BS EN 12697-20:2012

BSI Standards Publication

Bituminous mixtures — Test methods for hot mix asphalt

Part 20: Indentation using cube or cylindrical specimens (CY)

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National foreword

This British Standard is the UK implementation of EN 12697-20:2012. It supersedes BS EN 12697-20:2003 which is withdrawn.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 secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Bituminous mixtures - Test methods for hot mix asphalt - Part 20: Indentation using cube or cylindrical specimens (CY)

Mélanges bitumineux - Méthodes d'essai pour mélange hydrocarboné à chaud - Partie 20: Essai d'indentation sur cubes ou éprouvettes Marshall

Asphalt - Prüfverfahren für Heißasphalt - Teil 20: Eindringversuch an Würfeln oder zylindrischen Probekörpern

This European Standard was approved by CEN on 26 February 2012.

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Foreword

This document (EN 12697-20:2012) 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of an identical text or by endorsement, at the latest by October 2012, and conflicting national standards shall be withdrawn at the latest by October 2012.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 12697-20:2003.

The following is a list of significant technical changes since the previous edition:

— Marshall specimens (MS) changed to cylindrical specimens (CY) in the title and elsewhere;

— the scope changed to covering mastic asphalt and other asphalt rather than mastic asphalt and rolled asphalt to avoid confusion with hot rolled asphalt;

— parting agent corrected to release agent;

— the description of the indentation test apparatus is broken down into separate components;

— accuracy requirement given for the water bath;

— the requirement that cylindrical specimens should not be removed from the compaction mould has been removed;

— requirement on the storage of samples prior to testing has been added;

— the requirements for the preparation of both cube and cylindrical samples have been redrafted;

— precision statement edited.

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

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

EN 12697-3, *Bituminous mixtures — Test methods for hot mix asphalt — Part 3: Bitumen recovery: Rotary evaporator*

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 specimens*

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: Compactibility*

EN 12697-11, *Bituminous mixtures — Test methods for hot mix asphalt — Part 11: Determination of the affinity between aggregate 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: Partial 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*

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*

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 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 matters in reclaimed asphalt*

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EN 12697-44, *Bituminous mixtures — Test methods for hot mix asphalt — Part 44: Crack propagation by semi-circular bending test*

prEN 12697-45, *Bituminous mixtures — Test methods for hot mix asphalt — Part 45: Saturation ageing tensile stiffness (SATS) conditioning test*

prEN 12697-46, *Bituminous mixtures — Test methods for hot mix asphalt — Part 46: Low temperature cracking and properties by uniaxial tension tests.*

EN 12697-47, *Bituminous mixtures — Test methods for hot mix asphalt — Part 47: Determination of the ash content of natural asphalt*

prEN 12697-48, *Bituminous mixtures — Test methods for hot mix asphalt — Part 48: Inter-layer bond strength*[1)]

prEN 12697-49, *Bituminous mixtures — Test methods for hot mix asphalt — Part 49: Determination of friction after polishing.*[1)]

prEN 12697-50, *Bituminous mixtures — Test methods for hot mix asphalt — Part 50: Scuffing resistance of surface course*[1)]

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1) In preparation

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.

1 Scope

This European Standard specifies a test method for determining the depth of indentation of mastic asphalt and other asphalt, when force is applied to them via a cylindrical indentor pin with a circular flat-ended base. This European Standard applies to aggregates of maximum nominal size less or equal to 16 mm.

