Designation: D6750 – 18

Standard Test Methods for Evaluation of Engine Oils in a High-Speed, Single-Cylinder Diesel Engine—1K Procedure (0.4 % Fuel Sulfur) and 1N Procedure (0.04 % Fuel Sulfur)[1]

This standard is issued under the fixed designation D6750; 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.

INTRODUCTION

Portions of this test method are written for use by laboratories that make use of ASTM Test Monitoring Center (TMC)[2] services (see Annex A1 – Annex A4).

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 These test methods cover the performance of engine oils intended for use in certain diesel engines. They are performed in a standardized high-speed, single-cylinder diesel engine by either the 1K (0.4 % mass fuel sulfur) or 1N (0.04 % mass fuel sulfur) procedure.[3] *The only difference in the two test methods is the fuel used.* Piston and ring groove deposit-forming tendency and oil consumption are measured. Also, the piston, the rings, and the liner are examined for distress and the rings for mobility. These test methods are required to evaluate oils intended to satisfy API service categories CF-4 and CH-4 for 1K, and CG-4 for 1N of Specification D4485.

1.2 These test methods, although based on the original Caterpillar 1K/1N procedures,[3] also embody TMC information letters issued before these test methods were first published. These test methods are subject to frequent change. Until the next revision of these test methods, TMC will update changes in these test methods by the issuance of information letters which shall be obtained from TMC (see Annex A1 – Annex A4).

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

1.3.1 *Exception*—Where there is no direct SI equivalent such as screw threads, national pipe threads/diameters, tubing size, or single source equipment specified. Also Brake Specific Fuel Consumption is measured in kilograms per kilowatthour.

1.4 The following is the Table of Contents:

[1] These test methods are under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.B0.02 on Heavy Duty Engine Oils.

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[2] 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, 6555 Penn Ave., Pittsburgh, PA 15206-4489. Attention: Administrator. This edition incorporates revisions in all information Letters through No. 17-1.

[3] These 1K/1N test procedures were developed by Caterpillar Inc., P.O. Box 610, Mossville, IL 61552-0610.

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

1.5 *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.* Specific precautionary statements appear throughout the text. Being engine tests, these test methods do have definite hazards that shall be met by safe practices (see Annex A19 on Safety Precautions).

1.6 *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:*[4]

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

D1298 Test Method for Density, Relative Density, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method

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

D1796 Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)

D2425 Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry

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

D3117 Test Method for Wax Appearance Point of Distillate Fuels (Withdrawn 2010)[5]

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

[4] 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.

[5] The last approved version of this historical standard is referenced on www.astm.org.

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)
D5186 Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels and Aviation Turbine Fuels By Supercritical Fluid Chromatography
D5844 Test Method for Evaluation of Automotive Engine Oils for Inhibition of Rusting (Sequence IID) (Withdrawn 2003)[5]
D5862 Test Method for Evaluation of Engine Oils in Two-Stroke Cycle Turbo-Supercharged 6V92TA Diesel Engine (Withdrawn 2009)[5]
D6202 Test Method for Automotive Engine Oils on the Fuel Economy of Passenger Cars and Light-Duty Trucks in the Sequence VIA Spark Ignition Engine (Withdrawn 2009)[5]
D6594 Test Method for Evaluation of Corrosiveness of Diesel Engine Oil at 135 °C
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
IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System

2.2 *SAE Standard:*
SAE J183 Engine Oil Performance and Engine Service Classification[6]

2.3 *API Standard:*
API 1509 Engine Service Classification and Guide to Crankcase Oil Selection[7]

2.4 *Other ASTM Document:*
ASTM Deposit Rating Manual 20 (Formerly CRC Manual 20)[8]

3. Terminology

3.1 *Definitions:*

3.1.1 *blind reference oil, n*—a reference oil, the indentity 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. **D5844**

3.1.2 *calibration test, n*—an engine test conducted on a reference oil under carefully prescribed conditions, the results of which are used to determine the suitability of the engine stand/laboratory for such tests on non-reference oils.

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

3.1.3 *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.

3.1.3.1 *Discussion*—In several automotive lubricant standard test methods, the TMC provides testing guidance and determines acceptability. **Sub. B Glossary**[2]

3.1.4 *candidate oil, n*—an oil that is intended to have the performance characteristics necessary to satisfy a specification and is to be tested against that specification. **D5844**

3.1.5 *debris, n—in internal combustion engines*, solid contaminant materials unintentionally introduced into the engine or resulting from wear. **D5862**

3.1.6 *double-blind test, n*—a standard test performed on a double-blind reference oil.

3.1.7 *double-blind reference oil, n*—a reference oil, the identity of which is unknown by either the submitting source or the test facility and is not known to be a reference oil by the test facility.

3.1.7.1 *Discussion*—This is a coded reference oil that is supplied by an independent source to a second party, who applies their own coded designation to the oil (and if necessary, repackages it to preserve its anonymity), and submits it to a third party for testing. **Sub. B Glossary**

3.1.8 *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 a combustion gas sealant for piston rings.

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

3.1.9 *erosion, n*—wearing away gradually, especially by rubbing or corroding.

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

3.1.11 *lubricating oil, n*—a liquid lubricant, usually comprising several ingredients, including a major portion of base oil and minor portions of various additives. **Sub. B Glossary**

3.1.12 *non-reference oil, n*—any oil other than a reference oil; such as a research formulation, commercial oil, or candidate oil. **D5844**

3.1.13 *purchaser, n—of an ASTM test*, a person or organization that pays for the conduct of an ASTM test method on a specified product.

3.1.13.1 *Discussion*—The preferred term is *purchaser*. Deprecated terms that have been used are *client*, *requestor*, *sponsor*, and *customer*. **D6202**

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

3.1.14.1 *Discussion*—Reference oils are used to calibrate testing facilities, to compare the performance of other oils, or

[6] Available from the Society of Automotive Engineers Inc., 400 Commonwealth Dr., Warrendale, PA 15096. Order *SAE Handbook*, Vol 3; the standard is not available separately.

[7] Available from the American Petroleum Institute, 1220 L St., NW, Washington, DC 20005.

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