SLOVENSKI STANDARD
SIST EN 16896:2017

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Naftni in sorodni proizvodi - Določevanje kinematične viskoznosti - Metoda s Stabingerjevim viskozimetrom

Petroleum products and related products - Determination of kinematic viscosity - Method by Stabinger Viscometer

Mineralölerzeugnisse und verwandte Produkte - Bestimmung der kinematischen Viskosität - Method mit dem Stabinger-Viskosimeter

Produits pétroliers et produits relatés - Détermination de la viscosité cinématique - Méthode par Viscometer Stabinger

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75.160.20	Tekoča goriva	Liquid fuels

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EUROPEAN STANDARD

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English Version

Petroleum products and related products - Determination of kinematic viscosity - Method by Stabinger type viscosimeter

Produits pétroliers et produits relatés - Détermination de la viscosité cinématique - Méthode par Viscometer Stabinger

Mineralölerzeugnisse und verwandte Produkte - Bestimmung der kinematischen Viskosität - Verfahren mit dem Viskosimeter nach dem Stabinger-Prinzip

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 16896:2016) has been prepared by Technical Committee CEN/TC 19 “Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin”, the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2017, and conflicting national standards shall be withdrawn at the latest by May 2017.

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1 Scope

This European Standard specifies a procedure for the determination of kinematic viscosity (ν) at 40 °C in the range from 2 mm²/s to 6 mm²/s by calculation from dynamic viscosity (η) and density (ρ) of middle distillate fuels, fatty acid methyl ester fuels (FAME) and mixtures of these using the Stabinger-type viscosimeter.

The result obtained using the procedure described in this standard depends on the behaviour of the sample. This European Standard should be used predominantly on liquids whose shear stress and shear rate are proportional (Newtonian flow behaviour). However, if the viscosity changes significantly with the shear rate, comparison with other measuring methods is only permissible at similar shear rates.

WARNING — The use of this Standard can 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 users of this standard to take appropriate measures to ensure the safety and health of personnel prior to the application of the Standard, and fulfil statutory and regulatory requirements for this purpose.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN ISO 3104, *Petroleum products - Transparent and opaque liquids - Determination of kinematic viscosity and calculation of dynamic viscosity (ISO 3104)*

EN ISO 3170, *Petroleum liquids - Manual sampling (ISO 3170)*

EN ISO 3171, *Petroleum liquids - Automatic pipeline sampling (ISO 3171)*

EN ISO 12185, *Crude petroleum and petroleum products - Determination of density - Oscillating U-tube method (ISO 12185)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
dynamic viscosity
η
ratio of the applied shear stress to the resulting shear rate of a liquid

3.2
kinematic viscosity
ν
ratio of the dynamic viscosity to the density of a liquid at the same temperature and pressure

Note 1 to entry: The kinematic viscosity is a measure of a liquid's resistance to flow under gravity.

3.3
density
ρ
mass of a substance divided by its volume at a given temperature

3.4
determinability
d
quantitative measure of the variability associated with the same operator in a given laboratory, obtaining successive determined values using the same apparatus for a series of operations leading to a single result, defined as the difference between two such single determined values

4 Principle

A test portion of a sample is introduced into the measuring cells, which are at closely controlled and known temperature. The measuring cells consist of a pair of rotating concentric cylinders and an oscillating U-tube. The dynamic viscosity is determined from the equilibrium rotational speed of the inner cylinder under the influence of the shear stress of the test specimen and an eddy current brake in conjunction with adjustment data. The density is determined by the oscillation frequency of the U-tube in conjunction with adjustment data. The kinematic viscosity is calculated by dividing the dynamic viscosity by the density.

5 Reagents and materials

5.1 Cleaning solvent, able to remove the sample from the measuring cell after the measurement and be completely miscible with all constituents of the sample.

5.2 Drying solvent, highly volatile and miscible with the cleaning solvent, shall be filtered before use and of an appropriate purity so that it does not leave any residues in the instrument.

NOTE 1 A separate drying solvent is not needed if the cleaning solvent also meets the requirements of the drying solvent.

NOTE 2 Commercially available volatile petroleum spirit or cleaner's naphtha of technical grade or better has proven suitable.

5.3 Compressed air, oil-free and filtered with a dew point considerably lower than the lowest measuring cell temperature at which the instrument should be dried.

The pressure should be limited to 100 kPa.

Instead of compressed air it is also possible to use inert gases, e.g. technical nitrogen. The requirements given for compressed air are also valid here.

5.4 Certified reference liquids for viscosity and density, identical to the reference standards referenced in EN ISO 3104 and EN ISO 12185 respectively.

