



Standard Test Method for Spreading of Liquid Agricultural Spray Mixtures¹

This standard is issued under the fixed designation E2044; 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 test method covers the visual evaluation of the relative spread radius of liquid spray mixture droplets.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

E1519 Terminology Relating to Agricultural Tank Mix Adjuvants

3. Terminology

3.1 *Definitions:*

3.1.1 *adjuvant, n*—a material added to a tank mix to aid or modify the action of an agrochemical, or the physical characteristics of the mixture. (See Terminology **E1519**.)

3.1.2 *spreader, n*—a material that increases the area that a droplet of a given volume of spray mixture will cover on a target. (See Terminology **E1519**.)

3.1.3 *spread radius, n*—the radius in millimetres or some other standardized unit, of a substrate covered by a droplet.

4. Summary of Test Method

4.1 The material(s) to be tested is mixed using the desired concentration of each component.

4.2 A 20- μ L droplet of the spray mixture is placed carefully onto a substrate. Under this substrate is a graph with concentric rings spaced at 1-mm intervals.

4.3 After 60 s, the number of rings that the droplet covers, and thus the radius of the droplet, is observed and recorded.

5. Significance and Use

5.1 This test method is intended to provide a rapid means of determining the relative ability of a liquid agricultural spray mixture to spread on a test substrate.

5.2 This test method was validated using Parafilm M³ as a test substrate. It is the user's responsibility for determining the validity of this test method for alternative test surfaces. While it may be generally agreed upon that there is no perfect model for the variety of surfaces for which spreading information would be useful, this test method does not limit users to any one surface. Further consideration must also be given to the potential effect that the liquid droplet may have on the chemical composition and morphology of the test surface. While this does not restrict the test method, an understanding of this potential can help in the interpretation of test data.

5.3 This test method will determine the relative spread of radii of water, fertilizers, oils, and mixtures of these carriers with surfactants. It is the user's responsibility to determine the validity of the test method with alternative liquids.

5.4 This test method will determine the relative spread radii of droplets over 30 s, 60 s, and 5 min. It is the user's responsibility to determine the validity of the test method at alternative spreading times.

5.5 This test method is appropriate for relative humidities within the range of 40 to 70 %. It is the user's responsibility to determine the validity of the test method at alternate relative humidities.

5.6 This test method is appropriate for temperatures within the range of 18 to 22°C. It is the user's responsibility to determine the validity of the test method at alternate temperatures.

¹ This test method is under the jurisdiction of ASTM Committee E35 on Pesticides, Antimicrobials, and Alternative Control Agents and is the direct responsibility of Subcommittee E35.22 on Pesticide Formulations and Delivery Systems.

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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.

³ The sole source of supply of the apparatus (Parafilm M, registered trademark) known to the committee at this time is American National Can Company, Chicago, IL 60631. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

5.7 This test method will determine the relative spread radii for droplets of 10 and 20 μL . It is the user's responsibility to determine the validity of the test method at alternate droplet sizes.

6. Apparatus

6.1 *Petri Dishes*, to be used inverted to make a flat surface on which to apply the intended test substrate. Other flat and uniform surfaces may be used.

6.2 *Test substrate* (Parafilm M).³

6.3 *Stopwatch*.

6.4 *Micropipetter*, capable of reproducibly delivering the desired droplet volume.

6.5 *Concentric Ring Graph Paper*, having rings separated by 1.0 mm.

6.6 Suitable equipment for preparing the spray mixture in the desired quantities and concentrations.

7. Procedure

7.1 Precut the concentric ring graph paper so it does not overhang the petri dishes. Place the graph paper onto the flat side of the inverted petri dish.

NOTE 1—Colored paper may be helpful in seeing some droplets under some lighting conditions.

7.2 Use the following standard test conditions:

7.2.1 *Test Substrate*—Parafilm M,

7.2.2 *Temperature*—18 to 22°C,

7.2.3 *Relative Humidity*—40 to 70 %,

7.2.4 *Droplet Volume*—20 μL ,

7.2.5 *Spread Time*—60 s,

7.2.6 *Concentration*—to be determined by user. Must be reported.

7.3 While holding the graph paper in place, carefully overlay the Parafilm M substrate onto the petri dish to cover the graph paper. The surface of the Parafilm M that was protected by a covering should be used after uncovering. Gently stretch the Parafilm M over the petri dish and tuck under the bottom rim of the dish. The Parafilm M should be stretched only sufficiently to ensure that the surface lies flat over the petri dish (see Fig. 1).

7.4 Lay the petri dish onto a level surface with the substrate facing up.

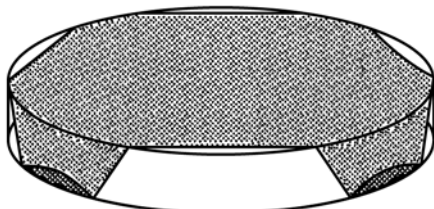


FIG. 1 Parafilm Folded Under Petri Dish

7.5 Prepare the test mixtures using the desired concentrations of each component. Samples should be weighed on a balance capable of weighing to the nearest $\pm 1\%$ of the desired weight.

7.6 Agitate the test mixture with a magnetic stirrer for 10 min or until the spray mixture is homogenous.

NOTE 2—Do not allow the test mixture to age over 30 min before testing unless specifically studying the effect of solution aging on spreading.

7.7 While maintaining agitation, carefully pull a 20- μL sample with the micropipette.

7.8 Place the droplet on the substrate aligning it with the center of the concentric rings under the substrate. The droplet should be placed onto the substrate from a height between 1 and 10 mm. The dispenser should not be allowed to touch the substrate. The droplet should form at the tip of the dispenser, and then freely drop onto the surface.

7.9 Immediately after placing the droplet onto the substrate, start the timer.

7.10 After the predetermined length of time, quickly count the rings that the droplet covers. Record this number as the spread radius, to the nearest $\frac{1}{2}$ ring.

7.11 If the droplet covers the entire surface or spreads unevenly on the surface, repeat the test. If the droplet behaves in this manner again, this test method cannot reliably determine the spread radius. Spreading unevenly shall be understood as a condition in which there is more than one ring difference between any two measurements of the same droplet along two separate axes at the same time span.

8. Report

8.1 Report the spread radius, mm, as given in 7.10.

8.2 Report any deviation from the standard ranges given in 7.2.

8.3 Report the age of the test solution if older than 30 min.

9. Precision and Bias

9.1 Eight laboratories participated in a collaborative study to determine the precision and bias of this test method. This study was conducted by sending surfactant and non-surfactant samples to participating laboratories. The laboratories were also provided Parafilm M as a test substrate.

9.1.1 *Precision*—The standard deviation for the collaborative study was determined to be 0.27 mm.

9.1.2 *Bias*—Since there is no known reference value for relative spread radii, no bias statement could be determined for this test method.

10. Keywords

10.1 adjuvant; agriculture; spreader; wetting

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