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Corrosion of metals and alloys — Wiping method for measurements of gases and particles on real structures and equipment

Corrosion des métaux et alliages — Méthodes d'essuyage pour mesurage des gaz et des particules sur structures et équipements en conditions réelles

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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 document 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 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.

Introduction

Airborne salts, gases and particles deposited on structures and equipment are corrosion and/or degradation factors for metals, alloys and organic materials. Information on the surfaces of these substances is useful for understanding the corrosion conditions or degradation mechanism, the remaining life of these materials and the corrosivity of the environment. The wiping method outlined in this document is an example of a measurement method used to determine the types and concentrations of depositions on real structures and equipment.

Depositions related to corrosion and degradation are classified as soluble and insoluble materials. Soluble depositions collect moisture and retain a thin layer of water on their surfaces. Prolonged wetness accelerates corrosion and degradation because the thin layer of water contains soluble depositions with a high concentration of electrolytes.

Various methods for collecting airborne gases and particles are widely used to categorize corrosivity. However, for example, the accumulation method described in ISO 9225 requires considerable time (over a year), sampling is conducted every month and a kit consisting of clean gauze and a frame is needed to obtain reliable data. The wiping method described in this document is also widely used in all industries, and is a quick, low-cost method to determine the specifications of materials and coatings, the intervals for maintenance and replacement and the progress of corrosion and degradation. Despite these advantages, procedures for deposition sampling and measurement have not yet been established, and measures to prevent contamination and improve measurement quality are also needed to conduct appropriate corrosion and degradation checks.

The deposition concentration obtained by the wiping method is useful for environmental management because it provides information for prioritising environmental degradation factors. Many instantaneous values are used for the deposition concentration, which is expressed by a mass per unit area without a time component.

Corrosion of metals and alloys — Wiping method for measurements of gases and particles on real structures and equipment

1 Scope

This document specifies a method for evaluating depositions on real structures and equipment by wiping. Depositions become corrosion and/or degradation factors for metals, alloys and organic materials, and can be analysed quantitatively to control the corrosion and degradation of real structures and equipment.

The method specified in this document is suitable for evaluating the type and amounts of depositions on real structures and equipment in all industries. This method identifies the type of depositions and gives instantaneous values of the concentrations of water-soluble and insoluble depositions, which are expressed by mass per area without a time component. These values provide information on environmental factors related to corrosion and degradation. The method can be used to detect water-soluble depositions, including chloride ion, sulfate ion and other ions, and can assist users in understanding the synergistic and antagonistic effects that accelerate corrosion.

This document is applicable to:

— metals and their alloys;

— metallic coatings;

— organic coatings;

— concretes and other structural materials.

The method for determining chloride on clean surfaces, which ensures the cleanness of steel substrates after surface preparation such as grinding, polishing, cleaning and rinsing and before the application of paints, is given in ISO 8502-2, ISO 8502-5, ISO 8502-6 and ISO 8502-9.

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 8044, *Corrosion of metals and alloys — Basic terms and definitions*

ISO 9225, *Corrosion of metals and alloys — Corrosivity of atmospheres — Measurement of environmental parameters affecting corrosivity of atmospheres*

ISO 11844-1, *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres — Part 1: Determination and estimation of indoor corrosivity*

ISO 11844-2, *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres — Part 2: Determination of corrosion attack in indoor atmospheres*

ISO 11844-3, *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres — Part 3: Measurement of environmental parameters affecting indoor corrosivity*

ISO 7503-1, *Measurement of radioactivity — Measurement and evaluation of surface contamination — Part 1: General principles*

ISO 8502-2, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 2: Laboratory determination of chloride on cleaned surfaces*

ISO 8502-5, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 5: Measurement of chloride on steel surfaces prepared for painting (ion detection tube method)*

ISO 8502-6, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 6: Extraction of water soluble contaminants for analysis (Bresle method)*

ISO 8502-9, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 9: Field method for the conductometric determination of water-soluble salts*

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044, ISO 9225, ISO 11844-1, ISO 11844-2, ISO 11844-3, ISO 7503-1, ISO 8502-2, ISO 8502-5, ISO 8502-6, ISO 8502-9 and ISO 3696 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/

