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## **Flight dynamics — Concepts, quantities and symbols —**

### **Part 1: Aircraft motion relative to the air**

*Mécanique du vol — Concepts, grandeurs et symboles —*

*Partie 1: Mouvement de l'avion par rapport à l'air*

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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 1151-1 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*.

This fourth edition cancels and replaces the third edition (ISO 1151-1:1985) of which it constitutes a technical revision: this fourth edition includes Draft Addenda ISO/DIS 1151-1/DAD 1, circulated in 1986 (addition of a symbol to 1.5.4, 1.6.1.3 and 1.6.2.9; new sub-clauses 1.4.10, 1.4.11, 1.5.10 to 1.5.13 and 1.10) and ISO/DIS 1151-1/DAD 2, circulated in 1986 (addition of annex B).

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

ISO 1151, *Flight dynamics — Concepts, quantities and symbols*, comprises, at present, seven parts:

*Part 1 : Aircraft motion relative to the air.*

*Part 2 : Motions of the aircraft and the atmosphere relative to the Earth.*

*Part 3 : Derivatives of forces, moments and their coefficients.*

*Part 4 : Parameters used in the study of aircraft stability and control.*

*Part 5 : Quantities used in measurements.*

*Part 6 : Aircraft geometry.*

*Part 7 : Flight points and flight envelopes.*

ISO 1151 is intended to introduce the main concepts, to include the more important terms used in theoretical and experimental studies and, as far as possible, to give corresponding symbols.

In all the parts comprising ISO 1151, the term "aircraft" denotes a vehicle intended for atmosphere or space flight. Usually, it has an essentially port and starboard symmetry with respect to a plane. That plane is determined by the geometric characteristics of the aircraft. In that plane, two orthogonal directions are defined: fore-and-aft and dorsal-ventral. The transverse direction, on the perpendicular to that plane, follows.

When there is a single plane of symmetry, it is the reference plane of the aircraft. When there is more than one plane of symmetry, or when there is none, it is necessary to choose a reference plane. In the former case, the reference plane is one of the planes of symmetry. In the latter case, the reference plane is arbitrary. In all cases, it is necessary to specify the choice made.

Angles of rotation, angular velocities and moments about any axis are positive clockwise when viewed in the positive direction of that axis.

All the axis systems used are three-dimensional, orthogonal and right-handed, which implies that a positive rotation through  $\pi/2$  around the  $x$ -axis brings the  $y$ -axis into the position previously occupied by the  $z$ -axis.

The centre of gravity coincides with the centre of mass if the field of gravity is homogeneous. If this is not the case, the centre of gravity can be replaced by the centre of mass in the definitions of ISO 1151; in which case, this should be indicated.

### Numbering of sections and clauses

With the aim of easing the indication of references from a section or a clause, a decimal numbering system has been adopted such that the first figure is the number of the part of ISO 1151 considered.

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# Flight dynamics — Concepts, quantities and symbols —

## Part 1:

## Aircraft motion relative to the air

### 1.0 Introduction

This part of ISO 1151 gives basic definitions and deals with aircraft motion relative to the atmosphere, assumed to be at rest or in translational motion at constant velocity relative to the Earth.<sup>1)</sup>

The aircraft is assumed to be rigid. However, most of the definitions can be applied to the case of a flexible aircraft.

When account is taken of the variations at the Earth's surface in the direction of the vertical (local direction of acceleration due to gravity), the term given in the sub-clauses and figures in question is qualified by the term "local".

### 1.1 Axis systems

No.	Term	Definition	Symbol
1.1.1	Earth-fixed axis system	A system with both the origin and axes fixed relative to the Earth, and chosen as appropriate.	$x_0 y_0 z_0$
1.1.2	Normal earth-fixed axis system	An earth-fixed axis system (1.1.1) in which the $z_0$ -axis is oriented according to the downward vertical passing through the origin.	$x_0 y_0 z_0$ NOTE — However, $x_g y_g z_g$ is an acceptable alternative.
1.1.3	Aircraft-carried earth axis system	A system in which each axis has the same direction as the corresponding earth-fixed axis, with the origin fixed in the aircraft, usually the centre of gravity.	$x_0 y_0 z_0$
1.1.4	Aircraft-carried normal earth axis system	A system in which each axis has the same direction as the corresponding normal earth-fixed axis, with the origin fixed in the aircraft, usually the centre of gravity.	$x_0 y_0 z_0$ NOTE — However, $x_g y_g z_g$ is an acceptable alternative.
1.1.5	Body axis system <sup>2)</sup>	A system fixed in the aircraft, with the origin, usually the centre of gravity, consisting of the following axes:	$x y z$
	Longitudinal axis	An axis in the reference plane (see foreword on p. iii) or, if the origin is outside that plane, in the plane through the origin, parallel to the reference plane.	$x$
	Transverse axis	An axis normal to the reference plane and positive to starboard.	$y$
	Normal axis	An axis completing the system.	$z$
		NOTE — This axis lies in the reference plane or is parallel to that plane. It is positive in the ventral sense.	

1) The motions of the atmosphere for which this assumption does not hold true will be examined in another part of ISO 1151.

2) Usually, the origins of the axis systems defined in 1.1.5, 1.1.6 and 1.1.7 coincide. If that is not the case, it is necessary to distinguish the different origins by appropriate suffixes.