INTERNATIONAL STANDARD 1151/II

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Terms and symbols for flight dynamics — Part II : Motions of the aircraft and the atmosphere relative to the Earth

Termes et symboles de la mécanique du vol — Partie II : Mouvements de l'avion et de l'atmosphère par rapport à la Terre

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up 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.

International Standard ISO 1152 was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles.*

It was submitted directly to the ISO Council, in accordance with clause 6.12.1 of the *Directives for the technical work of ISO.*

This International Standard cancels and replaces ISO Recommendation R 1152-1969, which had been approved by the Member Bodies of the following countries :

Belgium
Czechoslovakia
Egypt, Arab Rep. of
France
Germany
India
Israel
Italy
Netherlands
New Zealand
Poland
Spain
Sweden
Switzerland
Turkey
United Kingdom
Yugoslavia

The Member Bodies of the following countries had disapproved the Recommendation :

U.S.A.
U.S.S.R.

Printed in Switzerland

International Standard ISO 1152, *Terms and symbols for flight dynamics — Part II : Motions of the aircraft and the atmosphere relative to the Earth,* is the second in a series of International Standards, the purpose of which is to define the principal terms used in flight dynamics and to specify symbols for these terms.

Other International Standards in this series, which will be further extended in the future, are at present as follows :

ISO 1151, *Terms and symbols for flight dynamics — Part I : Aircraft motion relative to the air.*

ISO 1153, *Terms and symbols for flight dynamics — Part III : Derivatives of forces, moments and their coefficients.*

ISO 2764, *Terms and symbols for flight dynamics — Part IV : Parameters used in the study of aircraft stability and control.*

ISO 2765, *Terms and symbols for flight dynamics — Part V : Quantities used in measurements.*

In these International Standards, the term "aircraft" denotes an aerodyne having a fore-and-aft plane of symmetry. This plane is determined by the geometrical characteristics of the aircraft. When there are more than one fore-and-aft planes of symmetry, the reference plane of symmetry is arbitrary and it is necessary to indicate the choice made.

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

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

Numbering of sections and clauses

Each of these International Standards represents a part of the whole study on terms and symbols for flight dynamics.

To permit easier reference to a section or a clause from one part to another, a decimal numbering has been adopted which begins in each International Standard with the number of the part it represents.

CONTENTS

Terms and symbols for flight dynamics — Part II : Motions of the aircraft and the atmosphere relative to the Earth

2.0 INTRODUCTION

This International Standard deals with the motions of the aircraft and the atmosphere relative to the Earth.

In this International Standard:

1) the effects of the Earth's curvature are not considered; for the purpose of the definition of Earth axes, the Earth's surface is treated as a plane, that is, the Earth's radius is taken as infinite;

2) the motion of the air is defined at a given instant and in the space surrounding the aircraft (outside its aerodynamic field) by a single vector. The wind gradients and the turbulence in the air surrounding the aircraft are not taken into account.

To account fully for aeroelastic effects, certain aspects of the definition of the flight-path axis system would need to be considered in greater detail. This definition applies as it stands to the rigid aircraft.

2.1 AXIS SYSTEM

No.	Term	Definition	Symbol
2.1.1	Flight-path axis system	A system with origin O fixed in the aircraft (usually at the centre of gravity) and in which the x_k-axis is in the direction of the flight-path velocity (2.2.1). The two other axes are chosen to suit the problem.	x_k, y_k, z_k

2.2 VELOCITIES

No.	Term	Definition	Symbol
2.2.1	Flight-path velocity	The velocity of the origin O of the aircraft body axis system (1.1.5) (usually the centre of gravity) relative to the Earth. The corresponding scalar quantity is the flight-path speed. NOTE – The projection of the flight-path velocity on the horizontal plane is called the ground speed.	$\vec{V}_K (V_K)$
2.2.2	Components of flight-path velocity	The components of the flight-path velocity $\vec{V}_K$ for any of the axis systems used : In the axis systems 1.1.1 to 1.1.4 : component along x_o-axis component along y_o-axis component along z_o-axis In the body axis system (1.1.5) : component along the longitudinal axis component along the transverse axis component along the normal axis NOTE – In a flight-path axis system (2.1.1) the component along the x_k-axis is $u_{Kk} = V_K$.	 u_{Ko} v_{Ko} w_{Ko} u_K v_K w_K
2.2.3	Wind velocity	The velocity relative to the Earth of the air surrounding the aircraft. The corresponding scalar quantity is the wind speed. NOTE – In navigation and meteorology the wind velocity is usually taken to refer to the horizontal component of $\vec{V}_W$.	$\vec{V}_W (V_W)$

No.	Term	Definition	Symbol
2.2.4	Wind velocity components	The components of the wind velocity $\vec{V}_W$ for any of the axis systems used : In the axis systems 1.1.1 to 1.1.4 : component along x_o-axis component along y_o-axis component along z_o-axis In the body axis system (1.1.5) : component along the longitudinal axis component along the transverse axis component along the normal axis In the flight-path axis system (2.1.1) : component along x_k-axis component along y_k-axis component along z_k-axis	 u_{Wo} v_{Wo} w_{Wo} u_W v_W w_W u_{Wk} v_{Wk} w_{Wk}

