
Standard Method of Test for Particle Size Analysis of Soils

AASHTO Designation: T 88-22

Technically Revised: 2022

Technical Subcommittee: 1a, Soil and Unbound Recycled Materials



**American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004**

Standard Method of Test for

Particle Size Analysis of Soils

AASHTO Designation: T 88-22

AASHTO

Technically Revised: 2022

Technical Subcommittee: 1a, Soil and Unbound Recycled Materials

1. SCOPE

- 1.1. This method describes a procedure for the quantitative determination of the distribution of particle sizes in soils.
- 1.2. The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with ASTM E29.
- 1.3. The values stated in SI units are to be regarded as the standard.
- 1.4. Refer to 29 CFR 1910.1200 for regulatory information for chemicals.
- 1.5. *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 R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 145, Classification of Soils and Soil–Aggregate Mixtures for Highway Construction Purposes
 - M 147, Materials for Aggregate and Soil–Aggregate Subbase, Base, and Surface Courses
 - M 231, Weighing Devices Used in the Testing of Materials
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - R 58, Dry Preparation of Disturbed Soil and Soil–Aggregate Samples for Test
 - R 74, Wet Preparation of Disturbed Soil Samples for Test
 - T 100, Specific Gravity of Soils
 - T 265, Laboratory Determination of Moisture Content of Soils
- 2.2. *ASTM Standards:*

- C670, Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E100, Standard Specification for ASTM Hydrometers
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *Federal Standard:*

- Fed. Std. No. 29, CFR 1910.1200 OSHA Hazard Communication Standard; see also Permissible Exposure Limits—Annotated Tables, available at <https://www.osha.gov/dsg/annotated-pels/>

2.4. *International Electrotechnical Commission Standard:*

- IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances

3. APPARATUS

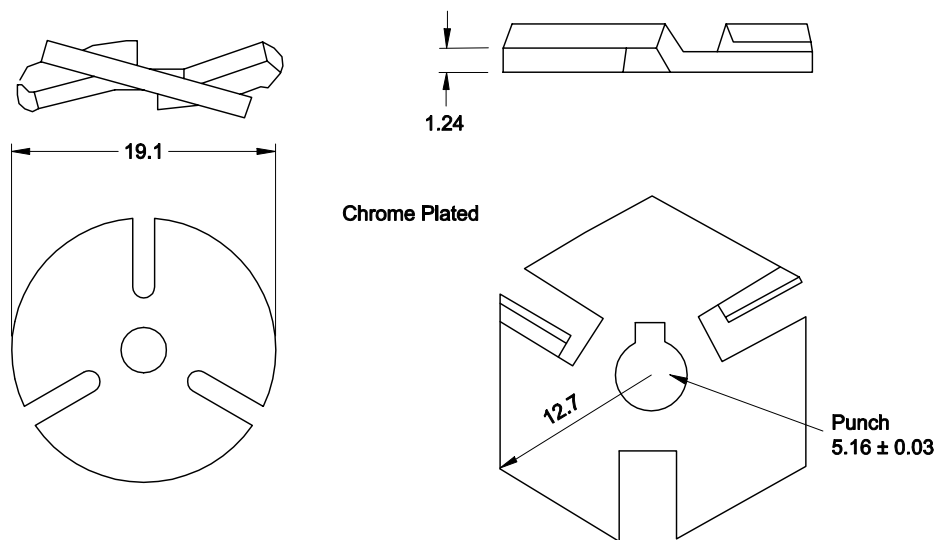
3.1. *The apparatus shall consist of the following:*

- 3.1.1. *Oven*—A thermostatically controlled drying oven capable of maintaining temperatures of $110 \pm 5^\circ\text{C}$ ($230 \pm 9^\circ\text{F}$) for drying the sieve analysis samples. Oven(s) for heating and drying shall be capable of operation at the temperatures required, between 100 to 120°C (212 to 248°F), within $\pm 5^\circ\text{C}$ ($\pm 9^\circ\text{F}$), as corrected, if necessary, by standardization. More than one oven may be used, provided each is used within its proper operating temperature range. The thermometer used for monitoring the temperature of the oven, or for measuring the temperature of materials shall meet the requirements of M 339M/M 339 with a temperature range of at least 90 to 130°C (194 to 266°F), and an accuracy of $\pm 1.25^\circ\text{C}$ ($\pm 2.25^\circ\text{F}$) (see Note 1).