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 12697-27, *Bituminous mixtures — Test methods for hot mix asphalt — Part 27: Sampling*

EN 12697-30, *Bituminous mixtures — Test methods for hot mix asphalt — Part 30: Specimen preparation by impact compactor*

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

EN 12970, *Mastic asphalt for waterproofing — Definitions, requirements and test methods*

EN 13108-1, *Bituminous mixtures — Material specifications — Part 1: Asphalt Concrete*

EN 13108-2, *Bituminous mixtures — Material specifications — Part 2: Asphalt Concrete for very thin layers*

EN 13108-3, *Bituminous mixtures — Material specifications — Part 3: Soft Asphalt*

EN 13108-4, *Bituminous mixtures — Material specifications — Part 4: Hot Rolled Asphalt*

EN 13108-5, *Bituminous mixtures — Material specifications — Part 5: Stone Mastic Asphalt*

EN 13108-6, *Bituminous mixtures — Material specifications — Part 6: Mastic asphalt*

EN 13108-7, *Bituminous mixtures — Material specifications — Part 7: Porous Asphalt*

ISO 48, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*

3 Apparatus

3.1 Moulding of test cubes of mastic asphalt

3.1.1 Cubic mould: composite metal mould with inside edges (70,7 ± 0,5) mm to mould the test cube (see Figure 1).

3.1.2 Oven capable of maintaining temperature of (250 ± 10) °C.

3.1.3 Hardwood tamper with a quadratic cross section, edge length about 30 mm.

3.1.4 Spatula about 30 mm wide.

3.1.5 Mixing bowl with spoon.

3.1.6 Thermometer capable to measure 300 °C accurate to 2 °C.

3.1.7 Thermometer capable to measure 40 °C accurate to 1 °C.

3.1.8 Release agent (e.g. glycerine or waxed paper).

3.1.9 Adjustable mould for the test cube (see Figure 6).

Dimensions in millimetres

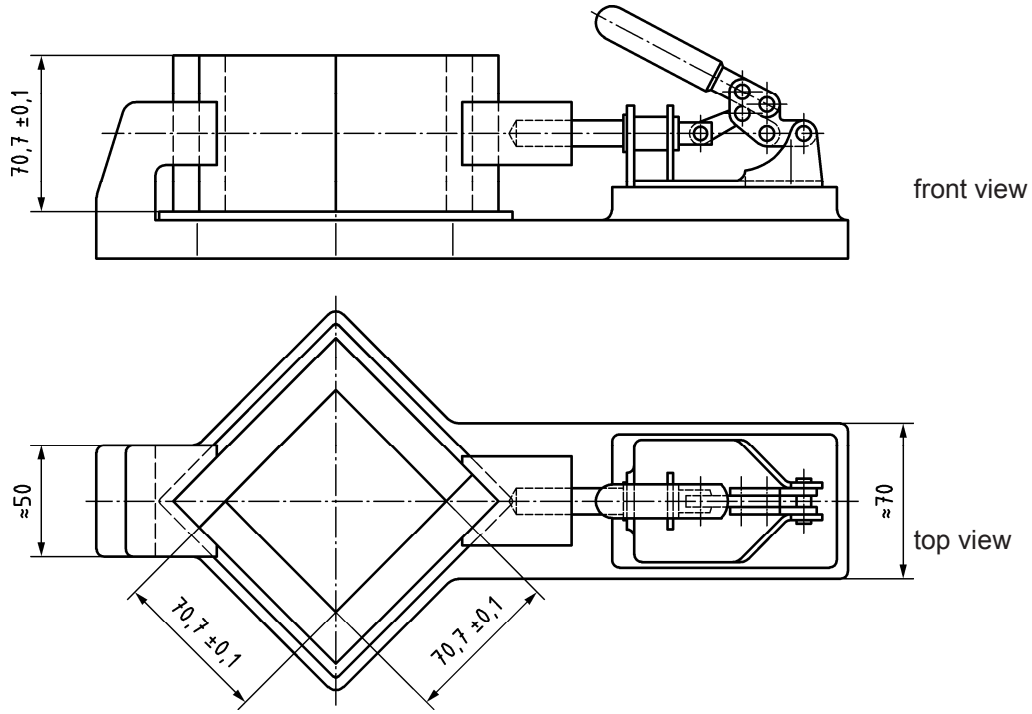


Figure 1 — Example of a mould for the preparation of test cubes

3.2 Indentation test apparatus

3.2.1 Loading apparatus

3.2.1.1 Description

Indentation test apparatus (see Figure 2) fitted with an indentor pin and a displacement transducer, suitable for one or two measuring points. Instead of the transducer, a dial gauge may also be used. The water bath, as specified in 3.2.2, shall be connected to the indentation test apparatus by means of a secure and watertight connection running from the bed plate, as specified in 3.2.3, through the bath to the base plate of the apparatus. The measuring pin of the displacement transducer shall not be located more than 50 mm from the axis of the guide rod.

