SLOVENSKI STANDARD
SIST EN 12697-46:2012

01-september-2012

Bitumenske zmesi - Preskusne metode za vroče asfaltne zmesi - 46. del: Odpornost asfaltne plasti proti razpokam pri nizkih temperaturah z enoosnimi nateznimi preskusi

Bituminous mixtures - Test methods for hot mix asphalt - Part 46: Low temperature cracking and properties by uniaxial tension tests

Asphalt - Prüfverfahren für Heißasphalt - Teil 46: Widerstand gegen Kälterisse und Tieftemperaturverhalten bei einachsigen Zugversuchen

Mélanges bitumineux - Essais pour enrobés à chaud - Partie 46: Fissuration à basse température et les propriétés des tensions uni axiaux par des tests

Ta slovenski standard je istoveten z: **EN 12697-46:2012**

ICS:

93.080.20	Materiali za gradnjo cest	Road construction materials

SIST EN 12697-46:2012 **en,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12697-46

May 2012

ICS 93.080.20

English Version

Bituminous mixtures - Test methods for hot mix asphalt - Part 46: Low temperature cracking and properties by uniaxial tension tests

Mélanges bitumineux - Essais pour mélange hydrocarboné à chaud - Partie 46: Fissuration et propriétés à basse température par des essais de traction uniaxiale

Asphalt - Prüfverfahren für Heißasphalt - Teil 46: Widerstand gegen Kälterisse und Tieftemperaturverhalten bei einachsigen Zugversuchen

This European Standard was approved by CEN on 23 March 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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.

CEN members are the national standards bodies of 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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

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

Management Centre: Avenue Marnix 17, B-1000 Brussels

Contents

Foreword

This document (EN 12697-46:2012) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by DIN.

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 2012, and conflicting national standards shall be withdrawn at the latest by November 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document is one of a series of standards for bituminous mixtures which includes the following:

EN 12697-1, *Bituminous mixtures — Test methods for hot mix asphalt — Part 1: Soluble binder content*

EN 12697-2, *Bituminous mixtures — Test methods for hot mix asphalt — Part 2: Determination of particle size distribution*

EN 12697-3, *Bituminous mixtures — Test methods for hot mix asphalt — Part 3: Binder recovery: Rotary evaporator*

EN 12697-4, *Bituminous mixtures — Test methods for hot mix asphalt — Part 4: Binder recovery: Fractionating column*

EN 12697-5, *Bituminous mixtures — Test methods for hot mix asphalt — Part 5: Determination of the maximum density*

EN 12697-6, *Bituminous mixtures — Test methods for hot mix asphalt — Part 6: Determination of bulk density of bituminous specimens*

EN 12697-7, *Bituminous mixtures — Test methods for hot mix asphalt — Part 7: Determination of bulk density of bituminous specimens by gamma rays*

EN 12697-8, *Bituminous mixtures — Test methods for hot mix asphalt — Part 8: Determination of void characteristics of bituminous specimens*

EN 12697-9, *Bituminous mixtures — Test methods for hot mix asphalt — Part 9: Determination of the reference density*

EN 12697-10, *Bituminous mixtures — Test methods for hot mix asphalt — Part 10: Compactibility*

EN 12697-11, *Bituminous mixtures — Test methods for hot mix asphalt — Part 11: Determination of the affinity between aggregates and binders*

EN 12697-12, *Bituminous mixtures — Test methods for hot mix asphalt — Part 12: Determination of the water sensitivity of specimen*

EN 12697-13, *Bituminous mixtures — Test methods for hot mix asphalt — Part 13: Temperature measurement*

EN 12697-14, *Bituminous mixtures — Test methods for hot mix asphalt — Part 14: Water content*

EN 12697-15, *Bituminous mixtures — Test methods for hot mix asphalt — Part 15: Determination of the segregation sensitivity*

EN 12697-16, *Bituminous mixtures — Test methods for hot mix asphalt — Part 16: Abrasion by studded tyres*

EN 12697-17, *Bituminous mixtures — Test methods for hot mix asphalt — Part 17: Particle loss of porous asphalt specimen*

EN 12697-18, *Bituminous mixtures — Test methods for hot mix asphalt — Part 18: Binder drainage*

EN 12697-19, *Bituminous mixtures — Test methods for hot mix asphalt — Part 19: Permeability of specimen*

EN 12697-20, *Bituminous mixtures — Test methods for hot mix asphalt — Part 20: Indentation using cube or Marshall specimen*

EN 12697-21, *Bituminous mixtures — Test methods for hot mix asphalt — Part 21: Indentation using plate specimen*

EN 12697-22, *Bituminous mixtures — Test methods for hot mix asphalt — Part 22: Wheel tracking test*

EN 12697-23, *Bituminous mixtures — Test methods for hot mix asphalt — Part 23: Indirect tensile test*

