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Standard Methods for Testing Agricultural Hydraulic Hydraulic Spray Nozzles Used in Agriculture[1]

This standard is issued under the fixed designation E 641; 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] These methods are under the jurisdiction of ASTM Committee E-35 on Pesticides, and are the direct responsibility of Subcommittee E35.22 on Pesticide Formulations and Application Systems.

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1. Scope

1.1 These methods cover procedures for testing agricultural hydraulic spray nozzles used in agriculture. The procedures covered methods herein include cover the following performance parameters: nozzle flow rate, nozzle spray angle, liquid distribution, spray droplet size, and nozzle wearability.

1.2 The types of hydraulic nozzles covered in these

1.2 These methods are those producing patterns of applicable to hydraulic spray nozzles which produce the following spray patterns: flat-fan, hollow cone, and full cone type. cone.

1.3 *This standard does not purport to address the safety problems 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. Terminology

2.1 *Definitions of Terms Specific to This Standard:*

2.1.1 The procedures set forth in these methods are for spray nozzles of the hydraulic energy type in which the spray material is forced through an orifice under pressure, providing fluid break-up into droplets. Droplet-producing elements that operate by means other than hydraulic energy are not a part of these methods.

2.1.2 The types of hydraulic spray nozzles considered are categorized according to spray characteristics, as follows:

2.1.21.1 *flant-fan "tapered edge" type spray nozzle*—this nozzle provides a range of atomization sizes throughout the pattern area. Its edges are tapered to permit the overlapping of spray patterns from adjacent nozzles, thereby providing relatively uniform overall distribution. These nozzles are popular on field-type crop sprayers where uniform coverage is desired across the swath.

2.1.21.2 *flat fan- "even edge" type spray nozzle with even spray distribution*—this nozzle provides fine relatively uniform atomization size as compared to the "tapered edge" type nozzle and comparatively uniform distribution throughout w the spreay pattern. There is no requirement for overlap of adjacent spray patterns when using this nozzle. It is used primarily to spray uniform strips or bands in fields.

2.1.21.3 *flooding or deflector-fan type spray nozzle*—this nozzle produces a low impact spray with a wide-angle flat spray pattern with coarse atomization and relatively having uniform distribution when low pressures are used. It is used primarily on field-type sprayers when broad coverage at lower pressures is desired.

2.1.2.4 *conventional hollow*

2.1.1.4 *hollow cone nozzle and full cone nozzle*—the conventional hollow cone nozzle normally provides fine atomization uniform distribution throughout a hollow cone pattern area. The full cone nozzle, on the other hand, normally provides relatively uniform distribution throughout its full cone pattern. Both types are used extensively for the spraying of fruits and vegetables and of vegetables, some row crops with pesticides, and for aerial applications.

3. Significance and Use

3.1 The purpose of these methods is to provide uniform testing procedures for evaluating the performance criteria of hydraulic spray nozzles used for various agricultural purposes.

3.2 The procedures set forth in these methods are for spray nozzles of the hydraulic energy type in which the spray material is forced through an orifice under pressure, providing fluid break-up into droplets.

3.3 Droplet producing nozzles that operate by means other than hydraulic energy are not applicable to these methods.

4. Apparatus

4.1 This section covers equipment used in testing hydraulic spray nozzles. The equipment and apparatus listed are sufficient to

~~cover optional procedures and methods~~ for~~ examining each of the nozzles' spray characteristics.~~ use in all methods described herein.

4.2 Fundamental equipment common to all of the~~ testing~~ test methods~~ and procedures for evaluating spray performance~~ are as follows:

4.2.1 *Water Reservoir or Retaining Vessel*—A water reservoir or vessel sufficiently large to provide smooth continuous flow to the nozzle(s) throughout the duration of a particular test.

4.2.2 *Pump or Source of Water Pressure*— A pump or source of water pressure~~ available and~~ sufficient to~~ conduct~~ maintain the ~~performance tests at the~~ required test pressure~~s,~~ with~~ no more~~ less than~~ 10 % pulse deviations~~ ±2 % deviation from the nominal ~~pressure as measured on a Bourdon-type gage.~~ pressure.

