BRITISH STANDARD

BS EN
12274-7:2005

Slurry surfacing — Test methods —

Part 7: Shaking abrasion test

The European Standard EN 12274-7:2005 has the status of a British Standard

ICS 93.080.20

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National foreword

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The UK participation in its preparation was entrusted by Technical Committee B/510, Road materials, to Subcommittee B/510/2, Surface dressings, sprays and slurry surfacings, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 15 and a back cover.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 12274-7

May 2005

ICS 93.080.20

English Version

Slurry surfacing - Test methods - Part 7: Shaking abrasion test

Matériaux bitumineux coulés à froid - Méthodes d'essai - Partie 7 : Essai d'abrasion par agitation

Dünne Asphaltschichten in Kaltbauweise - Prüfverfahren - Teil 7: Schüttel-Abriebprüfung

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Foreword

This document (EN 12274-7:2005) 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of an identical text or by endorsement, at the latest by November 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

This document describes a test method for determining the suitability and compatibility of aggregates and emulsions for slurry surfacings.

This European Standard is one of a series of standards as listed below:

EN 12274-1, *Slurry surfacing – Test methods – Part 1: Sampling for binder extraction.*

EN 12274-2, *Slurry surfacing – Test methods – Part 2: Determination of residual binder content.*

EN 12274-3, *Slurry surfacing – Test methods – Part 3: Consistency.*

EN 12274-4, *Slurry surfacing – Test methods – Part 4: Determination of cohesion of the mix.*

EN 12274-5, *Slurry surfacing – Test methods – Part 5: Determination of wearing.*

EN 12274-6, *Slurry surfacing – Test methods – Part 6: Rate of application.*

EN 12274-7, *Slurry surfacing – Test methods – Part 7: Shaking abrasion test.*

prEN 12274-8, *Slurry surfacing – Test methods – Part 8: Visual assessment.*

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1 Scope

This document specifies a test method for determining the suitability of aggregates and cationic emulsions for slurry surfacings and, where appropriate, the effect of individual additives.

This document applies to slurry surfacings.

NOTE 1 The procedure uses a standardized mix composition but the method may also be used to assess the effect of variations in the grading and binder content but this use is not part of the standard.

NOTE 2 Additives affecting the breaking behaviour may also be tested under standardised conditions. The test may also be used to study the effect of a particular type of bitumen or emulsifier.

2 Normative references

The following referenced documents are indispensable for the application 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 12697-6:2003, *Bituminous mixtures — Test methods for hot mix asphalt — Part 6: Determination of bulk density of bituminous specimens*

3 Principle

The shaking abrasion test determines the water sensitivity of mixes for slurry surfacings consisting of 0/2 mm aggregate and cationic emulsion for slurry surfacing.

The test measures the loss of material from standard specimens when cylinders of compacted material are placed in water filled cylinders which are rotated end over end in a suitable device.

The test uses mixtures for slurry surfacing using the materials to be used for producing slurry surfacing but made to a standard grading and binder content prepared at room temperature.

Four 25 mm high cylindrical specimens each with a diameter of 30 mm and prepared using a standardized mix for slurry surfacing are tested in each set of tests. The specimens are statically compacted and then conditioned by storage in water in a vacuum prior to testing.

