

## TESTING IMPERVIOUS MATERIALS & COMPOUNDS FOR CURING CONCRETE

(A Modification of AASHO Designation T 155)

### REFEREE TEST

#### Scope

1. This method is intended for use in determining the efficiency of liquid membrane-forming compounds for curing concrete, as measured by their ability to prevent loss of moisture during the early hardening period.

#### Apparatus

2. The apparatus shall consist of the following:

(a) Molds. — Molds shall be made of metal, glass, hard rubber, or plastic and shall be watertight, of such construction that distortion is prevented. Interior dimensions shall be: 6 x 12 in. at the top, 5¾ x 11¼ in. at the bottom, within  $\pm\frac{1}{4}$  in., and  $2 \pm\frac{1}{8}$  in. depth. A flat rim is required at the top and on all sides and shall be  $\frac{1}{4}$  in. in width.

(b) Curing Cabinet. — A cabinet capable of a temperature of  $100^{\circ} \pm 2^{\circ}$  F and relative humidity of  $32 \pm 2\%$ .

#### Specific Gravity Determination

3. (a) Fill a specific gravity flask with a well-stirred sample of curing compound.

(b) Gently lower a selected hydrometer into the compound, taking care the hydrometer does not touch the sides of the flask. If the trial hydrometer comes to rest and floats too high, a hydrometer of greater specific gravity is necessary; if the hydrometer sinks below the scale, a lighter hydrometer is required. Continue to change hydrometers until one is found which comes to rest on the scale.

(c) Allow the hydrometer to settle to a constant level. (For clear, wax and varnish compounds, this occurs in a very few minutes; but the heavy-pigmented types may require an hour or more). Read and record the specific gravity of the compound.

(d) From Table I which follows, find the quantity in grams of compound to use for the test. For unusual compounds which do not occur on the chart, consult the supervisor.

NOTE: *The amount of compound is calculated to represent 150 sq. ft. per gallon coverage. For clear type compounds this works out to 10.0 ml. per sample, but other types, and especially the pigmented types, may require more.*

NOTE: *To find the required grams of compound for any specific gravity values not listed on Table I, proceed as follows:*

1. Determine specific gravity.
2. Obtain the specific gravity in the New and Revised Tag Manual for Inspectors of Petroleum and obtain the corresponding POUNDS PER GALLON.
3. Multiply POUNDS PER GALLON by factor 1.4385 to find the weight in grams of compound required to cover the specimen.

#### Proportioning and Mixing Mortar

4. (a) Proportioning. — The proportions of cement and sand shall be determined by adding dry sand to a cement paste having a water-cement ratio of 0.40 by weight, to produce a flow of  $35 \pm 5$ . The flow test shall be made as described in the Standard Method of Test for measuring Mortar-Making Properties of Fine Aggregate (AASHO Designation: T 71).

(b) Mixing. — The mortar shall be mixed at room temperature, preferably  $73.4^{\circ} \pm 3^{\circ}$  F ( $23^{\circ} \pm 1.7^{\circ}$  C) if possible, and at a relative humidity of 40 to 60 percent. The temperature of the mortar at the time of molding shall be  $73.4^{\circ} \pm 3^{\circ}$  F ( $23^{\circ} \pm 1.7^{\circ}$  C). The cement and water shall be placed in a nonabsorbent vessel and the cement permitted to absorb water for 1 minute. These materials shall then be mixed with a spoon into a smooth paste. The sand shall be added to the paste and final mixing shall be accomplished by continuous kneading and squeezing with the hands for 2 min. Rubber gloves shall be worn during the mixing operation. A suitable mortar-mixing machine may be used in lieu of hand mixing.

(c) Three specimens shall be molded for testing with a given curing compound.

(d) The mix used to determine the portion of sand to cement to produce the specified consistency shall be discarded and shall not be used for making test specimens.

#### Molding Specimens

4. (a) Coat the insides of the molds with a very thin coating of a light lubricating oil.

(b) Place a layer of mortar approximately 1 inch thick in the mold, and tamp 50 times with a wooden rod 1-in. square. Fill the mold with mortar and again tamp 50 times.

