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Electrochemical impedance spectroscopy (EIS) on coated and uncoated metallic specimens —

Part 3: Processing and analysis of data from dummy cells

Spectroscopie d'impédance électrochimique (SIE) sur des éprouvettes métalliques revêtues et non revêtues —

Partie 3: Traitement et analyse des données obtenues à partir de cellules test

Reference number
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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 16773-3:2009), which has been technically revised. The main changes are the following:

a) the introductory element of the title, *Paints and varnishes*, has been omitted, because the scope is broadened to include metals and alloys and the main element of the title has been changed to: *Electrochemical impedance spectroscopy (EIS) on coated and uncoated metallic specimens*;

b) a reference to ISO/TR 16208 for dummy cells with low impedance values (10 Ω to 1 000 Ω) has been added;

c) a reference to ASTM G106 for the precision data of low impedance measurements has been added;

d) a test report has been added.

ISO 16773 consists of the following parts, under the general title *Electrochemical impedance spectroscopy (EIS) on coated and uncoated metallic specimens*:

— *Part 1: Terms and definitions*

— *Part 2: Collection of data*

— *Part 3: Processing and analysis of data from dummy cells*

— *Part 4: Examples of spectra of polymer-coated and uncoated specimens*

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Electrochemical impedance spectroscopy (EIS) on coated and uncoated metallic specimens —

Part 3:
Processing and analysis of data from dummy cells

1 Scope

This part of ISO 16773 specifies a procedure for the evaluation of the experimental set-up used for carrying out EIS on high-impedance coated samples. For this purpose, dummy cells are used to simulate high-impedance coated samples. On the basis of the equivalent circuits described, this part of ISO 16773 gives guidelines for the use of dummy cells to increase confidence in the test protocol, including making measurements, curve fitting and data presentation.

NOTE Due to the nature of the measurements, investigations of high-impedance coated samples are more susceptible to artefacts coming from electromagnetic interferences. Therefore, this part of ISO 16773 considers the aspects for measuring high-impedance samples by using appropriate dummy cells in a Faraday cage. However, most manufacturers offer complementary dummy cells in the low and medium impedance range. This allows checking the setup in the respective low impedance range.

2 Description of the dummy cells

2.1 General

A set of four equivalent circuits (dummy cells) is used to check the overall experimental arrangement. The dummy cells are mounted separately. Two types of equivalent circuit, A and B, are used, as shown in Figure 1. The specific electrical components of these four cells are given in Table 1. Dummy cells with low impedance values (10 Ω to 1 000 Ω) are described in ISO/TR 16208.

NOTE In Clause 8, the results of an interlaboratory test are used to evaluate the precision of this method. During the interlaboratory test, the participating laboratories also measured a fifth dummy cell consisting of an equivalent circuit of type B with unknown component values.

2.2 Components of the dummy cells

Each dummy cell consists of a combination of resistors and capacitors which are soldered directly onto a printed-circuit board (see Figures 1 and 2). Such networks of resistors and capacitors (equivalent circuits) are often used in work on high-impedance coated specimens.

NOTE Because of the very high overall resistance of circuits A and B, the resistor simulating the electrolyte can be neglected. Typically, the values of resistances R_1 and R_2 are above 100 MΩ whereas the electrolyte resistance is around 100 Ω to 500 Ω. As a consequence, the electrolyte resistance is not significant in this kind of EIS application.

The values of the components of the four dummy cells are chosen in accordance with the following considerations.

— Dummy cell 1 should check the input resistance as well as the input capacitance of the measurement equipment.

— Dummy cells 2 to 4 should check the capability of the evaluation software and the impedance measurement equipment to distinguish between only slightly different resistor/capacitor combinations.

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