SLOVENSKI STANDARD
SIST EN 14771:2023

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Nadomešča:
SIST EN 14771:2012

Bitumen in bitumenska veziva - Ugotavljanje upogibne togosti - Reometer z nosilcem, obremenjenim na upogib (BBR)

Bitumen and bituminous binders - Determination of the flexural creep stiffness - Bending Beam Rheometer (BBR)

Bitumen und bitumenhaltige Bindemittel - Bestimmung der Biegekriechsteifigkeit - Biegebalkenrheometer (BBR)

Bitumes et liants bitumineux - Détermination du module de rigidité en flexion - Rhéomètre à flexion de barreau (BBR)

Ta slovenski standard je istoveten z: **EN 14771:2023**

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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EUROPEAN STANDARD

NORME EUROPÉENNE

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English Version

Bitumen and bituminous binders - Determination of the flexural creep stiffness - Bending Beam Rheometer (BBR)

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 14771:2023) 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of an identical text or by endorsement, at the latest by January 2024, and conflicting national standards shall be withdrawn at the latest by January 2024.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 14771:2012.

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

a) Scope aligned with other test standards;

b) reference to EN 14023 moved from normative references to bibliography;

c) Notes in 3.3 and 3.4 updated with reference to SI unit;

d) wording of test specimen and sample applied consistently;

e) 5.1.1.1 reworded to provide more clarity;

f) 5.1.3 Note updated;

g) former 5.2.1, now 5.3, reworded to provide more clarity;

h) numbering in Clause 5 aligned with CEN-CENELEC Internal regulations: former 5.2.1, now 5.3;

i) 6.1 Sample preparation aligned with EN 12594 and reference to scope added in note;

j) 6.2: reference to plastic films added in Note 2;

k) 6.2: Note 3 turned into standard text and moved before notes;

l) 6.3 clarified with regards to pouring, and inconsistencies in the description of storage removed; Note 1 deleted as in conflict with standard text;

m) text on heated moulds moved from 6.3 to 6.2;

n) description reworded to provide more clarity; timing of trimming adjusted;

o) information to discard damaged or distorted test specimen added in 6.3, in c) wording aligned with 5.1.1.1;

p) information added in 7.1 to place test specimen 5 minutes apart into testing bath, wording aligned;

q) description of flexural creep stiffness worded more precisely in keys to formulae in 8.2 and 8.3;

r) writing of decimal logarithm aligned with ISO 80000-2:2019 [6] in 8.3, 8.4 and Annex A;

t) Keys in Figures 1 to 4 updated and formatted;

u) Figure 5: load in legend and in figure renamed as P, also consistent with Formula (1);

v) Annex A added;

w) Annex B added;

x) Bibliography updated with EN 1427.

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 flexural creep stiffness of bitumen and bituminous binders in the range of 30 MPa to 1 GPa by means of the bending beam rheometer.

The method can be applied to a variety of bitumens, including unmodified as well as modified binders, as fresh (unused) binders, as well as binders after laboratory ageing conditioning (e.g. EN 12607-1, EN 14769), and also binders that have been recovered from asphalt mixtures.

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 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 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
flexural creep stiffness
S(t)
ratio obtained by dividing the bending stress by the bending strain, given in MPa

Note 1 to entry: The strain will increase with the loading time and therefore the flexural creep stiffness will also be a function of time.

3.2
m-value
absolute value of the slope of the curve of the logarithm of the stiffness versus the logarithm of time

3.3
contact load
P_c
load required to maintain positive contact between the test specimen, supports and the loading shaft

Note 1 to entry: The SI unit for the load is N, however for practical reasons loads are given in mN for this test. The contact load of 25 mN to 45 mN is used in this method.

3.4
test load
P_t
load used to determine the stiffness of the bituminous binder being tested

Note 1 to entry: The SI unit for the load is N, however for practical reasons loads are given in mN for this test. The test load of 930 mN to 1 030 mN is used in this method.