EN 12697-24, *Bituminous mixtures — Test methods for hot mix asphalt — Part 24: Resistance to fatigue*

EN 12697-25, *Bituminous mixtures — Test methods for hot mix asphalt — Part 25: Cyclic compression test*

EN 12697-26, *Bituminous mixtures — Test methods for hot mix asphalt — Part 26: Stiffness*

EN 12697-27, *Bituminous mixtures — Test methods for hot mix asphalt — Part 27: Sampling*

EN 12697-28, *Bituminous mixtures — Test methods for hot mix asphalt — Part 28: Preparation of samples for determining binder content, water content and grading*

EN 12697-29, *Bituminous mixtures — Test methods for hot mix asphalt — Part 29: Determination of the dimensions of bituminous specimen*

EN 12697-30, *Bituminous mixtures — Test methods for hot mix asphalt — Part 30: Preparation of specimen by impact compactor*

EN 12697-31, *Bituminous mixtures — Test methods for hot mix asphalt — Part 31: Specimen preparation, gyratory compactor*

EN 12697-32, *Bituminous mixtures — Test methods for hot mix asphalt — Part 32: Laboratory compaction of bituminous mixtures by a vibratory compactor*

EN 12697-33, *Bituminous mixtures — Test methods for hot mix asphalt — Part 33: Specimen prepared by roller compactor*

EN 12697-34, *Bituminous mixtures — Test methods for hot mix asphalt — Part 34: Marshall test*

EN 12697-35, *Bituminous mixtures — Test methods for hot mix asphalt — Part 35: Laboratory mixing*

EN 12697-36, *Bituminous mixtures — Test methods for hot mix asphalt — Part 36: Method for the determination of the thickness of a bituminous pavement*

EN 12697-37, *Bituminous mixtures — Test methods for hot mix asphalt — Part 37: Hot sand test for the adhesivity of binder on precoated chippings for HRA*

EN 12697-38, *Bituminous mixtures — Test methods for hot mix asphalt — Part 38: Common equipment and calibration*

EN 12697-39, *Bituminous mixtures — Test methods for hot mix asphalt — Part 39: Binder content by ignition*

EN 12697-40, *Bituminous mixtures — Test methods for hot mix asphalt — Part 40: In-situ drainability*

EN 12697-41, *Bituminous mixtures — Test methods for hot mix asphalt — Part 41: Resistance to de-icing fluids*

EN 12697-42, *Bituminous mixtures — Test methods for hot mix asphalt — Part 42: Amount of coarse foreign matters in reclaimed asphalt*

EN 12697-43, *Bituminous mixtures — Test methods for hot mix asphalt — Part 43: Resistance to fuel*

EN 12697-44, *Bituminous mixtures — Test methods for hot mix asphalt — Part 44: Crack propagation by semi-circular bending test*

EN 12697-45, *Bituminous mixtures — Test methods for hot mix asphalt — Part 45: Saturation Ageing Tensile Stiffness (SATS) conditioning test*

EN 12697-46, *Bituminous mixtures — Test methods for hot mix asphalt — Part 46: Low temperature cracking and properties by uniaxial tension tests*

EN 12697-47, *Bituminous mixtures — Test methods for hot mix asphalt — Part 47: Determination of the ash content of natural asphalts*

prEN 12697-48[1)], *Bituminous mixtures — Test methods for hot mix asphalt — Part 48: Inter-layer bond strength*

prEN 12697-49, *Bituminous mixtures — Test methods for hot mix asphalt — Part 49: Skid resistance of asphalt in the laboratory*

prEN 12697-50[1)], *Bituminous mixtures — Test methods for hot mix asphalt — Part 50: Scuffing resistance of surface course asphalt*

According to the CEN/CENELEC Internal Regulations, the national standards organizations 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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1) In preparation.

1 Scope

This European Standard specifies uniaxial tension tests for characterising the resistance of an asphalt mixture against low temperature cracking. The results of the uniaxial tension tests can be used to evaluate the following:

— tensile strength at a specified temperature, using the uniaxial tension stress test (UTST);

— minimum temperature that the asphalt can resist before failure, using the thermal stress restrained specimen test (TSRST);

— tensile strength reserve at a specified temperature (using a combination of TSRST and UTST);

— relaxation time, using the relaxation test (RT);

— creep curve to back calculate rheological parameters, using the tensile creep tests (TCT);

— fatigue resistance at low temperatures due to the combination of cryogenic and mechanical loads, using the uniaxial cyclic tension stress tests (UCTST).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 12697-6:2012, *Bituminous mixtures — Test methods for hot mix asphalt — Part 6: Determination of bulk density of bituminous specimens*

EN 12697-27, *Bituminous mixtures — Test methods for hot mix asphalt — Part 27: Sampling*

