



Designation: D 976 – 04b

An American National Standard

Standard Test Method for Calculated Cetane Index of Distillate Fuels¹

This standard is issued under the fixed designation D 976; 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 Department of Defense.

1. Scope*

1.1 This test method covers the Calculated Cetane Index formula, which represents a means for directly *estimating* the ASTM cetane number of distillate fuels from API gravity and mid-boiling point. The index value, as computed from the formula, is termed the Calculated Cetane Index.²

1.2 The Calculated Cetane Index is not an optional method for expressing ASTM cetane number. It is a supplementary tool for predicting cetane number when used with due regard for its limitations.

1.3 The Calculated Cetane Index formula is particularly applicable to straight-run fuels, catalytically cracked stocks, and blends of the two.

NOTE 1—This test method is temporarily retained because the proposal to the U.S. EPA to control diesel fuel aromatics concentrations via a 40 Calculated Cetane Index minimum is based on the correlation between Test Method D 976 and aromatics concentration. Test Method D 4737 is the preferred method as estimator of cetane number.

1.4 *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.*

2. Referenced Documents

2.1 ASTM Standards:³

D 86 Test Method for Distillation of Petroleum Products at

Atmospheric Pressure

D 287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)

D 613 Test Method for Cetane Number of Diesel Fuel Oil

D 1298 Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

D 2887 Test Method for Boiling Range Distribution Distribution of Petroleum Fractions by Gas Chromatography

D 4052 Test Method for Density and Relative Density of Liquids by Digital Density Meter

D 4737 Test Method for Calculated Cetane Index by Four Variable Equation

2.2 ASTM Adjuncts:⁴

ADJ0976 Nomograph for Calculated Cetane Index

3. Significance and Use

3.1 The Calculated Cetane Index is a useful tool for estimating ASTM cetane number where a test engine is not available for determining this property. It may be conveniently employed for approximating cetane number where the quantity of sample is too small for an engine rating. In cases where the cetane number of a fuel has been initially established, the index is useful as a cetane number check on subsequent samples of that fuel, provided its source and mode of manufacture remain unchanged.

4. Equation for Calculated Cetane Index

4.1 The Calculated Cetane Index is determined from the following equation:

$$\begin{aligned} \text{Calculated cetane index} = & -420.34 + 0.016 G^2 + 0.192 G \log M \\ & + 65.01 (\log M)^2 - 0.0001809 M^2 \end{aligned} \quad (1)$$

or

$$\begin{aligned} \text{Calculated cetane index} = & 454.74 - 1641.416 D + 774.74 D^2 \\ & - 0.554 B + 97.803 (\log B)^2 \end{aligned} \quad (2)$$

where:

⁴ Available from ASTM International Headquarters. Order Adjunct No. ADJD0976.

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.E0 on Burner, Diesel, Non-Aviation Gas Turbine, and Marine Fuels.

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² A method of calculating cetane index was developed by the Diesel Fuels Division, Coordinating Fuel and Equipment Research Committee of the Coordinating Research Council. See Young, H. D., "Methods for Estimating Cetane Number," *Proceedings, PPIRA, American Petroleum Institute*, Vol. 30 M [III], 1950. This method was revised in 1960 by Research Division I of Committee D02 to conform to the revised Test Method D 613.

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.

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- G = API gravity, determined by Test Method **D 287**, **D 1298**, or **D 4052**,
 M = mid-boiling temperature, °F, determined by Test Method **D 86** and corrected to standard barometric pressure,
 D = density at 15°C, g/mL, determined by Test Method **D 1298** or **D 4052**, and
 B = mid-boiling temperature, °C, determined by Test Method **D 86** and corrected to standard barometric pressure.

