Recommend Approval:		Maryland Department of Transportation State Highway Administration Office of Materials Technology MARYLAND STANDARD METHOD OF TESTS	
	Assistant Division Chief — Date: 2-8-12 Division Chief — Date: 2/8/12		
Approved:	Director — Date: 03/12/12	TEST FOR RAPID HARDENING CEMENTITIOUS MATERIALS FOR CONCRETE PAVEMENT REPAIRS	MSMT 725

SCOPE:

This procedure is used for the qualification and subsequent evaluation of rapid hardening cementitious materials for use in concrete pavement repairs.

ORIGINAL SAMPLE FOR QUALIFICATION

Submit an original sample of 50 lb (min.) of the product in a typical container. Manufacturer's certification and actual test results for each class and type material submitted shall accompany the sample.

TEST SPECIMEN

1. Take a representative 3000 g sample from the original sample container in conformance with T 240, Method A.

2. The quantity of water, other liquid component, or both, added during mixing shall be based on the quantity per unit weight stated in the manufacturer's recommendations. Use the maximum amount recommended when a range is given.

3. Blend the mortar and the mixing liquid mechanically. Mold then cure the specimens in conformance with the individual physical test procedures described below.

4. Cure Class I and III material during the first 3 hours at temperatures 5 F above to 5 F below the extreme temperatures recommended by the manufacturer.

SETTING TIME

This procedure determines the time of setting of a mortar prepared from packaged cementitious patching materials by a modified Vicat needle. The zero time for the purpose of establishing initial and final setting time shall be the time of initial contact of mixing liquid with the packaged material.

MATERIALS AND EQUIPMENT:

1. Tamper & trowel conforming to T 106.

2. Vicat apparatus conforming to T 129, modified by C 807.

3. Cylindrical mold: 76 mm nominal inside diameter and a depth of 40 ±1 mm; cemented to a smooth metal or glass plate.

TEST PROCEDURE:

1. Prepare sample in conformance to C 807.

2. Immediately after molding the test sample, bring the needle of the apparatus into contact with the surface of the sample and tighten the set screw. Set the movable indicator to the upper zero mark on the scale.

3. Release the rod quickly by releasing the set screw and determine the penetration of the needle. If the sample is obviously fluid on early readings, slow the fall of the rod to avoid damage to the needle.

4. Take penetration tests at approximate three minute intervals.

   Note 1: Perform penetration tests no closer than 10 mm to previous penetration tests or to the inside edge of the mold. Record the results of all penetration tests and interpolate the time when a penetration of 25 mm is reached.

5. The difference in minutes between the time of contact of the mixing liquid with the material and the 25 mm penetration is the initial setting time. The final setting time is that time when the needle does not sink into the test sample.

   Note 2: Penetration intervals will vary with the type of material (slow, rapid, or very rapid) being tested. Use the manufacturer's test data to provide guidance for the approximate intervals.

REPORT:

Report the penetration time to the nearest whole minute.

COMPRESSIVE STRENGTH

MATERIALS AND EQUIPMENT:

Refer to T 106.

TEST PROCEDURE:

Refer to T 106 with the following exceptions:

1. Cure specimens in air at 73 ±5 F.

2. Mixing, molding and curing temperatures for Class I and III materials shall be 5 F above to 5 F below the extreme temperatures recommended by the manufacturer. Maintain these temperatures for the first 24 hours for the 28 day strength specimens.

CALCULATIONS:

Refer to T 106.

REPORT:

Report the compressive strength to the nearest 10 psi.

BOND STRENGTH

Place a representative portion of the freshly mixed packaged product into a 3 x 6 in. cylindrical mold containing a cured cementitious half cylinder (dummy section) of the dimensions shown in Figure 1. After curing of the packaged product as specified, determine the compressive strength of the composite cylinder in order to calculate the bond strength.

MATERIALS AND EQUIPMENT:

1. Apparatus used to mix portland cement mortar as specified in T 106.

2. Specimen molds constructed in the form of right cylinders, 3 in. inside diameter, and 6 in. in height. Other dimensions as specified in T 126 and M 205.

3. A dummy section (Figure 1) machined of hard material that is not attacked by portland cement mortar. It shall fit the mold and be equal to half the volume of the cylinder, but at an angle of 30 degrees from vertical.

4. Tamping rod - a round rod of brass, steel, or plastic, 3/8 in. diameter and approximately 12 in. in length with hemispheric ends.

5. Testing machine as referenced in T 22.

6. Moisture room conforming to M 201.

TEST PROCEDURE:

1. Mix the mortar for the standard mortar half cylinders in conformance with T 106, except increase the cement content by 20 percent.

2. Lightly oil the dummy section and the cylinder mold.

a. Position the dummy section in the mold with the slant side up.

b. Place the mortar in the mold in three layers of approximately equal volume.

c. Rod each layer with 25 strokes of the tamping rod uniformly over the section and deep enough to penetrate into the underlying layer.

Note 3: Strike off the surface of the mold with the trowel and cover with a glass or metal plate.

3. Remove the half cylinder specimens from the molds after one day and cure them as specified in T 126 for a minimum of 13 additional days in the moisture room.

4. A 3 x 6 in. standard mortar cylinder shall have a minimum compressive strength of 3000 psi at 7 days, calculated based on the normal cross-sectional area of the cylinder 7.07 in^2.

