



Designation: **D6681 – 13** **D6681 – 14**

Standard Test Method for Evaluation of Engine Oils in a High Speed, Single-Cylinder Diesel Engine—Caterpillar 1P Test Procedure¹

This standard is issued under the fixed designation D6681; 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

Any properly equipped laboratory without outside assistance can use the test method described in this standard. However, the ASTM Test Monitoring Center (TMC)² provides calibration oils and an assessment of the test results obtained on those oils by the laboratory. By this means the laboratory will know whether their use of the test method gives results statistically similar to those obtained by other laboratories. Furthermore, various agencies require that a laboratory utilize the TMC services in seeking qualification of oils against specifications. For example, the U.S. Army has such a requirement in some of its engine oil specifications. Accordingly, this test method is written for those laboratories that use the TMC services. Laboratories that choose not to use these services should ignore those portions of the test method that refer to the TMC. Information Letters issued periodically by the TMC may modify this method.³ In addition, the TMC may issue supplementary memoranda related to the test method.

1. Scope*

1.1 This test method covers and is required to evaluate the performance of engine oils intended to satisfy certain American Petroleum Institute (API) C service categories (included in Specification **D4485**). It is performed in a laboratory using a standardized high-speed, single-cylinder diesel engine.⁴ Piston and ring groove deposit-forming tendency and oil consumption is measured. The piston, the rings, and the liner are also examined for distress and the rings for mobility.

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 and health practices and determine the applicability of regulatory limitations prior to use.* Being an engine test method, this standard does have definite hazards that require safe practices (see **Appendix X2** on Safety).

1.4 The following is the Table of Contents:

	Section
Scope	1
Referenced Documents	2
Terminology	3
Summary of Test Method	4
Significance and Use	5
Apparatus and Installation	6
Intake Air System	6.2.1
Exhaust System	6.2.2
Fuel System	6.2.3

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.B0.02** on Heavy Duty Engine Oils.

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² ASTM Test Monitoring Center (TMC), 6555 Penn Ave., Pittsburgh, PA 15206-4489.

³ This edition incorporates revisions contained in all information letters through 42-13-1. Users of this test method shall contact the ASTM Test Monitoring Center to obtain the most recent information letters.

⁴ Available from Caterpillar Inc., Engine System Technology Development, P.O. Box 610, Mossville, IL 61552-0610.

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

	Section
Oil Consumption System	6.2.4
Engine Oil System	6.2.5
Oil Heating System	6.2.5.1
Oil Sample Valve	6.2.5.2
Engine Coolant System	6.2.6
Engine Instrumentation	6.2.7
Reagents and Materials	7
Oil Samples	8
Preparation of Apparatus	9
General Engine Assembly Practices	9.1
Complete Engine Inspection	9.2
Copper Components	9.3
Engine Lubricant System Flush	9.4
Engine Piston Cooling Jets	9.5
Engine Measurements and Inspections	9.6
Cylinder Head	9.7
Valve Guide Bushings	9.8
Fuel Injector	9.9
Piston and Rings	9.10
Cylinder Liner	9.11
Compression Ratio	9.12
Engine Timing	9.13
Engine Coolant System Cleaning Procedure	9.14
Calibration and Standardization	10
Test Cell Instrumentation	10.1
Instrumentation Standards	10.2
Coolant Flow	10.3
Re-calibration Requirements	10.4
Fuel Injectors	10.5
Air Flow	10.6
Intake Air Barrel	10.7
Fuel Filter	10.8
Oil Scale Flow Rates	10.9
Calibration of Test Stands	10.10
Extending Test Stand Calibration Period	10.11
Test Run Numbering	10.13
Humidity Calibration Requirements	10.14
Calibration of Piston Deposit Raters	10.15
Procedure	11
Engine Break-in Procedure	11.1
Cool-down Procedure	11.2
Warm-up Procedure	11.3
Shutdowns and Lost Time	11.4
Periodic Measurements	11.5
Engine Control Systems	11.6
Engine Coolant	11.6.1
Engine Fuel System	11.6.2
Engine Oil Temperature	11.6.3
Exhaust Pressure	11.6.4
Intake Air	11.6.5
Post-Test Procedures	11.7
Piston Ring Side Clearances	11.7.1
Piston Ratings	11.7.2
Referee Ratings	11.7.3
Ring End Gap Increase	11.7.4
Cylinder Liner Wear	11.7.5
Cylinder Liner Bore Polish	11.7.6
Photographs	11.7.7
Calculation and Interpretation of Results	12
Test Validity	12.1
Calculations	12.2
Quality Index	12.2.1
Oil Consumption	12.2.2
Report	13
Forms and Data Dictionary	13.1
Test Validity	13.2
Report Specifics	13.3
Precision and Bias	14
Precision	14.1
Bias	14.1.4
Keywords	15
Annexes	
Engine and Parts Warranty	Annex A1
Instrument Locations, Measurements, and Calculations	Annex A2
Cooling System Arrangement	Annex A3
Intake Air Mass Flow Sensor Installation	Annex A4
Fuel System Design and Required Components	Annex A5

