BS EN 12697-43:2023

BSI Standards Publication

Bituminous mixtures — Test methods

Part 43: Resistance to fuel

bsi.

National foreword

This British Standard is the UK implementation of EN 12697-43:2023. It supersedes BS EN 12697-43:2014, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee B/510/1, Asphalt products.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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Mélanges bitumineux - Méthodes d'essais - Partie 43 : Résistance aux carburants

Asphalt - Prüfverfahren - Teil 43: Widerstand gegen Treibstoffe

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

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Contents

European foreword

This document (EN 12697-43:2023) 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of an identical text or by endorsement, at the latest by October 2023, and conflicting national standards shall be withdrawn at the latest by October 2023.

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 12697-43:2014.

The main changes compared to the previous edition are listed below:

— the title no longer refers to hot mix asphalt;

— general editorial update according to current standard template and CEN/CENELEC Internal Regulations Part 3:2019;

— general editorial change of rotation speed indicated with "rpm" to "min^{-1}" ;

— [Clause 2] deletion of reference to EN 13108-20:2006;

— [Clause 2] added reference to EN 12697-7;

— [5.3] paragraph revised and the term accuracy amended to maximum permissible error;

— [5.6.2] keys referring to Figure 3 corrected to letters;

— [5.6.2] corrected reference to Clause 5.7 in Figure 3, E;

— [5.8] completion of description of soft-haired brush;

— [5.8] introduction of new Figure 5 (example of soft-haired brush). Following Figures re-numbered;

— [5.9] introduction of new Clause with description of pH-meter;

— [7.2] tolerance for the height of specimen amended from "40 to 60 mm" to "(50 ± 5) mm";

— [7.2] specimens to be tested amended from three to four;

— [7.2] clarified description of porous asphalt and non-porous asphalt with respect to void content;

— [7.2] introduction of paragraph with description of the use of compaction methods;

— [7.2] introduction of explanatory NOTE regarding the impact of height on the result;

— [7.2] introduction of explanatory NOTE regarding the impact of different compaction methods;

— [7.3] reference to EN 13108-20:2006. Annex A deleted;

— [7.3] addition of EN 12697-7 for the determination of bulk density;

— [8.1.1] amended description for the immersion of fuel of the test specimen;

— [8.1.1] changed storage temperature for the immersed specimen to 20 ± 2 °C;

— [8.1.1] introduction of explanatory NOTE regarding influence of the fuel temperature;

— [8.1.2] introduction of "WARNING" regarding the disposal of the soiled water;

— [8.1.3] the term "accuracy" amended to read "to the nearest"; NOTE changed to normal text;

— [8.2.1] clarified description of porous asphalt and non-porous asphalt with respect to void content;

— [8.2.2], [8.2.2.1], [8.2.2.2], [8.2.3], [8.2.3.1], [8.2.3.2], [8.2.4], [8.2.5] amended titles;

— [8.2.5] paragraph with "EXAMPLE" amended to normal text;

— [8.3] deletion of conflictiong and superfluous paragraph "Carry out the test with three specimens";

— [8.3] added references to Formulas;

— [Clause 9] bullets in test report revised and completed with additional information to be given.

A list of all parts in the EN 12697 series can be found on the CEN website.

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1 Scope

This document specifies a test method to determine the resistance of a bituminous mixture or pavement to fuels. The procedure involves initial soaking of a test specimen made in the laboratory or cored from a pavement in a fuel, followed by a brushing period with a brush test device. The material loss of the specimen is a measure of the resistance to that fuel for that bituminous mixture.

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 12697-6, *Bituminous mixtures - Test methods - Part 6: Determination of bulk density of bituminous specimens*

EN 12697-7, *Bituminous mixtures - Test methods - Part 7: Determination of the bulk density of bituminous specimens by gamma rays*

EN 12697-27, *Bituminous mixtures - Test methods - Part 27: Sampling*

EN 12697-30, *Bituminous mixtures - Test methods - Part 30: Specimen preparation by impact compactor*

EN 12697-31, *Bituminous mixtures - Test methods - Part 31: Specimen preparation by gyratory compactor*

EN 12697-33, *Bituminous mixtures - Test method - Part 33: Specimen prepared by roller compactor*

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 terminology databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
fuel
liquid (petroleum product) that might be spilled accidentally or sprayed deliberately onto an asphalt pavement and can cause damage to the asphalt mixture

4 Principle

A cylindrical test specimen with a known mass is immersed partly in a bath with the specified fuel for a specified period of time. After removal from the bath, cleaning with water and drying for 24 h at 25 °C, the loss of mass of the specimen is measured and the immersed surface is visually inspected. Then an abrasive loading is applied onto the immersed surface of the test specimen by a steel brush mounted onto a brush test device. The steel brush moves in epicycloids passages over the surface. After 30 s the brushing stops and the specimen is removed. The loss of mass is measured and the brushed surface is visually inspected. The specimen is then put back and the same procedure is carried out again after 30 s and after 60 s, when the brushed surface is visually inspected again.

