International Standard 1151/2

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Flight dynamics — Concepts, quantities and symbols — Part 2: Motions of the aircraft and the atmosphere relative to the Earth

Mécanique du vol — Concepts, grandeurs et symboles — Partie 2: Mouvements de l'avion et de l'atmosphère par rapport à la Terre

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Descriptors : aircraft, dynamic properties, flight dynamics, aerodynamics, quantities, symbols, definitions.

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 1151/2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*.

ISO 1151/2 was first published in 1974. This second edition cancels and replaces the first edition, of which it constitutes a technical revision.

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 more than one plane of symmetry, or when there is none, it is necessary to introduce 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.

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.

Contents

Flight dynamics — Concepts, quantities and symbols — Part 2: Motions of the aircraft and the atmosphere relative to the Earth

2.0 Introduction

This part of ISO 1151 gives basic definitions and deals with the motions of the aircraft and the atmosphere relative to the Earth.

The atmosphere is assumed to be at rest or in translational motion at constant velocity relative to the Earth.[1)]

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".

2.1 Axis system

No.	Term	Definition	Symbol
2.1.1	Flight-path axis system	A system with the origin fixed in the aircraft (usually 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 as appropriate.	$x_k y_k z_k$

2.2 Velocities

No.	Term	Definition	Symbol
2.2.1	Flight-path velocity	The velocity of the origin of the flight-path axis system (2.1.1) relative to the Earth.	$\vec{V}_K$
	Flight-path speed	The magnitude of the flight-path velocity.	V_K
	Ground speed	The projection of the flight-path velocity on the horizontal plane.	—

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

No.	Term	Definition	Symbol
2.2.2	Components of flight-path velocity	Components of the flight-path velocity, $\overrightarrow{V_K}$, for any of the axis systems used.	
		In the axis systems 1.1.1 to 1.1.4:	
		component along the x_o-axis	u_{Ko}
		component along the y_o-axis	v_{Ko}
		component along the z_o-axis	w_{Ko}
		In the body axis system (1.1.5):	
		component along the longitudinal axis	u_K
		component along the transverse axis	v_K
		component along the normal axis	w_K
		NOTE — In the flight-path axis system (2.1.1), the component along the x_k-axis is $u_{Kk} = V_K$.	
2.2.3	Wind velocity	The velocity relative to the Earth of the air surrounding the aircraft.	$\overrightarrow{V_W}$
	Wind speed	The magnitude of the wind velocity.	V_W
		NOTE — In navigation and meteorology, the wind velocity is usually taken to refer to the horizontal component of $\overrightarrow{V_W}$.	
2.2.4	Wind velocity components	The components of the wind velocity, $\overrightarrow{V_W}$, for any of the axis systems used.	
		In the axis systems 1.1.1 to 1.1.4:	
		component along the x_o-axis	u_{Wo}
		component along the y_o-axis	v_{Wo}
		component along the z_o-axis	w_{Wo}
		In the body axis system (1.1.5):	
		component along the longitudinal axis	u_W
		component along the transverse axis	v_W
		component along the normal axis	w_W
		In the flight-path axis system (2.1.1):	
		component along the x_k-axis	u_{Wk}
		component along the y_k-axis	v_{Wk}
		component along the z_k-axis	w_{Wk}