4.2.3 *Pressure Gage*:

4.2.3.1 A pressure gage with an accuracy of ±2 % at the actual working~~ pressure to be of a quality Bourdon-tube type with a minimum dial face diameter of 150 cm (6 in.).~~ pressure. It should have a maximum pressure reading on the dial face such that the test pressure can be as near the midrange of the gage as possible.

4.2.3.2 The pressure gage should be calibrated prior to use at each of the required test pressures by using a Certified Dead Weight Gage calibrator or a suitable manometer capable of gage calibration.

~~4.3 General equipment and arrangement schematics used in testing each of the performance criteria are as follows. All equipment shall be kept clean and in good condition.~~

4.2.4 *Pressure Regulator,*

4.2.5 *Control Valves,*

4.2.6 *Inline Strainer,*

4.2.7 *Piping,*

4.2.8 *Union Tees,*

4.2.9 *Union Elbows.*

4.3 General equipment and arrangement schematics used in testing each of the performance criteria are as follows.

4.3.1 *Discharge Rate*:

4.3.1.1 *Apparatus Schematic*—See Fig. 1.

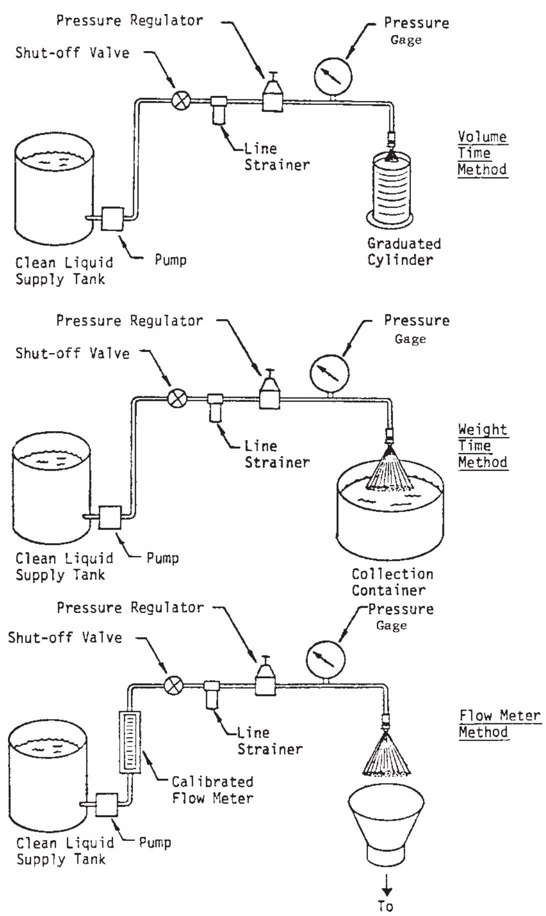

FIG. 1 Discharge Rate Test Equipment

4.3.1.2 *Cylinders*~~, Accurately calibrated, laboratory graduated.~~ Graduated, sized to meet specific test requirement.
4.3.1.3 *Stop Watch*~~, readable in 0.5-s increments.~~ having 0.2-s resolution or better.
4.3.1.4 *Collecting Vessel*, glass, metal or plastic, sized to meet test requirements.
4.3.1.5 *Laboratory Beakers*~~, calibrated.~~ ,
4.3.1.6 *Flowmeter*~~, calibrated.~~ Electronic or manual with accuracy of ±3 % of scale
4.3.1.7 ~~*Weight Scale*~~*Balance*~~, certified.~~ top loading with sensitivity of ±0.01g or better accuracy of 0.1g or better.
4.3.2 *Spray angle*:
4.3.2.1 *Apparatus Schematic*—See Fig. 2.
4.3.2.2 *Spray Pattern Distribution Testing Table*.
4.3.2.3 *Spray Protractor*~~, calibrated, with~~ having a minimum arm length of 300-mm ~~(12-in.) long arms.~~ (12-in.).
4.3.3 *Distribution*:
4.3.3.1 *Apparatus Schematic*—See Fig. 3 and Fig. 4.
4.3.3.2 *Spray Pattern Distribution Testing Table*.
4.3.3.3 *Spray Pattern Distribution Testing Racks, Troughs, and Beakers*.
4.3.3.4 ~~*Weight Scale*~~*Balance*~~, certified.~~ as in 4.3.1.7.
4.3.3.5 *Stop Watch*, as in 4.3.1.3.
4.3.4 *Particle Size*—Since there is no agreement on methods of sampling and measurement, this section is omitted at this time. (Note the section on reporting of measurements, 6.~~4~~5.)
4.3.5 *Wearability*:
4.3.5.1 *Apparatus Schematic*—See Fig. 5.
4.3.5.2 *Pressure Tank*, with agitator and air regulator.
4.3.5.3 *Wear Media*.
4.3.5.4 *Imhoff Settling Cone*, 1000-ml.
4.3.5.5 *Spray Pattern Distribution Testing Table*.
4.3.5.6 ~~*Containers*, water-collecting.~~ Spray Pattern Distribution Testing Racks, Troughs, and Beakers.
4.3.5.7 ~~*Weight Scale*~~*Collection Vessel*~~, certified.~~ as in 4.3.1.4.
4.3.5.8 *Balance*, as in 4.3.1.7.
4.3.5.9 *Stop Watch*, as in 4.3.1.3.
~~4.3.5.9 *Cylinder*, accurately calibrated, laboratory graduated.~~
4.3.5.10 *Cylinder*, as in 4.3.1.2.