The total brushing time is 120 s (two brushing periods of 30 s and one of 60 s). The combined material loss after the immersion and the brush test is the main parameter for the resistance to the particular fuel. As additional information the material loss after the immersion (chemical loading) and the brush test (mechanical loading) are further informative parameters for the resistance to the particular fuel.

5 Apparatus

5.1 Beaker with glass rod

Cylindrical beaker made of glass for soaking the test specimen in the fuel. The container shall be flat-bottomed and have an internal diameter of at least 140 mm (with porous asphalt specimens at least 190 mm) and an internal depth of at least 150 mm. A glass rod with a length of 70 mm and a diameter of 8 mm is put on one side of the bottom of the beaker so that one side of the immersed specimen can rest on the bottom of the beaker and the other side on the glass rod to prevent the enclosure of air under the immersed specimen.

5.2 Glass funnel

The size of the funnel shall be chosen in such a way that the rate of flow of the fluid into the beaker is as small as possible to prevent any damage to the specimen because of the injection of the fluid in the beaker.

5.3 Balance, with a maximum permissible error of 0,1 g.

5.4 Ventilated conditioning chamber, capable of maintaining temperature of (25 ± 2) °C in the vicinity of the specimen.

5.5 Impact hammer, gyrator or roller compactor

Impact hammer (according to EN 12697-30), gyrator (according to EN 12697-31) or roller compactor (according to EN 12697-33) to prepare laboratory made specimens.

5.6 Brush test device

Two different devices for the brush test are available.

5.6.1 Test device based on a laboratory mixer

Any mixer according to EN 12697-35 can be used. This mixer with epicyclical motion covers an area with a diameter 5 mm less than the diameter of the specimen. The rotation speed shall be (60 ± 3) min^{-1}.

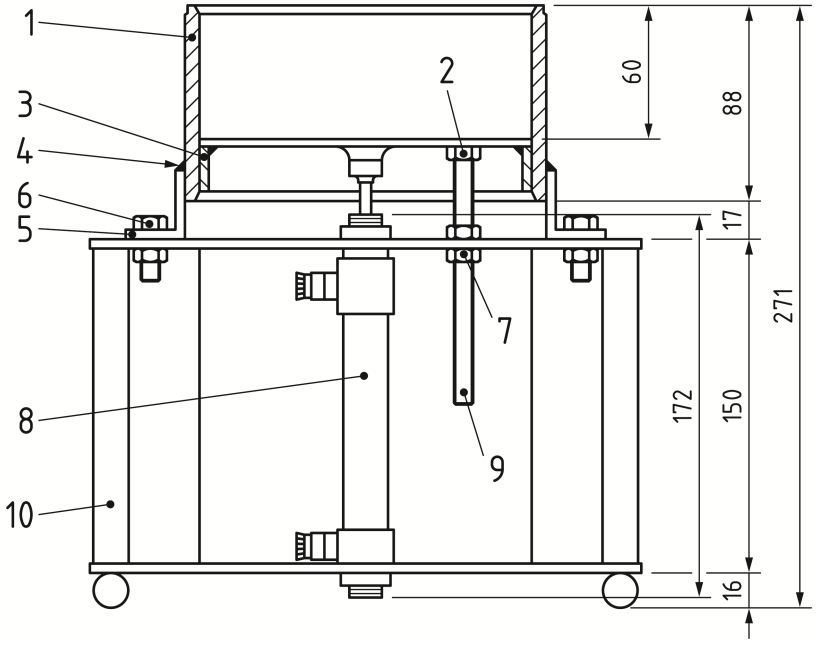
The steel brush is connected to the mixer (see Figure 1).

To press the specimen with a constant force to the brush a special frame shall be built. In Figure 2 an example of this frame is shown. A pneumatic actuator is using compressed air to press the specimen against the brush. The frame itself is placed under the rotating disk of the mixer.

The pressure shall be kept constant. This can be achieved by means of a manometer between the actuator and compressed air control valve.

