SLOVENSKI STANDARD
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Bitumenske zmesi - Preskusne metode za vroț e 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: Rissbildung und Eigenschaften bei niedrigen Temperaturen

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

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Bituminous mixtures - Test methods for hot mix asphalt - Part 46: Low Temperature Cracking and Properties by Uniaxial Tension Tests

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COMITÉ EUROPÉEN DE NORMALISATION
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Foreword

This document (prEN 12697-46:2009) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This European Standard is one of a series of standards as listed below:

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: 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 specimen by hydro-static method*

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 the air voids content of bituminous mixtures*

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

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 of bituminous mixtures*

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 specimen*

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

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: Dynamic creep 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 preparation, slab 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 pre-coated chippings for hot rolled asphalt*

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 of porous asphalt*

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 foreign matter in reclaimed asphalt*

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

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

prEN 12697-45, *Bituminous mixtures — Test methods for hot mix asphalt — Part 45: Saturation ageing tensile stiffness (SATS) conditioning test*

prEN 12697-46, *Bituminous mixtures — Test methods for hot mix asphalt — Part 46: Low temperature cracking and properties*

prEN 12697-47, *Bituminous mixtures — Test methods for hot mix asphalt — Part 47: Determination of the ash content of Lake Asphalt*

No existing European Standard is superseded.

1 Scope

This document (prEN 12697-46:2008) describes 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 tensile strength in dependence of the temperature by uniaxial tension stress test (UTST);

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

— the tensile strength reserve in dependence of the temperature (by a combination of TSRST and UTST);

— the relaxation time by the relaxation test (RT);

— the creep curve to back calculate rheological parameters in tension state by tensile creep tests (TCT); and

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

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.

3 Terms and definitions

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

3.1
tensile strength β_t
tension stress that causes the failure of the specimen

3.2
tensile failure strain $\varepsilon_{failure}$
tensile strain that is measured at failure of the specimen in the uniaxial tension stress test (UTST)

3.3
cryogenic tensile 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 decreased 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 in Megapascal [MPa] 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 by the uniaxial tension stress test (UTST), the thermal stress restrained specimen test (TSRST), the relaxation test (RT), the tensile creep test (TCT) and/or the uniaxial cyclic tension stress test (UCTST).

— In the UTST, a specimen is pulled with a constant strain rate at 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.

— In the TSRST, a specimen, which length is held constant, is subjected to a temperature decrease with constant temperature rate. Due to the prohibited thermal shrinkage, cryogenic stress is built up in the specimen until failure. 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 $T_{failure}$.

— In the TCT, the specimen is subjected to a constant tension stress σ at a constant temperature T. The progression of the strain ε is monitored. After a given time, the stress is withdrawn and the specimen degrades the strain. Rheological parameters describing the elastic and viscous properties of the asphalt can be estimated by interpreting the strain measurements.

— In the RT, the specimen is subjected to a spontaneous strain ε, which is held on 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 ended.

— In the 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 $N_{f/50}$.

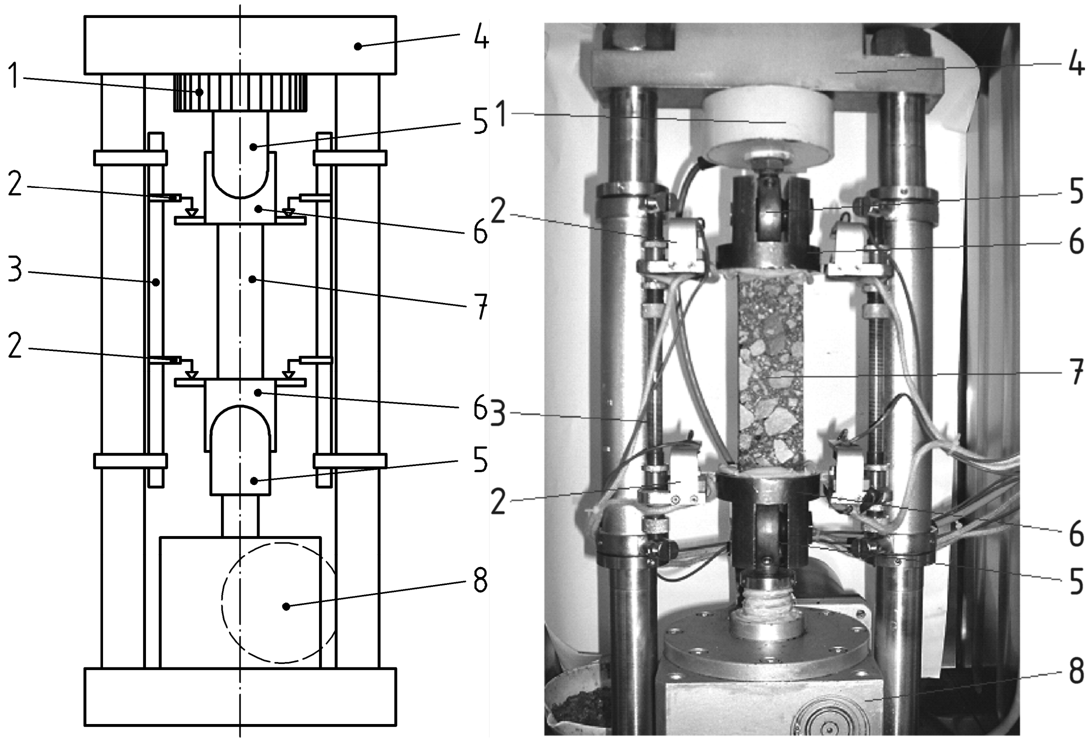
5 Apparatus

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

Figures 1 and 2 show suitable testing devices for conducting uniaxial tension stress, thermal stress restrained specimen, relaxation and tensile creep tests at low temperatures.

5.1.1 Load device

The load device must 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 placed into the loading device with 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 1 — Example of a test device for uniaxial tension tests at low temperatures