



Designation: D6890 – 22

Standard Test Method for Determination of Ignition Delay and Derived Cetane Number (DCN) of Diesel Fuel Oils by Combustion in a Constant Volume Chamber^{1,2}

This standard is issued under the fixed designation D6890; 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 automated laboratory test method covers the quantitative determination of the ignition characteristics of conventional diesel fuel oil, oil-sands based fuels, hydrocarbon oils, blends of fuel containing biodiesel material, diesel fuel oils containing cetane number improver additives, and is applicable to products typical of ASTM Specification [D975](#) grades No. 1-D S15, No. 1-D S500, and No. 1-D S5000, and grades No. 2-D S15, No. 2-D S500, and No. 2-D S5000 diesel fuel oils, European standard EN 590, and Canadian standards CAN/CGSB-3.517 and 3.520. The test method may also be applied to the quantitative determination of the ignition characteristics of diesel fuel blending components.

1.2 This test method measures the ignition delay of a diesel fuel injected directly into a constant volume combustion chamber containing heated, compressed air. An equation correlates an ignition delay determination to cetane number by Test Method [D613](#), resulting in a derived cetane number (DCN).

1.3 This test method covers the ignition delay range from 2.64 ms to 6.90 ms (75.1 DCN to 31.5 DCN). The combustion analyzer can measure shorter and longer ignition delays, but precision may be affected. For these shorter or longer ignition delays the correlation equation for DCN is given in [Appendix X2](#).

1.4 For purposes of determining conformance with the parameters of this test method, an observed value or a calculated value shall be rounded “to the nearest unit” in the last right-hand digit used in expressing the parameter, in accordance with the rounding method of Practice [E29](#).

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

1.6 *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:³

- [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

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.

Current edition approved Nov. 15, 2022. Published December 2022. Originally approved in 2003. Last previous edition approved in 2021 as D6890 – 21. DOI: 10.1520/D6890-22.

² This test method is based on IP PM CQ/2001, published in the IP Standard Methods for Analysis and Testing of Petroleum and Related Products and British Standard 2000 Parts. Copyrighted by Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK. Adapted with permission of Energy Institute.

³ 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

Purport to Measure the Same Property of a Material
E29 Practice for Using Significant Digits in Test Data to
 Determine Conformance with Specifications
E456 Terminology Relating to Quality and Statistics

2.2 *ISO Standards*:⁴

ISO 4010 Diesel Engines—Calibrating Nozzle, Delay Pintle
 Type

ISO 4259 Petroleum products—Determination and applica-
 tion of precision data in relation to methods of test

2.3 *EN Standard*:

EN 590 Automotive Fuels—Diesel—Requirements and Test
 Methods⁵

2.4 *Energy Institute Standard*:

IP 41 Ignition Quality of Diesel Fuels—Cetane Engine Test
 Method⁶

2.5 *Canadian Standards*:⁷

CAN/CGSB-3.517 Diesel Fuel

CAN/CGSB 3.520 Diesel Fuel Containing Low Levels of
 Biodiesel (B1–B5)

3. Terminology

3.1 Definitions:

3.1.1 *accepted reference value (ARV)*, *n*—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**

3.1.1.1 *Discussion*—In the context of this test method,
 accepted reference value is understood to apply to the ignition
 delay of specific reference materials determined under repro-
 ducibility conditions by collaborative experimental work.

3.1.2 *biodiesel*, *n*—fuel comprised of mono-alkyl esters of
 long chain fatty acids derived from vegetable oils or animal
 fats, designated B100.

3.1.3 *biodiesel blend (BXX)*, *n*—a homogeneous mixture of
 hydrocarbon oils and mono alkyl esters of long chain fatty
 acids.

3.1.3.1 *Discussion*—In the abbreviation, BXX, the XX rep-
 resents the volume percentage of biodiesel fuel in the blend.

3.1.4 *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**

3.1.4.1 *Discussion*—In the context of this test method,
 cetane number is that defined by Test Method **D613**/IP 41.

3.1.5 *check standard*, *n*—in *QC* testing, material having an
 accepted reference value used to determine the accuracy of a
 measurement system. **D6299**

3.1.5.1 *Discussion*—In the context of this test method,
 check standard refers to heptane.

3.1.6 *hydrocarbon oil*, *n*—a homogeneous mixture with
 elemental composition primarily of carbon and hydrogen that
 may also contain sulfur, oxygen, or nitrogen from residual
 impurities and contaminants associated with the fuel's raw
 materials and manufacturing processes and excluding added
 oxygenated materials.

3.1.6.1 *Discussion*—Neither macro nor micro emulsions are
 included in this definition since neither are homogeneous
 mixtures.

3.1.6.2 *Discussion*—Examples of excluded oxygenated ma-
 terials are alcohols, esters, ethers, and triglycerides.

3.1.6.3 *Discussion*—The hydrocarbon oil may be manufac-
 tured from a variety of raw materials, for example petroleum
 (crude oil), oil sands, natural gas, coal, and biomass.

3.1.7 *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*—pure chemical hav-
 ing an assigned ignition delay accepted reference value.

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

3.2.3 *charge air temperature*, *n*—temperature, in °C, of the
 air inside the combustion chamber.

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

3.2.5 *derived cetane number (DCN)*, *n*—a number calcu-
 lated using a conversion equation to determine a cetane
 number.

3.2.5.1 *Discussion*—The conversion equation relates a mea-
 sured ignition delay or ignition delay and combustion delay
 from a combustion analyzer to a cetane number.

3.2.6 *ignition delay (ID)*, *n*—that period of time, in milli-
 seconds (ms), between the start of fuel injection and the start of
 combustion as determined using the specific combustion ana-
 lyzer applicable for this test method.

3.2.6.1 *Discussion*—In the context of this test method, start
 of fuel injection is interpreted as the initial movement or lift of
 the injector nozzle needle as measured by a motion sensor; start
 of combustion is interpreted as that point in the combustion
 cycle when a significant and sustained increase in rate-of-
 change in pressure, as measured by a pressure sensor in the
 combustion chamber, ensures combustion is in progress.

⁴ Available from American National Standards Institute, 25 W. 43rd St., 4th floor,
 New York, NY 10036.

⁵ Available from European Committee for Standardization. Central Secretariat:
 rue de Stassart, 36, B-1050 Brussels, Belgium.

⁶ Available from Institute of Petroleum, 61 New Cavendish St., London, W1G
 7AR, U.K.

⁷ Available from Canadian General Standards Board (CGSB), 11 Laurier St.,
 Phase III, Place du Portage, Gatineau, Quebec K1A 0S5, Canada, <http://www.tpsgc-pwgsc.gc.ca/ongc-cgsb>.