Designation: D7468 – 16

# Standard Test Method for Cummins ISM Test[1]

This standard is issued under the fixed designation D7468; 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 The test method covers a heavy-duty diesel engine test procedure conducted under high soot conditions to evaluate oil performance with regard to valve train wear, top ring wear, sludge deposits, and oil filter plugging in an EGR environment. This test method is commonly referred to as the Cummins ISM Test.[2]

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*—The only exception is where there is no direct SI equivalent such as screw threads, national pipe threads/diameters, tubing sizes, or where there is a sole source of 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 and health practices and determine the applicability of regulatory limitations prior to use.* See Annex A1 for general safety precautions.

1.4 *Table of Contents:*



[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, 6555 Penn Avenue, Pittsburgh, PA 15206-4489, Attention: Administrator. This edition incorporates revisions in all information letters through No. 16–2.

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

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## 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

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

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

[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.

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
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E178 Practice for Dealing With Outlying Observations

2.2 *Other ASTM Document:*
ASTM Deposit Rating Manual 20 (Formerly CRC Manual 20)[4]

2.3 *National Archives and Records Administration:*
Code of Federal Regulations Title 40 Part 86.310-79[5]

## 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. **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 (e.g., thermometer, manometer, engine) with respect to that of a standard.

3.1.4 *exhaust gas recirculation (EGR), n*—a method by which a portion of the engine exhaust is returned to the combustion chambers through the intake system.

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

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

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

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

3.1.9 *reference oil, n*—an oil of known performance characteristics, used as a basis for comparison. **D4485**

3.1.10 *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**

3.1.11 *test oil, n*—any oil subjected to evaluation in an established procedure. **D5967**

3.1.12 *valve train, n—in internal combustion engines*, the series of components, such as valves, crossheads, rocker arms, push rods, and camshaft, that open and close the intake and exhaust valves.

3.1.13 *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. **D4175**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *crosshead, n*—an overhead component, located between the rocker arm and each intake valve and exhaust valve pair, that transfers rocker arm travel to the opening and closing of each valve pair.

3.2.1.1 *Discussion*—Each cylinder has two crossheads, one for each pair of intake valves and exhaust valves.

3.2.2 *de-rate protocols, n*—protocols in the engine control module that cause the engine to reduce power output when certain operating parameters are exceeded.

3.2.3 *overhead, n—in internal combustion engines*, the components of the valve train located in or above the cylinder head.

3.2.4 *overfuel, v*—to cause the fuel flow to exceed the standard production setting.

## 4. Summary of Test Method

4.1 This test method uses a Cummins ISM 500 diesel engine with a specially modified engine block. Test operation includes a 25 min warm-up, a 2 h break-in, and 200 h in four 50 h stages. During stages A and C the engine is operated with retarded fuel injection timing and is overfueled to generate excess soot. During stages B and D the engine is operated at conditions to increase valve train wear.

4.2 Prior to each test, the engine is cleaned and assembled with new cylinder liners, pistons, piston rings and overhead valve train components. All aspects of the assembly are specified.

4.3 A forced oil drain, an oil sample and an oil addition, equivalent to an oil consumption of 0.064 g/MJ, is performed at the end of each 25 h period.

4.4 The test stand is equipped with the appropriate instrumentation to control engine speed, fuel flow, and other operating parameters.

4.5 Oil performance is determined by assessing crosshead wear, top ring mass loss, injector adjusting screw mass loss, sludge deposits, and oil filter plugging.

## 5. Significance and Use

5.1 This test method was developed to assess the performance of an engine oil to control engine wear and deposits

[4] For stock #TMCMNL20, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org.

[5] Available from Superintendent of Documents, Attn: New Orders, P.O. Box 371954, Pittsburgh, PA 15250-7954. Charge orders may be telephoned to the Government Printing Office order desk.