

CRD-C 302-79

TEST METHOD FOR SPRAYABILITY AND  
UNIT MOISTURE LOSS THROUGH THE MEMBRANE  
FORMED BY A CONCRETE CURING COMPOUND

1. Scope

1.1 This method of test outlines a procedure for determining, under standard laboratory conditions, the unit moisture loss from a standard mortar specimen when covered by a membrane-forming compound, and for determining the sprayability of the compound at 40 F.

2. Apparatus

2.1 Molds.- Molds shall have an inside diameter of  $8.0 \pm 0.1$  in. at the top and  $7.5 \pm 0.25$  in. at the bottom and an inside depth of  $0.75 \pm 0.05$  in. They shall be rigid and noncorroding. Special Pyrex dishes, item 221, cut down to the proper diameter and depth; or aluminum dishes having a wall thickness of approximately 0.08 in. have been found satisfactory.

2.2 Balances.- The balances to be used in weighing materials shall have a maximum sensitivity and a maximum beam graduation of 0.1 g (a balance equivalent to Torsion Balance No. 255, capacity 4.5 kg, sensitivity 1/15 g, beam graduation 0.1 g, will be satisfactory).

2.3 Mixer.- Any mechanical mortar mixer similar to Model TM Lancaster mortar mixer, manufactured by the Posey Iron Works, Lancaster, Pennsylvania, or of the general type described in CRD-C 210.

2.4 Vibrator.- A vibrator table shall be mounted on a concrete pedestal and shall be of such size as to accommodate the filled mold. Clamps shall be provided on the top surface of the table to hold the mold firmly

to the vibrating surface. The vibrations shall be of low amplitude, and shall have a frequency of 5000 vibrations per min.

2.5 Air Compressor.- A source of compressed air shall be provided with a suitable regulator and gauge so that pressures up to 50 psi may be obtained.

2.6 Spray Gun.- The spray gun to be used shall be of such design and construction as to permit the compounds to be aspirated and applied uniformly to the test specimen surfaces at air pressures less than 50 psi when the distance from the nozzle to the specimen is less than 12 in.

2.7 Brush.- A stiff bristle brush shall be provided for brooming surfaces of specimens.

2.8 Cabinet.- A cabinet (or cabinets) shall be provided which is capable of maintaining the following conditions in the plane 1/2 in. above the upper surface of every test specimen during the preliminary evaporation and the testing periods:

Relative humidity, per cent. . . . .	$30 \pm 3$
Temperature, F. . . . .	$100 \pm 2$
Air velocity, mph. . . . .	$10 \pm 3$

Note.- The section of the cabinet for test specimens shall be kept full of test or dummy specimens at all times, in order to maintain proper and uniform distribution of air flow.

2.9 Hygrometer.- A hygrometer shall be provided which shall be capable of providing relative humidity measurements with an accuracy of 1% R.H.

2.10 Velometer.- A velometer shall be provided which shall be capable of measuring wind velocity with an accuracy of  $\pm 1$  mph (Fig. 1).

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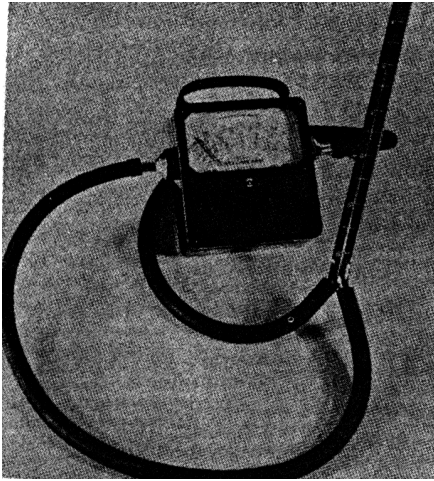


Fig. 1. Velometer with jet as used to measure air velocity in test cabinet

### 3. Samples and Test Specimens

3.1 Samples.- The moisture loss and sprayability tests shall be conducted on each sample taken as prescribed in CRD-C 301 and submitted to the laboratory for testing except that, for these tests, up to four 1-gal samples taken at the same time, submitted in a group, representing material from the same lot (as manufactured) may be tested as a single composite sample if the individual samples comply with the following requirements for similarity:

3.1.1 Specific gravity as calculated from the density determined in accordance with CRD-C 305, variation between individual samples not more than 0.01 (Note).

