SLOVENSKI STANDARD
SIST EN 12595:2023

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Nadomešča:
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Bitumen in bitumenska veziva - Določanje kinematične viskoznosti

Bitumen and bituminous binders - Determination of kinematic viscosity

Bitumen und bitumenhaltige Bindemittel - Bestimmung der kinematischen Viskosität

Bitumes et liants bitumineux - Détermination de la viscosité cinématique

Ta slovenski standard je istoveten z: **EN 12595:2023**

ICS:

75.140	Voski, bitumni in drugi naftni proizvodi	Waxes, bituminous materials and other petroleum products
91.100.50	Veziva. Tesnilni materiali	Binders. Sealing materials

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English Version

Bitumen and bituminous binders - Determination of kinematic viscosity

Bitumes et liants bitumineux - Détermination de la viscosité cinématique

Bitumen und bitumenhaltige Bindemittel - Bestimmung der kinematischen Viskosität

This European Standard was approved by CEN on 28 May 2023.

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Contents

Page

European foreword ... 3
1 Scope ... 5
2 Normative references ... 5
3 Terms and definitions ... 5
4 Principle ... 6
5 Apparatus ... 6
6 Preparation of test samples ... 8
7 Procedure ... 8
7.1 Test conditions ... 8
7.2 Determination and measurement ... 9
8 Calculation ... 9
9 Expression of results ... 10
10 Precision ... 10
10.1 Repeatability ... 10
10.2 Reproducibility ... 10
11 Test report ... 11
Annex A (normative) Specifications of viscometers ... 12
Annex B (informative) Calibration of viscometers ... 18
Annex C (informative) Example for calculation of results ... 21
Bibliography ... 23

European foreword

This document (EN 12595:2023) has been prepared by Technical Committee CEN/TC 336 “Bituminous binders”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by January 2024, and conflicting national standards shall be withdrawn at the latest by January 2024.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12595:2014.

In comparison with the previous edition, the main technical changes are:

— deletion of note in scope and new note added to scope regarding assumption of Newtonian behaviour under test conditions;

— removal of dated reference in normative references (ISO 2592);

— formula for the relationship between dynamic and kinematic viscosity added in 3.1;

— “accuracy” changed to “maximum permissible error” in several Clauses (5.2, 5.4, 5.5 and 5.6);

— references to mercury thermometers and total immersion thermometer in 5.2 deleted;

— new sub-Clause 5.7 added on Calibration/Verification;

— additional information on use of viscometers and references to figures added in 7.1;

— mandatory use of two BS/IP/RF viscometers for one determination of kinematic viscosity;

— precision on time for thermal equilibrium and removal of note in 7.2;

— information on validity of individual test data to calculate mean value added in Clause 8; including a new Note 1 and renumbering existing note to Note 2;

— key added to Figures A.1, A.2 and A.3 and correct diameter of bulb in key of Figure A.1;

— Figures A.2 and A.3 revised;

— Table B.1 updated with informative values for viscosity standards;

— Annex C deleted;

— new Annex C introduced with examples on calculation;

— ASTM E77-98 deleted from Bibliography;

— reference to ASTM D2170-01 in Bibliography has been updated and reference (footnote) to Institute of Petroleum deleted.

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom

1 Scope

This document specifies a method for the determination of the kinematic viscosity of bituminous binders at 60 °C and 135 °C, in a range from 6 mm^2/s to 300 000 mm^2/s. Other temperatures are possible if calibration constants are known. Bituminous emulsions are not covered within the scope of this method.

Results for this method can be used to calculate dynamic viscosity when the density of the test material is known or can be determined.

NOTE This document assumes Newtonian behaviour of the sample at test conditions.

