SLOVENSKI STANDARD
SIST EN 14771:2005

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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 - Rhéometre a flexion de barreau (BBR)

Ta slovenski standard je istoveten z: **EN 14771:2005**

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 the flexural creep stiffness - Bending Beam Rheometer (BBR)

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Foreword

This document (EN 14771:2005) 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of an identical text or by endorsement, at the latest by November 2005, and conflicting national standards shall be withdrawn at the latest by November 2005.

This European Standard is based on ASTM D 6648-01.

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

1 Scope

This European Standard specifies a method for the determination of the flexural creep stiffness of bituminous binders in the range of 30 MPa to 1 GPa by means of the bending beam rheometer.

WARNING — The use of this European Standard may involve hazardous materials, operations and equipment. This European Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this European Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

2 Normative references

The following referenced documents are indispensable for the application of this European Standard. 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 European Standard, the following terms and definitions apply.

3.1
flexural creep stiffness
S (t)
ratio obtained by dividing the bending stress by the bending strain; 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
the 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 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 The test load of 930 mN to 1030 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 defined 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 The loading frame consists of a set of sample 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 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 The loading system shall be capable of applying a contact load of 25 mN to 45 mN to the test specimen and maintaining a test load of 930 mN to 1030 mN within ± 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 The loading shaft shall be continuous and in line with the load cell and deflection measuring transducer with a spherically-shaped end 6,3 mm ± 0,3 mm in radius.

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

5.1.1.5 The sample supports, shall consist of two non-corrosive metal supports with a 3,0 mm ± 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 A temperature measurement device, as a calibrated temperature transducer shall be capable of measuring the temperature with the 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 A liquid bath capable of maintaining the desired test temperature near the test sample within ± 0,2 °C during isothermal conditioning and during 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 1050 kg/m^3 at the test temperature.

NOTE 95 % (volume fraction) ethanol has been found to be suitable as a bath liquid.

5.1.3.1 A bath agitator shall be used for maintaining the required temperature homogeneity with agitation intensity such that the fluid currents do not disturb the testing process.

5.1.3.2 A circulating bath, an optional separate bath unit, cools the test bath liquid.

5.1.4 A data acquisition and control system 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 mm ± 0,1 mm wide, 12,7 mm ± 0,1 mm deep and 127 mm ± 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.

6 Preparation of test samples

6.1 General

The laboratory sample shall be taken in accordance with EN 58 and prepared in accordance with EN 12594.

6.2 Preparation of moulds

A very thin layer of petroleum-based grease is spread on 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 demoulding 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.

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

NOTE 2 Polyvinyl alcohol and glycerol are found to be suitable as demoulding agents. It is recommended to avoid silicone-based demoulding agents that may affect the binder stiffness.

6.3 Preparation of test specimen

Hot binder is poured into the metal mould that is at room temperature. Slightly overfill the mould. Pour the binder continuously toward the other end in a single pass. Let the filled mould cool in the ambient temperature for 45 min to 60 min. After cooling to room temperature trim the exposed face of the cooled specimen flush with the top of the mould using a hot knife or a heated spatula.

Store all the test specimens in their moulds at the room temperature prior to testing. Testing shall be completed within 4 h after specimens are poured.

NOTE 1 If the test is done at several temperatures then it may be practical to have longer time between pouring and testing, this may effect on the precision of the test.

Just prior to demoulding, cool the mould containing the test specimen in a cold chamber or liquid bath for no longer than 5 min to stiffen the test specimen so that it can be readily demoulded without distortion. In no case shall the sample be exposed to a demoulding temperature less than the test temperature.

At least two specimens per test temperature shall be tested.

NOTE 2 Excessive cooling may cause unwanted hardening of the binder and affect the test result.

NOTE 3 During demoulding, the specimen should be handled with care to prevent distortion. A warped test specimen may 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.

After demoulding immediately place the test specimen in the testing bath and condition it at the testing temperature for 60 min ± 2 min before starting the test.

Place the test specimen on the supports so that the width of the specimen as moulded will be the thickness of the test specimen, see Figure 5.

Establish the thickness of the test specimen immediately before testing by placing the test specimen on the supports. Apply a contact load of 25 mN to 45 mN to the specimen and record the reading of the displacement transducer. Invert the test specimen and obtain the second reading. If the two readings agree within 1,0 mm, calculate the average. If the two readings differ by more than 1,0 mm, the flatness of the test specimen is suspect and it should be discarded.

The thickness and the width of the sample may be directly measured or the dimensions of the mould may be used. The latter procedure is not so accurate as the direct measurement. The thickness of the test specimen may be taken as the measured thickness of the metal inserts and the width may be taken as the height of the side bar used to mould the test specimen.

After the thickness measurement, check the placement of the test specimen on the test supports and gently position the backside of the test specimen against the alignment pins. Manually apply a contact load of 25 mN to 45 mN to the specimen to ensure the contact between the test specimen and the loading head. The time to apply and adjust the load shall be no greater than 10 s.

With the contact load applied to the specimen activate the automatic test system, which is programmed to proceed as follows:

a) Apply a 980 mN ± 50 mN seating load for 1,0 s ± 0,1 s.

b) Reduce the load to the 25 mN to 45 mN and allow the test specimen to recover for 20,0 s ± 0,1 s. The operator shall verify that the load on the test specimen returns to 25 mN to 45 mN. If it does not the test shall be rejected.

NOTE The verification may be achieved by monitoring the computer screen, if the equipment allows it.

c) Apply a 930 mN to 1030 mN test load to the specimen. Record the test load and the deflection during the test time of 240 s. The load shall be within ± 50 mN of the average test load between 0,5 s and 5,0 s and for the remaining times within ± 10 mN of the average test load.

d) Remove the test load and return to the 25 mN to 45 mN contact load.

e) Remove the specimen from the supports and proceed to the next test.