3.2.1.2 Loading weights

The indentation test apparatus shall be set up in such a way that first the preliminary force of (25 ± 1) N then the main force of a further 500 N may be applied vertically and without impact to the surface of the specimen. The apparatus shall be capable of maintaining the total test force of (525 ± 1) N constant through out the test. Two ball bearings shall be used to ensure a minimum of friction in the guidance of the indentor pin. With the exception of the ball bearings, all components shall have a clearance of at least 1 mm from the guide rod.

3.2.1.3 Steel identor pin

The bottom part of the steel indentor pin shall be in the shape of a regular flat ended cylinder with a base area of either 100 mm^2 or 500 mm^2 (corresponding to a diameter of (11,3 ± 0,1) mm or (25,2 ± 0,1) mm) and a length of at least 20 mm (see Figures 3 and 4). The sides and base of the cylinder shall be smoothed to a fine finish. The length and mass of the two indentor pins shall be identical, irrespective of the diameter of the base. The indentor pins shall screw coaxially into the loading cylinder. The thread cut in the bottom of the guide rod shall be at least so long, that the stop rings of the indentor pins with their thread, at least (6,5 ± 0,5) mm long, fit snugly against the end face of the guide rod.

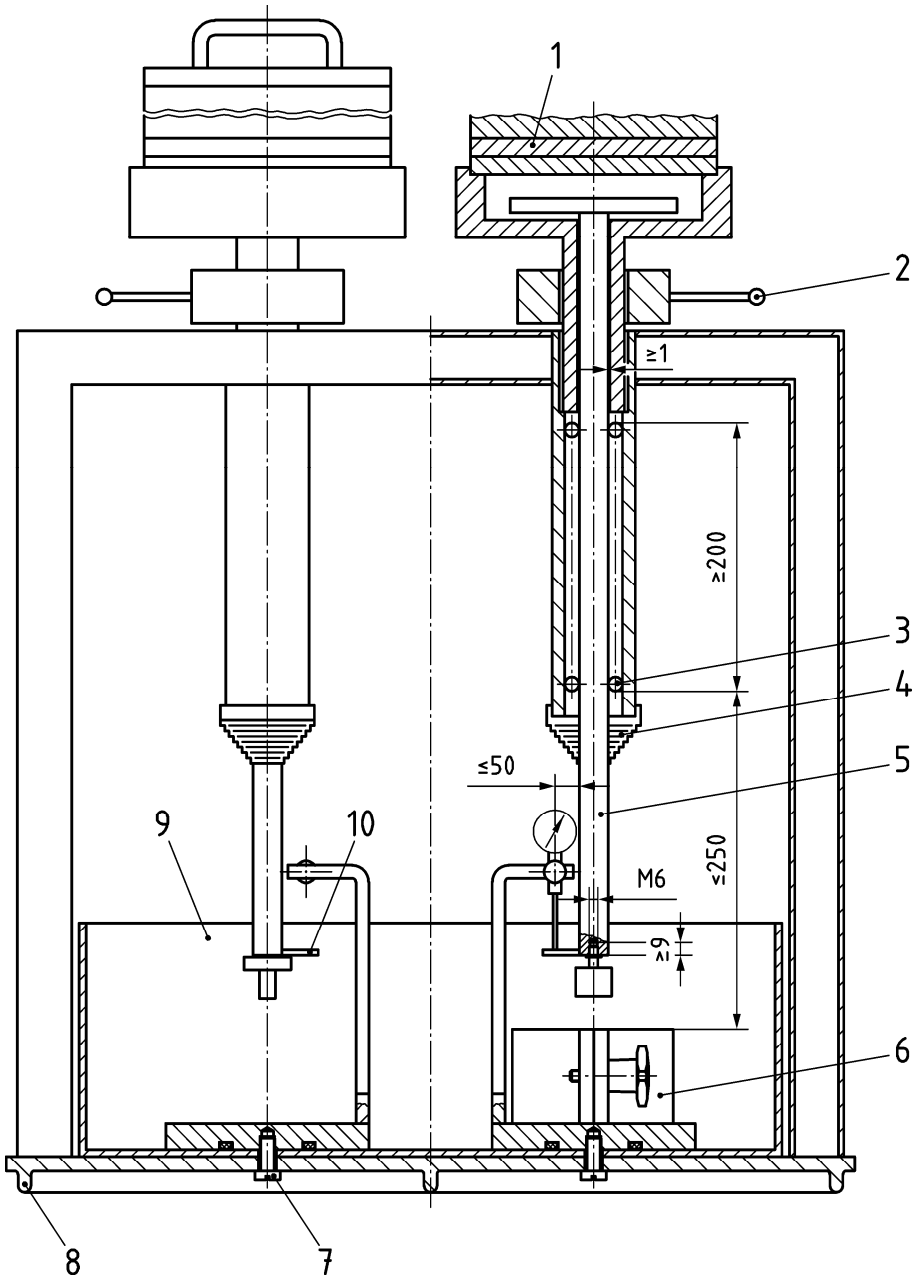
3.2.1.4 Deformation measurement gauge

If a mechanical dial gauge is used the measuring pin shall be lockable.

The deformation of the apparatus when force is applied or removed shall be less than 0,01 mm.

For indentation test apparatus fitted with two measuring points, this requirement applies analogously to the application and removal of both forces.

Dimensions in millimetres

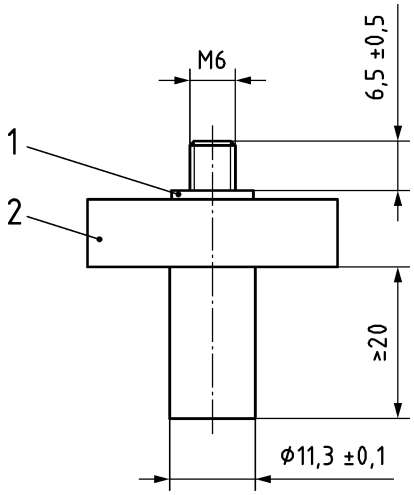


Key

1 weight
2 lifting device (hydraulic or mechanical)
3 ball bearing
4 concertina bellows
5 guide rod
6 adjustable mould
7 screw for the bed plate
8 stiffening rib
9 water bath
10 sensing plate for the displacement transducer (removable)

Figure 2 — Example of an indentation test apparatus with two measuring points (sketch of the principle)