4 Introduction of general wiping method

Depositions can be sampled by using the wiping method. The wiping method entails wiping not only the surfaces of metals and alloys, but also organic materials and paint systems of structures and equipment exposed to atmospheric conditions. The concentration of the depositions can also be determined by this method. This document applies to the measurement of gases and particles that affect corrosion and degradation of the surfaces of materials. The concentrations of the soluble and insoluble depositions are expressed by mass per unit area, and the time component is not considered. The risks of corrosion in metals and alloys and the risks of degradation in organic materials can be determined by comparing the concentration of depositions on various parts of the structures and equipment, or at various sites where structures and equipment are located. The wiping method is a powerful, low-cost and easy-to-use method for capturing soluble and insoluble depositions that does not require a fixed time exposures or exchanges of the sampling medium.

The wiping method provides information on the types and concentrations of corrosive chemical depositions. This helps users:

— understand the corrosion of metals and alloys and the degradation of organic materials;

— understand the synergistic and antagonistic effects of environmental degradation agents;

— find better maintenance methods and exchange maintenance cycles for real structures and equipment;

— perform environmental assessments and determine appropriate specifications for construction.

The wiping method can be used widely to measure depositions on various organic and inorganic materials with different surface roughness and water repellency. It is also applicable to various oxides of metals and alloys. The advantages of the wiping method include the following:

a) it applies to hydrophobic materials, hydrophilic materials and heavily-corroded rusty surfaces, which have different deposition efficiencies from polished surfaces of metals and alloys;

b) it provides instantaneous values for the concentration of depositions, which is useful for:

— maintaining structures and equipment;

— maintaining certain components such as bridges, solar cells, electric parts, electronic components, circuit boards, insulators and paint surfaces;

— making decisions on the appropriate times to start and finish the wash cycle;

— conducting an environmental assessment when making quick decisions about constructions and specifications;

— evaluating the penetration of Cl^- into the surfaces of concrete structures and ceramics;

— conducting environmental assessments for quick decisions on construction and specification;

— evaluating Cl^- penetration into concrete structures and ceramics.

5 Preparation

The tools used in the wiping method should be cleaned with boiling water and then rinsed with either distilled, pure or deionized water. The tools include:

a) any one of the following:

— one to three pieces of gauze for one part of wiping with the following dimensions: 100 mm to 500 mm × 100 mm to 500 mm;

— one to three pieces of cotton for one part of wiping with the following mass: 1 g to 10 g;

— one to three pieces of sponge for one part of wiping with the following dimensions: 100 mm to 300 mm × 100 mm to 300 mm × 10 mm to 30 mm.

b) cleaned gloves or tweezers (to handle the gauze, cotton or sponge);

c) cleaned square or rectangle frame for the determination of the wiping area.

The frames are made from plastic, metals and alloys, or using a magnet. Double-sided tape can be used to adhere the frame to the structure and equipment. Masking tape with a width of 5 mm to 20 mm can be used for the determination of the wiping area instead of the frame as shown in Figure 1. The four pieces of masking tape can outline a square or rectangle shape for the wiping area on a rough surface. The frames, which can be made and cleaned in advance, ensure the wiping area remains the same. Alternatively, a marker can be used to draw a square or rectangle to define the wiping area as shown in Figure 1. The square is drawn using a ruler or set square to ensure the wiping area remains the same. The dimensions for wiping shown in Figure 2 are as follows:

— The wiping area is 10 mm to 500 mm by 10 mm to 500 mm.

— The minimum wiping area, S_{min}, is 100 mm^2 as shown in Figure 2 a).

— The maximum wiping area, S_{max}, is 250 000 mm^2 as shown in Figure 2 c).

