



Designation: ~~D3910~~—15 D3910 – 21

## Standard Practices for Design, Testing, and Construction of Slurry Seal<sup>1</sup>

This standard is issued under the fixed designation D3910; 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 U.S. Department of Defense.*

### 1. Scope

1.1 These practices cover the design, testing, and construction of mixtures for surface treatment of pavements. It is written as a guide and should be used as such. End-use specifications should be adapted to conform to job and user requirements.

1.2 The values stated in SI units are to be regarded as the standard. The non-SI units used in this standard are allowed by the ~~sub-committee~~ subcommittee for clarification in the use of the standard.

1.3 The text of this standard references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 *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~~ safety, health, and health ~~environmental~~ environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

[C128 Test Method for Relative Density \(Specific Gravity\) and Absorption of Fine Aggregate](#)

[D8 Terminology Relating to Materials for Roads and Pavements](#)

[D242/D242M Specification for Mineral Filler for Asphalt Mixtures](#)

[D977 Specification for Emulsified Asphalt](#)

[D1073 Specification for Fine Aggregate for Asphalt Paving Mixtures](#)

[D2397/D2397M Specification for Cationic Emulsified Asphalt](#)

[D2419 Test Method for Sand Equivalent Value of Soils and Fine Aggregate](#)

[E145/D3666 Specification for ~~Gravity-Convection and Forced-Ventilation Ovens~~ Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials](#)

<sup>1</sup> These practices are under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and are the direct responsibility of Subcommittee D04.24 on Asphalt Surface Treatments.

Current edition approved June 15, 2015; Nov. 1, 2021. Published September 2015; November 2021. Originally approved in 1980. Last previous edition approved in 2014; 2015 as ~~D3910 – 11~~ D3910 – 15. DOI: ~~10.1520/D3910-15~~ 10.1520/D3910-21.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

**TABLE 1 Grading Requirements for Aggregate**

Sieve Size	Amount Passing Sieve, weight %		
	Type I	Type II	Type III
3/8 in. (9.5 mm)	100	100	100
No. 4 (4.75 mm)	100	90 to 100	70 to 90
No. 4 (4.75 mm)	100	90 to 100	70 to 90
No. 8 (2.36 mm)	90 to 100	65 to 90	45 to 70
No. 8 (2.36 mm)	90 to 100	65 to 90	45 to 70
No. 16 (1.18 mm)	65 to 90	45 to 70	28 to 50
No. 16 (1.18 mm)	65 to 90	45 to 70	28 to 50
No. 30 (600 µm)	40 to 60	30 to 50	19 to 34
No. 30 (600 µm)	40 to 60	30 to 50	19 to 34
No. 50 (300 µm)	25 to 42	18 to 30	12 to 25
No. 50 (300 µm)	25 to 42	18 to 30	12 to 25
No. 100 (150 µm)	15 to 30	10 to 21	7 to 18
No. 100 (150 µm)	15 to 30	10 to 21	7 to 18
No. 200 (75 µm)	10 to 20	5 to 15	5 to 15
No. 200 (75 µm)	10 to 20	5 to 15	5 to 15

## 2.2 Other Documents:<sup>3</sup>

[ISSA A105 Recommended Performance Guidelines For Emulsified Asphalt Slurry Seal](#)

[ISSA Technical Bulletin No. 139106 Test Method to Classify Emulsified Asphalt/Aggregate Mixture Systems by Modified Cohesion Tester Measurement of Set and Cure Characteristics for Measurement of Slurry Seal Consistency](#)

## 3. Terminology

3.1 *Definitions*—For definitions of terms used in this standard, refer to Terminology [D8](#).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *emulsified asphalt slurry seal mixtures*—as related to these practices, mixtures of fine aggregate with or without mineral filler, with or without mixing water, uniformly mixed with emulsified asphalt.

## 4. Significance and Use

4.1 These slurry seal practices are written as a guide and should not be construed as specifications.

4.2 End-use specifications should be adopted to conform to job and user requirements.

**NOTE 1**—The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of Specification [D3666](#) are generally considered capable of competent and objective testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Specification [D3666](#) alone does not completely ensure reliable results. Reliable results depend on many factors; following the suggestions of Specification [D3666](#) or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

## 5. Design

5.1 *Aggregates:*

5.1.1 The fine aggregate shall consist of natural or manufactured sand, slag, crushed fines, or other mineral aggregate that conforms to the quality requirements of Specification [D1073](#).

