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Bituminous mixtures - Test methods - Part 6: Determination of bulk density of bituminous specimens

Asphalt - Prüfverfahren Teil 6: Bestimmung der Raumdichte von Asphalt-Probekörpern

Matériaux enrobés - Méthodes d'essai - Partie 6 : Détermination de la masse volumique apparente des éprouvettes bitumineuses

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English Version

Bituminous mixtures - Test methods - Part 6:
Determination of bulk density of bituminous specimens

Mélanges bitumineux - Méthodes d'essai - Partie 6 :
Détermination de la masse volumique apparente des
éprouvettes bitumineuses

Asphalt - Prüfverfahren - Teil 6: Bestimmung der
Raumdichte von Asphalt-Probekörpern

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

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

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European foreword

This document (EN 12697-6:2020) 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of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.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 12697-6:2012.

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 adjusted according to ISO/IEC Directives – Part 2:2016, 24.5;
- [Clause 2] correction of title for EN 12697-29. Reference to EN 13108-20 deleted;
- [6.1.1] description of accuracy for balance amended to; "With an accuracy of at least 0,1 g for masses up to 5 kg, and 1 g for masses over 5 kg. (Ref. EN 12697-38);
- [6.2.2] description added for accuracy of thermometer to $\pm 0,5$ °C (Ref. EN 12697-38);
- [6.4.1] dated reference of EN 12697-29 deleted;
- [9.3 f)] clarified that also procedure D may be applicable;
- [9.4 a)] amended to include procedure when damp specimen is tested;
- [9.4 c)] added reference to 5.2 Additional materials for the sealed specimen procedure;
- [11.1] editorial: $\sigma_R = (8 - 28)$ amended to read $\sigma_R = (8 \text{ to } 28)$ and $R = (22 - 82)$ amended to read $R = (22 \text{ to } 82)$;
- [A.1] reference to EN 13108-20 deleted;
- [A.2] new NOTE 2 added referring to relevant ASTM methods;
- [A.3 a)] completed with limitation for procedure A, up to void content 7 %;
- [A.3 b)] limitation for procedure A, amended to void content 7 %;
- [A.3 c)] air voids level amended from 15 % to 10 %;
- [A.3 c)] sentence, stating that procedure C is less convenient and rarely used, deleted;
- [A.3 d)] air voids level amended from 15 % to 10 %.

EN 12697-6:2020 (E)

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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1 Scope

This document specifies test methods for determining the bulk density of a compacted bituminous specimen. The test methods are intended for use with laboratory compacted specimens or specimens from the pavement after placement and compacting, either by coring or sawing.

This document specifies the following four procedures, the choice of which is used being dependent on the estimated content and accessibility of voids in the specimen:

- a) bulk density — dry (for specimens with a very closed surface);
- b) bulk density — saturated surface dry (SSD) (for specimens with a closed surface);
- c) bulk density — sealed specimen (for specimens with an open or coarse surface);
- d) bulk density by dimensions (for specimens with a regular surface and with geometric shapes, i.e. squares, rectangles, cylinders, etc.).

NOTE Annex A (informative) gives general guidance on selecting the appropriate procedure.

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 12697-29, *Bituminous mixtures — Test methods — Part 29: Determination of the dimensions of a bituminous specimen*

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

bulk density

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

3.2

maximum density

mass per unit volume, without air voids, of a bituminous mixture at known test temperature

4 Principle

The bulk density of an intact compacted bituminous specimen is determined from the mass of the specimen and its volume. The mass of the specimen is obtained by weighing the dry specimen in air.

For the first three procedures, the volume of the specimen is obtained from its mass in air and its mass in water. In the dry procedure, the mass in water is determined without pre-treatment. In the SSD-procedure, the specimen is first saturated with water, after which its surface is blotted dry with a damp Chamois. In the sealed specimen procedure, the specimen is sealed before immersion in water to prevent access of water to the voids in the specimen. In the fourth procedure, by dimensions, the volume of the specimen is obtained by measurement of the dimensions.

5 Materials

5.1 General

Calculate the density of water at the test temperature in megagram per cubic metre (Mg/m³) to the nearest 0,000 1 Mg/m³ as follows:

$$\rho_w = 1,000\ 252\ 05 + \left(\frac{7,59 \times t - 5,32 \times t^2}{10^6} \right) \quad (1)$$

where

t is the temperature of the water, in degrees Celsius (°C);

ρ_w is the density of the water at test temperature, in megagram per cubic metre (Mg/m³).

5.2 Additional materials for the sealed specimen procedure

Material to seal the specimen, in such a way, that inclusion of voids (being no part of the specimen) between seal and specimen is prevented. The density of the sealing material at test temperature shall be known to the nearest 0,010 Mg/m³.

The material used can be paraffin wax, shrinkage foil, latex emulsion etc. The procedure to apply such materials should be such that the specimen is not damaged. It is very important that the seal exactly covers the specimen including the voids which technologically form part of its volume: when applying the seal penetration of the internal voids belonging to the material is prevented, as well as inclusion of extra voids between seal and specimen or in seal folds.

6 Apparatus

6.1 General

6.1.1 Balance, with sufficient capacity for weighing the specimen in air and under water (e.g. via a wire basket, the mass and water displacement of which are taken into account by taring), with an accuracy of at least 0,1 g for masses up to 5 kg, and 1 g for masses over 5 kg.

6.2 Additional apparatus for the dry, SSD and sealed specimen procedures

6.2.1 Water-bath, maintained at a uniform temperature within $\pm 1,0$ °C in the vicinity of the test specimen(s).

It shall be provided with a grid to ensure the water circulation around the test specimen. The bath shall have a capacity of at least three times that of the volume of the specimen.

6.2.2 Thermometer, with an accuracy of $\pm 0,5$ °C.

6.3 Additional apparatus for the SSD-procedure

6.3.1 Chamois, damp, for blotting and wiping the specimen.

The Chamois shall be damp enough to ensure that the moisture at the specimen surface is removed when wiping without withdrawing moisture from the internal voids.

6.4 Additional apparatus for the dimensions procedure

6.4.1 Calliper gauge, or other suitable apparatus for measuring the dimensions of the specimen to at least $\pm 0,1$ mm (see EN 12697-29).

7 Sample sizes and sample handling

The minimum thickness of the specimen shall be 20 mm or two times the maximum nominal size of the aggregate, whichever is largest.

Care shall be taken to ensure that the specimens are not disturbed during handling. The specimens shall be stored in a cool place at a temperature not exceeding 25 °C.

8 Preparation of sample

Specimens shall be cleaned if necessary, by brushing or washing, as required.

The specimens shall be dry, have a known water content, or be allowed to dry to constant mass.

NOTE Constant mass is defined as successive weighings after drying at least 1 h apart not differing more than 0,1 %.

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9 Procedure

9.1 General

All masses shall be determined in gram to the nearest 0,1 g. All measurements shall be determined in millimetre to the nearest 0,1 mm.

NOTE General guidance on determining the required procedure related to the specific bituminous material is given in Annex A.

9.2 Procedure A: Bulk density — dry

Carry out the procedure as follows:

- a) Determine the mass of the dry specimen (m_1). When testing damp specimens, step a) shall be carried out after steps b) to d).
- b) Determine the density of the water at test temperature at the nearest 0,000 1 Mg/m³ (ρ_w) according to 5.1.
- c) Immerse the specimen in the water-bath kept at known test temperature.
- d) Determine the mass of the specimen immediately the water has settled after immersion (m_2).