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Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres —

Part 2: Determination of corrosion attack in indoor atmospheres

Corrosion des métaux et alliages — Classification de la corrosivité faible des atmosphères d'intérieur —

Partie 2: Détermination de l'attaque par corrosion dans les atmosphères d'intérieur

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Contents

Page

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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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 156, *Corrosion of metals and alloys*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 11844-2:2005), which has been technically revised. The main changes compared with the previous edition are as follows:

— lead has been included as a standard specimen with high sensitivity to vapour organic acids;

— Annex D has been added.

A list of all parts in the ISO 11844 series can be found on the ISO website.

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

This document describes standard specimens, exposure and evaluation for the derivation of indoor corrosivity categories.

The determination of the corrosion attack is, at the present state of knowledge, the most reliable and, usually, also an economical way for evaluating corrosivity, taking into account all the main local environmental influences.

Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres —

Part 2: Determination of corrosion attack in indoor atmospheres

1 Scope

This document specifies methods for determining corrosion rates with standard specimens of metals in indoor atmospheres with low corrosivity. For this direct method of evaluation corrosivity, different sensitive methods can be applied using standard specimens of the following metals: copper, silver, zinc, steel and lead. The values obtained from the measurements are used as classification criteria for the determination of indoor atmospheric corrosivity.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Principle

The corrosivity of the indoor location (e.g. control rooms, electric boxes, storage rooms, during transportation, in museums) is determined from the corrosion rate calculated from the mass change or resistance change per unit area of standard specimens of metals after exposure for a certain time period. Different materials are sensitive to different environmental parameters or their combinations.

5 Methods

The following methods, described in Annexes A and B, are available for the evaluation of the corrosion attack:

— determination of corrosion rate by mass change measurements (see Annex A);

— determination of corrosion rate by electrolytic cathodic reduction (see Annex B).

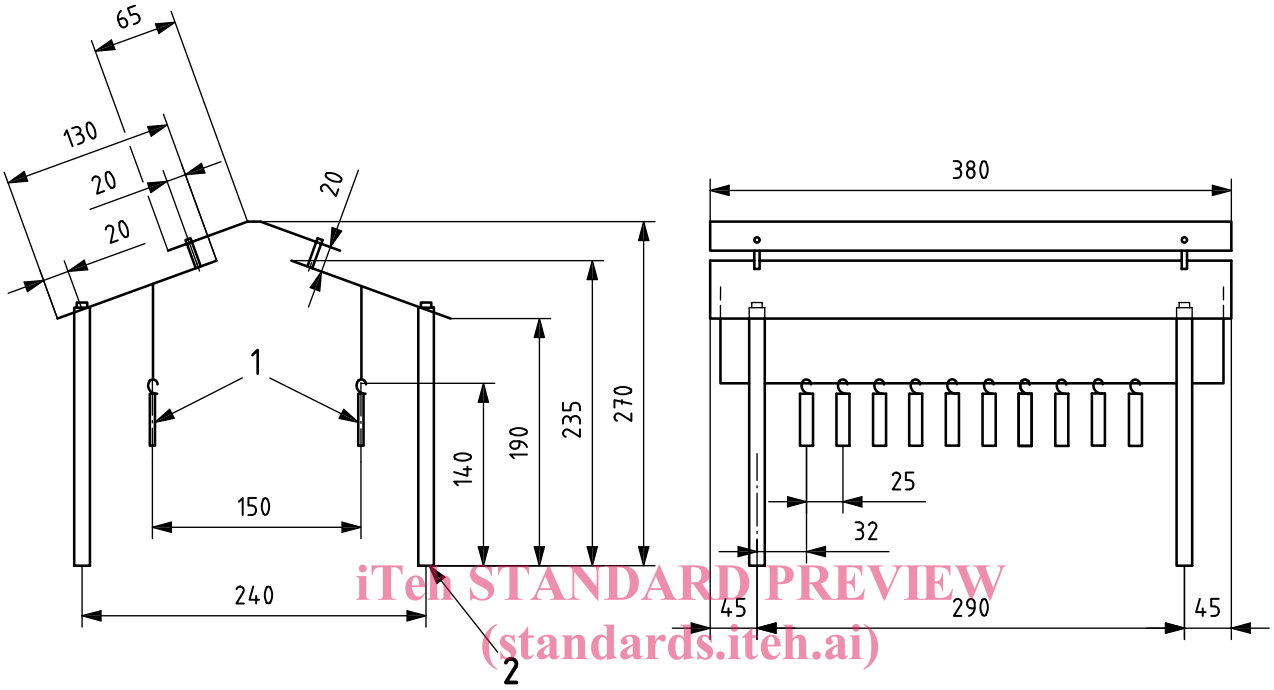
The methods described in Annexes C and D are suitable for continuous or periodic monitoring of the corrosion attack:

— determination of corrosion rate by resistance measurements (see Annex C);

— determination of corrosion rate by quartz crystal micro-balance methodology (see Annex D).

