PD CEN/TS 12697-50:2016

BSI Standards Publication

Bituminous mixtures — Test methods

Part 50: Resistance to scuffing

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National foreword

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European foreword

This document (CEN/TS 12697-50:2016) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by DIN.

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1 Scope

This European Technical Specification specifies a test method for determining the resistance to scuffing of asphalt mixtures which are used in surface layers and are loaded with high shear stresses in road or airfield pavement. These shear stresses occur in the contact area between tyre and pavement surface and can be caused by cornering of the vehicle. Due to these shear stresses, material loss will occur at the surface of these layers. The test is normally performed on asphalt layers with a high amount of air voids (e.g. porous asphalt), but can also be applied on other asphaltic mixtures. Test specimens are used either produced in a laboratory or cut from the pavement.

NOTE The test is developed to determine the resistance to scuffing for noise reducing surface layers where raveling is the normative damage criterion. The test can also be performed on other surface mixtures with a high resistance to permanent deformation. In case a mixture has a low resistance to permanent deformation, rutting can occur during the test. This can influence the test results.

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

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

3 Principle

Laboratory compacted asphalt specimens or asphalt specimens cut from a pavement is fixed in a test facility. In this facility, the asphalt material is loaded simultaneously with both normal and shear stresses. Due to these stresses, material loss will occur from the surface of the slab. This material loss depends on the resistance to scuffing of the tested asphalt mixture: the higher the resistance, the less material will disappear.

To determine the resistance to scuffing, two slabs or (set of) cores shall be tested. The average of both test results is reported as the resistance to scuffing.

In this Technical Specification four different kinds of loading facilities are described:

— The ARTe (the Aachener Raveling Tester);

— The DSD (the Darmstadt Scuffing Device);

— The RSAT (the Rotating Surface Abrasion Test) and

— The Triboroute.

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4 Terms, definitions, symbols and abbreviations

For the purposes of this document, the following term and definition, symbols and abbreviations apply.

4.1 Terms and definitions

4.1.1
material loss
amount of material that has been lost from the surface of the slab due to the test

Note 1 to entry: The amount of material loss can be determined in 3 different ways:

— Visually and/or by taking pictures;

— by weighing the mass of the slab before and after the test. The difference in mass per area is a measure for the resistance to scuffing of the tested asphalt mixture;

— by scanning the surface of the slab before and after the test. The scans provide a 3D picture from the surface of the slab. After subtracting mathematically the 3D picture after the test from the one before the test, an accurate 3D overview of the material loss can be generated. The calculated volume of this 3D overview of the material loss is a accurate value for the resistance to scuffing of the tested asphalt mixture.

Note 2 to entry: If permanent deformation occurs during the test, the results of the surface scan have to be compensated for this phenomenon.

4.2 Symbols and abbreviations

T is the thickness of the slab, in 0,1 mm;

W is the width of the slab, in 0,1 mm;

L is the length of the slab, in 0,1 mm;

A is the surface of the tested slab, in 0,01 mm^2;

M_0 is the mass of the slab before performing the test, in 1 grams;

M_1 is the mass of the slab after performing the test, in 1 grams;

ΔM is the loss of mass due to performing the test, in 1 grams;

V_0 is the volume of the texture of the slab before performing the test, in 0,1 mm^3;

V_1 is the volume of the texture of the slab after performing the test, in 0,1 mm^3;

ΔV is the loss of volume of the texture of the slab due to performing the test, in 0,1 mm^3.

5 Preparation of test specimens

5.1 General

To determine the resistance to scuffing of an asphalt mixture, 2 slabs or 2 (sets of) cores of that material shall be tested. The average of both test results shall be considered to determine the resistance to scuffing.

5.2 Compaction of the slabs

In the scuffing device, asphalt slabs or (sets of) cores shall be tested. These slabs or (sets of) cores shall be prepared according to EN 12697-33 or can be cut from pavements.

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5.3 Dimensions of the specimens

The test can be performed on specimens with various dimensions. However, standard dimensions of the slabs are (500 ± 20) mm by (500 ± 20) mm or (500 ± 20) mm by (320 ± 20) mm. Cores shall have a standard diameter of (150 ± 2) mm. The thickness of the specimen can vary between 30 mm and 80 mm.

NOTE Also larger slabs or cores can be prepared which are fit to the correct dimensions by sawing.

5.4 Age of the specimens

Prior to the start of testing, the specimen shall be stored on a flat surface at a temperature of not more than 20 °C for between 14 days and 42 days from the time of their manufacture. In the case of samples requiring cutting, the cutting shall be performed no more than 8 days after compaction of the asphalt. The time of manufacture for these samples is the time when they are cut.

NOTE Not only fresh asphalt mixtures can be tested, also aged specimens can be examined in the scuffing test. In literature several aging procedure can be found. The choice of a proper aging procedure depends on the characteristics of the tested material.

5.5 Dimensions and bulk density of the specimens

The dimensions of the slab shall be determined according to EN 12697-29. The length, L, and width, W, of the slab are measured at four positions of the slab, equally divided over the area. The accuracy of the measurements shall be 0,1 mm. The average of the four individual measurements are respective the length, L, and width, W, of the slab.

The thickness, T, of the slab shall be determined at eight points. Each point shall be taken 100 mm from the edge of the slab using a vernier calliper. All eight point shall be equally divided over the surface of the slab. The accuracy of each measurement shall be 0,1 mm. The maximum difference between the eight individual measurements shall be 2,5 mm. If not, the specimen shall not be tested. The average of the eight measurements is the thickness, T, of the slab.

If cores are tested, the diameter and thickness of each core shall be determined according to EN 12697-29 using a vernier calliper. The diameter, D, and the thickness, T, are measured at four positions of the slab, equally divided over the area. The accuracy of the measurements shall be 0,1 mm. The average of the four individual measurements shall be deemed to be the diameter of the core.

