



Designation: D8074 – 22

# Standard Test Method for Evaluation of Diesel Engine Oils in DD13 Diesel Engine<sup>1</sup>

This standard is issued under the fixed designation D8074; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

Portions of this test method are written for use by laboratories that make use of ASTM Test Monitoring Center (TMC)<sup>2</sup> services (see [Annex A1](#)).

The TMC provides reference oils, and engineering and statistical services to laboratories that desire to produce test results that are statistically similar to those produced by laboratories previously calibrated by the TMC.

In general, the Test Purchaser decides if a calibrated test stand is to be used. Organizations such as the American Chemistry Council require that a laboratory utilize the TMC services as part of their test registration process. In addition, the American Petroleum Institute and the Gear Lubricant Review Committee of the Lubricant Review Institute (SAE International) require that a laboratory use the TMC services in seeking qualification of oils against their specifications.

The advantage of using the TMC services to calibrate test stands is that the test laboratory (and hence the Test Purchaser) has an assurance that the test stand was operating at the proper level of test severity. It should also be borne in mind that results obtained in a non-calibrated test stand may not be the same as those obtained in a test stand participating in the ASTM TMC services process.

Laboratories that choose not to use the TMC services may simply disregard these portions.

## 1. Scope\*

1.1 This test method covers an engine test procedure for evaluating diesel engine oils for performance characteristics, including adhesive wear between an uncoated piston ring and cylinder liner. This test method is commonly referred to as the DD13 Scuffing Test.

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

1.2.1 *Exception*—Where there is no direct SI equivalent, such as the units for screw threads, National Pipe Threads/diameters, tubing size, and single source supply equipment specifications.

1.3 *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. See [Annex A2](#) for specific safety precautions.*

1.4 *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:<sup>3</sup>

D86 Test Method for Distillation of Petroleum Products and Liquid Fuels at Atmospheric Pressure

D93 Test Methods for Flash Point by Pensky-Martens Closed Cup Tester

D97 Test Method for Pour Point of Petroleum Products

D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

D235 Specification for Mineral Spirits (Petroleum Spirits)

<sup>1</sup> 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.B0 on Automotive Lubricants.

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<sup>2</sup> Until the next revision of this test method, the ASTM Test Monitoring Center will update changes in the test method by means of information letters. Information letters may be obtained from the ASTM Test Monitoring Center, 203 Armstrong Drive, Freeport, PA 16229, [www.astmtmc.org](http://www.astmtmc.org). Attention: Director. This edition incorporates revisions in all information Letters through No. 19-1.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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

(Hydrocarbon Dry Cleaning Solvent)

**D287** Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)

**D445** Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

**D482** Test Method for Ash from Petroleum Products

**D524** Test Method for Ramsbottom Carbon Residue of Petroleum Products

**D613** Test Method for Cetane Number of Diesel Fuel Oil

**D664** Test Method for Acid Number of Petroleum Products by Potentiometric Titration

**D975** Specification for Diesel Fuel

**D976** Test Method for Calculated Cetane Index of Distillate Fuels

**D1319** Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption

**D2274** Test Method for Oxidation Stability of Distillate Fuel Oil (Accelerated Method)

**D2500** Test Method for Cloud Point of Petroleum Products and Liquid Fuels

**D2622** Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry

**D2709** Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge

**D3338** Test Method for Estimation of Net Heat of Combustion of Aviation Fuels

**D3524** Test Method for Diesel Fuel Diluent in Used Diesel Engine Oils by Gas Chromatography

**D4052** Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter

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

**D4294** Test Method for Sulfur in Petroleum and Petroleum Products by Energy Dispersive X-ray Fluorescence Spectrometry

**D4683** Test Method for Measuring Viscosity of New and Used Engine Oils at High Shear Rate and High Temperature by Tapered Bearing Simulator Viscometer at 150 °C

**D4739** Test Method for Base Number Determination by Potentiometric Hydrochloric Acid Titration

**D5185** Test Method for Multielement Determination of Used and Unused Lubricating Oils and Base Oils by Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES)

