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Aggregates —

Part 9: Guidance on the use of European test method standards

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Foreword

This Published Document has been prepared under the direction of Subcommittee B/502/6, Tests for aggregates. It is one of nine parts that give guidance on the use and application of a series of European Standards for aggregates. These European Standards were prepared by CEN/TC 154, Aggregates, and have been adopted as British Standards. Conflicting British Standards relating to aggregates will be withdrawn at the latest by June 2004.

This part of PD 6682 gives guidance on the use of the following package of European Standards, prepared by CEN/TC 54, that specify test methods for aggregates.

— BS EN 932, *Tests for general properties of aggregates.*

— BS EN 933, *Tests for geometrical properties of aggregates.*

— BS EN 1097, *Tests for mechanical and physical properties of aggregates.*

— BS EN 1367, *Tests for thermal and weathering properties of aggregates.*

— BS EN 1744, *Tests for chemical properties of aggregates.*

— BS EN 13179, *Tests for filler aggregate used in bituminous mixtures.*

This package includes European Standards that supersede conflicting parts of BS 812. The parts of BS 812 that are superseded by European Standards in this package are listed in Annex A and will be withdrawn on 1 June 2004.

NOTE Users of the different parts of BS 812 should contact BSI Customer Services for confirmation of their withdrawal.

Guidance on the other European Standards in the series for aggregates is given in the following parts of PD 6682.

— Part 1: Aggregates for concrete — Guidance on the use of BS EN 12620.

— Part 2: Aggregates for bituminous mixtures and surface treatments for roads, airfields and other trafficked areas — Guidance on the use of BS EN 13043.

— Part 3: Aggregates for mortar — Guidance on the use of BS EN 13139.

— Part 4: Lightweight aggregates for concrete, mortar and grout — Guidance on the use of BS EN 13055-1.

— Part 5: Lightweight aggregates for bituminous mixtures and surface treatments and for unbound and bound applications excluding concrete, mortar and grout — Guidance on the use of BS EN 13055-2.[1)]

— Part 6: Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction — Guidance on the use of BS EN 13242.

— Part 7: Armourstone — Guidance on the use of BS EN 13383 (all parts).

— Part 8: Aggregates for railway track ballast — Guidance on the use of BS EN 13450.

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

This Published Document is not to be regarded as a British Standard.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 29 and a back cover.

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1) Both BS EN 13055-2 and PD 6682-5 are in preparation.

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Introduction

This Published Document provides guidance on the use of a package of European Standards specifying test methods for aggregates. The guidance is aimed primarily at potential UK users of the test methods, but will also be of interest to all in the UK associated with the use of aggregates throughout Europe.

Most of the European test methods for aggregates are based on national test methods from European countries, including UK test methods specified in British Standards. This part of PD 6682 gives a description of each of these European test methods along with guidance on their relevance and familiarity to UK users.

Some general features of the European Standards for aggregates are outlined in Clause **2**. These features make fundamental changes to the way in which aggregates are specified and tested in the UK. Clauses **3** to **8** give guidance on each of the European test method standards for aggregates, BS EN 932, BS EN 933, BS EN 1097, BS EN 1367, BS EN 1744 and BS EN 13179, with the scope of each European Standard reproduced in full.

For European test methods that are based on British Standards, only a brief description of the test method is given along with guidance about any changes that have been introduced and how they affect UK users. Some of the European test methods are similar, in part or in name, to existing British Standard test methods, however the differences are significant enough to necessitate a more detailed description of the test and how its implementation affects UK users.

For European test methods that are relatively new to the UK and are likely to be widely used in the future, a detailed description of the test methods is given in an attempt to anticipate the effects of the introduction of these new test procedures. Other tests, which are also unfamiliar to UK users but are not likely to be widely used in the UK, are described only for completeness.

1 Scope

This part of PD 6682 gives guidance on the use of each of the European test method standards for aggregates, BS EN 932, BS EN 933, BS EN 1097, BS EN 1367, BS EN 1744 and BS EN 13179. These specify tests for the following properties of aggregates:

a) general;

b) geometrical;

c) mechanical and physical;

d) thermal and weathering;

e) chemical;

f) filler aggregate used in bituminous mixtures.

Additional test methods, specific to particular end uses, are not discussed in this part of PD 6682. These tests are specified in BS EN 13055-1:2002, Annex A and Annex B, for lightweight aggregates for concrete, mortar and grout; BS EN 13055-2:2000[2)], Annex A and Annex B, for lightweight aggregates for unbound and bound applications; BS EN 13383-2 for armourstone and BS EN 13450:2002, Annex A, Annex C, Annex D, Annex E, Annex F and Annex G for railway ballast.

2 Overview of European Standards specifying test methods for aggregates

2.1 Test sieves

BS EN 932, BS EN 933, BS EN 1097, BS EN 1367, BS EN 1744 and BS EN 13179 specify the use of perforated plate square hole test sieves conforming to ISO 3310-2 for aperture sizes of ≥ 4 mm. For sieves with an aperture size of <4 mm, they specify the use of woven wire test sieves conforming to ISO 3310-1.

NOTE 1 ISO 3310-1:2000 and ISO 3310-2:1999 are published in the UK as BS 410-1:2000 and BS 410-2:2000.

NOTE 2 The series of European Standards for aggregates specifies sieve size ranges for use in the description of aggregate sizes. Many of these European sieves with an aperture size of ≥ 4 mm are identical to those specified in existing British Standards on aggregates, however some new sieves will be required in the UK because they are not specified in existing British Standards. All British woven wire sieves with an aperture size <4 mm need to be replaced because all the European sieves with an aperture of <4 mm differ from those specified in existing British Standards for aggregates.

2) In preparation.

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2.2 Aperture sizes of test sieves

BS EN 932, BS EN 933, BS EN 1097, BS EN 1367, BS EN 1744 and BS EN 13179 specify the use of test sieves with aperture sizes ranging from 0.063 mm to 125 mm.

BS EN 933-2 requires that test sieves for aggregate tests are selected from the R 20 series specified in ISO 565. The R 20 series of aperture sizes has a step ratio of consecutive aperture sizes of 1.12.

BS EN 933-2 also requires that particle size distributions include, in addition to any other necessary aperture sizes, appropriate sieves between 0.063 mm and 125 mm with a step ratio of 2. This involves the series: 0.063 mm, 0.125 mm, 0.250 mm, 0.500 mm, 1 mm, 2 mm, 4 mm, 8 mm, 16 mm, 31.5 mm, 63 mm and 125 mm.

2.3 Particle size fraction d_i/D_i

Particle size fractions are specified using the designation d_i/D_i representing the sieve aperture D_i through which all the particles in the fraction pass and the sieve aperture d_i on which they are all retained.

Some of the tests for geometrical properties of aggregates involve a preliminary sorting into size fractions d_i/D_i where $D_i \leq 2d_i$, i.e. single size fractions.

2.4 Fines

The fines content is defined as the percentage by mass that passes the 0.063 mm sieve rather than the 0.075 mm sieve used in current British Standards for aggregates.

2.5 Oven drying temperature

The specified temperature for oven drying of aggregate samples is (110 ± 5) °C rather than the current UK practice of (105 ± 5) °C.

2.6 Drying to constant mass

Constant mass is defined in the European Standards for aggregates as successive weighings, after drying, at least 1 h apart, not differing by more than 0.1 %.

The test procedure for the determination of water content of aggregates, as specified in BS EN 1097-5:1999, Clause **7** includes specific requirements for how to achieve constant mass. However, all of the European test method standards that require the determination of constant mass, state that in many cases constant mass can be achieved after a test portion has been dried for a predetermined time in a specified oven at (110 ± 5) °C. Test laboratories may determine the time required to achieve constant mass for specific types and sizes of sample dependent upon the drying capacity of the oven used.

3 Guidance on the use of BS EN 932 — Tests for general properties of aggregates

3.1 Guidance on the use of BS EN 932-1 — Methods for sampling

3.1.1 *Scope of BS EN 932-1*

BS EN 932-1 specifies methods for obtaining samples of aggregates from deliveries, preparation and processing plants including stocks.

The aim of sampling is to obtain a bulk sample that is representative of the average properties of the batch.

The methods specified in BS EN 932-1 are also suitable for obtaining sampling increments that may be tested separately.

Methods to be used for sample reduction are also given.

The methods specified in BS EN 932-1 are based on manual procedures. Mechanical or automatic sampling and sample reduction may also be used. Criteria for the design and the assessment of such equipment are given in BS EN 932-1:1997, Annex A.

The methods specified in BS EN 932-1 are limited to civil engineering purposes.

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3.1.2 *Summary of method*

BS EN 932-1 specifies procedures for sampling from specific types of location, e.g. conveyors, silos, belt and chute discharges, sampling stockpiles, etc., with informative examples of equipment such as sampling scoops, frames, tubes, spears, etc.

BS EN 932-1 also covers the reduction of bulk samples for the production of laboratory samples, nominating rotary sample dividers as the preferred means of sample reduction and giving examples of such dividers for both coarse and fine aggregate sizes. However, operational procedures for the use of rotary sample dividers are included only in BS EN 932-2, which specifies methods for reducing laboratory samples for the production of test portions.

Sample reduction by fractional shovelling and the use of random numbering techniques are also specified in BS EN 932-1. These methods are not specified in the current British Standard for aggregate sampling, BS 812-102.

BS EN 932-1 notes that sampling from stockpiles should, wherever possible, be avoided but includes a method for sampling from flat-topped sampling stockpiles. Guidance on sampling from conical and prismatically shaped stockpiles is given informatively in BS EN 932-1:1997, Annex C.

