



Standard Test Method for Gage Vapor Pressure of Liquefied Petroleum (LP) Gases (LP-Gas Method)¹

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1. Scope

1.1 This test method covers the determination of the gage vapor pressures of liquefied petroleum gas products at temperatures of 37.8°C (100°F) up to and including a test temperature of 70°C (158°F).

1.2 *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 Annex A2.

1.3 The values stated in acceptable metric units are to be regarded as the standard. The values in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

D 323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)²

D 1265 Practice for Sampling Liquefied Petroleum (LP) Gases (Manual Method)²

E 1 Specification for ASTM Thermometers³

2.2 Institute of Petroleum Standard:

IP 181 Sampling Petroleum Gases⁴

3. Terminology

3.1 Definitions:

3.1.1 *vapor pressure*—the pressure exerted by the vapor of a liquid when in equilibrium with the liquid.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *liquefied petroleum gases*—narrow boiling range hydrocarbon mixtures consisting chiefly of propane or propylene, or both, (Warning—see Note 1) butanes and butylenes, or both, in which the content of hydrocarbon compounds of higher boiling point than 0°C (32°F) is less than 5 % by liquid

volume, and whose gage vapor pressure at 37.8°C (100°F) is not greater than approximately 1550 kPa (225 psi).

NOTE 1—**Warning:** Extremely flammable. Harmful when inhaled.

4. Summary of Test Method

4.1 The test apparatus, consisting of two interconnected chambers and equipped with a suitable pressure gage, is purged with a portion of the sample which is then discarded. The apparatus is then filled completely with the portion of the sample to be tested. Thirty-three and one-third to forty volume percent of the sample content of the apparatus is immediately withdrawn to provide adequate free space for product expansion. The apparatus is then immersed in a water bath maintained at the standard test temperature of 37.8°C (100°F) or, optionally, at some higher test temperature up to and including a test temperature of 70°C (158°F).

4.2 The observed gage pressure at equilibrium, after correcting for gage error and correcting to a standard barometric pressure, is reported as the LPG Vapor Pressure at the selected test temperature.

5. Significance and Use

5.1 Information on the vapor pressures of liquefied petroleum gas products under temperature conditions from 37.8 to 70°C (100 to 158°F) is pertinent to selection of properly designed storage vessels, shipping containers, and customer utilization equipment to ensure safe handling of these products.

5.2 Determination of the vapor pressure of liquefied petroleum gas is important for safety reasons to ensure that the maximum operating design pressures of storage, handling, and fuel systems will not be exceeded under normal operating temperature conditions.

5.3 For liquefied petroleum gases, vapor pressure is an indirect measure of the most extreme low temperature conditions under which initial vaporization can be expected to occur. It can be considered a semi-quantitative measure of the amount of the most volatile material present in the product.

6. Apparatus

6.1 *Vapor Pressure Apparatus*, constructed as illustrated in Fig. A1.1, and the various items of auxiliary equipment, are completely described in Annex A1.

6.2 The air chamber of Test Method D 323, may be interchangeable with the upper chamber of this method. Similarly,

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² *Annual Book of ASTM Standards*, Vol 05.01.

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

⁴ Available from Applied Science Publishers, Ripple Rd., Barking, Essex, England

the liquid chamber (two-opening type) of Test Method D 323 is interchangeable with the B, 20 % lower chamber A1.1.4 of this method. Because of this interchangeability, the apparatus assembly of Test Method D 323 must pass, as a safety precaution, the hydrostatic test specified in A1.1.6 before using same in testing liquefied petroleum gas.

7. Sampling and Sample Handling

7.1 Samples shall be obtained and stored in accordance with Practice D 1265, or IP 181, Sampling Petroleum Gases, unless the test samples can be taken directly from the source of the material to be tested.

7.2 Any method of coupling the vapor pressure apparatus to the sample source can be employed. Tubing, 6 to 7 mm ($\frac{1}{4}$ in.) in diameter, of minimum length, of suitable-working pressure, and made of material corrosion-resistant to the products being sampled, is satisfactory for this purpose. A flexible tubing connection of a satisfactory type greatly facilitates the purging and sampling operations. The tubing should be a conducting material or constructed with a built-in ground connection to minimize the effect of static electricity.

