

# Testing aggregates —

## Part 105: Methods for determination of particle shape —

### Section 105.1 Flakiness index

UDC [625.07 + 691.22]:620.191.355

# Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Cement, Gypsum, Aggregates and Quarry Products Standards Policy Committee (CAB/-) to Technical Committee CAB/2, upon which the following bodies were represented:

Aggregate Concrete Block Association  
 Association of Consulting Engineers  
 Association of Consulting Scientists  
 Association of Lightweight Aggregate Manufacturers  
 Brick Development Association  
 British Aggregate Construction Materials Industries  
 British Cement Association  
 British Ceramic Research Ltd.  
 British Civil Engineering Test Equipment Manufacturers' Association  
 British Geological Sciences  
 British Precast Concrete Federation Ltd.  
 British Ready Mixed Concrete Association  
 British Steel Industry  
 Building Employers Confederation  
 Calcium Silicate Brick Association Limited  
 Chartered Institute of Building  
 Concrete Society  
 County Surveyors' Society  
 Department of the Environment (Building Research Establishment)  
 Department of the Environment (Property Services Agency)  
 Department of Transport (Transport and Road Research Laboratory)  
 Electricity Supply Industry in England and Wales  
 Federation of Civil Engineering Contractors  
 Institute of Concrete Technology  
 Institution of Civil Engineers  
 Institution of Highways and Transportation  
 Institution of Structural Engineers  
 Institution of Water and Environmental Management (IWEM)  
 Mortar Producers' Association Limited  
 Sand and Gravel Association Limited  
 Society of Chemical Industry

This British Standard, having been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on  
 31 January 1990

© BSI 02-2000

First published March 1985  
 New edition January 1990

The following BSI references relate to the work on this standard:  
 Committee reference CAB/2  
 Draft for comment 89/10123 DC

ISBN 0 580 17923 0

## Amendments issued since publication

Amd. No.	Date of issue	Comments

# Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
<hr/>	
1 Scope	1
2 Definitions	1
3 Principle	1
4 Sampling	1
5 Apparatus	1
6 Preparation of test portion	1
7 Procedure	2
8 Calculation and expression of results	3
9 Precision	3
10 Test report	3
<hr/>	
Figure 1 — Thickness gauge	2
<hr/>	
Table 1 — Particulars of sieves	1
Table 2 — Minimum mass of test portion	1
Table 3 — Data for determination of flakiness index	2
Table 4 — Precision data for determination of flakiness index	3
<hr/>	
Publications referred to	Inside back cover
<hr/>	

## Foreword

This Section of BS 812 has been prepared under the direction of the Cement, Gypsum, Aggregates and Quarry Products Standards Policy Committee. This is a new edition of this Section of BS 812. This edition introduces technical changes to bring the standard up-to-date but it does not reflect a full review of the standard, which will be undertaken in due course. BS 812-105.1:1985 was a revision of 7.3 of BS 812-1:1975 and in this edition the specification for the thickness gauge used in the method, and the procedure, have been revised to reflect current practice. The associated test for angularity number given in the 1975 edition of BS 812-1 was not included in the 1985 revision because of lack of use. The test for elongation index is under consideration as Section 105.2 of this standard.

The remainder of the 1975 edition is being revised and as each of the tests, or collection of related tests, is revised it is intended to issue it as a separate Part or Section of the standard.

As part of the new approach to harmonization and standards in Europe, work on testing of aggregates will become part of the programme of work to be undertaken in CEN/TC 154, Aggregates. If this method is to be included in that programme then, under the CEN Regulations, it will become subject to standstill. The standstill is an obligation on the part of members of CEN/CENELEC not to publish, during a given period, a new or revised national standard which is not completely in line with a European Standard (EN) or a Harmonized Document (HD) in existence or in preparation; or to take any other action which could prejudice the intended harmonization. The next edition of this standard could therefore be a dual British/European (EN) Standard. It is intended that other British Standards should call up BS 812 test methods as the basis of compliance. Nevertheless, it is *not* intended that all aggregates should be subjected regularly to all the listed tests. Specifications in other standards will refer only to the relevant test methods.