Note.- The procedures of CRD-C 305 shall be used to determine density at  $20 \pm 0.1$  C, and specific gravity shall be computed from the formula

$$\text{Specific gravity} = \frac{W - w}{N - M}$$

where these quantities are as defined in paragraphs 5(e) and 6(a) of CRD-C 305.

3.1.2 Flash-point (CRD-C 308) variation between individual samples, not more than 5 F (Note).

Note.- The procedures given in CRD-C 303 shall be used for tests of nonpigmented materials, and those of CRD-C 308 for tests of pigmented materials. Flash-point determinations on individual samples for the purpose of establishing similarity as a prerequisite to compositing may be omitted when the samples were taken by a representative of the Government at the plant at which the material was manufactured, during the operation of filling the drums, or when the samples were taken from material in bulk storage.

3.2 Specimens.- Test specimens for the moisture-loss test shall consist of 8-in. diam, circular mortar discs, 3/4 in. in thickness, and shall be made and tested in groups of five.

### 4. Materials

4.1 Sand.- Graded standard sand meeting the requirements of CRD-C 156 shall be used.

4.2 Portland Cement.- Portland cement shall be obtained from a single mill and shall conform to the requirements of CRD-C 200 for Type I or II.

4.3 Form Oil.- Petrolatum, mineral oil, or similar commercially available form oils shall be used.

Note.- Lubriplate 130-AA, manufactured by Fiske Brothers Refining Co., Newark, N.J., and Toledo, Ohio, is a highly satisfactory material for this purpose.

4.4 Sealing Compound.- A sealing compound shall be used to fill the groove at the contact between the mortar and the mold (Note).

Note.- Paraffin or microcrystalline wax having a melting point between 125 and 160 F (52 to 71 C), heated to a fluid consistency before use, has been found satisfactory for this purpose.

### 5. Procedure

5.1 Weighing of Materials.- Materials for mortar batches shall be

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weighed out, in quantities appropriate to the capacity of the mixer used, in the following proportions:

Proportion Cement : Sand	Water : Cement Ratio by Weight
1 : 3	0.530

5.2 Mixing of Mortar.- 5.2.1 Lancaster Mixer.- When a mortar mixer of the Lancaster type is used, the mixing procedure shall be as follows: The sand and cement shall be introduced into the mixer and mixed dry for 1 min. At the expiration of the 1-min mixing period, the water shall be added through the opening provided in the top of the mixer without stopping the mixer. The mortar shall then be mixed for an additional 3 min.

5.2.2 Hobart Mixer.- When a mortar mixer of the Hobart type is used, the mixing procedure shall be similar to that described in CRD-C 210.

5.3 Molding the Specimens.- The mixed mortar shall be placed in a mold (or molds), which has been previously coated with a thin layer of form oil and clamped to the vibrating table, and consolidated by vibrating for 45 sec. The mortar shall be troweled lightly during the vibrating period.

5.4 Preliminary Evaporation.- The molded specimens shall then be placed in the test cabinet to accelerate the disappearance of the supernatant water. The specimens shall be removed from the cabinet upon the disappearance of the surface water sheen.

5.5 Brooming.- After disappearance of the surface water sheen, the specimens shall be brushed lightly in parallel strokes with a stiff bristle brush. Specimens are to be brushed once only. The direction of motion of the strokes of the brush is to be parallel to the axis of the handle of the brush. In the event a surface water sheen is visible after brushing the specimen, this sheen shall be allowed to disappear before the curing compound is applied.