EN 12697-33, *Bituminous mixtures — Test methods for hot mix asphalt — Part 33: Specimen prepared by roller compactor*

3 Terms and definitions

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

3.1
tensile strength β_t
maximum tensile stress measured in a tensile stress test

3.2
tensile failure strain $\varepsilon_{failure}$
tensile strain that is measured when the tensile strength has been reached

3.3
cryogenic stress $\sigma_{cry}(T)$
tension stress, induced by prohibited thermal shrinkage, at the temperature T

3.4
failure stress $\sigma_{cry,\ failure}$
cryogenic stress that causes a failure of the specimen in the thermal stress restrained specimen test (TSRST)

3.5
failure temperature $T_{failure}$
temperature at which the cryogenic stress causes a failure of the specimen in the thermal stress restrained specimen test (TSRST)

3.6
tensile strength reserve $\Delta\beta_t$
difference between the tensile strength and the cryogenic stress at the same temperature T where

$$\Delta\beta_t(T) = \beta_t(T) - \sigma_{cry}(T)$$

3.7
time of relaxation t_{rel}
time until the stress decreases to 36,8 % (1/e) of its initial value

3.8
remaining tension stress $\sigma_{rem}(t)$
remaining stress after the time t in the relaxation test

3.9
initial complex modulus E^*_0
complex modulus after 100 load cycles, calculated according to EN 12697-26

3.10
conventional failure criterion $N_{f/50}$
number of load cycles reducing the complex modulus E^* to half of its initial value E^*_0 (fatigue criterion)

3.11
additional failure criterion $N_{failure}$
number of load cycles leading to the development of a visible and recognisable crack in the asphalt specimen (fracture criterion)

4 Principle

The low-temperature performance of asphalt specimens can be tested using different test methods:

— In the uniaxial tension stress test (UTST), a specimen is pulled with a constant strain rate at a constant temperature until failure. Results of the UTST are the maximum stress (tensile strength) $\beta_t(T)$ and the corresponding tensile failure strain $\varepsilon_{failure}(T)$ at the test temperature T (see Figure 1).

— In the thermal stress restrained specimen test (TSRST), a specimen, whose length is held constant, is subjected to a temperature decrease with a constant temperature rate. Due to the prohibited thermal shrinkage, cryogenic stress is built up in the specimen. The results are the progression of the cryogenic stress over the temperature $\sigma_{cry}(T)$ and the failure stress $\sigma_{cry,\ failure}$ at the failure temperature $T_{failure}$ (see Figure 2).

— In the the tensile creep test (TCT), the specimen is subjected to a constant tension stress σ at a constant temperature T. The progression of the strain ε is measured. After a given time, the stress is withdrawn. Rheological parameters describing the elastic and viscous properties of the asphalt can be determined by interpreting the strain measurements (see Figure 4).

— In the relaxation test (RT), the specimen is subjected to a spontaneous strain ε, which is held on a constant level. The decrease of tension stress by relaxation over the testing time is monitored. The results are the time of relaxation t_{rel} and the remaining tension stress σ_{rem} after the test has ended (see Figure 3).

— In the uniaxial cyclic tension stress test (UCTST), a specimen is subjected to a cyclic tensile stress which is characterised by a sinusoidal stress to simulate the dynamic loading condition by traffic in combination with a constant stress, which symbolises the cryogenic stress. During the test, the strain response is monitored and the course of the stiffness is recorded until fatigue failure. Results of the tests are the number of applied load cycles until failure $N_{failure}$ and the number of load cycles until the conventional fatigue criterion is reached $N_{f/50}$ (see Figure 5).

