



Designation: C 1141 – 01

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

This standard is issued under the fixed designation C 1141; 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 approval. 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 *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.*

1.3 The values stated in inch-pound units are to be regarded as the standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- C 125 Terminology Relating to Concrete and Concrete Aggregates<sup>2</sup>
- C 136 Test Method For Sieve Analysis of Fine and Coarse Aggregates<sup>2</sup>
- C 138 Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete<sup>2</sup>
- C 173 Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method<sup>2</sup>
- C 183 Practice for Sampling and the Amount of Testing of Hydraulic Cement<sup>3</sup>
- C 231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method<sup>2</sup>
- C 260 Specification for Air-Entraining Admixtures for Concrete<sup>2</sup>
- C 311 Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete<sup>2</sup>
- C 494 Specification for Chemical Admixtures for Concrete<sup>2</sup>
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete<sup>2</sup>
- C 979 Specification for Pigments for Integrally Colored Concrete<sup>2</sup>

- C 989 Specification for Ground Granulated Blast Furnace Slag for Use in Concrete and Mortars<sup>2</sup>
- C 1240 Specification for Silica Fume for Use in Hydraulic-Cement Concrete and Mortar<sup>2</sup>
- C 1438 Specification for Latex and Powder Polymer Modifiers for Hydraulic Cement Concrete and Mortar<sup>2</sup>
- D 98 Specification for Calcium Chloride<sup>4</sup>
- 2.2 ACI Documents:
  - 318 Building Code Requirements for Reinforced Concrete<sup>5</sup>

### 3. Terminology

3.1 The terms used in this standard are defined in Terminology C 125.

#### 3.2 Definitions of Terms Specific to This Standard:

- 3.2.1 *dry-mix shotcrete*—Shotcrete in which most of the mixing water is added at the nozzle.
- 3.2.2 *shotcrete*—Mortar or concrete pneumatically projected at high velocity onto a surface.
- 3.2.3 *wet-mix shotcrete*—Shotcrete in which most of the ingredients, including the water, are mixed prior to introduction into the delivery hose.

### 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.
  - 4.1.1.1 *Grade 1*—Accelerating admixture, conventional.
  - 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.
  - 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.

<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.

Current edition approved Jan. 10, 2001. Published March 2001. Originally published as C 1141 – 89. Last previous edition C 1141 – 95.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.02.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.03.

<sup>5</sup> Available from American Concrete Institute, P.O. Box 19150, Detroit, MI 48219.

- 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 careful 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:*

**TABLE 1 Shotcrete Admixture Requirements**

| Type I—Dry-Mix Shotcrete  |                             |                               |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
|---------------------------|-----------------------------|-------------------------------|---|----------------|----------|-----------------|-----|-----------------|--------|------------------|-------|-----------------|-------|-----------------|------|------------------|-----|
| Grade                     | Admixture                   | ASTM Standard                 | Other Limits  |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 1                         | Accelerating, conventional  | D 98, C 494 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 C 136: <table border="1"> <thead> <tr> <th>U.S. Sieve No.</th> <th>%Passing</th> </tr> </thead> <tbody> <tr> <td>4.75 mm (No. 4)</td> <td>100</td> </tr> <tr> <td>2.36 mm (No. 8)</td> <td>90–100</td> </tr> <tr> <td>1.18 mm (No. 16)</td> <td>70–85</td> </tr> <tr> <td>600 μm (No. 30)</td> <td>20–35</td> </tr> <tr> <td>300 μm (No. 50)</td> <td>0–10</td> </tr> <tr> <td>150 μm (No. 100)</td> <td>0–5</td> </tr> </tbody> </table> | U.S. Sieve No. | %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 |
| U.S. Sieve No.            | %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                         |                               |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 2                         | Retarding                   | C 494 Type B or D             |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 3                         | Pozzolanic                  | C 618, C 989, C 1240          |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 4                         | Metallic iron               | Not established               |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 5                         | Coloring                    | C 979                         | Even when using materials conforming to C 979, it may be difficult to obtain uniformity of coloring because of the placement procedures in dry-mix shotcreting.   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 6                         | Organic Polymer             | C 1438                        | 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.   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 9                         | Accelerating, quick-setting | C 1102                        |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| Type II—Wet-Mix Shotcrete |                             |                               |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| Grade                     | Admixture                   | ASTM Standard                 | Other Limits  |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 1                         | Accelerating, conventional  | D 98, C 494 Types C or E      | See Type I, Grade 4   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 2                         | Retarding                   | C 494, Type B, D or G         |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 3                         | Pozzolanic                  | C 618, C 989, C 1240          |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 4                         | Metallic iron               | Not established               |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 5                         | Coloring                    | C 979                         | See Type I, Grade 9   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 6                         | Organic Polymer             | C 1438                        |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 7                         | Water reducing              | C 494, Types A, D, E, F, or G |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 8                         | Air-entraining              | C 260                         |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |
| 9                         | Accelerating, quick-setting | C 1102                        |   |                |          |                 |     |                 |        |                  |       |                 |       |                 |      |                  |     |