4 Materials and equipment

4.1 Plastic, glass or porcelain containers with capacities of approximately 0,5 l.

4.2 Stirring spatula (or metal fork).

4.3 Balance accurate to ±0,1 g.

4.4 Warm air dryer.

4.5 Compaction moulds with bedplates (at least 4 are required for each test) (see Figure 1).

4.6 Compaction plugs, one for each compaction mould (see Figure 2).

4.7 Funnel (see Figure 3).

4.8 Press with a load range of 10 kN and an advance speed of 20 mm/min.

4.9 Shaking device (see Figure 4).

4.10 Shaking cylinders (see Figure 5).

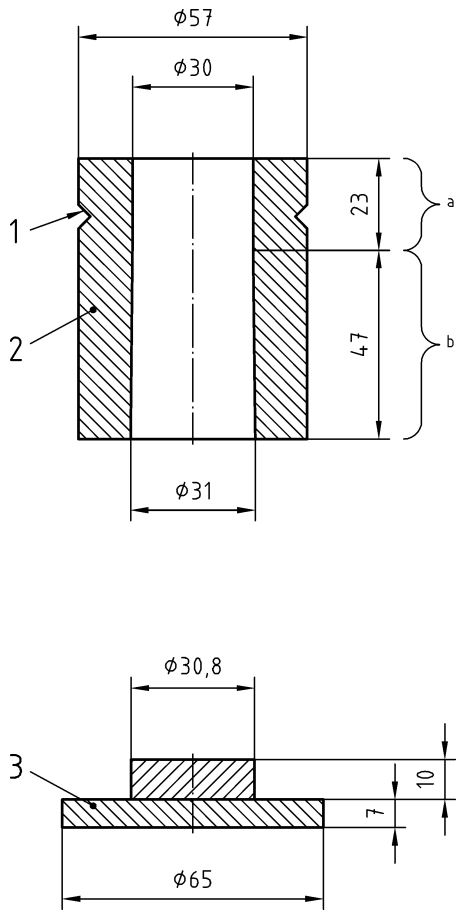
4.11 Vacuum desiccator

4.12 Vacuum gauge accurate to 0,1 kPa.

4.13 Chamois leather cloths

NOTE Information on accuracy and calibration of equipment may be found in EN 12697-38.

Dimensions in millimetres



Key

1 Marking to show direction of filling
2 Compaction mould
a Drilling, ∅ 30
b Conical widening from ∅30 to ∅31
3 Bed plate

Figure 1 — Compaction mould (tolerances ± 0,1)

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Dimensions in millimetres

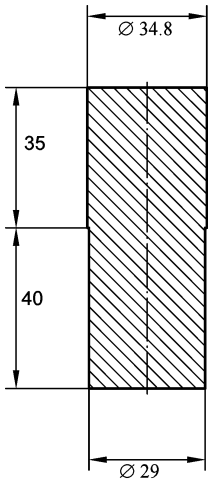

Figure 2 — Compaction mould plug (tolerances ± 0,1)

Dimensions in millimetres

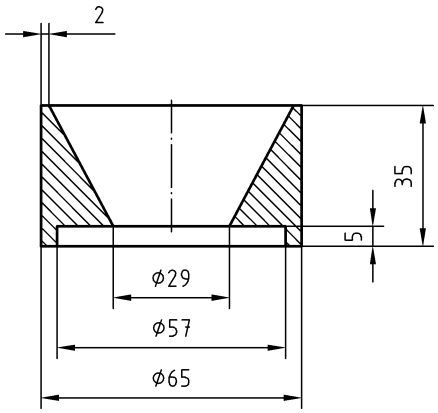

Figure 3 — Example for a funnel for filling the mould (many other designs are suitable) (tolerances ± 0,1)

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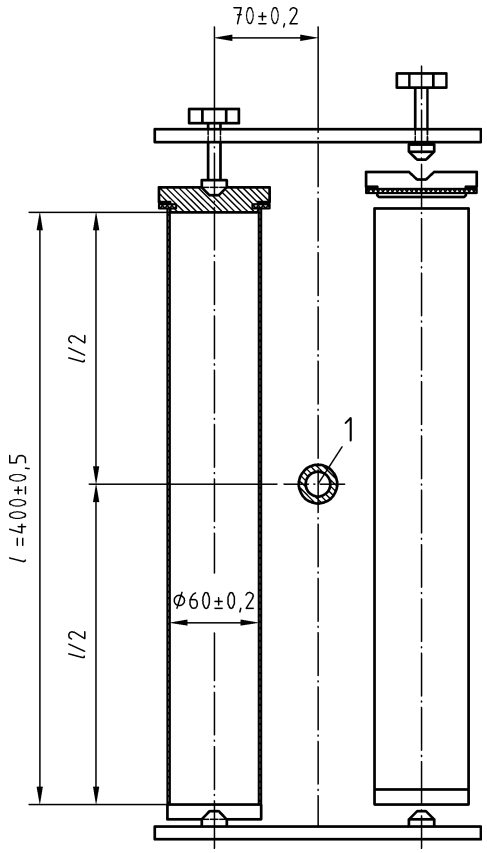
Dimensions in millimetres