5.1.2 Recommended grading requirements are shown in [Table 1](#). These requirements are taken from those given in [ISSA A105](#).

5.1.3 Smooth-textured sand of less than 1.25 % water absorption shall not exceed 50 % of the total combined aggregate. (For heavy duty surface requirements, use 100 % crushed material.)

<sup>3</sup> Available from the International Slurry Surfacing Association, 3 Church Circle, PMB 250, Annapolis, MD 21401, 800 Roosevelt Road, Building C, Suite 312, Glen Ellyn, IL 60137, <http://www.slurry.org>.

5.1.4 When tested by Test Method **D2419**, the combined aggregate prior to the addition of any chemically active mineral fillers shall have a sand equivalent of not less than 45.

## 5.2 Mineral Filler:

5.2.1 Mineral fillers are of two types, chemically active and chemically inactive. Both shall conform to Specification **D242D242/D242M**.

5.2.2 Chemically active mineral fillers such as portland cement, hydrated lime, and ~~ammonium~~ aluminum sulfate are used to improve the workability, regulate the setting time and, in some cases, to alter the aggregate gradation.

5.2.3 Chemically inactive mineral fillers such as limestone dust, ~~flyash,~~ fly ash, and rock dust are used mainly to alter aggregate gradation.

5.3 *Emulsified Asphalt*—~~The emulsified asphalt Slow Set (SS-1, CSS-1, SS-1h, and CSS-1h) or Quick Set (QS-1, CQS-1, QS-1h, and CQS1h) grades of emulsified asphalt used in the design shall conform to Grade SS-1h of Specification the D977, for emulsified asphalt, or Grade CSS-1h of Specification~~ emulsified asphalt grades fitted for slurry seal applications as **D2397**, for cationic emulsified found in Specification **D977** asphalt or Specification **D2397/D2397M**.

5.3.1 Quick-Set emulsified asphalts, QS-1h and CQS-1h may also be used. They shall conform to Specifications **D977** and **D2397**, respectively. Refer to the International Slurry Surfacing Association (ISSA) Bulletin No. 139.

## 5.4 Composition of Slurry Seal Mixtures:

5.4.1 A job mixture shall be selected that conforms to the specification limits, and that is suitable for the traffic, climatic conditions, curing conditions, and final use. All materials to be used shall be pretested for their suitability in the mixture as described in Section 6.

5.4.2 The mixture shall attain an initial set in not less than 15 min nor more than 12 h. The setting time may be regulated by the addition of mineral fillers or chemical agents.

5.4.3 The mixture shall be one of three ~~types,~~ types whose combined aggregates conform to the gradation requirements of **Table 1**.

5.4.3.1 Type I is suitable to seal cracks, fill voids, and correct surface erosion conditions. The residual asphalt content shall be from 10 to 16 weight % of dry aggregate. It shall be applied at a rate of 3.3 to 5.4 kg/m<sup>2</sup> (6 to 10 lb/yd<sup>2</sup>). ~~This type is used on airfields where surface sealing and skid resistance are the primary needs.~~

NOTE 2—This type is used on airfields, parking lots, and urban and rural streets where surface sealing and skid resistance are the primary needs.

5.4.3.2 Type II is suitable to fill surface voids, correct severe surface erosion conditions, and provide a minimum wearing surface. The residual asphalt content shall be from 7.5 to 13.5 weight % of dry aggregate. It shall be applied at a rate of 5.4 to 8.2 kg/m<sup>2</sup> (10 to 15 lb/yd<sup>2</sup>). ~~This type is used on airfields and pavements that are severely eroded, or have numerous cracks. It may also be used as wearing surface on bituminous base courses or soil-cement bases, or as a sealer on stabilized base courses.~~

NOTE 3—This type is used on airfields and pavements that are severely eroded or have numerous cracks. It may also be used as wearing surface on bituminous base courses or soil-cement bases, or as a sealer on stabilized base courses.

