Designation: D2885 – 13

Standard Test Method for Determination of Octane Number of Spark-Ignition Engine Fuels by On-Line Direct Comparison Technique[1]

This standard is issued under the fixed designation D2885; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the quantitative online determination by direct comparison of the difference in knock rating or delta octane number of a stream sample of spark-ignition engine fuel from that of a comparison reference fuel.

1.2 This test method covers the methodology for obtaining an octane number using the measured delta octane number and the octane number of the comparison reference fuel.

1.3 The comparison reference fuel is required to be of essentially the same composition as the stream sample to be analyzed and can be a secondary fuel termed standard fuel or a tertiary fuel termed prototype fuel.

1.4 The test method utilizes a knock testing unit/automated analyzer system that incorporates computer control of a standardized single-cylinder, four-stroke cycle, variable compression ratio, carbureted, CFR engine with appropriate auxiliary equipment using either Test Method D2699 Research method or Test Method D2700 Motor method operating conditions.

1.4.1 Knock measurements are based on operation of both fuels at the specific fuel-air ratio that produces maximum knock intensity for that fuel.

1.4.2 Measured differences in knock intensity are scaled to provide a positive or negative delta octane number of the stream sample from the comparison reference fuel when the fuels are compared at the same compression ratio.

1.4.3 Measured differences in compression ratio are scaled to provide a positive or negative delta octane number of the stream sample from the comparison reference fuel when the fuels are compared at the same knock intensity.

1.5 This test method is limited to testing 78 to 102 octane number spark-ignition engine fuels using either research or motor method conditions.

1.6 The octane number difference between the stream sample and the applicable comparison reference fuel is self-limiting by specifications imposed upon the standard and prototype fuels.

1.7 Specifications for selection, preparation, storage, and dispensing of standard and prototype fuels are provided. Detailed procedures for determination of an appropriate assigned octane number for both standard and prototype fuels are also incorporated.

1.8 The values of operating conditions are stated in SI units and are considered standard. The values in parentheses are historical inch-pound units. The standardized CFR engine measurements continue to be expressed in inch-pound units only because of the extensive and expensive tooling that has been created for this equipment.

1.9 *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 more specific warning statements, see Section 8 and Annex A1.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1193 Specification for Reagent Water

D2699 Test Method for Research Octane Number of Spark-Ignition Engine Fuel

D2700 Test Method for Motor Octane Number of Spark-Ignition Engine Fuel

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products 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.

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

D4814 Specification for Automotive Spark-Ignition Engine Fuel
D6299 Practice for Applying Statistical Quality Assurance and Control Charting Techniques to Evaluate Analytical Measurement System Performance
D5842 Practice for Sampling and Handling of Fuels for Volatility Measurement
D6300 Practice for Determination of Precision and Bias Data for Use in Test Methods for Petroleum Products and Lubricants
D6624 Practice for Determining a Flow-Proportioned Average Property Value (FPAPV) for a Collected Batch of Process Stream Material Using Stream Analyzer Data
D7453 Practice for Sampling of Petroleum Products for Analysis by Process Stream Analyzers and for Process Stream Analyzer System Validation
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
E456 Terminology Relating to Quality and Statistics

2.2 *Waukesha CFR Engine Manuals:*
CFR F-1 & F-2 Octane Rating Units Operation & Maintenance FORM 847[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *accepted reference value, n*—a value that serves as an agreed-upon reference for comparison, and which 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, or (*3*) a consensus value, based on collaborative experimental work under the auspices of a scientific or engineering group. **E456/E177**

3.1.1.1 *Discussion*—In the context of this test method, accepted reference value is understood to apply to standard fuel or check fuel average research or motor octane numbers determined under reproducibility conditions by a recognized exchange testing organization having a minimum of 16 participants.

3.1.2 *analytical measurement system, n*—a collection of one or more components or subsystems, such as a sampler, test equipment, instrumentation, display devices, data handler, and printout or output transmitters that is used to determine a quantitative value of a specific property for an unknown sample. **D6299**

3.1.2.1 *Discussion*—In the context of this test method, the analytical measurement system is comprised of the knock testing unit, automated analyzer system, and any auxiliary equipment required for the safe operation of the engine.

3.1.3 *cylinder height, n—for the CFR engine*, the relative vertical position of the engine cylinder with respect to the piston at top dead center (TDC) or the top machine surface of the crankcase. **D2699/D2700**

3.1.4 *determinability, n*—quantitative measure of the variability associated with the same operator in a given laboratory obtaining successive determined values using the same apparatus for a series of operations leading to a single result; it is defined as that difference between two such single determined values as would be exceeded in the long run in only one case in 20 in the normal and correct operation of the test method. **D6300**

3.1.5 *detonation meter, n—for knock testing*, the signal conditioning instrument that accepts the electrical signal from the detonation pickup and provides an output signal for display. **D2699/D2700**

3.1.6 *detonation pickup, n—for knock testing*, magnetostrictive type transducer that threads into the engine cylinder and is exposed to combustion chamber pressure to provide an electrical signal that is proportional to the rate-of-change of cylinder pressure. **D2699/D2700**

3.1.7 *digital counter reading, n—for the CFR engine*, a numerical indication of cylinder height, indexed to a basic setting at a prescribed compression pressure when the engine is motored. **D2699/D2700**

3.1.8 *fuel-air ratio for maximum knock intensity, n—for knock testing*, that proportion of fuel to air which produces the highest knock intensity for each fuel in the knock testing unit, provided this occurs within the specified carburetor fuel level limits. **D2699/D2700**

3.1.8.1 *Discussion*—In the context of this test method, the fuel-air ratio for maximum knock intensity can be determined manually or by the automated analyzer system.

3.1.8.1 *dynamic fuel-air ratio for maximum knock, n—for knock testing*, the changing of the mixture of fuel and air for engine combustion determined by continually varying fuel level in the carburetor delivery components, through the maximum knock intensity so that the observed peak knock intensity value can be selected as maximum knock intensity reading.

3.1.8.2 *equilibrium fuel-air ratio for maximum knock, n—for knock testing*, the changing of the mixture of fuel and air for engine combustion determined by making incremental step changes in fuel-air ratio, observing the equilibrium knock intensity for each step and selecting the fuel-air ratio which produces the highest knock meter reading.

3.1.9 *guide tables, n— for knock testing*, the specific relationship between cylinder height (compression ratio) and octane number at standard knock intensity. **D2699/D2700**

3.1.10 *knock, n—in a spark-ignition engine*, abnormal combustion, often producing audible sound, caused by autoignition of the air/fuel mixture. **D4175**

3.1.11 *knock intensity, n—for knock testing*, a measure of the level of knock. **D2699/D2700**

3.1.12 *knockmeter, n—for knock testing*, the 0 to 100 division indicating meter that displays the knock intensity signal from the detonation meter. **D2699/D2700**

[3] The sole source of supply of the apparatus known to the committee at this time is Waukesha Engine Division, Dresser Equipment Group, Inc., 1000 W. St. Paul Avenue, Waukesha, WI 53188. Waukesha Engine Division also has CFR engine authorized sales and service organizations in selected geographical areas. 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.