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## Standard Specification for Admixtures for Shotcrete<sup>1</sup>

This standard is issued under the fixed designation C1141/C1141M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

1.1 This specification covers materials proposed for use as admixtures to be added to a portland-cement shotcrete mixture for the purpose of altering the properties of the mixture.

1.2 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.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

### 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[C125 Terminology Relating to Concrete and Concrete Aggregates](#)

~~E136~~[C136/C136M Test Method for Sieve Analysis of Fine and Coarse Aggregates](#)

[C138/C138M Test Method for Density \(Unit Weight\), Yield, and Air Content \(Gravimetric\) of Concrete](#)

[C173/C173M Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method](#)

~~E183~~[C183/C183M Practice for Sampling and the Amount of Testing of Hydraulic Cement](#)

~~E231~~[C231/C231M Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method](#)

~~E260~~[C260/C260M Specification for Air-Entraining Admixtures for Concrete](#)

~~E311~~[C311/C311M Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete](#)

[C494/C494M Specification for Chemical Admixtures for Concrete](#)

[C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete](#)

~~E979~~[C979/C979M Specification for Pigments for Integrally Colored Concrete](#)

~~E989~~[C989/C989M Specification for Slag Cement for Use in Concrete and Mortars](#)

[C1240 Specification for Silica Fume Used in Cementitious Mixtures](#)

~~E1398 Test Method for The Laboratory Determination of the Time of Setting of Hydraulic-Cement Mortars Containing Additives for Shotcrete by the Use of Gillmore Needles (Withdrawn 2010)~~<sup>3</sup>

[C1438 Specification for Latex and Powder Polymer Modifiers for use in Hydraulic Cement Concrete and Mortar](#)

[D98 Specification for Calcium Chloride](#)

2.2 *ACI Documents:*

[318 Building Code Requirements for Structural Concrete](#)<sup>3</sup>

### 3. Terminology

3.1 For definitions of terms used in this standard, refer to Terminology [C125](#).

### 4. Classification

4.1 This specification recognizes grades of admixtures, used in shotcrete made by either of two processes, as follows:

4.1.1 *Type I*—Dry mix shotcrete.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee [C09](#) on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee [C09.46](#) on Shotcrete.

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<sup>2</sup> 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.

<sup>3</sup> Available from American Concrete Institute (ACI), P.O. Box 9094, Farmington Hills, MI 48333-9094, [http://www.concrete.org](#).

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

- 4.1.1.1 *Grade 1*—Accelerating admixture, ~~conventional admixture.~~
- 4.1.1.2 *Grade 2*—Retarding admixture.
- 4.1.1.3 *Grade 3*—Pozzolanic admixture.
- 4.1.1.4 *Grade 4*—Metallic iron admixture.
- 4.1.1.5 *Grade 5*—Coloring admixture.
- 4.1.1.6 *Grade 6*—Organic polymer admixture.
- 4.1.1.7 *Grade 7*—Not applicable.
- 4.1.1.8 *Grade 8*—Not applicable.
- 4.1.1.9 ~~*Grade 9*—Accelerating admixture, quick-setting.~~
- 4.1.2 *Type II*—Wet-mix shotcrete.
  - 4.1.2.1 *Grade 1*—Accelerating admixture, ~~conventional admixture.~~
  - 4.1.2.2 *Grade 2*—Retarding admixture.
  - 4.1.2.3 *Grade 3*—Pozzolanic admixture.
  - 4.1.2.4 *Grade 4*—Metallic iron admixture.
  - 4.1.2.5 *Grade 5*—Coloring admixture.
  - 4.1.2.6 *Grade 6*—Organic polymer admixture.
  - 4.1.2.7 *Grade 7*—Water reducing admixture.
  - 4.1.2.8 *Grade 8*—Air-entraining admixture.
  - 4.1.2.9 ~~*Grade 9*—Accelerating admixture, quick-setting.~~
- 4.1.3 Each of the above grades is further classified by identifying it according to the following classes:
  - 4.1.3.1 *Class A*—Liquid.
  - 4.1.3.2 *Class B*—Non-liquid.

## 5. Ordering Information

- 5.1 The purchaser shall include the following information in the contract or purchase order, if applicable:
  - 5.1.1 The specification designation and date of issue,
  - 5.1.2 Type of shotcrete, grade and class of admixture,
  - 5.1.3 Quantity of admixture required,
  - 5.1.4 Special packaging and package marking requirements,
  - 5.1.5 Special sampling for inspection requirements, and
  - 5.1.6 Any supplementary requirements.

## 6. Requirements

- 6.1 Shotcrete admixtures shall conform to the requirements for the applicable type and grade as given in **Table 1**.
- 6.2 At the request of the purchaser, the manufacturer shall state in writing that the admixture supplied is essentially identical in concentration, composition, and performance to the admixture previously tested under this specification and found to comply with the applicable requirements thereof.
- 6.3 Requirements for establishing compositional or chemical equivalence of a lot or of a subsequent lot relative to a previous lot that was subjected to quality tests and found to comply with the applicable requirements may be determined by agreement between the purchaser and the manufacturer. At the request of the purchaser, the manufacturer shall recommend appropriate test procedures, such as infrared spectrophotometry, pH value, and solids content, for establishing the equivalence of material from different lots or different portions of the same lot.
- 6.4 At the request of the purchaser, the manufacturer shall state in writing the chloride content of the admixture.

