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Institut luxembourgeois de la normalisation de l'accréditation, de la sécurité et qualité des produits et services

ILNAS-EN 12596:2023

Bitumen and bituminous binders -Determination of dynamic viscosity by vacuum capillary

Bitumes et liants bitumineux -Détermination de la viscosité dynamique par viscosimètre capillaire sous vide

Bitumen und bitumenhaltige Bindemittel - Bestimmung der dynamischen Viskosität mit Vakuum-Kapillaren



National Foreword

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Bitumen and bituminous binders - Determination of dynamic viscosity by vacuum capillary

Bitumes et liants bitumineux - Détermination de la viscosité dynamique par viscosimètre capillaire sous vide Bitumen und bitumenhaltige Bindemittel -Bestimmung der dynamischen Viskosität mit Vakuum-Kapillaren

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European foreword

This document (EN 12596:2023) 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of an identical text or by endorsement, at the latest by January 2024, and conflicting national standards shall be withdrawn at the latest by January 2024.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 12596:2014.

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

- amended scope (clarification of applicability of test methods); deletion of notes from scope;
- "accuracy" is changed to "maximum permissible error" in several clauses (5.2, 5.4, 5.5 and 5.6);
- reference to mercury thermometer deleted (5.2);
- reference to total immersion thermometer deleted (5.2);
- maximum permissible error for temperature of bath changed from 0,5 °C to 0,3 °C (5.3);
- the required precision of the oven reduced to (135 ± 5) °C in (5.7, 7.2, 7.4 and 7.5);
- time to reach thermal equilibrium prolonged to 1 hour;
- "bulb" changed into "tube section" in 5.1.2, 5.1.3, Figures A.2 and A.3, and added "tube section" to Clause 9 (consistency of wording);
- new subclause 5.8 added on Calibration/Verification;
- information on validity of individual test data to calculate mean value added in Clause 8; including a new NOTE 2 and renumbering existing notes respectively;
- appropriate range of flow time readings added in Clause 9;
- Table B.1 updated with informative values for viscosity standards;
- all time measurements with a maximum permissible error of 0,1 s in B.3.1;
- Annex C deleted;
- new Annex C introduced with examples on calculation;
- ASTM E77-98 deleted from the Bibliography;
- reference to ASTM D2171-01 in Bibliography 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 dynamic viscosity of bituminous binders by means of a vacuum capillary viscometer at 60 °C in a range between 0,003 6 Pa·s and 580 000 Pa·s. Other temperatures are possible if calibration constants are known. Bituminous emulsions and non-newtonian binders (e.g. some polymer modified bitumen) are not within the scope of this method.

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 ISO 3696:1995, Water for analytical laboratory use - Specification and test methods (ISO 3696:1987)

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 <u>https://www.iso.org/obp</u>
- IEC Electropedia: available at <u>https://www.electropedia.org/</u>

3.1

dynamic viscosity

ratio between the applied shear stress and the velocity gradient

Note 1 to entry: Dynamic viscosity is a measure of the resistance to the flow of a liquid and is commonly called the viscosity of the liquid. For the purposes of this document, the word viscosity means the dynamic viscosity of a liquid.

Note 2 to entry: The SI unit of dynamic viscosity is $\mbox{Pa}{\cdot}\mbox{s}{\cdot}$

3.2

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.

3.3 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 stated explicitly, for example kg/m^3 .

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

3.4

kinematic viscosity

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

Note 1 to entry: Kinematic viscosity is a measure of the resistance to flow of a liquid 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.

4 Principle

To determine the time for a fixed volume of the liquid to be drawn up through a capillary tube by means of a vacuum, under closely controlled conditions of vacuum and temperature. The viscosity is calculated by multiplying the flow time in seconds by the viscometer calibration factor.

5 Apparatus

5.1 Viscometer, capillary-type and made of borosilicate glass as described in 5.1.1 to 5.1.3.

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

5.1.1 Cannon-Manning vacuum capillary viscometer (CMVV).

The CMVV is available in eleven sizes (see Table A.1), covering a range between 0,003 6 Pa·s to 8 000 Pa·s.

Details of the design and construction of CMVV are shown in Figure A.1. The size numbers, approximate calibration factors *K*, and viscosity ranges for the series of CMVV are given in Table A.1.

For all viscometer sizes, the volume of measuring bulb C is approximately three times that of bulb B. Bulb B, bulb C and bulb D are defined by timing marks F, G and H.

5.1.2 Asphalt Institute vacuum capillary viscometer (AIVV).

The AIVV is available in seven sizes (see Table A.2) from a range between 4,2 Pa·s to 580 000 Pa·s. Sizes 50 to 200 are best suited to viscosity measurements of bituminous binders at 60 °C.

Details of design and construction of the AIVV are shown in Figure A.2. The size numbers, approximate capillary radii, approximate calibration factors *K*, and viscosity range for the series of AIVV are given in Table A.2.

This viscometer has measuring tube section B, tube section C and tube section D, located on the viscometer arm M, which is a precision bore glass capillary. The measuring bulbs/test sections are 20 mm long capillary segments defined by timing marks F, G, H and I.

5.1.3 Modified Koppers vacuum capillary viscometer (MKVV).

The MKVV is available in five sizes (see Table A.3) covering a range between 4,2 Pa \cdot s to 20 000 Pa \cdot s. Sizes 50 to 200 are best suited to viscosity measurements of bituminous binders at 60 °C.