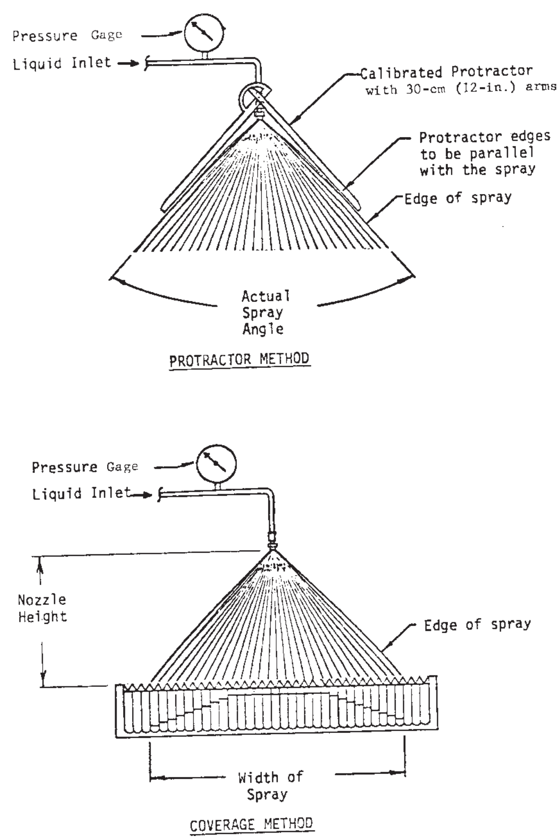

FIG. 2 Spray Angle Test Equipment

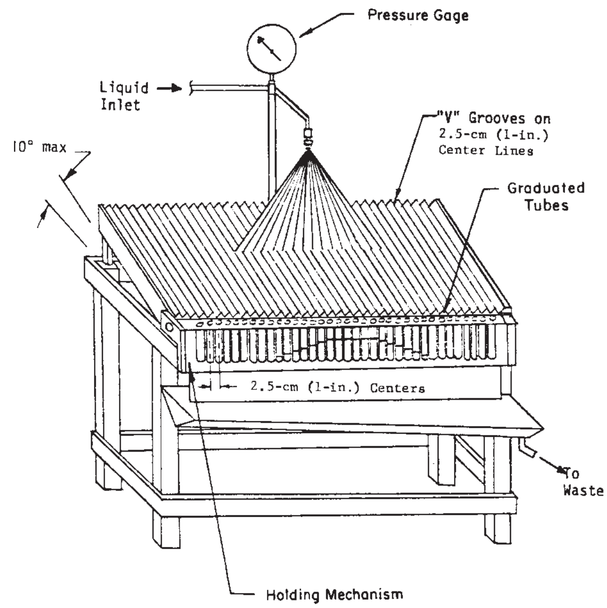

FIG. 3 Distribution Table

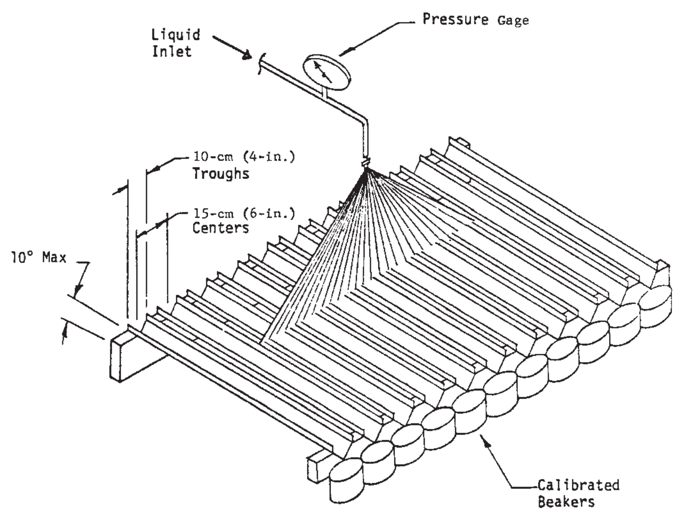

FIG. 4 Distribution Rack

4.3.5.11 *Flowmeter*, ~~calibrated.~~ as in 4.3.1.6.

5. Spray Medium

5.1 It has been accepted practice to use clean, clear water as a standard. However, testing procedures do not preclude using these methods for other liquids.

5.2 Unless otherwise indicated, references to water shall be understood to mean clean, clear, filtered water at a temperature of 2~~1~~0–25°C (68–70°F).

6. Procedure

6.1 *Pressure Adjustment*:

6.1.1 *Pump Method*:

6.1.1.1 Add the spray media to the system.

6.1.1.2 With the recirculation valve open and the spray valve closed, turn on the spray pump.

6.1.1.3 Open the spray valve and slowly close the recirculation valve until the desired spray pressure is reached.

6.1.2 *Air Pressure Method*:

6.1.2.1 Add the spray media to the system.

6.1.2.2 With both the spray valve and pressure regulator closed, apply air pressure to the system.

