

AS 1141.11.1:2020



STANDARDS
Australia



Methods for sampling and testing aggregates

Method 11.1: Particle size distribution — Sieving method



AS 1141.11.1:2020

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Methods for sampling and testing aggregates

Method 11.1: Particle size distribution — Sieving method

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Preface

This Standard was prepared by the Standards Australia Committee CE-012, Aggregates and Rock for Engineering Purposes, to supersede AS 1141.11.1—2009.

The objective of this document is to define procedures for measuring the particle size distribution of aggregate samples produced from rock, gravel, sand and recycled aggregate sources. The samples may be either plant produced, or laboratory crushed. The method uses standardized sieves in sizes between 75 mm and 75 μm .

The major changes in this edition are as follows:

- (a) Addition of a Preface.
- (b) Additional terms and definitions, see [Clause 3](#).
- (c) Addition of a new clause on sampling, see [Clause 5](#).
- (d) Addition of mandatory washing where testing evaluates a specification requirement for the passing 75 μm sieve, see [Clause 6.6](#).

The term “informative” is used in Standards to define the application of the appendices to which it applies. An “informative” appendix is only for information and guidance.

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Australian Standard®

Methods for sampling and testing aggregates

Method 11.1: Particle size distribution — Sieving method

1 Scope

This document sets out the method for the determination of particle size distribution in coarse and fine aggregates by sieving. The amount passing a 75 µm sieve may be determined using AS 1141.12 or by the method given in this document when samples are washed over a 75 µm sieve. If the percentage of material passing a 75 µm sieve is specified, the procedures detailed in [Clause 6.6](#) of this method or in AS 1141.12 apply.

The procedure for the determination of fine particle size distribution by decantation is described in AS 1141.19.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents referenced for informative purposes are listed in the Bibliography.

AS 1141.1, *Methods for sampling and testing aggregates, Part 1: Definitions*

AS 1141.2, *Methods for sampling and testing aggregates, Method 2: Basic testing equipment*

AS 1141.3.1, *Methods for sampling and testing aggregates, Method 3.1: Sampling — Aggregates*

AS 1141.3.2, *Methods for sampling and testing aggregates, Method 3.2: Sampling — Rock spalls and boulders*

3 Terms and definitions

For the purposes of this document, the terms and definitions of AS 1141.1 and those below apply.

3.1

may

indicates the existence of an option

3.2

shall

indicates that a statement is mandatory

3.3

should

indicates a recommendation

4 Apparatus

4.1 Required equipment

Apparatus conforming to the relevant specifications of AS 1141.2 and the following shall be used:

- (a) *Balances* — Sufficient capacity with a limit of performance not exceeding ± 5 g for the coarse fraction of aggregate and ± 0.5 g for the fine fraction of aggregate and fillers.

- (b) *Drying oven* — Thermostatically controlled and capable of maintaining a temperature within the range of 105 °C to 110 °C.

NOTE 1 It is preferable that drying ovens be equipped with forced air circulation. This shortens drying times and helps prevent the build-up of humidity within the oven enclosure.

NOTE 2 Material may be dried to constant mass using alternative methods such as microwave ovens, infrared lights or hot plates, provided that these techniques do not disrupt or weaken particles to the extent that the property being measured changes.

- (c) *Sample divider*.
- (d) *Sieves* — Test sieves as listed in [Table 2](#).
- (e) *Brush* — A soft, fine brush.

4.2 Optional equipment

The following apparatus is highly useful especially for laboratories conducting a large number of tests. However, the procedure can be completed using hand sieving methods without the need for the apparatus listed below:

- (a) *Mechanical sieve shaker* — Sieve shakers suitable for 200 mm, 300 mm sieves and 450 mm sieves.
- (b) *Air-jet sieve* — For sieving fillers.
- (c) *Dispersing agent* — If the procedures of [Clause 6.6\(a\)](#) are followed, and clay is present in the sample, a dispersing agent (for example, sodium hexametaphosphate) may be required.

5 Sampling

Where applicable, samples shall be taken in accordance with AS 1141.3.1 or AS 1141.3.2 or other recognized sampling methods.

6 Preparation of test portion

6.1 General

The minimum mass of test portion taken shall be in accordance with the nominal size of the aggregate in [Table 1](#). The required test portion shall be obtained by sample division, no attempt being made to secure an exact predetermined mass.

