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Road vehicles — Vehicle dynamics and road-holding ability — Vocabulary

*Véhicules routiers — Dynamique des véhicules et tenue de route —
Vocabulaire*



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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.

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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 8855 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 8855:1991), which has been technically revised. It also incorporates the Addendum ISO 8855:1991/Add.1:1992.

Introduction

This International Standard defines terms appertaining to road vehicle dynamics, principally for use by design, simulation and development engineers in the automotive industries. This second edition has been prepared in response to a requirement to update the first, and to harmonize its contents with that of the comparable standard published by SAE International (SAE J670:JAN2008). This revision extends the scope to include provision for separate tyre and wheel axis systems, inclined and non-uniform road surfaces, tyre forces and moments, multiple unit commercial vehicles, and two-axle vehicles possessed of four-wheel steer geometry.

The vocabulary contained in this International Standard has been developed from the previous edition, and SAE J670, in order to facilitate accurate and unambiguous communication of the terms and definitions employed in the test, analysis and general description of the lateral, longitudinal, vertical and rotational dynamics of road vehicles.

Road vehicles — Vehicle dynamics and road-holding ability — Vocabulary

1 Scope

This International Standard defines the principal terms used for road vehicle dynamics. The terms apply to passenger cars, buses and commercial vehicles with one or more steered axles, and to multi-unit vehicle combinations.

2 Axis system

2.1 reference frame

geometric environment in which all points remain fixed with respect to each other at all times

2.2 inertial reference frame

Newtonian reference frame

reference frame (2.1) that is assumed to have zero linear and angular acceleration and zero angular velocity

NOTE In Newtonian physics, the Earth is assumed to be an inertial reference frame.

2.3 axis system

set of three orthogonal directions associated with X , Y and Z axes

NOTE A right-handed axis system is assumed throughout this International Standard, where: $\vec{Z} = \vec{X} \times \vec{Y}$.

2.4 coordinate system

numbering convention used to assign a unique ordered trio (x, y, z) of values to each point in a **reference frame** (2.1), and which consists of an **axis system** (2.3) plus an origin point

2.5 ground plane

horizontal plane in the **inertial reference frame** (2.2), normal to the gravitational vector

2.6 road surface

surface supporting the tyre and providing friction necessary to generate shear forces in the **road plane** (2.7)

NOTE The surface may be flat, curved, undulated or of other shape.

2.7 road plane

plane representing the **road surface** (2.6) within the tyre contact patch

NOTE 1 For an uneven road, a different road plane may exist at each tyre contact patch.

NOTE 2 For a planar road surface, the road plane is coincident with the road surface. For road surfaces with surface contours having a wavelength similar to or less than the size of the tyre contact patch, as in the case of many ride events,

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it is intended that an equivalent road plane be determined. Determination of the equivalent road plane is dependent on the requirements of the analysis being performed. The equivalent road plane may not be coincident with the actual road surface at the **contact centre** (4.1.4).

2.7.1

road plane elevation angle

λ
angle from the normal projection of the X_T axis on to the **ground plane** (2.5) to the X_T axis

2.7.2

road plane camber angle

η
angle from the normal projection of the Y_T axis on to the **ground plane** (2.5) to the Y_T axis

2.8

earth-fixed axis system

(X_E, Y_E, Z_E)

axis system (2.3) fixed in the **inertial reference frame** (2.2), in which the X_E and Y_E axes are parallel to the **ground plane** (2.5), and the Z_E axis points upward and is aligned with the gravitational vector

NOTE The orientation of the X_E and Y_E axes is arbitrary and is intended to be based on the needs of the analysis or test.

2.9

earth-fixed coordinate system

(x_E, y_E, z_E)

coordinate system (2.4) based on the **earth-fixed axis system** (2.8) with an origin that is fixed in the **ground plane** (2.5)

NOTE The location of the origin is generally an arbitrary point defined by the user.

2.10

vehicle axis system

(X_V, Y_V, Z_V)

axis system (2.3) fixed in the **reference frame** (2.1) of the vehicle **sprung mass** (4.12), so that the X_V axis is substantially horizontal and forwards (with the vehicle at rest), and is parallel to the vehicle's longitudinal plane of symmetry, and the Y_V axis is perpendicular to the vehicle's longitudinal plane of symmetry and points to the left with the Z_V axis pointing upward

See Figure 1.

NOTE 1 For multi-unit combinations a separate vehicle axis system may be defined for each **vehicle unit** (3.1) (see Figure 2).

NOTE 2 The symbolic notation $(X_{V,1}, Y_{V,1}, Z_{V,1}), (X_{V,2}, Y_{V,2}, Z_{V,2}), \dots, (X_{V,n}, Y_{V,n}, Z_{V,n})$ may be assigned to the vehicle axis systems of a multi-unit combination with n **vehicle units** (3.1).

