Designation: D 4863 – 00

An American National Standard

Standard Test Method for Determination of Lubricity of Two-Stroke-Cycle Gasoline Engine Lubricants[1]

This standard is issued under the fixed designation D 4863; 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 Department of Defense.

1. Scope

1.1 This test method[2] evaluates the ability of lubricants to minimize piston and bore scuffing in two-stroke-cycle spark-ignition gasoline engines.

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.*

1.3 The values stated in SI units are the standard. The values in parentheses are provided for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

B 152 Specification for Copper Sheet, Strip, Plate, and Rolled Bar[3]

D 439 Specification for Automotive Gasoline[4]

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)[5]

D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration[5]

D 874 Test Method for Sulfated Ash from Lubricating Oils and Additives[5]

D 2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40° and 100°C[5]

D 2700 Test Method for Knock Characteristics of Motor Octane Number of Spark-Ignition Engine Fuel[6]

D 2885 Test Method for Research and Motor Octane Ratings Using On-Line Analyzers[6]

D 2896 Test Method for Base Number of Petroleum Products by Potentiometric Perchloric Acid Titration[7]

D 4857 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[7]

D 4858 Test Method for Determination of the Tendency of Lubricants to Promote Preignition in Two-Stroke-Cycle Gasoline Engines[7]

E 178 Practice for Dealing with Outlying Observations[8]

2.2 *Coordinating European Council (CEC) Standard*[9]

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. **D 4858**

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.

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. **D 4858**

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

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. **D 4857**

3.1.6 *spark plug whiskering, or spark plug bridging*—a deposit of conductive material on the spark plug electrodes

[1] This standard is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.B 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. 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. 00–2.

[3] *Annual Book of ASTM Standards*, Vol 02.01.

[4] *Discontinued; see 1990 Annual Book of ASTM Standards*, Vol 05.01.

[5] *Annual Book of ASTM Standards*, Vol 05.01.

[6] *Annual Book of ASTM Standards*, Vol 05.05.

[7] *Annual Book of ASTM Standards*, Vol 05.02.

[8] *Annual Book of ASTM Standards*, Vol 14.02.

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

which tends to form a bridge between them, thus shorting out the plug. **D 4857**

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 cm^3 single-cylinder air-cooled two-stroke-cycle engine operated at 4000 r/min 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 (392°F) and again when it reaches 350°C (662°F), 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*—The mean torque drop obtained with a candidate oil shall be 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 may 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 cm^3 loop-scavenged air-cooled two-stroke-cycle engine is used. This has 40 mm (1.57 in.) bore, 39.2 mm (1.54 in.) 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 must 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.[10]

6.1.2 *Adjustment of Piston Clearance*— For the purposes of this test method, the cylinder bore shall be honed to give a 0.10 to 0.13 mm (0.004 to 0.005 in.) piston skirt diametral clearance with a 0.45 to 0.7 µm (18 to 28 µin.) arithmetic mean roughness finish, as specified in A3.4. 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. The modified cylinders shall be clearly marked as such.

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

(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 (3.3 hp) at 4000 r/min with an inherent torque measurement accuracy of ±0.5 % or better, and be capable of maintaining 4000 ± 30 r/min 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.[11]

6.3 *Cooling Blower*—The original internal engine fan shall be removed or have its blades machined off. A variable delivery blower with a free flow capacity of about 34 m^3/min (1200 ft ^{3}/min) of air is recommended. The flow from the blower shall be directed toward the intake side of the engine, as may be seen in Fig. 1.

6.4 *Fuel System*—Quick disconnects or other means to facilitate rapid interchange of fuel supply shall be provided as near to the carburetor as practicable. When local regulations permit their use, outboard portable fuel tanks of about 20 to 25 L (5 to 6 gal) capacity and flexible fuel hoses are suitable. In any case three fuel sources will be 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 (77°F), and this may require cooling in hot climates.

6.5 *Instrumentation*:

6.5.1 *Tachometer*—An electronic or vibration tachometer accurate to ±25 r/min.

6.5.2 *Measurement of Ambient Conditions*— It is assumed in this section that the engine draws ambient air from the test room. If it is supplied with air from a controlled source, references to ambient temperature, pressure and humidity apply to the air from the controlled source.

6.5.2.1 *Temperature*—A thermocouple or thermometer shall be provided to read air temperature in the range 10 to 50°C (50 to 120°F). The overall accuracy of temperature measurement, including that of recorders, shall be within ±1°C (2°F).

[10] Obtainable from Engineering and Service Dept., Yamaha International Corp., P.O. Box 6555, Cypress, CA 90630. Parts, but not complete engines, are obtainable from Yamaha motorcycle dealers.

[11] A thermocouple gasket that has been found satisfactory may be obtained from Lewis Engineering, 238-T Water St., Naugatuck, CT 06770.