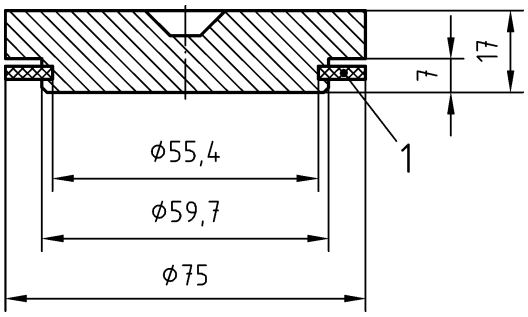
Key

1 Axis of rotation

Figure 4 — General view of cylinder construction

NOTE The cylinder will be replaced when the diameter has worn to 61,0 mm.

Dimensions in millimetres



Key

1 Rubber gasket

Figure 5 — Cylinder cap (tolerances ± 0,1)

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5 Preparation for the test

5.1 Preparation of specimens

5.1.1 General

The mixture under test shall be composed of 0/2 mm aggregate, emulsion for slurry surfacing, water, cement as additive and any other additions.

5.1.2 Grading curve for aggregates

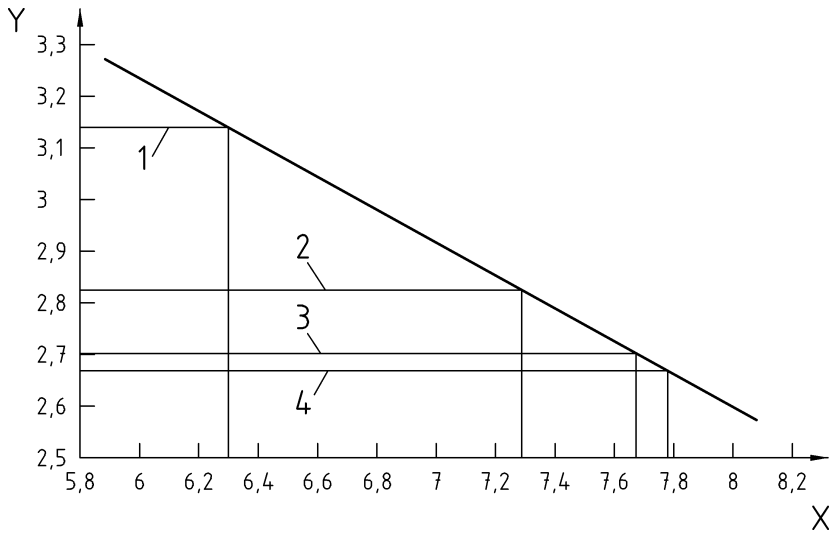
The standardized grading of the aggregates in Table 1 shall be used.

Table 1 — Grading curve

Column	1	2	3
Line	**Lower size of aggregate fraction mm**	**Upper size of aggregate fraction mm**	**Mass of fraction used in the mixture % by mass**
1	0	0,125	23 ± 0,5
2	0,125	0,25	11 ± 0,5
3	0,25	0,5	27 ± 0,5
4	0,5	1,0	21 ± 0,5
5	1,0	2,0	18 ± 0,5
NOTE One part cement used in normal production (CEM I 32,5 R is commonly used) shall be added to 100 parts aggregate.			

5.1.3 Binder content of the mix

The binder content of the dry mixture depends on the density of the aggregate used. The binder content of the slurry surfacing after removal of the water shall be selected from Figure 6 (or calculated in accordance with Equation (1)).