5.5 Reference thermometer and probe, for verification of the temperature calibration.

The measuring uncertainty of the reference thermometer including the probe shall not exceed 0,01 °C. The resolution shall be at least 0,001 °C.

The probe used for the calibration (with an adapter if necessary) shall have a shape which fits the geometry of the viscosity cell. The probe replaces the measuring system (tube and measuring rotor).

6 Apparatus

Usual laboratory apparatus and glassware, together with the following:

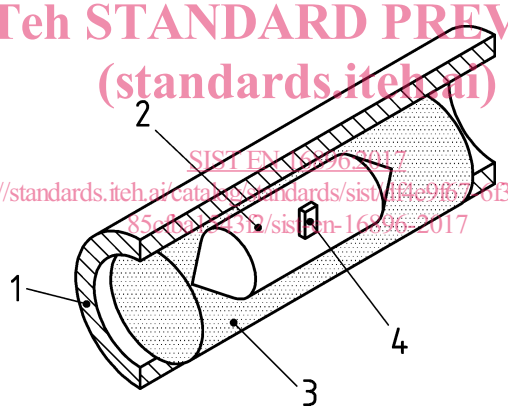
6.1 Stabinger type viscosimeter

6.1.1 Viscosity measurement

The Stabinger type viscosimeter, a concentric rotating viscosimeter contains an outer rotor with an inner rotor (see Figure 1). The small concentric gap between these rotors is filled with sample. The outer rotor is driven at constant speed which makes the inner rotor rotating due to the sample's viscosity. The lightweight inner rotor is centred in the heavier sample due to the centrifugal forces. The equilibrated speed ratio is depending on the driving viscous shear force and the opposing magnetic induction force (eddy current). The dynamic viscosity is a function of the equilibrated speed ratio and adjustment constants. The kinematic viscosity is obtained by dividing the measured dynamic viscosity by the measured density.

6.1.2 Density measurement

The Stabinger type viscosimeter has an integrated density measurement based on the oscillating U-tube principle. The sample filled U-tube is oscillated and the instrument calculates the density from the measured natural frequency of the filled tube using adjustment factors. The viscosity-dependent error of this procedure is corrected using the measured viscosity value.



Key

1	outer rotor (constant speed)	3	sample fluid
2	inner rotor (measured speed)	4	magnet

Figure 1 — Viscosity cell

6.1.3 Temperature control

The Stabinger type viscosimeter has an integrated temperature control which keeps the viscosity and density measurement at the same temperature.

Using Peltier elements, a highly conductive measuring cell block which surrounds the measuring cells is set to the target temperature with a stability of ± 0,005 °C.

The measurement uncertainty of the temperature sensor shall be within ± 0,03°C at 40 °C.

6.1.4 Stability

The instrument automatically ensures the temperature equilibration of the sample by checking the stability of the continuously recorded viscosity and density values by limiting the maximum fluctuation range to ± 0,07 % for the dynamic viscosity and of ± 0,03 kg/m³ for the density within 60 s.

7 Sampling and sample handling

7.1 Sampling

Samples shall be taken as described in EN ISO 3170 or EN ISO 3171 and/or in accordance with the requirements of national standards or regulations for the sampling of petroleum products.

7.2 Sample handling

For waxy or other samples with high pour point, before drawing the test specimen, heat the sample to the desired temperature, which shall be high enough to dissolve the wax crystals.

8 Calibration and verification

8.1 General

The calibration shall be verified periodically using certified reference standards as described in 5.4.

Due to the measuring range of the viscosity and temperature, more than one calibration fluid can be required. If a reference liquid gives no reference value or if the given reference value is not sufficiently precise for one of the two parameters (viscosity or density) – e.g. a density standard without viscosity values, the affected parameter shall be verified with another suitable reference liquid.

Verify the calibration of the temperature measurement periodically by using a reference thermometer as described in 5.5.

The recommended interval to verify viscosity and density calibration is once a month, for temperature control once a year.

8.2 Verification of calibration

Ensure that the instrument is leak tight and the measuring cells have been cleaned and dried before verification of the calibration is undertaken.

The verification of the calibration should be carried out according to the instrument manufacturer's instructions.

If, despite the correct condition of the instrument, the measured viscosity does not correspond to the certified value with a deviation of less than 0,35 % then the viscosity measurement shall be adjusted according to the instrument manufacturer's instructions.

If, despite the correct condition of the instrument, the measured density does not correspond to the certified value with a deviation of less than 0,001 g/cm³ then the density measurement shall be adjusted according to the instrument manufacturer's instructions.

If, despite the correct condition of the instrument, the measured temperature does not correspond to the certified value with a deviation of less than 0,03 °C then the temperature measurement shall be adjusted according to the instrument manufacturer's instructions.