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Standard Test Method for Dye Penetration of Solid Fiberglass Reinforced Pultruded Stock[1]

This standard is issued under the fixed designation D 5117; 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 (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This dye-penetrant test method covers a means of evaluating solid fiberglass all-roving reinforced pultruded rod or bar stock for longitudinal wicking. There are generally three mechanisms that promote wicking, any or all of which may be operating at a given time.

NOTE 1—The specimen's cross-section may reflect delaminations, longitudinal continuous voids, or the presence of hollow fibers, or all three. Occasionally these flaws may be detected by this test, but other tests are usually required.

1.2 The results of a wicking test are dependent on specimen type and size, penetrant type, time of exposure in the penetrant, penetrant viscosity, etc. Any attempt to use a wicking test to establish specification criteria should be made with great care.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with 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 and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see 10.3 and 10.6.

NOTE ~~2—There is no similar or equivalent ISO standard.~~ 2—There is no known ISO equivalent to this test method.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D 618 Practice for Conditioning Plastics for Testing

D 3918 ~~Definitions of Terms Relating to Reinforced Plastic Pultruded Products~~ Terminology Relating to Reinforced Plastic Pultruded Products

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 ~~Definition~~*Definitions of Terms Specific to This Standard:*

3.1.1 *wicking*—transmission of a gas or liquid due to pressure differential or capillary action along fibers incorporated in a fiberglass reinforced pultruded product.

4. Summary of Test Method

4.1 ~~P~~All-roving pultruded rod stock ~~of circular cross-section~~ is tested by placing the specimen(s) on end into the dye penetrant to a specified depth and observing the wicking action as spots, or dots, on the opposite, dry face.

4.2 The wicking action through the length of the specimen is due to the capillary action of the penetrant through the open pathways in the composite. These pathways are typically occupied by air and can be caused by continuous voids, cracks, or hollow fibers, or all three, in the reinforcement.

5. Significance and Use

5.1 This test method is useful for establishing the integrity of composite rod. The presence of voids, cracks, and hollow fibers

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[1] This test method is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.18 on Reinforced Thermosetting Plastics.

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[2] 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.

***A Summary of Changes section appears at the end of this standard.**

are considered detrimental to the structural integrity of the composite and may cause reduced electrical resistance and increased current leakage.

5.2 A perfect composite would be flaw-free, and there would be no possibility of wicking. Composites of this type are virtually nonexistent, as there will typically be entrapped air in the resin developed during manufacture, occasional hollow fibers, and occasional cracks due to thermal stresses.

5.3 This test method is intended to provide a tool for measuring the extent of ~~flaws~~wicking in a composite over very short lengths of material for comparative purposes. The presence of wicking over 1 in. ~~[2.54 cm]~~(2.54 cm) lengths may not necessarily imply that the composite will perform unsatisfactorily for its intended end-use. Therefore, interpretation of test results should be made with care.

5.4 This test method was developed as a technique for estimating quality and consistency of pultruded rod and bar stock, which is a composite of resin and all-roving reinforcement. The manufacturing process may also affect the quality of the product. It should be useful for a manufacturer in determining whether any gross changes in quality have taken place due to process or raw material changes.

5.5 Since the results of this test are so sensitive to sample size, penetrant type, penetrant used, viscosity, duration of test, and other factors, no attempt to arrive at or recommend development of a specification for these materials has been made. It is suggested that such a specification should be negotiated between supplier and end user.

6. Apparatus

6.1 *Dye Penetrant*[3]

6.2 *Ultraviolet Light Source*—The penetrant used is fluorescent, and requires a black lamp light source.

6.3 *Dark Room*—An area for viewing the presence of fluorescent spots on the test specimens is required.

6.4 *Hood*—There is a need to provide adequate air ventilation for the elimination of any annoying vapors from the penetrant. These vapors are nontoxic, but could be an irritant.

6.5 *Shallow Pan*, for holding the penetrant is required. A thin, spongy material that can be placed in the pan and upon which the specimens may rest is recommended.

6.6 *Stop Watch*, or other means for timing the length of the test is required.

6.7 *Magnifying Glass*, 5×, recommended for identifying very small fluorescent specks, or dots, on the specimen's upper face. It is not regarded as essential.

7. Materials

7.1 This test method was developed for use on solid pultruded all-roving rod and bar stock reinforced with fiberglass. An evaluation employed 1 in. diameter rod stock using epoxy, vinyl ester and polyester resins. It is recognized that this test method will be used with other resin system and rod-stock sizes.

7.2 Use rod-stock representative of typical production lots and select random specimens for testing.

8. Sampling and Test Specimens

8.1 Take at least three test specimens for each sample.

8.2 Specimens shall not be taken from material that has been damaged or subjected to previous testing.

8.3 Select at least three 1-in. ~~[2.54 cm]~~(2.54 cm) length specimens taken at random locations along the rod stock to be tested. These should be cut dry with a diamond-dust blade to ensure a smooth test surface.

8.4 In order to prevent the problem of wicking up the sides of some composites, paint a ring of clear nail polish or other suitable inhibitor below the top surface and around the circumference of each test specimen.

9. Conditioning

9.1 Condition the test specimens at 23 ± 2°C ~~[73.4~~(73.4 ± ~~3.6°F]~~3.6°F) and 50 ± ~~5%~~10 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D 618.

9.2 *Test Conditions*—Conduct all testing in the Standard Laboratory Atmosphere of 23 ± 2°C ~~[73.4~~(73.4 ± ~~3.6°F]~~3.6°F) and 50 ± ~~5%~~10 % relative humidity, unless otherwise specified.

10. Procedure

10.1 Preheat the ultraviolet light source for 15 min or in accordance with the manufacturer's recommendations. Position the light to shine on the pan (penetrant) surface.

10.2 Place a thin, spongy material such as common household plastic foam sponge on the bottom of the pan to support the specimens. This material aids in properly wetting the bottom surface of the specimen and reduces possible problems associated with air entrapment.

[3] Zyglo Penetrex ZL 30A dye penetrant, manufactured by Magnaflex, or equivalent, is suitable for this purpose. During the initial round-robin work, three standard penetrants of the industry were evaluated. The above referenced penetrant provided the most discriminating, rapid, and consistent results.