5.4.3.3 Type III is suitable to provide a new wearing surface or build up a crown. The residual asphalt content shall be from 6.5 to 12 weight % of dry aggregate. It shall be applied at a rate of 8.2 or more kg/m<sup>2</sup> (15 or more lb/yd<sup>2</sup>).

5.4.4 *Consistency Test*—This test is used to determine optimum mix design for aggregate, filler, water, and ~~emulsion,~~ emulsified asphalt. A flow of 2 to 3 cm is considered to be the consistency normally required for a workable field mix (see 6.1).

5.4.5 *Set Time*—This test determines the time required for slurry seal to reach initial set with paper blot method. A properly mix-designed slurry seal should be set at the end of 12 h. A 1-h set time is considered acceptable for a quick-setting quick-setting slurry seal (see 6.2).

5.4.6 *Cure Time*—This test is used to determine initial cohesion of slurry seal mat and resistance to traffic. A properly designed slurry seal mix should be completely cured at the end of 24 h after placement (see 6.3).

5.4.7 *Wet Track Abrasion Test*—This test method covers measurement of the wearing qualities of slurry seal under wet abrasion conditions.

NOTE 4—As a guide, slurry seal shall not show a loss of more than  $75\text{--}75\text{ g/ft}^2$ .

## 6. Test Methods for Emulsified Asphalt Slurry Seal

### 6.1 Consistency Test:

6.1.1 This test method is used to determine the proper consistency (mix design) formulation for a slow-setting slurry seal mixture.

6.1.2 The consistency test should be performed as a method of determining the optimum mix design formulation (proper ratio of aggregate, filler, water, and emulsion) emulsified asphalt as related to proper mixture consistency for pavement surface placement. Several mixes are made using dried aggregate and various ratios of portland cement, or hydrated lime or chemical modifier, or both, water and asphalt emulsion. Mix time shall be for no less than 1 min when mixed at  $25 \pm 1^\circ\text{C}$ . water, and emulsified asphalt.

NOTE 5—Ideal relative humidity for this test is  $50 \pm 5\%$ . Results will vary at different relative humidity values.

6.1.3 Mold, metal or plastic, in the form of a frustum of a cone 38 mm ( $1\frac{1}{2}$  in.) in diameter at the top, 89 mm ( $3\frac{1}{2}$  in.) in diameter at the bottom, and 76 mm (3 in.) in height (see Test Method C128).

6.1.4 The center of a 228 by 228-mm piece of 3-mm thick metal plate is inscribed with a circle 89 mm in diameter. Three to four additional circles, each 13 mm greater in radius than the preceding circle, are inscribed on the metal plate around the center circle. In lieu of the metal plate, a paper version of a flow scale may be used as found in ISSA Technical Bulletin 106 (see Note 6).

NOTE 3—Plastic plates are subject to eventual crazing and abrasion loss of the inscribed circles.

6.1.5 The mold as described in 6.1.3 is loosely filled with a test slurry mix and struck off. The mold and contents are then inverted in the center placed over the center circle of the metal plate as described in or flow scale 6.1.4 by placing the inscribed surface of the metal plate on the slurry-filled cone which, while holding cone and plate firmly together, is quickly inverted. paper. A 400 g to 600 g test mixture (based on dry mass of aggregate) is prepared and after 30 s of mixing, it is poured into the mold, completely filling it, and struck off to be level-full. The mold is quickly removed and the contents allowed to flow over the inscribed circles scale until flow of the slurry stops. mixture stops. Four flow measurements (in centimeters) are made at  $90^\circ$  points along the flow scale. The average value of the four measurements is to be taken and reported as the “flow.” Project aggregate and emulsion emulsified asphalt grade are considered essential for proper relevancy of the method.

NOTE 6—Referenced ISSA Technical Bulletin No. 106 titled “Measurement—Test Method for Measurement of Slurry Seal Consistency.”<sup>3</sup>

### 6.2 Set Time:

6.2.1 This test method is used to determine the time required for the slurry seal mat to reach initial set (resistance to paper blot).