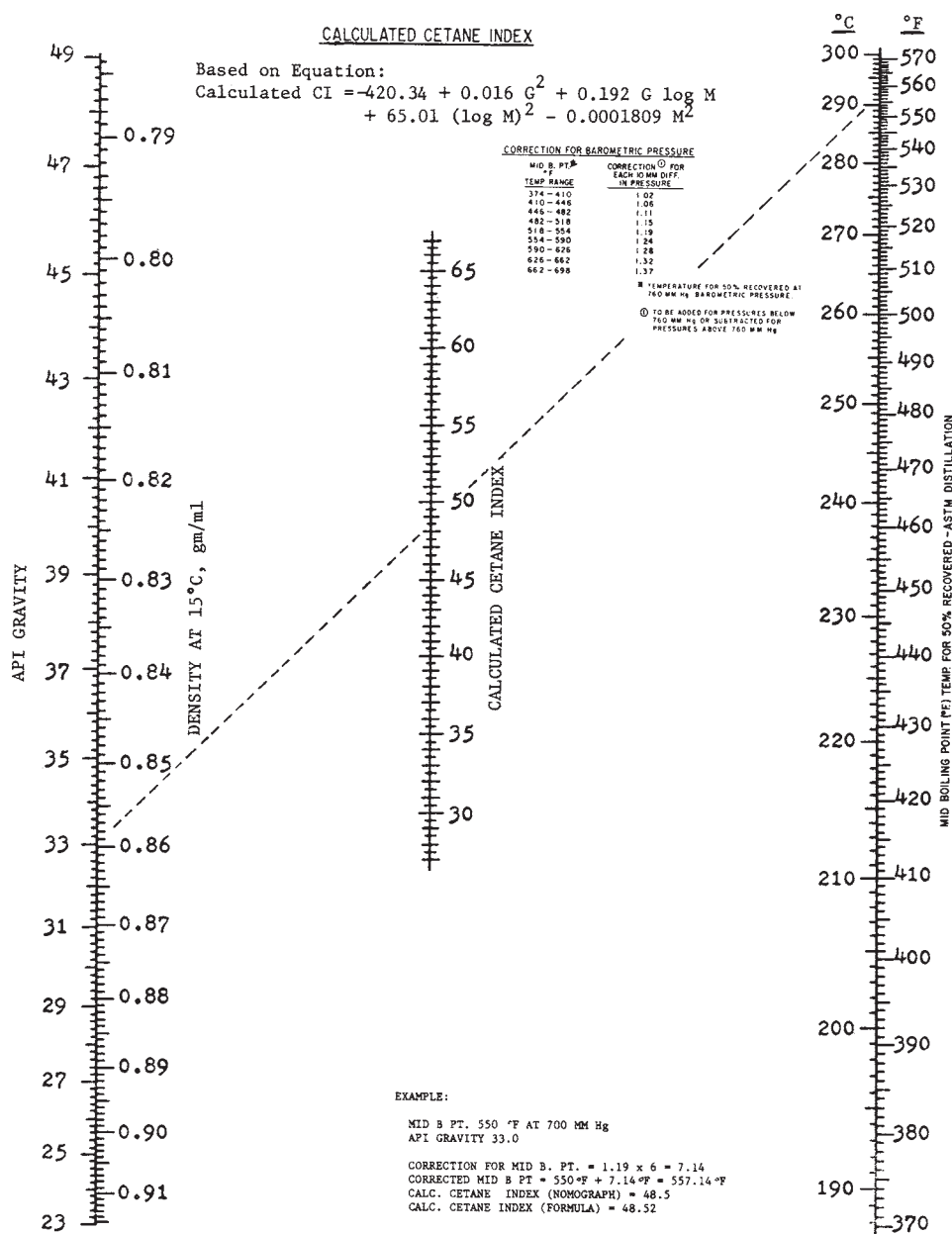
4.2 Calculated Cetane Index values for distillate fuels may be conveniently determined by means of the alignment chart in **Fig. 1** rather than by direct application of the equation. Use of

the chart is illustrated by the example shown on the chart.

4.3 Test Method **D 2887** may be used as an alternative to Test Method **D 86** to determine the mid-boiling temperature of the fuel.

4.3.1 If Test Method **D 2887** is used, convert the data to estimated Test Method **D 86** data following Appendix X5, Correlation of Jet and Diesel Fuel of test Method **D 2887** and use the data from Test Method **D 86** in place of the actual Test Method **D 86** data in the calculations.

NOTE 2—Current U.S. EPA regulations for low sulfur (500 ppm maximum) No. 1-D and No. 2-D diesel fuel require the use of Test Method **D 967 – 80** to calculate Cetane Index.



NOTE—The Calculated Cetane Index equation represents a useful tool for *estimating* cetane number. Due to inherent limitations in the equation's application, Index values may not be a valid substitute for ASTM cetane numbers as determined in a test engine.

FIG. 1 Nomograph for Calculated Cetane Index (ECS-1 Meter Basis—Test Method **D 613**)