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An American National Standard

Standard Test Method for Copper Strip Corrosion by Liquefied Petroleum (LP) Gases[1]

This standard is issued under the fixed designation D 1838; 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.

ε[1] NOTE—Warning notes were placed in the text editorially in May 2001.

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.H0 on Liquefied Petroleum Gas.

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1. Scope *

1.1 This test method detects the presence of components in liquefied petroleum gases which may be corrosive to copper.

NOTE 1—For an equivalent copper strip test applicable to less volatile petroleum products, see Test Method D 130.

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

1.3 *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 and health practices and determine the applicability of regulatory limitations prior to use.* For specific hazard warning statements, see 6.1, 8.3.1, and Annex A1.

2. Referenced Documents

2.1 *ASTM Standards:*

D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test[2]

E 1 Specification for ASTM Thermometers[3]

2.2 *ASTM Adjuncts:*

ADJD0130, ASTM Copper Strip Corrosion Standards[4]

3. Summary of Test Method

3.1 A polished copper strip is immersed in approximately 100 mL of the sample and exposed at a temperature of 37.8°C (100°F) for 1 h in a cylinder of suitable working pressure. At the end of this period, the copper strip is removed and rated as one of the four classifications of the ASTM Copper Corrosion Standards.

4. Significance and Use

4.1 Copper corrosion limits provide assurance that difficulties will not be experienced in deterioration of the copper and copper-alloy fittings and connections that are commonly used in many types of utilization, storage, and transportation equipment.

5. Apparatus

5.1 *Corrosion Test Cylinder*, constructed of stainless steel with an O-ring removable top closure according to the dimensions given in Fig. 1. Provide a flexible aluminum connecting hose with swivel connections with adapter to a 6.4 mm (¼-in.) pipe. The whole assembly shall be capable of withstanding a hydrostatic test pressure of 6895 kPa (1000 psig). No leak shall be discernible when tested at 3450 kPa (500 psig) with gas.

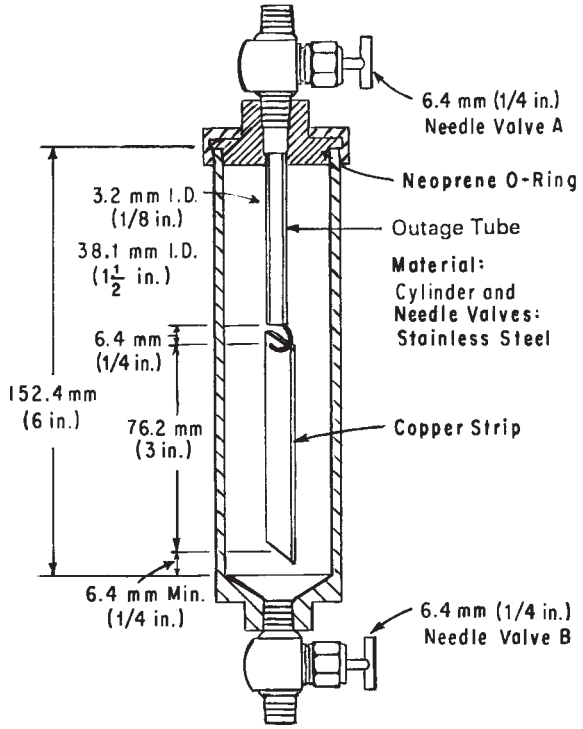
5.2 *Water Bath*, capable of being maintained at 37.8 ± 0.5°C (100 ± 1°F). Incorporate suitable supports to hold the test cylinder in an upright position. Make the bath deep enough so that the entire cylinder and valves will be covered during the test.

5.3 *Thermometer*—An ASTM Density Thermometer having a range from − 20 to 105°C (− 5 to + 215°F), graduated Temperature Sensing Device (TSD)— Capable of monitoring the desired test temperature in 0.2°C (0.5°F) subdivisions, and conforming to the

[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 14.03.

[4] The ASTM Copper Strip Corrosion Standards approved by Committee D-2 are available Available from ASTM International Headquarters. Request Order Adjunct No. ADJD0130.



Metric Equivalents

in.	mm	in.	mm
⅛	3.2	3	76
~~¼~~	~~6.4~~		
¼	6.4	6	152
~~1½~~	~~38.1~~	~~6~~	~~152~~
1½	38.1		

FIG. 1 Copper Strip Corrosion Test Cylinder

~~requirements for Thermometer~~ bath to within an accuracy of ±0.5°C (1°F) or better. The ASTM 12C ~~(12F), as prescribed~~ (12F) total immersion thermometer has been found suitable to use in the test (see Specification E 1). If used, no more than 25 mm (1 in.) of the mercury should extend above the surface of the bath at the test temperature.

5.4 *Strip Polishing Vise*, to hold the copper strip firmly without marring the edges. For convenient vises see Test Method D 130.