2.3 FLIGHT-PATH ANGLES

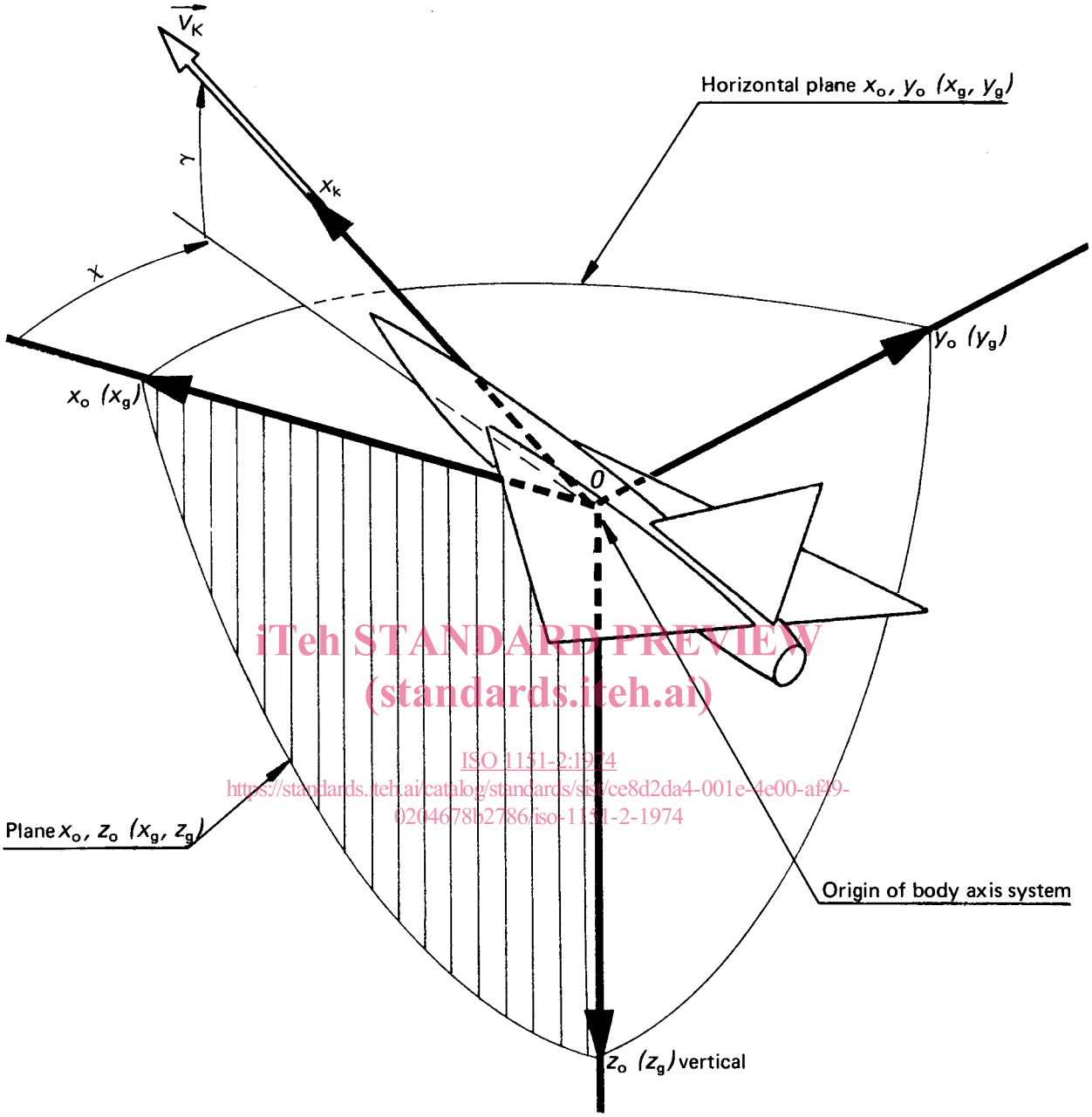
Orientation of the flight-path velocity with respect to the aircraft-carried normal earth axis system (see figure 1).

No.	Term	Definition	Symbol
2.3.1	Flight-path azimuth angle (angle of track*)	The angle through which the x_o (x_g)-axis of the aircraft-carried normal earth axis system (1.1.4) has to be rotated about the z_o (z_g)-axis to bring the former axis into coincidence with the projection of the flight-path velocity (2.2.1) on the horizontal plane through the origin O. It is positive in the clockwise sense. *NOTE – In navigation, the term "angle of track" has reference to a particular direction of the x_o-axis.	χ
2.3.2	Angle of climb (flight-path inclination angle)	The angle between the flight-path velocity (2.2.1) and the horizontal plane. It is positive when the flight-path velocity is above the horizontal plane through the origin O. It has by convention the range $-\frac{\pi}{2} \leqslant \gamma \leqslant \frac{\pi}{2}$	γ

2.4 WIND DIRECTION ANGLES

Orientation of the wind velocity with respect to the normal earth-fixed axis system (see figure 2).

No.	Term	Definition	Symbol
2.4.1	Wind azimuth angle	The angle through which the x_o (x_g)-axis of the normal earth-fixed axis system (1.1.2) has to be rotated about the z_o (z_g)-axis to bring the former axis into coincidence with the projection of the wind velocity (2.2.3) on the horizontal plane through the origin O_o. It is positive in the clockwise sense. It has by convention the range $0 \leqslant \chi_w < 2\pi$ NOTE – If the x_o (x_g)-axis is directed towards geographic North, the wind azimuth angle differs by 180° from the wind direction used in meteorology.	χ_w
2.4.2	Wind elevation angle	The angle between the wind velocity (2.2.3) and the horizontal plane. It is positive when the wind is directed upwards. It has by convention the range $-\frac{\pi}{2} \leqslant \gamma_w \leqslant \frac{\pi}{2}$	γ_w



IN RED : Aircraft-carried normal earth axis system

NOTE – The angles shown are positive.

FIGURE 1 – **Flight-path angles**