2.3 Flight-path angles

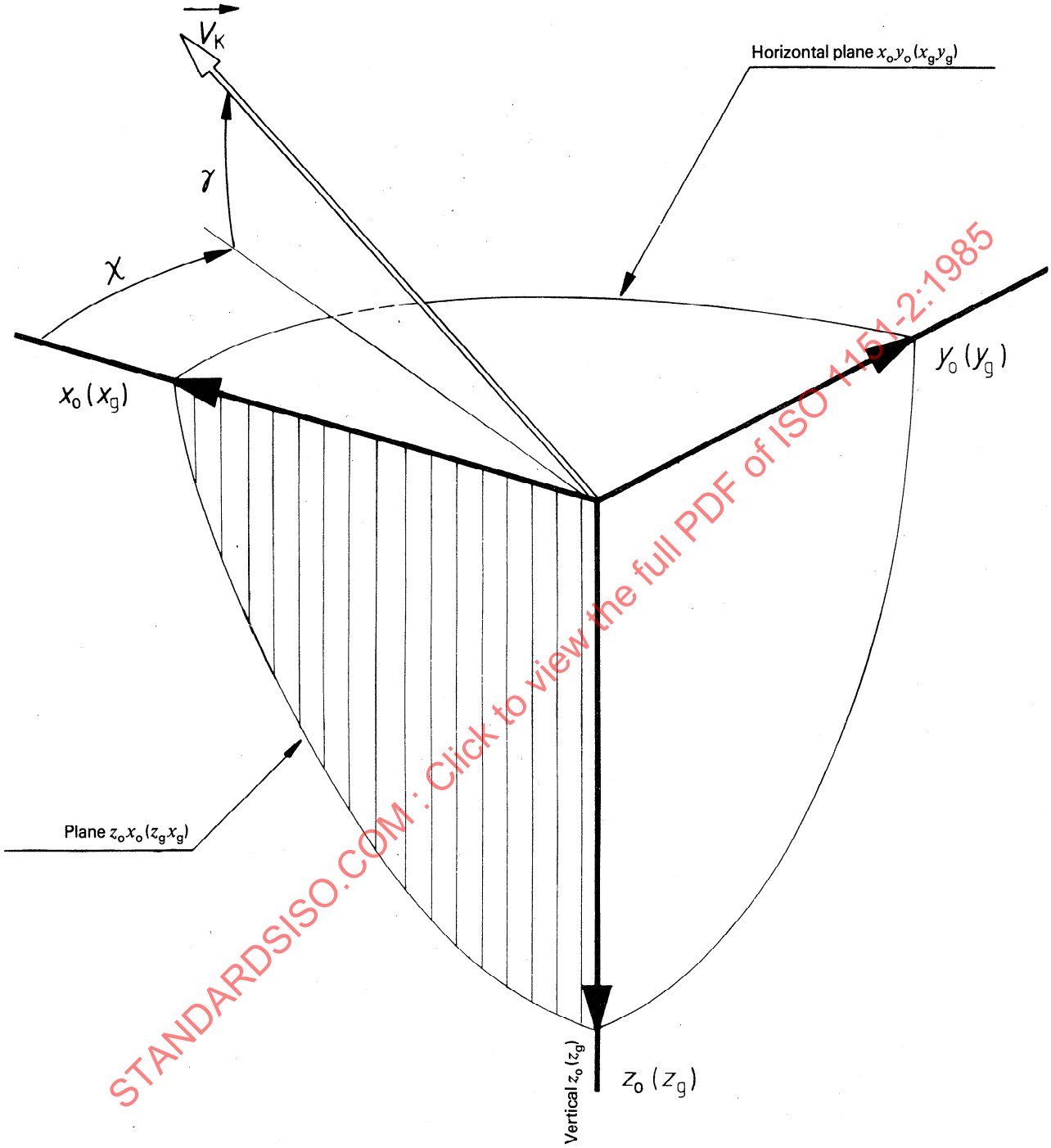
Orientation of the flight-path velocity with respect to the aircraft-carried normal earth axis system (see figure 1).

No.	Term	Definition	Symbol
2.3.1	Flight-path azimuth angle	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 of this axis system. It is positive in the clockwise direction. NOTE — In navigation, the flight-path azimuth angle, when referring to a particular direction of the x_o-axis, is known as the "angle of track".	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 of the aircraft-carried normal earth axis system (1.1.4). According to convention, it has 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).

