
Quantities and units —
Part 5:
Thermodynamics

Grandeurs et unités —

Partie 5: Thermodynamique



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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 12, *Quantities and units*, in collaboration with Technical Committee IEC/TC 25, *Quantities and units*.

This second edition cancels and replaces the first edition of (ISO 80000-5:2007), which has been technically revised.

The main changes compared to the previous edition are as follows:

- the table giving the quantities and units has been simplified;
- some definitions and the remarks have been stated physically more precisely.

A list of all parts in the ISO 80000 and IEC 80000 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Quantities and units —

Part 5: Thermodynamics

1 Scope

This document gives names, symbols, definitions and units for quantities of thermodynamics. Where appropriate, conversion factors are also given.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

Names, symbols, definitions and units for quantities used in thermodynamics are given in [Table 1](#).

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

Table 1 — Quantities and units used in thermodynamics

Item No.	Quantity		Unit	Remarks
	Name	Symbol		
5-1	thermodynamic temperature	T, θ	K	It is measured with a primary thermometer, examples of which are gas thermometers of different kinds, noise thermometers, or radiation thermometers. The Boltzmann constant (ISO 80000-1) relates energy at the individual particle level with thermodynamic temperature. Differences of thermodynamic temperatures or changes may be expressed either in kelvin, symbol K, or in degrees Celsius, symbol °C (item 5-2). Thermodynamic temperature is one of the seven base quantities in the International System of Quantities, ISQ (see ISO 80000-1). The International Temperature Scale of 1990 For the purpose of practical measurements, the International Temperature Scale of 1990, ITS-90, was adopted by CIPM in 1989, which is a close approximation to the thermodynamic temperature scale. The quantities defined by this scale are denoted T_{90} and t_{90}, respectively (replacing T_{68} and t_{68} defined by the International Practical Temperature Scale of 1968, IPTS-68), where $\frac{t_{90}}{1^{\circ}\text{C}} = \frac{T_{90}}{1\text{ K}} - 273,15$

Table 1 (continued)

Item No.	Quantity			Unit	Remarks
	Name	Symbol	Definition		
5-1 (cont.)					The units of T_{90} and t_{90} are the kelvin, symbol K, and the degree Celsius, symbol °C (item 5-2), respectively. For further information, see References[5], [6]. For ready conversion between temperatures reported on the International Temperature Scale and thermodynamic temperatures the systematic deviations can be found in Reference[7].
5-2	Celsius temperature	t, ϑ	temperature difference from the thermodynamic temperature of the ice point is called the Celsius temperature t, which is defined by the quantity equation: $t = T - T_0$ where T is thermodynamic temperature (item 5-1) and $T_0 = 273,15$ K	°C	The unit degree Celsius is a special name for the kelvin for use in stating values of Celsius temperature. The unit degree Celsius is by definition equal in magnitude to the kelvin. A difference or interval of temperature may be expressed in kelvin or in degrees Celsius. The thermodynamic temperature T_0 is 0,01 K below the thermodynamic temperature of the triple point of water. The symbol °C for the degree Celsius shall be preceded by a space (see ISO 80000-1). Prefixes are not allowed in combination with the unit °C.
5-3.1	linear expansion coefficient	α_l	relative change of length with temperature: $\alpha_l = \frac{1}{l} \frac{dl}{dT}$ where l is length (ISO 80000-3) and T is thermodynamic temperature (item 5-1)	K ⁻¹	The subscripts in the symbols may be omitted when there is no risk of confusion.
5-3.2	cubic expansion coefficient	α_V, γ	relative change of volume with temperature: $\alpha_V = \frac{1}{V} \frac{dV}{dT}$ where V is volume (ISO 80000-3) and T is thermodynamic temperature (item 5-1)	K ⁻¹	Also called volumetric expansion coefficient. The subscripts in the symbols may be omitted when there is no risk of confusion.