Liquid-in-Glass Thermometer Usage in Common AASHTO and ASTM Construction Materials Test Methods

Note: *The intent of this table is to describe liquid-in-glass (LiG) thermometers specified in AASHTO and ASTM Test Methods. In most cases, alternatives to LiG are also allowed by the standard. These alternatives are not described or mentioned in this table. For specific alternatives to LiG thermometers, the applicable AASHTO or ASTM standard should be consulted.*

AGGREGATE TESTS

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Unit Weight of Aggregate	T 19	C 29	Not Specified	Not Specified	Yes	A partial immersion thermometer is recommended for determining the temperature of the water in the measure.

SOIL TESTS

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Particle Size Analysis of Soils	T 88	D 422	Not Specified	Not Specified	Yes	A partial immersion thermometer is recommended for determining the temperature of the soil-water slurry. Temperature measurements are time-sensitive for this test, and should be performed quickly and with minimal disturbance to the test sample.
Specific Gravity of Soils	T 100	D 854	Not Specified	*AASHTO T 100*: Not Specified; *ASTM D 854*: Partial Immersion with depth between 25 and 80 mm	Yes	A partial immersion thermometer is recommended for AASHTO T 100, and required for ASTM D 854. The thermometer should be correctly immersed to the depth specified for the thermometer used.

EMULSIFIED ASPHALT TESTS

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Saybolt Furol Viscosity	T 59, T 72	D 7496, D 88	ASTM 17F/17C; ASTM 19F/19C	Total Immersion	No	The thermometer used depends upon the test temperature. The thermometer is used to simultaneously stir the test sample while monitoring the sample temperature. It may be impossible to properly immerse the thermometer to the top of the mercury column due to the height of the viscometer. Attempts should be made to immerse the thermometer a close as possible to the correct temperature, ensuring that the top of the mercury column is still visible so that temperature measurements can easily be obtained.
Residue of Emulsified Asphalt by Distillation	T 59	D 6997	ASTM 7C/7F (Two Required)	Total Immersion	No	One thermometer is position ¼ in. from the bottom of the still, and the other 6 ½ in. from the bottom of the still. The height of the mercury column will rise throughout the test. The positioning described in the method should be used.

ASPHALT MIXTURES (HOT-MIX) TESTS

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Bulk Specific Gravity of Compacted Asphalt Mixtures	T 166, Method B	---	ASTM 17F/17C	Total Immersion	Yes	Only required for AASHTO Method B. The thermometer should be properly immersed with the top of the mercury column within 1 cm of the water level.
Maximum Specific Gravity of Asphalt Mixtures (Rice Test)	T 209	D 2041	Not Specified	Not Specified	Yes	A partial immersion thermometer is recommended for determining the temperature of the water.
Marshall Apparatus for Compacted Asphalt Mixtures-Flow Portion	T 245	D 6927	Not Specified	Not Specified	Yes	A total immersion thermometer is recommended for monitoring the temperature of the water bath.

ASPHALT BINDER TESTS

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Cleveland Open Cup Flash	T 48	D 92	ASTM 11C/11F or IP 28C/28F	25-mm immersion	No	Method calls for the thermometer to be held 6.4 ± 0.1 mm from the bottom of the cup, for a total immersion depth of 16 to 18.7 mm. The immersion depth described in the method should be used.
Penetration of Bituminous Materials	T 49	D 5	Not Specified	Not Specified.	Yes	A total immersion thermometer is recommended. AASHTO T 49 requires that the bulb of the thermometer be level with the perforated bath shelf. The height of water in the bath should be adjusted to that the thermometer is immersed correctly.
Float Test for Bituminous Materials	T 50	D 139	ASTM 15C/15F or equivalent	Total Immersion	No	Method calls for the thermometer to be immersed to a depth of 40 ± 2 mm below the water surface, regardless of the height of the mercury column. The immersion depth described in the method should be used.
Ductility & Force Ductility of Bituminous Materials	T 51 / T300	D 113	ASTM 63C/63F or equivalent	Total Immersion	Yes	Often times the same bath and thermometer as used for AASHTO T 49 / ASTM D 5 is used for this test.
Softening Point of Bituminous Materials	T 53	D 36	ASTM 15C/F; ASTM 16C/F; ASTM 113C/F (AASHTO only);	Total Immersion	No	The thermometer used depends upon the liquid medium used for testing (distilled water, USP Glycerin, or Ethylene Glycol). The method calls for the thermometer to be positioned so that the bottom of the bulb is level with the bottom of the rings within 13 mm (0.5 in.). The height of the mercury column will change throughout the test. The immersion depth described in the method should be used.
Distillation of Cutback Asphalt	T 78	D 402	ASTM 8C/8F or IP 6C	Total Immersion	No	The method calls for the thermometer to be supported 6.4 mm above the bottom of the flask. The height of the mercury column will change throughout the test. The immersion depth described in the method should be used.
Tag Open Cup Flash	T 79	D 3134	ASTM 9C/9F or equivalent	57-mm immersion	No	Method calls for the thermometer to be held 6.4 mm from the bottom of the cup, for a total immersion depth of approximately 40.4 to 43.6 mm. The immersion depth described in the method should be used.