**D5186** Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels By Supercritical Fluid Chromatography

**D5453** Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence

**D5967** Test Method for Evaluation of Diesel Engine Oils in T-8 Diesel Engine

**D6078** Test Method for Evaluating Lubricity of Diesel Fuels by the Scuffing Load Ball-on-Cylinder Lubricity Evaluator (SLBOCLE) (Withdrawn 2021)<sup>4</sup>

**D6984** Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIF, Spark-Ignition Engine

**D7320** Test Method for Evaluation of Automotive Engine Oils in the Sequence IIIG, Spark-Ignition Engine

**E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

**E168** Practices for General Techniques of Infrared Quantitative Analysis

2.2 *Other Standards:*

Code of Federal Regulations Title 40 Part 86.310-79<sup>5,6</sup>

2.3 *Other ASTM Document:*

ASTM Deposit Rating Manual 20 Formerly CRC Manual 20<sup>7</sup>

### 3. Terminology

3.1 *Definitions:*

3.1.1 *adhesive wear (scuffing), n*—wear due to localized bonding between contacting solid surfaces leading to material transfer between the two surfaces or loss from either surface. **D4175**

3.1.2 *blind reference oil, n*—a reference oil, the identity of which is unknown by the test facility.

3.1.2.1 *Discussion*—This is a coded reference oil that is submitted by a source independent from the test facility. **D4175**

3.1.3 *blowby, n*—in internal combustion engines, that portion of the combustion products and unburned air/fuel mixture that leaks past piston rings into the engine crankcase during operation. **D4175**

3.1.4 *break-in, v*—in internal combustion engines, the running of a new engine under prescribed conditions to help stabilize engine response and help remove initial friction characteristics associated with new engine parts. **D4175**

3.1.5 *calibrate, v*—to determine the indication or output of a measuring device with respect to that of a standard. **D4175**

3.1.6 *calibrated test stand, n*—a test stand on which the testing of reference material(s), conducted as specified in the standard, provided acceptable test results.

3.1.6.1 *Discussion*—In several automotive lubricant standard test methods, the ASTM Test Monitoring Center provides testing guidance and determines acceptability. **D4175**

3.1.7 *calibration test, n*—an engine test conducted on a reference oil under carefully prescribed conditions, the results

<sup>4</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>5</sup> Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

<sup>6</sup> <https://www.gpo.gov/fdsys/granule/CFR-2013-title40-vol19/CFR-2013-title40-vol19-sec86-310-79>.

<sup>7</sup> For stock #TMCML20, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org).

of which are used to determine the suitability of the engine stand/laboratory for such tests on non-reference oils.

3.1.7.1 *Discussion*—A calibration test also includes tests conducted on parts to ensure their suitability for use in reference and non-reference tests. **D4175**

3.1.8 *candidate oil, n*—an oil that is intended to have the performance characteristics necessary to satisfy a specification and is intended to be tested against that specification. **D4175**

3.1.9 *engine oil, n*—a liquid that reduces friction or wear, or both, between the moving parts within an engine; removes heat particularly from the underside of pistons; and serves as combustion gas sealant for the piston rings.

3.1.9.1 *Discussion*—It may contain additives to enhance certain properties. Inhibition of engine rusting, deposit formation, valve train wear, oil oxidation, and foaming are examples. **D4175**

3.1.10 *exhaust gas recirculation (EGR), n*—the mixing of exhaust gas with intake air to reduce the formation of nitrogen oxides (NO<sub>x</sub>). **D4175**

3.1.11 *heavy-duty, adj—in internal combustion engine operation*, characterized by average speeds, power output and internal temperatures that are close to the potential maximums. **D4175**

3.1.12 *heavy-duty engine, n—in internal combustion engine types*, one that is designed to allow operation continuously at or close to its peak output.