2.11

vehicle coordinate system

(x_V, y_V, z_V)

coordinate system (2.4) based on the **vehicle axis system** (2.10) with the origin located at the **vehicle reference point** (2.12)

2.12

vehicle reference point

point fixed in the vehicle **sprung mass** (4.12)

NOTE The vehicle reference point may be defined in a variety of locations, based on the needs of the analysis or test. Commonly used locations include the total vehicle centre of gravity, the sprung mass centre of gravity, the mid-**wheelbase** (4.2) point at the height of the centre of gravity, and the centre of the front axle. For multi-unit combinations, a vehicle reference point may be defined for each **vehicle unit** (3.1).

**2.13
intermediate axis system**

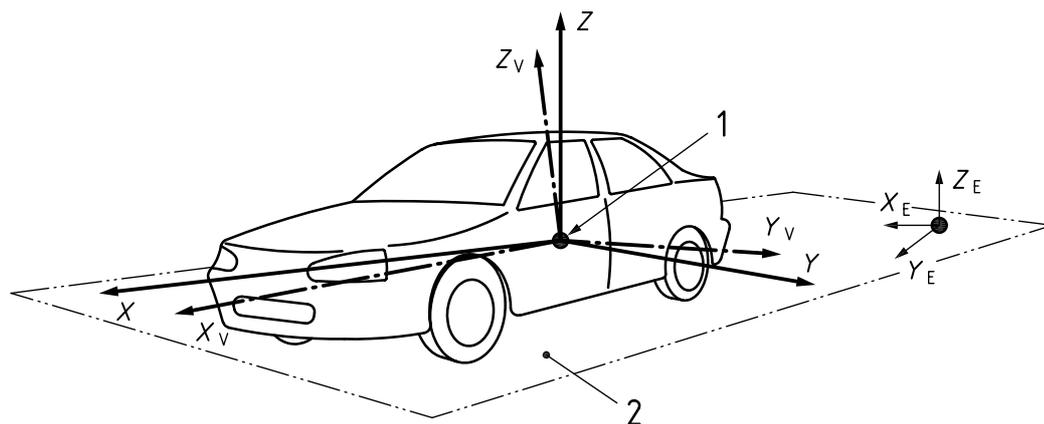
(X, Y, Z)

axis system (2.3) whose X and Y axes are parallel to the **ground plane** (2.5), with the X axis aligned with the vertical projection of the X_V axis on to the **ground plane** (2.5)

See Figure 1.

NOTE 1 For multi-unit combinations, a separate intermediate axis system may be defined for each **vehicle unit** (3.1).

NOTE 2 The intermediate axis system is used to facilitate the definition of angular orientation terms and the components of force, moment, and motion vectors. An intermediate coordinate system is not defined herein.



Key

- 1 vehicle reference point
- 2 ground plane

Figure 1 — Vehicle and intermediate axis systems

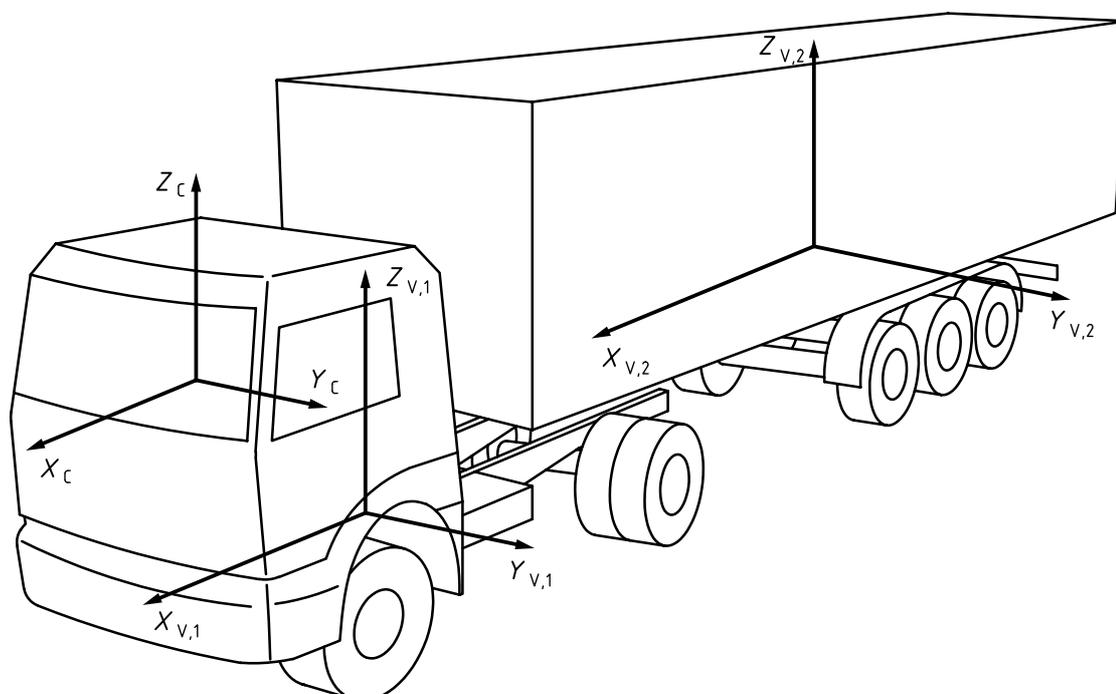


Figure 2 — Multi-unit axis systems

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2.14
tyre axis system

(X_T, Y_T, Z_T)

axis system (2.3) whose X_T and Y_T axes are parallel to the local **road plane** (2.7), with the Z_T axis normal to the local road plane, where the orientation of the X_T axis is defined by the intersection of the **wheel plane** (4.1) and the road plane, and the positive Z_T axis points upward

NOTE A local tyre axis system may be defined at each wheel (see Figure 3).