4 Principle

The bending beam rheometer is used to measure the mid-point deflection, in three-point bending, of a beam of bituminous binder. A constant load is applied to the mid-point of the test specimen for a specified loading time and the deflection is measured as a function of time. A low temperature liquid bath is used to control the temperature. The stiffness of the test specimen for the specific loading times is calculated from the bending stress and strain.

5 Apparatus

5.1 Bending Beam Rheometer (BBR), consisting of a loading frame with test specimen supports, a controlled temperature liquid bath and a data acquisition system.

5.1.1 Loading frame, consisting of a set of specimen supports, a blunt-nosed shaft to apply the load to the mid-point of the test specimen, a load cell mounted in line with the loading shaft, a means for zeroing the load applied to the test specimen, a means for applying a constant load to the test specimen and a deflection measuring transducer attached to the loading shaft. A schematic picture of the device is shown in Figure 1.

5.1.1.1 Loading system, which shall be capable of applying a contact load of 25 mN to 45 mN to the test specimen and maintaining a constant test load from within the range of 930 mN to 1 030 mN with a tolerance of ± 10 mN. The rise time from the contact load to the test load shall be less than 0,5 s. Details of the loading pattern are shown in Figure 2.

5.1.1.2 Loading shaft, which shall be continuous and in line with the load cell and deflection measuring transducer with a spherically shaped end (6,3 ± 0,3) mm in radius.

5.1.1.3 Load cell, which shall have a minimum capacity of no less than 2,0 N and a resolution of at least 2,5 mN.

5.1.1.4 LVD-transducer, or other suitable device to measure the deflection of the test specimen that shall have a linear range of at least 6 mm, and be capable of resolving linear movement of 2,5 µm.

NOTE LVD stands for Linear Variable Differential, also called Linear Variable Displacement. The transducer is sometimes also called transformer.

5.1.1.5 Specimen supports, which shall consist of two non-corrosive metal supports with a (3,0 ± 0,3) mm contact radius and spaced 101 mm to 103 mm apart. The spacing of the supports shall be measured to 0,3 mm (see Figure 3).

5.1.2 Temperature measurement device, used as a calibrated temperature transducer that shall be capable of measuring the temperature with an accuracy of ± 0,1 °C, over the range of - 36 °C to 0 °C. The measuring head shall be mounted within 50 mm of the mid-point of the test specimen.

5.1.3 Liquid bath, capable of maintaining the desired test temperature near the test specimen within ± 0,2 °C during isothermal conditioning and during the test procedure in the range of -36 °C to 0 °C. Bath

liquid shall not affect the properties of the bituminous binder being tested. The density of the liquid shall not exceed 1 050 kg/m^3 at the test temperature.

NOTE 95 % (volume fraction) ethanol or methanol have been found to be suitable as a bath liquid. Attention is drawn to the WARNING in the Scope (see Clause 1), Safety Data Sheets and risk assessments.

5.1.3.1 Bath agitator, which shall be used for maintaining the required temperature homogeneity with agitation intensity so that the fluid currents do not disturb the testing process.

5.1.3.2 Circulating bath, an optional separate bath unit, cooling the test bath liquid.

5.1.4 Data acquisition and control system, which resolves loads to at least 2,5 mN, test specimen deflection to at least 2,5 µm, and bath liquid temperature to the nearest 0,1 °C. The software shall control the measuring system and record time, load deflection and temperature during the test. All the load and deflection readings shall be an average of at least five points within ± 0,2 s of the reporting time.

5.2 Test specimen moulds, with the interior dimensions (6,4 ± 0,1) mm wide, (12,7 ± 0,1) mm deep and (127 ± 5) mm long, fabricated from a suitable metal as shown in Figure 4. The thickness of the two end pieces used for each mould shall not vary from each other in thickness by more than 0,1 mm.

NOTE Small errors in thickness of the test specimen can have a large effect on the calculated modulus because the calculated modulus is a function of the thickness raised to the third power.

5.3 Plastic strips, or strips from silicone paper or similar material that does not adhere to the test specimen and does not interact with the bituminous binder, to cover those sections of the test specimen moulds which will come in contact with test specimen during their preparation, except for the end pieces.