6.2.2 The slurry mix mixture or mixtures that provide the desired consistency shall be repeated to determine their setting characteristics. A mix mixture passing the consistency test is poured onto a 152 by 152-mm asphalt felt pad (30 lb (30-lb roofing felt) and screeded to 6 mm thickness using a 6-mm template. At the end of 15 min, at  $25 \pm 1^\circ\text{C}$  and  $50 \pm 5\%$  relative humidity, a white paper towel or tissue is lightly pressed or blotted on the slurry mixture surface. If no brown stain is transferred to the paper, the slurry mixture is considered set. If a brown stain does appear, repeat the blot procedure at 15-min intervals. After 3 h of blotting, 30-min (or longer) blot intervals would be suitable. Record and report the time required to obtain a stain-free blot as the set time.

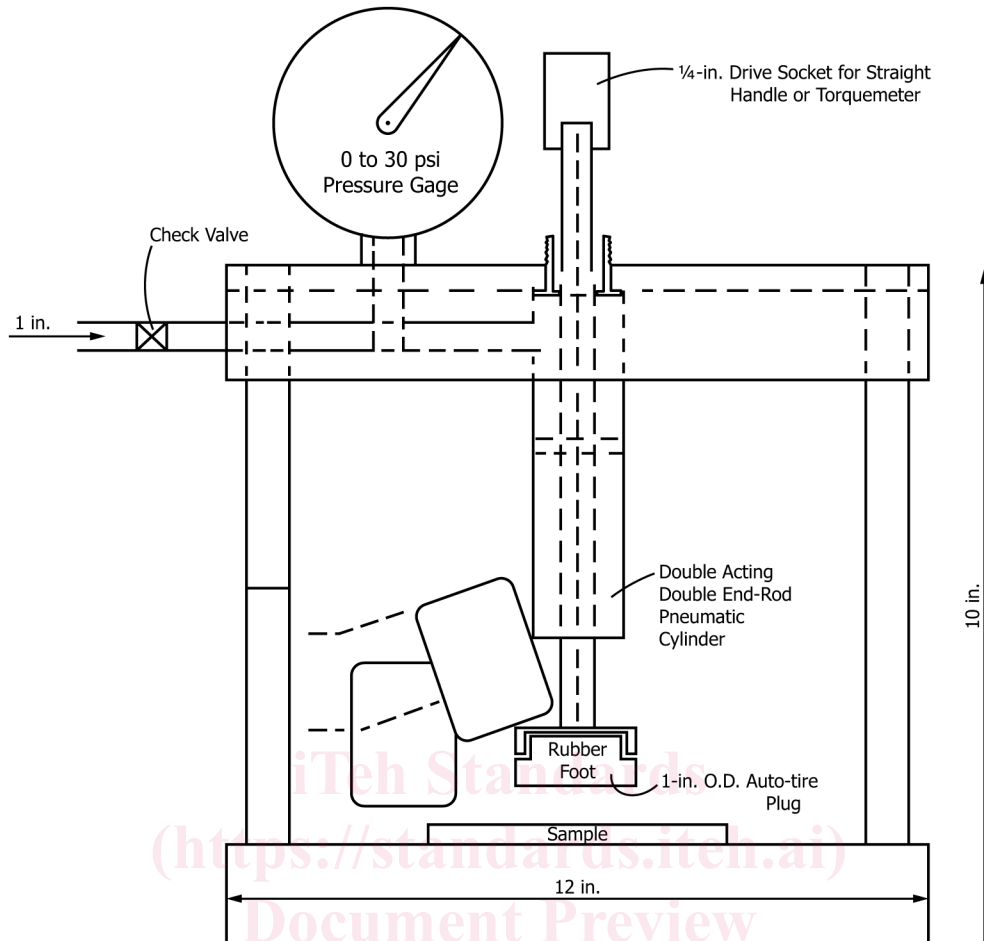


FIG. 1 Cohesion Tester (Front View)

ASTM D3910-21

<https://standards.iteh.ai/catalog/standards/sist/02c0d5dd-f9f4-4036-8f64-66ffef2606e9/astm-d3910-21>

### 6.3 Cure Time:

6.3.1 Total cure of a slurry mixture mat is obtained when complete cohesion between asphalt-coated aggregate particles occurs. A cohesion testing device is used to measure cure time.