**TABLE 1**  
**GRAVITY CHART**  
For Use in Testing Curing Compounds

Range in Gravity	Grams of Compound	Range in Gravity	Grams of Compound
0.664 - 0.671	8.0	0.873 - 0.881	10.5
0.672 - 0.681	8.1	0.882 - 0.889	10.6
0.682 - 0.689	8.2	0.890 - 0.897	10.7
0.690 - 0.697	8.3	0.898 - 0.906	10.8
0.698 - 0.706	8.4	0.907 - 0.914	10.9
0.707 - 0.714	8.5	0.915 - 0.922	11.0
0.715 - 0.723	8.6	0.923 - 0.930	11.1
0.724 - 0.731	8.7	0.931 - 0.939	11.2
0.732 - 0.739	8.8	0.940 - 0.947	11.3
0.740 - 0.748	8.9	0.948 - 0.955	11.4
0.749 - 0.756	9.0	0.956 - 0.964	11.5
0.757 - 0.764	9.1	0.965 - 0.972	11.6
0.765 - 0.772	9.2	0.973 - 0.980	11.7
0.773 - 0.781	9.3	0.981 - 0.989	11.8
0.782 - 0.789	9.4	0.990 - 0.997	11.9
0.790 - 0.797	9.5	0.998 - 1.006	12.0
0.798 - 0.806	9.6	1.007 - 1.013	12.1
0.807 - 0.814	9.7	1.014 - 1.022	12.2
0.815 - 0.822	9.8	1.023 - 1.030	12.3
0.823 - 0.831	9.9	1.031 - 1.038	12.4
0.832 - 0.839	10.0	1.039 - 1.047	12.5
0.840 - 0.847	10.1	1.048 - 1.055	12.6
0.848 - 0.856	10.2	1.056 - 1.064	12.7
0.857 - 0.864	10.3	1.065 - 1.072	12.8
0.865 - 0.872	10.4	1.073 - 1.076+	12.9

(c) Immediately after completing the tamping, strike off the specimen level with the top of the mold, with a sawing motion of a wooden screed having a flat surface 1-inch in width. One pass only shall be made in the direction of the long axis of the mold.

**Storage of Specimens**

5. (a) Immediately after molding, weigh each full mold to the nearest 1 g. and place in the curing cabinet. Specimens shall be arranged so as to provide a clear space on all sides of from 2 to 7 inches.

NOTE: *The movement of conditioned air within the cabinet shall be such that the solvent from curing compounds will readily evaporate. During the first day of drying, sufficient fresh air shall be admitted into the cabinet to eliminate solvent vapors.*

**Application of Curing Materials**

7. (a) After approximately 1½ hours, check the specimens for surface water. If surface water is evident, leave the specimens in the cabinet until all surface water has disappeared. Then lightly brush the surface of the specimens with a stiff bristle brush. If surface water appears upon brushing, return the specimen to the curing cabinet. Remove the specimen immediately upon disappearance of the surface water

brought to the surface, and brush again. Repeat the process until no surface water appears when the specimen is brushed.

(b) When the proper surface condition has been attained, form a V-shaped groove approximately ¼ in. deep and not more than 1/16 in. wide between the edge of the mortar and the mold, extending all around the specimen. Fill the groove with a sealing compound that will not be affected by the curing material under test. This compound shall not extend more than ¼ in. from the mold onto the surface of the specimen.

(c) Weigh the specimen to the nearest 1 g. Then with a spray gun (for clear compounds), or with a soft-bristle brush 1 in. in width or a pipette (for pigmented compounds) apply the amount of curing compound determined from Section 3. Take care that the entire surface of the specimen is coated uniformly. Record the weight to the nearest 1 g. Place the specimen in the curing cabinet.

(d) After 3 hours, remove the specimens from the cabinet and weigh to the nearest 1 g. An unusually heavy loss in weight indicates a leaking mold or faulty seal. In such a case, the specimen shall be discarded. Return the specimens to the curing cabinet without delay.

### Duration of Curing

8. The specimens shall be cured for 72 hours with occasional daily checks, and the amount of water lost shall be determined by weighing the specimen.

