SLOVENSKI STANDARD
SIST EN 13703:2004

01-september-2004

Bitumen in bitumenska veziva ï Določ evanje deformacijske energije

Bitumen and bituminous binders - Determination of deformation energy

Bitumen und bitumenhaltige Bindemittel - Bestimmung der Formänderungsarbeit

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Bitumes et liants bitumineux - Détermination de l'énergie de déformation

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Ta slovenski standard je istoveten z: EN 13703:2003

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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 13703:2004 **en**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 13703

December 2003

ICS 91.100.50

English version

Bitumen and bituminous binders - Determination of deformation energy

Bitumes et liants bitumineux - Détermination de l'énergie de déformation

Bitumen und bitumenhaltige Bindemittel - Bestimmung der Formänderungsarbeit

This European Standard was approved by CEN on 21 November 2003.

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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 Management Centre has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document EN 13703:2003 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of an identical text or by endorsement, at the latest by June 2004, and conflicting national standards shall be withdrawn at the latest by June 2004.

Annex A is normative.

This document includes a Bibliography.

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

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1 Scope

This European Standard specifies a method for determining the conventional energy of bituminous binders from tensile characteristics.

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 determine the applicability of regulatory limitations prior to use.

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references, the latest edition of the publication referred to applies (including amendments).

EN 13587, *Bitumen and bituminous binders — Determination of the tensile properties of bituminous binders by the tensile test method.*

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EN 13589, *Bitumen and bituminous binders — Determination of the tensile properties of modified bitumen by the force ductility method.*

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3 Terms and definitions

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

3.1
tensile force
force undergone by a specimen subjected to extension; the unit is N

3.2
elongation
D
increase in length of a specimen expressed in metres

NOTE Percent elongation is calculated as [(new length – initial length)/initial length] x 100.

3.3
breaking point
displacement corresponding to the rupture of the test specimen

3.4
deformation energy
E_i
energy in joules (J) supplied by test pieces, until displacement, i, of the moving element

3.5
conventional energy
E'_i
quotient of deformation energy, E_i (in joules) and the initial cross section of the test pieces (in square centimetres)

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4 Principle

The deformation energy (E_i) is determined from the recordings of the tensile curves (see Figure A.1) obtained according to EN 13587 and EN 13589 by calculating the area delimited by:

- the abscissa axes corresponding to elongations;
- the recorded curve (force versus elongation);
- a parallel to the ordinates axis which passes by a given elongation or the breaking point (see Figure A.2).

Conventional energy (E'_i) is obtained as a quotient of the deformation energy and the initial cross-area of the test specimens.

NOTE Conventional energy can be also called cohesion energy.

5 Apparatus

A calculator, enabling the determination of the areas from the numerical data recorded or, otherwise, any device enabling the calculation of the area from graphic registration.

6 Procedure

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6.1 Energy calculation from numerical data registry of variables

For each test specimen, the energy calculation is accomplished from the computerised data of couples force/elongation. This calculation can be done using any specific reprocess data software of computer worksheet. This will be the calculation method to be used preferably.

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6.2 Energy calculation from the graphics registry of variables

For each test piece, the energy calculation is accomplished from the rough curve obtained on the device recorder. This curve resembles the one illustrated in Figure A.2.

6.2.1 Determination of unit energy (E_u)

Unit Energy is defined as the energy corresponding to one square centimetre of the recording paper. It is expressed in joules (J).

6.2.1.1 Calculation of unit force (F_u)

Knowing the maximal capacity of the force measurement device and its sensitiveness (expressed in percentage), determine the value of the nominal force (expressed in newtons) for full-scale of the registration considered.

Then calculate the unit force, F_u, corresponding to one centimetre on the ordinates axis of the registration.

$$F_u = \frac{F}{L}$$

Where:

L is the length, in cm, of the scale of the ordinate axis;

F is the nominal force, in N, of the measurement device taking into account its sensitiveness.

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6.2.1.2 Calculation of unit displacement (d_u)

Knowing the displacement velocity of the recording paper, calculate the unit displacement, d_u, of the moving element (expressed in metres), corresponding to one centimetre of the recording paper abscissa scale.

$$d_u = \frac{D}{v \times t}$$

where:

D corresponds to the specimen elongation;

v is the recording paper speed;

t is the time needed to accomplish the test.

6.2.1.3 Unit energy (E_u)

The unit energy, E_u, corresponds to the unit area of the recording paper. It is calculated from the following equation and expressed in joules:

$$E_u = d_u \times F_u$$

6.2.2 Energy calculation

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Energy calculation can be carried out in one of the two following ways:

a) By counting the number of unit squares, n_i, included in the evaluated areas as defined in clause 4, calculate the energy through the expression:

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$$E_i = n_i \times E_u$$

b) By weighing (on a balance accurate to 0,1 mg) determine the mass of the cut paper, P_i, corresponding to the evaluated areas as defined in clause 4. It would be suitable to practise a calibration of the paper used in the registration, in order to calculate the unit mass, P_u, of a square of paper:

$$E_i = (P_i / P_u) \times E_u$$

7 Calculation and expression of results

The final results are expressed as conventional energy, E'_i, in joules per square centimetre.

Conventional energy is calculated dividing the energy, E_i, obtained as indicated in clause 6 by the initial cross section of the test specimen expressed in square centimetres. The dimensions of the mould used to cast the specimen will be used to calculate the initial cross section of it.

The end calculation shall correspond to the average of, at least, three specimens tested without significant incidents.

8 Precision

NOTE In the case of the force ductility method (described in EN 13589), a round robin test carried out according to ISO 5725-2 [1], permitted to establish the precision values given in Table 1.

In the case of the tensile test method (EN 13587), the precision data given in Table 1, are the best currently estimated, from a cross-laboratory test. They are proposed until results of further round robin test are available.

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8.1 Repeatability

The difference between two successive test 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, exceed the values given in Table 1 in only one case in twenty.

8.2 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, exceed the values given in Table 1, in only one case in twenty.

Table 1 — Repeatability and reproducibility

Test method	Deformation energy	Repeatability r	Reproducibility R
EN 13587 tensile test	$E'_{0,2}$ (J/cm²)	10 %	30 %
EN 13589 force ductility	$E'_{0,2\text{-}0,4}$ < 1 J/cm² (absolute value to be used)	0,11 J/cm²	0,39 J/cm²
	$E'_{0,2\text{-}0,4}$ > 1 J/cm²	8 %	33 %

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9 Test report

The test report shall contain at least the following information:

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a) a complete identification of the sample under test;

b) a reference to this European Standard;

c) a reference to the test used either force ductility or tensile test;

d) the test conditions (speed in millimetres per minute, temperature in Celsius degree) and all the operating details which are optional or not provided for in the standard as well as any incidents;

e) the type of either graphic or numerical;

f) the conventional energy, E'_i, calculated for each test specimen as well as the mean value and the standard deviation of the, at least, three measurements done;

g) any deviation, by agreement or otherwise, from the procedure specified;

h) the date of the test.