SLOVENSKI STANDARD

SIST EN 12697-5:2004

01-junij-2004

Bitumenske zmesi ï Preskusne metode za vroļ e asfaltne zmesi ï 5. del: Ugotavljanje najveļ je gostote

Bituminous mixtures - Test methods for hot mix asphalt - Part 5: Determination of the maximum density

Asphalt - Prüfverfahren für Heißasphalt - Teil 5: Bestimmung der Rohdichte

Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné a chaud - Partie 5: Masse volumique maximale (masse volumique réelle) des matériaux bitumineux

Ta slovenski standard je istoveten z: EN 12697-5:2002

ICS:

93.080.20 Materiali za gradnjo cest Road construction materials

SIST EN 12697-5:2004 **en**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12697-5

July 2002

ICS 93.080.20

English version

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This European Standard was approved by CEN on 1 March 2002.

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Management Centre has the same status as the official versions.

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

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Ref. No. EN 12697-5:2002 E

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Foreword

This document EN 12697-5:2002 has been prepared by Technical Committee CEN/TC 227 "Road mixtures", 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of an identical text or by endorsement, at the latest by January 2002, and conflicting national standards shall be withdrawn at the latest by August 2005.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*

prEN 12697-2, *Bituminous mixtures – Test methods for hot mix asphalt – Part 2: 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*

prEN 12697-5, *Bituminous mixtures - Test methods for hot mix asphalt - Part 5: Determination of the maximum density*

prEN 12697-6, *Bituminous mixtures – Test methods for hot mix asphalt – Part 6: Determination of bulk density of bituminous specimen by hydro-static method*

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

prEN 12697-8, *Bituminous mixtures – Test methods for hot mix asphalt – Part 8: Determination of the air voids content of bituminous mixtures*

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

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 compatibility between aggregate and bitumen*

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*

prEN 12697-15, *Bituminous mixtures – Test methods for hot mix asphalt – Part 15: Determination of the segregation sensitivity of bituminous mixtures*

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: Particles 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 specimens*

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 fatique*

prEN 12697-25, *Bituminous mixtures – Test methods for hot mix asphalt – Part 25: Dynamic creep 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*

prEN 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: Specimen preparation, impact compactor*

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

prEN 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*

prEN 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: Common equipment and calibration*

The applicability of this European Standard is described in the product standards for bituminous mixtures.

No existing European Standard is superseded.

WARNING — The method described in this European Standard can require the use of dichloromethane (methylene chloride), this solvent is hazardous to health and is subject to occupational exposure limits as described in relevant legislation and regulations.

Exposure levels are related to both handling procedures and ventilation provision and it is emphasised that adequate training should be given to staff employed in the use of this substances.

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, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies test methods for determining the maximum density of a bituminous mixture (voidless mass). It specifies a volumetric procedure, a hydrostatic procedure and a mathematical procedure.

The test methods described are intended for use with loose bituminous mixtures containing paving grade bitumens, modified binders or other bituminous binders used for hot mix asphalt. The tests are suitable for both fresh or aged bituminous mixtures.

NOTE 1 Samples can be supplied as loose mixture or as compacted mixture.

NOTE 2 General guidance on selection of a test procedure to determine the maximum density of a bituminous mixture is given in annex A.

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 1097-6, *Test for mechanical and physical properties of aggregates – Part 6: Determination of particle density and water absorption.*

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

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 ISO 3838, *Crude oil and liquid or solid petroleum products – Determination of density or relative density – Capillary-stoppered pyknometer and graduated bicappilary pyknometer methods (ISO 3838:1995).*

3 Terms and definitions

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

3.1
maximum density
mass per unit volume, without air voids, of a bituminous mixture at known test temperature

3.2
bulk density
mass per unit volume, including the air voids, of a specimen at known test temperature

3.3
apparent particle density
ratio of the oven dried mass of a sample of aggregate to the volume it occupies in water including any internal sealed voids but excluding water accessible voids

3.4
particle dry density
ratio of the oven dried mass of a sample of aggregate to the volume it occupies in water including both internal sealed voids and water accessible voids

3.5
loose bulk density of aggregate
quotient obtained when the mass of dry aggregate filling a specified container without compaction is divided by the capacity of that container

4 Principle

The maximum density, together with the bulk density, is used to calculate the air voids content of a compacted sample and other volumetric-related properties of a compacted bituminous mixture.

In the volumetric and hydrostatic procedures the maximum density of bituminous mixtures is determined from the volume of the sample without voids and from its dry mass.

In the volumetric procedure the volume of the sample is measured as the displacement of water or solvent by the sample in a pyknometer.

In the hydrostatic procedure the volume of the sample is calculated from the dry mass of the sample and from its mass in water.

In the mathematical procedure the maximum density of a bituminous mixture is calculated from its composition (binder content and aggregate content) and the densities of the constituent mixtures.

5 Materials

5.1 De-aired water (freshly de-aired and cooled) or organic solvent, suitable to solve bituminous binders (for the volumetric and hydrostatic procedures).

5.2 Dispersion agent, [e.g. 7 % of Nonylphenolpolyglcolether (7 groups of Ethoxyl) in water].

5.3 Boiling water.

6 Apparatus

6.1 Tools to clean samples (if required).

6.2 Ventilated cabinet, capable of drying the sample and maintaining a uniform temperature within (110 ± 5) °C in the vicinity of the test sample(s).

6.3 Suitable tools to loosen and separate the sample, e.g. spatula.

6.4 Balance, accurate to at least 0,1 g.

6.5 Thermometer, accurate to at least 0,1 °C.

6.6 Water-bath, maintaining the water at a uniform temperature within ± 0,2 °C in the vicinity of the test sample(s). The water-bath shall contain a grid to permit submersion of the pyknometer or container to around 20 mm below the upper edge of pyknometer or container and to allow water to circulate. The volume of the bath shall be at least three times that of the pyknometer/container.