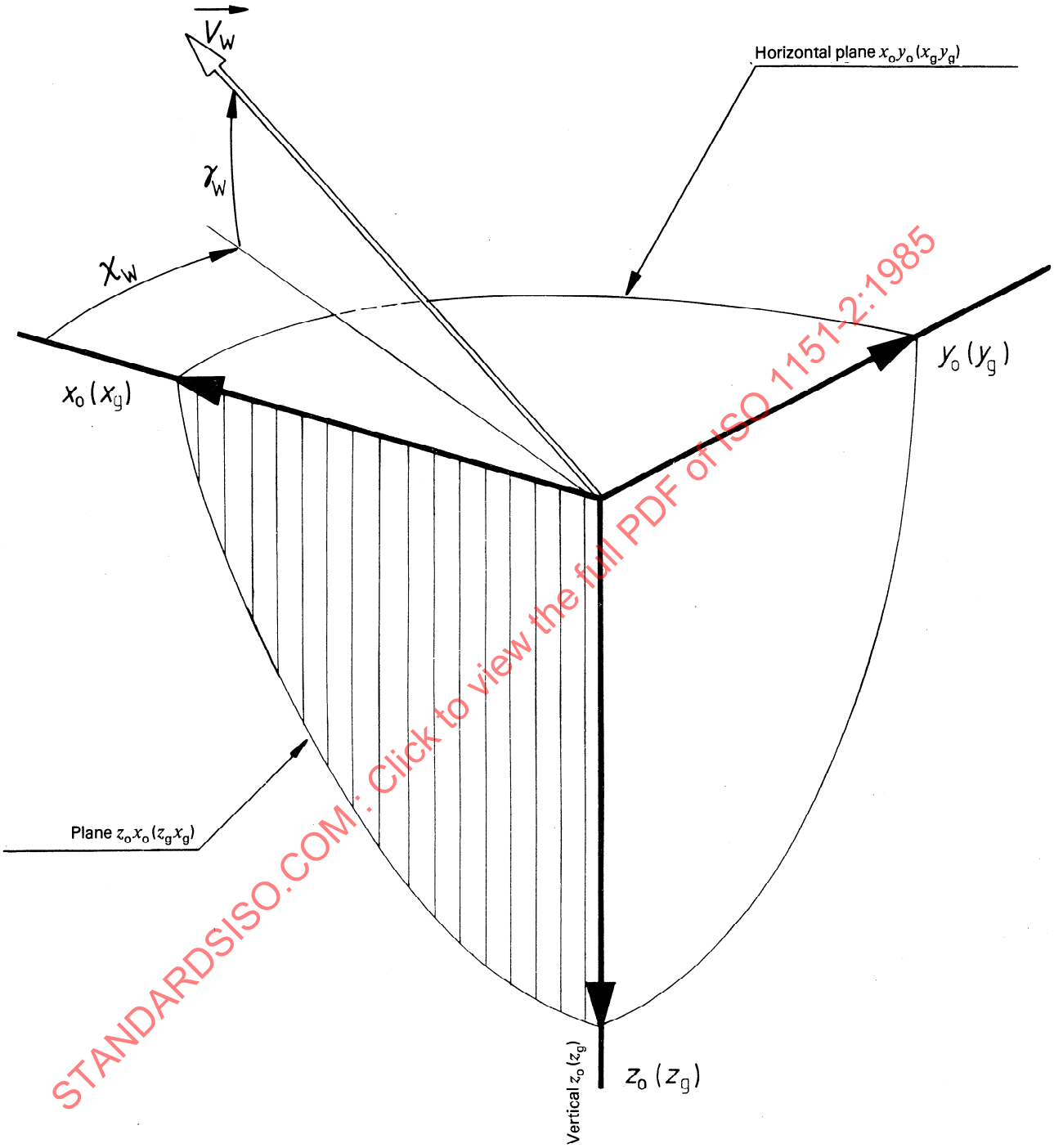
No.	Term	Definition	Symbol
2.4.1	Wind azimuth angle	The angle which the x_o(x_g)-axis of the normal earth-fixed axis system (1.1.2) has to be rotated about the z_o(z_g)-axis to bring the former axis into coincidence with the projection of the wind velocity (2.2.3) on the horizontal plane through the origin of this axis system. It is positive in the clockwise direction. According to convention, it has 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. According to convention, it has the range: $-\frac{\pi}{2} \leqslant \gamma_W \leqslant \frac{\pi}{2}$	γ_W



IN RED LINES: Aircraft-carried normal earth axis system

NOTE — The angles shown are positive.

Figure 1 — Flight-path angles



IN RED LINES: Normal earth-fixed axis system

NOTE — The angles shown are positive.

Figure 2 — Wind direction angles