INTERNATIONAL STANDARD 2160

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION • МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ • ORGANISATION INTERNATIONALE DE NORMALISATION

ex. Iso
par ISO 2160 : 1985

Petroleum products — Corrosiveness to copper — Copper strip test

First edition — 1972-11-01

UDC 662.75 : 620.193 : 546.56

Ref. No. ISO 2160-1972 (E)

Descriptors : petroleum products, tests, corrosion tests, copper

Price based on 5 pages

FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2160 was drawn up by Technical Committee ISO/TC 28, *Petroleum products.*

It was approved in July 1971 by the Member Bodies of the following countries :

Australia	Ireland	South Africa, Rep. of
Austria	Israel	Spain
Belgium	Italy	Sweden
Chile	Korea, Rep. of	Switzerland
Czechoslovakia	Netherlands	Turkey
Egypt, Arab Rep. of	New Zealand	United Kingdom
France	Poland	U.S.A.
Germany	Portugal	U.S.S.R.
India	Romania	

No Member Body expressed disapproval of the document.

Printed in Switzerland

Petroleum products — Corrosiveness to copper — Copper strip test

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies a method for evaluating the corrosive tendencies towards copper of petroleum products such as aviation gasoline, aviation turbine fuel, automotive gasoline, farm tractor fuel, cleaners (Stoddard) solvent, kerosine, diesel fuel, distillate fuel oil, and lubricating oil.[1)]

2 PRINCIPLE

A polished copper strip is immersed in a given quantity of sample and heated at a temperature and for a time specified for the material being tested. At the end of this period, the copper strip is removed, washed, and compared with corrosion standards.

3 REAGENTS AND MATERIALS

3.1 Wash solvent

Any volatile, sulphur-free hydrocarbon solvent may be used provided that it shows no tarnish when tested at 50 °C (122 °F). Knock test grade *iso*-octane is a suitable solvent and shall be used in case of dispute. Details of the essential requirements of Knock test *iso*-octane are given in the Annex.

3.2 Copper strip

Copper strips 12,5 mm ($^1/_2$ in) wide, 1,5 to 3,0 mm ($^1/_{16}$ to $^1/_8$ in) thick, 75 mm (3 in) long, cut from smooth-surfaced, hard-temper, cold-finished, electrolytic type copper of 99,9 + % purity; electrical bus-bar stock is generally suitable.

The strips may be used repeatedly but shall be discarded when they show pitting or deep scratches that cannot be removed, or when the surfaces become deformed on handling.

3.3 Polishing materials

Silicon-carbide or alumina abrasive paper of varying degrees of fineness including 63 μm (240 grit) silicon-carbide paper or cloth, or equivalent; also a supply of 90 μm (150 mesh) silicon-carbide powder, and pharmaceutical grade absorbent cotton (cotton wool).

4 APPARATUS

4.1 Test bomb, constructed of stainless steel according to the dimensions shown in Figure 1, and capable of withstanding a test pressure of 7 bar (100 lbf/in^2). Alternative designs for the bomb cap and synthetic rubber gasket may be used provided that the internal dimensions of the bomb are the same as those shown in Figure 1.

4.2 Test tubes, 25 mm × 150 mm, as liners for the test bomb, to hold the samples.

4.3 Water or other liquid bath, capable of being maintained at 100 ± 1 °C (212 ± 2 °F), and having suitable supports to hold the test bomb in a vertical position. The bath must be deep enough so that the entire bomb will be submerged during the test.

Dimensions in millimetres
(inch values in parentheses)

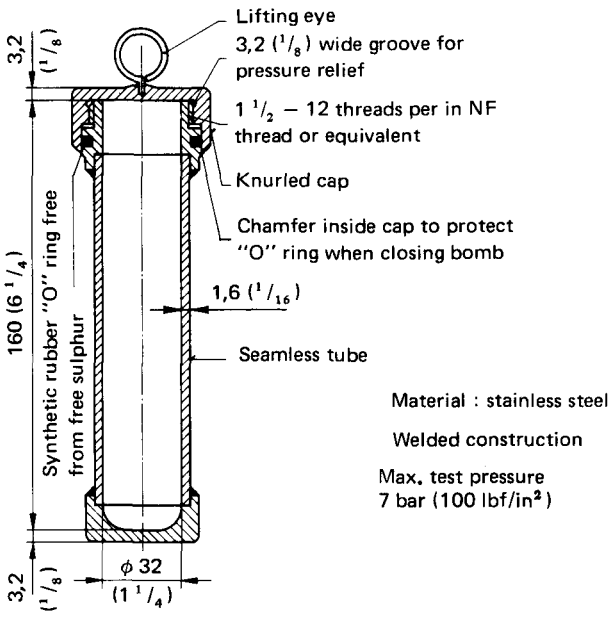

FIGURE 1 — **Test bomb for the copper strip corrosion test**

1) A different method of evaluating corrosive tendencies of electrical insulating oils is given in IEC Publication 296, *Specification for new insulating oils for transformers and switchgear.*

4.4 Water or oil bath, or aluminium block, for maintaining a constant temperature of 50 ± 1 °C (122 ± 2 °F) or 100 ± 1 °C (212 ± 2 °F), or both, and having suitable supports to hold the test tube (4.2) upright and submerged to a depth of about 100 mm (4 in).

