



Standard Test Method for Vapor Pressure of Petroleum Products (Automatic Method)¹

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1. Scope

1.1 This test method covers the determination of the total pressure of air-containing, volatile, petroleum products. This test method is suitable for testing samples with boiling points above 0°C (32°F) that exert a vapor pressure between 7 and 172 kPa (1 and 25 psi) at 37.8°C (100°F) at a vapor-to-liquid ratio of 4:1. This test method is suitable for testing gasoline samples that contain oxygenates. No account is made of dissolved water in the sample.

1.1.1 Some gasoline-oxygenate blends may show a haze when cooled to 0 to 1 °C. If a haze is observed in 8.5, it shall be indicated in the reporting of results. The precision and bias statements for hazy samples have not been determined (see Note 10).

1.2 This test method is suitable for the calculation of a dry vapor pressure equivalent (DVPE) by means of a correlation equation (see 13.1). The calculated DVPE very closely approximates the dry vapor pressure that would be obtained on the same material when tested in accordance with Test Method D 4953.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given in parentheses are provided for information only.

1.4 *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.* For specific hazard statements, see Note 2 and Note 5.

2. Referenced Documents

2.1 ASTM Standards:

D 4057 Practice for Manual Sampling of Petroleum and Petroleum Products²

D 4953 Test Method for Vapor Pressure of Gasoline and Gasoline-Oxygenate Blends (Dry Method)³

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.08 on Volatility.

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² Annual Book of ASTM Standards, Vol 05.02.

³ Annual Book of ASTM Standards, Vol 05.03.

D 5191 Test Method for Vapor Pressure of Petroleum Products (Mini Method)³

2.2 ASTM Adjuncts:

Detailed Drawings for Automatic Vapor Pressure Instrument⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *total pressure, n*—the observed pressure measured in the experiment, that is, the sum of the partial pressure of the sample and the partial pressure of the dissolved air.

3.1.2 *dry vapor pressure equivalent (DVPE), n*—a value calculated by a correlation equation (see 13.1) from the total pressure.

3.1.2.1 *Discussion*—The DVPE is expected to be equivalent to the value obtained on the sample by Test Method D 4953, Procedure A.

4. Summary of Test Method

4.1 The chilled sample cup of the automatic vapor pressure instrument is filled with chilled sample and is coupled to the instrument inlet fitting. The sample is then automatically forced from the sample chamber to the expansion chamber where it is held until thermal equilibrium at 37.8°C (100°F) is reached. In this process the sample is expanded to five times its volume (4:1 vapor-to-liquid ratio). The vapor pressure is measured by a pressure transducer.

4.2 The measured vapor pressure is automatically converted to a DVPE value by the instrument. A correction to this value is necessary to account for the observed bias between the test result and that obtained by Test Method D 4953.

5. Significance and Use

5.1 Vapor pressure is an important physical property of volatile liquids.

5.2 The vapor pressure of gasoline and gasoline-oxygenate blends is regulated by various government agencies.

5.3 Specifications for volatile petroleum products generally include vapor pressure limits to ensure products of suitable volatility performance.

⁴ Available from ASTM Headquarters. Order PCN 12-500140–12.

5.4 This test method is more precise than Test Method D 4953.

6. Apparatus

6.1 *Automatic Vapor Pressure Instrument*,⁵ the essential features describing the sample flow and operation of the automatic vapor pressure instrument is provided in Annex A1. Critical elements of the apparatus are included as follows:

6.1.1 *Pressure Transducer*, capable of operating in the range from 0 to 172 kPa (0 to 25 psi) with the resolution of 0.1 kPa (0.01 psi) and a minimum accuracy of ± 0.7 kPa (± 0.10 psi).

6.1.2 *Thermostatically Controlled Heater*, capable of maintaining an oil bath surrounding the test chambers at $37.8 \pm 0.1^\circ\text{C}$ ($100 \pm 0.2^\circ\text{F}$) for the duration of the test.

6.1.3 *Sample Cup*, capable of holding up to 125 mL.

6.2 *Iced-Water Bath or Air Bath*, for chilling the test samples and sample cup to temperatures between 0 to 1°C (32 to 34°F).

7. Reagents and Materials

7.1 *Purity of Reagents*—Chemicals of at least 98 % purity shall be used in the calibration procedure (see Section 10). Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society where such specifications are available.⁶ Lower purities may be used, provided it is first ascertained that the reagent is of sufficient purity to permit its use without lessening the accuracy of the determination.

