SLOVENSKI STANDARD
kSIST-TS FprCEN/TS 15963:2009

01-september-2009

Bitumen in bitumenska veziva - Določanje temperature lomne žilavosti s tritočkovnim upogibnim preskusom

Bitumen and bituminous binders - Determination of the Fracture Toughness temperature by a notched three point bending test

Bitumes et liants bitumineux - Détermination de la température de résistance à la rupture par un essai de flexion 3 points sur un barreau entaillé

Ta slovenski standard je istoveten z: **FprCEN/TS 15963**

ICS:

91.100.50 Veziva. Tesnilni materiali Binders. Sealing materials

kSIST-TS FprCEN/TS 15963:2009 **en,fr,de**

TECHNICAL SPECIFICATION

SPÉCIFICATION TECHNIQUE

TECHNISCHE SPEZIFIKATION

FINAL DRAFT
FprCEN/TS 15963

June 2009

ICS 91.100.50

English Version

Bitumen and bituminous binders - Determination of the Fracture Toughness temperature by a notched three point bending test

Bitumes et liants bitumineux - Détermination de la température de résistance à la rupture par un essai de flexion 3 points sur un barreau entaillé

This draft Technical Specification is submitted to CEN members for formal vote. It has been drawn up by the Technical Committee CEN/TC 336.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. FprCEN/TS 15963:2009: E

Contents

Page

Foreword

This document (FprCEN/TS 15963:2009) has been prepared by Technical Committee CEN/TC 336 “Bituminous binders”, the secretariat of which is held by AFNOR.

This document is currently submitted to the Formal Vote.

1 Scope

This Technical Specification specifies a method for the determination of the Fracture Toughness temperature, T_{FT}, of bituminous binders by means of a three point bending test on a notched binder sample.

WARNING — The use of this Technical Specification can involve hazardous materials, operations and equipment. This Technical Specification does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this Technical Specification 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 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.

3.1
maximum force
F
highest force measured during the bending test

NOTE 1 The test is done in the brittle state or close to that, so that the maximum force is considered as the onset of the crack propagation.

NOTE 2 Force is expressed in Newton (N).

3.2
displacement at maximum force
D
bending of the test beam from the beginning of the test (from the zero point) to the break point

NOTE Displacement is expressed in millimetre (mm).

3.3
work
W
area under the force-displacement curve from the beginning of the test to the break of the sample, i.e. at the maximum force

NOTE Work is expressed in Newton · meter (N · m) or in Joule (J).

3.4
Fracture Toughness temperature
T_{FT}
temperature at which the displacement at the maximum force is 0,3 mm (from the zero point)

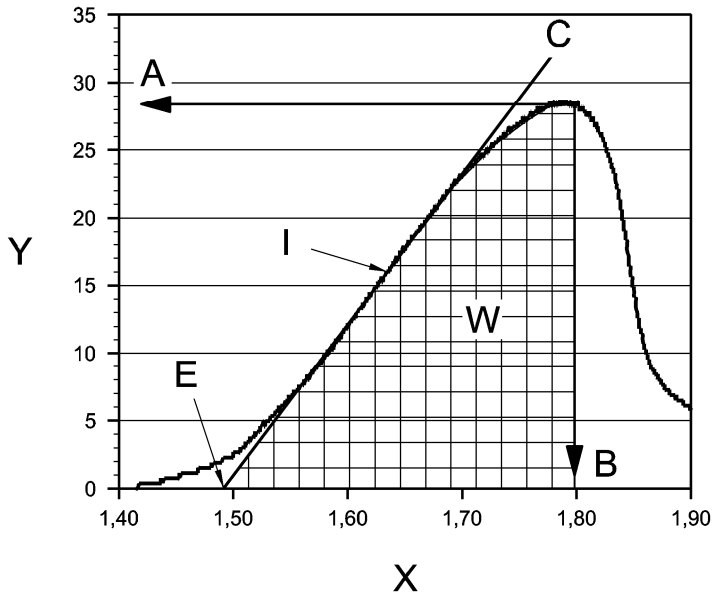
NOTE Fracture Toughness temperature is expressed in degrees Celsius (°C).

3.5
initial stiffness
S
value calculated as the tangent of the force-displacement curve at the inflection point

NOTE Stiffness is expressed in Newton per millimetres (N/mm).