Guidance on the measurement of sampling variation is given informatively in BS EN 932-1:1997, Annex B. This information provides the user with a procedure that checks whether the number of sampling increments taken is adequate for subsequent test methods.

3.1.3 *Relationship to equivalent British Standards*

BS EN 932-1:1997 partially supersedes BS 812-102:1989, which will be withdrawn on 1 June 2004.

3.1.4 *Implications for the UK*

BS EN 932-1 significantly expands on BS 812-102 by covering a wide range of techniques and equipment for sampling aggregates.

BS 812-102, Appendix A gives guidance on petrological description. In the series of European Standards for aggregates, a procedure and terminology for petrographical description is specified in BS EN 932-3.

The description of particle shape and surface texture in BS 812-102 is not included in similar detail in BS EN 932-1, but BS EN 932-3 requires "brief information" to be given about shape, roundness and surface texture of aggregate particles.

3.2 Guidance on the use of BS EN 932-2 — Methods for reducing laboratory samples

3.2.1 *Scope of BS EN 932-2*

BS EN 932-2 specifies methods for reducing laboratory samples of aggregates to test portions, when the test portion mass is:

a) specified by a lower limit on the mass;

b) specified by a tolerance around a target mass;

c) determined precisely by the requirements of a test method.

3.2.2 *Summary of method*

Each of the European test method standards for aggregates specifies a quantity of material to be tested (a test portion) in one of three ways listed in **3.2.1**. BS EN 932-2 gives methods of preparing test portions to meet each of these different types of test method.

For tests relating to **3.2.1** a), BS EN 932-2:1999, **6.2** specifies a test portion mass yield of 100 % to 150 % of the minimum mass specified by the test method. BS EN 932-2:1999, **6.2** specifies sample reduction by rotary sample divider, riffle box, fractional shovelling or quartering. However, it does not recommend sample reduction by quartering for wide gradings.

For tests relating to **3.2.1** b), BS EN 932-2:1999, **6.3** specifies a test portion mass yield that is within 15 % of the mass specified by the test method. BS EN 932-2:1999, **6.3** specifies sample reduction by rotary sample divider, riffle box or fractional shovelling.

For tests relating to both **3.2.1** a) and b), BS EN 932-2:1999, **6.2** and **6.3** notes that rotary sampling is the preferred procedure for sample reduction.

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For tests relating to **3.2.1** c), BS EN 932-2:1999, Clause **11** specifies the reduction of laboratory samples by a two-stage process. First using a method specified in BS EN 932-2:1999, **6.2** to produce a subsample in excess of the required mass, followed by a technique to further reduce the subsample to the mass required for the test procedure.

Sample reduction with crushing to reduce the particle size and procedures for obtaining duplicate test portions are also included in BS EN 932-2.

3.2.3 *Relationship to equivalent British Standards*

BS EN 932-2:1999 partially supersedes BS 812-102:1989, which will be withdrawn on 1 June 2004.

3.2.4 *Implications for the UK*

BS EN 932-2 specifies, in more detail than existing British Standards, the manner in which laboratory samples are reduced to test portions for use in test methods.

3.3 Guidance on the use of BS EN 932-3 — Procedure and terminology for simplified petrographic description

3.3.1 *Scope of BS EN 932-3*

BS EN 932-3 specifies a basic procedure for the petrographic examination of aggregates for the purposes of general classification. The procedure is not suitable for the detailed petrographical study of aggregates for specific end uses.

NOTE The examination should be carried out by a qualified geologist (petrographer), with experience of materials used in civil engineering.

This European Standard covers only natural aggregates, sand and gravel or crushed rock aggregate as well as their source materials.

3.3.2 *Summary of method*

BS EN 932-3 is intended for the general classification of rocks and aggregates rather than detailed petrographic study for specific end uses.

BS EN 932-3 specifies the minimum mass to be “delivered for examination”. BS EN 932-3 also specifies examination methods for both rock and aggregate samples.

For the examination of aggregate samples, BS EN 932-3 specifies that, in addition to petrographic identification, a description of particle shape, roundness and surface texture is required. BS EN 932-3 also specifies that, for aggregate samples, the degree of weathering and the presence of any exterior coating on the surface of the grains shall be noted.

3.3.3 *Relationship to equivalent British Standards*

BS EN 932-3:1997 partially supersedes BS 812-102:1989, which will be withdrawn on 1 June 2004.

3.3.4 *Implications for the UK*

BS EN 932-3 expands on the simplified procedure for petrographic description in BS 812-102:1989, Appendix A.

BS EN 932-3 requires “brief information” to be given about the surface characteristics of aggregate particles, though not in similar detail as in BS 812-102:1989, Appendix C.

The series of European Standards for aggregates does not include a method for qualitative and quantitative petrographic examination. BS 812-104 describes such a method and as such will remain in use in the UK.

3.4 Guidance on the use of BS EN 932-5 — Common equipment and calibration

3.4.1 *Scope of BS EN 932-5*

BS EN 932-5 specifies general requirements for common equipment, calibration procedures and reagents for the testing of the properties of aggregates.

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3.4.2 *Summary of method*

BS EN 932-5 is based on, and closely follows, the requirements specified in BS 812-100.

BS EN 932-5, **5.5.2** informatively references the International Organization for Legal Metrology (OILM) classification of weights. BS EN 932-5 adopts the OILM classification of weights for the purposes of calibrating and checking measuring instruments.

3.4.3 *Relationship to equivalent British Standards*

BS EN 932-5:2000 supersedes BS 812-100:1990, which will be withdrawn on 1 June 2004.

3.4.4 *Implications for the UK*

BS EN 932-5 simplifies some of the requirements of BS 812-100 and redefines the method for calibration and the methods for checking ovens and test sieves.

3.5 Guidance on the use of BS EN 932-6 — Definitions of repeatability and reproducibility

3.5.1 *Scope of BS EN 932-6:1999*

BS EN 932-6 gives definitions of repeatability and reproducibility adapted from ISO 5725-1 to the specific situation of sampling and testing aggregates.

These adjustments have been made because, contrary to what is specified in ISO 5725-1, test portions or test specimens of aggregates are not usually identical to each other.

3.5.2 *Summary of method*

BS EN 932-6 gives definitions of sampling errors, sample reduction errors and testing variations and definitions of repeatability and reproducibility conditions.

Equations that relate repeatability and reproducibility limits to standard deviations are also included.

3.5.3 *Relationship to equivalent British Standards*

BS EN 932-6:1999 supersedes BS 812-101:1984, which will be withdrawn on 1 June 2004.

3.5.4 *Implications for the UK*

The guidance given in BS 812-101, on general aspects of aggregate sampling and testing and on the significance and precision of test results, is not expressed in similar detail in BS EN 932-6.

4 Guidance on the use of BS EN 933 — Tests for geometrical properties of aggregates

4.1 Guidance on the use of BS EN 933-1 — Determination of particle size distribution — Sieving method

4.1.1 *Scope of BS EN 933-1*

BS EN 933-1 specifies a method, using test sieves, for the determination of the particle size distribution of aggregates. It applies to aggregates of natural or artificial origin, including lightweight aggregates, up to 63 mm nominal size, but excluding filler.

NOTE The determination of the grading of fillers is specified in BS EN 933-10.

4.1.2 *Summary of method*

BS EN 933-1 specifies that the test portion is washed to remove fine particles passing a 0.063 mm sieve. After drying, the remaining material is separated on a series of sieves of decreasing aperture sizes and the particle size distribution is calculated from the percentages by mass retained on each sieve.

4.1.3 *Relationship to equivalent British Standards*

BS EN 933-1:1997 supersedes BS 812-103.1:1985, which will be withdrawn on 1 June 2004.

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4.1.4 *Implications for the UK*

The test procedure specified in BS EN 933-1 is based on the traditional UK method of washing and dry sieving, albeit using sieves of a different series.

The requirements of BS EN 933-1 for the minimum test portion masses and the maximum loading limits of sieves are not identical to BS 812-103.1.

In the UK, aggregates are washed by agitating the test portion with water in a container. However, it should be noted that elsewhere in Europe, whilst aggregates are washed in the same way, the washing process is often completed directly on the guarded 0.063 mm sieve rather than decanting only the wash water and suspended fines. Either process is permitted in BS EN 933-1 with a note that overloading and overflowing should be avoided.

4.2 Guidance on the use of BS EN 933-2 — Determination of particle size distribution — Test sieves, nominal size of apertures

4.2.1 *Scope of BS EN 933-2*

BS EN 933-2 specifies nominal aperture sizes and shape for woven wire cloth and perforated plate in test sieves used for test methods for aggregates.

It applies to aggregates of natural or artificial origin including lightweight aggregates.

4.2.2 *Summary of method*

BS EN 933-2 does not contain a test method, but sets out requirements for test sieves used in the testing of aggregates. The key BS EN 933-2 requirements are listed below.

a) Test sieves shall have square apertures.

b) Sieves with an aperture size of <4 mm shall be woven wire test sieves conforming to ISO 3310-1.

c) Sieves with an aperture size of ≥ 4 mm shall be perforated plate square hole test sieves and shall conform to ISO 3310-2.

NOTE ISO 3310-1 and ISO 3310-2 are published in the UK as BS 410-1:2000 and BS 410-2:2000 respectively.

A standard set of sieves from the R 20 series specified in ISO 565 is listed. These sieves are required to be included when carrying out a particle size distribution, in addition to any other required sieves.