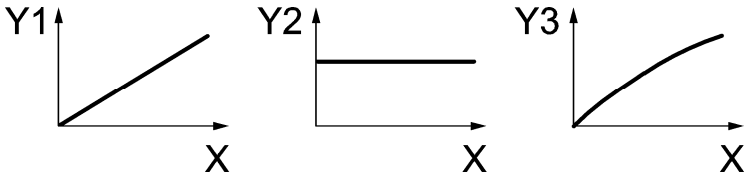


Figure 1 — Test principle of UTST

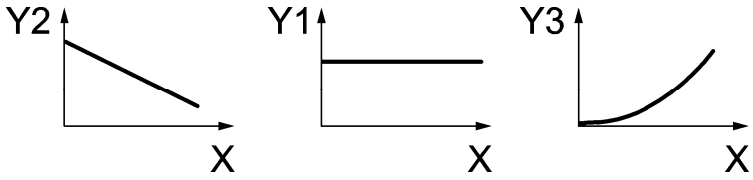


Figure 2 — Test principle of TSRST

Figure 3 — Test principle of RT

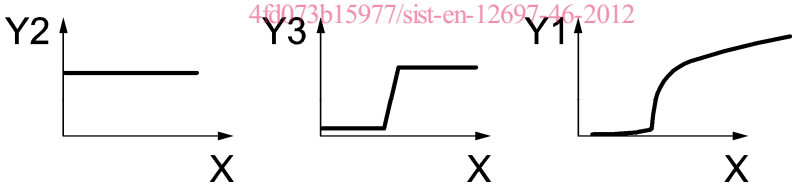


Figure 4 — Test principle of TCT

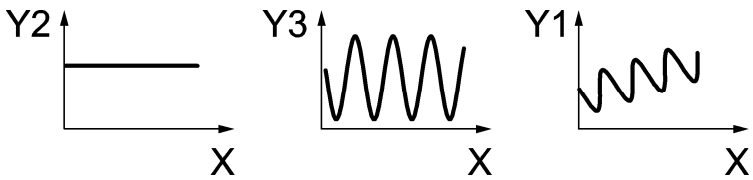


Figure 5 — Test principle of UCTST

Key for Figures 1 to 5

Y1 strain
X time
Y2 temperature
Y3 stress

5 Apparatus

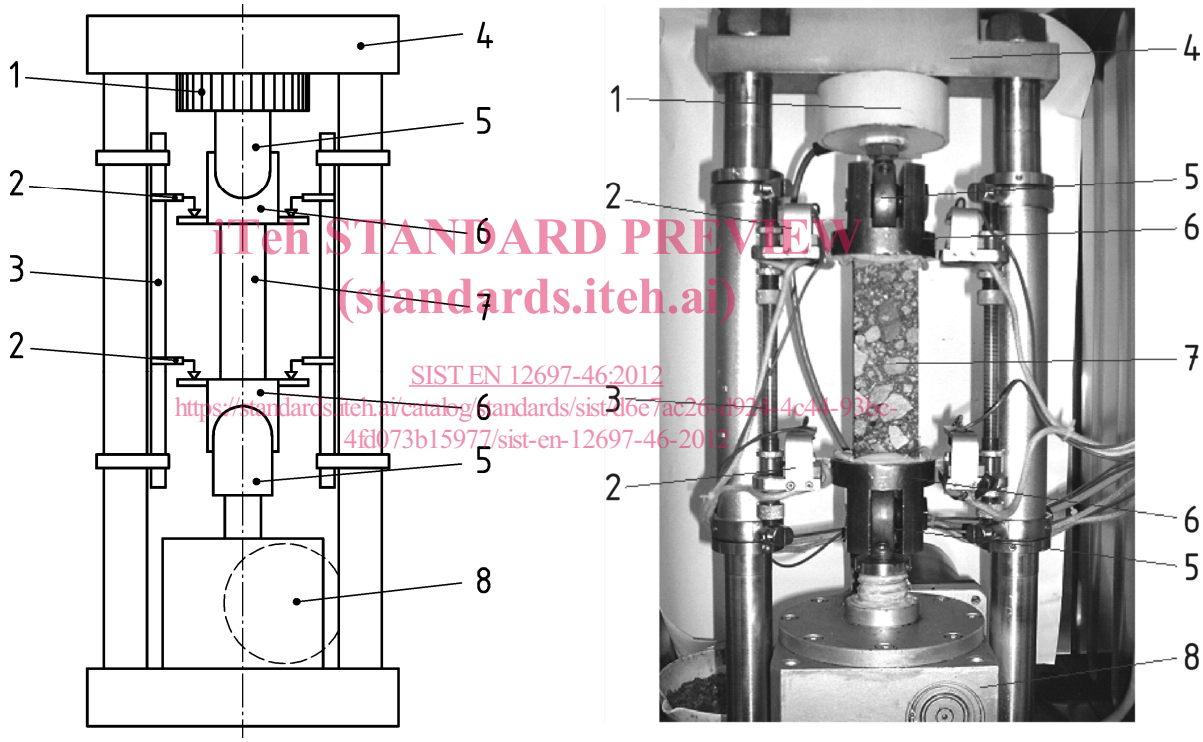
5.1 Testing device for conducting UTST, TSRST, RT and TCT

5.1.1 General

Figures 6 and 7 show suitable testing devices for conducting uniaxial tension stress, thermal stress restrained specimen, relaxation and tensile creep tests, at low temperatures.

5.1.2 Load device

The load device shall be able to generate movements with an accuracy of 0,1 µm. In order to avoid radial and/or transversal forces as well as moments in the test specimen, the specimen is connected to the loading device by two gimbal suspensions.



Key

1 load cell
2 displacement transducer
3 thermal indifferent measurement base
4 crossbeam
5 gimbal suspension
6 adapter
7 specimen
8 gear box with stepping motor

Figure 6 — Example of a test device for uniaxial tension tests at low temperatures