Key

X B = binder content of the dry product, in percentage by mass (%)
Y Density of the aggregate, in grams per cubic centimetre (g/cm^3)
1 Example for aggregate 1
2 Example for aggregate 2
3 Example for aggregate 3
4 Example for aggregate 4

NOTE The aim is to ensure comparability of the results for different types of aggregate for identical volumetric ratios as otherwise the properties of the binder will affect those of the mix (especially with regard to affinity and swelling properties). The diagram shows typical examples of common aggregates.

$$B = 16{,}09 - 3{,}125 \times \rho \quad (1)$$

where

B is the binder content of the dry mixture as a proportion of the density of the dry aggregate, in percentage by mass (%);

ρ is the density of the aggregate, in grams per cubic centimetre (g/cm^3).

Figure 6 — Determination of target binder content as a function of the density of the aggregates

5.2 Production of the mix

The quantity of emulsion-bound 0/2 mix required for a series of four specimens shall be produced manually in a single operation.

The materials used in the mix shall be the same as those intended for use on site. The quantities to be used for each set of four specimens are:

— (200 ± 2) g of the dry aggregate prepared to the standard grading, m_{agg};

— (2 ± 0,1) g of cement, m_{cem};

— w g potable water, usually (40 ± 0,5) % of the mass of dry aggregate;

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An empirical value for the amount of water to be added to the mix is 40g. The amount is dependent on the type of emulsion used and shall be determined by preliminary testing. A mixture time of at least 2 min shall be measured.

m g emulsion for slurry surfacing in accordance with Equation (2):

$$m = \frac{(m_{\text{agg}} + m_{\text{cem}}) \times B}{(100 - B) \times B_{\text{emuls}}} \times 100 \qquad (2)$$

where

m is the mass of emulsion for slurry surfacing to be used, in grams (g);

m_{agg} is the dry mass of aggregate in the mixture, in grams (g);

m_{cem} is the mass of cement in the mixture, in grams (g);

B is the target binder content of the dry product, in percentage by mass (%);

B_{emuls} is the binder content of the emulsion for slurry surfacing, in percentage by mass (%).

The materials shall be placed in the stirring vessel in the following order:

Add the cement to the aggregate and mix; add the water and mix again; add the bitumen emulsion and stir until the mixture is fully broken (speed of manual stirring: approximately 60 rev/min) at this stage the aggregate in the mixture is generally completely coated with binder and the water expelled from the mixture is clear. Partially coated single particles are acceptable. Any free water remaining in the mixing vessel shall be drained off.

The fully broken mixture shall be granulated manually to obtain pieces with a diameter of less than approximately 5 mm.

5.3 Production of test specimens

A series of four specimens shall be prepared, treated and tested at room temperature.

The four compaction moulds and four bed plates shall be at room temperature. The height of each specimen shall be (25 ± 1) mm. The mass of mixture required to provide the correct size of cylinder shall be determined by means of preliminary tests.

The quantity of mixture required for each specimen is placed in the compaction mould by means of the funnel. Preliminary compaction is achieved by lightly tapping the filled mould on the laboratory bench. The compaction plugs are then placed on the moulds and the mix compacted with the press, the advance speed of the compaction plug shall be (20 ± 3) mm/min up to a maximum force of 10 kN. The final load of 10 kN shall be maintained for 1 min. The specimens are then demoulded and any burrs removed (fine sandpaper has been found suitable for this purpose).

6 Test procedure

6.1 Determination of water absorption

6.1.1 Water absorption test

The four test specimens shall be weighed in air and water in accordance with EN 12697-6:2003, method B, except that:

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— the density shall be corrected, if the temperature of the water bath is different from 25 °C by more than 2 °C;

— a chamois leather cloth shall be used to dry the specimen.

The four test specimens shall then be placed in water with a temperature of approximately 1 °C (iced water) in the vacuum desiccator.

The pressure shall be steadily and continuously reduced to $(3 \pm 0{,}1)$ kPa absolute over a period of about 30 min without any sudden reductions in pressure. This pressure shall be maintained for a further period of (150 ± 5) min. The pressure shall be increased to atmospheric in approximately 1 min and the specimens shall be immersed in water for 30 min. The specimens shall be removed from the desiccator and any free water on the surface removed with a damp cloth prior to being reweighed in air and in water.