6.1.2.3 Open the spray valve and slowly open the pressure regulator until the desired spray pressure is obtained.

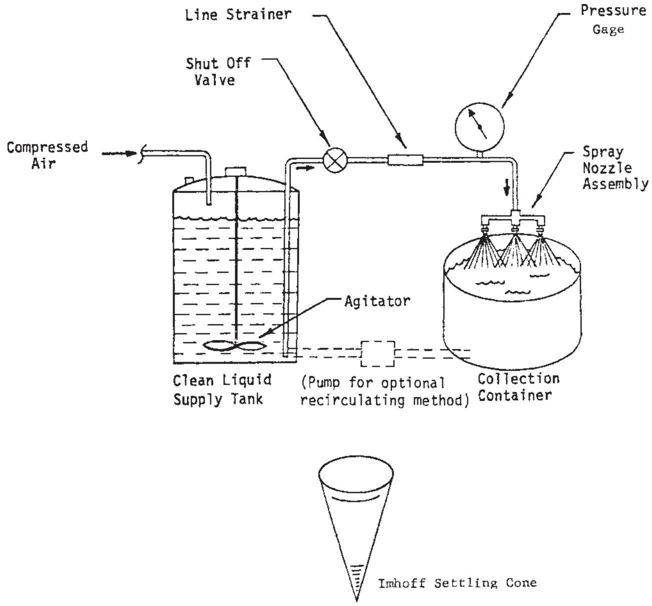

FIG. 5 Wearability Test Equipment

6.2 *Discharge Rate*:

6.~~1~~2.1 The discharge rate of a nozzle is normally denoted in volume-time units such as litres per minute, litres per second, or gallons per minute.

6.~~1~~2.2 The discharge rate can be determined by a method such as an actual volume-time measurement, an actual weight-time measurement, or a volume-time measurement observed directly from an accurately calibrated flow~~ meter, usually of the rotometer type.~~ meter. The discharge rate of the nozzle may determine what method of measurement is practical. (See Fig. 1.)

6.~~1~~2.3 *Volume-Time Measurement Method*~~—~~:

6.2.3.1 Adjust spray pressure to desired setting.

6.2.3.2 Pass water through the nozzle~~ at the desired test pressure, as determined by the specific spray application,~~ and collect it in a clean,~~ accurately~~ dry, graduated cylinder for an interval of at least 1 min, as measured by a stop watch. The nozzle discharge during the time interval should fill at least 75 % of the cylinder graduated volume.