5.6 Sealing.- After the specimen has been brushed and the surface of the specimen is ready for the application of the curing compound, a

groove approximately 1/4 in. deep and 1/4 in. wide shall be made with an appropriate tool at the circumferential contact between the mortar and the mold; the circumferential edges of the molds shall be wiped carefully with a clean, dry rag and the sealing compound applied in such a manner as to seal effectively the boundary between the mold and the mortar, covering the top rim of the mold, filling the groove, and extending onto the surface of the mortar approximately 1/4 in. beyond the inner edge of the groove. Sealing compound may be applied by either a one-step, two-step, or three-step procedure. When a three-step procedure is used, the sealing compound shall be applied in the following manner:

5.6.1 A bead of sealing compound placed in the groove by means of an electrically heated wax pot similar to Type 252R, Staywarm Electric Company, Ravenna, Ohio, this bead to extend approximately 1/8 in. above the surface of the specimen and mold.

5.6.2 The bead described above shall then be sealed to the edge of the mold by the addition of more compound using a small spatula.

5.6.3 Additional compound shall then be added by means of a spatula so as to extend the seal to a feathered edge on the surface of the mortar 1/4 in. beyond the inner edge of the groove.

5.7 Application of Compound.- Following the sealing procedure specified in Paragraph 5.6 above, each specimen shall be weighed, and the test compound applied immediately. The weighing shall be made at the time of disappearance of the surface water sheen developed during brooming, so that the mortar will neither have surface water nor be dry below the surface at the time the test compound is applied. Determination of the time when the surface water sheen has disappeared will be only by observation of light reflection without touching the surface of the specimen. The air pressure shall be determined by trial and shall be just sufficient to atomize the test compound. The spray will be applied, with the nozzle of the spray gun held

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vertically over the specimen surface at the height (Fig. 2) required to give



Fig. 2. Applying curing compound to mortar test specimen

uniform application and minimum over spray. The material in the gun shall be agitated to insure thorough mixing of the ingredients at the time of application. The application of the compound shall be completed in not more than 45 sec and with every practicable effort to obtain the specified coverage in one application. Additional applications necessary to achieve the specified coverage shall not exceed two; should it not be possible to achieve the coverage in the time and number of applications stipulated, the specimen shall be discarded. The final weight shall be recorded. The coverage to be used shall be as close to 200 sq ft per gal as practicable. Specimens having coverages outside the range  $200 \pm 10$  sq ft per gal shall be discarded and replaced. The weight of the given compound to be applied to a given specimen of known area shall be computed from the specific gravity determined in accordance with CRD-C 305 and the following formula:

$$W = \frac{A \times G \times 3785.3}{200 \times 929.1}$$

where:

W = weight of compound to be applied to test specimen, g,  
 A = area of test specimen, including sealing compound, in sq cm,  
 G = specific gravity of compound at 20 C,  
 200 = specified coverage at 20 C, sq ft per gal (Note),  
 3785.3 = milliliters per gal, and  
 929.1 = sq cm per sq ft.

Note.- The weights obtained from this formula will be exact only at 20 C, the temperature at which the specific gravity of the compound is determined. However, only slight deviation will result when the compound is tested at somewhat different temperatures. The determination of W may be conveniently accomplished by the use of the nomograph reproduced as Fig. 5. The nomograph may also be used for determining the actual coverage value required for the calculation described in Par. 7.3 by using actual values for W.

5.8 Handling of Specimens.- Upon completion of the weighing specified in Paragraph 5.7 above, each specimen shall be allowed to cure under laboratory atmospheric conditions until the compound has hardened sufficiently to prevent its displacement by the air currents when the specimen is placed in the test cabinet. Ordinarily, this preliminary hardening period will be not more than 15 min and shall in no case be more than 30 min. Care shall be taken to keep the specimen in a level position to minimize ponding or flowing of the compound on the specimen surface.

