INTERNATIONAL STANDARD

ISO 15720

First edition
2001-04-15

Metallic coatings — Porosity tests — Porosity in gold or palladium coatings on metal substrates by gel-bulk electrography

Revêtements métalliques — Essais de porosité — Porosité des revêtements d'or ou de palladium sur métaux par électrographie par gélification

Reference number
ISO 15720:2001(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15720 was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, Subcommittee SC 7, *Corrosion tests*.

Annexes A and B of this International Standard are for information only.

Introduction

This test method is an electrographic technique, "gel-bulk electrography." The specimen is made the anode in a cell containing a solid or semi-solid electrolyte of gelatin, conducting salts and an indicator. Application of current to this cell results in the migration of base metal ions through continuous pores. Reaction of cations with an indicator gives rise to coloured *reaction products* (not to be confused with *corrosion products)* at pore sites which may be counted through the clear gel. Individual spots are counted with the aid of a lense or low-power stereomicroscope.

The test method is designed to show whether the porosity level is less than or greater than a given value which, from experience, is considered by the user to be acceptable for the intended application.

These porosity tests involve corrosion reactions in which the products delineate defect sites in coatings. Since the chemistry and properties of these products do not resemble those found in natural or service environments, these tests can not be recommended for the prediction of the electrical performance of contacts unless correlation is first established with service experience.

This test method is suitable for coatings containing 75 % or more of gold on substrates of silver, nickel, copper and its alloys that are commonly used in electrical contacts. This test method is also suitable for coatings of 95 % or more of palladium on nickel, copper and its alloys, and for coatings of palladium-nickel alloy (75 % or more of palladium) on nickel, copper and its alloys.

This test method is capable of detecting porosity or other defects in gold or palladium coatings that could participate in substrate corrosion reactions. In addition, it can be used on contacts having complex geometry such as pin-socket contacts (although difficulty may be experienced in inspecting deep recesses).

This test is considered destructive because it reveals the presence of porosity by contaminating the surface with corrosion products and by it undercuts the corrodible metal at pore sites and at unplated areas. In addition, the surface is coated with a corrosive gel mixture which is difficult to remove completely. Any parts exposed to the gel test shall not be placed in service.

Metallic coatings — Porosity tests — Porosity in gold or palladium coatings on metal substrates by gel-bulk electrography

WARNING — This International 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 International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific hazard statements, see clause 6.

1 Scope

This test method covers equipment and techniques for determining porosity in noble metal coatings, particularly electrodeposits of gold, palladium and palladium-nickel alloy (70 % to 90 % palladium) and clad metals used on electrical contacts.

The gel-bulk procedure is not as sensitive to small pores and is more complex than porosity tests involving gaseous corrodants (see ISO 14647 and ISO 15721). It also involves more chemicals, preparation and auxiliary equipment.

This test is intended to be used for quantitative descriptions of porosity (such as number of pores per unit area or per contact) only on measurement areas where coatings have a sufficiently low pore density such that the corrosion sites are well separated and can be readily resolved. As a general guideline this can be achieved for pore densities up to about 25/cm^2.

Other porosity testing methods are outlined in ISO 10308. Detailed critical reviews of porosity testing are also available. Other porosity test methods are described in ISO 12687, ISO 14647 and ISO 15721.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 2064, *Metallic and other inorganic coatings — Definitions and conventions concerning the measurement of thickness.*

ISO 2079, *Surface treatment and metallic coatings — General classification of terms*.

ISO 2080, *Electroplating and related processes — Vocabulary*.

ISO 10308, *Metallic coatings — Review of porosity tests*.

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 2064, ISO 2079, ISO 2080 and ISO 10308 as well as the following apply.

3.1
decorations
coloured reaction products emanating from the pores that provide visual contrast with the gel medium

NOTE While non-standard terms are deprecated, the term decorations has had long-standing use in differentiating between coloured pore indicators and true corrosion products. The term can be found in the technical literature.

3.2
metallic coatings
Includes platings, claddings, or other metallic layers applied to the substrate

NOTE The coatings can comprise a single metallic layer or a combination of metallic layers.

3.3
porosity
The presence of any discontinuity, crack, or hole in the coating that exposes a different underlying metal

4 Apparatus

4.1 Test vessel, of glass, acrylic resin or other inert colourless transparent material. It shall have thin-walled flat sides and be of a size appropriate to the sample to be tested.

4.2 Power supply, rated at 0 A to 1 A and 0 V to 10 V dc; an electronically regulated, constant-current (± 5 %) apparatus is preferred.

4.3 dc milliammeter.

4.4 Separate dc voltmeter.

4.5 Cathode material, in the form of plain expanded foil or wire and made of titanium and coated with platinum, gold or other inert coating. Alternatively, platinum, gold or other inert metals may be used.

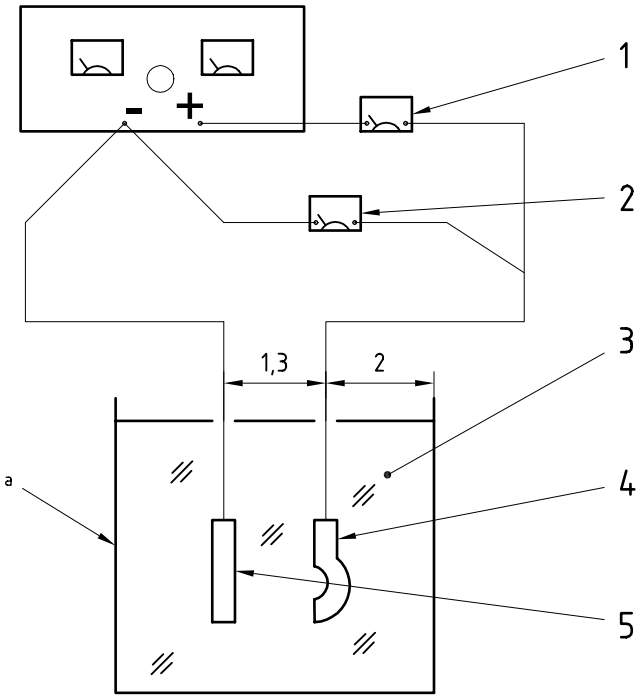
The cathode and specimen (anode) areas shall be approximately the same. Additional, gold or platinum wires for cathode and anode are needed for that portion of the electrical connection that is in the reagent solution. If small alligator clips are used to secure the lead wires to the cathode and anode they shall be heavily gold-plated so as to be entirely free of porosity. A variation of this procedure, suitable for samples with relatively few pores, is to use a second identical test sample as the cathode. The test can be run with current first in the forward, then in the reverse direction so that the porosity in both samples may be determined. Figure 1 is a diagram of the test cell setup.

NOTE A commonly used alternative cell design incorporates the cathode as part of the cell structure (as shown in Figure 2). In addition, the samples may be attached to a common carrier strip or holder, so that only the sample surfaces need be in the gel.

4.6 Timer, capable of indicating seconds.

4.7 Stereomicroscope, with ×10 magnification and an illuminator for sample inspection after test. An eyepiece reticule is recommended for convenience in locating the contact area or other significant measurement areas.

Dimensions in millimetres



Key

1 dc milliammeter (4.3)
2 dc voltmeter (4.4)
3 Gel
4 Contacts (anode)
5 Cathode (approximately same surface area as specimens under test)

a Observation at ×10 magnification of components *in situ*.

Figure 1 — Schematic representation of typical test-cell set-up; anode (sample) and cathode are facing each other (preferred orientation)