8. Preparation of Apparatus

8.1 If the apparatus has been used for testing products other than the type of product to be tested, disassemble, clean thoroughly, and purge the parts in a stream of dry air.

8.2 Assemble the apparatus with the inlet valve of the lower chamber open, the straight-through valve between the two chambers open, the bleeder valve closed, and with the proper range pressure gage attached.

9. Procedure

9.1 Safe means for the disposal of vapors and liquids during this operation and in the subsequent sampling operation must be provided.

9.2 *Purging*—With the assembled apparatus in an upright position, connect the inlet valve of the lower chamber to the sample source with the sampling connection (7.2). Open the sample source valve to the apparatus. Cautiously open the bleeder valve on the upper chamber, permitting the air or vapors, or both, in the apparatus to escape until the apparatus is full of liquid. Close the lower chamber inlet valve and open the bleeder valve to its wide open position. Allow the contained liquid to evaporate until the apparatus is covered with white frost (may require more than one chilling), then invert the assembly, and expel any residual material through the bleeder valve. Allow the residual vapors to escape until the pressure in the apparatus is essentially atmospheric, then close the bleeder valve.

9.3 *Sampling*—Return the apparatus, now containing only vapors, to its normal upright position and open the inlet valve. As soon as the apparatus attains essentially the same pressure as the pressure of the sample source, momentarily open the bleeder valve. If liquid does not promptly emerge, repeat the purging step (9.2). If liquid appears immediately, close the bleeder and inlet valves in that order (Note 2). Close the valve on the sample source, and disconnect the sampling line. Immediately close the straight-through valve between the two chambers and open the inlet valve, with the apparatus in an

upright position. Close the inlet valve as soon as no more liquid escapes, and immediately open the straight-through valve (Note 1).

NOTE 2—Transfer of the sample is facilitated by chilling the apparatus with a portion of the material under test.

9.3.1 When using the 33 $\frac{1}{3}$ % lower chamber (A1.1.3) proceed to 9.4.

9.3.2 When using the 20 % lower chamber (Appendix A1.1.4), close the straight-through valve and again open the inlet to permit expulsion of the lower chamber contents. As soon as no more liquid escapes from the lower chamber, close the inlet valve and immediately open the straight-through valve.

9.3.3 The upper chamber, prior to this operation, is liquid full at some temperature that is normally below the environmental temperature. Since any warming of the apparatus would cause expansion of the liquid content of the upper chamber, leading to possible rupture of the chamber, it is necessary that the procedural steps of providing free space in the apparatus be completed promptly.

9.4 Vapor Pressure Determination:

9.4.1 Invert the apparatus and shake it vigorously. Return the apparatus to its normal upright position and immerse it in the constant-temperature water bath maintained at the test temperature (4.1). The apparatus including the bleeder valve coupling, but not the pressure gage, must be immersed. Throughout the determination, the temperature of the water bath shall be checked periodically by means of the bath thermometer.

9.4.1.1 At test temperatures of 50°C (122°F) or below, maintain the bath at $\pm 0.1^\circ\text{C}$ (0.2°F). At test temperatures above 50°C (122°F), up to and including 70°C (158°F), maintain the bath at $\pm 0.3^\circ\text{C}$ (0.5°F).

9.4.1.2 Observe the apparatus assembly throughout the test period to ensure freedom from leaks. Discontinue the test and discard the results at any time a leak is detected.

9.4.2 After 5 min have elapsed, withdraw the apparatus from the water bath, invert it, shake it vigorously, and then return it to the bath. Perform the shaking operation quickly to avoid excessive cooling of the apparatus and its contents. Thereafter, at intervals of not less than 2 min, withdraw the apparatus from the bath, invert, shake it vigorously, and then return it to the bath. Prior to each removal of the apparatus from the water bath, tap the gage lightly and observe the pressure reading. These operations will normally require 20 to 30 min to ensure equilibrium. After this time, if consecutive observed gage readings are constant, record the pressure reading as the Uncorrected LP-Gas Vapor Pressure of the sample at the test temperature.

9.4.3 Without removing the pressure gage from the apparatus or the apparatus from the bath, attach a test gage, previously calibrated against a dead-weight tester, to the bleeder valve outlet and open the bleeder valve. At the end of 5 min compare the readings of the two gages. Record any correction thus determined as gage correction.