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

Part 1: General introduction

Peintures et vernis — Anticorrosion des structures en acier par systèmes de peinture —

Partie 1: Introduction générale

Reference number
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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 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 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 12944-1:1998), which has been technically revised.

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

— some parts of the scope have been moved to Clause 4;

— the terms and definitions which were not used in the main part of the standard have been deleted;

— the normative references have been updated;

— the requirements regarding sample areas have been included;

— 7.8 with reference to ISO 12944-9 has been added.

— a bibliography has been added.

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

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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.

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

Part 1: General introduction

1 Scope

This document defines the overall scope of ISO 12944 (all parts). 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.

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 4628-1, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 4628-3, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 3: Assessment of degree of rusting*

ISO 4628-4, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 4: Assessment of degree of cracking*

ISO 4628-5, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 5: Assessment of degree of flaking*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

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*

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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 12944-2, 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
coat
continuous layer of metal material or a continuous film of *paint* (3.6), resulting from a single application

3.2
corrosion
physicochemical interaction between a metal and its environment that results in changes in the properties of the metal, and which can often lead to impairment of the function of the metal, the environment or the technical system of which these form a part

[SOURCE: ISO 8044:2015, 2.1, modified — in the definition “may” has been replaced by “can often” and Note 1 to entry has been deleted.]

3.3
corrosion damage
corrosion (3.2) effect which is considered detrimental to the function of the metal, the environment or the technical system of which these form a part

3.4
corrosion stress
environmental factor which promotes *corrosion* (3.2)

3.5
durability
expected life of a *protective paint system* (3.8) to the first major maintenance painting

Note 1 to entry: Durability is a technical consideration/planning parameter that can help the owner set up a maintenance programme (see 5.5).

3.6
paint
pigmented coating material which, when applied to a *substrate* (3.9), forms an opaque dried film having protective, decorative or specific technical properties

[SOURCE: ISO 4618:2014, 2.184]

3.7
protective coating system
sum total of the *coats* (3.1) of metal materials and/or *paints* (3.6) or related products which are to be applied or which have been applied to a *substrate* (3.9) to provide *corrosion* (3.2) protection

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3.8
protective paint system
sum total of the *coats* (3.1) of *paints* (3.6) or related products which are to be applied or which have been applied to a *substrate* (3.9) to provide *corrosion* (3.2) protection

3.9
substrate
surface to which the coating material is applied or is to be applied

Note 1 to entry: The substrate is considered to be carbon steel.

3.10
spot repair
localized repair (including surface preparation) of deteriorated *corrosion* (3.2) protection system

3.11
partial refurbishment
spot repair (3.10) of coating defects followed by surface preparation and application of a minimum of one top *coat* (3.1) over the whole area

3.12
total refurbishment
total removal of protective *paint* (3.6) system and application of a new one

3.13
sample area
area on which the properties of a newly applied coating are tested

4 General introduction to the ISO 12944 series

4.1 Summary

ISO 12944 (all parts) deals with the corrosion protection of steel structures by protective paint systems.

4.2 Protective functions covered

ISO 12944 (all parts) covers only the corrosion-protective function of paint systems. Other protective functions, like protection against

— microorganisms (marine fouling, bacteria, fungi, etc.),

— chemicals (acids, alkalis, organic solvents, gases, etc.),

— mechanical action (abrasion, etc.), and

— fire

are not covered by ISO 12944 (all parts).

4.3 Field of application

4.3.1 Overview

The field of application is characterized by

— the type of structure,

— the type of surface and surface preparation,

— the type of environment,

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— the type of protective paint system,

— the type of work, and

— the durability of the protective paint system.

Although ISO 12944 (all parts) does not cover all types of structure, surface and surface preparation, it can, by agreement, also be applied to those cases which are not covered by ISO 12944.

The various aspects of the field of application are described in more detail in 4.3.2 to 4.3.7.

4.3.2 Type of structure

ISO 12944 (all parts) concerns structures made of carbon steel (e.g. in accordance with EN 10025-1 and EN 10025-2) of not less than 3 mm thickness, which are designed using an approved strength calculation.

Not covered by ISO 12944 (all parts) are concrete structures reinforced with steel.

4.3.3 Type of surface and surface preparation

ISO 12944 (all parts) deals with the following types of surface consisting of carbon or low-alloy steel, and their preparation:

— uncoated surfaces;

— surfaces thermally sprayed with zinc, aluminium or their alloys;

— hot-dip-galvanized surfaces;

— zinc-electroplated surfaces;

— sherardized surfaces;

— surfaces painted with prefabrication primer;

— other painted surfaces.

