BS ISO 21234:2022

BSI Standards Publication

Road vehicles — Heavy commercial vehicles and buses — Mass moment of inertia measurement

Documents
Document Sharing Hub

Full document details: BS ISO 21234:2022

National foreword

This British Standard is the UK implementation of ISO 21234:2022.

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 committee manager.

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

© The British Standards Institution 2022
Published by BSI Standards Limited 2022

ISBN 978 0 539 03608 4

ICS 43.080.01

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 July 2022.

Amendments/corrigenda issued since publication

Date	Text affected

Documents
Document Sharing Hub

Full document details: BS ISO 21234:2022

INTERNATIONAL STANDARD

ISO 21234

First edition
2022-05

Road vehicles — Heavy commercial vehicles and buses – Mass moment of inertia measurement

Véhicules routiers — Véhicules utilitaires lourds et autobus — Mesure du moment d'inertie de masse

Reference number
ISO 21234:2022(E)

Documents
Document Sharing Hub

© ISO 2022

Full document details: BS ISO 21234:2022

COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub

Full document details: BS ISO 21234:2022

Contents

Page

Foreword ... **v**

Introduction ... **vi**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **1**

4 Principles ... **2**

5 Variables ... **3**
5.1 Reference system ... 3
5.2 Variables to be measured ... 3

6 Measuring equipment ... **4**

7 Test conditions ... **4**
7.1 General ... 4
7.2 Ambient conditions ... 4
7.3 Test surface ... 4
7.4 Test vehicle ... 4
7.5 Operating and other liquids ... 5
7.6 Loading conditions, suspension and mechanical parts ... 5

8 Determination of the I_{xx}, I_{yy}, I_{zz}, and I_{xz} mass moments of inertia ... **5**
8.1 General ... 5
8.1.1 Platform levelness ... 5
8.1.2 Platform weight and stiffness ... 5
8.1.3 Pivot location ... 6
8.1.4 Vehicle weight ... 6
8.1.5 Vehicle/platform MOI comparison ... 6
8.1.6 Vehicle location on the platform ... 6
8.1.7 Vehicle restraints ... 6
8.1.8 Platform oscillation amplitude ... 6
8.1.9 Pivot bearing damping ... 7
8.1.10 Oscillation period measurement ... 7
8.2 Determination of I_{xx} and I_{yy} using a stable pendulum ... 8
8.2.1 General guidance ... 8
8.2.2 Procedure ... 9
8.2.3 Determination of I_{xx} and I_{yy} ... 9
8.2.4 Data presentation ... 10
8.3 Determination of I_{xx} and I_{yy} using an unstable pendulum ... 10
8.3.1 General guidance ... 10
8.3.2 Procedure ... 10
8.3.3 Calculation of I_{xx} and I_{yy} ... 11
8.3.4 Data presentation ... 12
8.4 Determination of I_{zz} using a torsional pendulum ... 12
8.4.1 General guidance ... 12
8.4.2 Procedure ... 12
8.4.3 Calculation of I_{zz} ... 12
8.4.4 Data presentation ... 13
8.5 Determination of I_{xz} using a torsional pendulum ... 13
8.5.1 General guidance ... 13
8.5.2 Procedure ... 13
8.5.3 Calculation of I_{xz} ... 13
8.5.4 Data presentation ... 14
8.6 Determination of I_{zz} using a multi-filar torsional pendulum ... 14
8.6.1 General guidance ... 14

AVA Documents
Document Sharing Hub

© ISO 2022 – All rights reserved

Full document details: BS ISO 21234:2022

8.6.2 Procedure 15
8.6.3 Calculation of I_{zz} 16
8.6.4 Data presentation 16
8.7 I_{xx}, I_{yy}, I_{zz}, and I_{xz} results checks 16
8.8 Parallel Axis Theorem 16

Bibliography **17**

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 21234:2022

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 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.

© ISO 2022 – All rights reserved

Documents
Document Sharing Hub
Full document details: BS ISO 21234:2022

Introduction

Methods are presented for determining the roll (I_{xx}), pitch (I_{yy}), and yaw (I_{zz}) mass moments of inertia (MOI) and roll-yaw (I_{xz}) product of inertia (POI) of an individual vehicle unit about the vehicle unit axis system and centre of gravity reference point. I_{xx}, I_{yy}, I_{zz}, and I_{xz} are fundamental mass properties that provide information on a vehicle's mass distribution and rotational acceleration responses to applied forces. The I_{xy} and I_{yz} components of the inertia tensor are less significant to vehicle dynamics and are not addressed in this document. The MOIs are determined using a pendulum device with measurements of oscillation period and reaction forces. The location of the vehicle unit's centre of gravity (CG) reference point is required beforehand. Knowledge of a vehicle unit's mass moments of inertia supports vehicle modelling work, design validation, and planning for other dynamic tests yet to be performed.

Performing measurements for MOI determination of heavy commercial vehicles and buses may be challenging in practice due to the wide variety of vehicles that vary significantly in terms of weight, size, and number of axles. Adaptability of a heavy vehicle MOI facility's layout is an important attribute.

© ISO 2022 – All rights reserved
Documents
Document Sharing Hub
Full document details: BS ISO 21234:2022

Road vehicles — Heavy commercial vehicles and buses – Mass moment of inertia measurement

1 Scope

This document provides standard methods for determining a vehicle's roll, pitch, and yaw mass moments of inertia (MOI) and roll-yaw product of inertia (POI). It applies to heavy vehicles, that is commercial vehicles and buses as defined in ISO 3833 (trucks and trailers with maximum weight above 3,5 tons and buses and articulated buses with maximum weight above 5 tons, according to ECE and EC vehicle classification, categories M3, N2, N3, O3 and O4). Mass moment of inertia measurements are performed separately for each single unit.

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 612, *Road vehicles — Dimensions of motor vehicles and towed vehicles — Terms and definitions*

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

ISO 15037-2, *Road vehicles — Vehicle dynamics test methods — Part 2: General conditions for heavy vehicles and buses*

3 Terms and definitions

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

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

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

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

3.1
stable pendulum
pendulum apparatus for supporting a vehicle on a nominally planar surface where the combined vehicle and pendulum CG height is below the pivot point

3.2
unstable pendulum
pendulum apparatus for supporting a vehicle on a nominally planar surface where the combined vehicle and pendulum CG height is above the pivot point

3.3
torsional pendulum
pendulum apparatus where the restoring force is torsion

3.4
multi-filar torsional pendulum
torsional pendulum (3.3) with multiple vertical wires, cables or chains supporting the vehicle and test *platform* (3.5) where the torsional restoring force is due to gravity and spring force in twisting cables

© ISO 2022 – All rights reserved

AVA Documents Document Sharing Hub
Full document details: BS ISO 21234:2022