INTERNATIONAL STANDARD ISO 2533

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

Standard Atmosphere

(identical with the ICAO and WMO Standard Atmospheres from – 2 to 32 km)

Atmosphère Type

(identique aux atmosphères standard de l'OACI et de l'OMM entre – 2 et 32 km)

Стандартная атмосфера

(от — 2 до 32 км идентична стандартным атмосферам ИКАО и ВМО)

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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 2533 was drawn up by Technical Committee ISO/TC 20, *Aircraft and space vehicles,* and circulated to the Member Bodies in April 1972. [The tables of the ISO Interim Standard Atmosphere (see page iii) were circulated separately to the Member Bodies in August 1972 as Addendum 1 and have now been incorporated in the present document.]

It has been approved by the Member Bodies of the following countries :

Austria*	India*	South Africa, Rep. of*
Belgium*	Ireland*	Thailand*
Brazil	Japan	Turkey*
Czechoslovakia*	Netherlands*	United Kingdom*
Egypt, Arab Rep. of*	New Zealand*	U.S.A.*
France*	Portugal	U.S.S.R.*
Germany*	Romania*	

* Also approved Addendum 1.

No Member Body has expressed disapproval of the document.

NOTE — The following International Organizations took part in the discussion of this International Standard at all stages of its development :

International Civil Aviation Organization (ICAO).

World Meteorological Organization (WMO).

Printed in Switzerland

The characteristics of the ISO Standard Atmosphere have been calculated as functions of geometric and geopotential altitudes for altitudes from − 2 000 to 50 000 m based on the standard atmospheres of ICAO 1964 and USA 1962, which for these altitudes were recognized as the most representative when comparing the current national and international standards and recommendations on the atmosphere [1-4], [6-7] with the results of recent research.

Data from this recent research have been used for calculation of the atmospheric characteristics for altitudes from 50 000 to 80 000 m, representing the ISO Interim Standard Atmosphere.

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Standard Atmosphere

(identical with the ICAO and WMO Standard Atmospheres from − 2 to 32 km)

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of an ISO Standard Atmosphere and is intended for use in calculations and design of flying vehicles, to present the test results of flying vehicles and their components under identical conditions, and to allow unification in the field of development and calibration of instruments. Its use is also recommended in the processing of data from geophysical and meteorological observations.

2 BASIC PRINCIPLES AND CALCULATION FORMULAE

2.1 Primary constants and characteristics

The tables of the ISO Standard Atmosphere have been calculated assuming the air to be a perfect gas free from moisture and dust and based on conventional initial values of temperature, pressure and density of the air for mean sea level. The following constants and characteristics are used for calculations and their numerical values are given in table 1 :

g_n — standard acceleration of free fall. It conforms with latitude $\varphi = 45° 32' 33''$ using Lambert's equation of the acceleration of free fall as a function of latitude φ [5] :

$$g_\varphi = 9{,}806\ 16\ (1 - 0{,}002\ 637\ 3 \cos 2\varphi + 0{,}000\ 005\ 9 \cos^2 2\varphi)$$

M — air molar mass at sea level, as obtained from the perfect gas law (2) when introducing the adopted values p_n, ρ_n, T_n, R^* (see table 1);

N_A — Avogadro constant, based on the value of the nuclide ^{12}C, atomic mass = 12,000, as adopted in 1961 by the Conference of the International Union of Pure and Applied Chemistry as the basic atomic mass unity;

p_n — standard air pressure;

R^* — universal gas constant;

R — specific gas constant;

S and β_s — Sutherland's empirical coefficients in the equation for dynamic viscosity;

T_o — thermodynamic ice-point temperature, at mean sea level;

T_n — standard thermodynamic air temperature at mean sea level;

t_o — Celsius ice-point temperature at mean sea level;

t_n — standard Celsius air temperature at mean sea level;

$\kappa = \dfrac{c_p}{c_v}$ — adiabatic index, the ratio of the specific heat of air at constant pressure to its specific heat at constant volume;

ρ_n — standard air density;

σ — effective collision diameter of an air molecule; taken as constant with altitude.

TABLE 1 — **Main constants and characteristics adopted for the calculation of the ISO Standard Atmosphere**

Symbol	Value	Unit of measurement
g_n	9,806 65	$m \cdot s^{-2}$
M	28,964 420	$kg \cdot kmol^{-1}$
N_A	$602{,}257 \times 10^{24}$	$kmol^{-1}$
p_n	$101{,}325 \times 10^3$	Pa
	$1{,}013\ 250 \times 10^3$	mbar
	760	mmHg
R^*	8 314,32	$J \cdot K^{-1} \cdot kmol^{-1}$ or $kg \cdot m^2 \cdot s^{-2} \cdot K^{-1} \cdot kmol^{-1}$
R	287,052 87	$J \cdot K^{-1} \cdot kg^{-1}$ or $m^2 \cdot K^{-1} \cdot s^{-2}$
S	110,4	K
T_o	273,15	K
T_n	288,15	K
t_o	0,00	°C
t_n	15,00	°C
β_s	$1{,}458 \times 10^{-6}$	$kg \cdot m^{-1} \cdot s^{-1} \cdot K^{-1/2}$
κ	1,4	dimensionless
ρ_n	1,225	$kg \cdot m^{-3}$
σ	$0{,}365 \times 10^{-9}$	m