



Standard Specification for Concrete Aggregates¹

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^{ε1} NOTE—Editorially corrected 3.2.1 and Footnote B of Table 1 in November 2016.

1. Scope*

1.1 This specification defines the requirements for grading and quality of fine and coarse aggregate (other than lightweight or heavyweight aggregate) for use in concrete.²

1.2 This specification is for use by a contractor, concrete supplier, or other purchaser as part of the purchase document describing the material to be furnished.

NOTE 1—This specification is regarded as adequate to ensure satisfactory materials for most concrete. It is recognized that, for certain work or in certain regions, it may be either more or less restrictive than needed. For example, where aesthetics are important, more restrictive limits may be considered regarding impurities that would stain the concrete surface. The specifier should ascertain that aggregates specified are or can be made available in the area of the work, with regard to grading, physical, or chemical properties, or combination thereof.

1.3 This specification is also for use in project specifications to define the quality of aggregate, the nominal maximum size of the aggregate, and other specific grading requirements. Those responsible for selecting the proportions for the concrete mixture shall have the responsibility of determining the proportions of fine and coarse aggregate and the addition of blending aggregate sizes if required or approved.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this standard.

¹ This specification is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.20 on Normal Weight Aggregates.

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² For lightweight aggregates, see Specifications C330, C331, and C332; for heavyweight aggregates see Specification C637 and Descriptive Nomenclature C638.

2. Referenced Documents

2.1 *ASTM Standards*:³

- C29/C29M Test Method for Bulk Density (“Unit Weight”) and Voids in Aggregate
- C40 Test Method for Organic Impurities in Fine Aggregates for Concrete
- C87 Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
- C88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
- C117 Test Method for Materials Finer than 75- μm (No. 200) Sieve in Mineral Aggregates by Washing
- C123 Test Method for Lightweight Particles in Aggregate
- C125 Terminology Relating to Concrete and Concrete Aggregates
- C131 Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C136 Test Method for Sieve Analysis of Fine and Coarse Aggregates
- C142 Test Method for Clay Lumps and Friable Particles in Aggregates
- C150 Specification for Portland Cement
- C227 Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)
- C289 Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method) (Withdrawn 2016)⁴
- C294 Descriptive Nomenclature for Constituents of Concrete Aggregates
- C295 Guide for Petrographic Examination of Aggregates for Concrete
- C311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
- C330 Specification for Lightweight Aggregates for Structural Concrete

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard



TABLE 1 Grading Requirements for Fine Aggregate

Sieve (Specification E11)	Percent Passing
9.5-mm (3/8-in.)	100
4.75-mm (No. 4)	95 to 100
2.36-mm (No. 8)	80 to 100
1.18-mm (No. 16)	50 to 85
600- μ m (No. 30)	25 to 60
300- μ m (No. 50)	5 to 30
150- μ m (No. 100)	0 to 10
75- μ m (No. 200)	0 to 3.0 ^{A,B}

^A For concrete not subject to abrasion, the limit for material finer than the 75- μ m (No. 200) sieve shall be 5.0 % maximum.

^B For manufactured fine or other recycled aggregate, if the material finer than the 75- μ m (No. 200) sieve consists of the dust of fracture, essentially free of clay or shale, this limit shall be 5.0% for concrete subject to abrasion, and 7% maximum for concrete not subject to abrasion.

- C331 Specification for Lightweight Aggregates for Concrete Masonry Units
- C332 Specification for Lightweight Aggregates for Insulating Concrete
- C342 Test Method for Potential Volume Change of Cement-Aggregate Combinations (Withdrawn 2001)⁴
- C441 Test Method for Effectiveness of Pozzolans or Ground Blast-Furnace Slag in Preventing Excessive Expansion of Concrete Due to the Alkali-Silica Reaction
- C535 Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
- C586 Test Method for Potential Alkali Reactivity of Carbonate Rocks as Concrete Aggregates (Rock-Cylinder Method)
- C595 Specification for Blended Hydraulic Cements
- C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
- C637 Specification for Aggregates for Radiation-Shielding Concrete
- C638 Descriptive Nomenclature of Constituents of Aggregates for Radiation-Shielding Concrete
- C666/C666M Test Method for Resistance of Concrete to Rapid Freezing and Thawing
- C989 Specification for Slag Cement for Use in Concrete and Mortars
- C1105 Test Method for Length Change of Concrete Due to Alkali-Carbonate Rock Reaction
- C1157 Performance Specification for Hydraulic Cement
- C1240 Specification for Silica Fume Used in Cementitious Mixtures
- C1260 Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
- C1293 Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
- C1567 Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
- D75 Practice for Sampling Aggregates
- D422 Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)⁴
- D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate

D3665 Practice for Random Sampling of Construction Materials

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

2.2 Other Standards:

AASHTO T 330 Method of Test for the Qualitative Detection of Harmful Clays of the Smectite Group in Aggregates Using Methylene Blue⁵

3. Terminology

3.1 For definitions of terms used in this standard, refer to Terminology C125.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 aggregate, recycled, *n*—granular material that has been diverted, separated, or removed from the solid waste stream, and processed for use in the form of raw materials or products.

4. Ordering and Specifying Information

4.1 The direct purchaser of aggregates shall include the information in 4.2 in the purchase order as applicable. A project specifier shall include in the project documents information to describe the aggregate to be used in the project from the applicable items in 4.3.

4.2 Include in the purchase order for aggregates the following information, as applicable:

4.2.1 Reference to this specification, as C33 _____,

4.2.2 Whether the order is for fine aggregate or for coarse aggregate,

4.2.3 Quantity, in metric tons or tons,

4.2.4 When the order is for fine aggregate:

4.2.4.1 Whether the restriction on reactive materials in 7.3 applies,

4.2.4.2 In the case of the sulfate soundness test (see 8.1) which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used,

4.2.4.3 The appropriate limit for material finer than 75- μ m (No. 200) sieve (see Table 1). If not stated, the 3.0 % limit shall apply,

4.2.4.4 The appropriate limit for coal and lignite (see Table 2). If not stated, the 1.0 % limit shall apply,

4.2.5 When the order is for coarse aggregate:

⁵ AASHTO Standard Specifications, Part 2B: Tests. Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

TABLE 2 Limits for Deleterious Substances in Fine Aggregate for Concrete

Item	Mass Percent of Total Sample, max
Clay lumps and friable particles	3.0
Coal and lignite:	
Where surface appearance of concrete is of importance	0.5
All other concrete	1.0

4.2.5.1 The grading (size number) (see 10.1 and Table 3), or alternate grading as agreed between the purchaser and aggregate supplier.

4.2.5.2 The class designation (see 11.1 and Table 4),

4.2.5.3 Whether the restriction on reactive materials in 11.2 applies,

4.2.5.4 In the case of the sulfate soundness test (see Table 4), which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used, and

4.2.6 Any exceptions or additions to this specification (see Note 1).

4.3 Include in project specifications for aggregates the following information, as applicable:

4.3.1 Reference to this specification, as C33 ____.

4.3.2 When the aggregate being described is fine aggregate:

4.3.2.1 Whether the restriction on reactive materials in 7.3 applies,

4.3.2.2 In the case of the sulfate soundness test (see 8.1) which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used.

4.3.2.3 The appropriate limit for material finer than the 75- μm (No. 200) sieve (see Table 1). If not stated, the 3.0 % limit shall apply, and

4.3.2.4 The limit that applies with regard to coal and lignite (Table 2). If not stated, the 1.0 % limit shall apply.

4.3.3 When the aggregate being described is coarse aggregate, include:

4.3.3.1 The nominal maximum size or sizes permitted, based on thickness of section or spacing of reinforcing bars or other criteria. In lieu of stating the nominal maximum size, the specifier shall designate an appropriate size number or numbers (see 10.1 and Table 3). Designation of a size number to indicate a nominal size shall not restrict the person responsible for selecting proportions from combining two or more gradings of aggregate to obtain a desired grading, provided that the gradings are not otherwise restricted by the project specifier and the nominal maximum size indicated by the size number is not exceeded,