WARNING — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this document to identify the hazards and assess the risks involved in performing this test method and to implement sufficient control measures to protect individual operators (and the environment). This includes appropriate safety and health practices and determination of the applicability of regulatory limitations prior to use.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 58, *Bitumen and bituminous binders - Sampling bituminous binders*

EN 12594, *Bitumen and bituminous binders - Preparation of test samples*

EN 12607-2, *Bitumen and bituminous binders - Determination of the resistance to hardening under influence of heat and air - Part 2: TFOT method*

EN ISO 2592, *Petroleum and related products - Determination of flash and fire points - Cleveland open cup method (ISO 2592)*

EN ISO 3696:1995, *Water for analytical laboratory use - Specification and test methods (ISO 3696)*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
kinematic viscosity
ratio between the dynamic viscosity and the density of a liquid at the temperature of measured viscosity

$$\nu = \frac{\eta}{\rho}$$

where

- ν is kinematic viscosity;
- η is dynamic viscosity;
- ρ is density.

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

Note 2 to entry: The SI unit of kinematic viscosity is m^2/s; for practical use, a sub-multiple (mm^2/s) is more convenient.

3.2
density
mass of a liquid divided by its volume

Note 1 to entry: When reporting density, the unit of density used, together with the temperature, is explicitly stated, for example kg/m^3.

Note 2 to entry: The SI unit of density is kg/m^3.

3.3
dynamic viscosity
ratio between the applied shear stress and the velocity gradient

Note 1 to entry: Dynamic viscosity is a measure of a liquid's resistance to flow, and is commonly called the viscosity of the liquid.

Note 2 to entry: The SI unit of dynamic viscosity is Pa·s.

3.4
Newtonian liquid
liquid with a viscosity that is independent of the rate of shear

Note 1 to entry: The constant ratio of the shear stress to the velocity gradient is the dynamic viscosity of the liquid. If this ratio is not constant, the liquid is non-Newtonian.

4 Principle

The time for a fixed volume of the liquid to flow through the capillary of a calibrated glass capillary viscometer under an accurately reproducible head and at a closely controlled temperature is determined (efflux time). The kinematic viscosity is calculated by multiplying the efflux time in seconds by the viscometer calibration factor.

5 Apparatus

Usual laboratory apparatus and glassware, together with the following:

5.1 Viscometer, Cannon-Fenske, BS/IP/RF and the Zeitfuchs Cross-Arm viscometers[1], capillary-type, made of borosilicate glass, suitable for this method are described in Figure A.1, Figure A.2 and Figure A.3, and Table A.1, Table A.2 and Table A.3. Other viscometers are allowed if test results obtained are comparable.

Calibrated viscometers are available from commercial suppliers. Details regarding the calibration of viscometers are given in Annex B.

5.2 Temperature measuring device.

A temperature measuring device (combining sensor and reading unit) shall:

— have a range from at least 55 °C to 140 °C;

— be readable to 0,05 °C or less;

— have a maximum permissible error of 0,1 °C.

NOTE For practical reasons, separate temperature measuring devices for individual temperature ranges can be used.

Sensors based on platinum resistance thermometers have been found suitable but other principles are also allowed. The temperature measuring device shall be calibrated regularly.

When measuring and controlling nominally constant temperatures, as in this test method, the thermal response time can be rather high (e.g. slow response to a change in temperature). Care shall be taken to consider this aspect since low thermal response times of the sensor can indicate greater cyclic variations than the bituminous material in practice experiences.

5.3 Bath, suitable for immersion of the viscometer so that the liquid reservoir or the top of the capillary, whichever is uppermost, is at least 20 mm below the top of the bath level, and with provisions for visibility of the viscometer and the thermometer. Firm supports for the viscometer shall be provided, or the viscometer shall be an integral part of the bath. The efficiency of the stirring and the balance between heat losses and heat input shall be such that the temperature of the bath medium does not vary by more than 0,3 °C (measurement at 60 °C) or 0,5 °C (measurement at 135 °C) over the length of the viscometer, or from viscometer to viscometer in the various bath positions.

Water, conforming to grade 3 of EN ISO 3696:1995, is a suitable bath liquid for determinations at 60 °C. USP white oil or any paraffinic or silicone oil with a flash point above 215 °C has been found suitable for determination at 135 °C. The flash point shall be determined in accordance with EN ISO 2592.

