



Standard Test Method for Determination of Lubricity of Two-Stroke-Cycle Gasoline Engine Lubricants¹

This standard is issued under the fixed designation D4863; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method² evaluates the ability of lubricants to minimize piston and bore scuffing in two-stroke-cycle spark-ignition gasoline engines.

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

1.3 *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.*

2. Referenced Documents

2.1 ASTM Standards:³

B152/B152M Specification for Copper Sheet, Strip, Plate, and Rolled Bar

D439 Specification for Automotive Gasoline (Withdrawn 1990)⁴

D445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)

D664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration

D874 Test Method for Sulfated Ash from Lubricating Oils and Additives

D2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40 and 100°C

D2700 Test Method for Motor Octane Number of Spark-Ignition Engine Fuel

D2885 Test Method for Determination of Octane Number of Spark-Ignition Engine Fuels by On-Line Direct Comparison Technique

D2896 Test Method for Base Number of Petroleum Products by Potentiometric Perchloric Acid Titration

D4857 Test Method for Determination of the Ability of Lubricants to Minimize Ring Sticking and Piston Deposits in Two-Stroke-Cycle Gasoline Engines Other Than Outboards

D4858 Test Method for Determination of the Tendency of Lubricants to Promote Preignition in Two-Stroke-Cycle Gasoline Engines

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

E178 Practice for Dealing With Outlying Observations

2.2 Coordinating European Council (CEC) Standard⁵

CEC L-19-T-77 The Evaluation of the Lubricity of Two-Stroke Engine Oils

3. Terminology

3.1 Definitions:

3.1.1 *combustion chamber*—in reciprocating internal combustion engines, the volume bounded by the piston crown and any portion of the cylinder walls extending above the piston crown when in the top dead center position, and the inner surface of the cylinder head including any spark plugs and other inserted components. **D4858**

3.1.2 *lubricity*—a qualitative term describing the ability of a lubricant to minimize friction between and damage to surfaces in relative motion under load.

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.B0.06 on Two-Stroke Cycle Gasoline.

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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. These can be obtained from the ASTM Test Monitoring Center, 6555 Penn Ave., Pittsburgh, PA 15206-4489. ATT: Administrator. This edition incorporates revisions in all Information Letters through No. 01–4.

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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

⁵ Order from the Coordinating European Council, 61 New Cavendish Street, London W1M 8AR, England.

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

3.1.3 *preignition*—in a spark-ignition engine, ignition of the mixture of fuel and air in the combustion chamber before the passage of the spark. **D4858**

3.1.4 *scuffing, n*—in lubrication, damage caused by instantaneous localized welding between surfaces in relative motion that does not result in immobilization of the parts. **D6593**

3.1.5 *spark plug fouling*—deposition of essentially nonconducting material onto the electrodes of a spark plug that may, but will not necessarily, prevent the plug from operating. **D4857**

3.1.6 *spark plug whiskering, or spark plug bridging*—a deposit of conductive material on the spark plug electrodes which tends to form a bridge between them, thus shorting out the plug. **D4857**

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *benchmark reference oil*—a reference oil that represents an acceptable level of performance with regard to the property evaluated in an engine test and whose performance in the test is equaled, within the tolerance allowed, or exceeded by that of the non-reference oil.

4. Summary of Test Method

4.1 The test has been developed to replace the CEC L-19-T-77 Lubricity Test, for which test engines are no longer available. It is run in a 49 cm³ single-cylinder air-cooled two-stroke-cycle engine operated at 4000 rpm wide open throttle (WOT) using a 150:1 mixture of gasoline and oil by volume. After conditions have stabilized, the cooling air is cut off. The output torque is measured when the spark plug gasket temperature reaches 200 °C and again when it reaches 350 °C, at which point the cooling air is restored. The smaller the reduction in torque output during this period, the better the ability of the oil to lubricate the piston. This test is not normally damaging to the engine. Sets of five such tightenings are normally run, using alternately a benchmark reference oil and the non-reference oil for each set.