4.3.3.2 The class designation (see 11.1 and Table 4),

4.3.3.3 Whether the restriction on reactive materials in 11.2 applies,

4.3.3.4 In the case of the sulfate soundness test (see Table 4), which salt is to be used. If none is stated, either sodium sulfate or magnesium sulfate shall be used, and

4.3.4 The person responsible for selecting the concrete proportions if other than the concrete producer.

4.3.5 Any exceptions or additions to this specification (see Note 1).

FINE AGGREGATE

5. General Characteristics

5.1 Fine aggregate shall consist of natural sand, manufactured sand, or other recycled aggregate, or a combination thereof.

NOTE 2—This standard only addresses properties of aggregates considered necessary for use in concrete and the associated test methods contained within this standard. Certain recycled aggregate sources may contain materials and properties not addressed as part of the document

specifications, limits, or test methods. Recycled aggregates may require evaluation for environmental considerations (air quality, water quality, storage) using the appropriate local, state, and federal test methods in effect at the time of use.

6. Grading

6.1 *Sieve Analysis*—Fine aggregate, except as provided in 6.2 and 6.3 shall be graded within the limits in Table 1.

NOTE 3—Concrete with fine aggregate gradings near the minimums for percent passing the 300 μm (No.50) and 150 μm (No.100) sometimes have difficulties with workability, pumping or excessive bleeding. The addition of entrained air, additional cement, or the addition of an approved mineral admixture to supply the deficient fines, are methods used to alleviate such difficulties.

6.2 The fine aggregate shall have not more than 45 % passing any sieve and retained on the next consecutive sieve of those shown in 6.1, and its fineness modulus shall be not less than 2.3 nor more than 3.1.

6.3 Fine aggregate failing to meet these grading requirements shall meet the requirements of this section provided that the supplier can demonstrate to the purchaser or specifier that concrete of the class specified, made with fine aggregate under consideration, will have relevant properties (see Note 6) at least equal to those of concrete made with the same ingredients, with the exception that the reference fine aggregate shall be selected from a source having an acceptable performance record in similar concrete construction.

NOTE 4—Manufactured fine aggregate having elevated proportions of material passing the 75- μm (No. 200) sieve may need further evaluation to ensure that material passing the 75- μm (No. 200) sieve is essentially composed of dust of fracture derived from the parent rock in the crushing operation, and does not contain an appreciable level of clay minerals or other deleterious constituents as described in Descriptive Nomenclature C294. Because some of the dust of fracture may occur in the clay size range, defined here as material finer than 2 μm , care must be taken to properly differentiate these clay-sized materials from clay minerals. Natural fine aggregate with elevated proportions of material passing the 75- μm (No. 200) sieve may have higher potential for clay mineral content.

Various means are available for characterizing these fines, such as petrographic analysis (Guide C295), sand equivalent determination (Test Method D2419), hydrometer analysis (Test Method D422), methylene blue adsorption determination (AASHTO T 330) and X-ray diffraction analysis. While these techniques are useful for investigative purposes, no specific limits have been established for prediction of performance of these materials in concrete under various intended service conditions. Methylene blue adsorption and hydrometer analyses are believed to be two relatively quick and reliable tests for characterization of material passing the 75- μm (No. 200) sieve to determine suitability for use in concrete. Research (1,2) has indicated that manufactured fine aggregate with less than 4 % by mass finer than 2 μm , and with methylene blue adsorption values less than 5 mg/g generally is suitable for use in concrete. Fine aggregate that exceeds these values also may be suitable for use provided that fresh and hardened concrete properties are shown to be acceptable.

NOTE 5—Fine aggregate that conforms to the grading requirements of a specification, prepared by another organization such as a state transportation agency, which is in general use in the area, should be considered as having a satisfactory service record with regard to those concrete properties affected by grading.

NOTE 6—Relevant properties are those properties of the concrete that are important to the particular application being considered. STP 169D⁶ provides a discussion of important concrete properties.

⁶ *Significance of Tests and Properties of Concrete and Concrete Making Materials, STP 169D, ASTM, 2006.*