Designation: D8003 – 22

Standard Test Method for Determination of Light Hydrocarbons and Cut Point Intervals in Live Crude Oils and Condensates by Gas Chromatography[1]

This standard is issued under the fixed designation D8003; 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 determination of light hydrocarbons and cut point intervals by gas chromatography in live crude oils and condensates with $VPCR_4$ (see Note 1) up to 500 kPa at 37.8 °C.

NOTE 1—As described in Test Method D6377.

1.2 Methane (C_1) to hexane (nC_6) and benzene are speciated and quantitated. Samples containing mass fractions of up to 0.5 % methane, 2.0 % ethane, 10 % propane, or 15 % isobutane may be analyzed. A mass fraction with a lower limit of 0.001 % exists for these compounds.

1.3 This test method may be used for the determination of cut point carbon fraction intervals (see 3.2.1) of live crude oils and condensates from initial boiling point (IBP) to 391 °C (nC_{24}). The nC_{24} plus fraction is reported.

1.4 Dead oils or condensates sampled in accordance with 12.1 may also be analyzed.

1.5 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.5.1 *Exception*—Where there is no direct SI equivalent such as tubing size.

1.6 *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.*

1.7 *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]

D1265 Practice for Sampling Liquefied Petroleum (LP) Gases, Manual Method

D3700 Practice for Obtaining LPG Samples Using a Floating Piston Cylinder

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

D4307 Practice for Preparation of Liquid Blends for Use as Analytical Standards

D5002 Test Method for Density, Relative Density, and API Gravity of Crude Oils by Digital Density Analyzer

D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance

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

D6792 Practice for Quality Management Systems in Petroleum Products, Liquid Fuels, and Lubricants Testing Laboratories

E1510 Practice for Installing Fused Silica Open Tubular Capillary Columns in Gas Chromatographs

2.2 *Other Regulations:*

CAN/CGSB-3.0 No. 14.3-99 Standard Test Method for the Identification of Hydrocarbon Components in Automotive Gasoline using Gas Chromatography[3]

3. Terminology

3.1 *Definitions:*

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cut point carbon fraction interval, n*—the percent mass obtained between two selected n-paraffins of the interval. The

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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.

[3] Available from Standards Council of Canada (SCC), 600–55 Metcalfe St., Ottowa, ON K1P 6L5, http://www.scc.ca.

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

cut point carbon fraction interval as used in this test method is defined as the percent mass obtained between the end of one n-paraffin peak to the end of the next n-paraffin peak, thus a temperature interval is not used to determine the cut points but rather the end points sequential of a n-paraffin peak pair.

3.2.2 *D1265 cylinder, n*—a container used for storage and transportation of a sample obtained at pressures above atmospheric pressure as described in Practice D1265.

3.2.3 *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.

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

3.2.4 *floating piston cylinder, n*—a high pressure sample container, with a free floating internal piston that effectively divides the container into two separate compartments, as described in Practice D3700.

3.2.5 *live crude oil, n*—crude oil with sufficiently high vapor pressure that it would boil if exposed to normal atmospheric pressure at room temperature.

3.2.5.1 *Discussion*—Sampling and handling of live crude oils requires a pressurized sample system and pressurized sample containers to ensure sample integrity and prevent loss of volatile components.

3.2.6 *residue, n*—the percent mass of the sample that either does not elute from the column or elutes after the end of the nC_{24} peak.

3.2.7 *vapor pressure of crude oil ($VPCR_x$), 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 0.02.

4. Summary of Test Method

4.1 This is a gas chromatographic method using a Heated Pressurized Liquid Injection System (HPLIS) (trademarked)[4], split/splitless inlet, capillary column, and flame ionization detector. A calibration mixture which fully elutes from the capillary column, consisting of a full range of hydrocarbons including methane, ethane, and normal paraffins up to C_{24} is used to ensure system performance (Section 7). This calibration mixture serves as an external response standard to determine sample recovery. Samples are introduced to the GC system by loading the HPLIS valve under pressure followed by the pneumatic piston action of the HPLIS injection system introducing the sample into the gas chromatographic injection port.

[4] HPLIS (trademarked) has been found to be a suitable injector. The sole source of supply of the HPLIS known to the committee at this time is Transcendent Enterprises Inc., #33: 17715 - 96 Ave Edmonton, Alberta, Canada, T5T 6W9, www.transcendent.ca. 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.

5. Significance and Use

5.1 This test method determines methane (nC_1) to hexane (nC_6), cut point carbon fraction intervals to nC_{24} and recovery (nC_{24}+) of live crude oils and condensates without depressurizing, thereby avoiding the loss of highly volatile components and maintaining sample integrity. This test method provides a highly resolved light end profile which can aid in determining and improving appropriate safety measures and product custody transport procedures. Decisions in regards to marketing, scheduling, and processing of crude oils may rely on light end compositional results.

5.2 Equation of state calculations can be applied to variables provided by this method to allow for additional sample characterization.

6. Apparatus

6.1 *Gas Chromatograph*—The recommended conditions of the gas chromatograph are listed in Table 1. The gas chromatograph shall be equipped with an electronic pressure control (EPC) or manual split/splitless inlet system. A 4-way 24 VDC solenoid valve controlled from the gas chromatograph keyboard for actuator air pressure control to accommodate the HPLIS is also required. Important features of instrument components are listed in 6.2 to 6.4.

6.2 *Data System*—A data system capable of measuring the retention time and areas of eluting peaks accurately and repeatedly as well as possess a data rate to achieve 10 points to 20 points per peak.

6.3 *Flame Ionization Detector (FID)*—A FID system shall be connected to the column to avoid any cold spots and have the ability to operate at a temperature equivalent to the maximum column temperature used. The detector shall have sufficient sensitivity to detect n-heptane at a mass fraction of 0.01 % with a signal-to-noise greater than 5.

TABLE 1 Gas Chromatograph Parameters

Initial Oven Temperature	35 °C
Initial Oven Time	2 min
Oven Temperature Program	20 °C/min
Final Oven Temperature	310 °C
Final Hold Time	10 min
HPLIS Collar Heater Temperature	200 °C
Inlet Temperature	400 °C
Column	15 m × 0.28 mm × 3 µm PDMS
Column Flow (Hydrogen)	2 mL/min
Carrier Control	Constant Flow
Detector	FID
Detector Temperature	425 °C
Detector Gases:	
Hydrogen	40 mL/min
Air	450 mL/min
Make-Up (N_2)	25 mL/min
Volume Injected	0.5 µL
Split Ratio	30:1
Data Acquisition Rate	10 Hz
HPLIS Valve Timing On	0 min
HPLIS Valve Timing Off	0.3 min
Total Acquisition Time	25.75 min