SLOVENSKI STANDARD
oSIST prEN 12697-46:2019

01-februar-2019

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

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

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

Mélanges bitumineux - Méthodes d'essai - Partie 46: Fissuration à basse température et les propriétés des tensions uni axiaux par des tests

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English Version

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

Mélanges bitumineux - Méthodes d'essai - Partie 46: Fissuration à basse température et les propriétés des tensions uni axiaux par des tests

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

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 227.

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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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

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Ref. No. prEN 12697-46:2018 E

Contents

European foreword

This document (pEN 12697-46:2018) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by BSI.

This document is currently submitted to the enquiry.

This document will supersede EN 12697-46:2012.

The following is a list of significant technical changes since the previous edition:

— The title no longer makes the method exclusively for hot mix asphalt;

— [ge] Editorial update according to current standard template;

— [5.1.4] Accuracy of (20 ± 20) N corrected to: “(25 ± 0,025) kN with an accuracy of 0,001 kN or better”;

— [5.1.4] Excessive and incorrect NOTE deleted;

— [5.2.1] Correction of accuracy for Dynamic testing device to : ± 0,1 Hz ;

— [5.2.5] Clarified that temperature is measured on a dummy specimen;

— [6.1.1] Clarified that the main reason for required calibration is to obtain correct loading condition;

— [8.2.2] Clarified that the results of the test evaluation are measured (not failure stress and failure temperature;

— [8.5.3.6] The reason for measuring clarified.

A list of all parts in the EN 12697 series can be found on the CEN website.

1 Scope

This document specifies uniaxial tension tests for characterizing 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 are referred to in the text in such a way that some or all of their content constitutes requirements 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 12697-6, *Bituminous mixtures - Test methods for hot mix asphalt - Part 6: Determination of bulk density of bituminous specimens*

EN 12697-27, *Bituminous mixtures - Test methods - Part 27: Sampling*

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

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

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 characterized 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 Nfailure and the number of load cycles until the conventional fatigue criterion is reached Nf/50 (see Figure 5).

