



Technical Report

ISO/TR 5604

Electrochemical noise measurement for assessing the protection of metal afforded by organic coatings

*Mesurage du bruit électrochimique pour l'évaluation de la
protection du métal induit par des revêtements organiques*

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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principles	2
4.1 Organically coated metal exposed to a corrosive environment – how a resistance measurement can indicate protection	2
4.2 Generation of electrochemical noise from bare and coated metal	3
4.3 Evaluation criteria	3
5 Apparatus	3
5.1 Test cell	3
5.2 Field or site work	3
5.3 Reference electrode	4
5.4 Working electrode	4
5.5 Electrolyte	4
6 Description of the measurement system	4
7 Electrode configurations	5
7.1 General	5
7.2 Bridge (laboratory use)	5
7.3 Single substrate (laboratory use)	5
7.4 No connection to the substrate as used in the laboratory	6
7.5 Field measurement	7
8 Dummy cell and checking/calibration	7
9 Measurement	7
10 Data analysis and data treatment	8
11 Summary	8
Annex A (informative) Description of an experiment with resistors simulating a paint system	9
Annex B (informative) Data analysis and data treatment	11
Annex C (informative) Comparison of noise data from bare metal compared with organically coated metal	12
Bibliography	14

Foreword

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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

There are several test methods for assessing the protection afforded by organic coatings on metal, particularly on low carbon steel, using the available electrochemical measurements. The most commonly used technique is electrochemical impedance spectroscopy (EIS), which is detailed in the ISO 16773 series, and is well suited for laboratory use. However, there is a strong need for a non-intrusive technique that can be used on site to monitor or for quality control that is quick and is relatively simple to use and interpret.

This document gives the current state of the art for such a technique, which is electrochemical noise measurement (EN). The developments described in this document suggest that electrochemical noise measurement can be used as an alternative to and potentially even as the preferred process for field or on-site use.

For further information, a detailed description of the EN methodology when applied to bare metal can be found in ISO 17093. The differences associated with using the technique for organic coatings are described in this document, which is intended to complement ISO 17093.

The EN approach has been directly compared with methodologies such as EIS and DC resistance, with good agreement. [\[3\]](#)[\[4\]](#)

Furthermore, electrochemical noise applied to assess coatings has been reviewed in References [\[5\]](#) and [\[6\]](#), showing the potential for this technique.

Electrochemical noise measurement for assessing the protection of metal afforded by organic coatings

1 Scope

This document describes the principle of electrochemical noise measurement (EN), specifically focusing on the application of the technique to indicate the level of protection provided by an organic coating to the underlying metal. It discusses the principles behind the measurement method but also the type of electrochemical apparatus, the experimental set-up and electrodes configurations, the presentation of measured data, and analysis of results that have been used in the work done so far and reported in the references. This work has mainly been done in the laboratory, and there are some examples of work conducted in the field.

NOTE At the time of publication of this document, electrochemical noise measurement for coatings is mainly used by a number of academic groups. This document aims to encourage more general application of this method, particularly to field work.

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

ISO 17093, *Corrosion of metals and alloys — Guidelines for corrosion test by electrochemical noise measurements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16773-1, ISO 17093 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 electrochemical noise EN

fluctuation typically at low frequencies (≤ 1 Hz) and low amplitude in current and potential, generated by electrochemical reactions and other processes on the surface, for example, bubble evolution

3.2 electrochemical potential noise

fluctuation in potential of an electrode relative to a reference electrode or fluctuation in potential between two similar electrodes

Note 1 to entry: The electrochemical potential noise is expressed in microvolts (μV) or millivolts (mV).