INTERNATIONAL STANDARD

ISO 17463

Second edition
2022-01

Paints and varnishes — Guidelines for the determination of anticorrosive properties of organic coatings by accelerated cyclic electrochemical technique

Peintures et vernis — Lignes directrices pour la détermination des propriétés anticorrosives de revêtements organiques par une technique électrochimique cyclique accélérée

Reference number
ISO 17463:2022(E)

© ISO 2022



COPYRIGHT PROTECTED DOCUMENT

© ISO 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

© ISO 2022 – All rights reserved

Contents

Page

Foreword ..... **iv**
Introduction ..... **v**
1 Scope **1**
2 Normative references **1**
3 Terms and definitions **1**
4 Principle **2**
4.1 General 2
4.2 EIS measurement 2
4.3 Cathodic polarization 3
4.4 Potential relaxation 3
5 Apparatus **3**
6 Specimens **3**
6.1 Samples preparation 3
6.2 Environmental control 3
6.3 Number of specimens and repeatability of results 3
7 Procedure **4**
7.1 EIS measurement 4
7.2 Cathodic polarization 4
7.3 Relaxation process 4
7.4 Number of cycles 4
8 Data presentation **4**
8.1 Graphics for EIS 4
8.2 Graphics for the potential relaxation 5
9 Precision **5**
10 Test report **5**
Annex A (informative) **Typical example of results from coatings** **7**
Bibliography **14**

© ISO 2022 – All rights reserved

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 139, *Paints and varnishes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 17463:2014), which has been technically revised.

The main changes are as follows:

— the symbol for the potential has been changed from *U* to *E*;

— the specification of instrumental assembly has been deleted from the list in the scope;

— Bode plots and relaxation curves have been added as examples for the presentation of experimental results in the scope;

— the data presentation has been qualified to equally Nyquist plots in 8.1;

— degradation has been stated more precisely to change in A.2 and A.3;

— the text has been editorially revised and the normative references have been updated.

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.

© ISO 2022 – All rights reserved

Introduction

This document describes the determination of the anticorrosive properties of organic coatings by means of the accelerated cyclic electrochemical technique (ACET). The method is based on the so-called AC/DC/AC procedure. This technique allows comparing the protective and anticorrosive properties of different coating systems on metal in short times and in a qualitative and quantitative way. ACET consists of the application of cycles of electrochemical impedance spectroscopy (EIS) measurements, cathodic polarizations and potential relaxation. Degradation of the coating system is accelerated by the cathodic polarization. EIS and potential relaxation monitor the change of the coating system induced by the cathodic polarization. The technique evaluates the permeability of the coating and properties which can be attributed to adhesion to the substrate.

© ISO 2022 – All rights reserved

Paints and varnishes — Guidelines for the determination of anticorrosive properties of organic coatings by accelerated cyclic electrochemical technique

1 Scope

This document gives guidelines on how to perform accelerated cyclic electrochemical technique (ACET) with organic protective coatings on metals.

This document specifies the execution of an ACET test and the considerations relative to the samples and electrochemical cell, test parameters and procedure.

This document also provides guidelines for the presentation of experimental results such as Bode plots and relaxation curves and other types of information obtained.

Some typical examples are shown in Annex A.

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 2808, *Paints and varnishes — Determination of film thickness*

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

ISO 16773-2:2016, *Electrochemical impedance spectroscopy (EIS) on coated and uncoated metallic specimens — Part 2: Collection of data*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in 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
cathodic polarization
change of the electrode potential in the negative direction caused by current flow

[SOURCE: ISO 8044:2020, 7.1.26]

3.2
relaxation time
t_{relax}
time between the *cathodic polarization* (3.1) and the beginning of the electrochemical impedance spectroscopy (EIS) measurement

Note 1 to entry: This value is defined by the operator.

© ISO 2022 – All rights reserved

3.3
cathodic disbonding
failure of adhesion between a coating and a metallic surface that is directly attributable to cathodic protection conditions and that is often initiated by a defect in the coating system, such as accidental damage, imperfect application or excessive permeability of the coating

[SOURCE: ISO 15711:2003, 3.1]

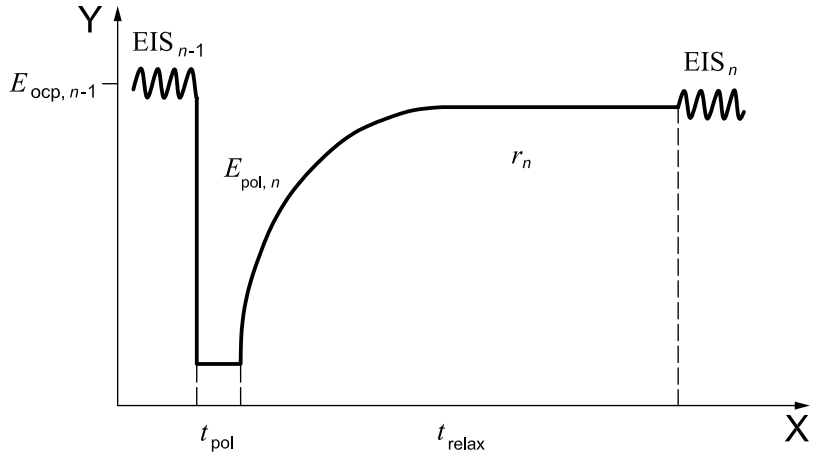
3.4
cathodic potential
E_{pol}
potential applied, more negative than open circuit potential, E_{ocp}

4 Principle

4.1 General

The initial state of the coating system is characterized by an electrochemical impedance spectroscopy (EIS) measurement (EIS_{n-1} – see Figure 1). Then the surface is polarized by application of the cathodic potential E_{pol} for a certain period of time, t_{pol}, followed by the relaxation process, r_n, over the time, t_{relax}. Finally, the new state of the coating system is characterized by a second EIS measurement, EIS_n. These steps define a cycle which can be repeated n number of times (n is the number of cycles).

NOTE Typically six cycles are used.



Key
X time, t
Y potential, E

Figure 1 — ACET cycle

4.2 EIS measurement

A special type of potentiostat intended for EIS is connected to an electrochemical cell. A single-sinusoidal-waveform potential is applied and the resulting alternating current is measured. Both potential and current data are collected and analysed for amplitude and phase shift. More information about the procedure can be found in ISO 16773-2.

© ISO 2022 – All rights reserved