The bulk density of the slab or the core shall be determined according to EN 12697-6 using the bulk density by dimensions procedure. Before measuring the mass, M_0, of the slab, the specimen shall be dried to constant mass in air at a relative air humidity of less than 80 % at a temperature not more than 20 °C. A test specimen shall be considered to be dry after at least 8 h drying time and when two weighings performed minimum 4 h apart differ by less than 0,1 %.

6 Loading devices

The resistance to scuffing can be determined using one of the following test devices:

— The ARTe (the Aachener Raveling Tester) see Annex A;

— The DSD (the Darmstadt Scuffing Device) see Annex B;

— The RSAT (the Rotating Surface Abrasion Test) see Annex C and

— The Triboroute see Annex D.

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7 Test results

The results of the tests shall be reported using the results of the visual inspection and/or pictures before and after the test and the material loss per covered area (= *MLpA*). Alternatively, the increase in texture per covered area, ΔV, can be used. The following formulae shall be used:

— Material loss per covered area *MLpA* when slabs are tested determine by

$$MLpA_{\mathrm{i}} = \frac{M_{0,\mathrm{i}} - M_{1,\mathrm{i}}}{W_{\mathrm{i}} L_{\mathrm{i}}} = \frac{\Delta M_{\mathrm{i}}}{W_{\mathrm{i}} L_{\mathrm{i}}} \text{ with i = 1,2} \tag{1}$$

$$MLpA = \frac{\sum_{i=1}^{2} MLpA_{\mathrm{i}}}{2} \tag{2}$$

where

$M_{0,\mathrm{i}}$ is the mass of the slab i (i = 1,2) before performing the test, in 1 g (grams);

$M_{1,\mathrm{i}}$ is the mass of the slab i (i = 1,2) after performing the test, in 1 g (grams);

W_{i} is the width of the slab i (i = 1,2) in 0,1 mm (millimeter);

L_{i} is the length of the slab i (i = 1,2) in 0,1 mm (millimeter.

— Material loss per covered area *MLpA* when a (set of) cores are tested determine

$$MLpA_{\mathrm{i}} = \frac{M_{0,\mathrm{i}} - M_{1,\mathrm{i}}}{\frac{1}{4}\pi D_{\mathrm{i}}^2} = \frac{\Delta M_{\mathrm{i}}}{\frac{1}{4}\pi D_{\mathrm{i}}^2} \text{ with i = 1,2} \tag{3}$$

$$MLpA = \frac{\sum_{i=1}^{2} MLpA_{\mathrm{i}}}{2} \tag{4}$$

where

$M_{0,\mathrm{i}}$ is the mass of the (set of) core i (i = 1,2) before performing the test, in 1 g (grams);

$M_{1,\mathrm{i}}$ is the mass of the (set of) core i (i = 1,2) after performing the test, in 1 g (grams);

D_{i} is the diameter of the (set of) core i (i = 1,2) in 0,1 mm (millimetre).

— Increase in texture ΔV per covered area using 3D laser measurements when using slabs or (a set of) cores determine

$$\Delta V_{\mathrm{i}} = \frac{V_{1,\mathrm{i}} - V_{0,\mathrm{i}}}{W_{\mathrm{i}} L_{\mathrm{i}}} \text{ with i = 1,2} \tag{5}$$

$$\Delta V = \frac{\sum_{i=1}^{2} \Delta V_{\mathrm{i}}}{2} \tag{6}$$

where

$V_{0,\mathrm{i}}$ is the volume of the texture of the slab or (a set of) cores i (I = 1, 2) before performing the test, in

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0,1 mm^3 (cubic millimetre);

$V_{1,i}$ is the volume of the texture of the slab or (a set of) cores i (I = 1, 2) after performing the test, in 0,1 mm^3 (cubic millimetre);

W_i is the width of the slab or (a set of) cores i (I = 1, 2) in 0,1 mm (millimetre);

L_i is the length of the slab or (a set of) cores i (I = 1, 2) in 0,1 mm (millimetre).

— Increase in texture ΔV per covered area using 3D laser measurements when using (a set of) cores determine

$$\Delta V_i = \frac{V_{1,i} - V_{0,i}}{\frac{1}{4}\pi D_i^2} \text{ with i = 1,2} \tag{7}$$

$$\Delta V = \frac{\sum_{i=1}^{2} \Delta V_i}{2} \tag{8}$$

where

$V_{0,i}$ is the volume of the texture of (a set of) cores i (I = 1, 2) before performing the test, in 0,1 mm^3 (cubic millimetre);

$V_{1,i}$ is the volume of the texture of (a set of) cores i (I = 1, 2) after performing the test, in 0,1 mm^3 (cubic millimetre);

D_i is the diameter of (a set of) cores i (i = 1,2) in 0,1 mm (millimetre).

NOTE Sometimes a substantial part of the scuffing occurs close to the edges of the slab or the core. This phenomenon especially occurs when course graded porous asphalt specimens are tested. In this situation, the increase in volume can be determined for a smaller area of the slab or core. If, for example, a slab of 500 mm by 500 mm shows excessive scuffing close to the edges, ΔV can be determined over an area of 400 mm by 400 mm, skipping the material loss which occurs in the outer strip with a width of 50 mm of the slab. It is essential to mention the considered area in the report.

8 Test report

8.1 General

The test report shall contain not less than the following information:

a) name of organisation carrying out the test;

b) date of the test;

c) reference to this test method and test conditions;

d) characterization and the origin (lab compacted slabs or cut from a pavement) of the tested material;

e) short description of the test facility.

For each specimen tested, report:

f) length, width and thickness of the tested slab, expressed to the nearest 0,1 mm;

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