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An American National Standard

Standard Specification for Lubricants for Two-Stroke-Cycle Spark-Ignition Gasoline Engines-TC[1]

This standard is issued under the fixed designation D 4859; 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 specification covers lubricants intended for use in two-stroke-cycle spark-ignition gasoline engines, typically other than outboard motors, that are particularly prone to ring sticking, but which are also liable to suffer damage arising from deposit induced preignition, piston scuff, spark plug fouling and piston varnish.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

D 445 Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)[2]

D 664 Test Method for Acid Number of Petroleum Products by Potentiometric Titration[2]

D 874 Test Method for Sulfated Ash from Lubricating Oils and Additives[2]

D 2270 Practice for Calculating Viscosity Index from Kinematic Viscosity at 40° and 100°C[2]

D 2896 Test Method for Base Number of Petroleum Products by Potentiometric Perchloric Acid Titration[2]

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[3]

D 4858 Test Method for Determination of the Tendency of Lubricants to Promote Preignition in Two-Stroke-Cycle Gasoline Engines[3]

D 4863 Test Method for Determination of Lubricity of Two-Stroke-Cycle Gasoline Engine Lubricants[3]

2.2 *Coordinating European Council (CEC) Standard:*

CEC L-19-T-77 The Evaluation of the Lubricity of Two-Stroke Engine Oils[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *cold sticking—of piston rings*, a condition in which the ring is free in its groove while the engine is running but stuck when the piston is cold, normally indicated by the absence of varnish or other deposits on the outer face of the ring and of signs of blowby on the piston skirt. **D 4857**

3.1.2 *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**

3.1.3 *hot sticking—of piston rings*, a condition in which the ring is stuck in its groove while the engine is running, normally indicated by varnish or other deposits on the outer face of the ring, by signs of blowby on the piston skirt, or both. **D 4857**

3.1.4 *lubricity*—a qualitative term describing the ability of a lubricant to minimize friction between and damage to surfaces in relative motion under load. **D 4863**

3.1.5 *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**

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

3.1.7 *seizure—in lubrication*, welding between surfaces in relative motion that results in immobilization of the parts. **D 4863**

3.1.8 *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**

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

[1] This specification 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] *Annual Book of ASTM Standards*, Vol 05.01.

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

[4] 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 *Definition of Terms Specific to This Standard:*

3.2.1 *benchmark reference oil*—an oil meeting the requirements of a test of this specification and whose performance on that test is equalled or exceeded by that of the candidate oil within the specified tolerances.

3.2.2 *major preignition*—preignition indicated by an increase in the combustion chamber temperature of 10°C (18°F) or more over a period of less than a minute.

3.2.3 *minor preignition*—preignition indicated by an increase in the combustion chamber temperature of 7°C (13°F) or more but less than 10°C (18°F) over a period of less than a minute.

4. General Requirements

4.1 This specification covers only specific aspects of the performance of the lubricant in an engine under the conditions of test. Requirements additional to those of this specification, such as miscibility with gasoline, may be agreed between the purchaser and the supplier.

4.2 Performance testing of each batch of lubricant shall not be required. The supplier shall certify that the product supplied meets the requirements of this specification and that it conforms in all significant respects to a batch of lubricant that has met the requirements of this specification. The supplier shall provide on request the batch and test number and the date and place of qualification of this previously qualified batch of oil, and such additional information on the physical and chemical properties of the lubricant as shall enable the purchaser to detect contamination or substitution of product.

4.3 *Ring Sticking and Piston Deposit Test*—The performance of the candidate oil shall be equal to, within the specified tolerances, or better than that of the benchmark reference oil when run under the conditions required by this specification and by the test procedure. The benchmark reference oil used when testing to this specification is ASTM 600.[5]

4.4 *Lubricity Test*—The performance of the candidate oil shall be equal to, within the specified tolerances, or better than that of the benchmark reference oil when run under the conditions required by this specification and by the test procedure. The benchmark reference oil required by this specification is ASTM 600.[5]

4.5 *Preignition Test*—Not more than one major preignition may occur when running the candidate oil. Minor preignitions shall be reported with the temperature increase and the time of occurrence in running hours to the nearest 0.1 h. The benchmark reference oil used when testing to this specification is ASTM 601.[6]

NOTE 1—Find a general description of these benchmark reference oils in Annex A1.

5. Summary of Test Methods

5.1 *Ring Sticking and Piston Deposits-Test Method D 4857*—This test is run in a 347 cm^3 Yamaha RD-350B twin-cylinder air-cooled motorcycle engine for 20 h, set up with number one cylinder supplied with a fuel mix containing the benchmark reference oil and number two cylinder with a fuel mix containing the candidate oil, both at 50:1 fuel to oil ratio by volume. The test is normally run twice, exchanging the oils between cylinders for the second run, unless the performance of the candidate oil exceeds that of the benchmark reference oil by the margins specified in 6.2.7, in which case the second run need not be made.

5.2 *Lubricity-Test Method D 4863*—The procedure is a development of CEC L-19-T-77, for which test engines are no longer available. It is run in a Yamaha CE-50 49 cm^3 single-cylinder air-cooled engine supplied with a 150:1 by volume fuel to oil mix. The engine is brought to equilibrium at 4000 r/min wide open throttle (WOT), and the cooling air flow adjusted to give a spark plug gasket temperature of 169 to 171°C (336 to 340°F). The cooling air to the cylinder is then cut off and the output torque recorded when the plug gasket temperature reaches 200°C (392°F) and again when it reaches 350°C (662°F), when the cooling air flow is restored. The smaller the reduction in torque output at constant engine speed during this interval, the better the ability of the oil to lubricate the piston. Tests are run alternately on the benchmark reference oil, ASTM 600, and on the candidate oil. This test does not normally damage the engine.