4.3.4 Type of environment

ISO 12944 (all parts) deals with

— six corrosivity categories for atmospheric environments, and

— four categories for structures immersed in water or buried in soil: Im1, Im2, Im3, and Im4.

4.3.5 Type of protective paint system

ISO 12944 (all parts) covers a range of paint products which dry or cure at ambient conditions. Not covered by ISO 12944 (all parts) are

— powder coating materials,

— stoving enamels,

— heat-cured paints, and

— protective coating on the inner surface of a tank (linings).

4.3.6 Type of work

ISO 12944 (all parts) covers both new work and maintenance.

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4.3.7 Durability of the protective paint system

ISO 12944 (all parts) considers four different durability ranges (i.e. low, medium, high, and very high). See 3.5 and Clause 5.

The durability range is not a "guarantee time".

5 General considerations and requirements

5.1 Since the durability of a protective system is normally assumed to be shorter than the expected service life of the structure, additional considerations shall be given at the planning and design stage to the possibility of their maintenance or (partial or total) refurbishment.

Sample areas provide guidance on the type of refurbishment and can also be used for the assessment of the visual appearance.

5.2 Structural components which are exposed to corrosion stresses and which are no longer accessible for corrosion protection measures after assembly shall be provided with corrosion protection that will remain effective, and hence ensure the stability of the structure, for the duration of the service life of the structure. If this cannot be achieved by means of protective coating systems, other measures shall be taken (for example, manufacturing components from corrosion-resistant material, designing components so that they are replaceable or the specification of a corrosion allowance).

5.3 The cost-effectiveness and sustainability of a given corrosion protection system will generally be in direct proportion to the length of time for which effective protection is maintained, since the amount of maintenance or replacement work required during the service life of the structure will be reduced to a minimum.

5.4 The type of environmental conditions (4.3.4) and the durability of coatings systems (5.5) are the main parameters for selecting the coating systems.

5.5 The level of coating failure before the first major maintenance painting shall be agreed upon by the interested parties and shall be assessed in accordance with ISO 4628-1, ISO 4628-2, ISO 4628-3, ISO 4628-4 and ISO 4628-5, unless otherwise agreed between the interested parties.

For example, the first major maintenance painting would normally need to be carried out for reasons of corrosion protection once about 10 % of the coatings have reached Ri 3, as defined in ISO 4628-3. This requirement may be applied to the whole structure or to representative sections as agreed upon between involved parties, which may then be classified separately.

In this document, durability is expressed in terms of four ranges:

— low (L) up to 7 years;

— medium (M) 7 years to 15 years;

— high (H) 15 years to 25 years;

— very high (VH) more than 25 years.

The durability range is not a "guarantee time". Durability is a technical consideration/planning parameter that can help the owner set up a maintenance programme. A guarantee time is a consideration that is the legal subject of clauses in the administrative part of the contract. The guarantee time is usually shorter than the durability range. There are no rules that link the two periods of time.

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6 Health and safety and environmental protection

It is the duty of clients, specifiers, contractors, paint manufacturers, inspectors and all other personnel involved in a project to carry out the work for which they are responsible in such a manner that they do not endanger the health and safety of themselves or others.

Items that will need particular attention are, for example, as follows:

— not specifying or using toxic or carcinogenic substances;

— emissions of volatile organic compounds (VOCs);

— measures against harmful effects of fumes, dust, vapours and noise, as well as fire hazards;

— protection of the body, including the eyes, the skin, the ears and the respiratory system;

— protection of water and soil during corrosion protection work;

— recycling of materials and waste disposal.

7 Information on the other parts of ISO 12944

7.1 ISO 12944-2 describes the corrosion stresses produced by the atmosphere, by different types of water and by soil. It defines atmospheric-corrosivity categories and indicates the corrosion stresses to be expected in situations where steel structures are immersed in water or buried in soil. The corrosion stresses to which a steel structure is exposed represent one essential parameter governing the selection of appropriate protective paint systems in accordance with ISO 12944-5.

7.2 ISO 12944-3 gives information on basic design criteria for steel structures for the purpose of improving their resistance to corrosion. It gives examples of suitable and unsuitable designs, indicating, with the help of diagrams, which structural elements and combinations of elements are likely to cause accessibility problems during surface preparation work and when applying, inspecting and maintaining paint systems. In addition, design features which facilitate the handling and transport of steel structures are discussed.

