Designation: D7667 – 21

Standard Test Method for Determination of Corrosiveness to Silver by Automotive Spark-Ignition Engine Fuel—Thin Silver Strip Method[1]

This standard is issued under the fixed designation D7667; 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.

1. Scope*

1.1 This test method covers the determination of the corrosiveness to silver by automotive spark-ignition engine fuel (for example, gasoline), as defined by Specification D4814 or similar specifications in other jurisdictions, having a vapor pressure no greater than 124 kPa (18 psi) at 37.8 °C (100 °F) by one of two procedures.

1.1.1 *Procedure A*—Involves the use of a pressure vessel.

1.1.2 *Procedure B*—Involves the use of a vented test tube.

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

1.3 **WARNING**—Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Use caution when handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. The potential exists that selling mercury or mercury-containing products, or both, is prohibited by local or national law. Users must determine legality of sales in their location.

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, health, and 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:*[2]

D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

D3241 Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels

D4057 Practice for Manual Sampling of Petroleum and Petroleum Products

D4177 Practice for Automatic Sampling of Petroleum and Petroleum Products

D4814 Specification for Automotive Spark-Ignition Engine Fuel

E1 Specification for ASTM Liquid-in-Glass Thermometers

2.2 *Energy Institute Standards:*[3]

IP 227 Determination of Corrosiveness to Silver of Aviation Turbine Fuels - Silver Strip Method

2.3 *ASTM Adjuncts:*[4]

Color standard for tube deposit rating (5 aluminum strips)

3. Terminology

3.1 *Abbreviations:*

3.1.1 *PTFE*—polytetrafluoroethylene

3.1.2 *PV*—pressure vessel

3.1.3 *PVP*—pressure vessel procedure

3.1.4 *SSCD*—silver strip centering device

3.1.5 *TSMD*—temperature sensing and monitoring device

3.1.6 *VTTP*—vented test tube procedure

4. Summary of Test Method

4.1 A polished, thin silver strip is immersed in 30 mL of the sample being tested, and heated at 50 °C (122 °F) for 2 h. At the end of the heating period, the silver strip is removed,

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products, Liquid Fuels, and Lubricants and is the direct responsibility of Subcommittee D02.05 on Properties of Fuels, Petroleum Coke and Carbon Material.

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[2] 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] Available from Energy Institute, 61 New Cavendish St., London, WIG 7AR, U.K., http://www.energyinst.org.uk.

[4] 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**

washed, and the color and tarnish level assessed against the Silver Strip Classifications in Table 1.

5. Significance and Use

5.1 Crude petroleum contains sulfur compounds, most of which are removed during refining. However, of the sulfur compounds remaining in the petroleum product or introduced into the fuel during storage and distribution, some can have a corroding action on various metals and this corrosivity is not necessarily related directly to the total sulfur content. The effect can vary according to the chemical types of sulfur compounds present. The silver strip corrosion test is designed to assess the relative degree of corrosivity of a petroleum product towards silver and silver alloys.

5.2 Under some circumstances, reactive sulfur compounds present in automotive spark-ignition engine fuels can tarnish or even corrode silver alloy fuel gauge in-tank sender units or silver-plated bearings (in 2-stroke cycle engines). To minimize or prevent the failure of silver alloy in-tank sender units by tarnish or corrosion, Specification D4814 requires that fuels shall pass a silver strip corrosion test.

6. Apparatus

6.1 *Silver Strip Corrosion Pressure Vessel (Procedure A),* constructed from stainless steel according to dimensions given in Fig. 1, as described in Test Method D130. The vessel shall be capable of withstanding a test pressure of 700 kPa (100 psi). Alternative designs for the vessel's cap and synthetic rubber gasket may be used provided that the internal dimensions of the vessel are the same as shown in Fig. 1, which allow a nominal 25 mm by 150 mm (1 in. by 6 in.) test tube (see 6.2) and the SSCD (see 6.4) to be placed inside the pressure vessel.

6.2 *Test Tubes,* of borosilicate glass of nominal 25 mm by 150 mm (1 in. by 6 in.) dimensions, preferably graduated at 30 mL volume. The internal dimensions shall be checked as acceptable by use of a silver strip (see 7.4). When 30 mL of sample is added to the test tube with the silver strip in it, a minimum of 5 mm of liquid shall be above the top surface of the strip.

