



## Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete<sup>1</sup>

This standard is issued under the fixed designation C 309; 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.

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

### 1. Scope

1.1 This specification covers liquid membrane-forming compounds suitable for application to concrete surfaces to reduce the loss of water during the early-hardening period. White-pigmented membrane-forming compounds serve the additional purpose of reducing the temperature rise in concrete exposed to radiation from the sun. The membrane-forming compounds covered by this specification are suitable for use as curing media for fresh concrete, and may also be used for further curing of concrete after removal of forms or after initial moist curing.

NOTE 1—Solutions of silicate salts are chemically reactive in concrete rather than membrane-forming; therefore, they do not meet the intent of this specification.

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

1.3 The following precautionary caveat pertains only to the test methods portion, Section 10, of this specification: *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.*

1.4 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes shall not be considered as requirements of the standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

C 156 Test Method for Water Retention by Concrete Curing Materials<sup>2</sup>

C 1151 Test Method for Evaluating the Effectiveness of Materials for Curing Concrete<sup>2</sup>

D 56 Test Method for Flash Point by Tag Closed Tester<sup>3</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.22 on Curing Materials.

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

<sup>3</sup> Annual Book of ASTM Standards, Vol 05.01.

D 869 Test Method for Evaluating Degree of Settling of Paint<sup>4</sup>

D 883 Terminology Relating to Plastics<sup>5</sup>

D 1309 Test Method for Settling Properties of Traffic Paints During Accelerated Storage<sup>4</sup>

D 2369 Test Method for Volatile Content of Coatings<sup>6</sup>

D 3960 Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings<sup>6</sup>

E 1347 Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry<sup>6</sup>

### 3. Classification

3.1 The following types of liquid membrane-forming compounds are included:

3.1.1 *Type 1*—Clear or translucent without dye,

3.1.2 *Type 1-D*—Clear or translucent with fugitive dye, and

3.1.3 *Type 2*—White pigmented.

3.2 The solids dissolved in the vehicle shall be one of the following classes:

3.2.1 *Class A*—No restrictions,

3.2.2 *Class B*—Must be a resin as defined in Terminology D 883.

NOTE 2—Permanent colors other than white, or other special attributes, are beyond the scope of this specification and are subject to negotiation between the purchaser and the supplier.

### 4. Ordering Information

4.1 The purchaser shall include the following information in the purchase order when applicable:

4.1.1 Type of liquid membrane-forming compound and class of solids to be furnished, and

4.1.2 Rate of application to be used to determine conformance to this specification. If not specified, the liquid membrane-forming material shall be applied at a rate of 5.0 m<sup>2</sup>/L (200 ft<sup>2</sup>/gal) for testing purposes.

NOTE 3—The application rate used for testing may, or may not, be the same as the rate to be used for field application. Many agencies use the same rate for field application on relatively smooth surfaces as the rate used for testing, while requiring a substantially greater field application rate on deeply textured surfaces.

<sup>4</sup> Annual Book of ASTM Standards, Vol 06.02.

<sup>5</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>6</sup> Annual Book of ASTM Standards, Vol 06.01.

4.1.3 The intended method of application (for example, spraying, brushing, or by roller). If not specified, the material shall be of a sprayable consistency.

4.1.4 Maximum permissible volatile organic compound (VOC) content if required by applicable regulations.

## 5. General Requirements

5.1 Liquid membrane-forming compound Types 1 and 1-D shall be clear or translucent. Membrane-forming compounds with a fugitive dye (Type 1-D) shall be readily distinguishable upon the concrete surface for at least 4 h after application but shall become inconspicuous within 7 days after application if exposed to direct sunlight.

NOTE 4—No laboratory test for the fugitive characteristic of the color in dyed (Type 1-D) compounds is provided in this specification. The disappearance of these colors is strongly dependent on the nature of the exposure and the rate of application of the compounds.

5.2 Type 2 liquid membrane-forming compounds shall consist of finely-divided white pigment and vehicle, ready-mixed for immediate use as is. The membrane-forming compound shall present a uniform white appearance when applied uniformly to a new concrete surface at the specified rate of application.

5.3 Liquid membrane-forming compounds shall be of such a consistency that they can be readily applied by spraying, or by brushing or rolling, when specified, to a uniform coating at temperatures above 4°C (40°F).

NOTE 5—For uniform application in the field on vertical concrete surfaces, the specified rate of application may be achieved by two coats applied at an interval of approximately 1 h.

5.4 Liquid membrane-forming compounds shall adhere to freshly placed concrete that has stiffened or set sufficiently to resist marring during application, and to damp, hardened concrete, and shall form a continuous film when applied at the specified rate of application.

5.5 Liquid membrane-forming compounds shall not react deleteriously with concrete. Deleterious reactions are detected by scratching the surface of a mortar specimen (used for the water-retention test) with a knife or screwdriver, not less than 72 h after application, and comparing with the surface hardness similarly determined of a similar specimen that has been moist-cured for approximately half as long. Any softening of the liquid membrane-forming compound-treated surface indicated by such a comparison shall be considered sufficient cause for rejection of the compound.

NOTE 6—Testing for deleterious reactions need only be done for curing compounds of a new or unknown composition.

5.6 Liquid membrane-forming compounds shall be storable for at least 6 months without deterioration, except compounds of the water-emulsion type will not be expected to resist freezing. Type 2 liquid membrane-forming compounds shall not settle out excessively or cake in the container, and shall be capable of being mixed to a uniform consistency by moderate stirring or agitation. When tested for long-term settling, as stated in 10.4, the compound shall have a rating of not less than four.

