SLOVENSKI STANDARD
SIST EN 13702:2018

01-december-2018

Nadomešča:
SIST EN 13702:2010

Bitumen in bitumenska veziva - Določevanje dinamične viskoznosti bitumna in bitumenskih veziv z metodo s konusom in ploščo

Bitumen and bituminous binders - Determination of dynamic viscosity of bitumen and bituminous binders by the cone and plate method

Bitumen und bitumenhaltige Bindemittel - Bestimmung der dynamischen Viskosität von Bitumen und bitumenhaltigen Bindemitteln mit dem Platte-Kegel-Verfahren

BItume et liants bitumineux - Détermination de la viscosité dynamique des bitumes modifiés par la méthode cône et plateau

Ta slovenski standard je istoveten z: **EN 13702:2018**

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

SIST EN 13702:2018 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13702

October 2018

ICS 75.140; 91.100.50

Supersedes EN 13702:2010

English Version

Bitumen and bituminous binders - Determination of dynamic viscosity of bitumen and bituminous binders by the cone and plate method

Bitumes et liants bitumineux - Détermination de la viscosité dynamique des bitumes et liants bitumineux par la méthode du cône et plateau

Bitumen und bitumenhaltige Bindemittel - Bestimmung der dynamischen Viskosität von Bitumen und bitumenhaltigen Bindemitteln mit dem Platte-Kegel-Verfahren

This European Standard was approved by CEN on 27 August 2018.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Ref. No. EN 13702:2018 E

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European foreword

This document (EN 13702:2018) 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 month year of April 2019, and conflicting national standards shall be withdrawn at the latest by April 2019.

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 13702:2010.

There are three major changes in this revised standard compared to the former version:

— the Scope and title of the test method has been changed so the standard covers bituminous binders and not just modified bitumen;

— the requirement in Clause 6 that the sample shall not contain any filler has been deleted. It is not the intention that the test method can be used on bituminous mortars but to accommodate the use of the test method for bituminous binders recovered from asphalt mixtures;

— the test method has been changed to a general test method with the conditions at 60 °C, 100 °C and 150 °C given as examples.

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, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This document specifies a method for determining the dynamic viscosity of a bituminous binder over a range of temperatures by means of a cone and plate viscometer. The test method is intended for all bituminous binders (e.g. paving grade bitumen and polymer modified), unaged or aged. It is also suitable for recovered bituminous binders according to EN 12697-3 [1] and EN 12697-4 [2] with no or limited amount of filler.

WARNING — The use of this document may 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 establish appropriate safety and health practices and to determine 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*

3 Terms and definitions

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

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

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

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

3.1
shear stress
force acting tangentially to a surface divided by the area of the surface

Note 1 to entry: Shear stress is expressed in Newton per square metre ($N \cdot m^{-2}$), kilogram per meter per square second ($kg \cdot m^{-1} \cdot s^{-2}$) or Pascal (Pa).

3.2
shear rate
velocity gradient in a flowing fluid perpendicular to the stress

Note 1 to entry: Shear rate is expressed in units per second (s^{-1}).

Note 2 to entry: The shear rate calculation depends upon the viscometer geometry. This should be mentioned by the viscometer manufacturer.

3.3
dynamic viscosity
ratio between the applied shear stress and the shear rate

Note 1 to entry: Dynamic viscosity is expressed in Pascal second ($Pa \cdot s$). Millipascal second ($mPa \cdot s$) is a frequently used sub-unit.

Note 2 to entry: Dynamic viscosity is the measurement of the resistance to flow of a liquid.

3.4
Newtonian fluid
fluid having a viscosity that is independent of the shear rate

Note 1 to entry: The ratio of the shear stress to the shear rate is the viscosity of the fluid. If this ratio is not constant the liquid is non-Newtonian and many fluids exhibit both Newtonian and non-Newtonian behaviour, depending on the temperature and the shear rate.

3.5
apparent viscosity
term used to characterise the resistance to flow of a Newtonian or non-Newtonian fluid

3.6
cone factor
specific factor or factors to be applied for the individual equipment in order to obtain the actual viscosity from the readings, mainly due to the geometry of the apparatus

4 Principle

The sample is placed on a plate, a cone is pressed onto the sample and the system is brought to the test temperature. A stress is applied to the sample by rotation. For most viscometers, the torque is measured at the applied shear rate and dynamic viscosity is calculated by:

$$\eta = \tau / \dot{\gamma} \tag{1}$$

where

$\dot{\gamma}$ is the shear rate expressed in s^{-1};

τ is the stress expressed in Pa, calculated by:

$$\tau = A \times M_d \tag{2}$$

where

A is the cone factor expressed in m^{-3};

M_d is the torque expressed in N · m.

