Designation: D 2935 – 96 (Reapproved 2000)

Standard Test Method for Apparent Density of Industrial Aromatic Hydrocarbons[1]

This standard is issued under the fixed designation D 2935; 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 Department of Defense.

1. Scope

1.1 This test method covers the measurement of apparent density in pounds in air per U.S. gallon at convenient temperatures using a hydrometer, and reporting at any specified atmospheric temperature.

1.2 The following applies to all specified limits in this test method: for purposes of determining conformance with this test method, an observed value or a calculated value shall be rounded off "to the nearest unit" in the last right-hand digit used in expressing the specification limit, in accordance with the rounding-off method of Practice E 29.

1.3 *This standard does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific hazard statements are given in Section 7 and Note 3.

2. Referenced Documents

2.1 *ASTM Standards:*

D 3437 Practice for Sampling and Handling Liquid Cyclic Products[2]

E 1 Specification for ASTM Thermometers[3]

E 12 Terminology Relating to Density and Specific Gravity of Solids, Liquids, and Gases[4]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[5]

E 100 Specification for ASTM Hydrometers[3]

2.2 *Other Document:*

OSHA Regulations, 29 CFR, paragraphs 1910.1000 and 1910.1200[6]

3. Terminology

3.1 *Definitions:*

3.1.1 *apparent density at 60°F*—the weight in air of a unit volume of sample at 60°F; in this test method, the weight is in pounds, and the volume in U.S. liquid gallons. Average air in this test method is assumed to have a density of 0.0012 g/cm^3.

NOTE 1—This definition is not in conflict with that given in the current version of Terminology E 12.

4. Summary of Test Method

4.1 A hydrometer reading is made at any convenient temperature. The difference between hydrometer reading and a tabulated value at test temperature is applied to tabular values at any other temperature to get the apparent density at this other temperature.

4.2 The precision of this test method is such that the determination should be made in duplicate (11.1) in case of dispute or for referee purposes. In other cases single determinations may suffice.

5. Significance and Use

5.1 This test method is intended for measurements on high-purity benzene, toluene, styrene, *o*-, *m*-, *p*-xylene, mixed xylenes, and cyclohexane. It can be extended for use on any material for which a precise density-temperature relationship is known. It has been tested for precision between 55 and 100°F.

5.2 This test method is not intended for use in setting specifications on industrial aromatic hydrocarbons. It may also be used as an internal quality control tool and in development or research work.

6. Apparatus

6.1 *Hydrometer*, ASTM pounds per gallon, having a range consistent with the density of the material being tested. The hydrometer shall conform to the requirements prescribed in

[1] This test method is under the jurisdiction of ASTM Committee D16 on Aromatic Hydrocarbons and Related Chemicals and is the direct responsibility of Subcommittee D16.01 on Benzene, Toluene, Xylenes, Cyclohexane, and Their Derivatives.

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[2] *Annual Book of ASTM Standards*, Vol 06.04.

[3] *Annual Book of ASTM Standards*, Vol 14.03.

[4] *Annual Book of ASTM Standards*, Vol 15.05.

[5] *Annual Book of ASTM Standards*, Vol 14.02.

[6] Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

Specification E 100. Table 1 shows the ranges of several hydrometers suitable for testing the industrial aromatic hydrocarbons within the scope of this method.

6.2 *Thermometer*, graduated in 0.1°F in the range from 54 to 101°F and conforming to the requirements for Gas Calorimeter Inlet Thermometer 50F described in Specification E 1.

6.3 *Cylinder*, made of clear glass or plastic. For convenience in pouring, the cylinder may have a lip on the rim. Use a cylinder having an inside diameter 25 mm greater than the diameter of the hydrometer and a height to provide a clearance of 25 mm between the lower end of the hydrometer and the inside bottom of the cylinder.

6.4 *Bath*, for maintaining the contents of the hydrometer cylinder constant to 0.05°F at any convenient temperature during the test.

7. Hazards

7.1 Consult the latest OSHA regulations, supplier's Material Safety Data Sheets, and local regulations regarding all materials used in this test method.