3.1.13 *lubricant test monitoring system (LTMS), n*—an analytical system in which ASTM calibration test data are used to manage lubricant test precision and severity (bias). **D4175**

3.1.13.1 *LTMS date, n*—the date the test was completed unless a different date is assigned by the TMC. **D6984/D7320**

3.1.13.2 *LTMS time, n*—the time the test was completed unless a different time is assigned by the TMC. **D6984/D7320**

3.1.14 *lubricant, n*—any material interposed between two surfaces that reduces the friction or wear, or both, between them. **D4175**

3.1.15 *mass fraction of B, w<sub>B</sub>, n*—mass of a component B in a mixture divided by the total mass of all the constituents of the mixture.

3.1.15.1 *Discussion*—Values are expressed as pure numbers or the ratio of two units of mass (for example, mass fraction of lead is  $w_B = 1.3 \times 10^{-6} = 1.3 \text{ mg/kg}$ ). **D4175**

3.1.16 *non-reference oil, n*—any oil other than a reference oil; such as a research formulation, commercial oil or candidate oil. **D4175**

3.1.17 *non-standard test, n*—a test that is not conducted in conformance with the requirements in the standard test method; such as running on an uncalibrated test stand, using different test equipment, applying different equipment assembly procedures, or using modified operating conditions. **D4175**

3.1.18 *oxidation, n—of engine oil*, the reaction of the oil with an electron acceptor, generally oxygen, that can produce deleterious acidic or resinous materials often manifested as sludge formation, varnish formation, viscosity increase, or corrosion, or combination thereof. **D4175**

3.1.19 *quality index (QI), n*—a mathematical formula that uses data from controlled parameters to calculate a value indicative of control performance. **D4175**

3.1.20 *quantity, n—in the SI*, a measurable property of a body or substance where the property has a magnitude expressed as the product of a number and a unit; there are seven, well-defined base quantities (length, time, mass, temperature, amount of substance, electric current and luminous intensity) from which all other quantities are derived (for example, volume whose SI unit is the cubic metre).

3.1.20.1 *Discussion*—Symbols for quantities must be carefully defined; are written in italic font, can be upper or lower case, and can be qualified by adding further information in subscripts, or superscripts, or in parentheses (for example,  $t_{fuel} = 40 \text{ }^\circ\text{C}$ , where  $t$  is used as the symbol for the quantity Celsius temperature and  $t_{fuel}$  is the symbol for the specific quantity fuel temperature). **D4175**

3.1.21 *reference oil, n*—an oil of known performance characteristics, used as a basis for comparison.

3.1.21.1 *Discussion*—Reference oils are used to calibrate testing facilities, to compare the performance of other oils, or to evaluate other materials (such as seals) that interact with oils. **D4175**

3.1.22 *sludge, n—in internal combustion engines*, a deposit, principally composed of insoluble resins and oxidation products from fuel combustion and the lubricant, that does not drain from engine parts but can be removed by wiping with a cloth. **D4175**

3.1.23 *standard test, n*—a test on a calibrated test stand, using the prescribed equipment in accordance with the requirements in the test method, and conducted in accordance with the specified operating conditions.

3.1.24 *test oil, n*—any oil subjected to evaluation in an established procedure.

3.1.24.1 *Discussion*—It can be any oil selected by the laboratory conducting the test. It could be an experimental product or a commercially available oil. Often it is an oil that is a candidate for approval against engine oil specifications (such as manufacturers' or military specifications, and so forth). **D4175**

3.1.25 *test parameter, n*—a specified component, property, or condition of a test procedure.

3.1.25.1 *Discussion*—Examples of components are fuel, lubricant, reagent, cleaner, and sealer; of properties are density, temperature, humidity, pressure, and viscosity; and of conditions are flow rate, time, speed, volume, length, and power. **D4175**

3.1.26 *volume fraction of B, φ<sub>B</sub>, n*—volume of component B divided by the total volume of the all the constituents of the mixture prior to mixing.

3.1.26.1 *Discussion*—Values are expressed as pure numbers or the ratio of two units of volume (for example,  $\phi_B = 0.012 = 1.2 \% = 1.2 \text{ cL/L}$ ). **D4175**

3.1.27 *varnish, n—in internal combustion engines*, a hard, dry, generally lustrous deposit that can be removed by solvents but not by wiping with a cloth. **D4175**