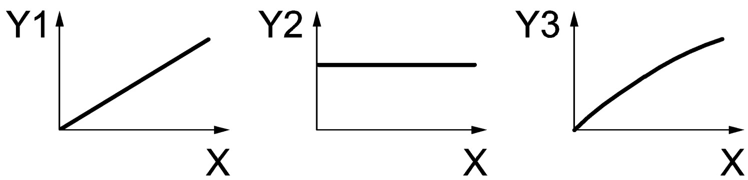


Figure 1 — Test principle of UTST

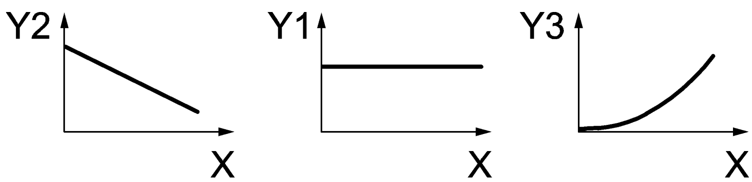


Figure 2 — Test principle of TSRST

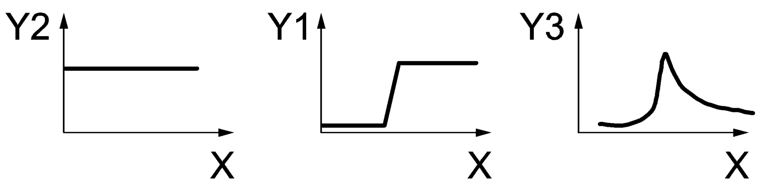


Figure 3 — Test principle of RT

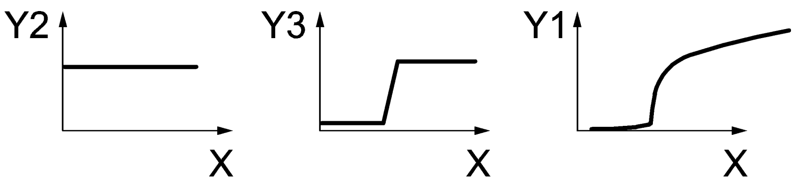
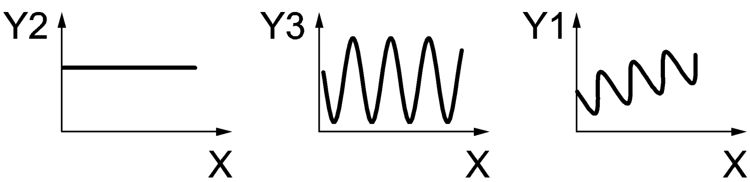


Figure 4 — Test principle of TCT



Key for Figures 1 to 5

Y1 strain

X time

Y2 temperature

Y3 stress

Figure 5 — Test principle of UCTST

5 Apparatus

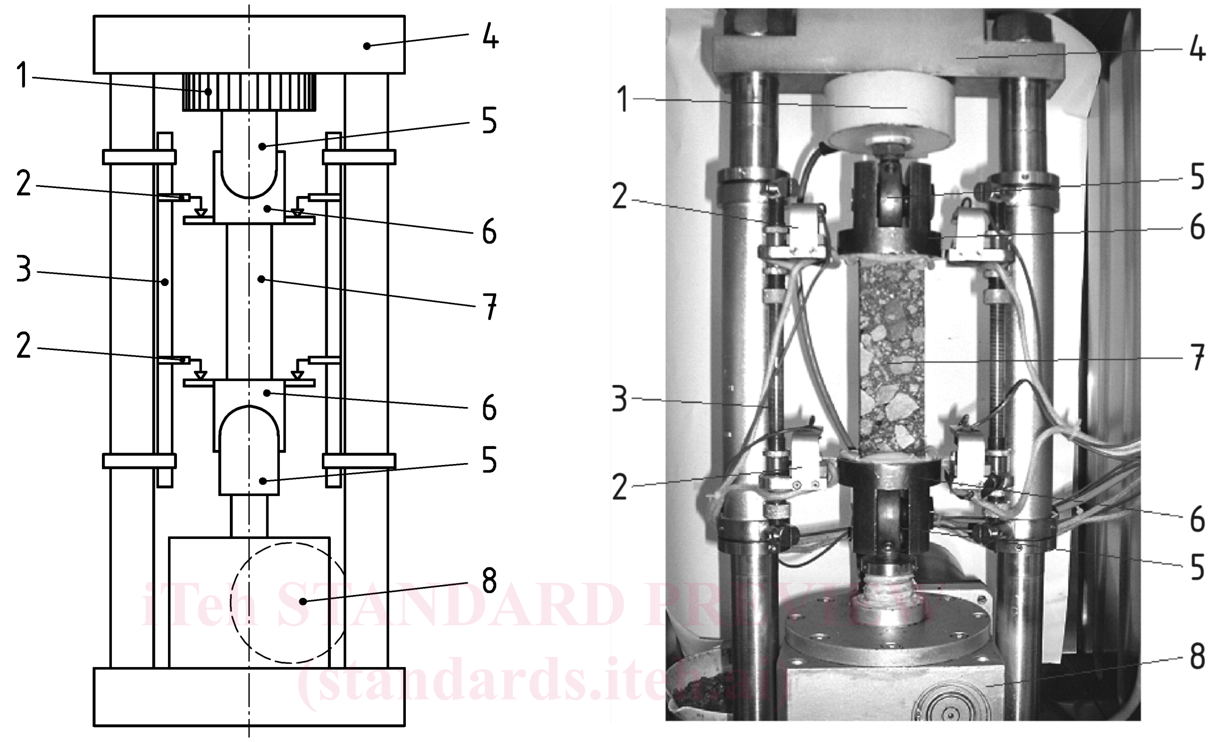
5.1 Testing device for conducting UTST, TSRST, RT and TCT

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