6. Materials

6.1 *Wash Solvent*—Use acetone or knock test grade 2.2.4 trimethylpentane. (**Warning—** Extremely flammable. See Annex A1.)

6.2 *Copper Strip*, approximately 12.5 mm (½ in.) wide, 1.5 to 3.0 mm (1⁄16 to ⅛ in.) thick, cut approximately 75 mm (3 in.) long from smooth-surfaced, hard-temper, cold-finished copper of ~~99.9 + percent~~ 99.9 + % purity; electrical bus bar stock is generally suitable. Drill a 3.2 mm (⅛ in.) hole approximately 3.2 mm (⅛ in.) from one end in the center of the strip. The strips ~~can~~ may be used repeatedly but should be discarded if ~~the~~ surfaces become deformed.

6.3 *Surface Preparation/Polishing Materials*—S00 grade or finer steel wool; silicon carbide grit paper or cloth of ~~various~~ varying degrees of fineness including 65-µm (240-grit) ~~paper or cloth;~~ grade; also a supply of 105-µm (150-mesh) size silicon carbide grain or powder and absorbent cotton. A commercial grade is suitable, but pharmaceutical grade ~~absorbent~~ cotton ~~(cotton wool).~~ wool is most commonly available and is acceptable.

6.4 *Copper Corrosion Standard Plaques* are available.[4] Their care and inspection for stability are described in detail in Test Method D 130.

7. Preparation of Strips

7.1 *Surface Preparation*—Remove all surface blemishes from all six sides of the strip obtained from a previous analysis. One way to accomplish this is to use 00 grade or finer steel wool or silicon carbide ~~grit~~ paper or cloth of such degrees of fineness as are needed to accomplish the desired results efficiently. Finish with 65-µm (240-grit) silicon carbide paper or cloth, removing all marks that ~~were~~ may have been made by other grades of paper used previously. ~~Immerse~~ Ensure the prepared copper strip is protected from oxidation prior to final preparation, such as by immersing the strip in wash solvent from which it can be withdrawn immediately for finish prepa~~l~~ration (polishing) or in which it can be stored for future use.

7.1.1 As a practical manual ~~polishing procedure, place~~ procedure for surface preparation, a sheet of ~~the~~ silicon carbide paper may be placed on a flat surface~~,~~ and then moisten ~~it~~ the paper with wash solvent ~~and rub~~ before rubbing the strip against the silicon

carbide paper or cloth with a ~~rotary motion, protecting~~ circular motion. Protect the strip from contact with the fingers ~~wit~~, such as by using ashless filter paper. Alternatively, the surface of the strip can be prepared by use of motor-driven machines using appropriate grades of dry paper ~~on~~ or cloth.

7.2 *Final ~~Polishing~~* —~~Remove~~ Preparation—For strips prepared in 7.1 or new strips being used for the first time, remove a strip from its protected location, such as by removing it from the wash solvent. ~~Holding it in the fingers protected with ashless filter paper, polish~~ Polish first the ends and then the sides with the 105-μm (150-μm mesh) silicon carbide grains picked up ~~from a clean glass plate~~ with a pad of absorbent cotton moistened with ~~a drop of~~ wash solvent, making sure that the surface is protected from coming in contact with the fingers, such as by using ashless filter paper. Wipe vigorously with fresh pads of absorbent cotton and subsequently handle ~~only~~ without touching the surface of the strip with ~~stainless steel forceps; do not touch with~~ the fingers. ~~Clamp~~ Padded forceps (to prevent the scratching of the surface) have been found suitable to use. Secure the copper strip in a vise or suitable holder and polish the main surfaces with silicon carbide grains on absorbent cotton. Do not polish in a circular motion. Rub in the direction of the long axis of the strip, carrying the stroke beyond the end of the strip before reversing the direction. Clean all metal dust from the strip by rubbing vigorously with clean pads of absorbent cotton until a fresh pad remains unsoiled. When the strip is clean, with m~~med~~inimal delay, attach to the dip tube and ~~immerse it in~~ lower into the prepared corrosion test ~~bomb.~~ cylinder (see Fig. 1).

7.2.1 It is important to polish the whole surface of the strip uniformly to obtain a uniformly stained strip. If the edges show wear (surface elliptical) they will likely show more corrosion than the center. The use of a vise will facilitate uniform polishing.

7.2.2 It is important to follow the order of preparation with the correctly sized silicon carbide material as described in 7.1 and 7.2. The final preparation is with 105-μm silicon carbide grain. This is a larger grain size than the 65-μm paper used in the surface preparation stage. The reason for this use of larger silicon carbide grains in the final preparation is to produce asperities (controlled roughness) on the surface of the copper, which acts as sites for the initiation of corrosion reactions.

