



# Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete<sup>1</sup>

This standard is issued under the fixed designation C 937; 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 (ε) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

## 1. Scope

1.1 This specification covers fluidifier for grout used for preplaced-aggregate (PA) concrete.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information purposes only.

1.3 The following precautionary caveat pertains only to the test method portion, Section 8, of this standard: *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:*

- C 33 Specification for Concrete Aggregates<sup>2</sup>
- C 150 Specification for Portland Cement<sup>3</sup>
- C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete<sup>2</sup>
- C 637 Specification for Aggregates for Radiation-Shielding Concrete<sup>2</sup>
- C 938 Practice for Proportioning Grout Mixtures for Preplaced-Aggregate Concrete<sup>2</sup>
- C 939 Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)<sup>2</sup>
- C 940 Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory<sup>2</sup>
- C 941 Test Method for Water Retentivity of Grout Mixtures for Preplaced-Aggregate Concrete in the Laboratory<sup>2</sup>
- C 942 Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory<sup>2</sup>

<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 C9.41 on Concrete for Radiation Shielding.

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

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 14.01.

TABLE 1 Expansion Limits

Alkali Content of Cement, % Expressed as Na <sub>2</sub> O	Expansion Limits, %
0.80 or more	7 to 14
0.40 to 0.79	5 to 12
0.39 or less	3 to 9

C 943 Practice for Making Test Cylinders and Prisms for Determining Strength and Density of Preplaced-Aggregate Concrete in the Laboratory<sup>2</sup>

C 953 Test Method for Time of Setting of Grouts for Preplaced-Aggregate Concrete in the Laboratory<sup>2</sup>

## 3. Ordering Information

3.1 The purchaser shall specify the material desired as “grout fluidifier for preplaced-aggregate concrete.” The material shall meet the requirements of this specification.

## 4. Materials

4.1 Grout ingredients shall conform to the following requirements:

4.1.1 Portland cement shall meet the requirements of Specification C 150 for the type to be used.

4.1.2 Pozzolan shall meet the requirements of Specification C 618.

4.1.3 Fine aggregate shall meet the requirements of Specification C 33 except that grading shall conform to Specification C 637, Table number 2, Grading 1 for Fine Aggregate.

## 5. Physical Requirements

5.1 The fluidifier, when tested in grout as specified herein, shall conform to the following requirements:

Reduction in mixing water, min, % of control (Test Method C 941)	3
Expansion, 3 h after mixing, (Test Method C 940)	See Table 1
Bleeding, 3 h after mixing, (Test Method C 940), max, %	2
Increase in water retentivity (Test Method C 941), min, % of control	60
Initial setting time, min, h (Test Method C 953)	4
Final setting time, max, h (Test Method C 953)	24

Compressive strength at 7 days and 28 days, (Test Method C 942), min, % of control

$$R_w = \frac{(W_c - W_t) \times 100}{W_c} \quad (1)$$

## 6. Composition

6.1 The fluidifier shall be composed of materials that will yield a product having the properties stipulated under Physical Requirements when tested in accordance with this specification.

## 7. Sampling

7.1 The test sample of fluidifier shall have a mass of at least 225 g (½ lb) and shall be representative of the material supplied. When feasible, the test sample shall be composited from grab samples taken from not fewer than four packages selected at random.

## 8. Test Method

8.1 *Summary of Method*—Physical properties of grout containing fluidifier are determined and compared with corresponding properties of grout made without fluidifier.

8.2 *Significance and Use*—The effects of adding fluidifier to a standard grout mixture are determined in order to evaluate its ability to reduce mixing water, prevent early stiffening, hold solid constituents in suspension, produce controlled expansion prior to initial setting, and maintain or increase compressive strength.

### 8.3 Procedure:

8.3.1 Have all grout materials including mixing water at  $23.0 \pm 2.0^\circ\text{C}$  ( $73.5 \pm 3.5^\circ\text{F}$ ) at the start of the test.

8.3.2 Maintain the laboratory and curing room at  $23.0 \pm 2.0^\circ\text{C}$  ( $73.5 \pm 3.5^\circ\text{F}$ ) at all times during testing.

### 8.3.3 Grout Preparation:

8.3.3.1 Proportion two grout mixtures, one a control mixture without and one a test mixture with the grout fluidifier under consideration, each containing equal parts, by weight, of cementitious material and fine aggregate, with sufficient water to produce a grout efflux time by Test Method C 939 of  $21 \pm 2$  s. The cementitious material shall consist of two parts portland cement to one part of pozzolan, by weight.

8.3.3.2 The test mixture shall contain grout fluidifier equal to 1% of the combined weight of portland cement plus pozzolan; unless otherwise recommended by the manufacturer. The control mixture shall contain no fluidifier.

8.3.3.3 The volume of each batch shall be approximately  $0.03 \text{ m}^3$  ( $1 \text{ ft}^3$ ).

8.3.3.4 Mix grout in a mixer of the type shown in Fig. 1 of Practice C 938. Dampen the inside of the drum, start the mixer and charge ingredients within a period of 2 min in the following order: water, fluidifier (if used), pozzolan, cement, and fine aggregate. Mix for 3 to  $3\frac{1}{4}$  min.

8.3.3.5 Determine time of efflux by Test Method C 939. If within acceptable range, proceed with tests to provide data required for the calculations.

### 8.4 Calculations—Calculate the following items:

8.4.1 Reduction in water requirement ( $R_w$ ):

where:

$R_w$  = reduction in water requirement, %,

$W_c$  = mass of water required in grout mixture without fluidifier, and

$W_t$  = mass of water required in grout mixture with fluidifier.

8.4.2 Increase in water retentivity ( $I_r$ ):

$$I_r = \frac{(R_t - R_c) \times 100}{R_c} \quad (2)$$

where:

$I_r$  = increase in water retentivity, %,

$R_c$  = time required to extract 60 mL of water from the control sample without fluidifier, s, and

$R_t$  = time required to extract 60 mL of water from the test sample with fluidifier.

8.5 *Report*—For each grout mixture, the following test data shall be reported:

8.5.1 Description and source of materials used,

8.5.2 Material proportions by mass,

8.5.3 Average time of grout efflux, s,

8.5.4 Expansion and bleeding, %,

8.5.5 Water retentivity, s,

8.5.6 Initial setting time, h,

8.5.7 Final setting time, h,

8.5.8 Compressive strength at 7 days, psi or MPa, and

8.5.9 Compressive strength at 28 days, psi or MPa.

8.5.10 The following computed values shall also be reported:

8.5.11 Reduction in water requirement,  $R_w$ , %,

8.5.12 Increase in water retentivity,  $I_r$ , %,

8.5.13 Compressive strength at 7 days, expressed as percentage of control specimens, %.

## 9. Rejection

9.1 The fluidifier shall be rejected if it fails to meet any of the requirements of this specification.

## 10. Packaging and Marking

10.1 Grout fluidifier shall be packaged in moisture-resistant containers and stored in a dry covered area to prevent deterioration.

10.2 Containers shall be marked to provide at least the following information:

10.2.1 A statement to the effect that the contained material meets the requirements of this specification.

10.2.2 Weight of the contained material.

10.2.3 Basic instructions for use of the material.

10.2.4 Manufacturer's lot number and date of manufacture.

## 11. Keywords

11.1 efflux time; fluidifier; grout; pre-placed aggregate; water demand; water retentivity

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