4.5 Strip vice or holder, for holding copper strips firmly without marring the edges while polishing. Any convenient type of holder 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.

4.6 Viewing test tubes, flat, as shown in Figure 2, for protecting corroded strips during close inspection or during storage.

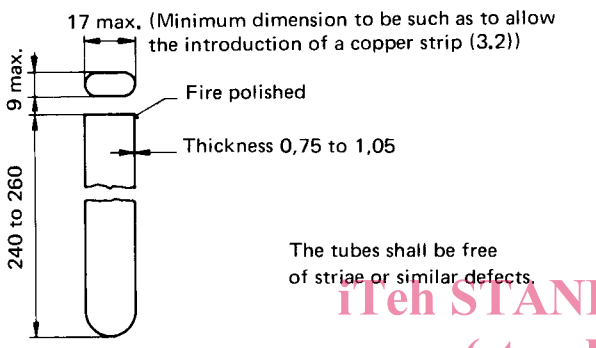

FIGURE 2 – **Viewing test tube**

4.7 Thermometers, total immersion, for indicating the required test temperature, 50 ± 1 °C or 100 ± 1 °C (122 ± 2 °F or 212 ± 2 °F), with the smallest graduations of 1 °C (2 °F) or less. No more than 25 mm (1 in) of the mercury thread shall extend above the surface of the bath at the test temperature.

5 CORROSION STANDARDS

The corrosion standards[1)] for this test consist of full-colour reproductions, printed on aluminium sheets by a 4-colour process, of typical test strips representing increasing degrees of tarnish and corrosion (see Table.) The reproductions are encased for protection in plastics in the form of a plaque. Directions for their use are given on the reverse side of each plaque.

The plastics-encased corrosion standards shall be protected from light to avoid the possibility of fading. They shall be inspected for fading by comparing two different plaques, one of which has been carefully protected from light (new). Both sets shall be observed 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 plaque that is the more faded with respect to the other be discarded.

Alternatively, a 20 mm ($^3/_4$ in) opaque strip (masking tape) shall be placed across the top of the coloured portion of the plaque when initially purchased. At intervals, the opaque strip shall be removed and an examination made for any evidence of fading of the exposed portion. If any fading has occurred, it is suggested that the corrosion standard be replaced.

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

TABLE – **Classification of corrosion standards**

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

* The corrosion standard is made up of strips characteristic of these descriptions.

** The freshly polished strip is included in the 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.

6 PREPARATION OF TEST STRIPS

6.1 Surface preparation

Remove all surface blemishes from all six sides of a copper strip (3.2) with silicon-carbide or alumina abrasive paper (3.3) of such degrees of fineness as are needed to achieve the desired results efficiently. Finish with 63 μm (240 grit)

1) Available from the Headquarters of the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103, USA.

silicon-carbide paper or cloth, removing all marks that may have been made by other grades of paper used previously. Immerse the copper strip in wash solvent (3.1) from which it may be withdrawn immediately for final polishing or in which it may be stored for future use.

As a practical manual procedure for surface preparation, place a sheet of the abrasive paper on a flat surface, moisten it with kerosine or wash solvent and rub the copper strip against the paper with a rotary motion, protecting the strip from contact with the fingers with an ashless filter paper. Alternatively, the surface of the copper strip may be prepared by use of motor-driven machines using appropriate grades of dry paper or cloth.

6.2 Final polishing

Remove a strip from the wash solvent. Holding it in the fingers, protected with ashless filter paper, polish first the ends and then the sides with the 90 μm (150 mesh) silicon-carbide powder (3.3) picked up from a clean glass plate with a pad of absorbent cotton moistened with a drop of wash solvent. Wipe vigorously with fresh pads of absorbent cotton and subsequently handle only with stainless steel forceps; *do not touch with the fingers.* Clamp in a vice (4.5) and polish the main surfaces with silicon-carbide powder on absorbent cotton. Rub in the direction of the long axis of the copper 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, immediately immerse it in the prepared sample.

NOTE — 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 be likely to show more corrosion than the centre of the strip. The use of a vice will facilitate uniform polishing.

7 SAMPLES

7.1 It is particularly important that all types of samples which should pass a low tarnish strip classification be collected in clean, dark glass bottles, plastic bottles or other suitable containers that will not affect the corrosive properties of the fuel. Avoid the use of tinplate containers for the collection of samples, since experience has shown that they may contribute to the corrosiveness of the sample.

7.2 Fill the containers as completely as possible and close them immediately after taking the sample. Take care during sampling to protect the samples from exposure to direct sunlight or even diffused daylight. Carry out the test as soon as possible after receipt at the laboratory, and immediately after opening the container.