Some of the tests in other Parts of this standard are of limited application, and advice on the use of simpler tests is given, for example when they can be used for a preliminary sorting of aggregates to see whether more expensive testing is justified.

Reference should be made to BS 812-101 for general guidance on testing aggregates, precision of test methods and variance arising from sampling errors. A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

### Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 4, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

## 1 Scope

This Section of BS 812 describes the method for determining the flakiness index of coarse aggregate.

NOTE The titles of publications referred to in this standard are listed on the inside back cover.

## 2 Definitions

For the purposes of this Section of BS 812 the definitions given in BS 812-101 and BS 812-102 apply.

## 3 Principle

Aggregate particles are classified as flaky when they have a thickness (smallest dimension) of less than 0.6 of their mean sieve size, this size being taken as the mean of the limiting sieve apertures used for determining the size fraction in which the particle occurs. The flakiness index of an aggregate sample is found by separating the flaky particles and expressing their mass as a percentage of the mass of the sample tested. The test is not applicable to material passing a 6.30 mm BS test sieve or retained on a 63.0 mm BS test sieve.

## 4 Sampling

The sample used for the test (the laboratory sample) shall be taken in accordance with the procedure described in clause 5 of BS 812-102:1989.

## 5 Apparatus

**5.1** A *sample divider*, of size appropriate to the maximum particle size to be handled or alternatively a flat shovel and a clean, flat, hard horizontal surface, e.g. a metal tray for use in quartering.

NOTE A suitable divider is the riffle box illustrated in BS 812-102.

**5.2** A *ventilated oven*, thermostatically controlled to maintain a temperature of  $105 \pm 5$  °C.

**5.3** A *balance, or balances*, of suitable capacity accurate to 0.1 % of the mass of the test portion.

NOTE In general two balances, one of approximately 5 kg capacity accurate to 1 g and the other of approximately 500 g capacity accurate to 0.1 g, will suffice. If aggregate of larger than 28 mm nominal size is to be tested a balance of 50 kg capacity accurate to 10 g will also be required.

**5.4** *Test sieves*, of the sizes and apertures appropriate to the specification of the material being tested, complying with BS 410 and with the appropriate sizes of lids and receivers.

NOTE A set of sieves of the sizes and apertures given in Table 1 will cover most applications of the method.

**Table 1 — Particulars of sieves**

Nominal aperture sizes (Square hole perforated plate 450 mm or 300 mm diameter)
mm
63.0
50.0
37.5
28.0
20.0
14.0
10.0
6.30