5.9 Exposure in Test Cabinet.- The specimen shall then be placed in the test cabinet in such a position that the brush marks are approximately parallel to the direction of the movement of air through the cabinet. The specimens shall remain in the cabinet for 7 days, at which time they shall be removed and weighed and the unit moisture loss calculated. The appearance of the finally prepared specimen is shown in Fig. 3.

#### 6. Determination of Volatile Loss

6.1 Procedure.- Three glass plates upon which areas approximately 8 in. in diameter have been circumscribed by a bead of sealing compound 1/8 in. high shall be weighed and then sprayed

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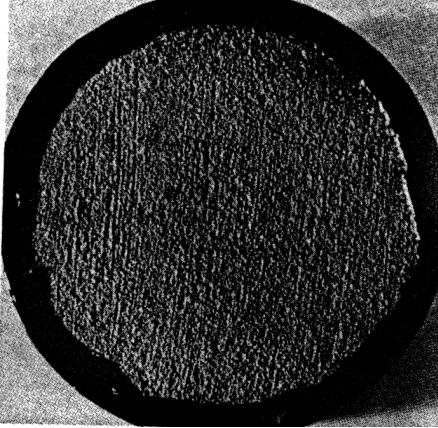


Fig. 3. Specimen prepared for unit moisture-loss test

with the test compound under the conditions of Paragraph 5.7 referred to on previous page. These specimens, referred to as "pilot plates," shall be weighed and then placed in the test cabinet in the same manner as a test specimen. The pilot plates shall be removed from the cabinet at the end of 2 days and again weighed. From the loss in weight, a correction factor for volatility of the compound shall be computed for use in calculating unit moisture loss. The following formula shall be used for determining this correction factor:

$$V = \frac{L}{W}$$

where:

V = correction factor for volatility,  
L = loss in weight of the pilot plate,  
grams, and

W = weight of compound sprayed on  
pilot plate, grams.

The average of the three values shall be used as the volatility correction factor for the compound under test.

## 7. Calculation of Results

7.1 Unit Moisture Loss.- The unit moisture loss for a given specimen at a given age shall be calculated

from the following formula:

$$L = \frac{(G - I) - V(G - F)}{A}$$

where:

L = unit moisture loss, grams per  
sq cm,

G = weight of specimen after spraying,  
grams,

I = weight of specimen after given  
period in test cabinet, grams,

V = correction factor for volatility,  
F = weight of specimen before spray-  
ing, grams, and

A = area of test surface, sq cm.

7.2 Area of Test Surface.- Determination of the precise area of the test surface shall be made at the termination of the test exposure. The area shall be stated in square centimeters and shall be accurate to  $\pm 3$  per cent. To determine the average diameter, for use in the calculation of area, 4 to 8 equally spaced measurements of diameter should be made, the number of such readings depending upon the circular uniformity of the inner edge of the sealing compound.

7.3 Defective Specimens.- Each specimen shall be carefully inspected for defects. Values obtained from specimens that are defective due to the presence of cracks or failure of the sealing compound, or reaction of the curing compound with the sealing compound shall be discarded. Should values for more than two in any group of five be discarded, the entire test shall be repeated.

7.4 Average Unit Moisture Loss.- The average unit moisture loss for the specimens in a group shall be the arithmetic average of the individual values for unit moisture loss.

Note.- The use of the nomograph reproduced as Fig. 4 may prove to be of convenience in determining the unit moisture loss from determinations of total moisture loss and average diameter.

## 8. Sprayability

8.1 A representative portion of the test sample shall be placed in the spray gun, Paragraph 2.6, and stored at a temperature of  $40 \pm 3$  F until the

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sample, container, and gun come to equilibrium temperature. The spray gun shall then be connected immediately to the source of air pressure, the sample agitated (if possible), and an attempt made to spray. The material shall be regarded as "not sprayable" in cases where only part of the material is fluid enough to spray.

9. Report

9.1 In reporting unit moisture-loss values, appropriate comment will be made regarding any abnormalities of the surface film.