6.3 *Test Bath, General,* whether liquid or solid, the test bath shall be able to maintain the test temperature to within ±1 °C (2 °F) of the required test temperature. It is recommended that baths be placed inside a fume-hood.

6.3.1 *Bath,* shall be fitted with suitable supports to hold each test tube (see 6.2) in a vertical position to a depth of about 100 mm (4 in.) as measured from the bottom of the test tube to the bath surface.

6.3.2 *Bath Medium,* as a liquid bath medium, both water and oil have been found to be satisfactory and controllable at the specified test temperature and duration required by the test procedure.

6.3.3 *Solid Block Bath,* made of aluminum, shall meet the test temperature control, test duration, and immersion conditions required by the test procedure, and shall be verified, at least annually, for temperature measurement (heat transfer) by running tests on tubes filled with 30 mL of product plus a thin silver strip of the given nominal dimensions, plus a temperature sensor.

6.3.3.1 Wells provided in the solid block bath to accommodate pressure vessels (see Fig. 1) shall be of the following dimensions: ~54 mm (2⅛ in.) diameter from top, up to a depth of ~70 mm (2¾ in.) continuing with an opening of ~38 mm (1½ in.) diameter up to a depth of ~140 mm (5½ in.). An opening of ~8 mm (5⁄16 in.) diameter by ~210 mm (8¼ in.) depth shall be provided in the center of the block for immersion of a metal temperature sensor (connected to a suitable 50 °C ± 1 °C (122 °F ± 2 °F) temperature controller), or thermometer (see 6.5).

6.3.3.2 Wells provided in the solid block bath to accommodate test tubes shall be of the following dimensions: ~20 mm (1⁄16 in.) diameter by ~140 mm (5½ in.) deep. An opening of ~8 mm (5⁄16 in.) diameter by ~210 mm (8¼ in.) depth shall be provided in the center of the block for immersion of a metal temperature sensor (connected to a suitable 50 °C ± 1 °C (122 °F ± 2 °F) temperature controller), or thermometer (see 6.5).

6.3.3.3 Provide insulation made of ~25.4 mm (1.0 in.) thick fiberglass with aluminum backing (or, similar insulation) to cover all the four sides of the solid block bath.

6.4 *Silver Strip Centering Device (SSCD),*[5,6]made of material which is gasoline-compatible at 50 °C (122 °F) for the duration of the test, such as Acetal Resin, White Nylon 6/6, or

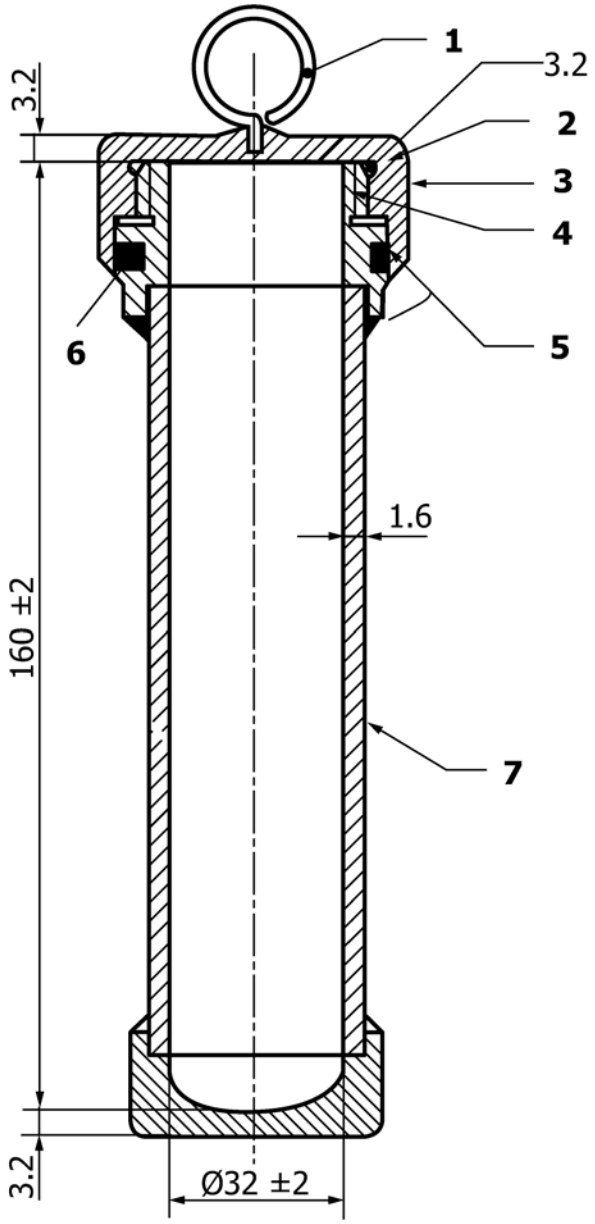
[5] The sole source of supply of the apparatus known to the committee at this time is K & C Manufacturing, 210 S. Main, Newkirk, OK 74647.