**5.5** A *mechanical sieve shaker* (optional).

**5.6** *Trays*, of suitable size, which can be heated in the ventilated oven (5.2) without damage or change in mass.

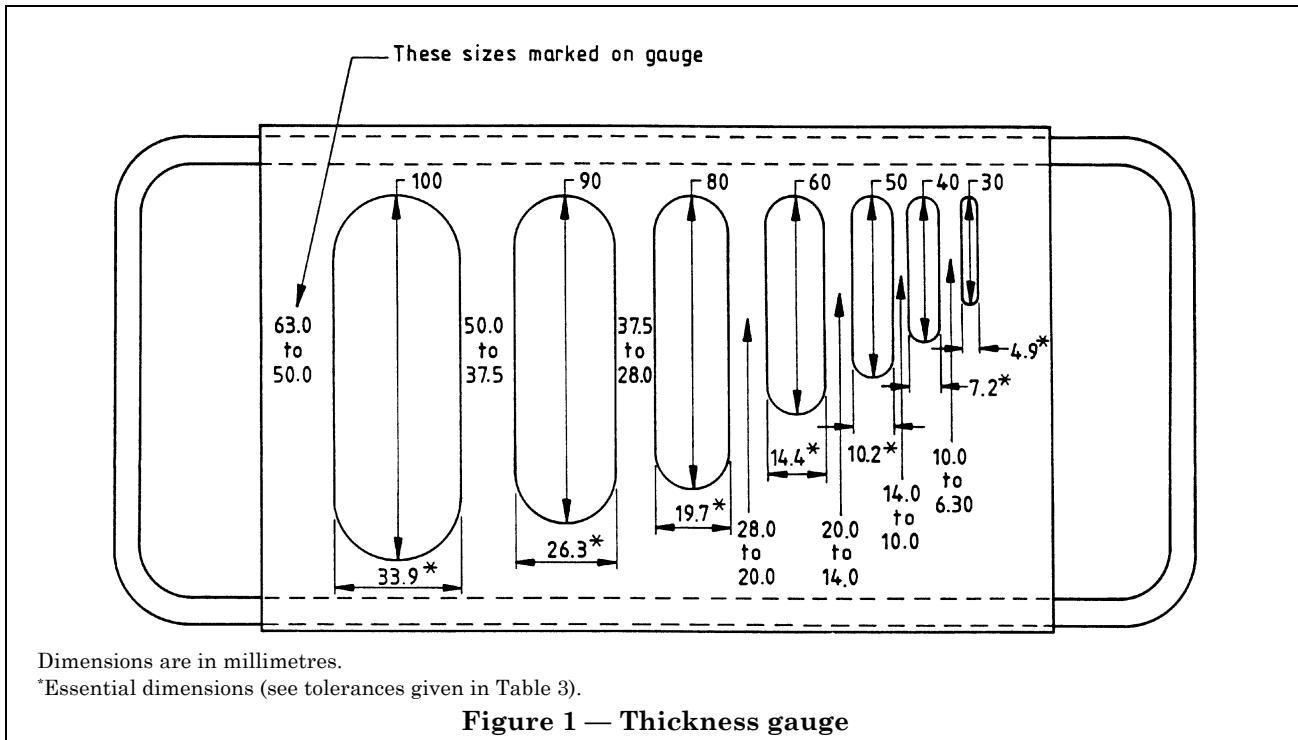
**5.7** A *metal thickness gauge*, of the pattern shown in Figure 1 or similar, or special sieves having elongated apertures. Special sieves for each aggregate size fraction shall have elongated apertures of the dimensions shown in Figure 1 for the relevant size fraction. The width and length of the apertures in the thickness gauge and in the sieves shall be within the tolerances given in Table 3. The gauge shall be made from 1.5 mm thickness sheet steel.

## 6 Preparation of test portion

Reduce the sample by the procedures described in clause 6 of BS 812-102:1989 to produce a test portion that complies with Table 2 with due allowance for the later rejection of particles retained on a 63.0 mm test sieve and passing a 6.30 mm test sieve. Dry the test portion by heating at a temperature of  $105 \pm 5$  °C to achieve a dry mass which is constant to within 0.1 %. Allow to cool and weigh.

**Table 2 — Minimum mass of test portion**

Nominal size of material	Minimum mass of test portion after rejection of oversize and undersize particles
mm	kg
50	35
40	15
28	5
20	2
14	1
10	0.5



## 7 Procedure

**7.1** Carry out a sieve analysis in accordance with 7.3 of BS 812-103.1:1985 using the sieves given in Table 1 of that standard.

NOTE For aggregates which may contain clay or other materials likely to cause agglomeration of particles, a sieve analysis in accordance with 7.2 of BS 812-103.1:1985 should be used.

Discard all aggregates retained on the 63.0 mm test sieve and all aggregate passing the 6.30 mm test sieve.

**Table 3 — Data for determination of flakiness index**

Aggregate size-fraction		Width of slot in thickness gauge or special sieve	Minimum mass for subdivision
BS test sieve nominal aperture size			
100 % passing	100 % retained		
mm	mm	mm	kg
63.0	50.0	33.9 ± 0.3	50
50.0	37.5	26.3 ± 0.3	35
37.5	28.0	19.7 ± 0.3	15
28.0	20.0	14.4 ± 0.15	5
20.0	14.0	10.2 ± 0.15	2
14.0	10.0	7.2 ± 0.1	1
10.0	6.30	4.9 ± 0.1	0.5

**7.2** Weigh each of the individual size-fractions retained on the sieves, other than the 63.0 mm BS test sieve, and store them in separate trays with their size marked on the trays.

