



Aggregates and rock for engineering purposes

Part 1: Concrete aggregates



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- Australian Chamber of Commerce and Industry
- Australian Geomechanics Society
- Austroads
- Bureau of Steel Manufacturers of Australia
- Cement Concrete and Aggregates Australia
- Engineering and Construction Laboratories Association
- Institute of Quarrying Australia
- National Association of Testing Authorities Australia
- Rail Industry Safety and Standards Board

A1

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Australian Standard[®]

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Part 1: Concrete aggregates

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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 2758.1—1998.

This Standard incorporates Amendment No. 1 (October 2016). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This Standard is part of a series that covers specification for aggregates and rock, as follows:

AS

2758	Aggregates and rocks for engineering purposes
2758.0	Part 0: Definitions and classification
2758.1	Part 1: Concrete aggregates (this Standard)
2758.2	Part 2: Aggregate for sprayed bituminous surfacing
2758.4	Part 4: Aggregate for gabion baskets and wire mattresses
2758.5	Part 5: Asphalt aggregates
2758.6	Part 6: Guidelines for the specification of armourstone
2758.7	Part 7: Railway ballast

This Standard is called up by AS 3600, *Concrete structures*. In this Standard, extensive reference is made to AS 1141, *Methods for sampling and testing aggregates* (series), which is designed to include all aggregate tests, not only those for concrete.

This revision of AS 2758.1 has introduced the following changes to the 1998 edition:

- (a) A note to the scope advising of the application of the specification to individual components of a concrete mix and the subsequent need for concrete mix design.
- (b) Removal of specified aggregate gradings, recognizing the wide variety of gradings in use in Australia. The assumption is made that a supply agreement will exist between the aggregate supplier and the concrete producer and that what must be specified is the deviations in the agreed gradings. Aggregate gradings are recommended in informative Appendix B.
- (c) A full specification for manufactured fine aggregate has been included.
- (d) Specification requirements for testing, classifying and reporting the potential for aggregates to react with the alkalis in the concrete mix are included. Requirements for dealing with aggregates that are classified as reactive to alkalis in concrete are included by linking requirements to the specifications in AS 1379, *Specification and supply of concrete*.

This specification has relevance to aggregate suppliers and concrete suppliers. It will also be of relevance to specifiers of concrete, consultants, contractors, manufacturers and suppliers of precast concrete products and asset owners, all of whom may be concerned with the properties of aggregates used in production of concrete or concrete products used for engineering purposes

One normative appendix and two informative appendices are included as follows:

- (i) The exposure classifications of concrete structures, in accordance with AS 3600, which may impact on the properties of aggregate required for satisfactory performance (Appendix A, normative).
- (ii) Advice on suitable standard aggregate gradings where this information is not provided in a supply agreement, or where parties to a supply agreement are seeking guidance on suitable grading envelopes (Appendix B, informative).

- (iii) Guidance on mitigative procedures for the control of alkali-silica reactivity, including details of procedures used by State road authorities on the East Coast of Australia (Appendix C, informative).

The terms 'normative' and 'informative' have been used in this Standard to define the application of the appendix to which they apply. A 'normative' appendix is an integral part of a Standard, whereas an 'informative' appendix is only for information and guidance.

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STANDARDS AUSTRALIA

Australian Standard

Aggregates and rock for engineering purposes

Part 1: Concrete aggregates

1 SCOPE

This Standard provides a basis for specifying requirements for aggregates intended for use in the production of concrete, including precast products. The requirements and alternatives relate to—

- (a) the quality of rock;
- (b) the potential for reaction between the aggregate and other components of the concrete mix; and
- (c) the properties of aggregates including lightweight aggregates and manufactured fine aggregate, referring to the relevant test methods in the AS 1141 series, the AS 1012 series and AS 4489.7.1 and to the requirements and recommendations for the production of concrete in AS 1379 and AS 3600.

NOTE: This Standard specifies the requirements for the individual aggregate components used to produce a concrete mix. At the very least, the mix will comprise one coarse and one fine aggregate component, but many mixes will include multiple coarse and fine aggregates. The Standard is based on the successful use of individual components, complying with the properties specified; however, it is not possible for this Standard to consider the performance of all possible combinations of aggregates. Therefore, although a material complying with this Standard should be acceptable as a mix component, the selection and proportions of the components in the concrete mix will need to be determined by trial mixes and/or from records of field performance.

