Designation: D7671 – 21

Standard Test Method for Corrosiveness to Silver by Automotive Spark–Ignition Engine Fuel–Silver Strip Method[1]

This standard is issued under the fixed designation D7671; 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, 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. Procedure A involves the use of a pressure vessel, whereas Procedure B involves the use of a vented test tube.

1.2 The result of the test is based on a visual rating that is classified as an integer in the range from 0 to 4 as defined in Table 1.

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

1.5 *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 and Section 7.

1.6 *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 Standard:*

IP 227 Determination of Corrosiveness to Silver of Aviation Turbine Fuels–Silver Strip Method[3]

2.3 *ASTM Adjuncts:*

Color Standard for Tube Deposit Rating[4]

3. Summary of Test Method

3.1 This test method covers two procedures. Procedure A involves the use of a pressure vessel (to prevent the loss of volatile components in the sample), whereas Procedure B involves the use of a vented test tube. In both procedures, a freshly polished silver strip is suspended in 30 mL of sample which is heated to 50 °C ± 1 °C for a duration of 3 h ± 5 min. At the end of the heating period, the silver strip is removed, washed and the color and tarnish level assessed against the requirements in Table 1.

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

Current edition approved Nov. 1, 2021. Published December 2021. Originally approved in 2010. Last previous edition approved in 2021 as D7671 – 10 (2021). DOI: 10.1520/D7671-21.

[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] Withdrawn without replacement in 2001. Copies of IP 227/99 can be obtained at The Publications Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR, United Kingdom.

[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**

TABLE 1 Silver Strip Classifications

NOTE 1—Classifications provided by IP 227 Determination of Corrosiveness to Silver of Aviation Turbine Fuels–Silver Strip Method.

NOTE 2—Distinctions between Classifications 1 and 2 are made using The Color Standard for Tube Deposit Rating (referenced in Test Method D3241) in accordance with 11.1.1.

Classification	Designation	Description
0	No tarnish	Identical to a freshly polished strip, but may have some very light loss of luster
1	Slight tarnish	Faint brown or white discoloration of strip (see 12.1)
2	Moderate tarnish	Peacock colors such as blue or mauve or medium/dark straw or brown coloration (see 12.1)
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

4. Significance and Use

4.1 Crude petroleum contains sulfur compounds, most of which are removed during refining. However, of the sulfur compounds remaining in the petroleum product, some can have a corroding action on various metals and this corrosivity is not related to the total sulfur content. In addition, fuels can become contaminated by corrosive sulfur compounds during storage and distribution. The corrosive effect can vary according to the chemical types of sulfur compounds present.

4.2 The silver strip corrosion test is designed to assess the relative degree of corrosivity of a petroleum product towards silver and silver alloys.

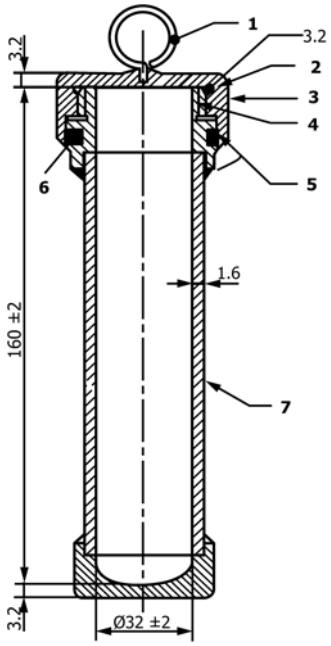
4.3 Reactive sulfur compounds present in automotive spark-ignition engine fuels under some circumstances can corrode or tarnish silver alloy fuel gauge in-tank sender units (and silver-plated bearings in some 2-stroke cycle engines). To minimize or prevent the failure of silver alloy in-tank sender units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

5. Apparatus

5.1 *Silver Strip Corrosion Pressure Vessel (Procedure A),* constructed from stainless steel or similar strong and non-corroding metallurgy according to the dimensions as given in Fig. 1, that is the apparatus described in Test Method D130. The vessel shall be capable of withstanding a test pressure of 700 kPa gauge (100 psi).

5.1.1 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 those shown in Fig. 1. The internal dimensions of the pressure vessel are such that a nominal 25 mm by 150 mm test tube can be placed inside the pressure vessel.

5.2 *Test Tubes,* of borosilicate glass of nominal 25 mm by 150 mm dimensions. The internal dimensions shall be checked as acceptable by use of a silver strip (see 6.3). When 30 mL of liquid 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.



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)

5.3 *Stoppers (Procedure B),* such as cork, to accompany test tubes in 5.2. Each stopper shall have a vent hole to equilibrate pressure that may build up in the test. The stoppers should be drilled through the center and fitted with a length of 3.2 mm (⅛ in.) OD glass or Nalgene vent tube.

