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Standard Test Method for Density or Relative Density of Engine Coolant Concentrates and Engine Coolants By The Hydrometer[1]

This standard is issued under the fixed designation D1122; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

ε[1] NOTE—Editorial changes were made throughout in April 2017.

1. Scope

1.1 This test method covers the determination of the relative density of engine coolant concentrates and engine coolants.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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.*

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1176 Practice for Sampling and Preparing Aqueous Solutions of Engine Coolants or Antirusts for Testing Purposes

E1 Specification for ASTM Liquid-in-Glass Thermometers

E100 Specification for ASTM Hydrometers

E230/E230M Specification and Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples

3. Terminology

3.1 *Definitions:*

3.1.1 *relative density, n*—the ratio of the density of a material at a stated temperature to the density of water at the same stated temperature.

4. Significance and Use

4.1 The relative density of an engine coolant may be used to determine the approximate percent glycol, freezing point, and boiling point, provided the glycol type is known.

4.2 The relative density of an engine coolant concentrate can be used as a production control test.

5. Apparatus

5.1 *Hydrometers*—Hydrometers shall be of glass, graduated in specific gravity range as listed in Table 1, and shall conform to Specification E100.

5.2 *Hydrometer Cylinder*—The hydrometer cylinder in which the sample for the relative density test is confined shall be made of clear glass and shall be cylindrical in shape. For convenience in pouring, it may have a lip on the rim. The inside diameter of the cylinder shall be at least 25.4 mm (1.0 in.) greater than the outside diameter of the hydrometer. The height of the cylinder shall be such that the length of the column of sample it contains is greater by at least 25.4 mm (1.0 in.) than the portion of the hydrometer which is immersed beneath the surface of the sample after a state of equilibrium has been reached.

5.3 *Temperature Measuring Instrument*—(Environmentally safe thermometer or thermocouple). An ASTM Partial Immersion Thermometer, having a range from –5 to 300 °C and conforming to the requirements for thermometer 2C or 2F, as prescribed in Specification E1, or some suitable non-mercury containing temperature measuring device, such as a thermocouple, capable of operating in the same temperature range and having equal or better accuracy as summarized in Specification E230/E230M. See Section 8, Precision and Bias.

[1] This test method is under the jurisdiction of ASTM Committee D15 on Engine Coolants and Related Fluids and is the direct responsibility of Subcommittee D15.03 on Physical Properties.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

TABLE 1 Available Hydrometer Sets

ASTM Hydrometer No.	Type	Range	
		Total	Each Hydrometer
111H to 117H	for general use in heavy liquids	1.000 to 1.350	0.050

5.4 *Water Bath*—A water bath capable of maintaining a sample temperature of 15.5 ± 0.3 °C (60 ± 0.5 °F) during the test.

6. Sampling

6.1 Sample the coolant in accordance with Test Method D1176, except as specified in this test method.

7. Procedure

7.1 If the coolant has a small amount of separated upper layer, remove it before determining the relative density of the lower layer. To separate, pour the sample into a 500-mL separatory funnel, allow to stand for 3 h at room temperature but not below 20 °C (68 °F), and then draw off the lower layer.

7.2 If the original coolant is homogeneous, no separation will be required.

7.3 Cool the homogeneous sample or the separated lower layer sample to about 14 °C (57 °F). Pour the sample into the clean, dry hydrometer cylinder without splashing, so as to reduce to a minimum the formation of air bubbles (see Note 1). Place the cylinder vertically in the water bath and let the temperature of the sample reach 15.0 ± 0.3 °C (59 ± 0.5 °F). Slowly and carefully lower the hydrometer into the sample to a level two smallest scale divisions below that at which it will float and then release the hydrometer. When the hydrometer has come to rest and floats freely away from the walls of the cylinder and the temperature has reached 15.5 ± 0.3 °C (60 ± 0.5 °F), read the hydrometer.

NOTE 1—When handling the sample (that is, mixing, transferring, or stirring) be careful to avoid formation of air bubbles. Remove any air bubbles by touching them with a clean, dry glass rod.

7.4 The hydrometer is read in the following ways: If the sample is sufficiently transparent, place the eye slightly below the level of the liquid and slowly raise it until the surface of the sample changes from a distorted ellipse to a straight line cutting the hydrometer scale. If the sample is opaque, read the point on the hydrometer scale to which the sample rises above the main surface of the liquid with the eye placed slightly above the plane of the surface of the sample. Correct this reading by an amount equal to the height to which the sample rises on the hydrometer stem above the main liquid surface. This height will vary for different coolants and different hydrometers, and the correction will depend upon the width of the hydrometer scale graduations. Determine the correction factor for the hydrometer used by observing the height above the main surface of the liquid to which the coolant rises on the hydrometer scale when the hydrometer is immersed in a transparent liquid, such as an ethylene or propylene glycol solution, having a surface tension similar to that of the sample under test.

8. Precision and Bias

8.1 *Precision:*

NOTE 2—Previous versions of this test method permitted the use of mercury-containing thermometers. The data for the Precision and Bias statement were generated under earlier versions of the test method, and were generated with mercury-filled thermometers.

8.1.1 *Repeatability*—For different operators their results should vary not more than 0.0012 from the average value when the relative density of the engine coolant concentrate sample is between 1.0000 and 1.1300.

8.1.2 *Reproducibility*—For different apparatus the results should vary not more than 0.0012 from the average value when the density or relative density of the engine coolants concentrate is between 1.0000 and 1.1300.

8.2 *Bias*—Bias of the procedure in this test method for measuring density or relative density has not been determined because an accepted reference material has not been determined.

9. Keywords

9.1 engine coolant; engine coolant concentrate; hydrometer; relative density