



Designation: D7156 – 24

Standard Test Method for Evaluation of Diesel Engine Oils in the T-11 Exhaust Gas Recirculation Diesel Engine¹

This standard is issued under the fixed designation D7156; 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 an engine test procedure for evaluating diesel engine oils for performance characteristics in a diesel engine equipped with exhaust gas recirculation, including viscosity increase and soot concentrations (loading).² This test method is commonly referred to as the Mack T-11.

1.1.1 This test method also provides the procedure for running an abbreviated length test, which is commonly referred to as the T-11A. The procedures for the T-11A are identical to the T-11 with the exception of the items specifically listed in **Annex A7**. Additionally, the procedure modifications listed in **Annex A7** refer to the corresponding section of the T-11 procedure.

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 *Exceptions*—Where there is no direct SI equivalent such as screw threads, National Pipe Threads/diameters, tubing size, or where there is a sole source supply equipment specification.

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 A6** for specific safety hazards.

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.*

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.B0 on Automotive Lubricants.

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² Until the next revision of this test method, the ASTM Test Monitoring Center will update changes in this test method by means of Information Letters. Information Letters may be obtained from the ASTM Test Monitoring Center, 203 Armstrong Drive, Freeport, PA 16229, Attention: Director, www.astmtmc.org. This edition incorporates revisions in all Information Letters through No. 23-1.

2. Referenced Documents

2.1 ASTM Standards:³

- 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) (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
- 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
- D3524 Test Method for Diesel Fuel Diluent in Used Diesel Engine Oils by Gas Chromatography
- D4052 Test Method for Density, Relative Density, and API

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

- 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
- D4485** Specification for Performance of Active API Service Category Engine Oils
- D4737** Test Method for Calculated Cetane Index by Four Variable Equation
- 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)
- 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
- D6278** Test Method for Shear Stability of Polymer Containing Fluids Using a European Diesel Injector Apparatus
- D6896** Test Method for Determination of Yield Stress and Apparent Viscosity of Used Engine Oils at Low Temperature
- D7109** Test Method for Shear Stability of Polymer-Containing Fluids Using a European Diesel Injector Apparatus at 30 Cycles and 90 Cycles
- D7422** Test Method for Evaluation of Diesel Engine Oils in T-12 Exhaust Gas Recirculation Diesel Engine
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

3.1 Definitions:

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

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

3.1.2 *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.

3.1.3 *calibrate*, *v*—to determine the indication or output of a device (for example, thermometer, manometer, engine) with respect to that of a standard.

3.1.4 *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**

3.1.5 *exhaust gas recirculation (EGR)*, *n*—the mixing of exhaust gas with intake air to reduce the formation of nitrogen oxides (NO_x).

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3.1.6 *heavy-duty*, *adj*—in internal combustion engine operation, characterized by average speeds, power output and internal temperatures that are close to the potential maximums. **D4485**

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

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

3.1.9 *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**

3.1.10 *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.

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

3.1.11.1 *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**

3.1.12 *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**

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

3.1.14 *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**

3.1.15 *wear*, *n*—the loss of material from a surface, generally occurring between two surfaces in relative motion, and resulting from mechanical or chemical action, or a combination of both. **D7422**

4. Summary of Test Method

4.1 The test operation involves use of a Mack E-TECH V-MAC III diesel engine with Exhaust Gas Recirculation (EGR). Two oil flushes, each for 30 min, are followed by a test at constant speed and torque conditions for 252 h.

4.2 Take oil samples periodically and analyze for viscosity increase and soot content.

4.3 Engine rebuilds may be necessary as indicated by degradation of test parameters and are left to the discretion of the test laboratory. At rebuild, the power section of the engine is disassembled, solvent-cleaned, and rebuilt, using all new

⁴ Available from Robert Bosch GmbH, Postfach 50, D-7000 Stuttgart 1, Germany.