



# Standard Practice for Determining Spray Patterns of Mechanical Pump Dispensers<sup>1</sup>

This standard is issued under the fixed designation D4041/D4041M; 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.

<sup>ε1</sup> NOTE—Units information was corrected editorially in March 2011.

## 1. Scope

1.1 This practice covers the determination of spray patterns from pump dispensers.

1.2 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 non-conformance with the 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:*<sup>2</sup>

D996 Terminology of Packaging and Distribution Environments

## 3. Terminology

3.1 See Terminology D996 for applicable definitions.

## 4. Significance and Use

4.1 This practice can be used to compare spray patterns of different pump dispensers and of different products.

4.2 Spray patterns from pump dispensers will vary greatly with the design of the actuator and the nature of the liquid. Liquids with differing physical properties will not necessarily yield the same spray pattern when sprayed from the same

actuator. Likewise, actuators of different designs will yield spray patterns distinct from each other when the same liquid is used.

## 5. Apparatus

5.1 *Target Support Stand*, approximately 250 mm wide with the vertical component approximately 400 mm high. The stand shall be attached securely at right angles to the horizontal component. The component shall be approximately 700 mm long and free of air turbulence, that will provide for stationary positioning of the paper target. An optional paper target is positioned along the length of the horizontal component to record fallout.

5.2 *Container Support Stand*, that will position the pump dispenser and container a specific distance and center them to the target. (Alternatively, the pump dispenser and container may be held firmly by hand on a flat, horizontal surface.)

5.3 *Measuring Rule*.

5.4 *Alcohol-Sensitive Paper*, cut to the desired length and width.

5.5 *Plain White Paper*, cut to the desired length and width.

5.6 *Dyes of Oil Base for Petroleum-Based Products or Water Base for Water-Based Products*—These dyes, when dissolved in the liquid, shall be in sufficient concentrate to give a strong color when sprayed onto the target paper.

NOTE 1—Dyes must be compatible and completely soluble in the test liquid. The dyed liquid shall be filtered prior to use to remove any solid particles.

## 6. Sampling

6.1 Select an appropriate number of dry, unused dispensers at random for the precision and bias desired.

## 7. Conditioning

7.1 If possible, condition the test specimens at  $23 \pm 3^{\circ}\text{C}$  [ $73 \pm 5.4^{\circ}\text{F}$ ] for not less than 4 h. If the test specimens are not conditioned at the recommended temperature, this should be noted in the test report discussed in 10.1.

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D10 on Packaging and is the direct responsibility of Subcommittee D10.33 on Mechanical Dispensers.

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

7.2 Test pumps should be tested no sooner than 24 h after assembly when possible. If the pumps are not conditioned at the recommended time, this should be noted in the test report discussed in 10.1.

## 8. Procedure

8.1 Attach the pump to the container of the test liquid.

NOTE 2—If the plain white paper is selected as the target, then the liquid product must contain a dye. If the alcohol-sensitive paper is selected as the target, then the liquid product must contain alcohol in order to stain this special paper. This method is acceptable for all products.

NOTE 3—Liquid products with water should not be tested on alcohol-sensitive paper, since the pattern will begin to change in size and shape immediately due to evaporation. With no alcohol to permanently stain the alcohol-sensitive paper, the results may be unreliable. This method is acceptable for products containing alcohol.

8.2 If the pump dispenser is equipped with an overcap or locking feature, remove or release them to permit the pump dispenser to be in the operable mode. If the pump dispenser possesses an adjustable product dispensing feature, make the appropriate adjustment to the feature at this time as determined by preliminary experimentation.

8.3 Secure a sheet of the desired paper against the target support stand. Take special care in ensuring that the paper is flat against the target support stand in a vertical plane. At this time, the optional horizontal paper target may be placed in the bottom of the target support stand.

8.4 Prime the pump dispenser until a full discharge is obtained.

8.5 Immediately place the primed pump dispenser at the desired distance from the target 102 mm [4 in.], 152 mm [6 in.], or 204 mm [8 in.] are common distances used). The face of the exit orifice should be parallel with the surface of the spray target and aim at the center of the spray target.

8.6 Actuate the pump dispenser once manually or with mechanical/pneumatic means at a velocity equivalent to 60 to 120 strokes/min, or at an appropriate velocity.

8.7 Remove the target paper from the stand and allow it to dry flat.

8.8 If a spray pattern is irregular in shape, perform an additional test with that pump.

## 9. Interpretation of Results

9.1 Measure the diameter of the concentrated pattern along the approximate *X*- and *Y*-axes. Spray patterns may not be

round, so the aspect ratio of the *X*-axis by the *Y*-axis will be helpful in documenting non-round shapes. An average value for the two measurements may also be reported.

9.2 If a void is found on the perimeter of the spray pattern, and this void affects the true measurement of the diameter, estimate the project of the spray pattern's arc through the measurement axis. This defect should be documented in the report.

9.3 If a "pull," a single concentrated group of spray particles radiating from the spray pattern's center to beyond the perimeter of the spray pattern, is present, it should not be included in the measurement. This defect should be documented in the report.

9.4 If the axes of an oblong or elliptical pattern are not in line with the *X*- and *Y*-axes of the target, the long and short axes should be measured and the angle of the pattern from the *X*-axis of the target should be documented in the report.

9.5 If the spray pattern results in a star shape, then the longest dimensions on the *X*- and *Y*-axes should be recorded, and the irregular shape of the pattern should be documented in the report.

## 10. Report

10.1 Report the following information:

10.1.1 All identifications, that is, product, pump dispenser, temperature, dosage, orifice size, type of target paper used, type of dye used and, if available, the properties of the liquid product (viscosity, density, and surface tension).

NOTE 4—The absorbency of the different types of target papers vary and this should be taken into consideration when comparing results from another test.

10.1.2 Distance in millimetres or inches from orifice to target.

10.1.3 Verbal description of spray pattern (for example, round, oval, irregular, star-shaped, heavy, light, moderate, spotty, and so forth).

10.1.4 Verbal description of fallout (for example, heavy, light, moderate, spotty, and so forth).

10.1.5 Measurement of the *X*- and *Y*-axes of the spray pattern; in increments of 1 cm, ¼ in. or ½ in. are recommended.

## 11. Keywords

11.1 measurement of spray patterns from pump dispensers; pump dispensers—spray pattern; spray pattern measurement

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