2 APPLICATION

This Standard is intended to be used in combination with a works specification for contract purposes. While a number of the basic requirements are not negotiable, the specifier may select from the options available in this Standard, or use alternative test methods and limits (which may be from Australian Standards or other appropriate Standards) for incorporation into the works specification.

The basic requirements for all concrete aggregates are prescribed in Clauses 7 to 14. Additional basic requirements for slag and lightweight aggregates are prescribed in Clauses 15 and 16 respectively. Alternatives are presented for the assessment of durability in Clause 9. However, not more than one of these alternatives should be specified for routine supply from a known aggregate source.

The selection of test procedures and test limits, where alternatives are provided, and the frequency at which individual tests are required, is a subject of the individual supply agreement.

The works specification should specify all the tests appropriate to the source rock or the tender samples, or both, but the whole range of tests is not necessarily applied to control acceptance of the product during the performance of a contract.

For contractual purposes, it is the works specification that is binding; however, the case may arise where a contract document uses phrases such as ‘material complying with AS 2758.1’ without providing a supply agreement. In this event, the supplier needs to obtain further details from the purchaser. In the continued absence of a supply agreement, material will be deemed to comply with this Standard if the supplier can show that the material to be supplied—

- (a) is of normal weight;
- (b) fulfils the requirements for aggregate to be used in concrete in B1 and B2 exposure classifications; and
- (c) complies with Clauses 7 to 15 inclusive of this Standard.

3 REFERENCED DOCUMENTS

The following documents are referred to in this Standard:

AS

A1	1012	Methods of testing concrete
	1012.20.1	Method 20.1: Determination of chloride and sulfate in hardened concrete and aggregates—Nitric acid extraction method
	1012.20.2	Method 20.2: Determination of water-soluble chloride in aggregates and hardened concrete
	1141	Methods for sampling and testing aggregates
	1141.3.1	Method 3.1: Sampling—Aggregates
	1141.3.2	Method 3.2: Sampling—Rock spalls and boulders
	1141.4	Method 4: Bulk density of aggregate
	1141.5	Method 5: Particle density and water absorption of fine aggregate
	1141.6.1	Method 6.1: Particle density and water absorption of coarse aggregate—Weighing-in-water method
	1141.6.2	Method 6.2: Particle density and water absorption of coarse aggregate—Pycnometer method
	1141.11.1	Method 11.1: Particle size distribution—Sieving method
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	1141.15	Method 15: Flakiness index
	1141.22	Method 22: Wet/dry strength variation
	1141.23	Method 23: Los Angeles value
	1141.24	Method 24: Aggregate soundness—Evaluation by exposure to sodium sulphate solution
	1141.25.3	Method 25.3: Degradation factor—Fine aggregate
	1141.30.1	Method 30.1: Coarse aggregate quality by visual comparison
	1141.31	Method 31: Light particles
	1141.32	Method 32: Weak particles (including clay lumps, soft and friable particles) in coarse aggregates
	1141.34	Method 34: Organic impurities other than sugar
	1141.35	Method 35: Sugar
	1141.37	Method 37: Iron unsoundness
	1141.60.1	Method 60.1: Potential alkali-silica reactivity—Accelerated mortar bar method
	1141.60.2	Method 60.2: Potential alkali-silica reactivity—Concrete prism method
	1141.66	Method 66: Methylene blue adsorption value of fine aggregate and mineral fillers

AS

1379—2007 Specification and supply of concrete

2758 Aggregate and rock for engineering purposes

2758.0 Part 0: Definitions and classification

3600 Concrete structures

4489 Test methods for limes and limestones

4489.7.1 Method 7.1: Loss on ignition—Quicklime, hydrated lime and limestone

SA

HB 79 Alkali aggregate reaction—Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia

4 DEFINITIONS

For the purpose of this Standard the definitions below apply.

NOTE: AS 2758.0, Appendix B, provides some general definitions for reference purposes.

4.1 Aggregate

4.1.1 Coarse aggregate

Aggregate having a nominal size greater than or equal to 5 mm.

4.1.2 Fine aggregate

Aggregate having a nominal size less than 5 mm.