5. Remove three standard mortar half-cylinders from the curing room.

a. Sandblast or wire brush the elliptical surfaces and then carefully remove the loose surface material.

b. Mix ample material, in conformance with the manufacturer's instructions, to cast three composite bond strength specimens for each packaged cementitious material tested.

c. Place the mortar sections into three cylinder molds and slightly dampen the elliptical surfaces.

d. Place the molds in their normal vertical position and place a layer of freshly mixed material into the molds to a depth of approximately 1 in.

e. Rod sufficiently with the tamping rod to ensure that all voids are filled.

f. Place additional mortar into the mold in two layers of approximately equal volume.

g. Rod each layer with 25 strokes of the tamping rod. Distribute the strokes over the cross-section and tamp deep enough to penetrate into the underlying layer.

h. Strike off the surface of the mold with the trowel and cover with a glass or metal plate.

6. Remove the test specimens from the molds after 24 hr and cure for 6 additional days in conformance with T 126.

7. Cap all specimens after curing as specified in T 231.

8. Test the specimens as specified in T 22.

   Note 4: An external vibrator may be used in lieu of rodding to consolidate the mortar.

CALCULATION:

1. Calculate the bond strength of the bonding system by dividing the load carried by the specimen at failure by the actual cross-sectional area of the cylinder (approximately 7.07 in^2).

2. Should any specimen break 500 psi or more below the average of the three, disregard the results of that specimen and base acceptance or rejection on the basis of the average of the other two results.

LENGTH CHANGE

Determine length change as specified in T 160, except as modified by C 928.

FREEZE - THAW RESISTANCE

This procedure is used to determine the resistance of 2 x 2 in. cube specimens of mortar by alternately freezing and thawing while immersed in a brine solution of 10 percent by weight calcium chloride (USP or better) in water.

MATERIALS AND EQUIPMENT:

1. A suitable container of sufficient size to permit at least 6 specimens to be surrounded on 5 sides by not less than 1/2 in. of the salt solution at all times during freezing and thawing.

   Note 5: A plastic dish pan may be used.

2. Freezer having a chamber large enough to hold the container with specimens and salt solution and capable of uniformly maintaining temperatures of -10 F or lower.

3. Thawing area which is relatively dust free and having a temperature range of 60 to 90 F

Note 6: Room temperature is usually sufficient for thawing, but a 15 watt infra-red lamp may be used to accelerate it. When a lamp is used, place it at a distance of 7 in. or more from the test specimens and salt solution. The lamp may be used immediately after removing the container from the freezing chamber.

TEST PROCEDURE:

1. Prepare specimens used in this test as specified in T 106.

Note 7: Due to the composition of some materials, (especially pre-mixed aggregate-cement compounds), a standard method of sample preparation cannot always be followed. In those instances, follow the manufacturer's recommended procedures.

2. After the initial 22 ±2 hr storage in the moisture room, remove the specimens from the molds and identify each by number or other marking.

a. Immerse the specimens in clean water in the storage tanks of the moisture room.

b. Unless otherwise specified, keep the specimens in the storage tanks for 13 days ±6 hr to complete a 14 day curing period.

3. At the end of the specified curing period, remove the specimens from the storage tanks and then dry the surface with a damp cloth or towel.

a. Record the weight of each specimen to the nearest 0.1 g.

b. Protect the specimens from loss of moisture by completely covering with a damp cloth or towel.

4. Place the specimens at random locations within the container and cover with the specified salt solution so that all specimens are surrounded on 5 sides by not less than 1/2 in. of the solution**.**

Note 8: At no time during the test shall the salt solution be less than 2 1/2 in. deep.

5. Place the container inside the freezing chamber maintained at -10 F minimum for 16 ±2 hr.

6. After the freezing period, remove the container and permit the contents to thaw at a temperature of 75 to 90 F for a period of 7 ±1 hr.

7. Alternately freeze and thaw as specified in step 3 and 4
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a. At the end of the thawing phase of each five cycles, remove the specimens one at a time.

b. Rinse with clean water to remove all traces of brine, surface dry with a damp cloth or towel and weigh.

c. Record the weight to the nearest 0.1 g and return the specimens to random positions in the container. Care shall be taken to prevent loss of moisture during the weighing operation by covering completely with a damp cloth or towel if not returned directly to the container.

Note 9: Refer to T 161 for procedure to use if test must be suspended.

8. Subject the test specimens to 25 cycles of alternate freezing and thawing, unless a different number of cycles have been specified.

Note 10: Terminate testing if a loss greater than that anticipated or otherwise designated is encountered.

CALCULATIONS:

1. Perform calculations upon the completion of each 5 cycles to determine the percent loss during those cycles. Determine the total percent loss at the end of the testing period.

2. Calculate the percent loss using the following formula:

$$A = \frac{B - C}{B} \times 100$$

where:

A = Percent loss

B = Weight of specimen at O cycles

C = Weight of same specimen after completion of each testing period (5 cycles, then at 10 cycles, etc., up to and including final cycle.)

3. If a retest is deemed necessary, use a standard of known durability at the same time to verify the procedure.

REPORT:

Include the following data for both the standard cubes and the cubes made with the sample submitted:

1. Curing process (if other than that specified).
2. Weight at 0 cycles.
3. Weight and percent of loss after each 5 cycles.
4. Source of the cement used in the standard cubes.
5. Actual amount of water added to the weight of materials under test to make the mortar cubes.