

# INTERNATIONAL STANDARD

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**3675**

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## **Crude petroleum and liquid petroleum products — Laboratory determination of density or relative density — Hydrometer method**

*Pétroles bruts et produits pétroliers liquides — Détermination en  
laboratoire de la masse volumique ou de la densité relative — Méthode  
à l'aréomètre*



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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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 3675 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Sub-Committee SC 3, *Static petroleum measurement*.

This second edition cancels and replaces the first edition (ISO 3675:1976), which has been technically revised.

Annex A of this International Standard is for information only.



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# Crude petroleum and liquid petroleum products — Laboratory determination of density or relative density — Hydrometer method

## 1 Scope

**1.1** This International Standard specifies a method for the laboratory determination, using a glass hydrometer, of the density or relative density of crude petroleum, petroleum products and homogeneous mixtures of petroleum and non-petroleum products normally handled as liquids, and having a Reid vapour pressure of 180 kPa (1,8 bar) or less, determined according to ISO 3007.

Hydrometer readings are obtained at convenient temperatures, readings of density being reduced to 15 °C or 20 °C, and readings of relative density to 60/60 °F, by means of international standard measurement tables. By means of these same tables, values determined in each of the three systems of measurement are convertible to equivalent values in the other, so that measurements may be made in the units of local convenience.

**1.2** Accurate determination of the density or relative density of petroleum and its products is necessary for the conversion of measured volumes to volumes at the standard temperatures of 15 °C/20 °C or 60 °F and also volume to mass and vice versa.

**1.3** The hydrometer method is most suitable for determining the density or relative density of mobile transparent liquids. It can also be used for viscous oils by allowing sufficient time for the hydrometer to reach equilibrium, or for opaque oils by employing a suitable meniscus correction.

## 2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged

to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 91-1:1992, *Petroleum measurement tables — Part 1: Tables based on reference temperatures of 15 °C and 60 degrees F.*

ISO 91-2:1991, *Petroleum measurement tables — Part 2: Tables based on a reference temperature of 20 °C.*

ISO 649-1:1981, *Laboratory glassware — Density hydrometers for general purposes — Part 1: Specification.*

ISO 650:1977, *Relative density 60/60 degrees F hydrometers for general purposes.*

ISO 3007:1986, *Petroleum products — Determination of vapour pressure — Reid method.*

## 3 Definitions

For the purposes of this International Standard, the following definitions apply.

**3.1 density:** Mass of the liquid divided by its volume at 15 °C or 20 °C, reported in units of mass and volume, together with the standard reference temperature; for example, kilograms per cubic metre at 15 °C (see note 1).

For practical purposes, the apparent mass in air corrected for air buoyancy may be taken to represent the mass.

**3.2 relative density:** Ratio of the mass of a volume of a substance at a temperature  $t_1$  to the mass of an equal volume of another substance at a temperature  $t_2$ .

The temperatures  $t_1$  and  $t_2$  may be equal. For the purposes of this International Standard, the other substance is water, i.e. the relative density is the ratio of the density of the substance at temperature  $t_1$  to the density of water at temperature  $t_2$ .

When reporting the relative density, the temperatures  $t_1$  and  $t_2$  shall be explicitly stated. ISO 91 refers only to tables for the reduction of relative density to 60/60 °F. If results are required using another reference temperature, the determination should be carried out at that temperature.

#### NOTES

1 Since all hydrometers are calibrated to read correctly at a specified reference temperature, scale readings made at another temperature are only hydrometer readings and not values of density or relative density at that other temperature.

2 When used in connection with bulk oil measurements, errors due to volume correction are minimized by reading the hydrometer at a temperature close to that of bulk oil temperature.

## 4 Principle

The petroleum sample and a hydrometer cylinder are brought within a prescribed temperature range and a

test portion is transferred to the cylinder at approximately the same temperature. The appropriate hydrometer is lowered into the test portion and allowed to settle. After thermal equilibrium has been reached, the hydrometer scale is read, and the temperature of the test portion is noted. If necessary, the cylinder and its contents are placed in a constant-temperature bath to avoid excessive temperature variation during the test.

## 5 Apparatus

**5.1 Hydrometers**, of glass and of the general form and dimensions specified in ISO 649-1 and ISO 649-2, indicating density or relative density at the appropriate reference temperature as required, conforming to the requirements listed in table 1.

NOTE 3 Smaller hydrometers are widely used for product quality control; their essential requirements are given in annex A (see also note 4).

**5.2 Thermometers**, having ranges, graduation intervals and maximum permitted scale error as shown in table 2.

Thermometers ASTM 12C, IP 64C and 64F are suitable, but any thermometer conforming to the requirements of table 2 may be used.

**Table 1 — Essential requirements for hydrometers**

Units	Range	Each unit	Scale Interval	Maximum scale error	Meniscus correction
Density g/ml at 15 °C or 20 °C	0,600 - 1,100	0,05	0,000 5	± 0,000 3	+ 0,000 7
	0,600 - 1,100	0,05	0,001 0	± 0,000 6	+ 0,001 4
Density kg/m <sup>3</sup> at 15 °C or 20 °C	600 - 1 100	50	0,5	± 0,3	+ 0,7
	600 - 1 100	50	1,0	± 0,6	+ 1,4
Relative density 60/60 °F	0,600 - 1,100	0,05	0,000 5	± 0,000 3	+ 0,000 7
	0,600 - 1,100	0,05	0,001	± 0,000 6	+ 0,001 4
	0,650 - 1,100	0,05	0,000 5	± 0,000 5	—

**Table 2 — Requirements for thermometers**

Range	Graduation interval	Maximum scale error
– 20 °C to + 102 °C	0,2	± 0,1
– 5 °F to + 215 °F	0,5	± 0,25