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Standard Test Method for Oxidation Stability of Aviation Fuels (Potential Residue Method)[1]

This standard is issued under the fixed designation D873; 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 method[2] covers the determination of the tendency of aviation reciprocating, turbine, and jet engine fuels to form gum and deposits under accelerated aging conditions. (**Warning—**This test method is not intended for determining the stability of fuel components, particularly those with a high percentage of low boiling unsaturated compounds, as these may cause explosive conditions within the apparatus.)

NOTE 1—For the measurement of the oxidation stability (induction period) of motor gasoline, refer to Test Method D525.

1.2 The accepted SI unit of pressure is the kilo pascal (kPa); the accepted SI unit of temperature is °C.

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous material that can cause central nervous system, kidney and liver damage. Mercury, or its vapor, may be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury containing products. See the applicable product Material Safety Data Sheet (MSDS) for details and EPA's website—http://www.epa.gov/mercury/faq.htm—for additional information. Users should be aware that selling mercury and/or mercury containing products into your state or country may be prohibited by law.

1.4 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D381 Test Method for Gum Content in Fuels by Jet Evaporation
D525 Test Method for Oxidation Stability of Gasoline (Induction Period Method)
D4057 Practice for Manual Sampling of Petroleum and Petroleum Products
D5452 Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
E1 Specification for ASTM Liquid-in-Glass Thermometers

3. Terminology

3.1 The following definitions of terms are all expressed in terms of milligrams per 100 mL of sample, after "*X*" hours aging, "*X*" being the accelerated aging (oxidation) period at 100°C.

3.2 *Definitions of Terms Specific to This Standard:*

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[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum ~~Products~~ Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.14 on ~~Stability~~ Stability, Cleanliness and ~~Cleanliness~~Compatibility of Liquid Fuels.

This test method has been approved by the sponsoring committees and accepted by the Cooperating Societies in accordance with established procedures.

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[2] Further information can be found in the June 1978, January 1979, and June 1986 editions of the *Institute of Petroleum Review*.

[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.

3.2.1 *insoluble gum, n*—deposit adhering to the glass sample container after removal of the aged fuel, precipitate, and soluble gum.

3.2.1.1 *Discussion*—

Insoluble gum is obtained by measuring the increase in mass of the glass sample container.

3.2.2 *potential gum, n*—sum of the soluble and insoluble gum.

3.2.3 *precipitate, n*—sediment and suspended material in the aged fuel, obtained by filtering the aged fuel and washings from the glass sample container.

3.2.4 *soluble gum, n*—deterioration products present at the end of a specific aging period. These deterioration products exist in solution in the aged fuel and as the toluene-acetone soluble portion of the deposit on the glass sample container.

3.2.4.1 *Discussion*—

The soluble gum is obtained as a nonvolatile residue by evaporating the aged fuel and the toluene-acetone washings from the glass sample container.

3.2.5 *total potential residue, n*—sum of the potential gum and the precipitate.

4. Summary of Test Method

4.1 The fuel is oxidized under prescribed conditions in a pressure vessel filled with oxygen. The amounts of soluble gum, insoluble gum, and precipitate formed are weighed. (**Warning—**In addition to other precautions, to provide protection against the possibility of explosive rupture of the pressure vessel, the pressure vessel should be operated behind an appropriate safety shield.)

5. Significance and Use

5.1 The results (of these tests) can be used to indicate storage stability of these fuels. The tendency of fuels to form gum and deposits in these tests has not been correlated with field performance (and can vary markedly) with the formation of gum and deposits under different storage conditions.

6. Apparatus

6.1 *Oxidation Pressure Vessel, Burst Disc Assembly, Glass Sample Container and Cover, Accessories and Pressure Gage,* as described in the Annex to Test Method D525. (**Warning—**Provision shall be made to safely vent any expelled gases or flames away from the operator, other personnel, or flammable materials as a safety precaution if the burst-disc ruptures.)

NOTE 2—Pressure vessels conforming to Test Method D525~~-80~~–80 are also suitable, but the specified burst-disc shall be attached. The burst disc assembly shall be mechanically designed to ensure that it cannot be incorrectly fitted.

6.2 *Thermometer,* having a range as shown below and conforming to the requirements as prescribed in Specification E1, or specifications for IP thermometers:

Thermometer Range	Thermometer Number ASTM	IP
~~95 to 103°C~~	~~22C~~	~~24C~~
95 °C to 103 °C	22C	24C

NOTE 3—Other temperature sensing devices that cover the temperature range of interest, such as thermocouples or platinum resistance thermometers, that can provide equivalent or better accuracy and precision, may be used in place of the thermometers specified in 6.2.

6.3 *Drying Oven,* air oven maintained at ~~100~~100 °C to ~~150°C.~~150 °C.

6.4 *Forceps,* corrosion-resistant, steel.

6.5 *Filtering Crucible,* sintered-glass, fine porosity.

6.6 *Oxidation Bath,* as described in the Annex to Test Method D525. The liquid shall be water or a mixture of ethylene glycol and water, as required. The temperature can be controlled thermostatically at ~~100~~100 °C ± ~~0.2°C,~~0.2 °C, or by maintaining it at its boiling point, which must be between ~~99.5~~99.5 °C to ~~100.5°C.~~100.5 °C. If a liquid medium other than water is used, an appropriate mechanical stirrer/mixer shall be used to maintain uniformity of the liquid bath at ~~100~~100 °C ± ~~0.2°C.~~0.2 °C. A non self-resettable device shall be fitted on all new baths to ensure that the heater is switched off if the liquid bath falls below a safe level. Users of older baths without this device are strongly urged to have the equipment retrofitted to ensure safe operation.

NOTE 4—Electric heating blocks are known to be used. These blocks can have heating capacities, heating rates, and heat transfer characteristics that differ from those of a liquid bath. An electric heating block may be used in place of the liquid bath as long as the sample heating rate and sample temperature are demonstrated to be equivalent to that of the liquid bath.