NOTE 1 The advantages of this method are the use of a very small sample and the speed of the method, especially regarding thermal conditioning of the specimen. In modern instruments the software will do the calculations and generate the results.

NOTE 2 When changing the rotating speed, and therefore the shear rate, non-Newtonian behaviour can be observed. In such cases, from practical experience it is seen as useful to determine dependency upon shear rate following a path going from low to high, then from high to low shear rates.

5 Apparatus

Cone and plate viscometer, with the following minimum capabilities:

— range of shear rate: 5×10^{-2} s^{-1} to 5×10^{2} s^{-1};

— range of viscosity: 5×10^{-2} Pa · s to 10^{5} Pa · s;

— range of temperature: 60 °C to 180 °C with an accuracy of ± 0,5 °C up to and including 100 °C, and ± 1,0 °C above 100 °C.

The sample temperature shall be maintained within ± 0,5 °C up to 100 °C and within ± 1,0 °C above 100 °C.

To ensure correct operation and true measurements, follow the instructions given by the instrument manufacturer (user manual).

6 Sampling

Take the sample in accordance with EN 58 and prepare the sample in accordance with EN 12594.

7 Procedure

— Select the appropriate size (diameter and angle) of cone to allow measurement at the selected shear rate.

NOTE 1 The appropriate cone (diameter and angle) can be selected with reference to the instrument's user manual.

— Place the sample on the cone and plate apparatus in accordance with the viscometer's user manual. Lower the cone onto the test sample and remove any excess. If the viscometer's user manual prescribes preheating of the apparatus, this should be followed.

— Select the test temperature and allow to reach equilibrium for a length of time such that the sample temperature is held steady at the required test temperature ± 0,5 °C at and below 100 °C or ± 1,0 °C above 100 °C.

— Set the rotating speed such that the desired shear rate is achieved with a precision of ± 10 %.

— Allow to stabilize for a period of (60 ± 5) s, and then take a reading.

— If the reading has not stabilized within this time frame due to non-Newtonian behaviour (e.g. thixotropy in PMBs) prolong the period before taking a reading. If the reading has not stabilized sufficiently before 15 min, then take a reading after 15 min.

— Repeat the test and calculate the result as an average of two tests.

— If the results of the two tests differ more than 5 %, then discard the results and repeat the tests on a new sample.

— Report the value of the viscosity, the temperature and the shear rate.

— Select the next temperature and repeat the measurement on the same sample.

NOTE 2 For PMBs, a new sample for each temperature can be necessary due to the potential destruction of the internal structure of the binder.

Examples of test temperatures and shear rates are as follows:

— Temperature: (60,0 ± 0,5) °C;

— Shear rate: 5×10^{-2} s^{-1}.

— Temperature: (100,0 ± 0,5) °C;

— Shear rate: 5×10^{1} s^{-1}.

— Temperature: (150,0 ± 1,0) °C;

— Shear rate: $5 \times 10^{2}\ s^{-1}$.

8 Expression of results

Record the results of the measurement of dynamic viscosity with the corresponding shear rates and the test temperatures.

Express the viscosity values in Pa · s as follows: $(1{,}00 \times 10^{n})$ Pa · s.

NOTE Rheological effects, e.g. Weissenberg, can be observed for highly modified binders, which can influence the validity of results.

9 Precision

9.1 General

The following precision data are the best currently estimated and are proposed until results of further round robin tests are available. They may not necessarily apply to all bitumen and bituminous binders or all conditioning states.

9.2 Repeatability

The difference between two successive results, obtained by the same operator with the same apparatus under constant operating conditions on identical test material would, in the long run, in the normal and correct operation of the test method, differ by more than 5 % in only one case in 20.

9.3 Reproducibility

The difference between two single and independent results, obtained by different operators working in different laboratories on identical test material would, in the long run, in the normal and correct operation of the test method, differ by more than 15 % in only one case in 20.

10 Test report

The test report shall contain at least the following information:

a) type and complete identification of the sample under test, as well as the conditioning state (unaged, aged or recovered binder);

b) reference to this European Standard;

c) corresponding temperatures, shear rates and the result of the test (see Clause 8);

d) diameter and angle of the cone;

e) date of the test;

f) any deviation, by agreement or otherwise, from the specified procedure.