



Designation: D7975 – 22

Standard Test Method for Determination of Vapor Pressure of Crude Oil: VPCR_x-F(Tm°C) (Manual Expansion Field Method)¹

This standard is issued under the fixed designation D7975; 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.

1. Scope*

1.1 This test method covers the use of manual vapor pressure instruments to determine the vapor pressure of crude oils exerted in a vacuum. This test method is suitable for testing samples that exert a vapor pressure between 25 kPa and 180 kPa at 37.8 °C at vapor/liquid ratios from 4:1 to 0.25:1 ($X = 4$ to 0.25, see 3.2.4).

NOTE 1—This test method is suitable for the determination of the vapor pressure of crude oils at temperatures from 0 °C to 60 °C and pressures up to 500 kPa, but the precision and bias statements (see Section 15) may not be applicable.

1.2 This test method is meant primarily for use under field conditions for immediate evaluation of vapor pressure for storage, transport, or operational uses.

1.3 This test method is not intended for use in custody transfer applications. Test Method D6377 shall be used for custody transfer applications.

1.4 This test method provides a reasonable confirmation for the presence of light ends in the source material given that the partial pressure of low boiling components contribute significantly to total vapor pressure.

1.5 This test method allows both sample collection and subsequent vapor pressure measurement of crude oil samples directly from the sample source. The collected sample may also be transferred to an automated vapor pressure instrument such as used for Test Method D6377. The field test apparatus is suitable for transportation provided suitable over-pack is used to meet the regulations for the transportation of dangerous goods in the transportation jurisdiction(s).

1.6 This test method allows the determination of vapor pressure for crude oil samples having pour points below 0 °C and flow at the sampling conditions to allow inlet to the apparatus.

1.7 The values stated in SI units are to be regarded as standard.

¹ This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.08 on Volatility.

Current edition approved Dec. 1, 2022. Published January 2023. Originally approved in 2014. Last previous edition approved in 2014 as D7975 – 14. DOI: 10.1520/D7975-22.

1.7.1 *Exception*—Other units of measurement are included in this standard for ease of use in multiple jurisdictions.

1.8 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.9 *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

D323 Test Method for Vapor Pressure of Petroleum Products (Reid Method)

D1193 Specification for Reagent Water

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D5191 Test Method for Vapor Pressure of Petroleum Products and Liquid Fuels (Mini Method)

D5853 Test Method for Pour Point of Crude Oils

D6377 Test Method for Determination of Vapor Pressure of Crude Oil: VPCR_x (Expansion Method)

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology D4175.

3.1.2 *vapor/liquid ratio (V/L), n*—the ratio of the vapor volume to the liquid volume of specimen, in equilibrium, under specified conditions.

3.2 Definitions of Terms Specific to This Standard:

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.

*A Summary of Changes section appears at the end of this standard

3.2.1 *dead crude oil, n*—a term usually employed for crude oils that, when exposed to normal atmospheric pressure at room temperature, will *not* result in actual boiling of the sample.

3.2.1.1 *Discussion*—These crudes will have vapor pressures below atmospheric pressure at room temperature.

3.2.1.2 *Discussion*—This method will provide vapor pressure information that will allow the user to determine if a crude oil is considered “dead” or “live.” A crude oil shall always be considered “live” until the vapor pressure can be established. Sampling and handling of dead crude oils can usually be done without concern in normal, non-pressurized sample containers, such as cans and other atmospheric containers.

3.2.2 *light ends, n*—components that cannot be maintained as a liquid at atmospheric pressure at temperatures greater than 0 °C.

3.2.2.1 *Discussion*—This includes any materials that have atmospheric boiling points below 0 °C including methane, ethane, propane, butane, and fixed gases such as H₂S, CO₂, N₂, O₂, H₂, CO.

3.2.3 *live crude oil, n*—a term usually employed for crude oils contained in pressurized systems that, when brought to normal atmospheric pressure at room temperature, will result in actual boiling of the sample.