8. Sampling

8.1 Sample in accordance with Practice D 3437 for proper sampling and handling of aromatic hydrocarbons analyzed by this test method.

9. Procedure

9.1 Bring the sample, cylinder, thermometer, and bath to the same temperature, preferably ambient. Pour the sample into the clean cylinder avoiding formation of air bubbles. Remove any air bubbles formed, after they have collected on the surface of the sample by touching them with a piece of clean filter paper.

9.2 Place the cylinder containing the sample in a vertical position in a location free of air currents, preferably in the water bath. Take precautions to prevent the temperature of the sample from changing appreciably during the time necessary to complete the test. Measure the temperature and leave the thermometer in the liquid.

9.3 Lower the hydrometer gently into the sample and, when it has settled, depress it about two scale divisions into the liquid and then release; keep the rest of the stem dry, as unnecessary liquid on the stem changes the effective weight of the instrument, and so affects the reading obtained. A slight spin imparted to the instrument on releasing will assist in bringing it to rest, floating freely away from the walls of the hydrometer cylinder. Allow sufficient time for the hydrometer to become completely stationary and for all air bubbles to come to the surface. Again measure the temperature of the liquid.

9.4 When the hydrometer has come to rest, floating freely, and the temperature of the sample is constant to 0.1°F, read the hydrometer to the nearest ⅕ scale division (Note 2). The correct reading is that point on the hydrometer scale at which the surface of the liquid cuts the scale. Determine this point by placing the eye slightly below the level of the liquid and slowly raising it until the surface, first seen as a distorted elipse, appears to become a straight line cutting the hydrometer scale.

TABLE 1 Suitable Hydrometers for Testing Industrial Aromatic Hydrocarbons

ASTM Number	Normal Range, lb/gal
294H-68T	6.24 to 6.66
295H-68T	6.66 to 7.08
296H-68T	7.08 to 7.50
297H-68T	7.50 to 7.91

NOTE 2—One fifth of a scale division is equal to 0.001 lb/gal.

NOTE 3—**Precaution:** Avoiding breathing fumes of the sample, as some aromatic hydrocarbons, particularly benzene, are toxic and dangerous when inhaled in large quantities.

9.5 Observe the temperature immediately before and after observation of the indicated density, the liquid in the cylinder being thoroughly stirred with the thermometer, the whole mercury thread being immersed. Keep the thermometer in the sample at all times. Should the two temperature readings differ by more than 0.1°F repeat the temperature and density observations when the temperature of the sample has become more stable.

9.6 Record the mean of the thermometer reading before and after the final hydrometer reading, to the nearest 0.1°F as the temperature of the test. Record the hydrometer reading to nearest 0.001 lb/gal. This will require interpolation of the hydrometer subdivisions.

10. Calculation

10.1 Enter Table 2 with the temperature of the test. If the observed hydrometer reading at this temperature is greater than the table value, add the difference to the table value at 60°F to get the apparent density at 60°F. If the observed reading is less than the table value, subtract the difference from the table value at 60°F to get apparent density at 60°F.

10.2 If the temperature of the bulk of the material storage tank or drum is at some temperature other than 60°F, the same difference observed at the test temperature may be applied to the table value at the mean bulk liquid temperature to obtain the apparent density value for calculating the weight in air of the bulk material from its measured volume.

11. Report

11.1 Report the density to the nearest 0.001 lb/gal. Duplicate measurements that agree within 0.011 lb/gal are acceptable for averaging (95 % confidence level).

12. Precision

12.1 The following criteria should be used for judging the acceptability of results:

12.1.1 *Intermediate Precision* (*Formerly Repeatability* (*Single Analyst*))—The standard deviation of single results obtained by the same analyst on different days has been estimated to be 0.0042 lb/gal at 38 df. Two such values should be considered suspect (95 % confidence level) if they differ by more than 0.012. When duplicate determinations are made by the same analyst on each of different days, the standard deviation of results (each the average of duplicates) has been estimated to be 0.0016 lb/gal at 38 df, and two such values should be considered suspect (95 % confidence level) if they differ by more than 0.0046.

12.1.2 *Reproducibility* (*Multilaboratory*)—The standard deviation of single results obtained by analysts in different