5.3 *Preignition-Test Method D 4858*—This is run in a Yamaha CE-50 engine. For the purposes of this specification the engine is run for 50 h at 4000 r/min at wide open throttle (WOT) using a 20:1 volumetric fuel to oil ratio. The number of incidences of preignition, as determined by an increase in the temperature of the combustion chamber over the normal running level, is observed.

6. Pass-Fail Criteria

6.1 *All Tests*—The performance of the candidate oil shall be as good as, within the tolerance allowed, or better than that of the benchmark reference oil. Rating procedures are given in the test methods.

6.2 *Ring Sticking and Deposit Test*:

6.2.1 In this test two runs are normally made, exchanging the oils between cylinders after the first run and the means of the ratings for the candidate oil and reference oil are compared, *except* that a pass may be given to the candidate oil without making the second run if all conditions stated in 6.2.8 are met. If the first run of a two run test is conducted with oversize hardware, then the second run shall be conducted on oversize hardware. Conversely, it the first run of a two run test is conducted on standard size hardware, then the second run of the two part test shall also be run using standard size hardware.

6.2.2 The occurrence of scuff or seizure in any part of the test engine, with the candidate oil, shall require the test or current portion of Test Method D 4857, to be rerun. If scuff or seizure occurs again with the candidate oil, the test shall be terminated as a failure unless it can be established that the failures are caused by some deficiency of the equipment. In this case, after correction, the test may be rerun. The occurrence of scuffing or hot stuck rings in the reference oil cylinder shall not result in test invalidation.

[5] Order as Citgo No. 93734 from Citgo Petroleum Corp., 555 East Butterfield Rd., Lombard, IL 60148.

[6] Order from Lubrizol Corp., 29400 Lakeland Boulevard, Wickliffe, OH 44092.

6.2.3 *Second Ring Sticking*—The mean rating of the second rings of the candidate oil pistons shall be not more than 0.5 merit number below that of the rings run on the 600 reference oil. Under no circumstances shall there be any evidence of hot stuck rings in the candidate oil cylinder.

6.2.4 *Piston Skirt Varnish*—The average piston varnish rating of a candidate oil shall be not more than 0.5 merit number below that of the 600 benchmark reference oil.

6.2.5 *Spark Plug Fouling or Bridging*—Not more than two more occurrences per complete test (2 runs) with the candidate oil than with the 600 benchmark reference oil.

6.2.6 *Preignition*—More than one occurrence of major preignition in the candidate oil cylinder shall constitute a failure.

6.2.7 *Exhaust Port Blocking*—The percentage of the exhaust port area blocked by deposits in either run of the test shall be not more than 10 % greater for the candidate oil than for the 600 benchmark reference oil.

6.2.8 *Early Pass Criterion*—A test may be terminated after the first run with a pass for the candidate oil if the following conditions *all* exist:

6.2.8.1 Second ring sticking merit rating for the candidate oil is 9.0 or better, regardless of the second ring sticking performance of the benchmark reference oil, which can occasionally exhibit hot stuck rings.

6.2.8.2 The piston varnish rating for the candidate oil is absolutely (without consideration of tolerance) equal to or better than that for the benchmark reference oil.

6.2.8.3 There has been no incidence of preignition, major or minor.

6.2.8.4 Exhaust port blocking for the candidate oil is not more than 5 % greater than for the 600 benchmark reference oil.

6.2.8.5 There has been not more than one incidence of plug fouling with the candidate oil.

6.2.8.6 There is no evidence of scuff, hot stuck rings, or other lubricant related damage in the candidate oil cylinder.

6.2.9 *Early Fail Criterion*—A candidate oil test shall be rated as a failure, and may be terminated after the first run, if there has been any incidence in the candidate oil cylinder of hot stuck rings, major preignition, or excessive port blockage as defined in 6.2.7.

6.3 *Lubricity Test*—The average torque drop observed for the candidate oil shall be equal to or less than that for the benchmark reference oil ASTM 600. See the Test Method D 4863 (Annex A4) for the method of computation.

6.4 *Preignition Test*:

6.4.1 *Major Preignition*—Not more than 1 major preignition with the candidate oil.

6.4.2 *Minor Preignition*—The number of minor preignitions is not a pass-fail criterion due to poor reproducibility, but an oil showing six or more minor preignitions involving a temperature increase of 7°C (12°F) or more but less than 10°C (18°F) shall be retested. If the criterion of 6.4.1 is met on the second test the oil passes.

6.4.3 *Other Plug Malfunctions*—Not more than one occurrence of plug fouling or plug whiskering with the candidate oil.

7. Keywords

7.1 API TC; engine oil; TC; two-cycle; two stroke; two-stroke cycle engine oil; two-stroke cycle engine oil specification

ANNEX

(Mandatory Information)

A1. REFERENCE OILS

TABLE A1.1 Reference Oils

Designation (ASTM)	600	601
Oil Properties (Typical):		
Viscosity mm^2/s (cSt) D 445		
40°C (104°F)	34.2–38.2	121.0
100°C (212°F)	6.1–6.6	12.2
Viscosity index D 2270	128	90
TAN mg KOH/g D 664	1.7	n/a
TBN mg KOH/g D 2896	6.5	4.7
Sulfated Ash mass % D 874	<0.005	0.16
Calcium mass %	0	0.045
Barium mass %	0	0
Nitrogen mass %	0.58	0.17
Approximate Oil Composition, vol %		
Bright Stock	9.0	n/a
650 Neutral	61.65	n/a
Stoddard solvent	20.0	n/a
Additives	9.35[A]	n/a[B]

[A] Principally an ashless dispersant.
[B] Principally a metallic-based dispersant.