

---

---

**Corrosion of metals and alloys —  
Multielectrode arrays for corrosion  
measurement**

*Corrosion des métaux et alliages — Assemblages multi-électrodes  
pour la mesure de la corrosion*



This document is a preview generated by EKO



**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2020

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](mailto:copyright@iso.org)  
Website: [www.iso.org](http://www.iso.org)

Published in Switzerland

# Contents

Page

<b>Foreword</b>	<b>iv</b>
<b>Introduction</b>	<b>v</b>
<b>1 Scope</b>	<b>1</b>
<b>2 Normative references</b>	<b>1</b>
<b>3 Terms and definitions</b>	<b>1</b>
<b>4 Principle</b>	<b>3</b>
4.1 Multielectrode arrays	3
4.2 Coupled multielectrode array (CMA)	3
4.3 Multielectrode array with closely packed electrodes for studying spatiotemporal behaviour of localized corrosion	4
4.4 Coupled multielectrode array sensor (CMAS)	5
4.4.1 CMAS for corrosion monitoring	5
4.4.2 CMAS used without polarization to measure corrosion rate at free corrosion potential	6
4.4.3 CMAS used to evaluate the effectiveness of cathodic protection and the effect of stray current	6
4.5 Multielectrode arrays for high throughput measurements	7
4.6 Multielectrode arrays for other applications	7
<b>5 Instrumentation</b>	<b>8</b>
5.1 Potential measurement	8
5.2 Coupling current measurement	8
5.3 Effective coupling of individual electrodes	9
5.3.1 Coupling with multichannel ZVA	9
5.3.2 Coupling with wires and measuring current with a single ZVA	10
<b>6 Fabrication of multielectrode array</b>	<b>10</b>
6.1 Electrode preparation	10
6.2 Number of electrodes	10
6.3 Mounting of electrodes	11
6.4 Surface coating on electrodes for preventing crevice corrosion	11
6.5 Electrode configuration	11
6.6 Size of electrodes	11
6.7 Spacing of electrodes for spatiotemporal studies	12
6.8 Spacing of electrodes for corrosion monitoring in oil and gas application	12
6.9 Size and spacing of the electrodes for high throughput studies	12
<b>7 Test procedure</b>	<b>12</b>
<b>8 Test report</b>	<b>13</b>
<b>Annex A (informative) Typical results from multielectrode array with closely packed electrodes for studying spatiotemporal behaviour of localized corrosion</b>	<b>14</b>
<b>Annex B (informative) Typical results from a CMAS for corrosion monitoring</b>	<b>15</b>
<b>Annex C (informative) Example reports</b>	<b>17</b>
<b>Bibliography</b>	<b>18</b>

## 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](http://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](http://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](http://www.iso.org/iso/foreword.html).

This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

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](http://www.iso.org/members.html).

## Introduction

Multielectrode array technology has been used to study electrochemical behaviours and the localized corrosion of metals and alloys since the 1970s<sup>[1] to [5]</sup>. It has been demonstrated that multielectrode arrays are highly powerful tools for studying the spatiotemporal behaviour of metals in laboratories<sup>[2] to [16]</sup> and for monitoring non-uniform corrosion, especially localized corrosion in laboratories and plants<sup>[17]</sup>. Multielectrode arrays are also used as high throughput probes for studying the statistical behaviour of metal corrosion<sup>[1][18]</sup> and for the evaluation of inhibitors<sup>[19]</sup>.

This document is designed to outline the requirements and procedures for conducting corrosion measurements using multielectrode arrays.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent.

ISO takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured ISO that he/she is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from the patent database available at [www.iso.org/patents](http://www.iso.org/patents).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those in the patent database. ISO shall not be held responsible for identifying any or all such patent rights.



# Corrosion of metals and alloys — Multielectrode arrays for corrosion measurement

## 1 Scope

This document specifies the methodology of using multielectrode arrays for the measurement of the corrosion, especially localized corrosion, of metals and alloys. It can be used as a powerful tool for studying the initiation and propagation processes of localized corrosion. It is also a useful tool for long-term corrosion monitoring in the field, especially for localized corrosion, and for obtaining high throughput results for the evaluation of metals with different compositions and/or physical properties in different environments and the screening of a large number of inhibitors. Additionally, the galvanic coupling current and potential distribution of dissimilar metal pairings can be assessed by multielectrode arrays. Multielectrode arrays can be implemented in full-immersion, thin-film, spray and alternating wet-dry cycle exposures.

This document is not intended to be used for measurements of corrosion caused by a non-electrochemical mechanism.

## 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 8407, *Corrosion of metals and alloys — Removal of corrosion products from corrosion test specimens*

ISO 8044, *Corrosion of metals and alloys — Vocabulary*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044 and the following apply.

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

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

### 3.1

#### **uneven general corrosion**

corrosion that occurs over the whole exposed area of a metal at different rates across the exposed area

Note 1 to entry: It is a type of general corrosion, as defined in ISO 8044, that produces an uneven or wave-like surface<sup>[20][21]</sup> where the thickness reduction at the more corroded areas is significantly larger than the thickness reduction at the less corroded areas or the average corroded areas.

### 3.2

#### **non-uniform corrosion**

corrosion that occurs at different rates over a metal surface where there is a localized surplus of net anodic or net cathodic rates such that a localized area does not exhibit charge neutrality and electrons flow within the metal from the anodic-dominant areas to the cathodic-dominant areas

Note 1 to entry: Non-uniform corrosion includes both localized corrosion, as defined in ISO 8044, and *uneven general corrosion* (3.1). Non-uniform corrosion also includes the type of general corrosion that produces even surfaces at the end of a large time interval, but uneven surfaces within small time intervals.