Note 1—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type J or K, Special Class, Type T any Class; IEC 60584 thermocouple thermometer, Type J or K, Class 1, Type T any Class; or dial gauge metal stem (bi-metal) thermometer.

- 3.1.2. *Balance*—The balance shall have sufficient capacity, be readable to 0.1 percent of the sample mass, or better, and conform to the requirements of M 231.

- 3.1.3. *Stirring Apparatus*—A mechanically operated stirring apparatus consisting of an electric motor suitably mounted to turn a vertical shaft at a speed not less than 10 000 rpm without load, a replaceable stirring paddle made of metal, plastic, or hard rubber similar to one of the designs shown in Figure 1. The shaft shall be of such length that the stirring paddle will operate not less than 19.0 mm ($\frac{3}{4}$ in.) nor more than 38 mm (1.5 in.) above the bottom of the dispersion cup. A dispersion cup conforming to either of the designs is shown in Figure 2.

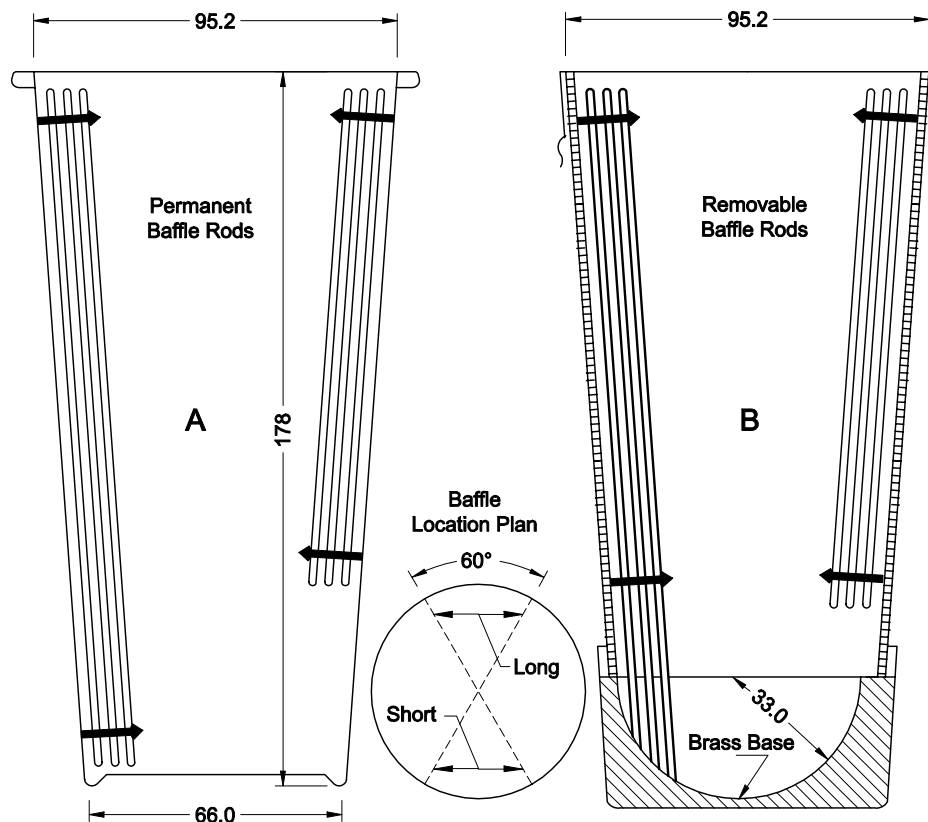


Dimensional Equivalents

mm	in.
19.1	$\frac{3}{4}$
12.7	$\frac{1}{2}$
5.16 ± 0.025	0.203 ± 0.001
1.24	0.049 (No. 18 BW Ga.)

Note: All dimensions are shown in millimeters unless otherwise noted.

Figure 1—Details of Stirring Paddles



Dimensional Equivalents

mm	in.
33.0	1.3
66.0	2.6
95.2	3.75
178	7.0

Note: All dimensions are shown in millimeters unless otherwise noted.

Figure 2—Dispersion Cups

3.1.3.1. (Alternate B)—An air-jet type dispersing device similar to either of the designs shown in Figure 3.