7.3 ISO 12944-4 describes different types of surface to be protected and gives information on mechanical, chemical and thermal surface preparation methods. It deals with surface preparation grades, surface profile (roughness), assessment of prepared surfaces, temporary protection of prepared surfaces, preparation of temporarily protected surfaces for further coatings, preparation of existing metal coatings, and environmental aspects. As far as possible, reference is made to the basic International Standards on the surface preparation of steel substrates before application of paints and related products. ISO 12944-4 is intended to be read in conjunction with ISO 12944-5 and ISO 12944-7.

7.4 ISO 12944-5 describes different generic types of paints on the basis of their chemical composition and the type of film formation process. It gives examples of various protective paint systems that have proved suitable for structures exposed to corrosive stresses and corrosivity categories described in ISO 12944-2, reflecting current knowledge on a world-wide scale. ISO 12944-5 is intended to be read in conjunction with ISO 12944-6.

7.5 ISO 12944-6 specifies laboratory test methods that are to be used when the performance of protective paint systems is to be assessed. It is particularly intended for paint systems for which sufficient practical experience is not yet available and covers testing of paint systems designed for application to steel prepared by blast-cleaning, to hot-dip-galvanized steel and to thermally sprayed metallic coatings. Atmospheric environments and immersion in water (fresh, brackish or sea water) are also covered.

7.6 ISO 12944-7 describes how paint work is to be carried out in the workshop or on site. It describes methods for the application of coating materials. Handling and storage of coating materials before

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application, inspection of the work and follow-up of the resulting paint system, as well as preparation of reference areas, are also covered. It does not cover surface preparation work (see ISO 12944-4).

7.7 ISO 12944-8 gives guidance for developing specifications for corrosion protection work, describing everything that has to be taken into account when a steel structure is to be protected against corrosion. For the convenience of the user, ISO 12944-8 distinguishes between project specification, paint system specification, paint work specification, and inspection and testing specification. Various annexes deal with particular aspects such as planning of the work, reference areas and inspection, and offer models of forms intended to facilitate the work.

7.8 ISO 12944-9 describes requirements, test methods and assessment criteria for protective systems under offshore and related conditions, classified as categories CX and Im4. ISO 12944-9 deals only with the offshore part of the CX category. Requirements, test methods and acceptance criteria for other extreme corrosive stresses included in category CX are agreed upon separately between the interested parties.

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Annex A
(informative)

Guidelines for using ISO 12944 (all parts) for a given project

In order to ensure effective corrosion protection, it is important that suitable specifications are written for the project (see ISO 12944-8), taking the following items as the basis:

a) analyse or estimate the corrosivity of the environment in the area where the structure is located or is to be located (see ISO 12944-2);

b) establish any special conditions which may affect the choice of paint system to be used (see ISO 12944-5);

c) examine the design of the structure and make sure that corrosion traps have been avoided and adequate access has been provided for corrosion protection work; avoid galvanic corrosion by insulating dissimilar metals from each other (see ISO 12944-3);

d) for maintenance painting, assess the condition of the surface to be treated (see ISO 12944-4);

e) identify those paint systems with the required durability from those listed as being suitable for the relevant environment (see ISO 12944-5), or from results of laboratory performance testing, if no long-term experience is available (see ISO 12944-6);

f) select from the paint systems identified the optimum one, taking into consideration the method of surface preparation which will be used (see ISO 12944-4);

g) make sure that damage to the environment and all health and safety risks are minimized (see ISO 12944-1 and ISO 12944-8);

h) draw up a plan of work and select a method of application (see ISO 12944-7);

i) establish a programme of inspections to be carried out during and after the work (see ISO 12944-7 and ISO 12944-8);

j) establish a maintenance programme covering the whole service life of the structure.

NOTE For detailed planning, see ISO 12944-8: 2017, Annexes C and D.

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Bibliography

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[2] ISO 8044: 2015, *Corrosion of metals and alloys — Basic terms and definitions*

[3] ISO 9001, *Quality management systems — Requirements*

[4] EN 10025-1, *Hot rolled products of structural steels — Part 1: General technical delivery conditions*

[5] EN 10025-2, *Hot rolled products of structural steels — Part 2: Technical delivery conditions for non-alloy structural steels*

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