4.2.3 *Relationship to equivalent British Standards*

BS EN 933-2:1999 does not supersede any British Standard.

4.2.4 *Implications for the UK*

The UK practice of using perforated plate square hole sieves rather than woven wire sieves for larger aperture sieves is retained by BS EN 933-2.

NOTE Further guidance on the implications of BS EN 933-2 on sieve use in the UK is given in **2.1**.

4.3 Guidance on the use of BS EN 933-3 — Determination of particle shape — Flakiness index

4.3.1 *Scope of BS EN 933-3*

BS EN 933-3 specifies the procedure for the determination of the flakiness index of aggregate and applies to aggregates of natural or artificial origin, including lightweight aggregates.

The test procedure specified in BS EN 933-3 is not applicable to particle sizes of <4 mm or >80 mm.

4.3.2 *Summary of method*

Test portions are first sorted by sieving into a specific series of particle size fractions.

Each particle size fraction is then sorted by sieving on a bar sieve with parallel slot openings of a width specified for that particle size fraction.

Flaky particles are those which can pass through the slots in the bar sieve.

The flakiness index is calculated as the sum of the masses of the flaky particles in each size fraction as a percentage of the total mass tested.

4.3.3 *Relationship to equivalent British Standards*

BS EN 933-3:1997 supersedes BS 812-105.1:1989, which will be withdrawn on 1 June 2004.

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4.3.4 *Implications for the UK*

BS EN 933-3 categorizes a particle as flaky if its minimum dimension is less than half its upper sieve size (D), as defined by the particle size fraction in which it falls. In terms of the BS 812-105.1 definition, this is effectively equivalent to 0.56 of the particle's mean sieve size.

Limits for flakiness index values for coarse aggregates intended for use in concrete or in bituminous mixtures are specified in BS EN 12620 and BS EN 13043 respectively. The flakiness index test specified in BS EN 933-3 produces lower flakiness index values than the test specified in BS 812-105.1, therefore the limits specified for flakiness in BS EN 12620 and BS EN 13043 are lower than those specified in the existing British Standards for concrete and bituminous mixtures, BS 882 and BS 63.

Test equipment for BS 812-105.1 is not suitable for testing in accordance with BS EN 933-3.

4.4 Guidance on the use of BS EN 933-4 — Determination of particle shape — Shape index

4.4.1 *Scope of BS EN 933-4*

BS EN 933-4 specifies a method for the determination of the shape index of coarse aggregates. It applies to aggregates of natural or artificial origin, including lightweight aggregates.

The test method specified in BS EN 933-4 is applicable to particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

4.4.2 *Summary of method*

Test portions are first sorted by sieving into one or more single particle size fractions, dependent upon the grading of the aggregate under test. Size fractions with few particles are discarded.

The length and thickness of particles in each remaining size fraction is assessed and particles with a length (L) to thickness (E) ratio of >3 are separated and weighed. These particles are classified as non-cubical.

The method suggests that most non-cubical particles with an L/E significantly different from 3 can be identified visually and separated from the test portion. However, a particle slide gauge, with jaws set at a ratio of 3 to 1, is to be used when necessary.

The shape index is calculated as the sum of the masses of the non-cubical particles in each size fraction as a percentage of the total mass tested.

4.4.3 *Relationship to equivalent British Standards*

BS EN 933-4:2000 does not supersede any British Standard.

4.4.4 *Implications for the UK*

Users of this method of characterizing particle shape in mainland Europe have suggested that shape index values often correlate with values of flakiness index.

The series of European Standards on aggregates give the option to determine the shape index value in accordance with BS EN 933-4, only when required by the aggregate user. However, it is unlikely that requirements for the determination of the shape index value will be specified for end uses in the UK for aggregates conforming to this series of European Standards on aggregates. In addition, UK producers are unlikely to routinely provide test data based on this procedure.

It should be noted that the shape index value measured in accordance with BS EN 933-4 is fundamentally different from the elongation index determined in accordance with BS 812-105.2.

4.5 Guidance on the use of BS EN 933-5 — Determination of percentage of crushed and broken surfaces in coarse aggregate particles

4.5.1 *Scope of BS EN 933-5*

BS EN 933-5 specifies a method for the determination of the percentage of particles with crushed and broken surfaces in a sample of natural coarse aggregate. It applies to gravel or mixed aggregate containing gravel.

The test method specified in BS EN 933-5 is applicable to particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

NOTE For aggregate sizes with $D > 63$ mm and/or $d < 4$ mm the test may be carried out on particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

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4.5.2 *Summary of method*

Test portions are first sorted by sieving into one or more particle size fractions, dependent upon the aggregate size (d/D) under test. Size fractions with few particles are discarded.

The test procedure involves the following two stages of hand sorting.

a) Particles in each size fraction are initially sorted into two groups: "crushed or broken" particles (c) and "rounded" particles (r). The mass of each group, M_c and M_r, is recorded.

b) Particles in each of these two groups are then assessed in a second sorting stage in which "totally crushed or broken" particles (tc) and "totally rounded" particles (tr) are separated out. The mass of each group, M_{tc} and M_{tr}, is recorded.

The percentage of particles in each of the four groups (c, r, tc and tr) is calculated from the values for M_c, M_r, M_{tc} and M_{tr}.

4.5.3 *Relationship to equivalent British Standards*

BS EN 933-5:1998 does not supersede any British Standard.

4.5.4 *Implications for the UK*

In some European countries gravel is widely used in asphalt, in surface dressing and in many other applications. The BS EN 933-5 test method was devised to satisfy the various requirements of the different uses of gravel aggregates throughout Europe.

The series of European Standards on aggregates give the option to determine the percentage of particles with crushed and broken surfaces in accordance with BS EN 933-5, only when required by the aggregate user. Of the four groups of particle type identified and measured in the BS EN 933-5 test, only two are likely to be specified in the UK by aggregate users: "crushed or broken" particles (c) and "totally rounded" particles (tr), for particular end uses such as crushed gravel in unbound sub-bases.

4.6 Guidance on the use of BS EN 933-6 — Assessment of surface characteristics — Flow coefficient of aggregates

4.6.1 *Scope of BS EN 933-6*

BS EN 933-6 specifies methods for the determination of the flow coefficient of coarse and fine aggregates. It applies to coarse aggregate of sizes between 4 mm and 20 mm and to fine aggregate of size up to 4 mm.

NOTE 1 For coarse aggregates between 4 mm and 20 mm, the flow coefficient is linked with the percentage of crushed or broken surfaces of an aggregate and can therefore be used in association with the method specified in BS EN 933-5. Shape and surface texture characteristics also influence the result.

NOTE 2 Experience with this test has been generally limited to natural aggregates.

4.6.2 *Summary of methods*

BS EN 933-6 contains two separate test methods for determining the flow coefficient, one for coarse aggregates and one for fine aggregates.

For coarse aggregates a device incorporating a flow channel on a vibrating table is used to time a given mass of particles sliding down the channel. A reference material is used to calibrate the equipment and control the result.

For fine aggregate a much simpler flow unit is used to time a given mass of sand passing through a funnel. No reference material is used.

4.6.3 *Relationship to equivalent British Standards*

BS EN 933-6:2001 does not supersede any British Standard.

4.6.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the flow coefficient of aggregates in accordance with BS EN 933-6, only when required by the aggregate user. In some European countries the flow coefficient of fine aggregate is used in the assessment of sands for asphaltic mixtures and the flow coefficient of coarse aggregate is used in association with the determination of the percentage of crushed and broken surfaces in aggregate particles. However, it is unlikely that requirements for the determination of the flow coefficient will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

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4.7 Guidance on the use of BS EN 933-7 — Determination of shell content — Percentage of shells in coarse aggregate

4.7.1 *Scope of BS EN 933-7*

BS EN 933-7 specifies a method for the determination of shell content of coarse aggregates. It applies to gravel or mixed aggregate containing gravel.

The test method specified in BS EN 933-7 is applicable to particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

NOTE For aggregate sizes with $D > 63$ mm and/or $d < 4$ mm the test may be carried out on particle size fractions d_i/D_i where $D_i \leq 63$ mm and $d_i \geq 4$ mm.

4.7.2 *Summary of method*

Test portions are first sorted by sieving into one or more particle size fractions, dependent upon the aggregate size (d/D) under test. Size fractions with few particles are discarded.

A hand sorting method is then employed to separate out the shells and shell fragments from other particles of aggregate in each size fraction.

Shell content is calculated as the total mass of shells and shell fragments as a percentage of the mass of aggregate tested.

4.7.3 *Relationship to equivalent British Standards*

BS EN 933-7:1998 supersedes BS 812-106:1985, which will be withdrawn on 1 June 2004.

4.7.4 *Implications for the UK*

BS EN 933-7 differs from BS 812-106 in that particles down to 4 mm in size, rather than 5 mm, are used and test portions are separated into size fractions dependent on the aggregate size.

Using BS 812-106, the shell content for each of two size fractions, coarser and finer than 10 mm, is calculated. However, using BS EN 933-7, the overall shell content of the entire coarse aggregate is calculated.

The series of European Standards on aggregates give the option to determine the shell content of coarse aggregates in accordance with BS EN 933-7, only when required by the aggregate user. A limit for shell content is likely to be specified in the UK solely for aggregates for use in concrete in accordance with the limits given in BS EN 12620 and the recommendations given in the accompanying guidance document, PD 6682-1.

4.8 Guidance on the use of BS EN 933-8 — Assessment of fines — Sand equivalent test

4.8.1 *Scope of BS EN 933-8*

BS EN 933-8 specifies a method for the determination of the sand equivalent (*SE*) value of the 0/2 mm fraction in fine aggregates and all-in aggregates. It applies to natural aggregates.