5.7 The volatile portion of liquid membrane-forming com-

pounds shall be of materials that are neither toxic,<sup>7</sup> nor have flash points less than 10°C (50°F), when tested in accordance with 10.6, and shall meet applicable air pollution requirements. When required by the purchaser, the manufacturer shall furnish the VOC content of the liquid membrane-forming compound. The VOC content shall be determined according to Practice D 3960 or as required by the applicable specifications. It is the responsibility of the purchaser to specify and apply the product in accordance with applicable Federal, state, and local regulations.

## 6. Water Retention Properties

6.1 Liquid membrane-forming compounds, when tested in accordance with 10.1, shall restrict the loss of water to not more than 0.55 kg/m<sup>2</sup> in 72 h.

## 7. Reflectance Properties

7.1 Type 2 liquid membrane-forming compounds, when tested in accordance with 10.2, shall exhibit a daylight reflectance of not less than 60 %.

## 8. Drying Time Requirement

8.1 Liquid membrane-forming compounds, when tested in accordance with 10.3, shall dry to touch in not more than 4 h.

## 9. Sampling

9.1 Samples shall be taken either at the plant or warehouse prior to delivery, or at the point of delivery, at the option of the purchaser. If sampling is done prior to shipment, the inspector representing the purchaser shall have free access to the materials being sampled and shall be afforded all reasonable facilities for inspection and sampling.

9.2 Shake or thoroughly stir liquid membrane-forming compounds before taking a sample. Take one sample for each lot, batch, or other unit of production in a shipment. If the liquid membrane-forming compound is in mixing tanks or vats, one third of the sample shall represent the material coming from the tank at the beginning of the filling operation, one third shall represent the material coming at the middle of the filling operation, and one third shall represent the material coming at the end of the filling operation. If the liquid membrane-forming compound to be sampled is in containers, obtain a sample by taking a portion out of a number of containers equal in number to the next integer larger than the cube root of the total number of containers in the lot.

9.3 Seal all of the filled containers represented by the sample to prevent leakage, substitution, or dilution. The sampling agency shall mark each container represented by the sample with a suitable identification mark for later identification and correlation.

## 10. Test Methods

10.1 *Water Retention Test*—Using the application rate

<sup>7</sup> Toxicity is dependent on the type of material, duration of exposure, and concentration. Concentration will depend on conditions under which the membrane-forming compound is used, that is, in an enclosed space, outside without wind, or outside with wind. Relative toxicity of some materials may be determined from the current edition of "Threshold Limit Values of Airborne Contaminants Adopted by ACGIH," available from the American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, OH 45201.

 **C 309**

specified by the purchaser, or 5.0 m<sup>2</sup>/L (200 ft<sup>2</sup>/gal) if no rate is specified, test for water retention using Test Method C 156.

NOTE 7—An alternative test method for determining relative efficacy of curing procedures has been published as Test Method C 1151.

10.2 *Reflectance Test*—For Type 2 compounds, on completion of the water retention test, determine the daylight reflectance of the specimens in accordance with Test Method E 1347.

NOTE 8—Daylight reflectance is total luminous reflectance factor, CIE tristimulus value Y for CIE 1931 (2°) standard observer and CIE standard illuminant C or D65.

10.3 *Drying Time Test:*

10.3.1 *Scope*—This test method is used to determine the length of time for a liquid membrane-forming curing compound to dry to the touch and develop into a film that will not track off the concrete.

10.3.2 *Significance and Use*—The ability of a liquid membrane-forming curing compound to dry in a suitable length of time ensures the user of the ability to perform other tasks on the concrete, such as sawing joints, and the like, without lifting the membrane from the concrete by tracking.

10.3.3 *Procedure*—Apply the membrane-forming compound to a fresh mortar specimen at the specified rate of application and expose it to air at 23 ± 2°C (73.4 ± 3.6°F), 50 ± 10 % relative humidity, and at an air velocity of approximately 183 m/min (600 ft/min) horizontally across the surface of the test specimen. Test the film with the finger using moderate pressure. Consider the film to be dry when the soft tacky condition no longer exists and the film feels firm.

10.3.4 *Precision and Bias*—The precision for this procedure is still being determined. The value of drying time can be defined only in terms of a test method; therefore, no statement of bias is being made.

10.4 *Long-Term Settling Test*—Use Test Method D 1309 for routine testing. In the case of dispute, use Test Method D 869.

10.5 *Nonvolatile Content Test*—Test in accordance with Test Method D 2369.

10.6 *Flash Point Test*—Test in accordance with Test Method D 56 using the liquid membrane-forming compound as supplied.

10.7 *VOC Content Test*—When required, use the applicable test methods from Practice D 3960 or determine the VOC content by the procedures specified by the purchaser.

## 11. Packaging and Package Marking

11.1 The liquid membrane-forming compound shall be delivered in the manufacturer's original, clean, sealed containers. Each container shall be legibly marked with the name of the manufacturer, the trade name of the liquid membrane-forming compound, the type of liquid membrane-forming compound and class of solids, the nominal percentage of nonvolatile material, and the manufacturer's batch or lot number (Note 9). The manufacturer will assign batch or lot numbers to the quantity of membrane-forming compound mixed, sampled, and tested as a single lot. The manufacturer shall exercise care in filling the containers so that all are equally representative of the compound produced.

NOTE 9—The listing of the nominal percentage of nonvolatile material by the manufacturer, and the reporting of this information on the identification accompanying the sample, will assist the testing agency in determining whether the compound in the containers was adequately stirred and the sample is reasonably representative of the membrane-forming compound produced. Type 2 membrane-forming compounds are especially prone to separation due to settling of the pigment.

## 12. Keywords

12.1 concrete curing; liquid membrane-forming compounds for curing concrete

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