6 Preparation of test samples

6.1 General

NOTE BBR testing can be done on a variety of binders and ageing/conditioning stages (see Scope); for specification purposes BBR testing is typically carried out on long-term aged binders.

Take the laboratory sample in accordance with EN 58, taking all necessary safety precautions, and ensuring that the test sample is representative of the laboratory sample from which it is taken. Ensure that the laboratory sample is homogeneous and is not contaminated (see EN 1425).

Remove a sufficient amount of the laboratory sample and transfer it to a suitable container. Prepare and melt the sample according to EN 12594.

Raise the material to the required temperature of not more than (85 ± 5) °C above the expected softening point as defined in EN 1427; this includes the maximum permissible measurement. For modified bitumen follow the procedure provided by the supplier. If no other guidance is provided by the supplier for polymer modified bitumen according to EN 14023, the temperature shall be set at (190 ± 5) °C, irrespective from the softening point; this includes the maximum permissible measurement error. In any case, 200 °C shall not be exceeded.

6.2 Preparation of moulds

Spread a very thin layer of petroleum-based grease onto the interior faces of the dry and clean metal mould sections. Press the plastic strips against the metal faces to force out any air bubbles. Cover the inside faces of the two end pieces with a thin film of de-moulding agent to prevent bituminous binder from sticking to the metal end pieces. Assemble the mould as shown in Figure 4 using O-rings to hold the pieces of the mould together. Ensure plastic sheeting fits so that no raised edges occur on the cast beam.

Careful pre-heating of moulds up to 80 °C before filling in the sample is acceptable. The moulds should in no case be heated to a temperature higher than that of the binder to be poured.

NOTE 1 Plastic sheeting 0,08 mm to 0,15 mm thick have been found suitable. Transparency film sold for use with laser printers has been found suitable for this purpose.

NOTE 2 Polyvinyl alcohol and glycerol are found to be suitable as de-moulding agents, while silicone-based de-moulding agents can affect the binder stiffness. Plastic, cling films have also been found suitable to be used instead of de-moulding agents.

NOTE 3 Binders with very high viscosity can be poured into slightly pre-heated moulds to prevent the binder cooling too quickly and to ensure a more uniform test specimen.

6.3 Preparation of test specimen

Pour hot binder (see 6.1) into the metal mould that is at room temperature. Slightly overfill the mould. Pour the binder continuously towards the other end in a single pass; pouring in layers is not acceptable.

Store all the test specimens in their moulds at room temperature prior to testing for at least 45 min and a maximum of 3 days. Only before testing, trim the exposed face of the cooled specimen flush with the top of the mould using a hot knife or a heated spatula.

Just prior to de-moulding, cool the mould containing the test specimen in a cold chamber or liquid bath for no longer than 5 min in order to stiffen the test specimen so it can be readily de-moulded without distortion. In no cases shall the test specimen be exposed to a de-moulding temperature below the test temperature.

At least two specimens per test temperature shall be tested.

NOTE Excessive cooling can cause unwanted hardening of the binder and affect the test result.

During de-moulding, the test specimen should be handled with care to prevent distortion. A warped test specimen might affect the measured values.

7 Procedure

7.1 Measurement

Clean the supports, loading head and bath liquid of any dust and coatings as necessary.

Check the adjustment of contact load and test load prior to testing each set of test specimens. Refer to the operating instructions of the apparatus for checking and calibration.

Select the first test temperature according to the expected stiffness level. Set the temperature control device to the desired test temperature and allow the apparatus to equilibrate. The bath liquid shall be at the test temperature ± 0,2 °C. Check that the temperature of the bath is stable for a minimum period of 20 min.

NOTE 1 Typical start temperatures are -10 °C, -12 °C, -16 °C or -18 °C, and typically applied differences between test temperatures are 6 °C.

After de-moulding, immediately place the test specimen in the testing bath and condition it at the testing temperature for (60 ± 2) min before starting the test. If more than one specimen is to be tested, place them 5 min apart in the testing bath in order not to exceed conditioning time prior to testing. Damaged or distorted specimen should be discarded.

NOTE 2 The mould base bar is a good support for the test specimen.