4.8.2 *Summary of method*

The sand equivalent test specified in BS EN 933-8 is performed on a test portion of sand that has not been oven dried.

Test portions are agitated with a small quantity of flocculating solution in a graduated cylinder. The sand is then "irrigated" with more flocculating solution, forcing the finest particles into suspension above the sand.

After leaving the contents of the graduated cylinder to settle for 20 min the *SE* value is calculated as the height of sediment expressed as a percentage of the total height of flocculated material in the cylinder.

4.8.3 *Relationship to equivalent British Standards*

BS EN 933-8:1999 does not supersede any British Standard.

4.8.4 *Implications for the UK*

The sand equivalent test specified in BS EN 933-8 appears similar to the UK field settling test. The field settling test was specified in BS 812-1:1975, which has been withdrawn. It should be noted that even though the field settling test is similar in principle to the BS EN 933-8 test, it is not similar in detail.

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The BS EN 933-8 test method to determine the *SE* value has been produced because, in some European countries, the *SE* value is used to differentiate between aggregates with similar fines content when the fines are of a different nature.

The series of European Standards on aggregates give the option to assess harmful fines content using the sand equivalent test in accordance with BS EN 933-8, only when required by the aggregate user. This test is not considered sufficiently precise for the purpose of determining harmful fines content in fine aggregates. In UK aggregates, the fines content has been considered non-harmful provided the materials conform to the limits for fines content given in the series of European Standards on aggregates. Therefore, it is unlikely that requirements for the determination of the *SE* value will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

4.9 Guidance on the use of BS EN 933-9 — Assessment of fines — Methylene blue test

4.9.1 *Scope of BS EN 933-9*

BS EN 933-9 specifies a method for the determination of the methylene blue (*MB*) value of the 0/2 mm fraction in fine aggregates or all-in aggregates. A procedure for the determination of the methylene blue value of the 0/0.125 mm fraction (MB_F) is specified in BS EN 933-9:1999, Annex A.

4.9.2 *Summary of method*

The BS EN 933-9 procedure involves adding a solution of methylene blue dye to a suspension of the test portion in water.

A stain test is carried out by depositing a drop of the mixture on filter paper. If sufficient clay fines are present to adsorb the dye, a simple blue stain is seen.

More dye is added incrementally until the point is reached when the fines cannot adsorb it all. Free dye can then be seen as a halo around the stain.

The *MB* value is expressed in grams of dye per kilogram of the size fraction tested. It is calculated from the volume of dye needed to produce a halo that persists for a 5 min period.

4.9.3 *Relationship to equivalent British Standards*

BS EN 933-9:1999 does not supersede any British Standard.

4.9.4 *Implications for the UK*

The series of European Standards on aggregates give the option to assess harmful fines content using the methylene blue test in accordance with BS EN 933-9, only when required by the aggregate user. This test is not considered sufficiently precise for the purpose of determining harmful fines content in fine aggregates. In UK aggregates, the fines content has been considered non-harmful provided the materials conform to the limits for fines content given in the series of European Standards on aggregates. Therefore, it is unlikely that requirements for the determination of the *MB* value will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

4.10 Guidance on the use of BS EN 933-10 — Assessment of fines — Grading of fillers (air-jet sieving)

4.10.1 *Scope of BS EN 933-10*

BS EN 933-10 specifies a method using air-jet sieving for the determination of the particle size distribution of fillers by mass. It applies to fillers of natural or artificial origin up to 2 mm nominal size.

4.10.2 *Summary of method*

For a single test portion, the mass of particles retained on three test sieves is determined using an air-jet sieving apparatus.

The test sieves have an aperture size of 0.063 mm, 0.125 mm and 2 mm, each of which are fitted in turn onto the air-jet sieving apparatus in this ascending order of aperture size.

The cumulative percentage of the original dry mass passing each sieve is calculated to determine the particle size distribution of the test portion.

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4.10.3 *Relationship to equivalent British Standards*

BS EN 933-10:2001 does not supersede any British Standard.

NOTE In the UK, air-jet sieving is specified in BS 6463-103 for tests for quicklime, hydrated lime and natural calcium carbonate.

4.10.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the grading of filler aggregates in accordance with BS EN 933-10, only when required by the aggregate user. A limit for this property is only likely to be specified in the UK for filler aggregates for use in bituminous mixtures and surface treatments for roads, airfields and other trafficked areas in accordance with the limits given in BS EN 13043.

5 Guidance on the use of BS EN 1097 — Tests for mechanical and physical properties of aggregates

5.1 Guidance on the use of BS EN 1097-1 — Determination of the resistance to wear (micro-Deval)

5.1.1 *Scope of BS EN 1097-1*

BS EN 1097-1 specifies a procedure for measuring the resistance to wear of a sample of aggregate. The sample is normally tested in a wet condition but the test may also be carried out in a dry condition. BS EN 1097-1 applies to natural or artificial aggregates used in building or civil engineering.

5.1.2 *Summary of method*

The test portion consists of two 500 g test specimens of dry aggregate from the 10/14 mm size fraction with a specified proportion of particles passing the 11.2 mm or 12.5 mm sieve.

Each test specimen is abraded by being rotated at a speed of 100 revolutions per minute for 12 000 revolutions in separate stainless steel drums, each containing 5 kg of steel balls and 2.5 l of water.

After abrading, each test specimen is passed through a 1.6 mm sieve protected by an 8 mm guard sieve and dried. The mass of the test portion retained on the 1.6 mm sieve is used to calculate the micro-Deval coefficient (M_{DE}).

A method to determine the micro-Deval coefficient in a dry condition (M_{DS}), without the addition of water to the drums, is included in BS EN 1097-1:1996, Annex A.

5.1.3 *Relationship to equivalent British Standards*

BS EN 1097-1:1996 does not supersede any British Standard.

5.1.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the micro-Deval coefficient of aggregates in accordance with BS EN 1097-1, only when required by the aggregate user. The micro-Deval coefficient determined in a wet condition (M_{DE}) is used to assess the resistance to wear of an aggregate. It is likely that requirements for the determination of M_{DE} will only be specified for end uses in the UK for unbound and hydraulically bound aggregates conforming to BS EN 13242.

For aggregates for railway ballast, BS EN 13450:2002, Annex E specifies conditions that modify the BS EN 1097-1 test method for determining the micro-Deval coefficient, for example by using 31.5/50 mm aggregate instead of 10/14 mm aggregate and by not using steel balls in the rotating drum. It is unlikely that requirements for the determination of M_{DE} will be specified for end uses in the UK for aggregates for railway ballast conforming to BS EN 13450.

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5.2 Guidance on the use of BS EN 1097-2 — Methods for the determination of resistance to fragmentation

5.2.1 *Scope of BS EN 1097-2*

BS EN 1097-2 specifies procedures for the determination of the resistance of coarse aggregate to fragmentation. Two methods are defined:

a) the Los Angeles test (reference method);

b) the impact test (alternative method).

NOTE The impact test can be used as an alternative to the Los Angeles test but a correlation with the Los Angeles test should first be established to avoid double testing and ensure mutual recognition of results. The Los Angeles test (reference method) should be used in cases of dispute.

BS EN 1097-2 applies to natural or artificial aggregates used in building and civil engineering.

5.2.2 *Summary of method*

In the Los Angeles test, a 5 kg test portion of 10/14 mm aggregate is rotated in a steel drum with a similar mass of large steel balls. The drum has a projecting shelf inside it that helps the steel balls collide with the test portion of aggregate particles when the drum is rotating.

The mass of the test portion retained on a 1.6 mm sieve, after the drum has rotated the test portion for 500 revolutions at a speed of (31 to 33) revolutions per minute, is used to calculate the Los Angeles coefficient (*LA*).

The alternative method of testing for resistance to fragmentation is the impact test. It is derived from a German (DIN) test method that may be used where a correlation exists to the reference Los Angeles test method. This BS EN 1097-2 test requires the use of a large impact testing machine not available in UK test laboratories.

NOTE The BS EN 1097-2 impact test is different to the aggregate impact test specified in BS 812-112.

5.2.3 *Relationship to equivalent British Standards*

BS EN 1097-2:1998 supersedes BS 812-110:1990, BS 812-111:1990 and BS 812-112:1990, which will be withdrawn on 1 June 2004.

5.2.4 *Implications for the UK*

The choice to use the Los Angeles test as the European reference test for the fragmentation resistance of aggregates was confirmed by a comprehensive study commissioned under the European Community Directorate General XXII Measurement and Testing programme [2].

In the UK, this means that the Los Angeles test will be used to determine aggregate fragmentation resistance instead of the tests traditionally used in the UK to define aggregate strength, i.e. the BS 812-110 test for determining the aggregate crushing value (ACV), the BS 812-111 test for determining the ten per cent fines value (TFV) and the BS 812-112 test for determining the aggregate impact value (AIV).

The series of European Standards on aggregates give the option to assess the resistance of fragmentation using the *LA* coefficient in accordance with BS EN 1097-2, only when required by the aggregate user. Limits on the *LA* coefficient are likely to be included for all end uses in UK specifications for coarse aggregates conforming to the series of European Standards on aggregates.

For aggregates for railway ballast, BS EN 13450:2002, Annex C specifies conditions that modify the BS EN 1097-2 test method for determining the *LA* coefficient, for example by using 31.5/50 mm aggregate instead of 10/14 mm aggregate.