6.1.2 Equations for water absorption test

$$W_V = \frac{m_{LV} - m_p}{m_{LA} - m_{WA}} \times 100 \qquad \text{for } V_V \le V_A \tag{3}$$

where

W_V is the water absorption, in volume fraction in percent (%);

m_{LA} is the mass of the specimen in air prior to vacuum application, in grams (g);

m_{WA} is the mass of the specimen in water prior to vacuum application, in grams (g);

m_{LV} is the mass of the specimen in air after vacuum application, in grams (g);

m_{WV} is the mass of the specimen in water after vacuum application, in grams (g);

m_p is the mass of the specimen in air prior to testing, in grams (g).

V_A approximately equivalent to $m_{LA} - m_{WA}$ in grams (g), is the volume of the specimen prior to water absorption, in cubic centimetres (cm^3);

V_V approximately equivalent to $m_{LV} - m_{WV}$ in grams (g), is the volume of the specimen after water absorption, in cubic centimetres (cm^3).

W_V shall be calculated by the following equation if the volume of the specimen after vacuum application V_V is greater than the volume of the specimen prior to vacuum application V_A:

$$W_V = \frac{(m_{WV} - m_p) + (m_{LA} - m_{WA})}{m_{LA} - m_{WA}} \times 100 \qquad \text{for } V_V > V_A \tag{4}$$

W_V is the water absorption, in volume fraction in percent (%);

m_{WV} is the mass of the specimen in water after vacuum application, in grams (g);

m_p is the mass of the specimen in air prior to testing, in grams (g);

m_{LA} is the mass of the specimen in air prior to vacuum application, in grams (g);

m_{WA} is the mass of the specimen in water prior to vacuum application, in grams (g);

V_A approximately equivalent to $m_{LA} - m_{WA}$ in grams (g), is the volume of the specimen prior to water absorption, in cubic centimetres (cm^3);

V_V approximately equivalent to $m_{LV} - m_{WV}$ in grams (g), is the volume of the specimen after water absorption, in cubic centimetres (cm^3).

The water absorption W_V shall be given in percentage by volume, rounded to 0,1 % to represent the average of the four individual values obtained.

If the range of the four results for the water absorption exceeds 0,7 % a set of four further specimens shall be manufactured. Alternatively more than four specimens may be made initially and four chosen to continue that have a water absorption within a 0,7 % range.

— Testing error (for water absorption % by volume) under repeatability conditions:

  — Standard deviation σ_r = 0,3 % by volume;

  — Repeatability $r = 2{,}77 \cdot \sigma_r$ = 0,8 % by volume.

— Testing error under reproducibility conditions:

  — Standard deviation σ_R = 0,5 % by volume;

  — Reproducibility $R = 2{,}77 \cdot \sigma_R$ = 1,4 % by volume;

  — Confidence interval $\pm q_R$

    — for a single test result: $\pm q_{R1} = 1{,}96 \cdot \sigma_R = \pm 1{,}0$ % by volume;

    — for two test results: $\pm q_{R2} = 1{,}38 \cdot \sigma_R = \pm 0{,}7$ % by volume;

    — for three test results: $\pm q_{R3} = 1{,}13 \cdot \sigma_R = \pm 0{,}6$ % by volume;

    — for four test results: $\pm q_{R4} = 0{,}98 \cdot \sigma_R = \pm 0{,}5$ % by volume.

6.2 Determination of abrasion

6.2.1 Abrasion test

The test shall be carried out on the 4 chosen specimens immediately upon completion of the procedure described in 6.1. Each test specimen shall be placed in a different shaking cylinder previously filled with (750 ± 5) ml of fresh potable water with a temperature of (25 ± 2) °C. The mechanical shaker shall operate at (20 ± 0,2) rev/min and at room temperature until the total number of revolutions has reached (3 600 ± 10) when the machine shall be stopped and the specimens removed from the cylinders.

All loose material shall be removed from the tested specimens by rinsing. Any free water on the surface shall be removed with a damp cloth and the specimen weighed.

