

# **SLOVENSKI STANDARD**

## **SIST EN 12697-11:2012**

**01-september-2012**

**Nadomešča:**

**SIST EN 12697-11:2006**

**SIST EN 12697-11:2006/AC:2007**

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**Bitumenske zmesi - Preskusne metode za vroče asfaltne zmesi - 11. del:  
Ugotavljanje sprejemljivosti med agregatom in bitumnom**

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

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Asphalt - Prüfverfahren für Heißasphalt - Teil 11: Bestimmung der Affinität von Gesteinskörnungen und Bitumen

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Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné à chaud - Partie 11: Détermination de l'affinité granulats-bitume

**Ta slovenski standard je istoveten z: EN 12697-11:2012**

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**ICS:**

93.080.20      Materiali za gradnjo cest      Road construction materials

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**en,fr,de**

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EUROPEAN STANDARD  
NORME EUROPÉENNE  
EUROPÄISCHE NORM

**EN 12697-11**

April 2012

ICS 93.080.20

Supersedes EN 12697-11:2005

English Version

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

Mélanges bitumineux - Méthodes d'essai pour mélange  
hydrocarboné à chaud - Partie 11: Détermination de  
l'affinité granulats-bitume

Asphalt - Prüfverfahren für Heiasphalt - Teil 11:  
Bestimmung der Affinität von Gesteinskörnungen und  
Bitumen

This European Standard was approved by CEN on 9 March 2012.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

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 CEN-CENELEC 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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## Foreword

This document (EN 12697-11:2012) 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 October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 12697-11:2005.

List of main changes since this new edition:

- Most clauses, subclauses, etc. in the existing standard renumbered and headlines for methods A (rolling bottle), B (static immersion) and C (Boiling water stripping method) deleted (which may be confusing to users of previous version of standard!);
- 5.1.12: Requirement to horizontally positioning of rolling machine added;
- 5.2.2.1: Reference to EN 58 added for sampling;
- 6.1.1: “Shallow trays” changed to “Flat bottomed container”;
- 6.3.1 and 6.3.2: Original text for preparation of aggregate and bitumen changed to reference to similar clauses in the rolling bottle method;
- 6.4.1: Now allowing use of 8-11,2 mm fraction alternatively, and definition of mixing temperature changed from  $130\text{ °C} \pm 5\text{ °C}$  to  $15\text{ °C}$  less than the mixing temperature defined in EN 12697-35;
- 6.6: In report, new list entry b) (sample identification number and date and time of testing, is added;
- 7.2.1: Requirements for test sieves changed to reference to 5.2.1 (previously specified sieves 7 and 14 mm deleted);
- 7.5.1.1., 7.5.1.2, 7.6.1.1, and 7.6.2.1: the symbol “r” previously used for acid/base equivalent factor is changed to “ $f_{eq}$ ” to avoid misunderstanding as “r” is also used for repeatability (change introduced with the latest comments);
- 7.3.3.4: Use of (8-11,2) mm aggregates added;
- Informative Annex A added.

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 method 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*

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- 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 specimen*
- 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 aggregates 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 for hot mix asphalt — Part 18: Binder drainage*
- 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*

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- 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 mixtures by a 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*
- 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 coarse foreign matter 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*
- FprEN 12697-45, *Bituminous mixtures — Test methods for hot mix asphalt — Part 45: Saturation Ageing Tensile Stiffness (SATS) conditioning test*
- FprEN 12697-46, *Bituminous mixtures — Test methods for hot mix asphalt — Part 46: Low temperature cracking and properties by uniaxial tension tests*

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- EN 12697-47, *Bituminous mixtures — Test methods for hot mix asphalt — Part 47: Determination of the ash content of natural asphalts*
- prEN 12697-49, *Bituminous mixtures — Test methods for hot mix asphalt — Part 49: Determination of friction after polishing*

According to the CEN/CENELEC Internal Regulations, the national standards organizations 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, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

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## 1 Scope

This European Standard specifies procedures for the determination of the affinity between aggregate and bitumen and its influence on the susceptibility of the combination to stripping. This property is intended to be of assistance to the designer for mixture design rather than as a type test. Susceptibility to stripping, as determined by these procedures, is an indirect measure of the power of a binder to adhere to various aggregates, or of various binders to adhere to a given aggregate. The procedures can also be used to evaluate the effect of moisture on a given aggregate-binder combination with or without adhesion agents including liquids, such as amines, and fillers, such as hydrated lime or cement.

In the rolling bottle method, the affinity is expressed by visual registration of the degree of bitumen coverage on uncompacted bitumen-coated mineral aggregate particles after influence of mechanical stirring action in the presence of water.

NOTE 1 The rolling bottle test is a simple but subjective test and suitable for routine testing. It is not appropriate for aggregates that are highly abrasive.