5.4 *Silver Strip Suspension Assembly,* such as examples shown in Fig. 2 (Procedure A) or Fig. 3 (Procedure B), capable of suspending the silver strip in approximately the center of the sample-filled test tube during the test, such that the strip is kept in an upright and vertical position.

5.4.1 For Procedure A, a cradle of glass, polytetrafluoroethylene or other inert material connected to a holder of sufficient length and width as shown in Fig. 2 has been found suitable to use.

5.4.2 For Procedure B, a cable tie (see 6.2) wrapped around the edges of the strip and inserted through the stopper has been found suitable to use for this purpose as shown in Fig. 3.

5.4.3 Other assemblies or designs capable of meeting the functional requirement may also be used in Procedures A or B.

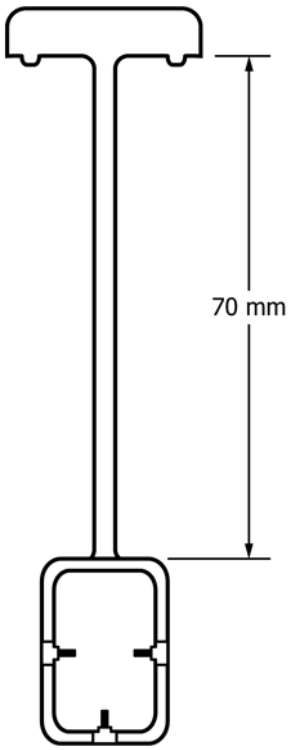
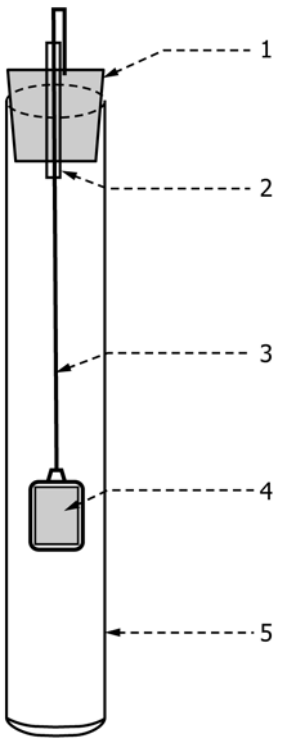


FIG. 2 Silver Strip Suspension Assembly (Procedure A)



Key:
1. Stopper
2. Vent tube
3. Cable tie
4. Silver strip
5. Test tube

FIG. 3 Silver Strip Suspension Assembly (Procedure B)

5.5 *Test Bath:*

5.5.1 *General*—The test baths shall be able to maintain the test temperature to within ±1 °C (2 °F) of the required test temperature (normally 50 °C).

5.5.2 *Liquid Bath Used for Submerging Pressure Vessel(s) (Procedure A)*—The bath shall be deep enough to submerge one or more pressure vessels (see 5.1) completely during the test. As the bath medium, use water or any liquid that can be satisfactorily controlled to the sample test temperature. The bath shall be fitted with suitable supports to hold each pressure vessel in a vertical position when submerged. The use of a solid block bath has been found as a suitable alternative to the liquid bath.

5.5.3 *Liquid Bath Used for Vented Test Tube Method (Procedure B)*—The bath liquid level shall be at a level that is higher than the liquid level in the test tube at the test temperature. It is recommended that the bath be placed inside an exhaust hood.

5.5.4 The use of a solid block bath has been found to be a suitable alternative to the liquid bath.

5.6 *Temperature Sensing Device (TSD),* capable of monitoring the desired test temperature in the bath to within accuracy of ±1 °C (2 °F), measured in the middle of the liquid bath. The ASTM 12C (12F) (see Specification E1) or ASTM E2251 (see Specification E1) or IP 64C (64F) total immersion thermometers have been found suitable for use in the test. If used, no more than 10 mm (0.4 in.) of the mercury should extend above the surface of the bath at the test temperature.

5.7 *Polishing Vise,* for holding the silver strip firmly without marring the edges while polishing. Any convenient type of holder (see Appendix X1) may be used provided that the strip is held tightly and that the surface of the strip being polished is supported above the surface of the holder.

5.8 *Viewing Test Tubes,* (optional) flat glass test tubes, are convenient for protecting corroded silver strips for close inspection or storage (see Appendix X1 for the description of a flat-glass viewing tube). The viewing test tube shall be of such dimensions as to allow the introduction of a silver strip (see 6.3) and made of glass free of striae or similar defects.

5.9 *Forceps,* with either stainless steel or polytetrafluoroethylene tips, for use in handling the silver strips, have been found suitable to use.

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

5.11 *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.

5.11.1 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