NOTE 1—Although higher purity chemicals in the 99 + % range are preferred for use in calibrations, the precision and bias statements (see Section 15) were derived with the minimum purity level stated in 7.1.

7.2 *2,2-Dimethylbutane*.

7.3 *n-Hexane*, (**Warning**—see Note 2).

7.4 *n-Pentane*, (**Warning**—see Note 2).

7.5 *Toluene*, (**Warning**—see Note 2).

NOTE 2—**Warning**: 2,2-Dimethylbutane, *n*-hexane, *n*-pentane, and toluene are extremely flammable, harmful if inhaled. Skin irritant on repeated contact. Aspiration hazard.

8. Sampling

8.1 *General Procedures*:

8.1.1 The extreme sensitivity of vapor pressure measurements to losses through evaporation and the resulting change in composition is such as to require the utmost precaution and the most meticulous care in the drawing and handling of samples.

8.1.2 Obtain a sample and test specimen in accordance with Practice D 4057, except do not use “Sampling by Water Displacement” for fuels containing oxygenates. Use a 1-L (1-qt) size container filled between 70 and 80 % with the sample.

⁵ The following instrument has been found suitable by interlaboratory cooperative testing: Vapor Pressure Instrument, available from Southwest Research Institute, San Antonio, Texas.

⁶ *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeial and National Formulary*, U.S. Pharmacopeial Convention, Inc. (USPC), Rockville, MD.

NOTE 3—The present precision statement was derived using the samples in 1-L (1-qt) containers. However, the samples in containers of other sizes, as prescribed in Practice D 4057 can be used, with the same ullage requirement, if it is recognized that the precision can be affected.

8.1.3 In the case of referee testing, the 1-L (1-qt) sample container is mandatory.

8.1.4 Perform the vapor pressure determination on the first test specimen withdrawn from a sample container. Do not use the remaining sample in the container for a second vapor pressure determination. If a second determination is necessary, obtain a new sample.

8.1.5 Protect the samples from excessive temperatures prior to testing. This can be accomplished by storage in an appropriate ice bath or refrigerator.

8.1.6 Do not test samples stored in leaky containers. If leaks are detected, discard and obtain a new sample.

8.2 *Sampling Handling Temperature*—Cool the sample container and contents in an ice bath or refrigerator to between 0 and 1°C (32 and 34°F) prior to opening the sample container. Allow sufficient time to reach this temperature. Verify the sample temperature by direct measurement of the temperature of a similar liquid in a similar container placed in the cooling bath or refrigerator at the same time as the sample.

8.3 *Verification of Sample Container Filling*—With the sample at a temperature of 0 to 1°C , take the container from the cooling bath or refrigerator and wipe dry with absorbent material. If the container is not transparent, unseal it and using a suitable gage, confirm that the sample volume equals 70 to 80 % of the container capacity (see Note 4). If the sample is contained in a transparent glass container, verify that the container is 70 to 80 % full by suitable means (see Note 4).

NOTE 4—For non-transparent containers, one way to confirm that the sample volume equals 70 to 80 % of the container capacity is to use a dipstick that has been pre-marked to indicate the 70 and 80 % container capacities. The dipstick should be of such material that it shows wetting after being immersed and withdrawn from the sample. To confirm the sample volume, insert the dipstick into the sample container so that it touches the bottom of the container at a perpendicular angle, before removing the dipstick. For transparent containers, using a marked ruler or comparing the sample container to a like container that has the 70 and 80 % levels clearly marked, has been found suitable.

8.3.1 Discard the sample if the container is filled to less than 70 volume % of the container capacity.

8.3.2 If the container is more than 80 volume % full, pour out enough sample to bring the container contents within 70 to 80 volume % range. Do not return any sample to the container once it has been withdrawn.

8.3.3 Reseal the container, if necessary, and return the sample container to the cooling bath or refrigerator.

8.4 *Air Saturation of the Sample in the Sample Container*:

8.4.1 *Transparent Containers Only*—Since 8.3 does not require that the sample container be opened to verify the sample capacity, it is necessary to unseal the cap momentarily before resealing it, so that samples in transparent containers are treated the same as samples in non-transparent containers.

8.4.2 With the sample again at a temperature of 0 to 1°C , take the container from the cooling bath or refrigerator, wipe it dry with an absorbent material, remove the cap momentarily, taking care that no water enters, reseal and shake vigorously.