2.15
tyre coordinate system

(x_T, y_T, z_T)

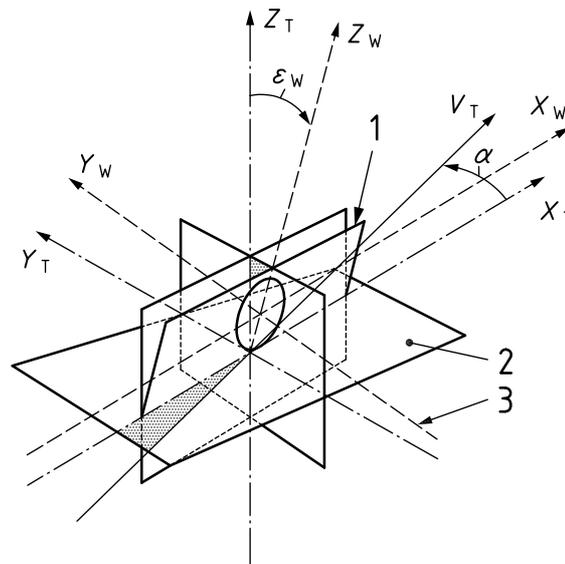
coordinate system (2.4) based on the **tyre axis system** (2.14) with the origin fixed at the **contact centre** (4.1.4)

2.16
wheel axis system

(X_W, Y_W, Z_W)

axis system (2.3) whose X_W and Z_W axes are parallel to the **wheel plane** (4.1), whose Y_W axis is parallel to the **wheel-spin axis** (4.1.1), and whose X_W axis is parallel to the local **road plane** (2.7), and where the positive Z_W axis points upward

NOTE A local wheel axis system may be defined for each wheel (see Figure 3).



- Key**
- 1 wheel plane
 - 2 road plane
 - 3 wheel-spin axis

Figure 3 — Tyre and wheel axis system

2.17
wheel coordinate system

(x_W, y_W, z_W)

coordinate system (2.4) based on the **wheel axis system** (2.16) with the origin fixed at the **wheel centre** (4.1.2)

2.18

cab axis system

(X_C, Y_C, Z_C)

axis system (2.3) fixed in the **reference frame** (2.1) of the cab sprung mass, so that the X_C axis is substantially horizontal and forwards (with the vehicle at rest), and is parallel to the vehicle's longitudinal plane of symmetry, and where the Y_C axis is perpendicular to the cab's longitudinal plane of symmetry and points to the left with the Z_C axis pointing upward

NOTE A cab axis system applies only to vehicles with a suspended cab only.

2.19

cab coordinate system

(x_C, y_C, z_C)

coordinate system (2.4) based on the **cab axis system** (2.18) with the origin fixed at an arbitrary point defined by the user

3 Vehicle unit

3.1

vehicle unit

rigid (i.e. non-articulating) vehicle element operating alone or in combination with one or more other rigid elements joined at yaw-articulation joints

NOTE Tractor, **semi trailer** (3.2.2) and **dolly** (3.2.4) are examples of vehicle units. A drawbar **trailer** (3.2) may consist of more than one vehicle unit.

3.2

trailer

vehicle unit (3.1) or combination of multiple vehicle units that is towed by another vehicle unit and can be disconnected from its towing vehicle unit

NOTE A trailer may have a single axle or multiple axles positioned along its length.

3.2.1

full trailer

trailer (3.2) that has both front and rear running gear and, hence, provides fully its own vertical support

3.2.2

semi trailer

trailer (3.2) that has only rear running gear and hence depends on its towing **vehicle unit** (3.1) for a substantial part of its vertical support

NOTE A semi trailer is typically coupled to the towing vehicle unit using a **fifth-wheel coupling** (3.2.6).

3.2.3

centre-axle trailer

trailer (3.2) with only rear running gear located only slightly aft of the nominal position of the centre of gravity of the unit

NOTE A centre-axle trailer is typically coupled to the towing unit with a **hitch coupling** (3.2.7).

3.2.4

dolly

portion of a **full trailer** (3.2.1) that includes the steerable front running gear and tow bar

3.2.5

converter dolly

dolly (3.2.4) unit that couples to a **semi trailer** (3.2.2) with a **fifth-wheel coupling** (3.2.6) and thereby "converts" the semi trailer to a **full trailer** (3.2.1)