NOTE Where the mass of any size-fraction is considered to be excessive, the fraction may be subdivided by the methods described in clause 6 of BS 812-102:1989 provided that the mass of the subdivided fraction is not less than half the appropriate mass given in Table 3. Under such circumstances the rest of the procedure should be suitably modified and the appropriate correction factor applied to determine the mass of flaky particles that would have been obtained had the whole of the original size-fraction been gauged.

**7.3** From the sums of the masses of the fractions in the trays ( $M_1$ ), calculate the individual percentage retained on each of the various sieves. Discard any fraction whose mass is 5 % or less of mass  $M_1$ . Record the mass remaining ( $M_2$ ).

**7.4** Gauge each fraction by using either of the procedures given in 7.4.1 and 7.4.2.

**7.4.1** Using the special sieves, select the special sieve (see 5.7) appropriate to the size-fraction under test. Place the whole of the size-fraction into the sieve and shake the sieve until the majority of the flaky particles have passed through the slots. Then gauge the particles retained by hand.

**7.4.2** Using the gauge, select the thickness gauge (see 5.7) appropriate to the size-fraction under test and gauge each particle of that size-fraction separately by hand.

**7.5** Combine and weigh all the particles passing each of the gauges ( $M_3$ ).

NOTE If required, a flakiness index may be determined separately for individual size-fractions by recording separately the masses of the individual size-fractions and the masses of each size-fraction passing the appropriate gauges.

## 8 Calculation and expression of results

The value of the flakiness index is calculated from the expression:

$$\text{Flakiness index} = \frac{M_3}{M_2} \times 100$$

Express the flakiness index to the nearest whole number.

NOTE When the flakiness index has been determined for individual size-fractions (see note to 7.5), the overall flakiness index of the aggregate is calculated by summing the appropriate masses ( $M_2$ ,  $M_3$  etc.) or as the weighted average of the individual size-fractions.

## 9 Precision

Estimates of the repeatability and reproducibility of the determination of the flakiness index are given in Table 4.

NOTE A limited amount of data obtained using the methods described in this standard is available and this is included in Table 4. Reference should be made to BS 812-101 for guidance on assessing the precision of the methods given in this standard.

**Table 4 — Precision data for determination of flakiness index**

Level	$r$	$r_1$	$R$	$R_1$	$R_2$	$V_s$
14 to 17	—	4.9	—	9.1	—	—

NOTE The precision data were determined from an experiment conducted in 1982 involving eight laboratories. Each laboratory tested duplicate samples of a) basalt and b) sandstone 14 mm single sized aggregate. The mean values were similar and there was no statistically significant difference in the precision data for the two aggregates.

## 10 Test report

The test report shall affirm that the flakiness index was determined in accordance with this Section of BS 812 and whether or not a certificate of sampling is available. If available, a copy of the certificate of sampling shall be provided. The test report shall include the following additional information:

- sample identification;
- flakiness index;
- sieve analysis obtained from this test.





## Publications referred to

BS 410, *Specification for test sieves.*

BS 812, *Testing aggregates.*

BS 812-101, *Guide to sampling and testing aggregates.*

BS 812-102, *Methods for sampling.*

BS 812-103, *Methods for determination of particle size distribution.*

BS 812-103.1, *Sieve tests.*

BS 812-105, *Methods for determination of particle shape.*

BS 812-105.2, *Elongation index of coarse aggregate*<sup>1)</sup>.

---

<sup>1)</sup> In preparation, referred to in the foreword only.

---

---

## BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

### Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

### Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

### Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

### Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

If permission is granted, the terms may include royalty payments or a licensing agreement. Details and advice can be obtained from the Copyright Manager. Tel: 020 8996 7070.