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6.2.2 Equation for abrasion test

$$AR' = \frac{m_f - m_{ar}}{m_f} \times 100 \quad (5)$$

where

AR' is the abrasion of a test specimen, in percentage by mass (%);

m_{LV} is the mass of a wet test specimen prior to abrasion, in grams (g);

m_{ar} is the mass of a wet test specimen after abrasion, in grams (g).

The average abrasion of the four samples, AR, shall be given in percentage by mass, rounded to 0,1 % to represent the average of the four individual values obtained.

If the range of the four results for abrasion exceeds 0,6 % by mass the whole test shall be repeated.

— Testing error under repeatability conditions:

  — Standard deviation σ_r = 0,3 % by mass;

  — Repeatability $r = 2{,}77 \cdot \sigma_r$ = 0,9 % by mass.

— Testing error under reproducibility conditions:

  — Standard deviation σ_R = 0,6 % by mass;

  — Reproducibility $R = 2{,}77 \cdot \sigma_R$ = 1,7 % by mass;

  — Confidence interval $\pm q_R$

    — for a single test result: $\pm q_{R1} = 1{,}96 \cdot \sigma_R = \pm 1{,}2$ % by mass;

    — for two test results: $\pm q_{R2} = 1{,}38 \cdot \sigma_R = \pm 0{,}8$ % by mass;

    — for three test results: $\pm q_{R3} = 1{,}13 \cdot \sigma_R = \pm 0{,}7$ % by mass;

    — for four test results: $\pm q_{R4} = 0{,}98 \cdot \sigma_R = \pm 0{,}6$ % by mass.

7 Record of results

The results shall be recorded using a form including the data required in Annex A.

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Annex A
(informative)

Test record and report expression of results

Aggregate type		Aggregate lab ref		Laboratory test ref		Laboratory	
Type of emulsion		Emulsion lab ref		Date of test		Operator	

		Water Absorption							Abrasion		
		Prior to vacuum			After 3 h vacuum		$V_V < V_a$ [a] [b]	$V_V > V_a$ [a] [c]			
	Sample	Initial mass in air	Initial mass in water	Mass in air before vacuum	Mass in water after vacuum	Mass in air after vacuum	Water absorption	Water absorption	Mass after abrasion	Difference	Abrasion resistance
Sample No	Height, mm	m_p, g	m_{WA}, g	m_{LA}, g	m_{WV}, g	m_{lLV}, g	$w_{V(3h)}$, % by volume	$w_{V(3h)}$, % by volume	m_{ar}, g	g	% by mass
1											
2											
3											
4											
Mean value											

NOTE This form has been found suitable but any other format may be used.

[a] Only one of these columns to be completed for any sample

[b] See equation (3)

[c] see equation (4)

Bibliography

[1] DIN 12775, *Laboratory glassware; laboratory thermometers, scale values 0,1 °C, 0,2 °C, 0,5 °C*

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[3] EN 58, *Bitumen and bituminous binders — Sampling bituminous binders*

[4] EN 932-1, *Tests for general properties of aggregates — Part 1: Methods for sampling*

[5] EN 933-1, *Tests for geometrical properties of aggregates — Part 1: Determination of particle size distribution —Sieving method*

[6] EN 1097-6, *Tests for mechanical and physical properties of aggregates — Part 6: Determination of particle density and water absorption*

[7] EN 12274-1, *Slurry surfacing — Test methods — Part 1: Sampling for binder extraction*

[8] EN 12274-2, *Slurry surfacing — Test methods — Part 2: Determination of residual binder content*

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[10] EN 12697-38, *Bituminous mixtures — Test methods for hot mix asphalt — Part 38: Common equipment and calibration*

[11] ISO 565, *Test sieves — Metal wire cloth, perforated metal plate and electroformed sheet — Nominal sizes of openings*

[12] ISO 3310-1, *Test sieves — Technical requirements and testing — Part 1: Test sieves of metal wire cloth*

[13] ISO 3819, *Laboratory glassware — Beakers*

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