The series of European Standards on aggregates also give the option to assess resistance of fragmentation using the impact test in accordance with BS EN 1097-2, only when required by the aggregate user. It is unlikely that requirements for the determination of the impact value using the impact test will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates because the impact test requires specialized equipment only available in Germany.

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5.3 Guidance on the use of BS EN 1097-3 — Determination of loose bulk density and voids

5.3.1 *Scope of BS EN 1097-3*

BS EN 1097-3 specifies the test procedure for the determination of the loose bulk density of dry aggregate and the calculation of voids.

The test is applicable to natural and artificial aggregates up to a maximum size of 63 mm.

A method for the determination of the apparent (bulk) density of filler in kerosene is given in BS EN 1097-3:1998, Annex A.

5.3.2 *Summary of method*

The BS EN 1097-3 procedure for the determination of loose bulk density of dry aggregate is based on that specified for the determination of uncompacted bulk density in BS 812-2:1995, **6.3.4.2**. The main difference is that the BS EN 1097-3 procedure requires the testing of three, rather than two, test specimens.

In BS EN 1097-3, each of the three test specimens is weighed in a watertight cylindrical container. A minimum capacity of the measuring container is specified for different upper sizes of the aggregate to be tested, with each container having a broadly similar ratio of diameter to depth.

The method for determination of apparent (bulk) density of filler in kerosene is specified in BS EN 1097-3:1998, Annex A.

The determination of compacted dry bulk density and the determination of loose bulk density with damp aggregates is referred to informatively in BS EN 1097-3:1998, Annex D.

5.3.3 *Relationship to equivalent British Standards*

BS EN 1097-3:1998 partially supersedes BS 812-2:1995, which will be withdrawn on 1 June 2004.

5.3.4 *Implications for the UK*

Of the containers specified in BS 812-2:1995, Table 1 for use in the determination of loose bulk density only the 10 l container is specified in BS EN 1097-3.

The test methods for the measurement of compacted bulk density and percentage bulking in BS 812-2:1995, Clause **6** are not included in BS EN 1097-3.

The apparent (bulk) density of filler in kerosene, included in BS EN 1097-3:1998, Annex A is based on the method specified in BS 812-2:1995, **6.4**.

The series of European Standards on aggregates give the option to determine the apparent (bulk) density of filler in kerosene in accordance with BS EN 1097-3, only when required by the aggregate user. A limit for this property is likely to be specified in the UK solely for filler aggregates for use in bituminous mixtures and surface treatments for roads, airfields and other trafficked areas in accordance with the limits given in BS EN 13043.

5.4 Guidance on the use of BS EN 1097-4 — Determination of the voids of dry compacted filler

5.4.1 *Scope of BS EN 1097-4*

BS EN 1097-4 specifies the procedure for determining the voids of dry compacted filler by means of a Rigden apparatus. The test is applicable to natural and artificial fillers. It is used for example to determine their bitumen carrying capacity.

5.4.2 *Summary of method*

The BS EN 1097-4 test procedure is based on the procedure specified for the determination of voids in BS 812-2:1995, **6.5**.

BS EN 1097-4 differs from BS 812-2 in that the requirements for the compaction apparatus are not the same, particularly with regards to tolerances, and the void content of the compacted filler is expressed as a percentage rather than as a ratio.

5.4.3 *Relationship to equivalent British Standards*

BS EN 1097-4:1999 partially supersedes BS 812-2:1995, which will be withdrawn on 1 June 2004.

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5.4.4 *Implications for the UK*

The BS EN 1097-4 test for determining the voids of dry compacted filler, together with the "delta ring and ball" test specified in BS EN 13179-1 and the "bitumen number" test specified in BS EN 13179-2, are intended to help in the assessment of the stiffening properties of fillers in bituminous mixtures.

The compaction equipment specified in the BS 812-2 test does not conform to the dimensional requirements for the compaction equipment specified in BS EN 1097-4.

Unlike BS 812-2:1995, **6.5** the results from the BS EN 1097-4 test are expressed as a percentage. Therefore a voids content of 0.11 determined in accordance with BS 812-2:1995, **6.5** would be reported as a voids content of 11 % if determined in accordance with BS EN 1097-4.

The series of European Standards on aggregates give the option to determine voids content in accordance with BS EN 1097-4, only when required by the aggregates user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

5.5 Guidance on the use of BS EN 1097-5 — Determination of water content by drying in a ventilated oven

5.5.1 *Scope of BS EN 1097-5*

BS EN 1097-5 specifies a procedure for determining the water content of aggregates by drying in a ventilated oven.

5.5.2 *Summary of method*

The test method specified in BS EN 1097-5 is based on the "definitive oven-drying method" of determining the moisture content of aggregate specified in BS 812-109:1990, Clause **6**.

BS EN 1097-5 differs from BS 812-109 in that the test portion masses are directly proportioned to the upper aggregate size (D), the temperature of drying is defined as (110 ± 5) °C and a method for drying the test portion to a constant mass is specified.

For lightweight aggregates, BS EN 1097-5:1999, Annex A specifies conditions that modify the BS EN 1097-5 test method for determining water content.

5.5.3 *Relationship to equivalent British Standards*

BS EN 1097-5:1998 supersedes BS 812-109:1990, which will be withdrawn on 1 June 2004.

5.5.4 *Implications for the UK*

In common with other European test method standards for aggregates, BS EN 1097-5 specifies that the temperature for oven drying to constant mass is (110 ± 5) °C rather than the (105 ± 5) °C specified in current British test method standards for aggregates.

BS EN 1097-5 specifies that the minimum mass of the test portion is calculated from the upper aggregate sieve size, instead of using tabulated values as in BS 812-109. In addition, BS EN 1097-5 more closely defines a method of achieving a constant mass. A more detailed description of the European method of achieving constant mass is given in **2.6**.

The "modified drying methods" specified in BS 812-109:1990, Clause **7**, i.e. the high temperature method, the microwave oven method and the calcium carbide method, are superseded by the test methods specified in BS EN 1097-5. Therefore, when the water content is required to be determined for UK aggregates conforming to the series of European Standards on aggregates it is a requirement that the method in BS EN 1097-5 is used.

5.6 Guidance on the use of BS EN 1097-6 — Determination of particle density and water absorption

5.6.1 *Scope of BS EN 1097-6*

BS EN 1097-6 specifies methods for the determination of the particle density and water absorption of aggregates. The first five methods are applicable to normal aggregates with a sixth method for lightweight aggregates.

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The principal methods specified are:

a) a wire basket method for aggregates passing a 63 mm sieve but retained on a 31.5 mm sieve;

b) pyknometer methods for aggregates passing a 31.5 mm sieve but retained on a 0.063 mm sieve.

NOTE 1 The wire basket method may be used as an alternative to the pyknometer method for aggregates between 4 mm and 31.5 mm. In case of dispute, the pyknometer method described in BS EN 1097-6:2000, Clause **8** should be used as the reference method.

NOTE 2 The wire basket method can also be used for single aggregate particles retained on a 63 mm sieve.

A method for the determination of pre-dried particle density of dense aggregates is specified in BS EN 1097-6:2000, Annex A.

NOTE 3 As the absorption of dense aggregates is low, pre-dried particle density can be determined directly in water. This method is different to the determination of particle density on an oven dried basis.

A modified version of the wire basket method suitable for determining the particle density and water absorption of coarse aggregates saturated to constant mass is specified in BS EN 1097-6:2000, Annex B.

For lightweight aggregates, a modified version of the pyknometer test specified in BS EN 1097-6:2000, Annex A is specified in BS EN 1097-6:2000, Annex C.

5.6.2 *Summary of methods*

BS EN 1097-6 specifies a wire basket method and a pyknometer method, for determining particle density and water absorption. These methods are similar to those specified in BS 812-2:1995, Clause **5**.

BS EN 1097-6 includes additional methods for pre-dried, saturated and lightweight aggregates.

5.6.3 *Relationship to equivalent British Standards*

BS EN 1097-6:2000 partially supersedes BS 812-2:1995, which will be withdrawn on 1 June 2004.

5.6.4 *Implications for the UK*

BS EN 1097-6 differs from BS 812-2:1995, Clause **5** in that it specifies the use of test portions with a larger mass and requires water to be used at a temperature of (22 ± 3) °C rather than (20 ± 5) °C.

BS EN 1097-6 also differs from BS 812-2 in that, when calculating the results of the wire basket method, an allowance is made for the density of water at the time of weighing the apparent mass in water.

In addition, BS EN 1097-6 limits the use of the wire basket method to aggregate particles of between 31.5 mm and 63 mm rather than to aggregate particles of larger than 10 mm as permitted in BS 812-2.

Gas jars and preserving jars with metal conical tops satisfy the BS EN 1097-6 requirements for pyknometers if the jars are of suitable volume and if their volume is constant to 0.5 ml for the duration of the proposed test.

The series of European Standards on aggregates give the option to determine particle density and water absorption in accordance with BS EN 1097-6, only when required by the aggregate user. It is unlikely that requirements for these properties will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates. However for some uses, such as unbound aggregates conforming to BS EN 13242 and aggregates for bituminous mixes conforming to BS EN 13043, there is an option to determine water absorption as a screening test for durability assessment, followed by a magnesium sulfate soundness test in accordance with BS EN 1367-2. In these cases it is likely that requirements to determine water absorption will be specified in the UK.

5.7 Guidance on the use of BS EN 1097-7 — Determination of particle density of filler — Pyknometer method

5.7.1 *Scope of BS EN 1097-7*

BS EN 1097-7 specifies the procedure for determining the particle density of filler by means of a pyknometer.