Table 1 — Minimum mass of test portion for sieving

Test portion description	Nominal size of aggregate								Fine aggregate	Fillers
	75 mm	40 mm	28 mm	20 mm	14 mm	10 mm	7 mm	5 mm		
Graded aggregate	30 kg	15 kg	5 kg	3 kg	1.5 kg	800 g	500 g	300 g	150 g	25 g
One-sized aggregate	25 kg	10 kg	4 kg	1.5 kg	700 g	500 g	300 g	200 g	100 g	—

6.2 Mixtures of coarse and fine aggregates

Mixtures of coarse and fine aggregates shall be separated into two sizes using a 4.75 mm test sieve. The portions obtained shall be measured out and tested separately. The size of the test portion for each fraction shall be in accordance with [Table 1](#).

NOTE The percentage passing each sieve should be calculated on the basis of the total mass of the test portion making appropriate calculations to take into account the ratio of the mass of the fine fraction tested to the total material.

6.3 Preparation of test portion

Test portions may be tested without further preparation or may be washed over a 75 µm sieve after drying, see [Clause 6.6](#).

6.4 Fillers for asphalt

Fillers for asphalt shall be separated on a 600 µm test sieve from material passing a 4.75 mm test sieve.

6.5 Drying

The test portions shall be dried to constant mass. The mass of each fraction or test portion (M_1) shall be determined and recorded.

6.6 Washing

With the exception of asphalt fillers (see [Clause 7](#), Note 2) where an aggregate sample is tested for comparison with a document in which the passing 75 µm size is specified, the test portion shall be washed over a 75 µm sieve as follows:

- (a) Place the dried test portion in a dish or pan and add sufficient clean water to cover it.

NOTE 1 For materials that contain clay, a dispersing agent that does not react with the test portion may be used.

NOTE 2 The water used should not react with the aggregate.

- (b) Vigorously agitate the contents without spilling the water to take the fine material into suspension and immediately pour the wash water through two sieves nested together with a guard sieve, e.g. 1.18 mm sieve, at the top and a 75 µm sieve below. Avoid, as far as possible, decantation of the coarse particles of the test portion.

- (c) Continue agitation and washing until the water is clear in the pan. Wash all the remaining test portion over the nested guard sieve and 75 µm sieve using a low-pressure water jet. Ensure that no material is lost from the sides of the sieves. Use small portions for each washing to avoid overloading of the sieves.

NOTE 3 Where the amount of material finer than 2 µm is to be determined, the wash water from Steps (b) and (c) may be retained for use with the AS 1141.13 method. If a soluble, non-volatile dispersing agent has been used in Step (a), the result of AS 1141.13 is to be corrected proportionally for the mass of agent used.

- (d) Dry the washed aggregate to constant mass. Determine and record the mass of the dried, washed aggregate (M_2).

7 Procedure

The test procedure shall be as follows:

- (a) Nest the required sieves in order of decreasing size of opening from top to bottom.

- (b) Place the test portion in the top sieve.
- (c) Agitate the sieves, either by hand or mechanically.

The determination of the time period for operation of each individual mechanical sieve shaker shall give the same separation as hand sieving.

Material shall not be forced through sieves by hand pressure. On sieves of aperture 19.0 mm and greater, hand-placing of particles, to facilitate passage of particles through the sieve shall be permitted.

When sieving fine materials, such as fillers for asphalt, the underside of the sieves may be lightly brushed with a soft, fine brush to prevent aggregation of particles (balling) and blocking of some of a sieve's apertures with sample particles (blinding) of the apertures. The following also applies:

- (i) Care shall be taken not to apply pressure to the surface of the sieve.
- (ii) Brushes with stiff or worn-down bristles shall not be used.
- (iii) Alternatively, an air-jet sieve may be used.

Hand sieving shall be completed when no more than an additional 1 % by mass of the residue on any individual sieve passes during a further 1 min of continuous hand sieving.

NOTE 1 Refer to ISO 2591-1 for a full description of hand sieving.

NOTE 2 In the case of fillers for asphalt or of other similarly fine materials, the sample should not be washed, since washing usually causes balling of the finest fractions and consequent blinding of the sieve apertures. In addition, some fillers either react with or are partially dissolved by water.

Fillers may be sieved over the fine sieves, including the 75 µm sieve, using an air-jet sieve apparatus.

- (d) Determine the mass of material retained on each sieve and ensure that this mass does not exceed that specified in [Table 2](#).

NOTE 3 In production testing of aggregates, if the amount of material likely to be retained on any one sieve does not exceed the amount specified in [Table 2](#), cumulative measuring of the material retained may be performed.

- (e) If the mass of material retained on any one sieve exceeds the permissible mass for that sieve, as shown in [Table 2](#), divide the material retained on the sieve concerned into sub-portions, none of which shall exceed the permissible mass shown in [Table 2](#). Retest as follows:
 - (i) Re-sieve each sub-portion for not less than 2 min.
 - (ii) Sum the masses of material retained for each sieving.
 - (iii) Determine this sum as the mass of material retained on the sieve.

