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Paints and varnishes — Corrosion protection of steel structures by protective paint systems —

Part 2: Classification of environments

Peintures et vernis — Anticorrosion des structures en acier par systèmes de peinture —
Partie 2: Classification des environnements

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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Foreword

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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 on 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 14, *Protective paint systems for steel structures*.

This second edition cancels and replaces the first edition (ISO 12944-2:1998), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the normative references have been updated;

— 4.2.1 "General" has been added;

— the units in Table 1 have been corrected;

— the bibliography has been updated;

— the text has been editorially revised.

A list of all parts in the ISO 12944 series can be found on the ISO website.

Introduction

Unprotected steel in the atmosphere, in water and in soil is subjected to corrosion that can lead to damage. Therefore, to avoid corrosion damage, steel structures are normally protected to withstand the corrosion stresses to which they will be subjected during the service life required of the structure.

There are different ways of protecting steel structures from corrosion. ISO 12944 (all parts) deals with protection by paint systems and covers, in the various parts, all features that are important in achieving adequate corrosion protection. Additional or other measures are possible but require particular agreement between the interested parties.

In order to ensure effective corrosion protection of steel structures, owners of such structures, planners, consultants, companies carrying out corrosion protection work, inspectors of protective coatings and manufacturers of coating materials need to have at their disposal state-of-the-art information in concise form on corrosion protection by paint systems. It is vital that such information is as complete as possible, unambiguous and easily understandable to avoid difficulties and misunderstandings between the parties concerned with the practical implementation of protection work.

ISO 12944 (all parts) is intended to give this information in the form of a series of instructions. It is written for those who have some technical knowledge. It is also assumed that the user of ISO 12944 (all parts) is familiar with other relevant International Standards, in particular those dealing with surface preparation.

Although ISO 12944 (all parts) does not deal with financial and contractual questions, attention is drawn to the fact that, because of the considerable implications of inadequate corrosion protection, non-compliance with requirements and recommendations given in ISO 12944 (all parts) can result in serious financial consequences.

ISO 12944-1 defines the overall scope of ISO 12944. It gives some basic terms and definitions and a general introduction to the other parts of ISO 12944. Furthermore, it includes a general statement on health, safety and environmental protection, and guidelines for using ISO 12944 (all parts) for a given project.

This document describes the environmental impact on steel structures. It covers structures exposed to the atmosphere as well as those immersed in water or buried in soil. For different atmospheric environments, a classification system based on corrosivity categories is also presented. Different environments for immersed and buried structures are also described. All these environments are relevant to the choice of protective paint systems.

Paints and varnishes — Corrosion protection of steel structures by protective paint systems —

Part 2: Classification of environments

1 Scope

This document deals with the classification of the principal environments to which steel structures are exposed, and the corrosivity of these environments. This document

— defines atmospheric-corrosivity categories, based on mass loss (or thickness loss) by standard specimens, and describes typical natural atmospheric environments to which steel structures are exposed, giving advice on the estimation of the corrosivity,

— describes different categories of environment for structures immersed in water or buried in soil, and

— gives information on some special corrosion stresses that can cause a significant increase in corrosion rate or place higher demands on the performance of the protective paint system.

The corrosion stresses associated with a particular environment or corrosivity category represent one essential parameter governing the selection of protective paint systems.

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 12944-1, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction*

ISO 12944-3, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 3: Design considerations*

ISO 12944-4, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 4: Types of surface and surface preparation*

ISO 12944-5, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 5: Protective paint systems*

ISO 12944-6, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 6: Laboratory performance test methods*

ISO 12944-7, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 7: Execution and supervision of paint work*

ISO 12944-8, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 8: Development of specifications for new work and maintenance*

ISO 12944-9, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 9: Protective paint systems and laboratory performance test methods for offshore and related structures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12944-1, ISO 12944-3, ISO 12944-4, ISO 12944-5, ISO 12944-6, ISO 12944-7, ISO 12944-8, ISO 12944-9 and the following apply.