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5.7.2 *Summary of method*

The BS EN 1097-7 procedure for the determination of the particle density of filler is based on the procedure specified for the determination of the particle density of filler in BS 812-2:1995, **5.7.3.3**. The main difference is that the BS EN 1097-7 procedure requires the testing of three, rather than two, test specimens.

5.7.3 *Relationship to equivalent British Standards*

BS EN 1097-7:1999 partially supersedes BS 812-2:1995, which will be withdrawn on 1 June 2004.

5.7.4 *Implications for the UK*

Of all the European Standards on aggregates only BS EN 13043, the specification for aggregates for bituminous mixtures, specifies the determination of particle density of fillers. BS EN 13043 gives the option to determine particle density and water absorption in accordance with BS EN 1097-7, only when required by the aggregate user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

5.8 Guidance on the use of BS EN 1097-8 — Determination of the polished stone value

5.8.1 *Scope of BS EN 1097-8*

BS EN 1097-8 specifies the method for determining the polished stone value (PSV) of a coarse aggregate used in road surfacings. An optional method for the determination of the aggregate abrasion value (AAV) which gives a measure of the resistance of aggregate to surface wear by abrasion under traffic is specified in BS EN 1097-8:2000, Annex A.

NOTE The AAV method should be used when particular types of skid resistant aggregates (typically those with PSV of 60 or greater), which can be susceptible to abrasion under traffic, are required.

5.8.2 *Summary of method*

The BS EN 1097-8 methods for determining the PSV and the AAV are based on the PSV method specified in BS 812-114 and the AAV method specified in BS 812-113. The main difference is that BS EN 1097-8 specifies different tolerances for the polishing apparatus and a different method of calibrating/checking the friction tester.

5.8.3 *Relationship to equivalent British Standards*

BS EN 1097-8:2000 supersedes BS 812-113:1990 and BS 812-114:1989, which will be withdrawn on 1 June 2004.

5.8.4 *Implications for the UK*

The BS EN 1097-8 PSV and AAV test methods are based on test methods specified in BS 812-113 and BS 812-114. Therefore, BS EN 1097-8 requires the use of apparatus that is generally in use in the UK and so testing in accordance with BS EN 1097-8 should present no significant problems. However, some of the apparatus tolerances have been refined and the method of calibrating/checking the friction tester has been changed.

The series of European Standards on aggregates give the option to determine the PSV or AAV in accordance with BS EN 1097-8, only when required by the aggregate user. This property is only likely to be specified in the UK for aggregates for use in running surfaces for roads, airfields and other trafficked areas in accordance with the PSV and AAV categories specified in BS EN 12620 and BS EN 13043. Guidance on the appropriate categories to choose is given in the corresponding UK guidance documents, PD 6682-1 and PD 6682-2.

5.9 Guidance on the use of BS EN 1097-9 — Determination of the resistance to wear by abrasion from studded tyres — Nordic test

5.9.1 *Scope of BS EN 1097-9*

BS EN 1097-9 specifies the test procedure for the simulation of the abrasive action of studded tyres on coarse aggregates used in a surface layer.

The test is applicable to crushed and uncrushed natural and artificial aggregates with a size fraction of 11.2 mm to 16.0 mm.

NOTE Deviations from this size range will not give consistent results.

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5.9.2 *Summary of method*

The test specimen consists of two recombined size fractions: 65 % 11.2/14 mm particle size fraction and 35 % 14/16 mm particle size fraction.

Test specimens are abraded in an internally-ribbed steel drum rotating at a speed of 90 revolutions per minute for 5 400 revolutions with 7 kg of steel balls and 2 l of water. After a specified number of revolutions, the contents are removed from the drum and the Nordic abrasion value (A_N) is calculated as the percentage of the original test portion passing a 2 mm sieve. The A_N value is used in assessing the extent of the wear on the aggregate.

The Nordic abrasion value is determined for two or four test specimens, depending on how closely matched the A_N values are.

5.9.3 *Relationship to equivalent British Standards*

BS EN 1097-9:1998 does not supersede any British Standard.

5.9.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the abrasive action of studded tyres on coarse aggregates in accordance with BS EN 1097-9, only when required by the aggregate user. Except for coarse aggregates intended for use in wearing surfaces in Scandinavia, it is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

5.10 Guidance on the use of BS EN 1097-10 — Determination of water suction height

5.10.1 *Scope of BS EN 1097-10*

BS EN 1097-10 specifies a procedure for determining the water suction height of an aggregate in direct contact with a free water surface.

NOTE The rise of moisture through an aggregate layer under the ground floor of a building can cause moisture problems in the building. If the aggregate layer is thicker than the water suction height of the aggregate used, the layer is considered as a water breaking layer.

5.10.2 *Summary of method*

The BS EN 1097-10 method involves bringing dry aggregate in a tube into direct contact with a free water surface, allowing the aggregate to take up water by suction. When equilibrium is reached, the water suction height is determined by measuring the variation in moisture content within the test portion.

5.10.3 *Relationship to equivalent British Standards*

BS EN 1097-10:2002 does not supersede any British Standard.

5.10.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the water suction height of an aggregate in accordance with BS EN 1097-10, only when required by the aggregate user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

6 Guidance on the use of BS EN 1367 — Tests for thermal and weathering properties of aggregates

6.1 Guidance on the use of BS EN 1367-1 — Determination of resistance to freezing and thawing

6.1.1 *Scope of BS EN 1367-1*

BS EN 1367-1 specifies a test method which provides information on how an aggregate behaves when it is subjected to the cyclic action of freezing and thawing.

NOTE The stresses on aggregates due to frost depend, amongst other factors, on the degree of water saturation as well as the rate of cooling.

The results provide a means for assessing an aggregate's resistance to this form of weathering.

The test is applicable to aggregates having a particle size between 4 mm and 63 mm.

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6.1.2 *Summary of method*

The BS EN 1367-1 test involves freezing water-saturated test portions of single sized aggregates at –17.5 °C and then thawing them at 20 °C. After 10 freeze-thaw cycles the test portion is washed and sieved and the degree of degradation resulting from freeze-thaw (*F*) is calculated as the percentage mass loss of the original test portion.

The BS EN 1367-1 test also provides a method for determining the strength loss of the aggregate after freeze-thaw cycling. The test portions are tested in accordance with the Los Angeles method specified in BS EN 1097-2, with and without the freezing and thawing procedure.

6.1.3 *Relationship to equivalent British Standards*

BS EN 1367-1:2000 does not supersede any British Standard.

6.1.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine resistance to freeze-thaw resistance in accordance with BS EN 1367-1, only when required by the aggregate user. There is limited experience of this BS EN 1367-1 test method for UK sources of aggregates. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

In the UK, when the durability of an aggregate is required to be tested by the aggregate user, it is recommended that this property is assessed in accordance with the magnesium sulfate soundness test in BS EN 1367-2. The BS EN 1367-2 test is based on the BS 812-121 method of soundness testing.

6.2 Guidance on the use of BS EN 1367-2 — Magnesium sulfate test

6.2.1 *Scope of BS EN 1367-2*

BS EN 1367-2 specifies a method for assessing how an aggregate behaves when subjected to the cyclic action of immersion in magnesium sulfate, followed by oven drying.

NOTE The majority of aggregates can be tested for performance using this method. Precision has been established for the rock types listed in BS EN 1367-2:1998, Annex A. The test may not be suitable for all rock types and reservations have been expressed elsewhere in respect of some carbonate aggregates and some aggregates having a high proportion of magnesium bearing minerals or of cryptocrystalline quartz.

6.2.2 *Summary of method*

The BS EN 1367-2 test procedure is based on the method given in BS 812-121. At least two test specimens of aggregate in the size range 10 mm to 14 mm are subjected to five cycles of immersion in a saturated solution of magnesium sulfate, followed by oven drying. Each cycle takes (48 ± 2) h.

Any aggregate degradation is measured by the extent to which material finer than 10 mm in particle size is produced.

The magnesium sulfate (*MS*) value is calculated as the mass of aggregate retained on the 10 mm sieve as a percentage of the initial mass of the test specimen.

6.2.3 *Relationship to equivalent British Standards*

BS EN 1397-2:1998 supersedes BS 812-121:1989, which will be withdrawn on 1 June 2004.

6.2.4 *Implications for the UK*

The BS EN 1367-2 test method is identical to the soundness test in BS 812-121, but it should be noted that the results are calculated in a different manner.

The *MS* value calculated in accordance with BS EN 1367-2 is equivalent to (100 – MSSV) where MSSV is the magnesium sulfate soundness value determined in accordance with BS 812-121.

The series of European Standards on aggregates give the option to determine magnesium sulfate soundness in accordance with BS EN 1367-2, only when required by the aggregate user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates. However for some uses, such as unbound aggregates conforming to BS EN 13242 and aggregates for bituminous mixes conforming to BS EN 13043, there is an option to determine the magnesium sulfate soundness test in the assessment of durability. This is only likely to be a requirement if water absorption values determined in accordance with BS EN 1097-6 exceed a specified limit. Guidance on these limits is given in PD 6682-2 and PD 6682-6.

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6.3 Guidance on the use of BS EN 1367-3 — Boiling test for "Sonnenbrand" basalt

6.3.1 *Scope of BS EN 1367-3*

BS EN 1367-3 specifies methods for the determination of the presence of signs of "Sonnenbrand" in basalt and the disintegration of aggregate produced from basalt showing such signs.

The test is applicable to pieces of rock and graded basalt coarse aggregates.