Figure 1 — Connection pin

Dimensions in millimetres



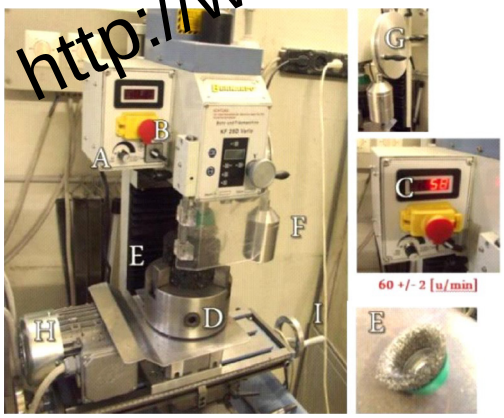
Key

1	ring (diameter 150 mm)	6	pin
2	nut	7	drilled nut
3	metal ring, 20 mm height, diameter 150 mm	8	pneumatic actuator
4	welding	9	thread
5	L-shaped corner profile	10	bar (diameter 16 mm)

Figure 2 — Example of the frame for the brush test

5.6.2 Test device based on a milling machine

A standard milling machine, as shown in Figure 3, can be adapted to carry out brush tests according to this document. The hand wheel usually used to set the milling head is replaced by a deflection pulley (G) carrying weights (F) that apply the contact pressure from above to the specimen using gravity. The milling head itself is replaced by a clamp for the steel brush (Figure 4). Hence, the brush is moveable in vertical direction throughout the test to ensure a constant contact pressure. The change in the height of the specimen due to abrasion is adjusted by the moving brush. The eccentricity of the epicyclical motion of the brush can be set in a wide range, so that specimens with a diameter of 100 mm and 150 mm can be brushed covering the entire surface. The specimen itself is fixed by clamping jaws (D) with a variable diameter (Figure 3). Thus the position of the specimen is fixed and always centred below the brush. The rotation speed shall be (60 ± 3) min^{-1}.



Key

A	digital speed control	F	weight at deflection pulley
B	emergency shutdown	G	deflection pulley
C	speed display	H	engine for clamping jaws
D	clamping jaws	I	hand wheel to position the clamping jaws for epicyclical motion
E	brush in accordance with 5.7		

Figure 3 — Brush test device based on a milling machine

5.7 Steel brush, (see Figure 4) with:

— power, cup brush with tempered quality crimped steel wires;

— outer diameter: 60 mm;

— inner diameter: 30 mm;

— the hair of the brush are rolled, curled steel with a diameter of 0,3 mm;

— trim length: about 17 mm. Due to brushing, the trim length of the brush decreases. When the trim length has reduced to 75 % of its initial length, the brush shall be replaced.

The allowable maximum rotation speed of the brush should be at least 50 times the rotation speed of the mixer.

Figure 4 — Steel brush

5.8 Soft-haired brush (see Figure 5)

Brush for cleaning and degreasing, for example in Nylon Fabric.

Figure 5 — Example of soft-haired brush

5.9 pH-meter

Device to measure the pH-value.

6 Fuels

The fuel against which resistance is to be determined shall be at the concentration at which it is normally used.

Most of the fuels occur in practice in high concentrations which can create safety issues, so great care should be exercised with these materials.

7 Preparation of test specimens

7.1 Mix the asphalt mixture either at a laboratory in accordance with EN 12697-35 or at a mixing plant.

7.2 Prepare four cylindrical specimens. When the fuel resistance of specimens of porous asphalt with void content ≥ 10 % is being determined, the specimens shall have a diameter of (150 ± 2) mm and a height of (50 ± 5) mm; for specimens of non-porous asphalt with void content < 10 %, the specimens shall have a diameter of (100 ± 2) mm and a height of (50 ± 5) mm and shall be prepared by either:

— compacting the asphalt mixture into specimens in accordance with EN 12697-30 or EN 12697-31; or

— extracting cored specimen in accordance with EN 12697-27 from a compacted pavement of the asphalt mixture or from a specimen of the asphalt mixture compacted in accordance with EN 12697-33.

NOTE 1 As the result consists of weight loss in percentage the height of the specimen has impact on the result.

When evaluating different mix designs of asphalt mixtures for the resistande against a certain fuel the same compaction method shall be used.

NOTE 2 Different compaction methods could have impact on the result due to different macro-texture of the specimens which influences the contact area between the core and the fuel.

7.3 Determine the bulk density of the test specimens in accordance with EN 12697-6 or EN 12697-7. Record the dry mass of each test specimen as m_1.

7.4 Store the test specimens at room temperature (between 18 °C and 25 °C) for at least 24 h after the bulk density has been determined. Store laboratory produced test specimens in dry conditions for between 14 days and 42 days from the time of their manufacture at room temperature (between 18 °C and 25 °C) before being soaked in fuel. During storage, they shall be laid on a flat surface.

