SLOVENSKI STANDARD
oSIST prEN 12697-24:2016

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Bitumenske zmesi - Preskusne metode - 24. del: Odpornost proti utrujanju

Bituminous mixtures - Test methods - Part 24: Resistance to fatigue

Asphalt - Prüfverfahren - Teil 24: Beständigkeit gegen Ermüdung

Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné à chaud - Partie 24 : Résistance à la fatigue

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Bituminous mixtures - Test methods - Part 24: Resistance to fatigue

Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné à chaud - Partie 24 : Résistance à la fatigue

Asphalt - Prüfverfahren - Teil 24: Beständigkeit gegen Ermüdung

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

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European foreword

This document (prEN 12697-24:2015) 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 document will supersede EN 12697-24:2012.

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: Determination of particle size distribution*

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

— EN 12697-4, *Bituminous mixtures — Test methods for hot mix asphalt — Part 4: Bitumen 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 12697-10, *Bituminous mixtures — Test methods for hot mix asphalt — Part 10: Compactability*

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

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

— 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 — Part 18: Binder drainage*[1)]

— 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 cylindrical specimens (CY)*

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

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

— EN 12697-23, *Bituminous mixtures — Test methods for hot mix asphalt — Part 23: Determination of the indirect tensile strength of bituminous specimens*

— 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 a bituminous specimen*

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

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

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

1) In preparation

— 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: 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 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*

— EN 12697-48, *Bituminous mixtures — Test methods — Part 48: Interlayer bonding*[1)]

— EN 12697-49, *Bituminous mixtures — Test methods for hot mix asphalt — Part 49: Determination of friction after polishing*

— CEN/TS 12697-50, *Bituminous mixtures — Test methods — Part 50: Resistance to scuffing*[1)]

— EN 12697-51, *Bituminous mixtures — Test methods — Part 51: Surface shear strength test*[1)]

— CEN/TS 12697-52, *Bituminous mixtures — Test methods — Part 52: Conditioning to address oxidative ageing*[1)]

1) In preparation

— EN 12697-53, *Bituminous mixtures — Test methods — Part 53: Cohesion increase by spreadability-meter method*[1)]

Compared with EN 12697-24:2012, the following changes have been made:

a) introduction of new annex for CITT;

b) clarification of several text blocks to elucidate the procedures.

1 Scope

This European Standard specifies the methods for characterizing the fatigue of bituminous mixtures using alternative tests, including bending tests and direct and indirect tensile tests. The tests are performed on compacted bituminous material under a sinusoidal loading or other controlled loading, using different types of specimens and supports.

The procedure is used:

a) to rank bituminous mixtures on the basis of resistance to fatigue;

b) as a guide to relative performance in the pavement;

c) to obtain data for estimating the structural behaviour of the road; and

d) to judge test data according to specifications for bituminous mixtures.

Because this European Standard does not impose a particular type of testing device, the precise choice of the test conditions depends on the possibilities and the working range of the device used. For the choice of specific test conditions, the requirements of the product standards for bituminous mixtures need to be respected. The applicability of this document is described in the product standards for bituminous mixtures.

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, *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 12697-26, *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 12697-29, *Bituminous mixtures - Test method for hot mix asphalt - Part 29: Determination of the dimensions of a bituminous specimen*

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

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

3 Terms, definitions, symbols and abbreviations

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

3.1 General

3.1.1
fatigue
reduction of strength of a material under repeated loading when compared to the strength under a single load

3.1.2
conventional criteria of failure
number of load applications, $N_{f/50}$, when the complex stiffness modulus $S_{mix,0}$ has decreased to half its initial value

Note 1 to entry: In this standard not only the conventional criteria of failure, based on the reduction of stiffness, is presented. Also other failure criteria like the occurrence of macro cracks or the energy-based failure mechanism are used.

Note 2 to entry: Different test methods and different failure criteria might lead to results that are not comparable.

Note 3 to entry: In a displacement controlled fatigue test the reduction to half of the initial stiffness is a gradual process. In a force controlled test in most cases there will be a progressive collapse of the specimen.

3.1.3
initial complex stiffness modulus
complex stiffness modulus, $S_{mix,0}$, after 100 load applications

3.1.4
fatigue life of a specimen
number of cycles $N_{i,j,k}$ corresponding to the failure criterion at the set of test conditions k (temperature, frequency and loading mode)

Note 1 to entry: A loading mode could be constant deflection level, or constant force level or any other constant loading condition.

3.2 Two-point bending test on trapezoidal specimens

3.2.1
constant relative to maximum strain
constant that enables the head displacement z of the trapezoidal specimen of dimensions [B, b, e, h], to which a bending strain level ε is applied, to be converted into maximum strain

Note 1 to entry: The following formulae express K_ε and its relationship with the parameters mentioned above:

$$K_\varepsilon \times z = \varepsilon \tag{1}$$

$$K_{\varepsilon j} = \frac{(B_i - b_i)^2}{8 * b_i * h_i^2 \left[\frac{(b_i - B_i) * (3B_i - b_i)}{2 * B_i^2} + \ln \frac{B_i}{b_i} \right]} \tag{2}$$

3.2.2 Symbols

Where a strain of 1 microstrain (μstrain) is equal to 10^{-6} by convention, the symbols are as follows:

i	he index of the specimen for an element test (varies from 1 to n);
h_i	is the height, in metres (m);
B_i	is the large base, in metres (m);
b_i	is the small base, in metres (m);
e_i	is the thickness, in metres (m);
v_i	is the void content of the specimen i by geometric method, in percent (%);
$K_{\varepsilon i}$	is the constant, relative to the maximum strain, in inverse metres (m^{-1});
z_i	is the amplitude of displacement imposed at the head of specimen i, in metres (m);
E_i	is the maximum relative strain of specimen i corresponding with the displacement imposed at the head;
N_i	is the conventional fatigue life of specimen i;
a	is the ordinate of the fatigue line according to the formula $\lg(N) = a + (1/b)\lg(\varepsilon)$;
r_2	is the linear correlation coefficient ($\lg(N_i)$, $\lg(\varepsilon_i)$);
$1/b$	is the slope of the fatigue line;
$\lg(\varepsilon)$	is the average value of $\lg(\varepsilon_i)$;
$S_{\lg(\varepsilon)}$	is the standard deviation of $\lg(\varepsilon_i)$;
$S_{\lg(N)}$	is the standard deviation of $\lg(N_i)$;
ε_6	is the strain corresponding to 10^6 cycles;
s_N	is the estimation of the residual standard deviation of the decimal logarithms of fatigue lives;
$\Delta\varepsilon_6$	is the quality index of the test;
n	is the number of specimens.

3.3 Two-point bending test on prismatic shaped specimens

3.3.1
constants for consideration of the geometry of specimen

constants that enable the strength of the head P_{ij} of the specimen i of dimensions b_i, e_i and h_i, to which a bending strength is applied, to be converted to a maximum tension

Note 1 to entry: The following formulae express $K_{\varepsilon\,i}$ and its relationship with the parameters mentioned above: