
Viri napak pri uporabi elektrokemijske impedančne spektroskopije pri preiskavah premazov in drugih materialov (ISO/TR 5602:2021)

Sources of error in the use of electrochemical impedance spectroscopy for the investigation of coatings and other materials (ISO/TR 5602:2021)

Fehlerquellen bei der Anwendung elektrochemischer Elektroimpdanzspektroskopie bei der Untersuchung von Beschichtungen und anderer Stoffe (ISO/TR 5602:2021)

Sources d'erreur dans l'utilisation de la spectroscopie d'impédance électrochimique pour l'étude des revêtements et autres matériaux (ISO/TR 5602:2021)

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Paints and varnishes

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CEN ISO/TR 5602

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Sources d'erreur dans l'utilisation de la spectroscopie d'impédance électrochimique pour l'étude des revêtements et autres matériaux (ISO/TR 5602:2021)

Fehlerquellen bei der Anwendung elektrochemischer Elektroimpedanzspektroskopie bei der Untersuchung von Beschichtungen und anderer Stoffe (ISO/TR 5602:2021)

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European foreword

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*Sources d'erreur dans l'utilisation de la spectroscopie d'impédance
électrochimique pour l'étude des revêtements et autres matériaux*

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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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This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Electrochemical impedance spectroscopy is described in detail in ISO 16773-1 to ISO 16773-4. It became apparent during use of these standards that sources of error and measurement artefacts that lead to incorrect interpretations are not dealt with comprehensively. This document supplements the ISO 16773 series of standards to deal with this issue.

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Sources of error in the use of electrochemical impedance spectroscopy for the investigation of coatings and other materials

1 Scope

This document describes the main sources of error in the use of electrochemical impedance spectroscopy for the investigation of coatings and other materials. The sources of error listed here include all process steps from the set-up of the sample with the measuring cell right through to evaluation.

NOTE The sources of error discussed here do not represent a complete list.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4618, *Paints and varnishes — Terms and definitions*

ISO 16773-1, *Electrochemical impedance spectroscopy (EIS) on coated and uncoated metallic specimens — Part 1: Terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618, ISO 16773-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

limit impedance

minimum or maximum impedance that can be measured using the impedance spectrometer

3.2

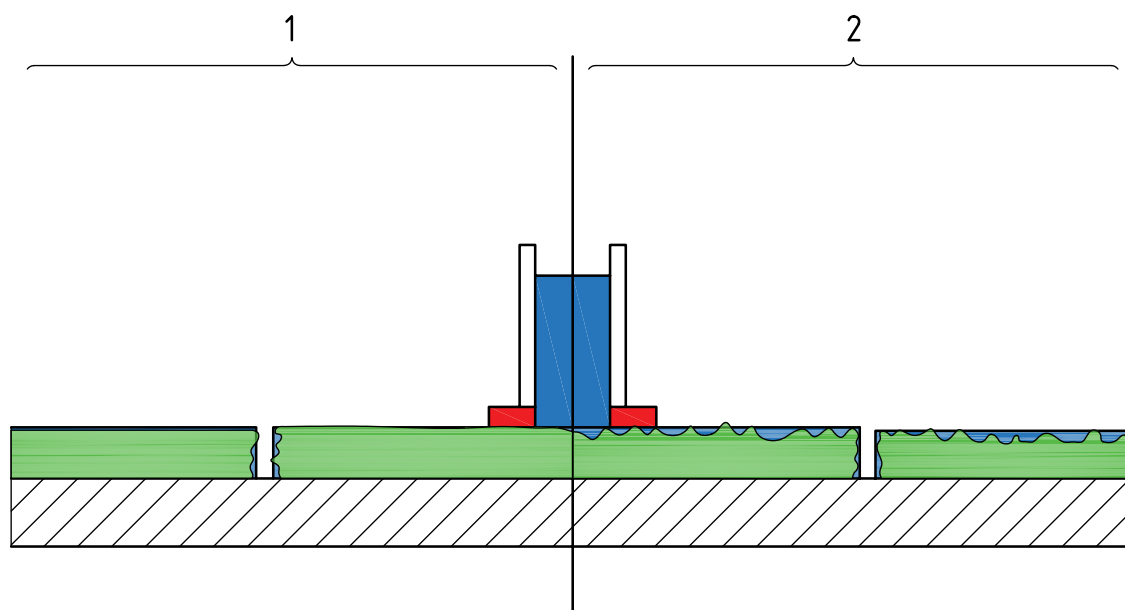
limit frequency

minimum or maximum frequency that can be set on the impedance spectrometer

4 Error in the make-up of the measuring cell

4.1 Roughness of the surface

A wet and rough surface could conduct stray currents to a scratch or artificial defect, see [Figure 1](#). This could yield in a spectrum showing a much lower resistance than in reality. Examples of spectra are shown in [Figure 2](#).

**Key**

1 without UV-irradiation

2 after UV-irradiation

□ PMMA tube

■ seal

■ coating

■ electrolyte

▨ steel

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Figure 1 — Conductive path from counter electrode to scratch due to surface roughness

The rough surface was measured on the unscratched area. Although the rough surface was dried with a tissue, the residual amount of water was sufficient to produce a conductive path via the scratch to the substrate. As result, the spectrum of the sample resulted in the incorrect identification of a defective coating. After 2 h of continuous immersion in the cell, the surface outside the cell had dried and the conductive path was interrupted, which resulted in a typical spectrum of an intact coating.

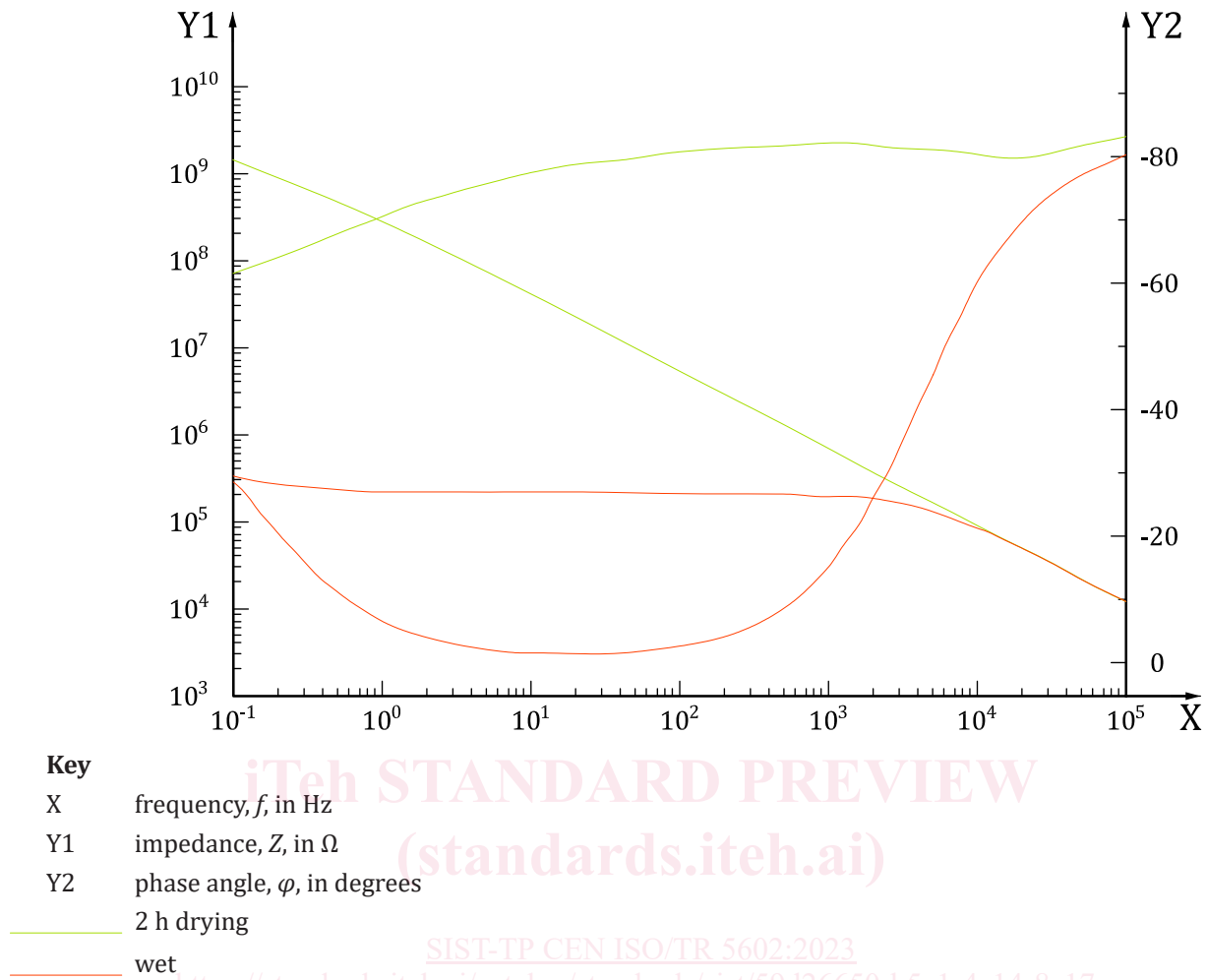
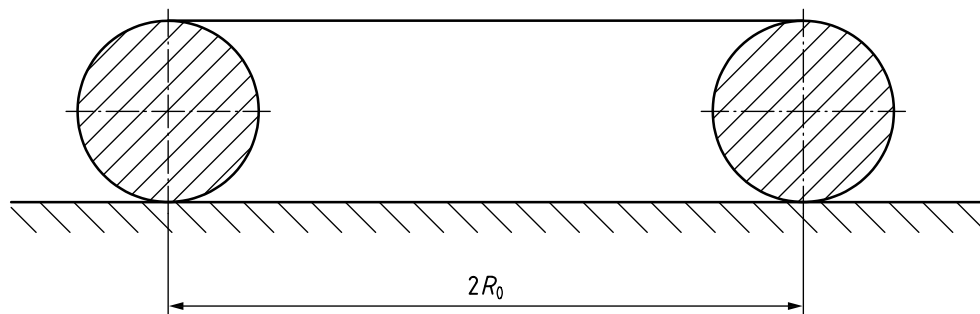


Figure 2 — EIS spectra of the initially wet coating and 2 h after drying

4.2 O-ring — Considerations about the precise determination of the exposed area

If an O-ring is used to seal the cell, the exposed area is smaller than the theoretically assumed area because the O-ring will be compressed, and therefore, the exposed area will be reduced (see Figure 3).



a) Ideal situation, uncompressed