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An American National Standard

# Standard Test Method for Evaluation of Engine Oils in Two-Stroke Cycle Turbo-Supercharged 6V92TA Diesel Engine[1]

This standard is issued under the fixed designation D 5862; 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

This test method can be used by any properly equipped laboratory, without outside assistance. However, the ASTM Test Monitoring Center (TMC)[2] provides reference oils and an assessment of the test results obtained on those oils by the laboratory (see Annex A1). 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 imposes such a requirement, in connection with several Army engine lubricating oil specifications.

Accordingly, this test method is written for use by laboratories that utilize the TMC services. Laboratories that choose not to use those services may simply ignore those portions of the test method that refer to the TMC.

This test method may be modified by means of Information Letters issued by the TMC. In addition, the TMC may issue supplementary memoranda related to this test method. (See Annex A1.)

## 1. Scope

1.1 This test method[3] describes a two-stroke cycle diesel engine test procedure for evaluating engine oils for certain high-temperature performance characteristics, particularly cylinder liner scuffing and piston ring face distress, but also including port plugging, slipper bushing, and piston skirt distress. Such oils include both single viscosity SAE grade and multiviscosity SAE grade oils used in diesel engines. It is commonly known as the 6V92TA test. (See Note 1.)

NOTE 1—Companion test methods used to evaluate other engine oil performance characteristics for specification requirements are discussed in Engine Oil tests—SAE J304.

1.2 *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.* Specific hazard statements are given in Sections 8, 10, 13, and 14.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. The values stated in each system may not be exact equivalents; therefore each system must be used independently of the other, without combining values in any way.

1.4 This test method is arranged as follows:


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[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.B0 on Automotive Lubricants.

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[2] ASTM Test Monitoring Center, 6555 Penn Ave., Pittsburgh, PA 15206-4489. Fax number: 412-365-1045. Web page: http://www.astmtmc.cmu.edu/. This test method is supplemented by Information Letters and memoranda issued by the TMC. Users of this test method shall contact the TMC to obtain the most recent of these. This edition incorporates revisions in all Information Letters through No. 02–1.

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR: D02-1319.

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## 2. Referenced Documents

2.1 *ASTM Standards:* [4]

D 86 Test Method for Distillation of Petroleum Products

D 92 Test Method for Flash and Fire Points by Cleveland Open Cup

D 240 Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter

D 287 Test Method for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method)

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)

D 482 Test Method for Ash from Petroleum Products

D 613 Test Method for Cetane Number of Diesel Fuel Oil

D 2622 Test Method for Sulfur in Petroleum Products by X-Ray Spectrometry

D 2709 Test Method for Water and Sediment in Distillate Fuels by Centrifuge

D 2887 Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography

D 4175 Terminology Relating to Petroleum, Petroleum Products, and Lubricants

D 4485 Specification for Performance of Engine Oils

D 4683 Test Method for Measuring Viscosity at High Temperature and High Shear Rate by Tapered Bearing Simulator

D 4739 Test Method for Base Number Determination by Potentiometric Titration

D 5185 Test Method for the Determination of Additive Metals, Wear Metals and Contaminants in Used Lubricating Oils by Inductively-Coupled Plasma Atomic Emission Spectrometry

E 344 Terminology Relating to Thermometry and Hydrometry

G 40 Terminology Relating to Wear and Erosion

2.2 *SAE Standards:*[5]

SAE J183 Engine Oil Performance and Engine Service Classification

SAE J304 Engine Oil Tests

2.3 *Military Specifications:*[6]

MIL-L-2104 Lubricating Oil, Internal Combustion Engine, Combat/Tactical Service

## 3. Terminology

3.1 *Definitions:*

3.1.1 *additive*, *n*—a material added to another, usually in small amounts, to impart or enhance desirable properties or to suppress undesirable properties. **D 4175**

3.1.2 *calibrate*, *v*—to determine the indication or output of a measuring device with respect to that of a standard. **E 344**

3.1.3 *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. **D 5844**

3.1.4 *corrosion*, *n*—the chemical or electrochemical reaction between a material, usually a metal surface and its environment, that can produce a deterioration of the material and its properties. **D 5844**

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

3.1.6 *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.

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

3.1.7 *free piston ring*, *n— in internal combustion engines*, a piston ring that will fall in its groove under its own weight when the piston, with the ring in a horizontal plane, is turned 90° (putting the ring in a vertical plane). **(Subcommittee B Glossary[7])**

3.1.8 *heavy-duty*, *adj— in internal combustion engine operation*, characterized by average speeds, power output, and internal temperatures that are close to the potential maximums. **D 4485**

3.1.9 *heavy-duty engine*, *n— in internal combustion engines*, one that is designed to allow operation continuously at or close to its peak output. **D 4485**

[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] This standard is not available separately. Either order the SAE Handbook Vol 3, or the SAE Fuels and Lubricants Standards Manual HS 23 from: Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

[6] Available from the Standardization Documents Order Desk, Building 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

[7] Available from the Secretary of the ASTM D02.B0 Subcommittee.