ASPHALT BINDER TESTS (Continued)

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Thin-Film Oven Test (TFOT) & Rolling Thin-Film Oven Tests (RTFOT)	T 179 / T 240	D 1754 / D 2872	ASTM 13C	Total Immersion	No	Method calls for entire thermometer to be positioned in the oven. The positioning described in the method should be used.
Kinematic Viscosity	T 201	D 2170	ASTM 47C/47F or IP 35C/35F; ASTM 110C/110F	Total Immersion	Yes	The thermometer used depends upon the test temperature. The thermometer should be properly immersed with the top of the mercury column within 1 cm of the bath fluid level.
Absolute Viscosity	T 202	D 2171	ASTM 47C/47F	Total Immersion	Yes	The thermometer should be properly immersed with the top the mercury column within 1 cm of the bath fluid level.
Density of Bituminous Materials (Pycnometer Method)	T 228	D 70	Not Specified	Total Immersion	Yes	An example of a suitable thermometer is an ASTM 63C/63F. The thermometer should be properly immersed in the water bath with the top of the mercury column within 1 cm of the water level.
API Gravity	T 295	D 3142	Not Specified	Not Specified	Yes	The method states that an ASTM 12C/12F is suitable for this test. This type of thermometer is total immersion. Some users may find that a partial immersion thermometer is easier to use. The thermometer should have a scale error of less than 0.1°C (0.25°F).
Elastic Recovery	T 301	D 6084	AASHTO calls for 17C/17F; ASTM Calls for 63C/63F	Total Immersion	Yes	Often times the same bath and thermometer as used for AASHTO T 49 / ASTM D 5 is used for this test.
Bending Beam Rheometer (BBR)	T 313	D 6648	Not Specified	Partial Immersion	Yes	A suitable thermometer is an ASTM 133C. The thermometer should be correctly immersed to the depth specified for that thermometer. (An ASTM 133C has an immersion depth of 76 mm.)
Direct Tension (DT) Test	T 314	D 6723	Not Specified	Not Specified	Yes	A partial immersion thermometer is recommended. A suitable thermometer is an ASTM 133C. (An ASTM 133C thermometer is a partial immersion thermometer with an immersion depth of 76 mm.)
Dynamic Shear Rheometer (DSR)	T 315	D 7175	Not Specified	Partial Immersion	Yes	The reference thermometer may be a partial immersion LiG thermometer. The thermometer should be correctly immersed to the depth specified for the thermometer used.

HYDRAULIC CEMENT & CONCRETE TESTS

Test Method	Test Designation		Thermometer Required	Immersion Design	Thermometer Used as Designed?	Comments
	AASHTO	ASTM				
Moist Rooms and Cabinets for Testing Hydraulic Cements and Concretes	---	C 511	Not Specified	Not Specified	No	Standard calls for a reference thermometer to be used to verify the accuracy of the temperature recorder during normal operation of the cabinet. Since the thermometer is completely immersed in the test medium, a complete immersion thermometer should be used. However, complete immersion thermometers are rare, and not specified in ASTM standards. Therefore, it is recommended that a total immersion thermometer be used instead.
Temperature of Freshly-Mixed Hydraulic-Cement Concrete	T 309	D 1064	Not Specified	Partial Immersion; immersion depth must be greater than 75 mm	Yes	The thermometer should be correctly immersed to the depth specified for the thermometer used.