6.3.2 *Summary of method*

"Sonnenbrand" is defined in BS EN 1367-3:2001, **3.1** as a type of rock decay that can be present in some basalts and which manifests itself under the influence of atmospheric conditions.

The BS EN 1367-3 test method for the visual determination of signs of "Sonnenbrand" is based on the examination of individual pieces of basalt rock that have been boiled for 36 h.

The BS EN 1367-3 test method for determining the loss in mass of basalt aggregate is based on the measurement of the percentage loss in mass of test portions from samples of graded basalt that have been boiled for 36 h.

The BS EN 1367-3 test method for determining the strength loss of basalt aggregate involves the preparation of two test portions of graded basalt in accordance with BS EN 1097-2:1998, **5.2**. One of the test portions is boiled for 36 h. Both test portions are tested in accordance with the Los Angeles test method specified in BS EN 1097-2. Strength loss is determined by comparing the results of the two tests.

6.3.3 *Relationship to equivalent British Standards*

BS EN 1367-3:2001 does not supersede any British Standard.

6.3.4 *Implications for the UK*

BS EN 1367-3:2001, **3.1** notes that "Sonnenbrand" starts with the appearance of grey/white star-shaped spots. Usually hairline cracks are generated radiating out from the spots and interconnecting them. This reduces the strength of the mineral fabric, and as a result the rock decays to small particles.

BS EN 1367-3:2001, **3.1** also notes that, depending on the source, this process can take place within months of extraction or extend over several decades. In exceptional cases a rapid decay results in the formation of large cracks and the breaking of aggregate particles.

The series of European Standards on aggregates give the option to determine for signs of "Sonnenbrand" in accordance with BS EN 1367-3, only when required by the aggregate user. There is no experience of this type of rock decay in the UK. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

6.4 Guidance on the use of BS EN 1367-4 — Determination of drying shrinkage

6.4.1 *Scope of BS EN 1367-4*

BS EN 1367-4 specifies a method for determining the effect of aggregates on the drying shrinkage of concrete.

BS EN 1367-4 is based on the testing of concretes of fixed mix proportions and aggregates of 20 mm maximum size.

NOTE 1 Guidance in the use of larger sizes is given in BS EN 1367-4:1998, Annex A. Precision data is not available for variations in size and for variations in the water content of the test concrete.

NOTE 2 In those cases where the drying shrinkage of a source of coarse aggregate only or a source of fine aggregate (sand) only are required, the other component to be used should be, respectively, a fine or coarse aggregate of known low shrinkage.

6.4.2 *Summary of method*

The BS EN 1367-4 test procedure is based on the method specified in BS 812-120.

An aggregate under test is mixed with cement and water and cast into prisms of specified dimensions.

The prisms are subjected to wetting followed by drying at (110 ± 5) °C and the change in the length from the wet to the dry state is determined.

The excess drying shrinkage of the concrete is attributed to the aggregate, and is expressed as the average change in length of the prisms, as a percentage of their final dry lengths.

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6.4.3 *Relationship to equivalent British Standards*

BS EN 1397-4:1998 supersedes BS 812-120:1989, which will be withdrawn on 1 June 2004.

6.4.4 *Implications for the UK*

BS EN 1367-4 test apparatus only differs from the BS 812-120 apparatus in that, if stainless steel balls are used as measurement location points, the balls are 8 mm in diameter rather than 6 mm.

The BS EN 1367-4 procedure differs from the BS 812-120 procedure in that, when proportioning the aggregates for the manufacture of prisms, the aggregates are combined in such proportions as to meet overall grading limits rather than being combined in fixed proportions of coarse and fine aggregates. Also, BS EN 1367-4 specifies a lower water content value for the prism mix than specified in BS 812-120, with a total water/cement ratio of 0.55 instead of 0.60.

The series of European Standards on aggregates give the option to determine drying shrinkage in accordance with BS EN 1367-4, only when required by the aggregate user. It is likely that requirements for this property will be specified in the UK for concrete aggregates conforming to BS EN 12620. The limits for drying shrinkage specified in BS EN 12620 are the same as the recommendations given in the existing British Standard for concrete, BS 5328-1, and its replacement, BS 8500-1.

6.5 Guidance on the use of BS EN 1367-5 — Determination of resistance to thermal shock

6.5.1 *Scope of BS EN 1367-5*

BS EN 1367-5 specifies methods for the determination of resistance to thermal shock of aggregates, subject to heating and drying in the production of hot bituminous mixtures.

6.5.2 *Summary of method*

BS EN 1367-5:2002, **3.1** defines thermal shock as a change in the physical properties of aggregates subjected to a 700 °C environment for a 3 min time interval.

The BS EN 1367-5 test method involves heating test portions of soaked, surface dry aggregate to 700 °C for 3 min and calculating the increase in undersize passing a 5 mm sieve.

The test method for determining the thermal shock resistance (V_{LA}) involves the preparation of two test portions of aggregate in accordance with BS EN 1097-2. One of the test portions is exposed to thermal shock. Both test portions are tested in accordance with the Los Angeles test method specified in BS EN 1097-2. V_{LA} is determined by comparing the results of the two tests.

6.5.3 *Relationship to equivalent British Standards*

BS EN 1367-5:2002 does not supersede any British Standard.

6.5.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the thermal shock resistance in accordance with BS EN 1367-5, only when required by the aggregate user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

7 Guidance on the use of BS EN 1744 — Tests for chemical properties of aggregates

7.1 Guidance on the use of BS EN 1744-1 — Chemical analysis

7.1.1 *Scope of BS EN 1744-1*

BS EN 1744-1 specifies procedures for the chemical analysis of aggregates. It specifies the reference procedures and, in certain cases, an alternative method which can be considered as giving equivalent results.

If other methods are used it is necessary to show that they give results equivalent to those given by the reference methods.

NOTE In cases of dispute, only the reference procedures should be used.

Unless otherwise stated, the test methods specified in BS EN 1744-1 may be used for factory production control, for audit tests or for type tests.

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7.1.2 *Summary of methods*

BS EN 1744-1 specifies the following test methods.

a) Chemical analysis test methods for determining water-soluble chloride and sulfate content, acid-soluble sulfate and sulfide content, total sulfur content, water solubility and loss on ignition.

NOTE BS EN 1744-1 specifies a reference method and two alternative methods for the determination of water-soluble chloride and sulfate.

b) Two test methods for determining the presence of components that affect the surface finish of concrete: one method for determining the presence of reactive iron sulfides and one for determining the presence of lightweight contaminators.

c) Three test methods for determining the presence of organic components affecting the setting and hardening of cement: one method for the determination of humus content, one for the determination of fulvo acid content and a mortar method.

d) A test method for determinating free lime in steel slag and three tests for determining the unsoundness of blast furnace and steel slags.

NOTE BS EN 1744-1 specifies a reference method and two alternative methods for the determination of free lime in steel slag.

7.1.3 *Relationship to equivalent British Standards*

BS EN 1744-1:1998 supersedes BS 812-117:1988, BS 812-118:1988, BS 812-119:1985 and BS 3797:1990 which will be withdrawn on 1 June 2004.

7.1.4 *Implications for the UK*

Most of the test methods specified in BS EN 1744-1 are based on the existing British Standards that specify test methods for the chemical analysis of aggregates, BS 812-117, BS 812-118, BS 812-119, BS 3797 and BS 1047.

The series of European Standards on aggregates give the option to determine values for chemical properties in accordance with BS EN 1744-1, only when required by the aggregate user. Limits for these chemical properties are likely to be specified, as appropriate, for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

In the UK there is limited experience of testing for the expansion of steel slag in accordance with BS EN 1744-1:1998, **19.3**. Limits are specified for this property in the European Standard for aggregates for bituminous mixtures, BS EN 13043, and the European Standard for unbound aggregates, BS EN 13242. Guidance on these limits is given in PD 6682-2 and PD 6682-6.

7.2 Guidance on the use of BS EN 1744-3 — Preparation of eluates by leaching of aggregates

7.2.1 *Scope of BS EN 1744-3*

BS EN 1744-3 specifies a method for the preparation of eluates, by leaching of aggregates, for subsequent investigation of physical and chemical properties by existing standard methods for the purposes of compliance testing. It applies to unbound aggregates that have a particle size below 32 mm with or without size reduction.

7.2.2 *Summary of method*

BS EN 1744-3 specifies that the aggregate test portion is leached by stirring in water on a screen in a tank for 24 h and a sufficient quantity of eluate drawn off for analysis.

Dependent upon whether the inorganic or organic parameters of the eluate are determined, the eluate is either filtered or centrifuged.

The properties of the eluate can subsequently be measured using methods developed for water analysis that have been adapted for use in the analysis of eluates. The methods used for the analysis of eluates depends on what national regulations exist in the place of use of the aggregate. The filtrate or centrifugate should be analysed immediately after completion of the BS EN 1744-3 test procedure. If this is not possible, it should be preserved.

7.2.3 *Relationship to equivalent British Standards*

BS EN 1744-3:2002 does not supersede any British Standard.

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7.2.4 *Implications for the UK*

Other CEN/TCs have developed short-term leaching procedures. For instance, CEN/TC 292 has devised a test, specified in BS EN 12457, for the leaching of granular waste materials in which the granular waste is first crushed and then agitated with a leachant, causing wet abrasion in the material. Such procedures are justified for waste materials because the characteristics of wastes are frequently unknown. The CEN/TC 292 procedure allows for the waste to be heterogeneous, crushing improves the reproducibility of the results and agitation of the solid ensures good mixing of the test portion.