Oil System	Section
Exhaust and Intake Barrel Piping	Annex A6
Humidity Probe Installation (Location)	Annex A7
Return Goods Authorization (Claim Form)	Annex A8
Engine Assembly Information	Annex A9
Flushing Instructions and Apparatus	Annex A10
Warm-up, Cool-down and Testing Conditions	Annex A11
Piston and Liner Rating Modifications	Annex A12
Additional Report Forms	Annex A13
Test Report Forms	Annex A14
	Annex A15
Appendixes	
Various Examples for Reference Purposes	Appendix X1
Safety	Appendix X2

2. Referenced Documents

2.1 ASTM Standards:⁵

- D86 Test Method for Distillation of Petroleum Products 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)
- 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
- 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)
- D2425 Test Method for Hydrocarbon Types in Middle Distillates by Mass Spectrometry
- D2500 Test Method for Cloud Point of Petroleum Products
- 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
- D3227 Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
- D3524 Test Method for Diesel Fuel Diluent in Used Diesel Engine Oils by Gas Chromatography
- D4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants
- D4052 Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
- D4485 Specification for Performance of Active API Service Category Engine Oils
- 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)
- D5862 Test Method for Evaluation of Engine Oils in Two-Stroke Cycle Turbo-Supercharged 6V92TA Diesel Engine (Withdrawn 2009)⁶
- 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)⁶
- D6593 Test Method for Evaluation of Automotive Engine Oils for Inhibition of Deposit Formation in a Spark-Ignition Internal Combustion Engine Fueled with Gasoline and Operated Under Low-Temperature, Light-Duty Conditions
- 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
- G40 Terminology Relating to Wear and Erosion

2.2 SAE Standard:

- SAE J183 Engine Oil Performance and Engine Service Classification⁷

2.3 API Standard:

- API 1509 Engine Service Classification and Guide to Crankcase Oil Selection⁸

⁵ 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.

⁶ The last approved version of this historical standard is referenced on www.astm.org.

⁷ Available from the Society of Automotive Engineers Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

⁸ Available from the American Petroleum Institute, 1220 L Street NW, Washington DC, 20005.

2.4 Other ASTM Document:

[ASTM Deposit Rating Manual 20 \(formerly CRC Manual 20\)](#)⁹

3. Terminology

3.1 Definitions:

3.1.1 *additive, n*—a material added to another, usually in a small amount, to impart or enhance desirable properties or to suppress undesirable properties. **D4175**

3.1.2 *automotive, adj*—descriptive of equipment associated with self-propelled machinery, usually vehicles driven by internal combustion engines. **D4485**

3.1.3 *blind reference oil, n*—a reference oil, the identity of which is unknown by the test facility. **D4175**

⁹ For Stock #TMCNML20, visit the ASTM website, www.astm.org, or contact ASTM International Customer Service at service@astm.org.

3.1.3.1 Discussion—

This is a coded reference oil which is submitted by a source independent from the test facility.

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

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

3.1.6 *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. **Sub. B Glossary**²

3.1.6.1 Discussion—

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

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

3.1.7.1 Discussion—

[ASTM D6681-14](#)

[/catalog/standards/astm/1b9fe3f7-dbbb-4296-bd81-6791ff8a3a74/astm-d6681-14](https://catalog/standards/astm/1b9fe3f7-dbbb-4296-bd81-6791ff8a3a74/astm-d6681-14)

These oils are mainly submitted for testing as *candidates* to satisfy a specified performance; hence the designation of the term.

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

3.1.9 *dispersant, n*—in engine oil, an additive that reduces deposits on oil-wetted engine surfaces primarily through suspension of particles. **D4175**

3.1.10 *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 the piston rings. **D5862**

3.1.10.1 Discussion—

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

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

3.1.12 *lubricant, n*—any material interposed between two surfaces that reduces the friction or wear, or both, between them. **D5862**

3.1.13 *lubricating oil, n*—a liquid lubricant, usually comprising several ingredients, including a major portion of base oil and minor portions of various additives. **D4175**²

3.1.14 *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 a combination thereof. **D4175**