6.3.2 A slurry mixture of optimum design obtained from use of the consistency test (see 5.4.4) is screeded onto a roofing felt pad to a thickness not exceeding the height of the largest aggregate fragment present in the mix. A template is recommended to obtain uniform thickness of the slurry mat.

6.3.3 After set of the slurry mixture mat has occurred (5.4.5), the mat is placed beneath the pneumatically actuated rubber foot (25.4 mm (1 in.) in diameter) of the cohesion tester (see 6.3.4).<sup>4</sup> A pressure of 200 kPa (28.5 psi) is considered to be equivalent to that exerted by an average automobile. The rubber foot is twisted by means of a handheld torque tester (see 6.3.4) which reads in kilogram-centimetres. The torque procedure is repeated at 15 to 30 ~~min~~ 30-min intervals until the highest torque reading obtainable remains constant. An undisturbed site on the slurry mixture pad should be selected for each time-interval test. The time required to reach a constant maximum torque or until the rubber foot rides freely over ~~slurry~~ the mixture mat without any aggregate particles being dislodged, is recorded as the cure time.

6.3.4 ~~Cohesion~~ A cohesion tester is a lightweight, portable device which can be adjusted to apply varying pressure to a slurry mixture pad (see Figs. 1 and 2). Torque can be applied with a ~~torque meter~~ handheld torque tester. The cohesion tester can be used in the laboratory or field and can be pressured with in-house air, a portable compressor, or a simple bicycle tire pump.

<sup>4</sup> A suitable rubber foot, having a durometer hardness range of 50 to 70.

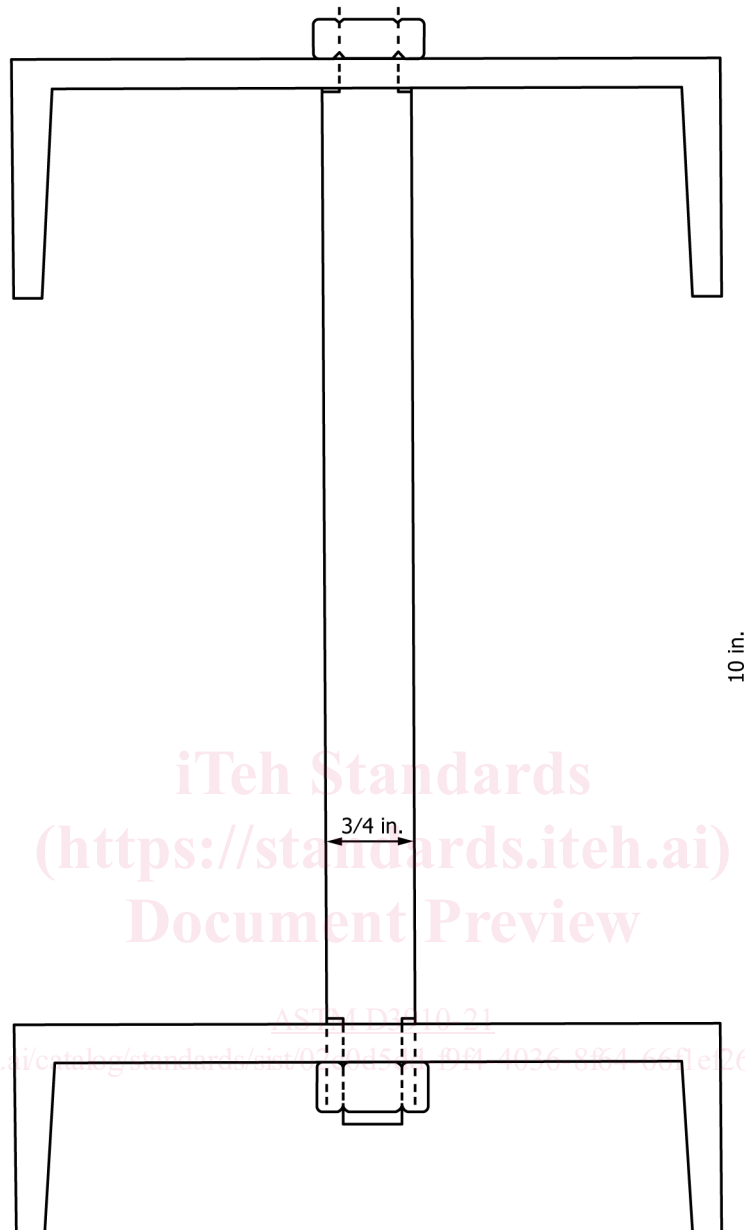


FIG. 2 Cohesion Tester (Side View)

