
Standard Method of Test for Determining the Liquid Limit of Soils

AASHTO Designation: T 89-22

Technically Revised: 2022

Technical Subcommittee: 1a, Soil and Unbound Recycled Materials



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1. SCOPE

- 1.1. The liquid limit of a soil is that water content, as determined in accordance with the following procedure, at which the soil passes from a plastic to a liquid state.
- 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 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.*

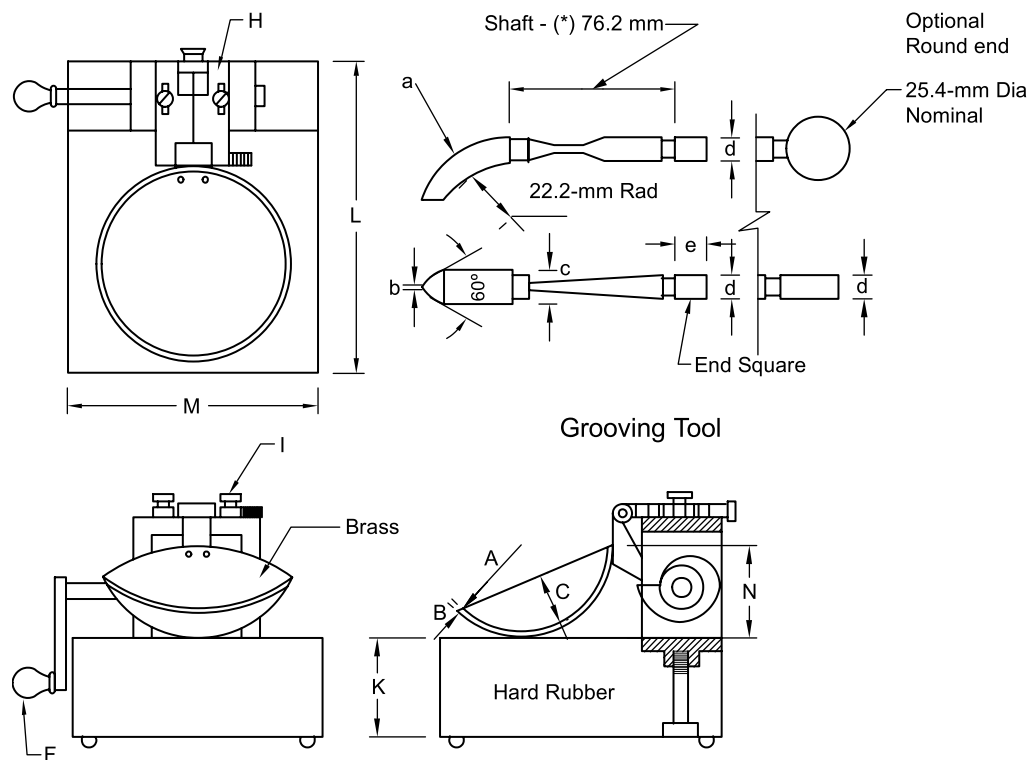
2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- M 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 265, Laboratory Determination of Moisture Content of Soils
- 2.2. *ASTM Standards:*
- D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
 - E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
 - E2877, Standard Guide for Digital Contact Thermometers

- 2.3. *International Electrotechnical Commission Standard:*
 ■ IEC 60584-1: 2013 Thermocouples - Part 1: EMF Specifications and Tolerances

3. APPARATUS

- 3.1. *Dish*—A porcelain dish, preferably unglazed, or similar mixing dish, about 115 mm in diameter.
- 3.2. *Spatula*—A spatula or pill knife having a blade about 75 to 100 mm in length and about 20 mm in width.
- 3.3. *Liquid Limit Device:*
- 3.3.1. *Manually Operated*—A device consisting of a brass dish and carriage, constructed according to the plan and dimensions shown in Figure 1 (see Note 1).



Dimension	Liquid Limit Device							Grooving Tool				
	Cup Assembly				Base			Curved End			Gauge	
Description	A	B	C	N	K	L	M	a	b	c	d	e*
Metric, mm	54	2.0	27	47	50	150	125	10.0	2.0	13.5	10.0	15.9
Tolerance, mm	2	0.1	1	1.5	5	5	5	0.1	0.1	0.1	0.2	—

Note: Plate "H" may be designed for using one (1) securing screw (I).
 An additional wear tolerance of 0.1 mm shall be allowed for dimension "b" for used grooving tools.
 Feet for base shall be of resilient material.
 (*) Nominal dimensions.
 All tolerances specified are plus or minus ($\pm$) except as noted above.

Figure 1—Manual Liquid Limit Device

- 3.3.2. *Mechanically Operated*—A motorized device equipped to produce the rise and rate of shocks to a brass cup as described in Sections 5.2 and 6.3 of this procedure, respectively. The cup and the critical dimensions of the device shall conform to those shown in Figure 1 of this procedure. The device shall give the same liquid limit values as obtained with the manually operated device (Note 1).
- Note 1**—The base of the liquid limit device should have a resilience of at least 80 percent and not more than 90 percent when determined in accordance with the procedure given in the Appendix.
- 3.4. *Grooving Tool:*
- 3.4.1. *Curved Grooving Tool*—A grooving tool conforming to the critical dimensions shown in Figure 1. The gauge need not be part of the tool.
- 3.4.2. *Flat Grooving Tool (Alternate)*—A grooving tool made of plastic or noncorroding metal conforming to the critical dimensions shown in ASTM D4318, Figure 3. The gauge need not be part of the tool (Note 2).
- Note 2**—The flat grooving tool should not be used interchangeably with the curved grooving tool. There are some data that indicate that the liquid limit is slightly increased when the flat tool is used instead of the curved tool.
- 3.5. *Gauge*—A gauge, whether attached to the grooving tool or separate, conforming to the critical dimension “d” shown in Figure 1 of this test method or “K” in Figure 3 of ASTM D4318, and may be, if separate, a metal bar 10.0 ± 0.2 mm thick and approximately 50 mm long.
- 3.6. *Containers*—Suitable containers made of material resistant to corrosion and not subject to change in mass or disintegration on repeated heating and cooling. Containers shall have close-fitting lids to prevent loss of moisture from samples before initial mass determination and to prevent absorption of moisture from the atmosphere following drying and before final mass determination. One container is needed for each moisture content determination.
- 3.7. *Balance*—The balance shall have sufficient capacity and conform to M 231, Class G 1.
- 3.8. *Oven*—A thermostatically controlled drying oven capable of maintaining temperatures of $110 \pm 5^\circ\text{C}$ for drying moisture 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 3).
- Note 3**—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.

METHOD A

4. SAMPLE

- 4.1. A sample with a mass of about 100 g shall be taken from the thoroughly mixed portion of the material passing the 0.425-mm sieve that has been obtained in accordance with R 58 or R 74; for structural analysis use R 74, Method B.