
Viscosity of water

Viscosité de l'eau



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 main task of technical committees is to prepare International Standards, but in exceptional circumstances a technical committee may propose the publication of a Technical Report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but not immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example).

Technical Reports of types 1 and 2 are subject to review within three years of publication, to decide whether they can be transformed into International Standards. Technical Reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

ISO/TR 3666, which is a Technical Report of type 3, was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*.

This second edition cancels and replaces the first edition (ISO/TR 3666:1977), which has been technically revised.

Annexes A and B of this Technical Report are for information only.

Viscosity of water

1 Scope

This Technical Report gives values for the viscosity of water at several reference temperatures. The viscosity of water is commonly used throughout the world as the basis for the calibration of relative viscometers.

2 Values for the viscosity of water

The dynamic viscosity, η , and the kinematic viscosity, ν , of water at 20 °C and normal atmospheric pressure (0,101 325 MPa) are given by:

$$\eta = 1,001\,6 \text{ mPa}\cdot\text{s}$$

$$\nu = 1,003\,4 \text{ mm}^2/\text{s}$$

The estimated relative uncertainty associated with both values is 0,17 %, as detailed in annex A.

NOTE 1 The viscosity values stated above are based on the value of 1,001 9 mPa·s reported by Swindells et al. in 1952 (see annex B) which was also the basis of ISO/TR 3666:1971 and corresponds to the IPTS-48 temperature scale. The change of this value by 0,000 3 mPa·s is due to the difference of 12 mK between the IPTS-48 and the ITS-90 temperature scale at 20 °C.

Based on a critical evaluation of the results of water viscosity measurements published between 1949 and 1994 (see annex A), the temperature dependence of the viscosity of water, expressed by the viscosity ratio $V_r = \eta(T)/\eta(20\text{ °C})$ for temperatures T between 15 °C and 40 °C, is given by the values listed in table 1.

Table 1 — Recommended values for the (dynamic) viscosity ratio $V_r = \eta(T)/\eta(20\text{ °C})$ of water at various reference temperatures; density ρ , temperature coefficients U_η , U_ν , and pressure coefficient γ

Temperature, T °C	Dynamic viscosity ratio, V_r	Density, ρ kg/m ³	Temperature coefficient, U_η K ⁻¹	Temperature coefficient, U_ν K ⁻¹	Pressure coefficient, γ 10 ⁻⁴ MPa ⁻¹
15	1,136 0 ± 0,000 6	999,10	0,026 5	0,026 4	-6,14
20	1,000 00	998,20	0,024 5	0,024 3	-4,28
23	0,930 6 ± 0,000 4	997,54	0,023 5	0,023 2	-3,28
25	0,888 5 ± 0,000 3	997,04	0,022 8	0,022 6	-2,65
30	0,795 8 ± 0,000 3	995,65	0,021 3	0,021 0	-1,22
40	0,651 4 ± 0,000 2	992,21	0,018 8	0,018 5	+1,20

For additional information the pressure coefficient, γ , is given by the following equation.

$$\gamma = \frac{1}{\eta} \cdot \frac{d\eta}{dp} \quad (1)$$

where

p is the pressure, in megapascals.