7.3 If suspended water (haze) is observed in the sample, dry by filtering a sufficient volume of the sample through a medium rapid qualitative filter into a clean, dry test tube (4.2). Carry out this operation in a darkened room or under a light-protected shield.

NOTE — Contact of the copper strip with water before, during, or after the completion of the test run will cause staining, making it difficult to evaluate the strips.

8 PROCEDURE

8.1 Test conditions

Those product classes to which given procedural variations are intended to be applied are listed below. Some product classes, being quite broad, may be tested by more than one set of conditions; in such cases, the copper strip quality requirement for a given product shall be limited to a single set of conditions.

8.1.1 *Diesel fuel, fuel oil, automotive gasoline, kerosine, stove oil, farm tractor fuel*

Place 30 ml of sample, completely clear and free of any suspended or entrained water (see 7.3), into a chemically clean, dry test tube (4.2) and, within 1 min after completing the final polishing, slide the copper strip into the sample in the tube. Stopper with a vented cork and place in the bath (4.4) maintained at 50 ± 1 °C (122 ± 2 °F). Protect the contents of the test tube from strong light during the test. After 3 h ± 5 min in the bath, examine the strip as described in 8.2.

8.1.2 *Cleaners (Stoddard) solvent, diesel fuel, fuel oil, kerosine, lubricating oil*

Carry out the test as described in 8.1.1, but at a temperature of 100 °C (212 °F).

8.1.3 *Lubricating oil*

Tests may be carried out for varying times and at elevated temperatures other than 100 °C (212 °F). For the sake of uniformity, it is suggested that even increments of 30 °C (50 °F), beginning with a temperature of 120 °C (250 °F), be used.

8.1.4 *Aviation gasoline and aviation turbine fuel*

Place 30 ml of sample, completely clear and free of any suspended or entrained water (see 7.3), into a chemically

clean, dry test tube (4.2) and within 1 min after completing the final polishing, slide the copper strip into the sample in the tube. Carefully slide the test tube into the test bomb (4.1) and screw the lid on tight. Completely immerse the test bomb in the water bath (4.3) at 100 ± 1 °C (212 ± 2 °F). After 2 h ± 5 min in the bath, withdraw the bomb and immerse for a few minutes in tap water. Open the bomb, withdraw the test tube and examine the strip as described in 8.2.

8.2 Strip examination

Empty the contents of the test tube into a 150 ml tall-form beaker, letting the copper strip slide in gently so as to avoid breaking the beaker. Immediately withdraw the strip with stainless steel forceps and immerse it in wash solvent. Withdraw the strip at once, dry with quantitative filter paper (by blotting and not by wiping), and inspect for evidence of tarnishing or corrosion by comparison with the corrosion standards. Hold both the test strip and the standards 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 tube (4.6) which is stoppered with absorbent cotton.

9 INTERPRETATION OF RESULTS

Interpret the corrosiveness of the sample accordingly as the appearance of the test strip agrees with that of one of the corrosion standards (see the Table in section 5).

9.1 When a strip is in the obvious transition state between that indicated by any two adjacent standards, judge the sample by the more tarnished standard. Should a strip appear to have a darker orange colour than standard 1, consider the observed strip as still belonging in classification 1; however, if any evidence of red colour is observed, the observed strip belongs in classification 2.

9.2 A claret red strip in classification 2 can be mistaken for a magenta overcast on brassy strip in classification 3 if the brassy underlay of the latter is completedly masked by a magenta overtone. To distinguish between the two, immerse the strip in wash solvent; the former will appear as a dark orange strip, while the latter will not change.

9.3 To distinguish between multicoloured strips in classifications 2 and 3, place the test strip in a test tube (4.2) and bring it to a temperature of 315 to 370 °C (600 to 700 °F) in 4 to 6 min with the tube lying on a hot-plate. Adjust the temperature while observing a high distillation thermometer in a second test tube. If the strip belongs in classification 2, it will assume the colour of a silvery and then a gold strip. If the strip belongs in classification 3 it will take on the appearance of a transparent black, etc., as described in classification 4.

9.4 Repeat the test if blemishes are observed due to finger prints or to spots from any particles or water droplets that may have touched the test strip during the digestion period.

9.5 Repeat the test also if the sharp edges along the flat faces of the strip appear to be in a classification higher than the greater portion of the strip; in this case it is likely that the edges were burnished during polishing.

10 TEST REPORT

Report the corrosiveness in accordance with one of the four numbered classifications listed in the Table and also state the following :

a) description of the sample (product type);

b) temperature of test;

c) duration of heating;

d) conditions of test;

e) reference to this International Standard.

ANNEX

SPECIFICATION FOR KNOCK TEST GRADE *ISO*-OCTANE

Density at 20 °C, g/ml	0,691 93 ± 0,000 15
Refractive index n_D^{20}	1,391 45 ± 0,000 15
Freezing point, °C	− 107,442 min.
Distillation :	
50 % recovered, °C	99,238 ± 0,025
Differential 80 % recovered minus 20 % recovered, °C	0,020 max.