5.4 Timer, stop watch (spring or battery driven) graduated in divisions of 0,1 s or less and with a maximum permissible error of 0,5 s over 1 000 s when tested over intervals of not less than 15 min. Verify the maximum permissible error frequently.

5.5 Electrical timing devices, for use only on electrical circuits the frequencies of which have a maximum permissible error of 0,5 s over 1 000 s. Verify the maximum permissible error frequently.

NOTE Alternating currents, the frequencies of which are intermittently and not continuously controlled, as provided by some public power systems, can cause large errors, particularly over short timing intervals, when used to actuate electrical timing devices.

[1] This information is given for the convenience of users of this document and does not constitute an endorsement by CEN of this product. Equivalent products may be used if they can be shown to lead to the same results.

5.6 Automatic or semi-automatic equipment are allowed providing that they meet the specifications and maximum permissible errors for temperature regulation and time described in Clause 5 and have been shown to achieve the same precision as given in Clause 10 and are fully calibrated.

5.7 Calibration/Verification, all equipment shall be calibrated/verified at least once per year.

6 Preparation of test samples

The laboratory sample shall be taken in accordance with EN 58. Prepare the sample in accordance with EN 12594.

Bring the viscometer and the sample to the test temperature (in order to avoid correction of constants of the viscometer). Stir the sample thoroughly without entrapment of air. If the temperature has dropped to 30 °C or more below the test temperature, reheat the sample.

Immediately charge the viscometer, or, if the test is to be made at a later time, pour approximately 20 ml into one or more clean and dry containers having an approximate volume of 30 ml and immediately seal with an airtight closure.

7 Procedure

7.1 Test conditions

Maintain the bath (5.3) at the test temperature to within ± 0,3 °C (measurements at 60 °C) or ± 0,5 °C (measurements at 135 °C). Apply the necessary corrections, if any, to all thermometer readings.

Select a clean, dry viscometer giving an efflux time greater than 60 s and preheat it to the test temperature.

Charge the viscometer in the manner dictated by the design of the instrument, as described in the following.

To charge the Cannon-Fenske opaque viscometer (Figure A.1), invert the viscometer and apply vacuum to the tube L, immersing tube N in the liquid sample. Draw liquid through tube N, filling bulb D to filling mark G. Wipe excess sample off tube N and invert the viscometer to its normal position. Mount the viscometer in the constant-temperature bath keeping tube L vertical.

Apply a stopper to the top of the apertures of tube L when bulb A is nearly 4/5th filled.

Mount the BS/IP/RF viscometer (Figure A.2) in the constant temperature bath keeping tube L vertical. Pour sample through tube N to a point just above filling mark G; allow the sample to flow freely through capillary R, taking care that the liquid column remains unbroken, until the lower meniscus is about 5 mm below the filling mark H and then arrest its flow by closing the timing tube with a cork or rubber stopper in tube L.

Add more liquid if necessary to bring the upper meniscus slightly above mark G.

After allowing the sample to attain bath temperature and any air bubbles to rise the surface, gently loosen the stopper allowing the sample to flow to the lower filling mark H and again arrest flow. Remove the excess sample above filling mark G by inserting the special pipette until its cork rests on top of tube N; apply gentle suction until air is drawn through. The upper meniscus shall coincide with mark G.

Mount the Zeitfuchs Cross-Arm viscometer (Figure A.3) in the constant temperature bath, keeping tube N vertical. Introduce sample through tube N taking care not to wet the sides of tube N, into the cross-arm D until the leading edge stands within 0,5 mm of fill mark G on the siphon tube.

For the Zeitfuchs Cross-Arm and BS/IP/RF viscometer, it is mandatory to use two viscometers. For Cannon-Fenske, for practical reasons it is recommended also to prepare two viscometers in case testing needs to be repeated, e.g. due to invalid results.