6.2.3.3 Read the amount of water collected directly from the graduated cylinder~~ in~~ to the nearest units denoted, thereby providing the volume-time discharge rate.

6.2.3.4 Repeat this procedure three separate times and use an average of the three observations as the measured discharge rate.

6.~~1~~2.3.5 *Report*—Nozzle type and size, test pressure, spray time, average discharge rate, graduated cylinder capacity and lowest unit of measure, and spray media.

6.2.4 *Weight-Time Method*~~—Spray clean, clear~~:

6.2.4.1 Establish the tare weight of a collection vessel.

6.2.4.2 Adjust spray pressure to desired setting.

6.2.4.3 Spray water into~~ a clean container at~~ the~~ desired test pressure~~ collection vessel for an interval of at least 1 min, as timed by a stop watch.

6.2.4.4 Establish the net weight of the discharged water by~~ weighing on a weight scale. The scale should be sensitive enough~~ reweighing the collection vessel to~~ weigh~~ the~~ discharged quantity within ±1 %.~~ nearest 0.1 g. The result is a weight-time discharge rate that is mathematically converted to the volume-time values normally used to denote discharge~~ rate.~~
rate.

$$\frac{\text{L}}{\text{min}} = \frac{\text{kg}}{\text{min}} \times 1$$

$$\left(\frac{\text{gal}}{\text{min}} = \frac{\text{lb}}{\text{min}} \times \frac{1}{8.32}\right)$$

6.2.4.5 Repeat this procedure three separate times and use an average of the three observations as the measured discharge rate.

~~6.1.5 The~~

6.2.4.6 *Report*—Nozzle type and size, test pressure, spray time, average discharge rate, net weight, net weight of~~ a nozzle may also be observed~~ discharge, and spray media.

6.2.5 *Flow Meter Method*:

6.2.5.1 Calibrate the flowmeter by an actual volume-time procedure as described in~~g~~ 6.2.3. Exerc~~l~~ise caution when using flowmeters since water temperature, build up of mineral deposits and age of meters can seriously alter accuracy.

6.2.5.2 Pass water directly through a flowmeter calibrated with various volume-time units of measurement the flow meter at the desired test pressure to provide "direct" discharge rate readings at the desired test pressure. It is suggested that the readings. An average of at least two meter reading should be used for determining the discharge rate. Observe the first meter One reading should be taken by slowly increasing the pressure up to the desired test pressure and observe the pressure. A second reading should be taken by going increasing the pressure beyond the desired test pressure and slowly lowering the pressure back to the required pressure. Exercise caution when using flowmeters since water temperature, build-up of mineral deposits on glass tube walls, desired pressure.

6.2.5.3 *Report*—Nozzle type and size, test pressure, spray time, average discharge rate, type and scale of meters can seriously alter accuracy. If a flowmeter is to be used, carefully calibrate it by an actual volume-time procedure as described in 6.1.3.

6.2 flowmeter, and spray media.

6.3 *Spray Angle*:

6.23.1 The spray angle of a nozzle is normally denoted in terms of degrees and is a measure of the angular segment formed by the nozzle orifice and the outermost edges of its generated spray.

6.23.2 The spray angle of the four different types of spray nozzles can be determined by an angular measure using a calibrated protractor or on a spray distribution testing table by measuring the effective pattern width and using the spray height to calculate the angle. The size of the nozzle may determine which method of measuring is practical. (See Fig. 2.)

6.23.3 *Angular Measurement*:

6.2.3.1 Pass water through

6.3.3.1 Set the nozzle at the desired test spray pressure, as determined by the specific spray application, according to the method given in 6.1.

6.3.3.2 Pass water through the nozzle and position the calibrated protractor above the spray.

6.23.3.23 Open the protractor arms wider than the spray pattern to be measured and position the apex above vertex of the nozzle angle as near close to the nozzle point of spray discharge as practical.

6.2.3.3 Then possible. Then slowly narrow the protractor's arms to where they become parallel for the longest distance with the edges of the spray pattern in.