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

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
corrosivity
ability of an environment to cause corrosion of a metal in a given corrosion system

[SOURCE: ISO 8044:2015, 2.14]

3.2
climate
weather prevailing at a given location or in a given area, as established statistically by meteorological parameters recorded over a prolonged period

3.3
atmosphere
mixture of gases, and normally also aerosols and particles, that surrounds a given object

3.4
atmospheric corrosion
corrosion with the earth's *atmosphere* (3.3) at ambient temperature as the corrosive environment

[SOURCE: ISO 8044:2015, 3.4]

3.5
type of atmosphere
characterization of the *atmosphere* (3.3) on the basis of the corrosive agents present and their concentration

Note 1 to entry: The main corrosive agents are gases (especially sulfur dioxide) and salts (especially chlorides and/or sulfates).

3.6
local environment
atmospheric conditions prevailing around a constituent element of a structure

Note 1 to entry: These conditions determine the *corrosivity* (3.1) category and include both meteorological and pollution parameters.

3.7
micro-environment
environment at the interface between a constituent element of a structure and its surroundings

Note 1 to entry: The micro-environment is one of the decisive factors in the assessment of corrosion stresses.

3.8
time of wetness
period when a metallic surface is covered by adsorptive and/or liquid films of electrolyte to be capable of causing atmospheric corrosion

Note 1 to entry: Guidance values for time of wetness can be calculated from temperature and relative humidity by summing the hours during which the relative humidity is above 80 % and, at the same time, the temperature is above 0 °C.

[SOURCE: ISO 9223:2012, 3.5, modified — Note 1 to entry has been added.]

4 Corrosion stresses due to the atmosphere, water and soil

4.1 Atmospheric corrosion

Atmospheric corrosion is a process that takes place in a film of moisture on the metal surface. The moisture film can be so thin that it is invisible to the naked eye.

The corrosion rate is increased by the following factors:

— an increase in the relative humidity;

— the occurrence of condensation (when the surface temperature is at or below the dew point);

— an increase in the amount of pollution in the atmosphere (the corrosive pollutants can react with the steel and can form deposits on the surface).

Experience has shown that significant corrosion is likely to take place if the relative humidity is above 80 % and the temperature above 0 °C. However, if pollutants and/or hygroscopic salts are present, corrosion occurs at much lower humidity levels.

The atmospheric humidity and air temperature in a particular region of the world will depend on the climate prevailing in that part of the world. A brief description of the most important climates is given in Annex A.

The location of the constituent element of a structure also influences corrosion. Where structures are exposed to the open air, climatic parameters such as rain and sunshine and pollutants in the form of gases or aerosols affect corrosion. Under cover, the climatic influences are reduced. Indoors, the effect of atmospheric pollutants is reduced, although a locally high corrosion rate caused by poor ventilation, high humidity or condensation is possible.

For the estimation of the corrosion stresses, an appreciation of the local environment and the micro-environment is essential. Examples of decisive micro-environments are the underside of a bridge (particularly over water), the roof of an indoor swimming pool, and the sunny and shady sides of a building.

4.2 Corrosion in water and soil

4.2.1 General

Special care shall be taken when considering structures that are partly immersed in water or partly buried in soil. Corrosion under such conditions is often restricted to a small part of the structure where the corrosion rate can be high. Exposure tests for estimating the corrosivity of water or soil environments are not recommended. However, different immersion/burial conditions can be described.

4.2.2 Structures immersed in water

The type of water — fresh, brackish or salt — has a significant influence on the corrosion of steel. Corrosivity is also influenced by the oxygen content of the water, the type and quantity of dissolved substances and the water temperature. Animal or vegetable growth can accelerate corrosion.

Three different zones for immersion in water can be defined:

— the underwater zone is the area which is permanently exposed to water;

— the intermediate (fluctuating level) zone is the area in which the water level changes due to natural or artificial effects, thus giving rise to increased corrosion due to the combined impact of water and the atmosphere;

— the splash zone is the area wetted by wave and spray action which can give rise to exceptionally high corrosion stresses, especially with sea water.