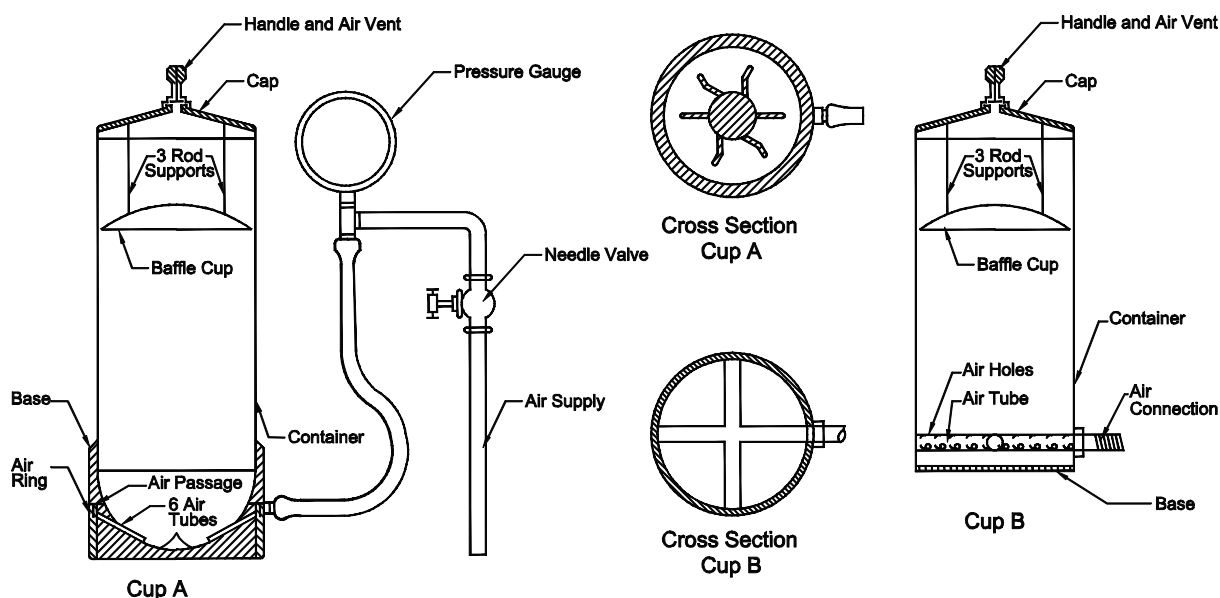


Figure 3—The Wintermeyer Soil Dispersion Cups

Note 2—The amount of air required by an air-jet dispersion cup is of the order of 0.06 m³/min (2 cfm); some small air compressors are not capable of supplying sufficient air to operate a cup.

Note 3—Another air-type dispersion device, known as a dispersion tube, developed by Chu and Davidson at Iowa State College, has been shown to give results equivalent to those secured by the air-jet dispersion cups. When it is used, soaking of the sample can be done in the sedimentation cylinder, thus eliminating the need for transferring the slurry. When the air-dispersion tube is used, it shall be so indicated in the report.

Note 4—Water may condense in air lines when not in use. This water must be removed, either by using a water trap on the air line, or by blowing the water out of the line before using any of the air for dispersion purposes.

3.1.4. *Hydrometer*—An ASTM hydrometer, graduated to read in either specific gravity of the suspension or grams per liter of suspension, and conforming to the requirements for hydrometers 151 H or 152 H in ASTM E100. Dimensions of both hydrometers are the same, the scale being the only item of difference.

3.1.5. *Sedimentation Cylinders*—A glass cylinder 460 mm ± 20 mm (18 in. ± 1.0 in) in height and 60 mm (2½ in.) in diameter and marked for a volume of 1000 mL. The inside diameter shall be such that the 1000 mL mark is 360 ± 20 mm (14 ± 1.0 in.) from the bottom on the inside.

3.1.6. *Thermometer*—A thermometer for measuring water bath and ambient temperature shall meet the requirements of M 339M/M 339 with a temperature range of at least 16 to 34°C (61 to 93°F) and an accuracy of ± 0.5°C (± 1.0°F) (see Note 5).

Note 5—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E230/E230M thermocouple thermometer, Type T, Class Special; IEC 60584 thermocouple thermometer, Type T, Class 1; or ASTM E2877 digital metal stem thermometer.

3.1.7. *Sieves*—A series of sieves of square mesh woven cloth, conforming to the requirements of ASTM E11. The sieves normally required are as follows: