BRITISH STANDARD

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12697-8:2003

Bituminous mixtures — Test methods for hot mix asphalt —

Part 8: Determination of void characteristics of bituminous specimens

The European Standard EN 12697-8:2003 has the status of a British Standard

ICS 93.080.20

National foreword

This British Standard is the official English language version of EN 12697-8:2003.

The UK participation in its preparation was entrusted by Technical Committee B/510, Road materials, to Subcommittee B/510/1, Coated macadam and hot asphalt, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

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Bituminous mixtures - Test methods for hot mix asphalt - Part 8: Determination of void characteristics of bituminous specimens

Mélanges bitumineux - Méthodes d'essai pour enrobés à chaud - Partie 8: Détermination de la teneur en vides des éprouvettes bitumineuses

Asphalt - Prüfverfahren für Heißasphalt - Teil 8: Bestimmung von volumetrischen Charakteristiken von Asphalt-Probekörpern

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

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Contents

Foreword

This document (EN 12697-8:2003) has been prepared by Technical Committee CEN/TC 227 "Road materials", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by September 2003, and conflicting national standards shall be withdrawn at the latest by August 2005.

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: 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 void characteristics of bituminous mixtures*

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

EN 12697-10, *Bituminous mixtures Test methods for hot mix asphalt Part 10: Compactibility*

prEN 12697-11, *Bituminous mixtures Test methods for hot mix asphalt Part 11: Determination of the compatability between aggregate and binder*

prEN 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*

prEN 12697-16, *Bituminous mixtures Test methods for hot mix asphalt Part 16: Abrasion by studded tyres*

prEN 12697-17, *Bituminous mixtures Test methods for hot mix asphalt Part 17: Partial loss of porous asphalt specimen*

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

prEN 12697-19*, Bituminous mixtures Test methods for hot mix asphalt Part 19: Permeability of specimen*

prEN 12697-20*, Bituminous mixtures Test methods for hot mix asphalt Part 20: Indentation using cube or marshall specimen*

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

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

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

prEN 12697-24*, Bituminous mixtures Test methods for hot mix asphalt Part 24: Resistance to fatigue*

prEN 12697-25*, Bituminous mixtures Test methods for hot mix asphalt Part 25: Cyclic compression test*

prEN 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*

prEN 12697-30*, Bituminous mixtures Test methods for hot mix asphalt Part 30: Preparation of specimen by impact compactor*

prEN 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*

prEN 12697-33*, Bituminous mixtures Test methods for hot mix asphalt Part 33: Specimen preparation, slab compactor*

prEN 12697-34*, Bituminous mixtures Test methods for hot mix asphalt Part 34: Marshall test*

prEN 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*

prEN 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*

prEN 12697-38*, Bituminous mixtures Test methods for hot mix asphalt Part 38: Test equipment and calibration*

The applicability of this European Standard is described in the product standards for bituminous mixtures.
No existing European Standard is superseded.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard describes a procedure for calculating two volumetric characteristics of a compacted bituminous specimen: the air voids content ($V_{\mathbf{m}}$) and the voids content in the mineral aggregate filed with binder (VFB).

The method is suitable for specimens which are laboratory compacted or specimens from cores cut from the pavement after placement and compacting.

These volumetric characteristics can be used as mix design criteria or as parameters for evaluating the mixture after placing and compacting in the road.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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 by hydro-static method.*

3 Terms and definitions

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

3.1
air void
pocket of air between the bitumen-coated aggregate particles in a compacted bituminous specimen

3.2
air voids content
(V_{m})
volume of the air voids in a bituminous specimen, expressed as a percentage of the total volume of that specimen

3.3
maximum density
mass per unit volume without air voids of a bituminous material at known test temperature

3.4
bulk density
mass per unit volume, including the air voids, of a specimen at known test temperature

3.5
void in the mineral aggregate
(VMA)
volume of inter-granular void space between the aggregate particles of a compacted bituminous mixture that includes the air voids and the volume of the bituminous binder in the specimen, expressed as a percentage of the total volume of the specimen

NOTE An allowance should be made for the absorbency of binder by the aggregate, which can otherwise lead to an over estimation of the air voids content. The level of absorbency depends on the porosity of the aggregate.

3.6
void filled with binder
(VFB)
percentage of the voids in the mineral aggregate, filled with binder

4 Determination of the air voids content (V_m)

4.1 Principle

The air voids content of a bituminous specimen is calculated using the maximum density of the mixture and the bulk density of the specimen.

4.2 Calculation

The air voids content shall be calculated to the nearest 0,1 % (v/v) as follows:

$$V_m = \frac{m \quad b}{m} \ 100 \ \% \text{ (v/v)} \tag{1}$$

where

V_m is the air voids content of the mixture, in 0,1 percent (v/v);

$_m$ is the maximum density of the mixture, in kilograms per cubic metre (kg/m^3);

$_b$ is the bulk density of the specimen, in kilograms per cubic metre (kg/m^3).

4.3 Precision

Calculate the precision of this test method from the precision of the test methods for maximum density and bulk density according to the following formula:

$$_{x/y} = \sqrt{\frac{\bar{y}^2 \ {}^2_x + \bar{x}^2 \ {}^2_y}{\bar{y}^4}} \tag{2}$$

where

$_{x/y}$ is the standard deviation for determining the precision limits of a new standard based on the air voids content of the present mixture;

$_x$ is the standard deviation from the precision statement EN 12697-5;

$_y$ is the standard deviation from the precision statement EN 12697-6;

$\bar{x}$ is the mean or average value of the bulk density of the present mixture;

$\bar{y}$ is the mean or average value of the maximum density of the present mixture.

From the average values of $_r$ and $_R$ as obtained in tests EN 12697-5 and EN 12697-6 this results in the following values for the air voids content calculation:

¾ Repeatability r:

Standard deviation: $_r$ = 0,4 % (v/v);

Repeatability: r = 2,77 $_r$ = 1,1 % (v/v)

¾ Reproducibility R:

Standard deviation: $_R$ = 0,8 % (v/v);

Reproducibility: R = 2,77 $_R$ = 2,2 % (v/v).

4.4 Test report

With reference to this European Standard the test report for the determination of the air voids content (V_m) shall include the following information:

a) Origin of the specimen;

b) methods used to determine maximum density and bulk density;

c) a maximum density and the bulk density, in kilogram per cubic metre;

d) air voids content in 0,1 % (v/v);

5 Determination of the percentage of the voids in the mineral aggregate filled with binder (VFB)

5.1 Principle

The percentage of the voids in the mineral aggregate of a bituminous specimen filled with binder is calculated from the binder content, the voids in the mineral aggregate, the bulk density of the specimen and the density of the binder.

5.2 Calculation

The percentage of the voids in the aggregate filled with binder shall be calculated to the nearest 0,1 % (v/v) as follows:

$$VFB = ((B \quad _b / \quad _B)/VMA) \quad 100\ \%\ (v/v) \tag{3}$$

where

VFB is the percentage of the voids in the mineral aggregate filled with binder in 0,1 % (v/v);

B is the percentage of binder in the specimen (in 100% mixture) in 0,1 % (v/v).

$_b$ is the bulk density of the specimen, in 1 kilogram per cubic metre (kg/m^3);

$_B$ is the density of the binder, in 1 kilogram per cubic metre (kg/m^3);

VMA is the voids content in the mineral aggregate in 0,1 % (v/v):

$$VMA = V_m + B \quad {}_b / \quad {}_B \ \% \ (v/v)$$

where

VMA is the voids content in the mineral aggregate in 0,1 % (v/v)

V_m is the air voids content of the specimen in 0,1 % (v/v);

B is the binder content of the specimen (in 100% mixture), in 0,1 % (m/m);

${}_b$ is the bulk density of the specimen, in 1 kilogram per cubic metre (kg/m^3);

${}_B$ is the density of the binder, in 1 kilogram per cubic metre (kg/m^3).

5.3 Precision

NOTE No precision data are available.

5.4 Test report

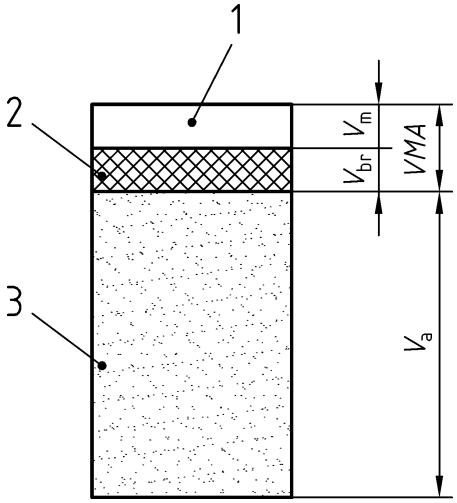
With reference to this European Standard the test report for the determination of the percentage of the voids in the mineral aggregate filled with binder (VFB) shall include the following information.

a) Origin of the specimen;

b) binder content (in the mixture) in 0,1 % (m/m);

c) bulk density of the specimen and the density of the binder, in 1 kilogram per cubic metre;

d) percentage of voids in the mineral aggregate filled with binder in 0,1 % (v/v).



Key
1 Voids
2 Bitumen
3 Mineral Aggregate

Figure 1 — Voids in the mineral aggregate (VMA)

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EN 12697-1, *Bituminous mixtures Test methods for hot mix asphalt Part 1: Soluble binder content*.

EN 12697-7, *Bituminous mixtures Test methods for hot mix asphalt Part 7: Determination of bulk density of bituminous specimens by gamma rays.*

EN ISO 3868, *Metallic and other non-organic coatings - Measurement of coating thicknesses - Fizeau multiple-beam interferometry method (ISO 3868:1976).*

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