The deposition on a real steel structure or a piece of equipment is wiped using a clean, wet gauze, cotton or sponge as follows:

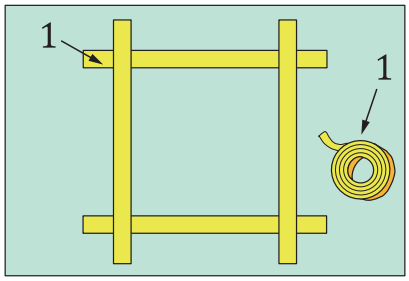
1) 10 ml to 50 ml of distilled, pure or deionized water, such as Grade 2 water (see ISO 3696) with an electrical conductivity of 0,1 mS m^{-1} per wiping area, which is applied to the wet gauze, cotton or sponge before wiping.

2) Plastic storage bags are prepared to hold the wet gauze, cotton or sponge before and after wiping.

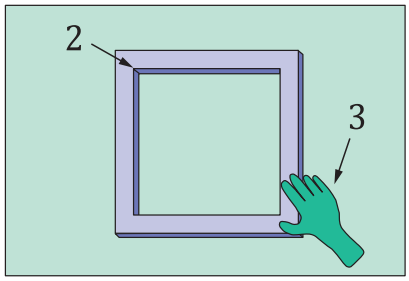
3) An example of the determination of wiping areas is shown Figure 3. Three wiping areas are determined at random to evaluate the average or median deposition concentration on a steel structure as shown in Figure 3 a) or on an equipment as shown in Figure 3 b).

4) After wiping, the gauze, cotton or sponge should be put in a plastic storage bag with labels indicating the date, location, position of wiping, wiped area, the weather and surface conditions of the steel structure or the equipment.

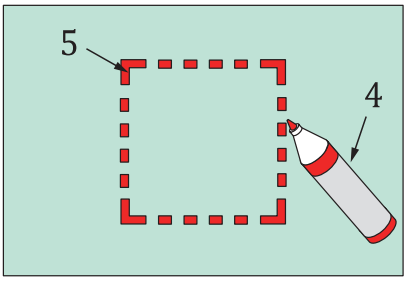
5) 100 ml to 500 ml of distilled, pure or deionized water for one wiping area to extract the deposition from the wet gauze, cotton or sponge after wiping.



a) Wiping area defined using masking tape



b) Wiping area defined using a magnetic frame, frame affixed with double-sided tape or frame held with hand wearing glove

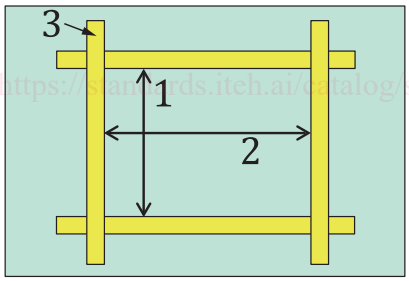


c) Wiping area defined by line drawn using marker

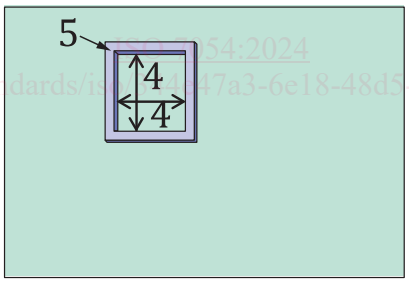
Key

1 masking tape
2 sheet frame
3 clean glove
4 marker
5 line drawn using marker

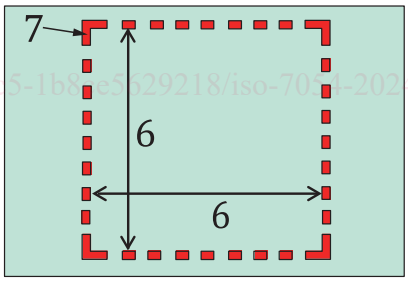
Figure 1 — Masking tape, frames and line drawn with marker to define the wiping area



a) Rectangle wiping area defined using masking tape



b) Minimum square wiping area defined using a magnetic frame or frame affixed with double-sided tape



c) Maximum square wiping area defined by line drawn using marker

Key

1 vertical length of wiping area, 10–500 mm
2 horizontal length of wiping area, 10–500 mm
3 masking tape
4 equal vertical and horizontal lengths of minimum wiping area, 10 mm
5 sheet frame
6 equal vertical and horizontal lengths of maximum wiping area, 500 mm
7 line drawn using marker

Figure 2 — Dimension of the wiping area