In the static test method, the affinity is expressed by visual registration of the degree of bitumen coverage on uncompacted bitumen-coated mineral aggregate particles after storage in water.

NOTE 2 The static test is a simple, though subjective test that is generally less precise, but that can cope with high PSV-aggregates.

In the boiling water stripping test method, the affinity is expressed by determining the degree of bitumen-coverage on uncompacted bitumen-coated aggregate after immersion in boiling water under specified conditions.

NOTE 3 The boiling water stripping test is an objective test and has a high precision. However, it is a more specialist test because it requires greater skill of the operatives and uses chemicals as reagent. The latter point may also imply extra health and safety considerations.

NOTE 4 The boiling water stripping test procedure can be used for any binder-aggregate combinations in which the mineral aggregate is calcareous, silico-calcareous or siliceous by nature.

## 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 58, *Bitumen and bituminous binders — Sampling bituminous binders*

EN 1426, *Bitumen and bituminous binders — Determination of needle penetration*

EN 12697-2, *Bituminous mixtures — Test method for hot mix asphalt — Part 2: Determination of particle size distribution*

EN 12697-35, *Bituminous mixtures — Test methods for hot mix asphalt — Part 35: Laboratory mixing*

## 3 Terms and definitions

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

### 3.1

#### acid/base equivalence factor

$f_{eq}$   
ratio of the volume of base needed to neutralise 25 ml of acid

**EN 12697-11:2012 (E)****3.2****affinity between aggregate and bitumen**

degree of bitumen coverage visually determined on uncompacted bitumen coated mineral aggregate particles after influence of mechanical stirring action in the presence of water

**3.3****completely coated**

aggregate particle is completely coated by binder when there are no visible breaks, however small, in the film of binder covering the particle

**3.4****degree of bitumen coverage**

average proportion of the surface area of the aggregate particles that are covered with bitumen, expressed as a percentage (equal to 100 minus the percentage of stripping)

**3.5****normality**

*N*

molar concentration expressed in hydrogen equivalent per dm<sup>3</sup> of solution

**3.6****percentage of stripping**

average proportion of the surface area of the aggregate particles from which the binder is soaked off due to the action of water, expressed as a percentage

**4 Principle****iTeh STANDARD PREVIEW**

An aggregate is sieved in accordance with EN 12697-2. The standard size is 8 mm to 11,2 mm fraction (Basic set plus set 1) or 6,3 mm to 10 mm fraction (Basic set plus set 2) which is washed, dried and mixed with bitumen to obtain uniform, total coverage.

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NOTE Other fractions may alternatively be used, but not smaller than the 2 mm to 4 mm fraction. However, to avoid clusters, the above mentioned standard sizes should be used.

For the method described in Clause 5, the bitumen coated aggregate is placed loosely distributed on a metal plate or silicone coated paper, stored at ambient temperature overnight, and then divided into three part samples for analysis. Each part sample is transferred to a bottle filled with water. The bottle is sealed and placed on a bottle-rolling device. The bottles are rolled at ambient temperature and at a specified speed. At specified time intervals the degree of bitumen coverage on the aggregate particles is visually estimated by two technicians independently (or alternatively by automated system).

For the method described in Clause 6, the bitumen coated aggregate is immersed in distilled water for 48 h and the number of particles that are no longer completely coated assessed.

For the method described in Clause 7, the bitumen coated aggregate is subjected to stripping in boiling water under specified conditions, using a simple device in which no local overheating can occur. By contact with a chemical reagent, the consumption of which is proportional to the uncoated surface of the aggregate, the degree of bitumen coverage is determined with reference to a calibration curve established by a well-defined procedure. The reagent used is hydrochloric acid for calcareous aggregates and hydrofluoric acid for silico-calcareous or siliceous aggregates.

**5 Rolling bottle method****5.1 Equipment****5.1.1 Test sieves.**

Square openings conforming to EN 12697-2; 11,2 mm and 8 mm or 6,3 mm and 10 mm.

NOTE Alternatively, square opening test sieves of 5,6 mm, 6 mm and 8 mm may be used.

**5.1.2 Ventilated oven**, thermostatically controlled, adjustable from 100 °C to 180 °C, able to maintain the sample at  $(110 \pm 5)$  °C for drying procedure and at the specified mixing temperature  $\pm 5$  °C (refer to 5.2.3.1).

**5.1.3 Temperature measuring device.**

**5.1.3.1 Temperature measuring device**, capable of measuring the water temperature of 5 °C and 20 °C with an accuracy of  $\pm 1$  °C.

**5.1.3.2 Temperature measuring device**, capable of measuring the aggregate and bitumen temperature at a range of 110 °C to 180 °C with an accuracy of  $\pm 2$  °C.

NOTE The temperature measuring device may be a thermometer or an electronical measuring device.