Dimensions in millimetres

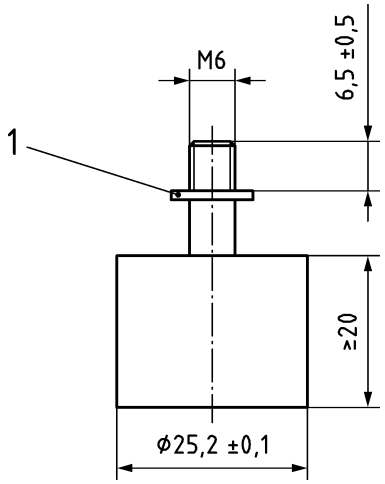


Key

1 stop ring
2 counterweight

Figure 3 — Indentor pin with a base area of 100 mm^2

Dimensions in millimetres



Key

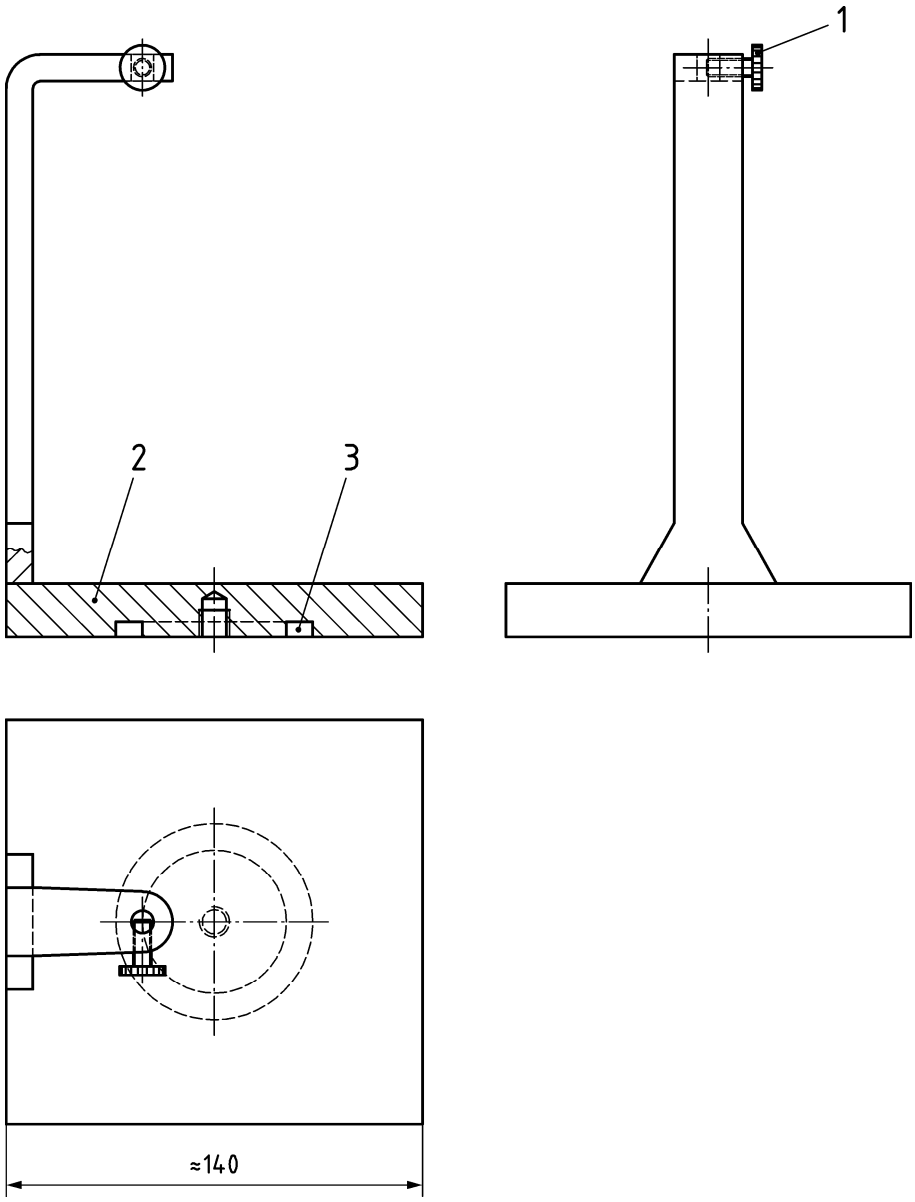
1 stop ring

Figure 4 — Indentor pin with a base area of 500 mm^2

3.2.2 Water bath having a capacity of at least 7,5 l per measuring point, and fitted with controls for the regulation of heating and temperature with an accuracy of ± 1 °C.

3.2.3 Bed plate (see Figure 5) made from stainless steel with an edge length of about 140 mm and an outside diameter of about 160 mm and a thickness of at least 20 mm, serving as a support for the specimen. There shall be a ring groove in the underside of the plate to accept a watertight O-ring, and a stand fixed securely to one side to accept the displacement transducer. The bed plate shall be fixed centrally under the indentor and be securely attached to the indentation apparatus.

