INTERNATIONAL STANDARD

ISO 12185

First edition
1996-06-15

Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method

Pétroles bruts et produits pétroliers — Détermination de la masse volumique — Méthode du tube en U oscillant

Reference number
ISO 12185:1996(E)

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 12185 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee SC 3, *Static petroleum measurement*.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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

Crude petroleum and petroleum products — Determination of density — Oscillating U-tube method

WARNING — The use of this International Standard may involve hazardous materials, operations and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies a method for the determination, using an oscillating U-tube density meter, of the density of crude petroleum and related products within the range 600 kg/m^3 to 1 100 kg/m^3 which can be handled as single-phase liquids at the test temperature and pressure.

This International Standard is applicable to liquids of any vapour pressure as long as suitable precautions are taken to ensure that they remain in single phase with no loss of light ends and subsequent changes in composition and density during both the sample handling and the density determination.

NOTE 1 If the determined density is to be converted to a density at some reference temperature using petroleum measurement tables, the determination should be carried out at a temperature as close as possible to the reference temperature in order to minimize uncertainties due to the use of generalized tables.

This method is not intended for use in calibrating on-line density meters.

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 3015:1992, *Petroleum products — Determination of cloud point.*

ISO 3016:1994, *Petroleum products — Determination of pour point.*

ISO 3170:1988, *Petroleum liquids — Manual sampling.*

ISO 3171:1988, *Petroleum liquids — Automatic pipeline sampling.*

ISO 3696:1987, *Water for analytical laboratory use — Specification and test methods.*

ISO 3838:1983, *Crude petroleum and liquid or solid petroleum products — Determination of density or relative density — Capillary-stoppered pyknometer and graduated bicapillary pyknometer methods.*

IP[1] 389/93, *Determination of wax appearance temperature of middle distillate fuels by differential thermal analysis or differential scanning calorimetry.*

IP 1995, *Standard methods for analysis and testing of petroleum and related products,* Appendix G *Density of water;* Appendix H *Density of ambient air.*

BIPM[2] Tables, *Density of water* and *Density of ambient air,* to replace, when published, the corresponding IP tables.

3 Definitions

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

3.1 density: Mass of the substance, expressed in kilograms, divided by its volume, expressed in cubic metres.

3.2 reference temperature: Temperature at which the sample density is to be reported.

NOTE 2 This temperature should be either 15 °C or 20 °C.

4 Principle

A small (typically less than 1 ml) portion of the test sample is introduced into a temperature-controlled sample cell. The oscillation frequency is noted, and the density of the test sample calculated using cell constants previously determined by measuring the oscillation frequencies when the cell is filled with calibration fluids of known density.

5 Apparatus

5.1 Density meter, capable, once calibrated, of determining density with a resolution of ± 0,1 kg/m^3 or better.

NOTES

3 Meters commonly display two forms of digital result, either a density value or the period of oscillation from which density can be calculated.

4 Research has shown that the density meter may show a bias of up to 1 kg/m^3 due to viscosity effects. Users should ascertain whether a viscosity correction is required by checking the result using a pyknometer method such as that given in ISO 3838. Alternatively, viscosity effects can be minimized by using certified calibration standards of chemical characteristics and viscosity similar to that of the sample under test [3].

5 Problems have been experienced with certain density meters due to condensation gathering on the cell sensors and electronics when the cell temperature is held below the dew-point of the ambient air. If there is risk of this occurring, the surrounding air should be kept dry.

5.2 Circulating constant-temperature bath, if required (see 9.1.2), capable of maintaining the temperature of the circulating liquid to within ± 0,05 °C of the required temperature.

5.3 Calibrated temperature sensor, capable of measuring the temperature of the cell to an accuracy of at least ± 0,10 °C.

The rate of energy transfer across the cell is low and therefore care should be taken to use sensors with very fine leads in order to minimize heat transfer in or out of the cell along the leads.

5.4 Homogenizer, suitable for the sample and sample container, and capable of producing homogeneous subsamples for test (see clause 8); a high speed shear or static mixer, or other type as appropriate.

6 Reagents

Unless otherwise stated, use only reagents of recognized analytical grade.

6.1 Flushing solvent.

NOTE 6 Any solvent may be used provided that it is capable of producing a clean dry cell.

6.2 Ammonium peroxydisulfate, solution in concentrated sulfuric acid, 8 g/l.

WARNING — Ammonium peroxydisulfate is a strong oxidizing agent.

6.3 Calibration fluids.

A minimum of two calibration fluids are needed to calibrate the cell. They shall be chosen so that their densities bracket the density of the sample under test. The density of the calibration fluids shall be traceable to recognized national standards or based on internationally accepted values.

1) Institute of Petroleum, 61 New Cavendish Street, London W1M 8AR, UK.

2) Bureau International des Poids et Mesures, Pavillon de Breteuil, F-92312 Sèvres Cedex, France.