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

Part 1: Determination and estimation of indoor corrosivity

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

Partie 1: Détermination et estimation de la corrosivité des atmosphères d'intérieur

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 11844-1 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

ISO 11844 consists of the following parts, under the general title *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres*:

— *Part 1: Determination and estimation of indoor corrosivity*

— *Part 2: Determination of corrosion attack in indoor atmospheres*

— *Part 3: Measurement of environmental parameters affecting indoor corrosivity*

Introduction

Metals, alloys and metallic coatings are subject to atmospheric corrosion under the impact of air humidity, especially when gaseous and solid substances of atmospheric pollution co-impact. Corrosivity data are of fundamental importance for derivation of suitable corrosion protection, or for evaluation of serviceability of metal elements of a product.

ISO 9223 classifies the atmospheric environment into 5 corrosivity categories.

Low-corrosivity indoor atmospheres are indoor atmospheres with C 1 (very low) or C 2 (low) corrosivity categories according to ISO 9223.

The classification in ISO 9223 is too broad for some purposes in low-corrosivity indoor atmospheres, e.g. places where electronic devices, sophisticated technical products, or works of art and historical objects are stored.

For such purposes, it is necessary to subdivide the corrosivity categories C 1 (very low) and C 2 (low) into indoor corrosivity categories in this part of ISO 11844.

The evaluation of low-corrosivity indoor atmospheres can be accomplished by direct determination of corrosion attack of selected metals (see ISO 11844-2) or by measurement of environmental parameters (see ISO 11844-3) which may cause corrosion on metals and alloys.

This part of ISO 11844 describes general procedures for derivation and estimation of indoor corrosivity categories.

A general approach to classification of corrosivity in indoor atmospheres is given in the scheme shown in Figure 1.

