**Designation: D3241 – 24**

**Designation 323/22**

# Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels[1,2]

This standard is issued under the fixed designation D3241; 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 covers the procedure for rating the tendencies of gas turbine fuels to deposit decomposition products within the fuel system.

1.2 The differential pressure values in mm Hg are defined only in terms of this test method.

1.3 The deposition values stated in SI units shall be regarded as the referee value.

1.4 The pressure values stated in SI units are to be regarded as standard. The psi comparison is included for operational safety with certain older instruments that cannot report pressure in SI units.

1.5 No other units of measurement are included in this standard.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific warning statements, see 6.1.1, 7.1, 7.3, 12.1.1, and Annex A6.

1.7 *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]

D1655 Specification for Aviation Turbine Fuels

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4175 Terminology Relating to Petroleum Products, Liquid Fuels, and Lubricants

D4306 Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *ISO Standards:*[4]

ISO 3274 Geometrical Product Specifications (GPS)—Surface texture: Profile method—Nominal characteristics of contact (stylus) instruments

ISO 4288 Geometrical Product Specifications (GPS)—Surface texture: Profile method—Rules and procedures for the assessment of surface texture

2.3 *ASTM Adjuncts:*[5]

Color Standard for Heater Tube Deposit Rating

## 3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology D4175.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *deposits, n*—oxidative products laid down on the test area of the heater tube or caught in the test filter, or both.

3.2.1.1 *Discussion*—Fuel deposits will tend to predominate at the hottest portion of the heater tube, which is between the 30 mm and 50 mm position.

[1] This test method is under the jurisdiction of ASTM International Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.J0.03 on Combustion and Thermal Properties. The technically equivalent standard as referenced is under the jurisdiction of the Energy Institute Subcommittee SC-B-8.

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[2] This test method has been developed through the cooperative effort between ASTM and the Energy Institute, London. ASTM and IP standards were approved by ASTM and EI technical committees as being technically equivalent but that does not imply both standards are identical.

[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] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, http://www.iso.org.

[5] Available from ASTM International Headquarters. Order Adjunct No. ADJD3241. Original adjunct produced in 1986.

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

3.2.2 *heater tube, n*—an aluminum coupon controlled at elevated temperature, over which the test fuel is pumped.

3.2.2.1 *Discussion*—The heater tube is resistively heated and controlled in temperature by a thermocouple positioned inside. The critical test area is the thinner portion, 60 mm in length, between the shoulders of the heater tube. Fuel inlet to the heater tube is at the 0 mm position, and fuel exit is at 60 mm.

3.3 *Abbreviations:*

3.3.1 *Δ*P—differential pressure.

## 4. Summary of Test Method

4.1 This test method for measuring the high temperature stability of gas turbine fuels uses an instrument that subjects the test fuel to conditions that can be related to those occurring in gas turbine engine fuel systems. The fuel is pumped at a fixed volumetric flow rate through a heater, after which it enters a precision stainless steel filter where fuel degradation products may become trapped.

4.1.1 The apparatus uses 450 mL of test fuel ideally during a 2.5 h test. The essential data derived are the amount of deposits on a heater tube, and the rate of plugging of a 17 µm nominal porosity precision filter located just downstream of the heater tube.

## 5. Significance and Use

5.1 The test results are indicative of fuel performance during gas turbine operation and can be used to assess the level of deposits that form when liquid fuel contacts a heated surface that is at a specified temperature.

## 6. Apparatus

6.1 *Aviation Fuel Thermal Oxidation Stability Tester*[6]—Six models of suitable equipment may be used as indicated in Table 1.

6.1.1 Portions of this test may be automated. Refer to the appropriate user manual for the instrument model to be used for a description of detailed procedure. A manual is provided with each test rig. (**Warning—**No attempt should be made to operate the instrument without first becoming acquainted with all components and the function of each.)

6.1.2 Certain operational parameters used with the instrument are critically important to achieve consistent and correct results. These are listed in Table 2.

6.2 *Heater Tube Deposit Rating Apparatus:*

6.2.1 *Visual Heater Tube Rater (VTR),* the tuberator described in Annex A1.

6.2.2 *Standardization of Metrology Requirements:*

6.2.2.1 *Number of Measured Points*—1200 in the ratable area of the heater tube (between 5 mm and 55 mm above the bottom shoulder of the heater tube).

[6] The following equipment, as described in Table 1 and RR:D02-1309, was used to develop this test method. The following equipment, as described in Table 1 and determined as equivalent in testing as detailed in RR:D02-1631, is provided by PAC, 8824 Fallbrook Drive, Houston, TX 77064. The following equipment, as described in Table 1 and determined as equivalent in testing as detailed in RR:D02-1728, is provided by Falex Corporation, 1020 Airpark Dr., Sugar Grove, IL, 60554-9585. The following equipment as described in Table 1 and determined as equivalent in testing as detailed in RR:D02-2071, is provided by AD Systems (www.adsystems-sa.com), 5, Allée de Cindais, 14320 Saint André sur Orne, France. This is not an endorsement or certification by ASTM International.

**TABLE 1 Instrument Models**

| Instrument Model | Pressurize With | Principle | Differential Pressure by |
|---|---|---|---|
| 230[A] | hydraulic | syringe | Transducer + Printout |
| 240[A] | hydraulic | syringe | Transducer + Printout |
| 230 Mk III[B] | hydraulic | dual piston (HPLC Type) | Transducer + Printout |
| F400[C] | hydraulic | dual piston (HPLC Type) | Transducer + Printout |
| 230 Mk IV[D, E] | hydraulic | single piston (HPLC Type) | Transducer + Printout |
| TO10[F] | hydraulic | dual syringe | Transducer + Printout |

[A] See RR:D02-1309.
[B] See RR:D02-1631.
[C] See RR:D02-1728.
[D] See RR:D02-1757.
[E] There are two versions of the 230 Mk IV instrument; one with an inline internal non-consumable filter located upstream of the 0.45 µm pre-filter and one without. Only the 230 Mk IV instruments without the inline internal non-consumable filter were included in RR:D02-1757 and have been determined by ASTM Committee D02 to be equivalent to the other apparatus listed above in Table 1. There are no external markings on the instruments to indicate which apparatus contains the inline internal non-consumable filter. Contact the manufacturer for further information on removal of the inline internal non-consumable filter.
[F] See RR:D02-2071.