



# SLOVENSKI STANDARD SIST EN 12697-11:2020

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## Bitumenske zmesi - Preskusne metode - 11. del: Ugotavljanje sprejemljivosti med agregatom in bitumnom

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

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

Mélanges bitumineux - Essais pour - Partie 11 : Détermination de la affinité entre granulation et bitume

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EUROPEAN STANDARD

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## Bituminous mixtures - Test methods - Part 11: Determination of the affinity between aggregate and bitumen

Mélanges bitumineux - Méthodes d'essai - Partie 11 :  
Détermination de l'affinité granulats-bitume

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

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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**EN 12697-11:2020 (E)****European foreword**

This document (EN 12697-11:2020) 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of an identical text or by endorsement, at the latest by August 2020, and conflicting national standards shall be withdrawn at the latest by August 2020.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 12697-11:2012.

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;
- [3.5] chemical expression for molar concentration updated. The definition “Normality, N” amended to molarity. Amended description of the definition and change of unit to mol/l;
- [5.1.5] alternative procedure for addition of adhesion agent by using a syringe introduced. Change of title for 5.1.5. The following clauses renumbered accordingly;
- [5.1.13] clarified that the speed requirements refer to bottle rather than machine rotation;
- [5.2.3.4] clarified procedure for the addition of liquid adhesion agents with time limits including description for addition of small amounts (less than 0,4 g). Clarified that the weighed amount of adhesive agent shall be reported in the test report. Description of the evaluation of heat stability of adhesion agents introduced;
- [5.2.3.6] Formula (1) clarified. Keys added;
- [5.4.1] editorial: clarified and simplified description;
- [5.6] bullet e): completed with “amount”;
- [6.4.5] NOTE clarified that additional procedure has to be mentioned in the test report;
- [7.1 to 7.6.2.1] chemical expressions for concentration, “N”, amended to mol/l in relevant places in line with changed definition in 3.5;

- [7.2.12] last paragraph clarified regarding concentration;
- [7.6.1.1] Formula (4) clarified. Keys added.

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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## EN 12697-11:2020 (E)

## 1 Scope

This document 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 might 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 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 58, *Bitumen and bituminous binders — Sampling bituminous binders*

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

EN 12697-2, *Bituminous mixtures — Test methods — Part 2: Determination of particle size distribution*

EN 12697-35, *Bituminous mixtures — Test methods — Part 35: Laboratory mixing*

## 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****acid/base equivalence factor** $f_{eq}$ 

ratio of the volume of base needed to neutralise 25 ml of acid

**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****molarity**

molar concentration expressed in mol/l

**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**

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.

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.

## EN 12697-11:2020 (E)

## 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.

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 can 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 might 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.

Suitable equipment for measuring small portions of adhesion agent in the required precision. If a balance is used, it shall allow for determining the adhesion agent portion with an accuracy of  $\pm 0,001$  g.

#### 5.1.5 Syringe for measuring volume of adhesion agent

If a syringe is used for addition of adhesion agent, it shall allow for determining the volume of adhesion agent with an accuracy of  $\pm 1$   $\mu$ l.

#### 5.1.6 Metal containers (tins)

Suitable size for bitumen heating and addition of adhesion agent.

#### 5.1.7 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 can be considered suitable.

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

**5.1.9 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 can be considered suitable.

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

**5.1.11 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. The bottle neck shall have an opening diameter of  $(30 \pm 5)$  mm, equipped with a water-tight fitting screw cap.

**5.1.12 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.

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

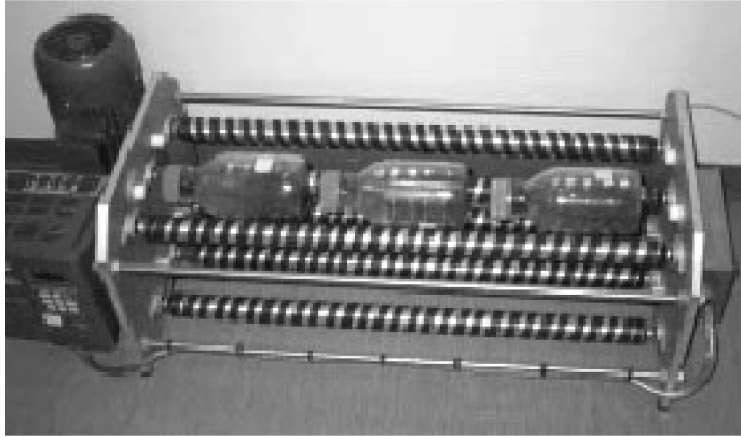
The rotation speed shall be adjustable, so that a bottle rotation a speed of  $40 \text{ min}^{-1}$  and  $60 \text{ min}^{-1}$  can be obtained with an accuracy of  $\pm 10 \%$ . The machine shall be positioned such that the bottles rotate horizontally with a tolerance of  $\pm 5^\circ$ .

NOTE An example of bottle rolling machine is shown in Figure 2.

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Figure 1 — Test bottle



**Figure 2 — Bottle rolling machine**

#### 5.1.14 Glass beakers.

Volume not less than 200 ml.

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

The bowls shall be flat-bottomed and of sufficient diameter to allow for placing of a test portion of (150 ± 2) 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 can be considered suitable.

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

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