NOTE 4 In some cases, the volume rather than the mass of material permitted on each sieve in one sieving operation may become excessive. This applies to materials of low bulk density such as fly ash used as a filler in asphalt.

Table 2 — Maximum mass of material retained on completion of sieving operation

Sieve aperture size	Maximum mass permitted		
	g		
	450 mm diameter sieve	300 mm diameter sieve	200 mm diameter sieve
75.0 mm	6 000	3 000	1 000
53.0 mm	5 500	2 750	1 000
37.5 mm	5 000	2 200	1 000
26.5 mm	4 000	1 800	800
19.0 mm	3 000	1 200	600
13.2 mm	2 000	900	400
9.50 mm	1 500	600	250
6.70 mm	1 250	500	225
4.75 mm	1 000	400	200
2.36 mm	600	300	150
1.18 mm	400	200	100
600 µm	—	150	75
425 µm	—	120	60
300 µm	—	100	50
150 µm	—	80	40
75 µm	—	50	25

8 Calculations

The percentage mass of material passing each sieve shall be calculated on the basis of the total mass of the sample, including any material washed through the 75 µm sieve.

NOTE A typical work sheet for particle size distribution by sieving is shown in [Appendix A](#).

9 Test report

The following shall be reported:

- (a) Sample identification.
- (b) Date tested.
- (c) Sampling method (if known), e.g. AS 1141.3.1, Clause 8.4.
- (d) Percentage of material passing each sieve, to the nearest whole number.
- (e) Whether the sample has been washed or not washed.
- (f) Method of drying, if other than oven-drying at 105 °C to 110 °C.
- (g) Number of this Australian Standard, i.e. AS 1141.11.1:2020.

Appendix A (informative)

Work sheet for particle distribution by sieving

300 mm dia. sieves						
Initial dry mass				3 212 g	M_1	
Dry mass after washing on 75 µm sieve				3 013 g	M_2	
Mass washed through 75 µm sieve $M_3 = (M_1 - M_2)$				199 g	M_3	
200 mm dia. sieves						
Mass of material quartered from 300 mm dia. pan				170.0 g	M_5	
Equivalent unwashed mass passing $M_6 = (M_3 + M_4) \times \frac{M_5}{M_4}$				192.9 g	M_6	
Mass washed through 75 µm sieve $M_7 = (M_6 - M_5)$				22.9 g	M_7	
Equivalent initial dry mass $M_8 = M_1 \times \frac{M_5}{M_4}$				370.2 g	M_8	
Max. sieve overload mass permitted (g)		Sieve aperture size (mm)	Mass retained (g)	Mass passing (g)	Percent of total passing (%)	
300 mm dia. sieve	200 mm dia. sieve					
Initial grading — using 300 mm dia. sieves						
2 200	1 000	37.5	0	3 212	100	Mass passing/ M_1
1 800	800	26.5	0	3 212	100	
1 200	600	19.0	146	3 066	95	
900	600	13.2	431	2 635	82	
600	250	9.5	386	2 249	70	
500	225	6.7	213	2 036	63	
400	200	4.75	362	1 674	52	
300 mm dia. pan			1 475	—		M_4
Total 300 mm dia. grading			3 013	Check = M_2		
Sample retained on 300 mm dia. pan is quartered to avoid overloading						
Subsequent grading — using 200 mm dia. sieves						
300	150	2.36	48.5	144.4	39	Mass passing/ M_8
200	100	1.18	26.5	117.9	32	
150	75	600 µm	28.7	89.2	24	
100	50	300 µm	33.4	55.8	15	
80	40	150 µm	23.2	32.6	9	
50	25	75 µm	9.4	23.2	6	
200 mm dia. pan			0.3	—		M_9
Total 200 mm dia. grading			170	Check = M_5		

Total mass passing last 300 mm dia. sieve ($M_3 + M_4$)	1 674 g
Total mass passing last 200 mm dia. sieve ($M_7 + M_9$)	23.2 g

Bibliography

AS 1141.12, *Methods for sampling and testing aggregates, Method 12: Materials finer than 75 μm in aggregates (by washing)*

AS 1141.13, *Methods for sampling and testing aggregates, Method 13: Material finer than 2 μm*

AS 1141.19, *Methods for sampling and testing aggregates, Method 19: Fine particle size distribution in road materials by sieving and decantation*

ISO 2591-1, *Test sieving — Part 1: Methods using test sieves of woven wire cloth and perforated metal plate*

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