Designation: D7668 – 23

Standard Test Method for Determination of Derived Cetane Number (DCN) of Diesel Fuel Oils—Ignition Delay and Combustion Delay Using a Constant Volume Combustion Chamber Method[1]

This standard is issued under the fixed designation D7668; 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 quantitative determination of the derived cetane number of conventional diesel fuel oils, diesel fuel oils containing cetane number improver additives, and is applicable to products typical of Specification D975, Grades No.1-D and 2-D regular, low and ultra-low-sulfur diesel fuel oils, European standard EN590, and Canadian standards CAN/CGSB-3.517, CAN/CGSB-3.520, and CAN/CGSB-3.522. The test method may be applied to the quantitative determination of the derived cetane number of biodiesel, blends of diesel fuel oils containing biodiesel material (for example, Specifications D975, D6751, and D7467), and diesel fuel oil blending components.

1.2 This test method utilizes a constant volume combustion chamber with direct fuel injection into heated, compressed synthetic air. A dynamic pressure wave is produced from the combustion of the sample. An equation converts the ignition delay and the combustion delay determined from the dynamic pressure curve to a derived cetane number (DCN).

1.3 This test method covers the ignition delay ranging from 1.9 ms to 25 ms and combustion delay ranging from 2.5 ms to 160 ms (30 DCN to 70 DCN). However, the precision stated only covers the range of DCN results from 38.45 to 64.35.

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

1.5 *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.*

1.6 *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]

D613 Test Method for Cetane Number of Diesel Fuel Oil
D975 Specification for Diesel Fuel
D1193 Specification for Reagent Water
D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants
D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products
D5854 Practice for Mixing and Handling of Liquid Samples of Petroleum and Petroleum Products
D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance
D6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products, Liquid Fuels, and Lubricants
D6708 Practice for Statistical Assessment and Improvement of Expected Agreement Between Two Test Methods that Purport to Measure the Same Property of a Material
D6751 Specification for Biodiesel Fuel Blendstock (B100) for Middle Distillate Fuels
D7467 Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20)
E456 Terminology Relating to Quality and Statistics

2.2 *EN Standards:*[3]

EN590 Automotive Fuels—Diesel—Requirements and Test Methods

[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 D02.01 on Combustion Characteristics.

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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 European Committee for Standardization. Central Secretariat: rue de Stassart, 36,B-1050 Brussels, Belgium.

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

2.3 *Energy Institute Standards:*[4]
IP41 Ignition Quality of Diesel Fuels—Cetane Engine Test Method

2.4 *Canadian Standards:*[5]
CAN/CGSB-3.517 Diesel fuel
CAN/CGSB-3.520 Diesel fuel containing low levels of biodiesel (B1–B5)
CAN/CGSB-3.522 Diesel fuel containing biodiesel (B6–B20)

2.5 *DIN Standards:*[6]
DIN 73372 Einspritzdüsen Grösse T und U

3. Terminology

3.1 *Definitions:*

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

3.1.2 *accepted reference value (ARV), n*—a value that serves as an agreed-upon reference for comparison and that is derived as *(1)* a theoretical or established value, based on scientific principles, *(2)* an assigned value, based on experimental work of some national or international organization, such as the U.S. National Institute of Standards and Technology (NIST), or *(3)* a consensus value, based on collaborative experimental work under the auspices of a scientific or engineering group. **E456**

3.1.2.1 *Discussion*—In the context of this method, accepted reference value is understood to apply to the ignition delay and the combustion delay of specific reference materials determined under reproducibility conditions by collaborative experimental work.

3.1.3 *cetane number (CN), n*—a measure of the ignition performance of a diesel fuel oil obtained by comparing it to reference fuels in a standardized engine test. **D4175**

3.1.3.1 *Discussion*—In the context of this test method, cetane number is that defined by Test Method D613/IP41.

3.1.4 *check standard, n*—in QC testing, a material having an accepted reference value used to determine the accuracy of a measurement system.

3.1.4.1 *Discussion*—In the context of this test method, check standard refers to the calibration reference material.

3.1.5 *quality control (QC) sample, n*—for use in quality assurance programs to determine and monitor the precision and stability of a measurement system, a stable and homogeneous material having physical or chemical properties, or both, similar to those of typical samples tested by the analytical measurement system. The material is properly stored to ensure sample integrity, and is available in sufficient quantity for repeated, long term testing. **D6299**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *calibration reference material, n*—a pure chemical or a specified mixture of pure chemicals having an assigned ignition delay accepted reference value and an assigned combustion delay accepted reference value.

3.2.2 *chamber wall temperature, n*—temperature, in °C, of the combustion chamber wall.

3.2.3 *charge air, n*—compressed synthetic air at a specified pressure introduced into the combustion chamber at the beginning of each test cycle.

3.2.4 *combustion analyzer, n*—an integrated compression ignition apparatus to measure the ignition and combustion characteristics of diesel fuel oil.

3.2.5 *combustion delay (CD), n*—that period of time, in milliseconds (ms), between the start of fuel injection and mid-point of the combustion pressure curve.

3.2.5.1 *Discussion*—In the context of this test method, the start of fuel injection is interpreted as the rise in the electronic signal that opens the injector and the combustion pressure curve mid-point is interpreted as the part of the pressure curve midway between the chamber static pressure and the maximum pressure generated during the combustion cycle, as measured by a pressure sensor in the combustion chamber. The combustion delay CD measures the time between the injection of the sample and phase of combustion controlled by the diffusive mixing of the air and fuel.

3.2.6 *derived cetane number (DCN), n*—a number calculated using a conversion equation to determine a cetane number.

3.2.6.1 *Discussion*—The conversion equation relates a measured ignition delay or ignition delay and combustion delay from a combustion analyzer, to a cetane number.

3.2.7 *ignition delay (ID), n*—that period of time, in milliseconds (ms), between the start of fuel injection and the start of combustion as determined using the specific combustion analyzer applicable for this test method.

3.2.7.1 *Discussion*—In the context of this test method, start of fuel injection is interpreted as the rise in the electronic signal that opens the injector; combustion is interpreted as the part of the pressure curve generated during the combustion cycle when significant (+0.02 MPa above the chamber static pressure) and sustained increase in rate-of-change in pressure, as measured by a pressure sensor in the combustion chamber.

3.2.8 *injection period, n*—the period of time, in microseconds (µs), that the fuel injector nozzle is open as determined by the length of the electronic signal, in microseconds, that opens the injector.

3.2.9 *operation period, n*—the time, not to exceed 12 h, between successive calibration or QC testing, or both, of the combustion analyzer by a single operator.

3.3 *Abbreviations:*

3.3.1 *ARV*—accepted reference value

3.3.2 *CD*—combustion delay

3.3.3 *CN*—cetane number

3.3.4 *DCN*—derived cetane number

3.3.5 *ID*—ignition delay

3.3.6 *QC*—quality control

[4] Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., http://www.energyinst.org.uk.

[5] Available from the Canadian General Standards Board, Sales Centre, Gatineau, Canada, K1A1G6. www.ongc-cgsb.ca.

[6] Available from Beuth Verlag GmbH (DIN–DIN Deutsches Institut fur Normung e.V.), Burggrafenstrasse 6, 10787, Berlin, Germany, http://www.en.din.de.