Dimensions in millimetres



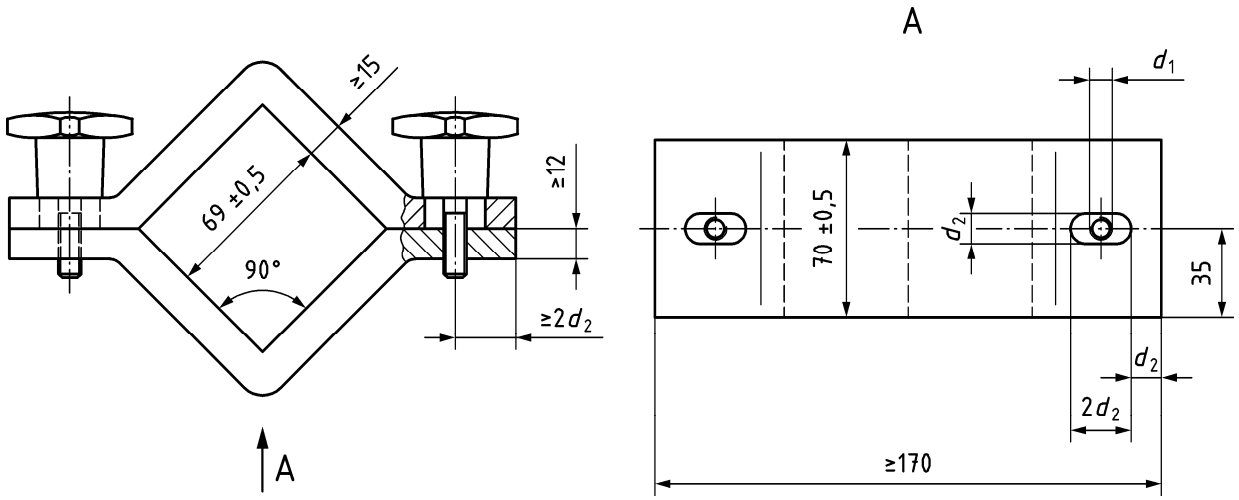
Key

1 mount for displacement transducer
2 bed plate
3 grove to accept a watertight O-ring

Figure 5 — Example of the bed plate with a mount for displacement transducer

3.2.4 Adjustable mould (see Figure 6) to hold the test cube during the course of the test. For practical reasons, the size shall be (69,0 ± 0,5) mm.

Dimensions in millimetres



top view front view

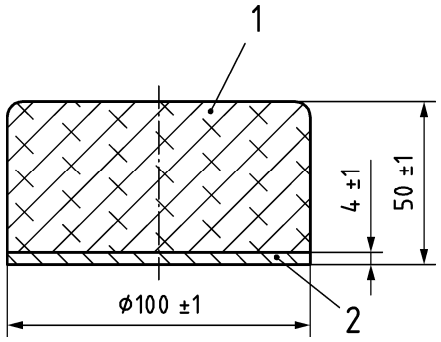
d_1 diameter of thread

d_2 diameter of associated clearance hole

Figure 6 — Adjustable mould for the test cubes

3.2.5 Calibration block (see Figure 7) for verifying the function of the indentation test apparatus. The rubber shall have a hardness of (58 ± 5) IRHD according to ISO 48.

Dimensions in millimetres



Key

1 rubber

2 steel plate

Figure 7 — Example of calibration block

3.2.6 Metal intermediate plate with a diameter of (100 ± 0,5) mm and a thickness of at least 16 mm, for testing cylindrical specimen.

4 Specimens

4.1 Specimen type

In accordance with 5.3 and 5.4 test cubes (C) shall be prepared for testing mastic asphalt, and cylindrical specimen, compacted according EN 12697-30 for testing rolled asphalt.