Special features of the methods, such as sensitivity, possibility for continuous or periodic assessment of corrosion attack, available space, etc., should be considered when choosing the most suitable methods. Examples of suitable racks for exposure of specimens are given in Figures 1 and 2.

Dimensions in millimetres



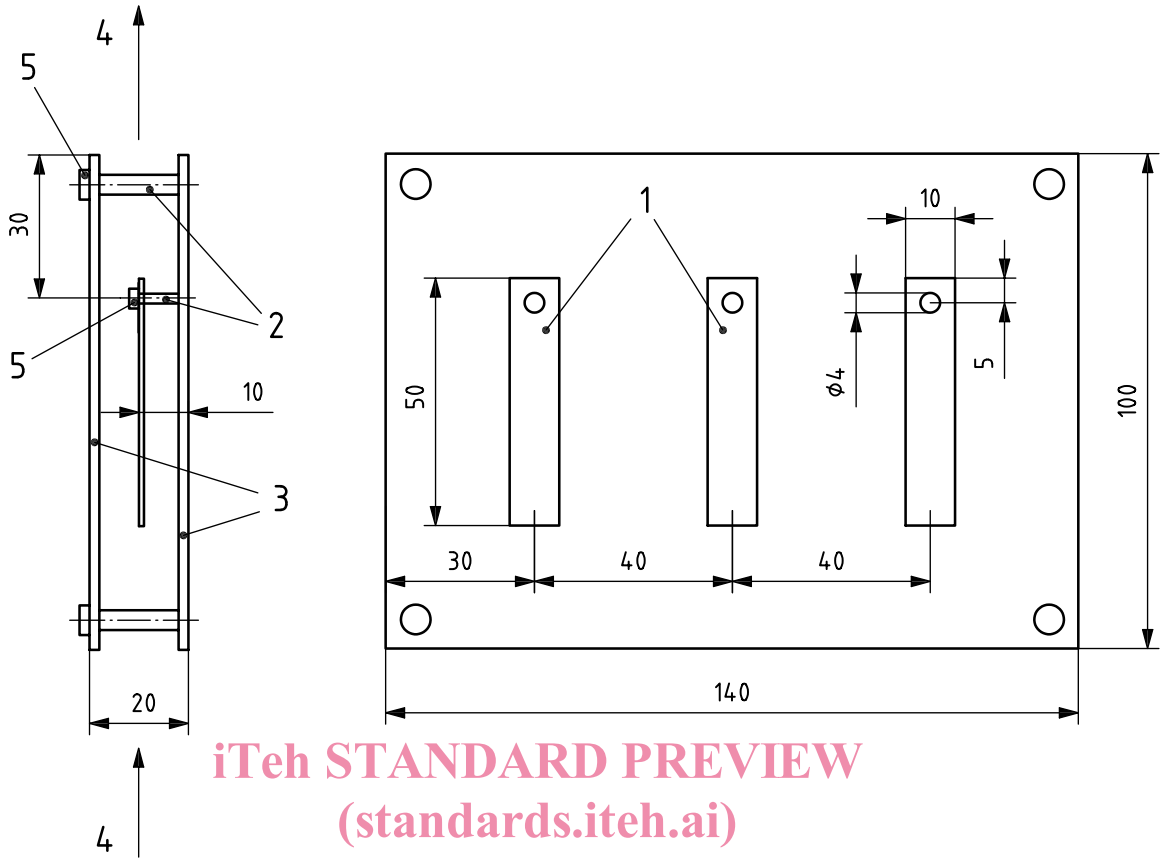
Key

1 specimens

2 support Ø approximately 15

Figure 1 — Example of exposure racks for the sheltered exposure of specimens

Dimensions in millimetres



Key

1 specimens
2 distance pins
3 plastic plates
4 open air flow
5 plastic screws

Figure 2 — A mounting plate for the unsheltered exposure of specimens

Annex A
(informative)

Determination of corrosion rate by mass change measurement

A.1 Principle

Mass increase measurements can be performed on all metals and comparatively large surfaces can be evaluated. The technique is relatively easy to operate.