### Corrections for Loss in Weight of Liquid Curing Materials During Test

9. (a) Take an identical quantity of curing compound and spread evenly over a clean, dry, tared metal pan approximately 6 in. x 12 in. x 1/8 in.

(b) Place the pan in the curing cabinet and dry it to constant weight. Reweigh to the nearest 0.1 g. Record the loss in weight of the curing compound as volatile matter.

### Calculations

10. (a) Calculate the loss of water and volatiles in the specimen and curing compound by the following:

$$W = S - S_c$$

Where:

- W = combined loss of water and volatile g.
- S = original weight of mold and specimen, with curing compound, g.
- S<sub>c</sub> = weight of cured specimen, plus mold, plus curing compound, g.

(b) Calculate the net loss of water from the specimen by the following:

$$L = W - W_v$$

Where:

- L = The net loss of water from specimen, g.
- W<sub>v</sub> = weight of volatile matter, as determined in section 9.(b), g.

(c) Measure the width of the mold in cm. in three areas and use the average with the length to acquire the surface area (A) of the mold.

(d) Calculate the weight of water lost per sq. cm. of surface area by the following:

$$W_a = L/A$$

Where:

- W<sub>a</sub> = weight of water lost per sq. cm. of area, g./cm.<sup>2</sup>
- A = surface area of mold (cm.<sup>2</sup>)

### Example

11. The following shall serve to illustrate calculations:

Orig. wt., Mold + Sample + Compound (S)	= 5502 g.
Cured wt. of above (S <sub>c</sub> )	= 5490 g.
Loss of water + Volatile (W)	= 12 g.
Volatile in 10 g. Curing Compound (W <sub>v</sub> )	= 7.2 g.
Net loss of water (L)	= 4.8 g.
Avg. width of mold	= 14.08 cm.
Avg. length of mold	= 29.50 cm.
Surface Area of mold (A)	= 415.4 cm. <sup>2</sup>

$$\text{Unit loss of water (W}_a\text{)} = \frac{L}{A} = \frac{4.8}{415.4} = 0.012 \text{ g./cm.}^2$$

### Report

12. Report the following:

- (a) Original weight of mold and specimen with curing compound, to nearest 1 g.
- (b) Weight of mold, specimen and compound after curing, to nearest 1 g.
- (c) Weight of loss of volatiles, to nearest 0.1 g.
- (d) Loss of water and volatiles in cured specimen to the nearest 0.1 g.
- (e) Net weight of water lost to the nearest 0.1 g.
- (f) Average width of mold, to nearest 0.01 cm.
- (g) Length of mold to nearest 0.01 cm.
- (h) Surface area of mold, to nearest 1 sq. cm.
- (i) Unit loss of water, to nearest 0.001 g. per sq. cm.

## ALTERNATE METHOD

### Scope

1. This method is a procedure for the determination of the non-volatile residue of curing compounds. It is

applicable for all types of membrane-forming curing compounds. The percent residue is used in determining the moisture retention efficiency of the curing compound.

### Apparatus

2. Apparatus shall consist of the following:

- (a) Balance, accurate to 0.1 gram.
- (b) Hot Plate, with a minimum of 3 heat variations.
- (c) Ointment Tins, 6 oz.

### Procedure

3. (a) Thoroughly stir the sample until it is completely free of lumps. Place 5 to 10 g. (weighed to the nearest 0.1 gram) into each of three 6 ounce ointment tins. Place the samples on a medium temperature hot plate (300° to 400° F) and heat until the volatile fraction is completely evaporated. This point can be determined when the formation of bubbles ceases and the residue starts to darken in color.

(b) Remove the cans from the hot plate and allow to cool to room temperature. Weigh each can to the nearest 0.1 gram and average the residue weights for the 3 cans.

### Calculation

4. Using the average weight, calculate the percent non-volatiles with the following formula:

$$\text{Percent} = \frac{B}{A} \times 100$$

Where:

A = Weight of compound before heating.

B = Weight of residue.

### Report

5. Report the result to the nearest 0.1 gram.

### Notes

(1) *Pigmented compounds should be allowed to settle until the clear liquid can be decanted. The clear liquid is then tested as above.*

(2) *Emulsion types should be heated slowly to avoid spattering.*