SURFACE VEHICLE RECOMMENDED PRACTICE

J1510™ JAN2025

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Lubricants for Two-Stroke-Cycle Gasoline Engines

RATIONALE

Updated SAE J1510 to refer to the current NMMA Two-Stroke specification and added ASTM D97 to 2.1.2.

1. SCOPE

The information in this SAE Recommended Practice has been compiled by Technical Committee 1 (Engine Lubrication) of the SAE Fuels and Lubricants Division. The intent is to provide those concerned with the design and maintenance of two-stroke-cycle engines with a better understanding of the properties of two-stroke-cycle lubricants. Reference is also made to test procedures which may be used to measure the chemical and physical characteristics of these lubricants.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1536 Two-Stroke-Cycle Engine Oil Fluidity/Miscibility Classification

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D93 Test Methods for Flash Point by Pensky-Martens Closed Tester

ASTM D97 Standard Test Method for Pour Point of Petroleum Products

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J1510_202501/

ASTM D874 Test Method for Sulfated Ash from Lubricating Oils and Additives

ASTM D3607 Method for Removing Volatile Contaminants from Used Engine Oils by Stripping

ASTM D4682 Specification for Miscibility with Gasoline and the Fluidity of Two-Stroke-Cycle Gasoline Engine Lubricants

3. LUBRICANT CLASSIFICATION

At the present time, two-stroke-cycle engine and lubricant manufacturers use a variety of engine and bench tests to define lubricant performance. For example, for several years, the National Marine Manufacturers Association (NMMA) has been approving oils for water-cooled, two-stroke-cycle outboard engines. Products with this approval bear a NMMA TC-W3® logo.

4. ENGINE APPLICATIONS

Two-stroke-cycle engines are used in many applications with a broad range of specific power outputs. Water-cooled outboard engines with displacements to 4000 cc are not uncommon. At the other end of the scale are air-cooled engines for power tools, with displacements of 30 cc or less. In between are engines with various displacements and specific outputs. Typically, they are used to power motorbikes, lawn mowers, motorcycles, small tractors, chainsaws and other handheld equipment, portable generators or pumps, snowmobiles, personal watercraft, etc.

5. LUBRICATION SYSTEMS

Two approaches to two-stroke-cycle engine lubrication are common:

a. Pre-mixing, in which the lubricant is added to the fuel either in the fuel tank or before it is put in the fuel tank

b. Injection, in which the lubricant is metered directly into the intake manifold or other points using a pump that is controlled by engine speed and/or throttle setting or where the lubricant is metered into the gasoline between the fuel tank and the engine

Use of oil injection systems is increasing. In addition to being more convenient, the injection system optimizes lubricant delivery rates over varying power and speed ranges.

6. FUEL:OIL RATIOS

The ratio of fuel to oil depends on the engine, the application, and the lubricant. A fuel-to-oil ratio of 50:1 is often specified by both engine manufacturers and lubricant marketers for oils such as those used in large outboard engines. However, higher ratios, for example, 100:1, are sometimes recommended. Ratios as low as 16:1 are sometimes specified for use in air-cooled engines.

Variable ratios are characteristic of lube-injection systems. In one lube-injected snowmobile, for example, the ratio varies from 100:1 at idle to 24:1 at wide open throttle (WOT).

7. LUBRICANT ROLE

Two-stroke-cycle gasoline engines typically utilize “once through” lubrication. In any application, the lubricant is expected to protect the engine from wear, scuffing, ring sticking, piston deposits, and rust. It must do so without causing excessive plug fouling, pre-ignition, detonation, or exhaust system blockage. If the engine is lube-injected, the lubricant should continue to flow from the reservoir to the injection pump at the lowest ambient temperature expected in the application for which the lubricant is intended.

8. OIL COMPOSITION

With the wide variety of two-stroke-cycle engines and uses, one lubricant composition may not be optimum for all applications. However, two-stroke-cycle engine lubricants, like other lubricant classes, do have features in common. The base oils are most often petroleum derived but can be synthetic or part synthetic containing base fluid components such as ester and polyisobutene. Frequently, a portion of the base oil is a high viscosity component such as bright stock. Most oils contain an additive package to improve engine cleanliness. Many contain a hydrocarbon diluent to improve the miscibility (rate of mixing) with gasoline and the fluidity (flow) at low ambient temperatures. Some two-stroke-cycle engine lubricants also contain a pour depressant.

For some applications, for example, large outboard engines, where WOT operation for extended periods is common practice, the cleanliness additives must be essentially ashless to avoid pre-ignition and detonation. However, most lubricants, especially those designed for air-cooled engines, contain ash-forming components to control ring zone deposits at high-operating temperatures. Some modern air-cooled engines perform best with oils containing a mixture of ashless and ash-forming components.

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Fluidity and Miscibility

The rheological requirements for two-stroke-cycle engine lubricants do not include viscosity exclusively. Lubricants must also have the ability to mix into gasoline and/or flow at the prevailing ambient temperature.

SAE J1536 and the supporting ASTM Standard Specification D4682 describe four grades of two-stroke-cycle engine lubricants according to rheological properties.

9.2 Rust

The ability of the oil to prevent internal engine corrosion during shutdown is critical. The NMMA TC-W3® standard provides a laboratory test procedure whereby the rust inhibiting properties of an oil in the presence of a brine solution can be established.

9.3 Stability and Compatibility

It is imperative that oils intended for use in lube-injected engines remain homogeneous over a broad range of ambient temperatures for extended periods of time. Otherwise, filter plugging and engine damage due to oil starvation may occur. Therefore, oils should be inspected to ensure that they are free of gel, sediment, particulates, immiscible liquids, etc. The NMMA TC-W3® specification requires that products demonstrate compatibility with commonly available two-stroke-cycle outboard lubricants.

Lubricants must remain fluid when contaminated with small amounts of water. Lubricants which are individually satisfactory may not be so when mixed with other oils.

9.4 Pour Point

Two-stroke-cycle engine lubricants are usually pour depressed to ensure adequate dispensability over extended periods of time at lower ambient temperatures. The degree of pour depression, which varies depending on the intended applications, can be established using method ASTM D97.

9.5 Solvent Content

The solvent content of a two-stroke-cycle engine lubricant can be established by using ASTM D3607. However, because the solvent levels are considerably higher than the fuel contents of used oils, the stripping time should be extended 6 hours.

9.6 Ash Content

The amount of ash formed from burning a two-stroke-cycle engine lubricant may be obtained by ASTM D874. As noted in Section 8, some engines do not perform satisfactorily with ash-forming lubricants, while others benefit from them.