4.2 Number of specimens

Two test specimens shall be tested in each case.

4.3 Conditioning

Prior to the start of testing, the specimens shall be stored on a flat surface at a temperature of not more than 25 °C for between 24 h and 42 days from the time of their manufacture.

NOTE 1 The storage time influences the mechanical properties of the specimen.

NOTE 2 For test purposes other than for CE marking, different storage times may be applied.

NOTE 3 Notify in the test report if a deviating conditioning time is used. For that reason, it cannot be used for CE-marking purposes.

5 Procedure

5.1 Checking

For checking the accuracy of the test device, replace the asphalt specimen with the calibration block (steel plate down), and apply the maximum test force as specified in 5.6 of (525 ± 1) N for 5 min. The coefficient of variation of the depth of indentation thus obtained from 10 consecutive applications shall not exceed 5 % of the arithmetic mean.

5.2 Test conditions

The conditions of testing, which depend on the intended application of the asphalt under test, shall be in accordance with Table 1.

Table 1 — Test conditions

Intended application	Type of specimen	Nominal base area of indentor pin in mm^2	Test temperature °C	Reading taken after minutes
Asphalt used in road construction	C, CY	500	40 ± 1	30 ± 1 and 60 ± 1
Asphalt used in building construction and for waterproofing [a]	C	100	22 ± 1	300 ± 1
	C	100	40 ± 1	120 ± 1
	C	500	40 ± 1	30 ± 1

[a] Test conditions for mastic asphalt, which depend on traffic loads and temperatures to be expected, shall be as given in EN 12970.

5.3 Cube specimen preparation

5.3.1 Specimen size

The base area of the test cubes (C) shall be 5 000 mm^2, edge length (70,7 ± 0,5) mm. The height of the cube shall be (70,7 ± 1) mm.

The mixture sample shall be sufficient to allow the moulding of one cube with a volume of 353 ml plus a certain amount extra to allow for looses occurring during the preparation of specimens.

5.3.2 Preparation of mastic asphalt samples mixed in industrial scale

5.3.2.1 The mixture prepared in accordance with EN 13108-6 shall be sampled in accordance with EN 12697-27. For the tests on one mixture sample a sample volume of at least 2 500 cm^3 shall be used.

NOTE This amount is essential to achieve a representative sample out of one batch mastic asphalt.

To obtain the mixture sample required for one test cube, heat the mastic asphalt gently to allow small increments to be taken over the entire thickness of the slab without crushing the particles.

5.3.2.2 Preheat the mixture required for one test cube without allowing fresh air circulation in an oven or a thermostatically regulated heating mantle up to the reference temperature according to EN 12697-35 or the temperature indicated by the producer.

5.3.2.3 Homogenise the mixture sample for one test cube by stirring in a gently heated bowl until it is thoroughly mixed and capable of being spread. During the procedure a maximum temperature of 240 °C shall not be exceeded.

NOTE Consult national regulation about maximum temperatures. If the mix is spreadable by that temperature, this can be applied instead of 240 °C.

5.3.3 Preparation of laboratory-mixed MA

The laboratory-mixed mastic asphalt shall be prepared in accordance to EN 12697-35. If the reference temperature is higher than 240 °C, the mixture shall be cooled down to 240 °C. Before moulding the mixture shall be homogenised.

5.3.4 Moulding of test cubes

5.3.4.1 Fill the heated test material with a spatula in small portions into a mould (see Figure 1), that has been previously heated to not less than 100 °C but not more than 150 °C.

NOTE It can be advisable to coat the mould in advance with a release agent, such as glycerine or to use waxed paper, to facilitate extraction from the mould.

5.3.4.2 Distribute the mastic asphalt and rod it with a spatula to expel included air voids if present. With the aid of a hardwood tamper, tamp the mass of mastic asphalt flush with the mould, particular care shall be taken in order to ensure that all corners are filled. Form the top of the cube into a slightly raised dome. When the mastic asphalt has cooled sufficiently (after approximately 15 min), smooth the surface with a heated spatula, the mould being taken as a gauge.