9.2 The results of the test for sprayability will be reported as "sprayable" or "not sprayable."

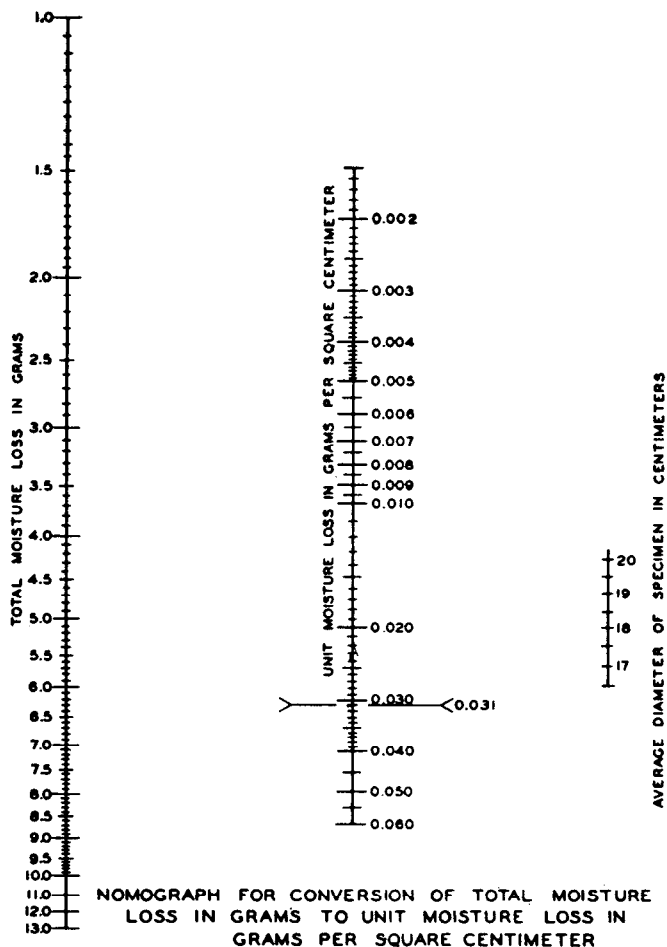


Fig. 4

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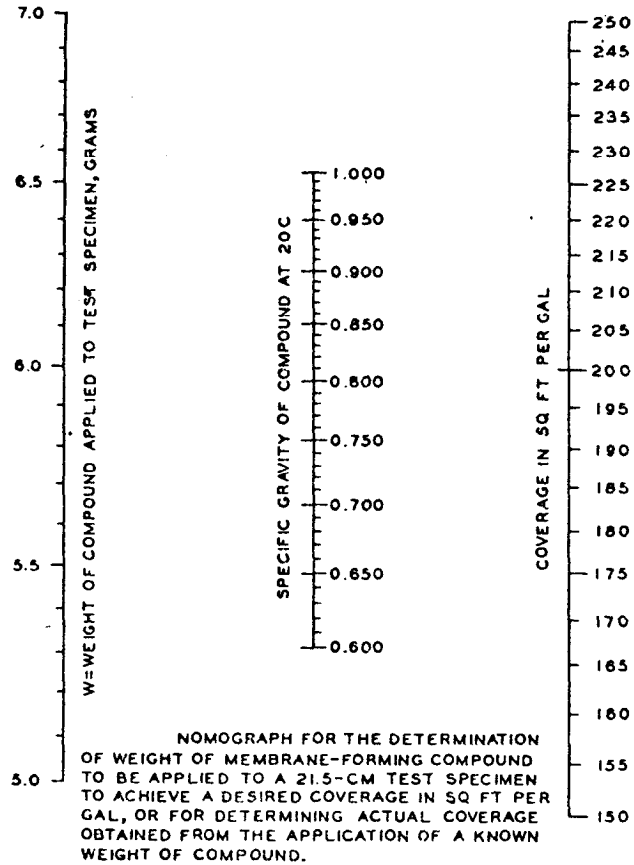


Fig. 5