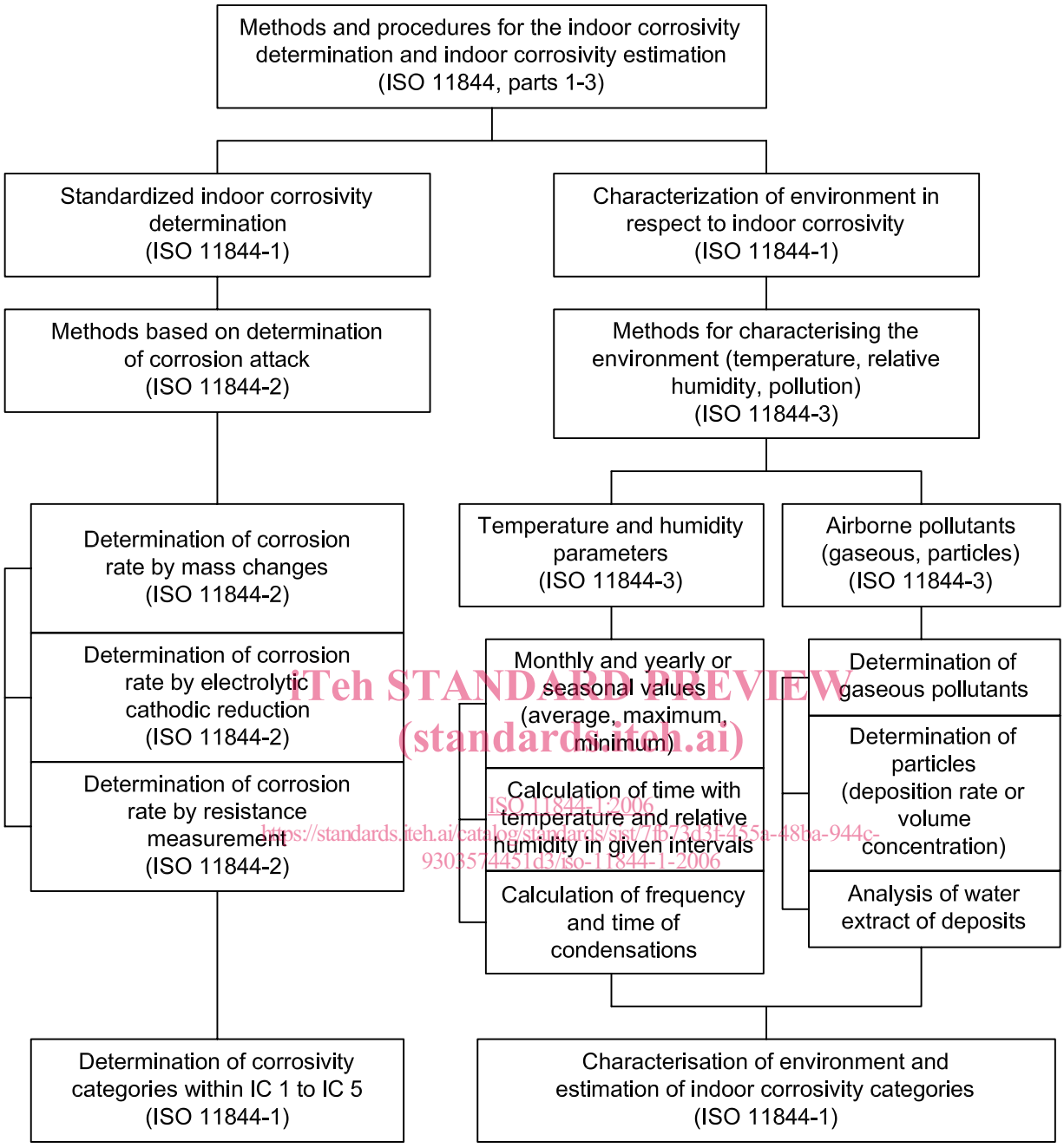

Figure 1 — Scheme for classification of low corrosivity in indoor atmospheres

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

Part 1: Determination and estimation of indoor corrosivity

1 Scope

This part of ISO 11844 deals with the classification of low corrosivity of indoor atmospheres.

The aim of this part of ISO 11844 is

— to characterise indoor atmospheric environments of low corrosivity that can affect metals and metallic coatings during storage, transport, installation or operational use,

— to set a consistent way of indoor corrosivity classification, and

— to prescribe procedures for derivation and estimation of indoor corrosivity categories.

This part of ISO 11844 specifies technical metals, whose corrosion attack after a defined exposure period is used for determination of corrosivity categories of indoor atmospheres of low corrosivity.

This part of ISO 11844 defines corrosivity categories of indoor atmospheres according to corrosion attack on standard specimens.

This part of ISO 11844 indicates important parameters of indoor atmospheres that can serve as a basis for an estimation of indoor corrosivity.

Selection of a method for determination of corrosion attack, description of standard specimens, its exposure conditions and evaluation are the subject of ISO 11844-2. Measurement of environmental parameters affecting indoor corrosivity is the subject of ISO 11844-3.

2 Normative references

The following referenced documents are indispensable for the application 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 9223:1992, *Corrosion of metals and alloys — Corrosivity of atmosphere — Classification*

ISO 11844-2:2005, *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres — Part 2: Determination of corrosion attack in indoor atmospheres*

ISO 11844-3:—[1], *Corrosion of metals and alloys — Classification of low corrosivity of indoor atmospheres — Part 3: Measurement of environmental parameters affecting indoor corrosivity*

IEC 60654-4:1987, *Operating conditions for industrial-process measurement and control equipment. Part 4: Corrosive and erosive influences*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
corrosivity of atmospheres
ability of the atmosphere to cause corrosion in a given corrosion system (e.g. atmospheric corrosion of a given metal or alloy)

[ISO 9223:1992, definition 3.1]

3.2
temperature-humidity complex
combined effect of temperature and relative humidity on the corrosivity of the atmosphere