6.3.3.4 Read the first 300 mm (12 in.) from the nozzle. Read the relative spray angle directly from the calibrated protractor. Repeat protractor.

6.3.3.5 Repeat this testing procedure three separate times and use an average of the three observations as the measured spray angle.

6.23.4 *Width-of-Coverage Method*:

6.2.4.1 Spray water onto

6.3.4.1 Mount the nozzle at a predetermined distance above the spray distribution testing table a.

6.3.4.2 Set the desired test pressure. Mount the nozzle a height recommended spray pressure as determined by the manufacturer and allow it to specific spray application, according to the method given in 6.1.

6.3.4.3 Pass water through the nozzle for an interval of time sufficient to define the spray pattern. Allow the water to run down the "V" grooves on the table and collect in the graduated tubes cylinders positioned under the grooves.

6.23.4.24 Determine the actual width of the spray pattern by observing the number of tubes cylinders outermost from the spray center retaining a sufficient amount of water to define the spray width.

6.2.4.3 Then obtain

6.3.4.5 Obtain the effective spray angle by using the following trigonometric calculations.:

$$\left(2 \times tan - 1\left(\frac{1}{2}\, width/height\right)\right)$$

6.34 *Spray Volume Distribution*:

6.3.1 Determine the

6.4.1 The relative volume distribution of a nozzle is determined by dividing the width-of-spray pattern into equal increments segments and comparing the amount of water collected in these increments each segment with those adjacent to it. The increments are distribution is normally represented in volumetric units such as millilitrers per minute, litres per minute, gallons per minute, or relative volumetric units.

6.3.2 Determine the

6.4.2 The volume distribution of the four different types of spray nozzles may be determined by an actual volume-time measurement or a weight-time measurement. The size and type of nozzle may determine which method of measurement is practical. The majority of the flat-fan type nozzles and the cone-type nozzles would encourage the use of the volume-time method. Large capacity flat-fan type nozzles and the flooding type nozzles would favor the weight-time method (see Fig. 3 and Fig. 4).

6.34.3 *Volume-Time Measurement Method*:

6.3.3.1 Pass water through

6.4.3.1 Mount the nozzle at a predetermined distance above the desired pressure, as determined by the specific spray application, onto a spray distribution testing table. Allow table.

6.4.3.2 Set the nozzle to desired spray pressure according to the method given in 6.1.

6.4.3.3 Pass water through the nozzle for a short period of time to allow the troughs to become wetted and provide uniform dripping from the valleys of the grooves. M To ensure that no water enters the nozzle a predetermined distance above graduated tubes cylinders located at the table and allow it to spray for a given interval end of time. Allow the water to run down the troughs on the table and collect it in the during this process, a graduated tubes positioned under the grooves. A tube holding mechanism which allows the test tubes cylinders to be quickly swung in and out of the spray's run-off. Read the amount of run-off is used.

6.4.3.4 Collect the water collected directly from in the graduated tubes, thereby providing the volume-time discharge tubes for equal increments within the spray.

6.3.3.2 In a given interval of time.

6.4.3.5 In some cases it may be impractical to swivel the tube holding mechanism. Under such circumstances it is desirable to use a shutter-type procedure in conducting the distribution test. Set the test pressure while diverting the spray away from the collection device until the pressure has stabilized. Then quickly release the deflection device and collect the spray for the appropriate interval. Take care using this method so as not to get extraneous readings caused by the movement of the shuttering device.

6.4.3.6 Read the amount of water collected directly from the graduated tubes cylinders to the nearest unit denoted, thereby providing the volume-time discharge for equal increments within the spray.

6.4.3.7 Repeat the procedure and use an average of the two observations as the result.

6.4.3.8 *Report*—Nozzle type and size, test pressure, spray time, average discharge rate for each segment, graduated tube capacity & lowest unit of measure, and spray media.

6.4.4 *Weight-Time Method*—Spray water through the nozzle over a distribution rack at the desired test pressure. A shuttering device as described in 6.3.3.2 is normally used. Collect the liquid in clean containers rather than graduated tubes for a given interval of time. Establish the net weight of the discharged water for each segment by weighing on a certified weight scale. The result is a weight-time discharge per interval that is mathematically converted to volume-time values normally used as in 6.1.4.

