



SLOVENSKI STANDARD SIST EN 12697-46:2020

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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
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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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93.080.20 Materiali za gradnjo cest Road construction materials

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EUROPEAN STANDARD

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

Mélanges bitumineux - Méthodes d'essai - Partie 46 :
Fissuration et propriétés à basse température par des
essais de traction uniaxiale

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

This European Standard was approved by CEN on 18 November 2019.

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EN 12697-46:2020 (E)**European foreword**

This document (EN 12697-46:2020) has been prepared by Technical Committee CEN/TC 227 “Road materials”, the secretariat of which is held by BSI.

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of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.

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

This document supersedes 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;
- [ge] NOTEs modified and adjusted to normal text where appropriate according to ISO/IEC Directives – Part 2:2016, 24.5;
- [Clause 4] changed order of indent 3 and 4 for consistency with Clause 8.3 and 8.4;
- [5.1.4] clause amended to read: Load measurement system, capable of monitoring the axial load up to $(25 \pm 0,025)$ kN with resolution of 0,001 kN or better and with an accuracy of $\pm 0,01$ kN or better.
- [5.1.4] excessive and incorrect NOTE deleted;
- [5.2.1] accuracy for Dynamic testing device (0,1 Hz) completed with “ \pm ”;
- [5.2.1] correction of keys for Figure 8;
- [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;
- [7.3.1] added description for sawing of prismatic specimen to ensure a precise cross section;
- [7.3.2] added description for thickness to enable sawing of prismatic specimens;
- [8.2.2] clarified that the results of the test evaluation are measured (not failure stress and failure temperature);

- [8.5.1]; NOTE modified and adjusted to normal text according to ISO/IEC Directives – Part 2:2016, 24.5. Added description of suitable test temperature and testing frequency for intermediate low temperatures;
- [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.

According to the CEN-CENELEC Internal Regulations, the national standards organisations 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, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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EN 12697-46:2020 (E)

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 — Part 6: Determination of bulk density of bituminous specimens*

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

EN 12697-33, *Bituminous mixtures — Test method — 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 <https://www.iso.org/obp/ui>

3.1 tensile strength

β_t

maximum tensile stress measured in a tensile stress test

3.2 tensile failure strain

$\epsilon_{\text{failure}}$

tensile strain that is measured when the tensile strength has been reached

3.3**cryogenic stress** $\sigma_{\text{cry}}(T)$ tension stress, induced by prohibited thermal shrinkage, at the temperature T **3.4****failure stress** $\sigma_{\text{cry, failure}}$

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

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

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3.7**time of relaxation** t_{rel}

time until the stress decreases to 36,8% (1/e) of its initial value

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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 $\varepsilon_{\text{failure}}(T)$ 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 $\sigma_{\text{cry}}(T)$ and the failure stress $\sigma_{\text{cry, failure}}$ at the failure temperature T_{failure} (see Figure 2).
- 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 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 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 N_{failure} and the number of load cycles until the conventional fatigue criterion is reached $N_{f/50}$ (see Figure 5).

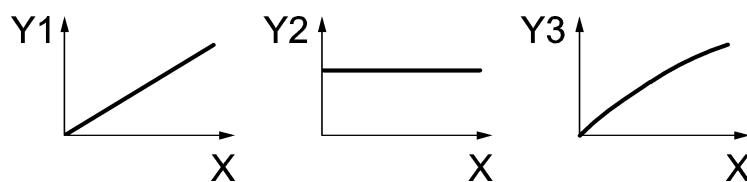


Figure 1 — Test principle of UTST

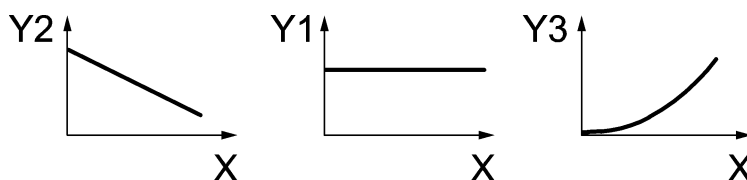


Figure 2 — Test principle of TSRST

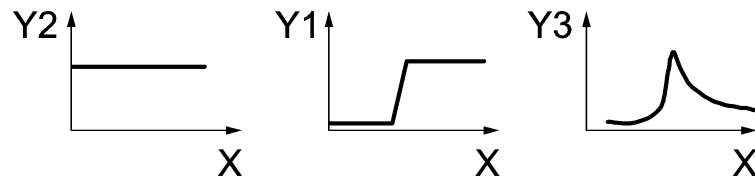


Figure 3 — Test principle of RT

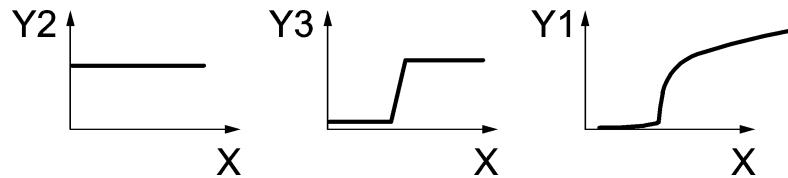


Figure 4 — Test principle of TCT

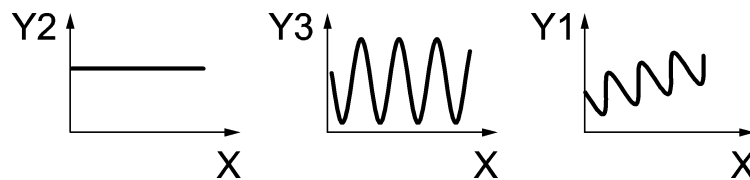


Figure 5 — Test principle of UCTST

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Key for Figures 1 to 5:

Y1 strain

X time

Y2 temperature

Y3 stress

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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.