[ISO 9223:1992, definition 3.5]

3.3
time of wetness
period during which a metallic surface is covered by adsorptive and/or liquid films of electrolyte that are capable of causing atmospheric corrosion

[ISO 9223:1992, definition 3.2]

3.3.1
calculated time of wetness
time of wetness estimated from the temperature-humidity complex

[ISO 9223:1992, definition 3.2.1]

3.3.2
experimental time of wetness
time of wetness indicated directly by various measuring systems

[ISO 9223:1992, definition 3.2.2]

3.4
atmospheric pollution
specific corrosion-active substances, gases or suspended particles in the air (both natural and the result of human activity)

4 Symbols and abbreviations

IC corrosivity categories of indoor atmospheres.

r_{corr} corrosion rate derived from mass-loss measurement after an exposure of one year.

r_{mi} rate of mass increase after an exposure of one year.

1) To be published.

5 Classification of corrosivity

5.1 General

The corrosivity of indoor atmospheres can be classified either by determination of the corrosion attack on standard specimens of selected standard metals as given in Clause 6 or, where this is not possible, by estimation of corrosivity based on the knowledge of humidity, temperature and pollution conditions as described in Clause 7 and informative Annexes B, C and D.

Estimation of corrosivity as described in 7.2. and Annexes C and D may lead to wrong conclusions. Therefore, the determination of corrosivity by measurement of the corrosion attack on standard specimens is strongly recommended.

5.2 Categories of indoor corrosivity

For the purpose of this part of ISO 11844, indoor atmospheres are classified into 5 corrosivity categories denoted IC 1 to IC 5. The classification is given in Table 1.

Table 1 — Corrosivity categories of indoor atmospheres

Indoor corrosivity category	
IC 1	Very low indoor corrosivity
IC 2	Low indoor corrosivity
IC 3	Medium indoor corrosivity
IC 4	High indoor corrosivity
IC 5	Very high indoor corrosivity

6 Determination of indoor atmospheric corrosivity

The determination of corrosivity of indoor atmospheres is based on measurements of corrosion attack on standard specimens of four reference metals after an exposure for one year in accordance with ISO 11844-2. From the mass loss or mass increase, the indoor corrosivity category for each metal is determined from Table 2.

Metals complement each other in the classification of indoor corrosivity for a given environment.

7 Characterization of indoor atmospheres with respect to indoor corrosivity

7.1 General

Environmental characteristics are informative and allow assessment of specific corrosion effects with regard to individual metals and metallic coatings.

Methods for characterization and measurement of environmental parameters in indoor atmospheres are given in ISO 11844-3.

This method of corrosivity estimation is, in many cases, oversimplified and may give misleading results.

An estimation of corrosivity is based on

— climatic influences (outdoor situation including pollution),

— indoor microclimate influences, and

— indoor gaseous and particle pollution.

The corrosivity of an indoor atmosphere increases with higher humidity and depends on the type and level of pollution.

Frequency of variation of relative humidity (RH) and temperature (T) in intervals, and frequency and time of condensation, are important characteristics.

Indoor atmospheres are polluted by the components from external and internal sources. Typical pollutants are SO_2, NO_2, O_3, H_2S, Cl_2, NH_3, HCl, HNO_3, Cl^-, NH_4^+, organic acids, aldehydes and particles (see informative Annex B).

Corrosion for many of the metals is significantly influenced by the synergistic effects of different pollutants.

Metals and metallic coatings have their own specific corrosion behaviour in indoor atmospheres (see informative Annex C).

7.2 Estimation of indoor corrosivity

7.2.1 Characterization of the environment summarised in a guideline (Annex D), forms a basis for indoor corrosivity estimation. Description of typical environments related to the estimation of indoor corrosivity categories is presented in Table D.3.

7.2.2 Important factors of indoor corrosion are defined as the highest levels of measured environmental parameters and as a description of other and specific environmental influences affecting indoor corrosion of metals.