4.1.3 Heavyweight aggregate

Aggregate composed of inorganic materials having a particle density on a dry basis of greater than or equal to 3.2 t/m³.

4.1.4 Lightweight aggregate

Aggregate composed of materials having a particle density on a dry basis of less than 2.1 t/m³, and greater than or equal to 0.5 t/m³.

4.1.5 Manufactured fine aggregate

A purpose-made crushed fine aggregate produced from a suitable source material.

NOTE: Only source materials with suitable strength, durability and shape characteristics should be considered. Production generally involves crushing, screening and possibly washing, or alternately dry extraction of fine components. Separation into discrete fractions, recombining and blending may be necessary. Some crusher dusts may have suitable strength, durability and shape characteristics to meet the specification and, in this case, may be used as manufactured sand.

4.1.6 Natural fine aggregate

Fine aggregate, derived from sand deposits in rivers, estuaries, dunes or similar, or from the processing of friable rocks, that produces a sand-sized product with minimal crushing.

4.1.7 Normal weight aggregate

Aggregate composed of inorganic materials having a particle density on a dry basis of less than 3.2 t/m³ and greater than or equal to 2.1 t/m³.

4.1.8 Ultra lightweight aggregate

Aggregate composed of materials having a particle density on a dry basis of less than 0.5 t/m³.

4.2 Bulk density

The mass of a unit volume of oven-dried aggregate.

NOTE: It may be determined for aggregate in either compacted or loose states.

4.3 Deleterious fines index (DFI)

The multiple of the methylene blue value, tested in accordance with AS 1141.66 and the percentage passing the 0.075 mm sieve, tested in accordance with AS 1141.11.1 (washed grading) or AS 1141.12.

4.4 Nominal size

A designation of an aggregate which gives an indication of the maximum size particle present.

NOTE: The concept of nominal size is for convenience of reference and of ordering.

4.5 Particle density

The mass of the oven-dried particles divided by the saturated surface-dried volume of the particles.

4.6 Single-size aggregates

Aggregates in which most of the particles are of sizes lying between a narrow range of sieve sizes.

NOTE: Recommendations for gradings for single-sized coarse aggregates are given in Table B1, Appendix B.

4.7 Supply agreement

That agreement between the aggregate supplier and a second party, usually a concrete supplier or producer of concrete products, that details, among other matters, the test procedures and limits for aggregate supply.

NOTE: The agreement may detail sampling requirements and testing frequency. The agreement may be for a specific project or for regular, routine supply.

4.8 Works specification

That body of documents that details the construction requirements for a works project, which, among many other items, will include specification and supply arrangements for materials, including concrete and concrete products delivered to or produced on site.

NOTE: This body of documents (the works specification) may include this document (AS 2758.1) reference to this document, extracts from this document or this document with included variations.

5 SAMPLING

The sampling of aggregate and source rock shall be carried out in accordance with the methods described in AS 1141.3.1 and AS 1141.3.2 respectively.

NOTE: The frequency of sampling should be nominated in the supply agreement. An indication of sampling frequency is given in AS 2758.0, Appendix A.

6 TESTING

Testing of aggregates shall be carried out in accordance with the methods described in the relevant parts of AS 1141 and AS 1012, and in AS 4489.7.1. Unless indicated otherwise, proportions, ratios and percentages are expressed on the basis of mass.

NOTE: The frequency of testing should be nominated in the supply agreement.

7 GENERAL REQUIREMENTS

7.1 Particle density

When determined in accordance with AS 1141.5 for fine aggregate, and AS 1141.6.1 or AS 1141.6.2 for coarse aggregate, the particle density of the aggregate shall be as follows:

- (a) For heavyweight aggregate, not less than 3.2 t/m^3 .
- (b) For normal weight aggregate, less than 3.2 t/m^3 and greater than or equal to 2.1 t/m^3 .
- (c) For lightweight aggregate, less than 2.1 t/m^3 , and greater than or equal to 0.5 t/m^3 .
- (d) For ultra-lightweight aggregate, less than 0.5 t/m^3 .

7.2 Bulk density of lightweight aggregate

When determined in accordance with AS 1141.4, the compacted bulk density of lightweight aggregate shall be less than 1.2 t/m^3 .