6.4 *Particle Size Distribution Reporting*:

6.4.1 Describe

6.4.4.1 Mount the method of sampling in any report. The results are preferred in nozzle at a predetermpined distance above the spraly distribution unless some special purpose is served by giving testing table.

6.4.4.2 Set the spatial distribution. State desired spray pressure according to the choice of distribution.

6.4.2 Report the largest and smallest drop sizes measured method given in 6.1.

6.4.4.3 Establish the distribution.

6.4.3 Report the total number tare weight of drops or all collection vessels.

6.4.4.4 Spray water through the total volume nozzle for a short period of liquid in the measured drops.

6.4.4 To avoid ambiguity, the representative mean diameters used time to describe allow the distribution should bear the following notation (similar troughs to that of Mugele become wetted and Evans):

$\bar{D}_{10}$ = usual arithmetic mean diameter
$\bar{D}_{20}$ = usual surface mean diameter
$\bar{D}_{30}$ = usual volume mean diameter
$\bar{D}_{32}$ = Sauter mean diameter
$\bar{D}_{43}$ = mean diameter over the volume
$\bar{D}_{43}$ = mean diameter over provide uniform dripping from the volume

NOTE 1—$\bar{D}_{pq}^{(p-q)}$ is the $(p-q)^{th}$ power valleys of $\bar{D}_{pq}$ and $\bar{D}_{pq}^{(p-q)} = (\Sigma_i D_i^{\,p})/(\Sigma_i D_i^{\,p})$ where D_i is the diameter of groves. To ensure that no water enters the *ith* particle, and collection vessels during this process, a shuttering device as described in 6.4.3.5 is normally used.

6.4.4.5 Collect the symbol Σ_i indicates summing over all particles water in the sample. $\Sigma_i D_i^{\,0}$ is then collection vessels for a given interval of time.

6.4.4.6 Establish the total number net weight of drops in the calculation.

6.4.5 Points on discharged water for each segment by reweighing each collection vessel to the cumulative distribution curve should nearest 0.1 gram. The result is a weight-time discharge per segment that can be identified as follows:

$\bar{D}_{V,0.5}$	= median volume diameter
$\bar{D}_{A,0.5}$	= median area diameter
$\bar{D}_{L,0.5}$	= median length diameter
$\bar{D}_{N,0.5}$	= median number diameter
$\bar{D}_{V,0.1}$	= diameter of drop such that 0.1× (liquid volume) is in drops of smaller diameter
$\bar{D}_{V,0.1}$	= diameter mathematically converted to a volume-time value if the specific gravity of the spray liquid is in drops of smaller diameter

The first subscript indicates known.

6.4.4.7 Repeat the b procedure and use an average of the accumulation and two observations as the second indicates the cumulative fraction from the smallest drop. (The reporting result.

6.4.4.8 *Report*—Nozzle type and size, test pressure, spray time, average discharge rate for each segment, net weight of methods of measurement are not to be included in this standard at this time.) discharge for each segment, and spray media.

6.5 *Particle Size Distribution Reporting*:

6.5.1 Refer to standards that pertain to measuring and reporting droplet size distributions which are under the jurisdiction of ASTM Subcommittee E29.04 "Liquid Particle Measurement". These standards currently include:

E 799 Practice for Determining Data Criteria and Processing for Liquid Drop Size Analysis

E 1088 Definitions of Terms Relating to Atomizing Devices

E 1296 Standard Terminology Relating to Liquid Particle statistics

E 1260 Test Method for Determining Liquid Drop Size Characteristics in a Spray Using Optical Non-Imaging Light-Scattering Instruments

E 1458 Test Method for Calibration Verification of Laser Diffraction Particle Sizing Instruments Using Photomask Reticles

E 1620 Standard Terminology Relating to Liquid Particles and Atomization

6.6 *Wearability*:

6.56.1 The tolerable deviations in nozzle performance parameters vary considerably from one application to another. The useful wear life of a nozzle is established when any one of its spray characteristics no longer meets performance requirements prescribed for a given application.

6.56.2 Test the wear characteristics of a nozzle with using an apparatus similar to that shown in Fig. 5.

6.56.3 *Specific Test Method*:

6.6.3.1 Use the methods described in 6.1, 6.2, 6.3, and 6.3 6.4 to measure the discharge rates, spray angles, and liquid spray volume distribution of each nozzle to be evaluated in the wear test and record the results. A minimum of three nozzles should be evaluated in order to allow for simultaneous testing and data averaging.