7.2.3 The determination of indoor corrosivity categories is illustrated in Tables 2 and 3.

Table 2 — Classification of corrosivity of indoor atmospheres based on corrosion rate measurements by mass loss determination of standard specimens

Corrosivity category		Corrosion rate (r_{corr}) mg/(m^2·a)			
		Carbon steel	Zinc	Copper	Silver
IC 1	Very low indoor	$r_{corr} \leqslant 70$	$r_{corr} \leqslant 50$	$r_{corr} \leqslant 50$	$r_{corr} \leqslant 170$
IC 2	Low indoor	$70 < r_{corr} \leqslant 1\,000$	$50 < r_{corr} \leqslant 250$	$50 < r_{corr} \leqslant 200$	$170 < r_{corr} \leqslant 670$
IC 3	Medium indoor	$1\,000 < r_{corr} \leqslant 10\,000$	$250 < r_{corr} \leqslant 700$	$200 < r_{corr} \leqslant 900$	$670 < r_{corr} \leqslant 3\,000$
IC 4	High indoor	$10\,000 < r_{corr} \leqslant 70\,000$	$700 < r_{corr} \leqslant 2\,500$	$900 < r_{corr} \leqslant 2\,000$	$3\,000 < r_{corr} \leqslant 6\,700$
IC 5	Very high indoor	$70\,000 < r_{corr} \leqslant 200\,000$	$2\,500 < r_{corr} \leqslant 5\,000$	$2\,000 < r_{corr} \leqslant 5\,000$	$6\,700 < r_{corr} \leqslant 16\,700$

Table 3 — Classification of corrosivity of indoor atmospheres based on rate of mass increase measured with standard specimens

Corrosivity category		Rate of mass increase (r_{mi}) mg/(m^2·a)			
		Carbon steel	Zinc	Copper	Silver
IC 1	Very low indoor	$r_{mi} \leqslant 70$	$r_{mi} \leqslant 50$	$r_{mi} \leqslant 25$	$r_{mi} \leqslant 25$
IC 2	Low indoor	$70 < r_{mi} \leqslant 700$	$50 < r_{mi} \leqslant 250$	$25 < r_{mi} \leqslant 100$	$25 < r_{mi} \leqslant 100$
IC 3	Medium indoor	$700 < r_{mi} \leqslant 7\,000$	$250 < r_{mi} \leqslant 700$	$100 < r_{mi} \leqslant 450$	$100 < r_{mi} \leqslant 450$
IC 4	High indoor	$7\,000 < r_{mi} \leqslant 50\,000$	$700 < r_{mi} \leqslant 2\,500$	$450 < r_{mi} \leqslant 1\,000$	$450 < r_{mi} \leqslant 1\,000$
IC 5	Very high indoor	$50\,000 < r_{mi} \leqslant 150\,000$	$2\,500 < r_{mi} \leqslant 5\,000$	$1\,000 < r_{mi} \leqslant 2\,500$	$1\,000 < r_{mi} \leqslant 2\,500$

NOTE 1 The specification of standard specimens of carbon steel, zinc, copper and silver, and the procedures for evaluation of the mass change is given in ISO 11844-2.

NOTE 2 Corrosion rate measurements by mass loss determination of standard specimens (Table 2) is preferably used for higher indoor corrosivity categories. Also, in atmospheres where a high deposition of particles is expected, the mass loss determination is preferred.

NOTE 3 An approximate relation between the corrosivity categories in this part of ISO 11844, and severity levels in ANSI/ISA –S71.04-1985, is given in Annex A (informative).

NOTE 4 The upper limit of corrosivity category IC 3 corresponds roughly to the upper limit of corrosivity category C 1 according to ISO 9223.

NOTE 5 The upper limit of corrosivity category IC 5 corresponds roughly to the upper limit of corrosivity category C 2 according to ISO 9223.