NOTE The storage time influences the mechanical properties of the specimen.

8 Procedure

8.1 Soaking in fuel and removing the fuel

8.1.1 Preparation for testing and immersion

Place the test specimen with the top down in a glass beaker with two glass rods (diameter 8 mm; length 70 mm) on the bottom in order to maintain the specimen horizontally. The glass rods prevents the enclosure of air between fuel and specimen. Fill the beaker with fuel by means of a glass funnel. The amount of fuel shall enable the specimen to be immersed to half its height in the fuel. Ensure that the minimum clearance between the specimen and the container wall is 10 mm.

Cover the beaker glass to prevent loss of fuel.

Store the immersed specimen for 24 h ± 30 min at room temperature (20 ± 2) °C. The storage temperature and the immersion time shall be reported.

To find differences between mixtures with modified binders, more severe test conditions can be reasonable. This can be accomplished by using a longer immersion time of 72 h ± 30 min.

NOTE The fuel temperature influences the fuel resistance of the specimen.

8.1.2 Cleaning the specimen

After immersion, remove the test specimen carefully from the beaker. Wash the specimen with water until the water coming off the specimen has a constant pH-value within ± 0,5. If salted fuels are used, the conductivity of the washing water shall be checked. When the conductivity remains constant, the specimens can be considered clean. Loose particles on the immersed surface shall be removed carefully by hand using only a soft-haired brush (see Figure 6). The loose particles shall not be removed directly by hand.

To measure the acidity or the conductivity of the water, standard equipment can be used. The equipment shall be able to measure differences in acidity or conductivity during cleaning of the specimen.

WARNING – Appropriate measures shall be taken in the disposal of the soiled water.

Figure 6 — Cleaning the specimen after immersion

8.1.3 Loss of mass due to immersion

After cleaning, put the specimen in a conditioning chamber at (25 ± 2) °C for (24 ± 2) h. The drying shall be verified as completete by successive weighting. The mass of the dry specimen shall be determined (= m_2) to the nearest 0,1 g. If the loss of mass is > 5 %, the test shall be stopped.

8.2 The brush test

8.2.1 General

There are two types of brush tests: one for porous asphalt specimens with high void content ≥ 10 % and one for non-porous asphalt specimens with void content < 10 %.

8.2.2 Brush test for a porous asphalt specimen with void content ≥ 10 % using a laboratory mixer

8.2.2.1 Installation of asphalt specimen

Mount the specimen firmly in position, centrally under the area that will be covered by the brush.

8.2.2.2 Brushing of asphalt specimen

After the specimen has been fixed, the pneumatic actuator will lift the specimen against the brush. The force between the brush and the asphalt specimen shall be (60 ± 6) N. Due to the fact that the covered area of the brush is about 100 mm wide, the surface of the asphalt specimen is not loaded completely: only the inner ring is affected by the brushing movements.

The speed of rotation of the brush shall be (60 ± 3) min^{-1}. The total brushing time shall be 120 s and divided into three periods: two periods each of 30 s and one period of 60 s. After each period the specimen shall be removed and the mass of the specimen shall be measured to the nearest 0,1 g (successively m_3, m_4 and m_5). The load itself shall be put gradually onto the specimen within 5 s from the start. During that time the brush shall rotate. The period with an increasing load shall be included in the total loading time of the specimen so that the first loading period of 30 s consists of 5 s loading from zero to maximum load and 25 s brushing with maximum load.

8.2.3 Brush test for a non-porous asphalt specimen with void content < 10 % using a laboratory mixer

8.2.3.1 Installation of asphalt specimen

Mount the specimen firmly in position, centrally under the area that will be covered by the brush.

8.2.3.2 Brushing of asphalt specimen

After the specimen has been fixed, the pneumatic actuator will lift the specimen against the brush. The force between the brush and the asphalt specimen shall be (140 ± 14) N. The specimen surface area with a diameter 5 mm less than the diameter of the specimen is loaded by the rotating brush.

The speed of rotation of the brush shall be (60 ± 3) min^{-1}. The total brushing time shall be 120 s and shall be divided into three periods: two periods each of 30 s and one period of 60 s. After each period, the specimen shall be removed and the mass of the specimen shall be measured to the nearest 0,1 g (successively m_3, m_4 and m_5). The load itself shall be put gradually onto the specimen within 5 s from the start. During that time the brush shall rotate. The period with an increasing load shall be included in the total loading time of the specimen so that the first loading period of 30 s consists of 5 s loading from zero to maximum load and 25 s brushing with maximum load.