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

3.1.11 *non-reference oil, n*—any oil other than a reference oil, such as a research formulation, commercial oil, or candidate oil. **D 5844**

3.1.12 *plugging, n*—the restriction of a flow path due to the accumulation of material along the flow path boundaries.

3.1.13 *reference oil*—an oil of known performance characteristics, used as a basis for comparison. **D 5844**

3.1.13.1 *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.

3.1.14 *scoring, n—in tribology*, a severe form of wear characterized by the formation of extensive grooves and scratches in the direction of sliding. **G 40**

3.1.15 *scuffing, n—in lubrication*, damage caused by instantaneous localized welding between surfaces in relative motion which does not result in immobilization of the parts. **D 4863**

3.1.16 *soot, n—in internal combustion engines*, sub-micron size particles, primarily carbon, created in the combustion chamber as products of incomplete combustion.

3.1.17 *tight piston ring, n— in internal combustion engines*, a piston ring that will not fall in its groove under its own weight when the piston, with the ring in a horizontal plane, is turned 90° (putting the ring in a vertical plane); by subsequent application of moderate finger pressure, the ring will be displaced. **Subcommittee B Glossary**[7]

3.1.18 *used oil, n*—any oil that has been in a piece of equipment (for example, an engine, gearbox, transformer, or turbine), whether operated or not. **D 4175**

3.1.19 *wear, n*—the loss of material from, or relocation of material on, a surface.

3.1.19.1 *Discussion*—Wear generally occurs between two surfaces moving relative to each other, and is the result of mechanical or chemical action or by a combination of mechanical and chemical actions. **D 5302**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *liner scuffing, n*—scuffing characterized by vertical markings in the direction of piston motion which obscure visual detection of the honing crosshatch pattern of the liner.

3.2.2 *test, n*—any engine run-time accumulated beyond the break-in conducted according to this test method.

## 4. Summary of Test Method

4.1 A 500 horsepower 6V92TA diesel engine[8] is completely disassembled, solvent-cleaned, measured, and assembled using new parts as specified.

4.2 The engine is installed on a test stand equipped with the appropriate accessories for controlling speed, load, and various other engine operating parameters.

4.3 The engine is charged with the test oil and operated for 6 h and 10 min on a break-in cycle. An airbox inspection is made after break-in to determine cylinder liner scuffing as a measure of the suitability of the engine build.

4.4 Following the break-in, the engine is operated under steady state conditions at both high load and high power for 7 cycles, totaling 100 h running time. Each cycle includes a heat soak and cool-down portion. This test stresses the lubricant thermally and mechanically to duplicate the service typical of these types of engines in use today.

4.5 Used oil samples are taken every 16 h with viscometric characteristics, metals, and base number (TBN) measured on a fixed schedule.

4.6 At the end of the test, the engine is disassembled, and the rings, liners, slipper bushings, and piston skirts are visually inspected for those signs of distress that relate to overall engine life.

## 5. Significance and Use

5.1 This test method was developed to evaluate diesel engine oils for protection against ring and liner distress caused by high thermal and mechanical loading.

5.2 Liner scuffing and ring distress experienced in this test method are measures of the oil's ability to protect against scuffing and scoring under high power and high load conditions typical of service experienced by engines in use today.

5.3 Piston pin slipper bushing wear, piston skirt tin removal, and liner port plugging are also examined in this test for distress which relates to overall engine life.

5.4 This test method was developed to correlate with field experience using oils of known good and poor protection against ring and liner distress.

5.5 The 6V92TA engine oil test is used in specifications and classifications of engine lubricating oils, such as the following:

5.5.1 Specification D 4485,

5.5.2 Military Specification MIL-L-2104, and

5.5.3 SAE Classification J 183.

## 6. Apparatus—General Description

6.1 The test engine is based on an 9 L Detroit Diesel 6V92TA, turbo-supercharged, aftercooled, two-stroke cycle diesel engine.

6.2 Use an engine test stand equipped to control engine speed and load, various temperatures, and other parameters.

6.3 Use appropriate air conditioning or heating apparatus, or both, as necessary to control the temperature of the intake air.

6.4 Use an appropriate fuel supply system.

## 7. Apparatus—Laboratory and Test Stand Requirements

7.1 *Laboratory*—Observe the following laboratory conditions to ensure good control of test operations and good repeatability:

7.1.1 Maintain the ambient laboratory atmosphere relatively free of dirt, dust, and other contaminants.

7.1.2 Control the temperature of the room in which parts measurements are made so that the temperature for after-test measurements is within a range of ±3°C (±5°F) relative to the temperature for the before-test measurements. If difficulty of parts fit during engine assembly is encountered, consider the effects of temperature coefficient of expansion.

[8] A Detroit Diesel 6V92TA engine shall be used; purchase it from a local Detroit Diesel Distributor. If it is necessary to locate a distributor, contact the Test Developer: Attention: Sequence 6V92TA Test Developer, Detroit Diesel Corporation, Fuels and Lubricants, 13400 West Outer Drive, Detroit, MI 48239-4001.