However, aggregates are not waste materials and it is appropriate to test them in the condition and particle size distribution in which they will be used.

The BS EN 1744-3 leaching procedure relies on an initial wash-off effect and the solubility of components from the outer surfaces of the aggregate particles and comprises a reproducible leaching test suitable for the production control of aggregates.

7.3 prEN 1744-4[3)] — Determination of water susceptibility of fillers for bituminous mixtures

NOTE This test method is still under development by CEN/TC 154. **7.3.1** and **7.3.2** below are therefore subject to change.

7.3.1 *Scope of prEN 1744-4*[3)]

prEN 1744-4 specifies the procedure for the determination of the water susceptibility of fillers for bituminous mixtures, by separation of filler from a bitumen filler mixture. An optional method for the determination of the volume increase of a Marshall specimen (VIM) which gives a measure of the influence of fillers on the durability of an asphalt under water conditions, is specified in prEN 1744-4:2001, Annex A.

NOTE The VIM method should be used:

a) when the filler in prEN 1744-4:2001, **5.5** separates; or

b) in the case of medium or strong turbidity of the water; or

c) when the result of the water susceptibility (W_S) exceeds a required value according to the particular application or end use.

7.3.2 *Summary of method*

A test portion of filler is stirred in water at 60 °C with low viscosity bitumen. If uncoated filler has not separated from the mixture, the water susceptibility of the filler is reported as 0 %.

However, if uncoated filler has become separated from the mixture (indicated by turbidity of the water), the water susceptibility of the filler is determined by filtration.

7.3.3 *Relationship to equivalent British Standards*

prEN 1744-4:2001[3)] does not supersede any British Standard.

7.3.4 *Implications for the UK*

The European Standard on aggregates for use in bituminous mixtures, BS EN 13043, gives the option to determine the water susceptibility of fillers for bituminous mixtures in accordance with prEN 1744-4, only when required by the aggregate user. However it is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to BS EN 13043.

[3)] In preparation.

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8 Guidance on the use of BS EN 13179 — Tests for filler aggregate used in bituminous mixtures

8.1 Guidance on the use of BS EN 13179-1 — Delta ring and ball test

8.1.1 *Scope of BS EN 13179-1*

BS EN 13179-1 specifies the procedure used to determine the stiffening effect of filler aggregate when mixed with bitumen.

8.1.2 *Summary of method*

BS EN 13179-1 specifies a ring and ball test method for determining the softening point of a test portion of bitumen and the softening point of a mixture, by volume, of 37.5 % filler and 62.5 % bitumen. The stiffening effect of the filler aggregate ($\Delta_{R \text{ and } B}$) is the difference between the two softening point temperatures.

8.1.3 *Relationship to equivalent British Standards*

BS EN 13179-1:2000 does not supersede any British Standard.

8.1.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the stiffening effect of filler aggregate when mixed with bitumen in accordance with BS EN 13179-1, only when required by the aggregate user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

8.2 Guidance on the use of BS EN 13179-2 — Bitumen number

8.2.1 *Scope of BS EN 13179-2*

BS EN 13179-2 specifies the procedure for determining the apparent viscosity of a water-filler aggregate mixture, expressed numerically.

The test procedure is applicable to filler aggregates used in bituminous mixtures to regulate production control.

8.2.2 *Summary of method*

A mixture of demineralized water and 50 g of undried filler is placed in a cylindrical cup in a penetrometer. The needle holder of the penetrometer is replaced by a round aluminium stamp with a diameter of 8 mm and a mass of 15 g. The aluminium stamp penetrates into the mixture for 5 s.

The amount of water required for the stamp to penetrate into the mixture by between 5.0 mm and 7.0 mm is determined. The bitumen number (*BN*) is calculated as twice the volume of water, in millilitres, needed to achieve this level of penetration.

The numerical value of *BN* obtained is taken as a measure of the apparent viscosity of the water-filler aggregate mixture.

8.2.3 *Relationship to equivalent British Standards*

BS EN 13179-2:2000 does not supersede any British Standard.

8.2.4 *Implications for the UK*

The series of European Standards on aggregates give the option to determine the bitumen number in accordance with BS EN 13179-2, only when required by the aggregate user. It is unlikely that requirements for this property will be specified for end uses in the UK for aggregates conforming to the series of European Standards on aggregates.

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Annex A (informative)
British and European standards specifying test methods for aggregates

Existing British Standards specifying test methods for aggregates are listed alongside their equivalent European Standards in Table A.1.

Table A.1 — Comparative list of British Standards and their equivalent European Standards

British Standards		Equivalent European Standards
BS 812-2	Determination of density	BS EN 1097-3, BS EN 1097-4, BS EN 1097-6, BS EN 1097-7
BS 812-100	Apparatus and calibration	BS EN 932-5
BS 812-101	Guide to sampling and testing	BS EN 932-6
BS 812-102	Methods for sampling	BS EN 932-1, BS EN 932-2, BS EN 932-3
BS 812-103.1	Sieve tests	BS EN 933-1
BS 812-103.2	Sedimentation test	No equivalent BS EN
BS 812-104	Petrographic examination	No equivalent BS EN
BS 812-105.1	Flakiness index	BS EN 933-3
BS 812-105.2	Elongation index	No equivalent BS EN
BS 812-106	Shell content	BS EN 933-7
BS 812-109	Moisture content	BS EN 1097-5
BS 812-110	Aggregate crushing value	BS EN 1097-2
BS 812-111	Ten per cent fines value	BS EN 1097-2
BS 812-112	Aggregate impact value	BS EN 1097-2
BS 812-113	Aggregate abrasion value	BS EN 1097-8
BS 812-114	Polished stone value	BS EN 1097-8
BS 812-117	Water soluble chloride salts	BS EN 1744-1
BS 812-118	Sulfate content	BS EN 1744-1
BS 812-119	Acid-soluble material in fine aggregate	BS EN 196-21[a], BS EN 1744-1
BS 812-120	Drying shrinkage for concrete aggregate	BS EN 1367-4
BS 812-121	Soundness	BS EN 1367-2
BS 812-123	ASR prism method	No equivalent BS EN
BS 812-124	Frost heave	No equivalent BS EN
BS 1047	Blast-furnace slag	BS EN 1744-1[b]
BS 3797	Lightweight aggregates	BS EN 1744-1
BS 5835-1	Compactibility test for graded aggregates	prEN 13286-4[4)]
BS 7943	ASR petrographical	No equivalent BS EN
DD 249	ASR mortar bar method	No equivalent BS EN

[a] BS EN 196-21 does not supersede BS 812-119 but it does contain similar provisions.
[b] BS EN 1744-1:1998 does not supersede BS 1047 but it does contain similar provisions.

[4)] In preparation.

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European Standards specifying test methods for aggregates are listed alongside their equivalent British Standards in Table A.2.

Table A.2 — Comparative list of European Standards and their equivalent British Standards

European Standards		Equivalent British Standards
BS EN 932-1	Methods for sampling	BS 812-102
BS EN 932-2	Methods for reducing laboratory samples	BS 812-102
BS EN 932-3	Simplified petrographic description	BS 812-102
BS EN 932-5	Common equipment and calibration	BS 812-100
BS EN 932-6	Definitions of repeatability and reproducibility	BS 812-101
BS EN 933-1	Particle size distribution – sieving method	BS 812-103.1
BS EN 933-2	Test sieves, nominal size of apertures	No equivalent BS
BS EN 933-3	Flakiness index	BS 812-105.1
BS EN 933-4	Shape index	No equivalent BS
BS EN 933-5	Crushed and broken surfaces in coarse aggregate particles	No equivalent BS
BS EN 933-6	Flow coefficient of aggregates	No equivalent BS
BS EN 933-7	Shell content in coarse aggregates	BS 812-106
BS EN 933-8	Sand equivalent test	No equivalent BS
BS EN 933-9	Methylene blue test	No equivalent BS
BS EN 933-10	Grading of fillers (air-jet sieving)	No equivalent BS
BS EN 1097-1	Resistance to wear (micro-Deval)	No equivalent BS
BS EN 1097-2	Resistance to fragmentation	BS 812-110, BS 812-111, BS 812-112
BS EN 1097-3	Loose bulk density and voids	BS 812-2
BS EN 1097-4	Voids of dry compacted filler	BS 812-2
BS EN 1097-5	Water content by drying in a ventilated oven	BS 812-109
BS EN 1097-6	Particle density and water absorption	BS 812-2
BS EN 1097-7	Particle density of filler – pyknometer method	BS 812-2
BS EN 1097-8	Polished stone value	BS 812-113, BS 812-114
BS EN 1097-9	Abrasion from studded tyres test – Nordic test	No equivalent BS
BS EN 1097-10	Water suction height	No equivalent BS
BS EN 1367-1	Resistance to freezing and thawing	No equivalent BS
BS EN 1367-2	Magnesium sulfate test	BS 812-121
BS EN 1367-3	Boiling test for “Sonnenbrand” basalt	No equivalent BS
BS EN 1367-4	Drying shrinkage	BS 812-120
BS EN 1367-5	Resistance to thermal shock	No equivalent BS
BS EN 1744-1	Chemical analysis	BS 812-117, BS 812-118, BS 812-119, BS 3797
BS EN 1744-3	Preparation of eluates by leaching of aggregates	No equivalent BS
prEN 1744-4[5)]	Water susceptibility of fillers for bituminous mixtures	No equivalent BS
BS EN 13179-1	Delta ring and ball test	No equivalent BS
BS EN 13179-2	Bitumen number	No equivalent BS

[5)] In preparation.

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