5.3.4.3 As soon as the test cube has cooled to a temperature of between 18 °C and 28 °C remove it from the mould and place it on a flat base.

5.4 Cylindrical specimen preparation

For testing asphalt mixtures other than mastic asphalt (MA), compacted specimen according EN 12697-30 by applying 50 blows from each side shall be used.

5.5 Mounting and temperature conditioning of the specimens

5.5.1 Clamp the test cubes in the adjustable mould (see Figure 6) with one side facing downwards (that is perpendicular to the direction of filling). Then place them for the test centrally on the bed plate (3.2.3) with this side uppermost. Test cubes shall not be tested in the mould in which they have been made.

5.5.2 Place the cylindrical specimens, without removing them from their mould, on the intermediate plate (3.2.6).

5.5.3 Condition the specimens together with their moulds, for at least 60 min under water at the test temperature of (40 ± 1) °C or (22 ± 1) °C respectively.

5.6 Application of the force

5.6.1 The adjustable mould for the test cubes and the cylindrical compaction mould of the Impact compactor shall be at least 0,5 mm clear of the bed plate during the test in order to prevent that the mould is supported by the bed plate.

NOTE It is recommended to mould the cube in the adjustable mould (70,0 ± 0,5) mm and to turn the moulded specimen on top.

5.6.2 Place the indentor pin vertically and as centrally as possible on the test cube and first apply the preliminary force of (25 ± 1) N for a period of (10 ± 1) min. Then read the initial value from the displacement transducer and apply the total test force (525 ± 1) N without impact. After further 30 min and 60 min or 120 min or 300 min, all with an accuracy of ± 1 min, read the depth of indentation of the indentor pin to the nearest 0,01 mm.

NOTE It is recommended, for the purposes of preparing a time/indentation graph, that the depth of indentation be read after 1 min, 2 min, 4 min, 8 min, 15 min, 30 min, 60 min and, where appropriate, 120 min and 300 min. The use of a x-y recorder is recommended.

6 Result

The result of the test shall be stated as the arithmetic mean of two separate determinations of the depth of indentation for each application of force, in millimetres, rounded to the nearest 0,1 mm.

7 Precision

Table 2 gives the test precision for tests on mastic asphalt. Precision for tests on cylindrical specimens are not available.

The permissible difference between the separate values taken for the calculation of the arithmetic mean shall be less or equal than 20 % of the numerical value of the result, but at least 0,2 mm.

The information given in Table 2 apply for the arithmetic mean (test result) of two separate values.

Table 2 — Precision

Indentation test on cube specimen	Repeatability		Reproducibility	
	Standard deviation, σ_r	Repeatability	Standard deviation, σ_R	Reproducibility
Percentage of the numerical value of the result	10 %	28 %	20 %	55 %

NOTE The precision data are estimated from DIN 1996-13.

8 Test report

The test report shall include the following information:

a) number code to identify the part of this European Standard;

b) letter code to identify the type of specimen:

- C for a test cube,
- CY for cylindrical specimen;

c) specimen conditioning duration between manufacture and testing;

d) area of base of indentor pin:

- 500 signifying an area of 500 mm^2 (nominal),
- 100 signifying an area of 100 mm^2 (nominal);

e) test temperature,

- 40 signifying (40 ± 1) °C,
- 22 signifying (22 ± 1) °C;

f) test result (indentation in millimetre at the stated time);

g) age of test specimen at test and storage conditions under which it was kept.

NOTE Example of the designation of an indentation test performed on test cubes (C) using an indentor pin with a base area of 500 mm^2 (500), at a test temperature of (40 ± 1) °C:

— Test EN 12697-20 — C 500 — 40

Bibliography

[1] DIN 1996-13, *Prüfung von Asphalt; Eindringversuch mit ebenem Stempel (Testing of asphalt; indentation testing using a flat-ended indentor pin)*

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