[6] If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

TABLE 1 Silver Strip Classifications

NOTE 1—Acknowledgement—This table has been reproduced from Standard IP 227.

Classification	Designation	Description
0	No Tarnish	Identical to a freshly-polished strip but may have some very slight loss of luster
1	Slight Tarnish	Faint brown or white discoloration of strip (see 12.2)
2	Moderate Tarnish	Peacock colors such as blue or mauve or medium/dark straw or brown coloration (see 12.2)
3	Slight blackening	Spots and patches of black or gray on surface or uniform thin film of black deposit
4	Blackening	Uniform heavy blackening with or without scaling



Key:
1. Lifting eye
2. Wide groove for pressure relief
3. Knurled cap
4. Twelve threads per inch NF thread or equivalent
5. Camber inside cap to protect "O" ring when closing pressure vessel
6. Synthetic rubber "O" ring without free sulfur
7. Seamless tube

Material: stainless steel
Welded construction
Maximum test gauge pressure: 700 kPa

NOTE 1—Dimensions in millimetres.

NOTE 2—All dimensions without tolerance limits are nominal values.

FIG. 1 Pressure Vessel for Silver Strip Corrosion Test – Procedure A

PTFE. See details in A1.1 (Assembly View) and A1.2 (Individual Parts View). Length of SSCD inside the test tube is such that the lower edge of the assembled silver strip is about 22 mm (⅞ in.) from the bottom of the test tube.

6.5 *Temperature Sensing and Monitoring Device (TSMD),* capable of sensing and monitoring the desired test temperature in the bath to within an accuracy of ±1 °C (2 °F). The ASTM 12C (12F) (see Specification E1) or IP 64C (64F) total immersion thermometer has been found suitable for use in the test. If used, no more than 10 mm (0.4 in.) of the mercury shall extend above the surface of the bath at the test temperature.

6.6 *Timing Device,* electronic or manual, capable of accurately measuring the test duration within the allowable tolerance.

6.7 *Forceps,* with inert tips, stainless steel or polytetrafluoroethylene (PTFE) tips, have been found suitable for use in handling the silver strips.

6.8 *Polishing Board,* 150 mm by 100 mm by 3 mm (6 in. by 4 in. by ⅛ in.) solid plastic piece having a smooth surface, for placement of silver strip during polishing.

6.9 *Optional Equipment:*

6.9.1 *Refrigerator,* for cooling samples below 5 °C (41 °F) during storage.

6.10 *ASTM Silver Strip Corrosion Standards,* consist of reproductions in color of typical test strips representing increasing degrees of tarnish and corrosion, the reproductions being encased for protection in plastic and made up in the form of a plaque. See Table 1.

6.10.1 Keep the plastic-encased ASTM Silver Strip Corrosion Standards protected from light to avoid the possibility of fading. Inspect for fading by comparing two different plaques, one of which has been carefully protected from light (for example, new plaque). Observe both sets in diffused daylight (or equivalent) first from a point directly above and then from an angle of 45°. If any evidence of fading is observed, particularly at the left-hand end of the plaque, it is suggested that the one that is the more faded with respect to the other be discarded.

6.10.1.1 Alternatively, place a suitably sized opaque strip (for example, 20 mm (¾ in.) black electrical tape) across the top of the colored portion of the plaque when initially purchased. At intervals remove the opaque strip and observe. When there is any evidence of fading of the exposed portion, the standards shall be replaced.

6.10.2 The plaques are full-color reproductions of typical strips. They have been printed on aluminum sheets by a 4-color process and are encased in plastic for protection. Directions for their use are given on the reverse side of each plaque.

6.10.3 If the surface of the plastic cover shows excessive scratching, it is suggested that the plaque be replaced.

7. Reagents and Materials

7.1 *Wash Solvent,* 2,2,4-trimethylpentane (iso-octane) of minimum 99.75 % purity. (**Warning—**Extremely flammable, see 8.1.)