SLOVENSKI STANDARD
SIST ISO 3675:1996

01-marec-1996

Surova nafta in tekoči naftni proizvodi - Laboratorijsko določanje gostote ali relativne gostote z areometrom

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

Ta slovenski standard je istoveten z: **ISO 3675:1993**

ICS:

75.040	Surova nafta	Crude petroleum
75.080	Naftni proizvodi na splošno	Petroleum products in general

SIST ISO 3675:1996 **en**

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INTERNATIONAL STANDARD

ISO 3675

Second edition
1993-03-15

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

Reference number
ISO 3675:1993(E)

Contents

International Organization for Standardization
Case Postale 56 • CH-1211 Genève 20 • Switzerland

Printed in Switzerland

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.

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

Table 2 — Requirements for thermometers

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

NOTE 4 A hydrometer or a thermometer that is provided with a calibration certificate issued by a recognized standardizing body is classed as "certified" and the appropriate corrections listed in the certificate shall be applied to the observed readings. Instruments that satisfy the requirements of this test method, but are not provided with a recognized calibration certificate, are classed as "uncertified".

5.3 Hydrometer cylinder, of clear glass or plastics material, or of metal for testing opaque samples (see note 6). Plastics materials used for the construction of hydrometer cylinders shall be resistant to discoloration or attack by oil samples, shall not become opaque under prolonged exposure to sunlight and oil samples, and shall not affect the properties of the sample. For convenience in pouring, the cylinder may have a lip on the rim. The inside diameter of the cylinder shall be at least 25 mm greater than the outside diameter of the hydrometer used in it. The height of the cylinder shall be such that the hydrometer floats in the sample with at least 25 mm clearance between the bottom of the hydrometer and the bottom of the cylinder.

5.4 Constant-temperature bath, for use when the nature of the sample requires a test temperature much above or below room temperature or when the requirements of 7.8 cannot otherwise be met.

6 Temperature of test

6.1 The determination of density or relative density by the hydrometer method is most accurate at or near the appropriate standard reference temperature. This or any other temperature between −18 °C and +90 °C shall be used, insofar as it is consistent with the type of sample and necessary limiting conditions shown in table 3.

6.2 When the hydrometer value is to be used to select multipliers for correcting volumes to standard reference temperatures, the hydrometer reading should be made preferably at a temperature within ± 3 °C (± 5 °F) of the temperature at which the bulk volume of the oil was measured (see note 5). However, in cases when appreciable amounts of light fractions may be lost during determination at the bulk oil temperature, the limits given in table 3 shall be applied.

NOTE 5 The tables for correcting volume, density or relative density to standard temperatures are based on an average expansion for a number of typical crude oils and products (see 8.2.1). The same coefficients are used in computing all the sets of tables referred to in ISO 91-1 and another set of coefficients for the tables in ISO 91-2. Therefore corrections made over the same temperature interval minimize errors arising from possible differences between the coefficients of the material under test and the standard coefficients. This effect becomes more important as temperatures diverge significantly from the selected reference temperature.

7 Procedure

7.1 Adjust the temperature of the sample according to the indications given in clause 6. Bring the hydrometer cylinder (5.3) and the appropriate thermometer (5.2) and hydrometer (5.1) (see note 11) to approximately the same temperature as the sample to be tested.

Table 3 — Limiting conditions and test temperatures

Sample type	Initial boiling point	Other limits	Test temperature
Highly volatile	—	Reid vapour pressure below 180 kPa (1,8 bar)	Cool in original closed container to 2 °C or lower.[1]
Moderately volatile	⩽ 120 °C	—	Cool in original closed container to 18 °C or lower.
Moderately volatile and viscous	⩽ 120 °C	Viscosity too high at 18 °C [2]	Heat to minimum temperature to obtain sufficient fluidity.
Non-volatile	> 120 °C	—	Use any convenient temperature between − 18 °C and 90 °C.
Mixtures with non-petroleum products	—	—	Test at 15 °C ± 0,2 °C, 20 °C ± 0,2 °C.

1) Cooling some crude oils to 2 °C or lower could cause wax precipitation, which will effect the measured density or relative density. In such cases the test temperature should be as low as possible to minimize light end loss, but not below the temperature of wax precipitation.

2) The maximum acceptable viscosity depends on the length of time allowed for the hydrometer to settle. The viscosity should not exceed 15 000 mm^2/s but at this level the hydrometer would take several minutes to settle.

7.2 Transfer the test portion (see note 6) to the clean temperature-stabilized hydrometer cylinder without splashing, to avoid the formation of air bubbles and to reduce to a minimum the evaporation of the lower boiling constituents of the more volatile samples. Transfer highly volatile samples to the cylinder by water displacement or by siphoning (see notes 7 and 8). Remove any air bubbles formed, after they have collected on the surface of the test portion, by touching them with a piece of clean filter paper before inserting the hydrometer.