6.7 Vibrating table, or other means to shake the pyknometer or container during evacuation of air.

6.8 Pyknometer, (for the volumetric procedure), of suitable size, with an accurately fitting head piece. The volume of the pyknometer shall be such that the sample occupies up to 2/3 of its volume. The volume of the pyknometer shall be regularly calibrated in accordance with annex C.

6.9 Vacuum system, (for the volumetric procedure), with manometer or calibrated vacuum gauge, capable of evacuating air from the pyknometer to a residual pressure of 4 kPa or less.

6.10 Container, (for the hydrostatic procedure), capable of being suspended in water. The shape of the container shall be such that the sample can be immersed completely when filling the container with water; the sample shall occupy up to 2/3 of the container's volume which shall be not less than 3 000 cm^3.

6.11 Vacuum desiccator, (for the hydrostatic procedure), or other vacuum vessel capable of accommodating the pyknometer or container.

7 Sampling

Samples of bituminous mixture shall be obtained in accordance with EN 12697-27.

Samples shall have a mass expressed in grams of at least 50 times the numerical value of the nominal maximum particle size of the aggregates in millimetres, i.e. the largest specified sieve size of the mixture with a minimum of 250 g.

8 Preparation of sample

8.1 Bulk samples

Obtain a test sample from a bulk sample after homogenising by riffling or quartering in accordance with EN 12697-28.

8.2 Samples from finished mixture

Samples of compacted mixture shall be cleaned by brushing or washing before being placed in the ventilated cabinet, at a temperature of (110 ± 5) °C, dried to constant mass and then separated.

NOTE Constant mass is obtained when the change of mass between two determinations at an interval of at least 30 min is less than 0,1 % (m/m).

8.3 Sample separation

Samples shall be loosened and separated into coarse particles and agglomerations. Agglomerations shall not be larger than 6 mm. If the mixture is not sufficiently soft to separate manually, warm it on a tray in an oven at a temperature not exceeding 110 °C, but only until it can be properly handled.

9 Procedure

9.1 General

All masses shall be determined in grams to the nearest 0,1 g. The volume of the pyknometer shall be determined in cubic metres to the nearest 0,5 x 10^{-6} m^3.

9.2 Procedure A: Volumetric procedure

9.2.1 Weigh the empty pyknometer including the head piece (m_1) of known volume (V_p).

NOTE The volume of the pyknometer can be determined in accordance with annex B.

9.2.2 Place the dry test sample into the pyknometer and bring it to ambient temperature, then weigh again, together with the head piece (m_2).

9.2.3 Fill the pyknometer with de-aired water or solvent, up to a maximum of 30 mm below the head joint.

9.2.4 Evacuate entrapped air, by applying a partial vacuum of a residual pressure of 4 kPa or less for (15 ± 1) min.

NOTE The evacuation of air in accessible pores is important. Evacuation can be assisted by stirring, rotating or vibrating the pyknometer on a vibrating table. When using water, adding a small amount of a dispersion agent (two drops only) can facilitate air evacuation. When using solvent, stirring and vibrating without applying a vacuum should be used. The de-aired water can be replaced by boiling water.

9.2.5 Fix the head piece or stopper, and carefully fill the pyknometer with de-aired water or solvent (ensuring no air is introduced) almost to the reference mark of the head piece or to the stopper.

9.2.6 Place the pyknometer in a water-bath at known uniform test temperature (± 1,0 °C) for at least 30 min, to bring the temperature of the sample and the water or solvent in the pyknometer to the same level as that of the water in the water-bath.

When using solvent, the uniform test temperature shall be kept within ± 0,2 °C; the pyknometer shall then be placed in the water-bath for at least 60 min but not longer than 180 min.

The water in the water-bath shall reach up to approximately 20 mm below the edge of the pyknometer.

9.2.7 Fill the pyknometer up to the measuring mark with the water or solvent. The container with water or solvent shall be brought to the test temperature in a water-bath.

9.2.8 Take the pyknometer out of the water-bath, wipe the outside dry and weigh it immediately (m_3).

9.3 Procedure B: Hydrostatic procedure

9.3.1 Determine the mass of the empty container in air (m_1), and when submerged in water (m_2).

9.3.2 Place the test sample in the dried container and bring it to ambient temperature, then determine the mass of the container plus test sample in air (m_3).

9.3.3 Fill the container with de-aired water and evacuate entrapped air, by stirring and/or vibrating.

NOTE The evacuation of air in accessible pores is important. Adding a small amount of a dispersion agent (two drops only) can facilitate the air evacuation. Further facilitation can be obtained by applying a vacuum of a residual pressure of approximately 4 kPa or less during (15 ± 1) min and/or by using boiling water (see also 9.2.4, concerning vacuum period).

9.3.4 Place the container in the water-bath at a known uniform temperature (± 1,0 °C) within the range from 20 °C to 30 °C for at least 30 min, to bring the temperature of the sample and the water in the container to the same level as that of the water in the water-bath.

The level of water in the water-bath shall reach up to approximately 20 mm below the top edge of the container.

9.3.5 Determine the mass of the container plus the test sample when suspended in water (m_4); the water shall be of the same temperature as used in **9.3.4**.

9.4 Procedure C: Mathematical procedure

Express the mixture composition in percentages of the total mix [percentage aggregate + percentage binder = 100,0 % (m/m)].

When the mixture composition is not known the binder content shall be determined according to EN 12697-1.

The densities shall be determined in accordance with EN 1097-6 for aggregates and EN ISO 3838 for binders.