#### 6.4 Wet Track Abrasion Test:

##### 6.4.1 Summary of Test Method:

6.4.1.1 A slurry mixture of fine graded aggregate, asphalt emulsion, emulsified asphalt, and water is prepared to a homogeneous flowing consistency (see consistency test). The slurry mixture is formed into a disk by pouring in the circular opening of a poly(methyl) methacrylate (PMMA) specimen mold or template resting on a larger circle of 30-lb roofing felt.

6.4.1.2 After removal of the template, the disk-shaped specimen is dried to constant weight at 60°C/60 °C. The cured slurry mixture is placed in a water bath for 1 h, then mechanically abraded under water with a rubber hose for 5 min. The abraded specimen is washed free of debris, dried at 60°C/60 °C, and weighed. The loss in weight expressed as grams per square metre (or square foot) is reported as the wear value (WTAT loss).

##### 6.4.2 Apparatus:



FIG. 3 Specimen in Place Ready for Test (C-100 machine pictured)

6.4.2.1 *Balance*, capable of weighing 5000 g to within  $\pm 1.0$  g.  $\pm 1.0$  g.

6.4.2.2 *Planetary Type Mechanical Stirrer*, (such as the Hobart Model N-50, Model C-100 or Model A-120 made by the Hobart Manufacturing Co., Troy, Ohio) equipped with a (5-lb) weighted rubber hose holding device (abrasion head) with about 12.7-mm  $2.27 \pm 0.06$  kg ( $5 \pm 0.13$  lb) abrasion head (holding device) with  $12.7 \pm 0.5$  mm ( $0.5 \pm 0.02$  in.) free up-and-down movement in the shaft sleeve (Fig. 3). The mass of the abrasion head shall not include the mass with the rubber hose attached.

NOTE 7—Examples of planetary mixers would be Hobart Model N-50, C-100, or A-120.

6.4.2.3 *Heavy Flat-Bottom Metal Pan*—(3.2 mm) Flat-Bottom Metal Pan, approximately 3.2 mm thick, 330 mm in diameter, with 51-mm vertical side walls (20 gage or heavier) having either four equispaced screw clamps capable of securing 285-mm diameter specimen to bottom of pan or a quick-clamp mounting plate (Fig. 4).

NOTE 8—The dimensions on the pan are specific to the C-100 machine. Dimensions may vary with machine type. The quick-clamp mounting plate is shown on an N-50 machine.

6.4.2.4 *Suitable Heavy-Gage Round-Bottom-Mixing Bowl*, durable with smooth bottom, made of non-absorptive material, large enough to contain the sample during mixing.

6.4.2.5 *Long-Handled Serving Spoon, Mixing Spoon or Spatula*, of made of non-absorptive material, of sufficient length to project 101 mm (4 in.) or more out of the round-bottom bowl during stirring adequately mix the sample.

6.4.2.6 *Specimen Disks*, supply of 286-mm diameter, cut minimum diameter of 286 mm and prepared from 30-lb roofing felt.

6.4.2.7 *Equipment*, used in specimen preparation such as a special circular poly(methyl methacrylate) (PMMA) specimen template 6 mm thick with a 279-mm diameter circular opening (Fig. 5) and a 305 to 355-mm short-handled window squeegee or a  $\frac{1}{2}$ -in. wooden dowel of similar length.

6.4.2.8 *Oven*, forced-draft, constant temperature, thermostatically controlled at  $60 \pm 3^\circ\text{C}$  see Specification 3 °C. E145 Type H-B.

6.4.2.9 *Water Bath*, constant-temperature, controlled at  $25 \pm 3^\circ\text{C}$ . 3 °C.