3.6
zero point
intersection of the x-axis and the tangent of the force-displacement curve at the inflection point

Figure 1 presents an example of the Force versus displacement curve at a temperature T close to T_{FT}.



Key

X displacement, mm
Y force, N

A maximum force, *F*
B displacement at maximum force, *D*
C tangent at the inflection point
W work, J
E zero point
I inflection point of *F* versus displacement

Figure 1 — Example of a Force versuss displacement curve at temperature *T* (close to T_{FT})

4 Principle

The notched three point bending test is used to measure cracking perfomance of unmodified and modified bituminous binder samples. The test sample is a beam with a notch in the middle of one side of the beam. The sample is conditioned in a temperature controlled bath. The beam is placed on two supports with the notch facing downwards and a vertical downward force is applied on the middle of the upper face of the sample. The beam is loaded until failure with a specified displacement rate, whereby force is recorded versus displacement.

NOTE The fracture properties of bituminous binders are strongly dependent on test temperature, loading rate and sample preparation method.

5 Apparatus

5.1 Testing apparatus

5.1.1 Tension-compression device

A universal tension-compression device, which is capable of sustaining a constant, predetermined displacement rate. A schematic picture of the set up is shown on Figure 2.

5.1.2 Loading frame

A loading frame consisting of 2 cylindrical specimen supports, a cylindrical-nosed shaft to apply the load to the mid-point of the test specimen and a load cell mounted in line with the loading shaft.

5.1.3 Loading system

A loading system, which is capable of applying a rate of displacement of 0,01 mm/s. The specified displacement rate shall fluctuate by no more than ± 10 % over time. The maximum stroke of the instrument shall be at least 20 mm for this test.

5.1.4 Loading shaft

A loading shaft, which is continuous and in line with the load cell and deflection measuring transducer. The T-shape shaft shall have a cylindrical-shaped loading pin in the end. The diameter of the pin shall be (10,0 ± 0,1) mm.

5.1.5 Load cell

A load cell having a minimum capacity of no less than 500 N and an accuracy of ± 1 % with a minimum resolution of at least 100 m·N is required. The load cell shall allow the measurement of the force at any time during the test.

5.1.6 LVD-transducer

An LVD transducer or other suitable device to measure the deflection of the sample is necessary. It shall have a linear range of at least 20 mm, and capable of resolving linear movement of 0,5 μm. The deflection may be measured using this separate transducer or by measuring the vertical movement of the tension/compression device.

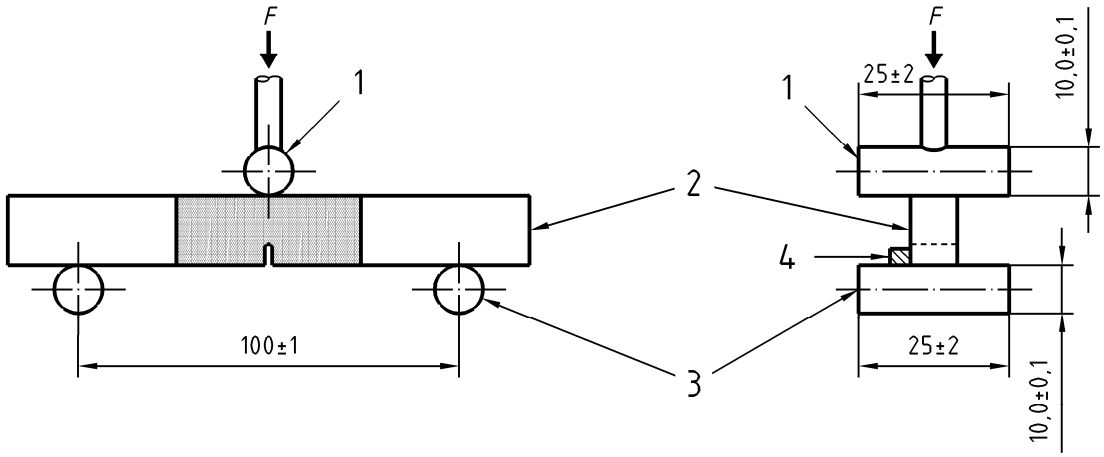
5.1.7 Specimen supports

Specimen supports which shall consist of two non-corrosive metal half-rounds or cylinders with a diameter of (10,0 ± 0,1) mm that are spaced (100 ± 1) mm apart (cylinder centre point to cylinder centre point). To ensure that the specimen is perpendicular to the supports and the loading pin, two vertical alignment pins of 2 mm to 4 mm in diameter shall be provided at the back of each support. A schematic diagram of the sample supports is shown on Figure 2.