NOTE 1—Ultraviolet absorption of solutions and infrared spectroscopy of dried residues have been found to be valuable for these purposes. The specific procedures to be employed and the criteria to establish equivalence should be stipulated with due regard to the composition and properties of the sample.

NOTE 2—Admixtures containing relatively large amounts of chloride ions may make embedded metals susceptible to corrosion when moisture and oxygen are present in hardened shotcrete.

## 7. Sampling

- 7.1 Access shall be provided to the purchaser for sampling, either at the point of manufacture, or at the site of the work, as may be specified by the purchaser.
- 7.2 Samples shall be either grab or composite samples, as specified or required by this specification. A grab sample is one secured in a single operation. A composite sample is one obtained by combining three or more grab samples.
- 7.3 The sample size for each class of admixture shall be as follows:
  - 7.3.1 *Class A Liquid Admixtures*:
    - 7.3.1.1 Liquid admixtures shall be agitated thoroughly immediately prior to sampling. Individual grab samples shall represent not more than 9500 L [2500 gal] of admixture and shall have a volume of at least 1 L [1 qt]. A minimum of four grab samples

**TABLE 1 Shotcrete Admixture Requirements**

Type I—Dry-Mix Shotcrete			
Grade	Admixture	ASTM Standard	Other Limits
4	Accelerating, conventional	D98, C494/C494M Type C or E	The metallic particles shall be ground iron free from rust, oil, foreign materials, and nonferrous metal particles. The grading of the metallic aggregates shall be as follows when tested according to <a href="#">C136</a> : The metallic particles shall be ground iron free from rust, oil, foreign materials, and nonferrous metal particles. The grading of the metallic aggregates shall be as follows when tested according to <a href="#">C136/C136M</a> : U.S. Sieve No. <sup>A</sup> %Passing 4.75 mm (No. 4) 100 2.36 mm (No. 8) 90–100 1.18 mm (No. 16) 70–85 600 µm (No. 30) 20–35 300 µm (No. 50) 0–10 150 µm (No. 100) 0–5 Even when using materials conforming to <a href="#">C979</a> , it may be difficult to obtain uniformity of coloring because of the placement procedures in dry-mix shotcreting. Even when using materials conforming to <a href="#">C979/C979M</a> , it may be difficult to obtain uniformity of coloring because of the placement procedures in dry-mix shotcreting.
1	Accelerating	D98, C494/C494M Type C or E	
2	Retarding	C494/C494M Type B or D	
3	Pozzolanic	G618, G989, C1240	
3	Pozzolanic	C618, C989/C989M, C1240	
4	Metallic iron	Not established	
4	Metallic iron	Not established	
5	Coloring	G979	
5	Coloring	C979/C979M	
6	Organic Polymer	C1438	
9	Accelerating, quick-setting	G1398	Initial time of setting 1 to 3 min and final time of setting not more than 12 min in two of every three tests and chloride limits of ACI 318 shall not be exceeded.
Type II—Wet-Mix Shotcrete			
Grade	Admixture	ASTM Standard	Other Limits
4	Accelerating, conventional	D98, C494/C494M Types C or E	See Type I, Grade 4
1	Accelerating	D98, C494/C494M Types C or E	
2	Retarding	C494/C494M, Type B, D or G	
3	Pozzolanic	G618, G989, C1240	
3	Pozzolanic	C618, C989/C989M, C1240	
4	Metallic iron	Not established	
5	Coloring	G979	
5	Coloring	C979/C979M	
6	Organic Polymer	C1438	
7	Water reducing	C494/C494M, Types A, D, E, F, or G	
8	Air-entraining	G260	
8	Air-entraining	C260/C260M	
9	Accelerating, quick-setting	G1398	See Type I, Grade 9

<sup>A</sup>The sieve designations in parentheses are provided for information only; the only standard sieve sizes are those stated in SI units.

shall be taken from different locations well distributed throughout the quantity to be represented. Composite samples shall be prepared by thoroughly mixing the selected grab samples, and the resultant mixture sampled to provide at least 4 L [1 gal] for testing.

7.3.1.2 Admixtures in bulk storage tanks shall be sampled equally from the upper, intermediate, and lower levels by means of drain cocks in the sides of the tanks, or a weighted sampling bottle fitted with a stopper that can be removed after the bottle is lowered to the desired depth.

7.3.1.3 Samples shall be packaged in impermeable, airtight containers which are resistant to attack by the admixture.

7.3.2 *Class B Non-liquid Admixtures:*

7.3.2.1 Individual grab samples (except pozzolanic) shall not represent more than 2 Mg [2 tons] of admixture and shall weigh at least 1 kg [2 lb]. A minimum of four grab samples shall be taken from different locations well distributed throughout the quantity to be represented. Composite samples shall be prepared by thoroughly mixing the selected grab samples, and the resultant mixture sampled to provide at least 2.2 kg [5 lb] for testing. Grading of composite samples shall be determined for each 2 Mg [2 tons] of Grade 4 metallic iron admixtures shipped.

7.3.2.2 Pozzolanic admixtures shall be sampled and tested in accordance with the requirements established in Test Methods [E3HC311/C311M](#).

7.3.2.3 Samples of packaged admixtures shall be obtained by means of a tube sampler as described in Practice [E183C183/C183M](#).

7.3.2.4 When recommended by the manufacturer, the entire sample of an admixture shall be dissolved in water prior to testing.

7.3.2.5 Samples shall be packaged in moisture-proof, airtight containers.