7.3 Water absorption

The percentage of water absorption shall be determined in accordance with AS 1141.5, AS 1141.6.1 or AS 1141.6.2. The concrete mix design needs to ensure that the water absorption of the aggregate does not affect the designed water-cement ratio.

NOTES:

- 1 The average absorption of natural aggregates is about 2%. Normal weight aggregates of higher absorption values may be acceptable, based on local performance records and provided the materials meet the requirements of Clauses 9 and 13.
- 2 The water absorption of lightweight, vesicular, or recycled aggregates can exceed 2% considerably without affecting many of the properties of concrete made using such aggregates. To minimize any effect of absorption variations, it is recommended that these aggregates be pre-wetted prior to the commencement of the mixing process.
- 3 Care will need to be exercised if water absorption is the result of deleterious mineralogy.

8 DIMENSIONAL REQUIREMENTS

8.1 Particle size distribution (grading)

8.1.1 General

A history of grading figures shall be provided for each aggregate component to indicate the average grading and variation of the aggregate proposed for supply. This data shall be known as the 'submitted grading'.

NOTE: Alternatively, the supply agreement may require the supplier to submit samples, the gradings of which will be the basis for acceptance of the quotation, tender or source of supply. These samples are used to establish the submitted grading.

The 'limits of deviation' (see Tables 1 and 2) are the maximum variations in percentage between the submitted grading or the grading of the submitted sample and any particular test result during the term of the supply agreement.

If the aggregate supply varies outside the limits of deviation specified in the supply agreement, grading data identifying results outside the limits of deviation shall be provided to enable alteration of the mix design, if necessary (see Note 4).

NOTES:

- 1 Reasonably consistent grading is necessary for aggregate under any supply agreement to ensure practical control of concrete manufacture.
- 2 It is recognized that smaller deviation values than those specified in Tables 1 and 2 may be more appropriate to particular projects. Where smaller deviations are required, values should be nominated in the supply agreement.
- 3 Guidelines for suitable gradings are given in Tables B1 and B2, Appendix B.
- 4 The concrete producer will need to be informed as soon as possible of any aggregate outside the specified limits of deviation to enable alternation of the mix design.

8.1.2 Coarse aggregate

When determined in accordance with AS 1141.11.1 or AS 1141.11.2, the grading of coarse aggregate supplied shall not deviate from the submitted grading, or the grading of the submitted sample, by more than the maximum permissible deviations given in Table 1.

NOTE: Coarse aggregates of nominal sizes greater than 40 mm may be appropriate for use in specific work (e.g. dam construction and other mass concrete sections). Dimensional requirements suitable for concrete aggregates of nominal sizes greater than 40 mm have not been addressed in Appendix B. The use of the other tests specified in this document would need to be carefully considered for aggregates of nominal sizes greater than 40 mm.

8.1.3 Fine aggregate (natural and manufactured fine aggregate)

When determined in accordance with AS 1141.11.1, the grading of fine aggregate supplied shall not deviate from the submitted grading, or the grading of the submitted sample, by more than the maximum permissible deviations given in Table 2.

TABLE 1
COARSE AGGREGATE—LIMITS OF DEVIATION

Sieve aperture mm	Limits of deviation, %†											
	Nominal size of graded aggregate, mm					Nominal size of single-size aggregate, mm						
	40	28	20	14	10	40	28	20	14	10	7	5
75.0	—	—	—	—	—	—	—	—	—	—	—	—
53.0	—	—	—	—	—	—	—	—	—	—	—	—
37.6	±10	—	—	—	—	±10	—	—	—	—	—	—
26.5	±15	±10	—	—	—	±10	±10	—	—	—	—	—
19.0	±15	±15	±10	—	—	±10	±10	±10	—	—	—	—
13.2	±10	±15	±15	±10	—	±5	±10	±10	±10	—	—	—
9.50	±10	±10	±15	±15	±10	—	±5	±10	±10	±10	—	—
6.70	±5	±10	±10	±15	±15	—	±5	±5	±10	±10	±10	—
4.75	—	±5	±5	±5	±10	—	—	—	±5	±10	±10	±10
2.36	—	—	—	—	±5	—	—	—	—	—	±10	±10
0.075*	—	—	—	—	—	—	—	—	—	—	—	—

* See Clause 8.2

† Limits of deviation on the submitted grading or the grading of the submitted sample (see Clause 8.1.1)