5.1.8 Ventilated oven, capable of maintaining a temperature up to 200 °C, with an accuracy of ± 1 °C.

The specified temperature shall only be assessed in the surroundings of the sample (see 6.3).

Dimensions in millimetres



Key

1 cylindrical loading shaft pin
2 specimen (see details on Figure 3)
3 specimen supports
4 alignment pin
F force applied

Figure 2 — Bending rig

Table 1 — Measurement and tolerances of the rig

Dimension	Size mm	Tolerance mm
Loading shaft pin length	25	± 2
Loading shaft diameter	10,0	± 0,1
Specimen support length	25	± 2
Specimen support diameter	10,0	± 0,1
Specimen support span	100	± 1

5.1.9 Temperature measurement device

A calibrated temperature transducer capable of measuring the temperature with the accuracy of ± 0,1 °C over the range of – 40,0 °C to 0,0 °C. The temperature measuring head shall be mounted in the surroundings of the specimen, at a distance of not more than 25 mm from the middle of the parallelepipedal specimen.

NOTE A platinum resistance thermometer meeting DIN 43760 (Class A) requirements is recommended.

5.1.10 Liquid bath

A liquid bath shall be capable of maintaining the required test temperature near the test specimen within ± 0,2 °C during the isothermal conditioning and the test procedure, enabling to reach the lower temperature required for testing the specimen.

Bath liquid shall not affect the properties of the bituminous binder being tested.

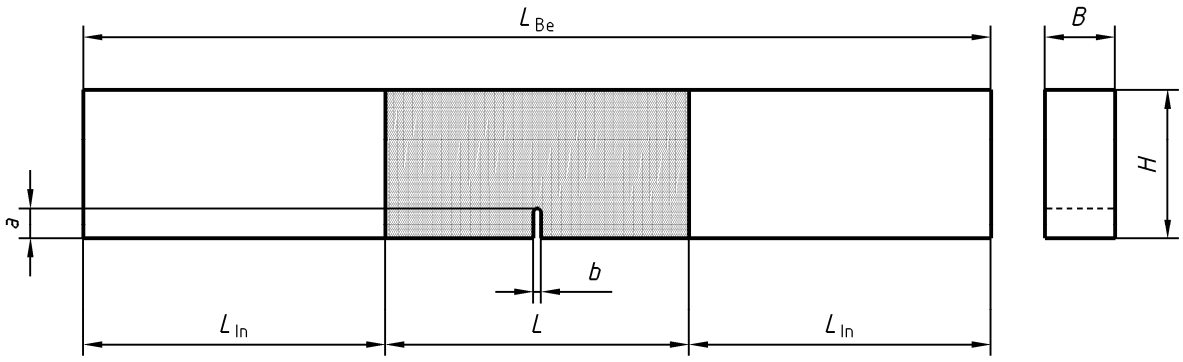
NOTE 95 % volume ethanol or a 40 % – 50 % mass potassium acetate-water solution has been found to be suitable as a bath liquid.

5.1.11 Data acquisition and control system

A data acquisition and control system shall resolve loads to the nearest 100 mN, test specimen deflection to the nearest 0,5 μm, and temperature around the sample to the nearest 0,1 °C. The software shall control the measuring system and record time, load, deflection and temperature during the test.

5.2 Test specimen

A test specimen as shown on Figure 3 is used. The sample is moulded from the bituminous binder to be assessed. Two aluminium inserts are installed at the ends of the mould. The notch is made by installing 2 layers of 25 μm thick PTFE film into the pre-notched mould frame.



Key

- beam length, L_{Be}
- specimen length, L
- insert length, L_{In}
- specimen height, H
- specimen thickness, B
- notch depth, a
- notch thickness, b

Figure 3 — Specimen geometry