8. Procedure

8.1 With valve *B* (Fig. 1), open, place approximately 1 mL of distilled water into a clean test cylinder and swirl to moisten the walls; allow the remainder to drain from the cylinder, insert the freshly polished copper strip suspended from the hook on the dip tube making sure that the bottom of the strip is at least 6.4 mm (¼ in.) from the bottom of the cylinder when assembled. After assembly of the apparatus, close both valve *A* (Fig. 1), on closure assembly with outage tube, and valve *B*.

8.2 Holding the test cylinder upright so as not to wet the copper strip with water, attach the sample source to the test cylinder valve A (Fig. 1) by means of a short length of flexible aluminum tubing that has been purged with the sample. Admit some sample to the cylinder by opening the valve at the sample source and then valve A.

8.3 Close valve A without disconnecting the test cylinder from the sample source. Invert the test cylinder and open valve B to purge the air from the test cylinder. Return the test cylinder to the upright position and drain any residual liquid through the open valve B. Close valve B with the test cylinder now in its upright position, open valve A and fill the test cylinder with the sample. When the test cylinder is full, close valve A, the valve at the sample source, and disconnect the aluminum tubing.

8.3.1 (**Warning**—Safe means for the disposal of vapors and liquids during this and subsequent procedures must be provided.)

8.4 As soon as the aluminum tubing is disconnected, and with the cylinder in its upright position, open valve A slightly so that all liquid above the end of the outage tube will be removed from the test cylinder. When vapor first emerges from valve A, close valve A.

8.5 Immediately after filling, and venting as described in 8.4, immerse the test cylinder in the water bath maintained at 37.8 ± 0.5°C (100 ± 1°F). Allow the cylinder to remain in the bath for 1 h ± 5 min.

8.6 At the end of the test period remove the cylinder from the bath and, holding the cylinder in a vertical position, open the bottom valve to a suitable disposal unit (8.3.1) until all of the liquid and most of the vapor is discharged.

8.7 When only a slight pressure remains in the cylinder, disassemble immediately and compare at once the copper strip that has been exposed to the liquefied petroleum gases with the ASTM Copper Strip Corrosion Standards.

8.8 Handling only with stainless steel forceps, compare the exposed strip with the ASTM Copper Strip Corrosion Standards. Hold both the test strip and the standard in such a manner that light reflected from them at an angle of approximately 45° will be observed. In handling the test strip during the inspection and comparison, the danger of marking or staining can be avoided if it is inserted in a flat test tube which is then stoppered with absorbent cotton.

8.9 If the copper strip shows any appreciable discoloration, the interior of the cylinder should be polished with steel wool and washed with wash solvent soon after use so as to be clean for another test.

9. Report

9.1 Report the results in accordance with one of the classifications listed in Table 1. State the duration of the test and the test temperature.

9.2 The added distilled water frequently causes isolated brown spots on the copper strip. The presence of these spots should be disregarded or the test should be repeated.

10. Precision and Bias

10.1 In the case of ordinal classification data, no generally accepted method for determining precision or bias is currently available.

TABLE 1 ASTM Copper Strip Classifications

Classification	Designation	Description[A]
Freshly polished strip	...	[B]
1	Slight tarnish	Light orange, almost the same as a freshly polished strip
		Dark orange
2	Moderate tarnish	Claret red
		Lavender
		Multicolored with lavender blue and/or silver overlaid on claret red
		Silvery
		Brassy or gold
3	Dark tarnish	Magenta overcast on brassy strip
		Multicolored with red and green showing (peacock), but no gray
4	Corrosion	Transparent black, dark gray or brown with peacock green barely showing
		Graphite or lusterless black
		Glossy or jet black

[A] The ASTM Copper Corrosion Standard is made up to strips characteristic of these descriptions.

[B] The freshly polished strip is included in a series only as an indication of the appearance of a properly polished strip before a test run; it is not possible to duplicate this appearance after a test even with a completely noncorrosive sample.

11. Keywords

11.1 copper corrosion; copper strip; liquefied petroleum gases

ANNEX

(Mandatory Information)

~~**A1. PRECAUTIONARY**~~

A1. WARNING STATEMENT

A1.1 2.2.4 Trimethylpentane

A1.1.1 Keep away from heat, sparks, and open flame.

A1.1.2 Keep container closed.

A1.1.3 Use with adequate ventilation.

A1.1.4 Avoid build-up of vapors and eliminate all sources of ignition, especially non-explosion proof electrical apparatus and heaters.

A1.1.5 Avoid prolonged breathing of vapor or spray mist.

A1.1.6 Avoid prolonged or repeated skin contact.

SUMMARY OF CHANGES

Subcommittee D02.H0 has identified the location of selected changes to this standard since the last issue (D 1838–91(2001)$^{\epsilon 1}$) that may impact the use of this standard.

(1) Updated paragraphs 5.3, 6.2, 6.3, 7.1, 7.1.1, 7.2, and 7.2.2 to be consistent with Test Method D 130.