations, buses and articulated buses, as defined in ISO 3833 for trucks and trailers above 3,5 t and buses above 5 t maximum weight, and in UNECE (United Nations Economic Commission for Europe) and EC vehicle classification, categories M3, N2, N3, O3 and O4.

NOTE The open-loop manoeuvres specified in this International Standard are not representative of real driving conditions, but are nevertheless useful for obtaining measures of vehicle transient behaviour — particularly with respect to that which the driver experiences — in response to several specific types of steering input under closely controlled test conditions. For combinations where the response of the last vehicle unit is of importance, see ISO 14791.

2 Normative references

The following referenced documents are indispensable for the application 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 1176:1990, *Road vehicles — Masses — Vocabulary and codes*

ISO 3833:1977, *Road vehicles — Types — Terms and definitions*

ISO/TR 8725:1988, *Road vehicles — Transient open-loop response test method with one period of sinusoidal input*

ISO/TR 8726:1988, *Road vehicles — Transient open-loop response test method with pseudo-random steering input*

ISO 8855:1991, *Road vehicles — Vehicle dynamics and road-holding ability — Vocabulary*

ECE Regulation No. 30, *Uniform provisions concerning the approval of pneumatic tyres for motor vehicles and their trailers*

3 Terms and definitions

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

3.1
vehicle unit
unit of a vehicle combination which is connected with a yaw-articulation joint

EXAMPLE Tractor, semitrailer, dolly.

NOTE The number of vehicle units is one more than the number of articulation joints.

© ISO 2011 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14793:2011

4 Principle

IMPORTANT — The method of data analysis in the frequency domain is based on the assumption that the vehicle has a linear response. Over the whole range of lateral acceleration this is unlikely to be the case, the standard method of dealing with such a situation being to restrict the range of the input so that linear behaviour can be assumed and, if necessary, to perform more than one test at different ranges of inputs which, together, cover the total range of interest.

The objective of these tests is to determine the transient response of a vehicle. Characteristic values and functions of both linear and nonlinear behaviour are considered necessary for fully characterizing vehicle transient response. Linear characteristic values and functions are determined with tests in the frequency domain and nonlinear characteristic values and functions with tests in the time domain. In the case of vehicle combinations, it is primarily the response of the first vehicle unit that is evaluated.

Important characteristics in the time domain are

— time lags between steering-wheel angle, lateral acceleration and yaw velocity,

— response times of lateral acceleration and yaw velocity (see 9.2.1),

— lateral acceleration gain (lateral acceleration divided by steering-wheel angle),

— yaw velocity gain (yaw velocity divided by steering-wheel angle), and

— overshoot values (see 9.2.3).

Important characteristics in the frequency domain are the transfer functions of

— lateral acceleration related to steering-wheel angle, and

— yaw velocity related to steering-wheel angle,

expressed as gain and phase functions between input and output variables.

There are several test methods for obtaining these characteristics in the time and frequency domains, as follows, the applicability of which depends in part on the size of the test track available.

a) time domain:

   1) step input;

   2) sinusoidal input (one period).

b) frequency domain:

   1) random input;

   2) pulse input;

   3) continuous sinusoidal input.

5 Reference system

The variables of motion used to describe the vehicle behaviour in a test-specific driving situation relate 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 shall be thus defined.

© ISO 2011 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14793:2011

6 Variables

The following variables shall be determined:

— yaw velocity, $\dot{\psi}$;

— lateral acceleration, a_Y;

— steering-wheel angle, δ_H;

— longitudinal velocity, v_X.

The following variables may be determined:

— lateral deviation, y;

— roll angle at relevant points, φ;

— steering-wheel torque, M_H;

— sideslip angle, β.

These variables, all but lateral deviation defined in ISO 8855, are not intended to comprise a complete list.

7 Measuring equipment

7.1 Description

The variables to be determined in accordance with Clause 6 shall be measured by means of appropriate transducers. Their time histories shall be recorded on a multi-channel recording system having a time base.

The typical operating ranges and recommended maximum errors of the transducers and the recording system are given in Table 1.

7.2 Transducer installation

The transducers shall be installed so that the variables corresponding to the terms and definitions of ISO 8855 can be determined.

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

7.3 Data processing

7.3.1 General

The frequency range relevant for this test is between 0 Hz and the maximum utilized frequency of f_{max} = 2 Hz. Depending on the data processing method chosen (analog or digital data processing) the provisions of 7.3.2 or 7.3.3 shall be observed.

For lighter trucks it may be necessary to increase f_{max} to 3 Hz. In this case, the following requirements concerning the frequency f_{max} may be modified correspondingly.

7.3.2 Analog data processing

The bandwidth of the entire, combined transducer/recording system shall be no less than 8 Hz.

© ISO 2011 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 14793:2011

In order to execute the necessary filtering of signals, low-pass filters of order four or higher shall be employed. The width of the passband (from 0 Hz to frequency f_0 at −3 dB) shall be not less than 9 Hz. Amplitude errors shall be less than ± 0,5 % in the relevant frequency range of 0 Hz to 2 Hz. All analog signals shall be processed with filters having phase characteristics sufficiently similar to ensure that time delay differences due to filtering lie within the required accuracy for time measurement.

NOTE During analog filtering of signals with different frequency contents, phase shifts can occur. Therefore, a digital data processing method, as described in 7.3.3, is preferable.

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

Variable	Range	Recommended maximum error of combined transducer and recorder system
Yaw velocity	− 50°/s to + 50°/s	± 0,5°/s
Lateral acceleration	− 15 m/s^2 to + 15 m/s^2	± 0,15 m/s^2
Steering-wheel angle	− 360° to + 360°	± 2° for angles < 180° ± 4° for angles > 180°
Longitudinal velocity	0 m/s to 35 m/s	± 0,35 m/s
Roll angle	− 15° to + 15°	± 0,15°
Side slip angle	− 10° to + 10°	± 0,3°
Lateral velocity	− 10 m/s to + 10 m/s	± 0,1 m/s
Steering-wheel torque		
without power steering	− 50 N·m to + 50 N·m	± 0,5 N·m
with power steering	− 20 N·m to + 20 N·m	± 0,2 N·m
Transducers for 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 under general data in the test report (see Annex A).		

7.3.3 Digital data processing

7.3.3.1 General considerations

Preparation of analog signals includes consideration of filter amplitude attenuation and sampling rate in order to avoid aliasing errors, and filter phase lags and time delays. Sampling and digitizing considerations include presampling amplification of signals so as to minimize digitizing errors, the number of bits per sample, the number of samples per cycle, sample and hold amplification, and timewise spacing of samples. Considerations for additional phaseless digital filtering include the selection of passbands and stopbands, and the attenuation and allowable ripple in each, as well as correction of anti-alias filter phase lags. Each of these factors shall be considered so that an overall data-acquisition accuracy of ± 0,5 % is achieved.

7.3.3.2 Aliasing errors

In order to avoid uncorrectable aliasing, the analog signals shall be appropriately filtered before sampling and digitizing. The order of the filters used and their passband shall be chosen according to both the required flatness in the relevant frequency range and the sampling rate. The minimum filter characteristics and sampling rate shall be such that

— within the relevant frequency range of 0 Hz to f_{max} = 2 Hz the attenuation is less than the resolution of the data acquisition system, and

— at one-half the sampling rate (i.e. the *Nyquist* or “folding” frequency) the magnitudes of all frequency components of signal and noise are reduced to less than the system resolution.

© ISO 2011 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 14793:2011