**5.1.4 Balance.**

Capacity not less than 600 g, capable of determining an aggregate portion of 510 g with an accuracy of  $\pm 2$  g, and a balance capable of determining a binder test portion of 16 g to 18 g with an accuracy of  $\pm 0,2$  g (see 5.2.1.3 and 5.2.3.6).

NOTE A 'dual range' type balance may allow to weigh the aggregate and bowl with an accuracy of  $\pm 2$  g and after use of tare-function to determine the mass of binder added into the same mixing bowl with an accuracy of  $\pm 0,2$  g.

**5.1.5 Metal containers (tins).**

Suitable size for bitumen heating and addition of adhesion agent.

**5.1.6 Mixing bowl.**

Glazed porcelain bowl or other bowl with smooth non-absorbent surface, suitable for mixing the specified test portion in accordance with 5.2.

NOTE A porcelain bowl with diameter of 200 mm and internal height 50 mm may be considered suitable.

**5.1.7 Spatula**, made of metal or other suitable, non-absorbent material for mixing of bitumen and aggregate.

**5.1.8 Silicone coated paper or a flat metal lid**, for storage of coated aggregate particles as individual, loose particles when cooling down after mixing.

NOTE A flat metal lid with a rim height of 10 mm and diameter 300 mm may be considered suitable.

**5.1.9 Refrigerator**, capable of maintaining a temperature of  $(5 \pm 2)$  °C.

**5.1.10 Test bottles**, made of borosilicate glass for high wear resistance.

The volume capacity shall be approximately 500 ml. The bottles shall have a diameter of  $(80 \pm 10)$  mm and a height of  $(175 \pm 10)$  mm. The bottle shall have a shoulder height of  $(110 \pm 10)$  mm (see Figures 1 and 2). The bottle neck shall have an opening diameter of  $(30 \pm 5)$  mm, equipped with a water-tight fitting screw cap.

**5.1.11 Glass-rods**, diameter of  $(6 \pm 1)$  mm, equipped with  $(30 \pm 10)$  mm long, fitting rubber tubes.

The rubber tube shall be positioned on one end of the glass-rod so that the length of the rod is extended by approximately half of the tube length. The length of the glass-rod shall be proportioned, so that the rod with rubber tube can be firmly fixed inside the test bottle between the bottom and the screw cap (see Figure 3).

NOTE The glass rod ensures mechanical stirring and reduces risk of coated aggregate forming lumps.

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**5.1.12 Bottle rolling machine**, capable of rolling not less than three test bottles at the same time.

The rotation speed shall be adjustable, so that both a speed of  $40 \text{ min}^{-1}$  and  $60 \text{ min}^{-1}$  can be obtained with an accuracy of  $\pm 10 \%$ . The machine shall be positioned such that the bottles rotate horizontally with a tolerance of  $\pm 5^\circ$ .



Figure 1 — Test bottle

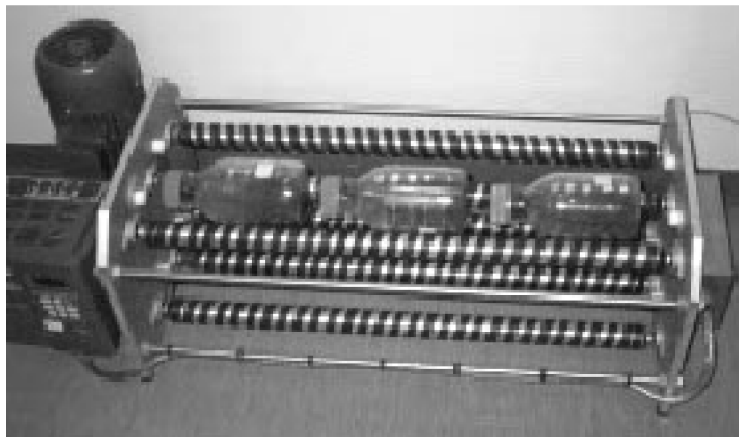


Figure 2 — Bottle rolling machine

**5.1.13 Glass beakers.**

Volume not less than 200 ml.

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**5.1.14 Test bowls**, suitable for visual determination of degree of binder coating on the aggregate.

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The bowls shall be flat-bottomed and of sufficient diameter to allow for placing of a test portion of  $(150 \pm 2) \text{ g}$  aggregate in a single layer, and of sufficient height to allow the test portion of aggregate to be completely submerged in water.

**NOTE** Flat-bottomed 'Petri-dishes' made of glass with approximate diameter 120 mm and height 15 mm may be considered suitable.

**5.1.15 Lamp** to provide a suitable light source to facilitate visual determination of binder coating on aggregate.

**5.1.16 Magnifying glass** with low magnification, to facilitate determination of degree of binder coating on aggregate (optional).