NOTE 1—*Pass-fail Criterion*—Obtain the mean torque drop with a non-reference oil that is the same or less than that with the reference oil as calculated by the procedures of **Annex A4**.

5. Significance and Use

5.1 The oil in a two-stroke-cycle gasoline engine is either mixed with the fuel prior to use or is metered into the fuel supply at, or at some point prior to, its passage into the engine crankcase. The possibility of the amount of oil actually present in the engine being less than optimum always exists. Also, with some oil metering systems short periods of operation with less oil than desirable can occur when the power is increased suddenly. It has also been found that the incidence of piston scuff early in the life of the engine might be related to the lubricity of the oil used as defined by test procedures of this type.

6. Apparatus

6.1 Test Engine and Stand:

6.1.1 *Test Engine Configuration*—A Yamaha CE-50 49 cm³ loop-scavenged air-cooled two-stroke-cycle engine is used.

This has 40 mm bore, 39.2 mm stroke, with an aluminum piston operating in a cast iron cylinder bore. The cylinder head is removable, with a hemispherical combustion chamber. Further details are given in **Annex A1**. For the purposes of this test, the standard piston-to-bore clearance is increased as specified in 6.1.2. The engine is no longer produced. Small quantities of parts can be obtained through Yamaha dealers. Special arrangements shall be made through Yamaha for the production of large quantities of test parts.

NOTE 2—The engine designation normally includes a final letter indicating the model, such as CE-50S, the model on which this test was developed. If this model is not available check the suitability for this test of available models with the manufacturer.⁶

6.1.2 *Adjustment of Piston Clearance*—For the purposes of this test method, hone the cylinder bore to give a (0.10 to 0.13) mm piston skirt diametral clearance with a (0.45 to 0.7) μm arithmetic mean roughness finish, as specified in . It is recommended that a number of cylinders be honed out as it is normally necessary to use a new piston for each test and a new cylinder after every three tests. Clearly mark the modified cylinders as such.

(1) The power and specific fuel consumption curves at 500 rpm intervals over the range from (3000 to 6000) rpm.

(2) The spark plug gasket temperatures for each point of the power curve.

(3) Modified piston clearance, with measurements of the piston and cylinder bore dimensions. Additional modified piston and cylinder assemblies can also be supplied.

(4) Measurements of the piston rings, ring grooves, ring clearances, and ring gaps.

6.2 *Test Stand*—The dynamometer shall be able to absorb 2.5 kW at 4000 rpm with an inherent torque measurement accuracy of ±0.5 % or better, and be capable of maintaining (4000 ± 30) rpm with varying power input. A direct shaft drive or a belt drive from the engine crankshaft may be used. A complete test stand assembly, as shown in **Fig. 1**, is available.⁷

6.3 *Cooling Blower*—Remove the original internal engine fan or have its blades machined off. A variable delivery blower with a free flow capacity of about 34 m³/min of air is recommended. Direct the flow from the blower toward the intake side of the engine, as can be seen in **Fig. 1**.

6.4 *Fuel System*—Provide quick disconnects or other means to facilitate rapid interchange of fuel supply as near to the carburetor as practicable. When local regulations permit their use, outboard portable fuel tanks of about (20 to 25) L capacity and flexible fuel hoses are suitable. In any case three fuel sources are needed for a test, one for the non-reference oil-fuel mix, one for the reference oil-fuel mix, and one supplying test gasoline only with no oil. The temperature of the fuel entering the carburetor shall not exceed 25 °C, and this might require cooling in hot climates.

6.5 Instrumentation:

⁶ Obtainable from Engineering and Service Dept., Yamaha Motor Corp., 6555 Katella Ave Cypress, CA 90630. Parts, but not complete engines, are obtainable from Yamaha motorcycle dealers.

⁷ A thermocouple gasket that has been found satisfactory may be obtained from The Lewis Engineering Company, 238 Water St., Naugatuck, CT 06770.