6.6.3.2 Prepare a wear test.

6.5.3.1 Prepare a pressure tank or a recirculated pumping system using the fluid spray mixture determined to be tested by filling the application. Install supply tank with a specified amount of water and adding the test material.

6.6.3.3 Install the pre-tested nozzles to be worn in the system and adjust the pressure to the desired test pressure. A minimum of three nozzles should pressure according to the method given in 6.1.

6.6.3.4 Spray the fluid mixture to be installed and tested simultaneously for data averaging.

6.5.3.2 At through the nozzle.

6.6.3.5 At periodic intervals during the wear test, remove the nozzles from the system, measure the discharge rate, spray angle, and distribution as previously described, and record observations along with the time interval of the tests.

6.5.3.3 Repeat the

6.6.3.6 Repeat procedure 6.6.3.5 until the prescribed limits for useful life are reached for the particular fluid mixture or application.

6.56.3.47 Conduct tests on a sufficient number of nozzles to give a statistical average indicative of the wear life of the particular type of nozzle.

6.5.4 Actual

6.6.3.8 *Report*—Nozzle type and size, test pressure, spray media w, time to failure, initial and final: discharge rate, spray angle, and distribution.

6.6.4 *Common Media Method*:

6.6.4.1 The wear life of a nozzle for a particular application is determined using a common spray media. This wear life can then be used as a standard reference for determining the expected wear life of other nozzles with regards to a specific spray media using various pressures. This method also allows wear data to be generated at an "accelerated" wear test.

6.5.4.1 *Accelerated Wear Test*—Measure rate when compared to performing the Specific Media Method.

6.6.4.2 Measure the discharge rate, spray angle, and liquid spray volume distribution of the each nozzle to be tested using the methods described in 6.1, 6.2, 6.3, and 6.3 6.4 and record the test results. A minimum of three nozzles should be evaluated in order to allow for simultaneous testing and data averaging.

6.56.4.23 Prepare a slurry (20 % solids content is normal) by filling the supply tank with a specified amount of liquid and wear media (such as a uniform sieve size quartz). Mou

6.6.4.4 Install the pre tested nozzles to be worn in the tank system and adjust the spray pressure to the desired test pressure. A minimum of three nozzles should be installed and tested simultaneously for data averaging. An pressure according to the method given in 6.1.

6.6.4.5 An agitation system in the tank is essential and shall be in operation at all times to assure uniform suspension of the slurry mixture. Before, and periodically throughout the wear test, obtain sedimentation readings of the slurry solution by collecting the discharge from one of the nozzles in a 1000-ml 100 ml Imhoff cone. Make a mixture ratio reading after the slurry has had 15 min to settle. The sedimentation level shall meet predetermined specifications that indicate the liquid and wear media suspension ratio is correct.

6.5.4.3 Now spray

6.6.4.6 Spray the slurry solution through a multiple-nozzle assembly and time accurately. At multiple nozzle assembly.

6.6.4.7 At predetermined intervals throughout the duration of the wear test, remove the nozzles from the test tank, system, measure the discharge rate, spray angle, and spray volume distribution using methods previously described, and record the values on a test form.

6.5.4.4 Repeat this same spray media used for the Specific Media Method. Record observations along with the time interval of the test.

6.6.4.8 Repeat procedure 6.6.4.7 until the nozzle's' performance deteriorates to the previously determined wear life established by the fluid actually used in Specific Media Method.

6.6.4.9 At the point of failure, (e.g predetermined percent of original flow) determine the discharge rate, spray angle, and spray volume distribution of each nozzle using the common media slurry and common media spray system. In order for these test to be performed, the spray nozzle assembly on the common media system will have to be reduced to a single nozzle.

6.56.4.510 *Report*—Nozzle type and size, test pressure, wear media & load, time to failure, final discharge rate, spray angle, and spray volume distribution.

6.6.4.11 The relationship of the wear life of the a nozzle on the common media tested to that of a fluid used in a particular application the Specific Media Method enables wear life evaluations to be more independent and allows comparison of one nozzle to another and one material to another.