3.2.3.1 *Discussion*—Sampling and handling of samples of live crude oils will necessitate the use of the field test apparatus and preclude the use of normal sample containers, such as cans and other atmospheric containers.

3.2.4 *vapor pressure of crude oil field measurement (VPCR_X-F), n*—the pressure exerted in an evacuated chamber at a vapor-liquid ratio of X:1 by conditioned or unconditioned crude oil, which may contain gas, air or water, or a combination thereof, where X may vary from 4 to 0.25.

3.2.4.1 *Discussion*—This measurement is performed using the field test apparatus described herein.

3.3 Abbreviations:

3.3.1 *ARV, n*—accepted reference value.

3.3.2 *RVP, n*—Reid Vapor Pressure.

3.3.3 *V/L, n*—vapor/liquid ratio.

3.3.4 *VPCR_X-F(Tm°C), n*—vapor pressure of crude oil field (-F) measurement at X vapor/liquid ratio at (Tm°C) measured temperature.

3.3.5 *STP, n*—Standard Pressure (101.325 kPa) and Temperature (0 °C)

4. Summary of Test Method

4.1 Using a portable variable volume measurement chamber with a built-in piston, a sample of crude oil of known volume is drawn from the sample point or sample container into the field test apparatus (see 7.1). After sealing the chamber, the volume is expanded by moving the piston until the final volume produces the desired V/L value. The temperature of the measuring chamber is then regulated to a specific measuring temperature if required (see 7.2).

4.2 After temperature and pressure equilibrium, the measured pressure is recorded as the VPCR_X-F(Tm°C) of the

sample. The test specimen is mixed during the measuring procedure by shaking the measuring chamber to achieve pressure equilibrium in a reasonable time of 1 min to 5 min.

4.3 For results related to Test Method D323, the final volume of the measuring chamber shall be five times the test specimen volume (4:1 V/L ratio) and the measuring temperature shall be 37.8 °C. The 4:1 V/L ratio is based on filling the measurement chamber 20 % full with liquid with vapor expansion to 100 %.

4.4 For the purpose of transportation, a lower V/L ratio is desirable to simulate the vapor pressure in vessel with 20 % outage. Filling the measurement chamber with 80 % liquid and expanding to 100 % will provide a 0.25:1 V/L ratio.

5. Significance and Use

5.1 Vapor pressure of crude oil at various vapor/liquid ratios is an important physical property for transport, storage, and refinery operations.

5.2 Vapor pressure of crude oil is important to crude oil producers, regulators, transporters and refiners for general handling, transportation, and initial refinery treatment.

5.3 The direct sample collection and subsequent, in place, vapor pressure measurement without the need for further sample handling eliminates the potential loss of light hydrocarbon material from the sample. The combination of sampling and testing may produce higher results than Test Method D323.

5.4 Chilling and air saturation of the sample prior to the vapor pressure measurement (as required in Test Method D323) is not required in this test method.

6. Interferences

6.1 Exposure of a sample to the atmosphere will result in air saturation of the sample and loss of volatile material. At low V/L ratios, the pressure exerted by air saturation can have a material effect on the vapor pressure measurement. Sample exposure to the atmosphere is avoided by sampling directly into the field test apparatus (see 7.1) from the sample source. The sample source shall not be an atmospheric container, such as a can or bottle, since vapor pressure measurement results can be impacted by air saturation and loss of volatile material.

7. Apparatus

7.1 *Field Test Apparatus*³—The apparatus is shown in Fig. 1 and described in detail in Annex A1.

7.1.1 The measuring chamber shall be designed to have a total volume of 100 mL to 120 mL and shall be capable of maintaining a V/L of 4:1 to 0.25:1. The accuracy of the adjusted V/L shall be within ±0.01.

NOTE 2—The measuring chambers employed by the instruments used in generating the precision and bias statements were constructed as per A1.1,

³ The sole source of supply of the apparatus known to the committee at this time is Parkes Scientific Inc. 17360-108 Ave NW, Edmonton, AB, Canada T5S 1E8, (780) 484-1849. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.