The mass loss determination gives a best estimate of the corrosion effect. The method is not yet applicable to all metals. Both mass increase and mass loss determination using an ultra-micro-balance has a precision of about ±10 mg/m^2 with the method described below.

Due to the difficulty of distinguishing corrosion effects from other surface-related phenomena, such as sorption and contamination by particulate matter, the specimens should preferably be exposed under shelter.

A.2 Specimens

It is preferable to use rectangular specimens in the form of flat sheets, as they can be readily weighed. A convenient specimen size is 10 mm × 50 mm. Specimens may be larger provided that they can be accurately weighed. The specimen thickness may preferably be 0,5 mm.

The materials used to prepare the specimens are of following quality:

Silver: 99,98 % min.

Copper: 99,85 % min.

Zinc: 99,45 % min.

Carbon steel: CR 1, max. 0,15 % C, max. 0,04 % P, max. 0,05 % S, max. 0,6 % Mn

Lead: 99,97 % min.

The specimens should, before weighing, be prepared as follows.

a) A hole with the diameter 4 mm is cut at the upper side of the specimen.

b) Abrading:

   1) silver and copper with silicon carbide paper to 1 200 P (600 grit);

   2) zinc, carbon steel and lead to 500 P (320 grit).

   To avoid risk of contamination, an abrading paper shall not be used for polishing specimens of different metals.

c) Cleaning in de-ionised water.

d) Degreasing in ethanol in an ultrasonic bath for 5 min.

e) Drying.

f) Storing in plastic tubes with a hole in the top. The plastic tubes are placed in a desiccator or sealed into plastic bags with desiccant before and after the weighing and the exposure.

After the final surface cleaning before exposure, it is important that limited handling occurs. Before and after weighing, the specimens are placed in tubes and are only handled with a clean pair of tweezers. To avoid marking on the specimens, the identity of the specimens may preferably be marked on the tubes.

A.3 Exposure

The specimens shall be exposed vertically, either with or without a shelter against settling particles (see Figure 1). The specimens shall be mounted between plastic plates or racks to permit free air circulation. A distance of a minimum of 10 mm between the surfaces and/or the surface and the mounting plate is recommended. The plastic racks or mounting plates are placed at a site with free air circulation, preferably at a height of 1 m above the floor. The exposure should be performed in an area with airflow rates characteristic of the site.

A map of specimen identity on the plastic rack, exposure date and location of the exposure rack should be established. The type of exposure, with or without a shelter, should be noted.

The test specimens (at least three) should be exposed preferably for one year, but at least for six months.

A.4 Mass increase

The specimens shall be weighed on a micro-balance, with an accuracy of ±0,1 mg. Each test specimen is weighed twice in relation to a reference balance standard of stainless steel having a similar mass to the specimen. The difference between the first mass of the test specimen m_1 and the reference balance standard $m_{r,1}$ is calculated as $(m_{r,1} - m_1)$, and the difference between the second masses $(m_{r,2} - m_2)$ is calculated in the same way. The mass of the test specimen is calculated in relation to the reference specimen as the average of the differences (m), as shown by Formula (A.1):

$$m = \frac{(m_1 - m_{r,1}) + (m_2 - m_{r,2})}{2} \quad \text{(A.1)}$$

where

m is the mass of the test specimen in relation to the reference balance standard, in mg;

m_1 is the mass of the test specimen at first weighing, in mg;

m_2 is the mass of the test specimen at second weighing, in mg;

$m_{r,1}$ is the mass of the reference balance standard at first weighing, in mg;

$m_{r,2}$ is the mass of the reference balance standard at second weighing, in mg.

The same weighing procedure is performed both before and after the exposure of the specimens. After the exposure, the specimens should be carefully blown with oil-free compressed air or nitrogen to remove dust before the weighing.

The rate of mass increase for each metal is given by Formula (A.2):

$$r_{mi} = \frac{m_{ae} - m_{be}}{A \cdot t} \quad \text{(A.2)}$$

where