8.2.4 Brush test for porous asphalt specimen with void content ≥ 10 % using an adapted milling machine

Place the specimen with the immersed surface facing up into the device between the clamping jaws (D in Figure 3). Fix the specimens position by drawing the clamping jaws tight. Use the correct weight (F in Figure 3) to ensure a force of the brush onto the specimen of (60 ± 6) N.

The total brush time shall be 120 s and shall be divided in three periods: two periods of each 30 s and one period of 60 s. After each period the specimen shall be removed from the device and the mass of the specimen shall be measured to the nearest 0,1 g (successively m_3, m_4 and m_5). Gradually put the load itself onto the specimen within 5 s from the start by lowering the deflection pulley (G in Figure 3) slowly by hand until it completely rests on the specimen. During that time, the brush shall rotate with (60 ± 3) min^{-1}. The period with an increasing load shall be included in the total loading time of the specimen so that the first loading period of 30 s consists of 5 s loading from zero to maximum load and 25 s brushing with maximum load.

8.2.5 Brush test for a non-porous asphalt specimen with void content < 10 % using an adapted milling machine

Place the specimen with the immersed surface facing up into the device between the clamping jaws (D in Figure 3). Fix the specimens position by drawing the clamping jaws tight. Use the correct weight (F in Figure 3) to ensure a force of the brush onto the specimen of (140 ± 14) N.

The total brush time shall be 120 s and shall be divided in three periods: two periods of each 30 s and one period of 60 s. After each period, the specimen shall be removed from the device and the mass of the specimen shall be measured to the nearest 0,1 g (successively m_3, m_4 and m_5). Gradually put the load itself onto the specimen within 5 s from the start by lowering the deflection pulley (G in Figure 3)

slowly by hand until it completely rests on the specimen. During that time the brush shall rotate with (60 ± 3) min^{-1}. The period with an increasing load shall be included in the total loading time of the specimen.

If load takes 5 s to reach maximum load, the first loading period of 30 s will consist of 5 s loading from zero to maximum load and 25 s of brushing with the maximum load.

8.3 Calculation and expression of results

For each specimen, calculate the parameters A_i, B_i and C_i according to formulae (1), (2) and (3).

$$A_i = \frac{m_{1,i} - m_{2,i}}{m_{1,i}} \times 100 \quad (1)$$

$$B_i = \frac{m_{2,i} - m_{5,i}}{m_{2,i}} \times 100 \quad (2)$$

$$C_i = \frac{m_{1,i} - m_{5,i}}{m_{1,i}} \times 100 \quad (3)$$

where

$m_{1,i}$ is the initial dry mass of the test specimen *i* before soaking in fuel, in grams (g);

$m_{2,i}$ is the mass of the dry test specimen *i* after soaking in fuel, in grams (g);

$m_{5,i}$ is the mass of the test specimen *i* after soaking and 120 s in the brush test, in grams (g).

A_i, B_i and C_i (i = 1, 2, 3) are rounded off to the nearest 0,1 %. Then calculate the average values of *A*, *B* and *C*, respectively, and round each average off to the nearest 1 %.

Parameter *C* indicates the total loss of mass after chemical and abrasive loading. Parameters *A* and *B* are to be obtained as valuable additional information about how the tested material reacts to fuel exposure and abrasive loading, respectively.

9 Test report

The test report shall include the following information as appropriate:

a) reference to this document;

b) method of mixing (laboratory or plant);

c) method of compaction of the specimen (impact, gyratory, roller compactor or site);

d) identification of the test specimen or origin of the cores including mix type;

e) specification of the fuel;

f) bulk density and void content of the specimens and test method used;

g) dimensions of the specimens, average height and average diameter;

h) storage conditions (time and temperature) of the specimens before testing and age of tested specimen;

i) time and temperature for storage of specimens in fuel;

j) individual values of the mass of the specimens before immersion in the fuel (= $m_{1,i}$), after immersion and drying (= $m_{2,i}$); after the first 30 s in the brush test (= $m_{3,i}$), after the second 30 s in the brush test (= $m_{4,i}$) and after completion of the brush test (= $m_{5,i}$);

k) individual values of the loss of mass after soaking in fuel (= A_i);

l) individual values of the loss of mass after the brush test (= B_i);

m) individual values of the combined loss of mass (= C_i);

n) mean value of the loss of mass after soaking in fuel (= A);

o) mean value of the loss of mass after the brush test (= B);

p) mean value of the combined loss of mass (= C);

q) any deviations from this test method;

r) any unusual features observed;

s) the date of the test.

10 Precision

The repeatability (r) and reproducibility (R) have not been determined yet.

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