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DRAFT

INTERNATIONAL
STANDARD

**ISO/FDIS
12944-6**

ISO/TC **35**/SC **14**

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

Part 6:
Laboratory performance test methods and associated assessment criteria

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

Partie 6: Essais de performance en laboratoire et critères d'évaluation associés

Please see the administrative notes on page iii

Reference number
ISO/FDIS 12944-6:2007(E)

ISO/CEN PARALLEL PROCESSING

The CEN Secretary-General has advised the ISO Secretary-General that this final draft International Standard covers a subject of interest to European standardization. Consultation on the ISO/DIS had the same effect for CEN members as a CEN enquiry on a draft European Standard. In accordance with the ISO-lead mode of collaboration as defined in the Vienna Agreement, this final draft, established on the basis of comments received, is hereby submitted to a parallel two-month FDIS vote in ISO and formal vote in CEN.

Positive votes shall not be accompanied by comments.

Negative votes shall be accompanied by the relevant technical reasons.

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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 12944-6 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 12944-6:1998), which has been technically revised.

ISO 12944 consists of the following parts, under the general title *Paints and varnishes — Corrosion protection of steel structures by protective paint systems*:

— *Part 1: General introduction*

— *Part 2: Classification of environments*

— *Part 3: Design considerations*

— *Part 4: Types of surface and surface preparation*

— *Part 5: Protective paint systems*

— *Part 6: Laboratory performance test methods and associated assessment criteria*

— *Part 7: Execution and supervision of paint work*

— *Part 8: Development of specifications for new work and maintenance*

Introduction

Unprotected steel in the atmosphere, in water and in soil is subject to corrosion that might lead to damage. Therefore, to avoid corrosion damage, steel structures are normally protected to withstand the corrosion stresses during the service life required of the structure.

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

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

This International Standard — ISO 12944 — 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 is familiar with other relevant International Standards; in particular those dealing with surface preparation, as well as relevant national regulations.

Although ISO 12944 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 this standard might result in serious financial consequences.

ISO 12944-1 defines the overall scope of all parts 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 for a given project.

ISO 12944-6 provides a way of assessing paint systems by means of laboratory tests in order to be able to select the most suitable for a given environment and durability.

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

Part 6: Laboratory performance test methods and associated assessment criteria

1 Scope

This part of ISO 12944 specifies laboratory test methods and test conditions for the assessment of paint systems for the corrosion protection of steel structures. The test results are to be considered as an aid in the selection of suitable paint systems and not as exact information for determining durability.

This part of ISO 12944 covers protective paint systems designed for application to uncoated steel, hot-dip-galvanized steel and steel surfaces with thermal-spray metallic coatings.

The environments considered are those defined in ISO 12944-2.

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 554, *Standard atmospheres for conditioning and/or testing — Specifications*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

ISO 1513, *Paints and varnishes — Examination and preparation of samples for testing*

ISO 2063, *Thermal spraying — Metallic and other inorganic coatings — Zinc, aluminium and their alloys*

ISO 2409, *Paints and varnishes — Cross-cut test*

ISO 2808, *Paints and varnishes — Determination of film thickness*

ISO 2811 (all parts), *Paints and varnishes — Determination of density*

ISO 2812-1, *Paints and varnishes — Determination of resistance to liquids — Part 1: Immersion in liquids other than water*

ISO 2812-2, *Paints and varnishes — Determination of resistance to liquids — Part 2: Water immersion method*

ISO 3231, *Paints and varnishes — Determination of resistance to humid atmospheres containing sulfur dioxide*

ISO 3251, *Paints, varnishes and plastics — Determination of non-volatile-matter content*

ISO 4624, *Paints and varnishes — Pull-off test for adhesion*

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 6270-1, *Paints and varnishes — Determination of resistance to humidity — Part 1: Continuous condensation*

ISO 7384, *Corrosion tests in artificial atmospheres — General requirements*

ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 8503-1, *Preparation of steel substrates before application of paints and related products — Surface roughness characteristics of blast-cleaned steel substrates — Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces*

ISO 9227, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 11997-2, *Paints and varnishes — Determination of resistance to cyclic corrosion conditions — Part 2: Wet (salt fog)/dry/humidity/UV light*

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

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

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

ISO 15528, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

ISO 19840, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Measurement of, and acceptance criteria for, the thickness of dry films on rough surfaces*

ISO 20340:2003, *Paints and varnishes — Performance requirements for protective paint systems for offshore and related structures*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply in addition to those given in ISO 12944-1.

3.1
artificial ageing
procedure designed to accelerate the ageing of a paint system

3.2
dry film thickness
DFT
thickness of a coating remaining on the surface when the coating has hardened

3.3
nominal dry film thickness
NDFT
dry film thickness specified for each coat or for the whole paint system

4 Performance testing design

4.1 Relationship between artificial ageing and natural exposure

The selection of a paint system for a specific situation should preferably be based on experience from the use of the system in similar cases, the durability of a paint system depending on many external factors such as the environment, the design of the structure, the surface preparation, the application procedure and the drying procedure.

The durability is among other things linked to the chemical and physical characteristics of the system, e.g. the type of binder and the dry film thickness. These characteristics can be evaluated by artificial-ageing tests. Of primary interest is resistance to water or moisture, and to salt fog, as an indication of wet adhesion and the barrier properties.

The tests and durations specified hereafter have been selected to determine fitness for purpose of the coating system in the intended application. However, results from artificial-ageing tests shall be used with caution. It shall be clearly understood that artificial ageing will not necessarily have the same effect as natural exposure. Many factors influence the degradation of coatings in the natural environment. It is difficult to simulate all the variables in the laboratory and, as a result, laboratory testing can lead to effective paint systems being rejected. It is therefore recommended that natural exposure trials always be undertaken in order to resolve such anomalies.

4.2 Laboratory tests

Suitable test methods for different corrosivity categories as defined in ISO 12944-2 and for different durability ranges as defined in ISO 12944-1 are described in Table 2.

Certain tests in this part of ISO 12944 are not applicable to many water-borne paint systems. Nevertheless, some water-borne paint systems are amenable to testing and evaluation using the procedures described herein, and the results of such testing could be taken into account.

4.3 Additional performance tests

Additional tests are recommended if more information is needed on corrosion protection or other properties.

Other test methods may also be used by agreement between the interested parties.

5 Test panels and sampling

5.1 Test panels

5.1.1 Steel substrates

The test panels shall be made of low-alloy carbon steel. The minimum panel size shall be 150 mm × 70 mm. The panel thickness shall be 3 mm at least. Unless otherwise agreed, the panel surface shall be prepared by abrasive blast-cleaning to a surface preparation grade of at least Sa 2 1/2 as defined in ISO 8501-1 and the surface roughness (profile) shall correspond to medium (G) as defined in ISO 8503-1. In all other respects, test panels shall comply with ISO 7384.

5.1.2 Metal-coated steel substrates

The panels shall be made of hot-dip-galvanized steel (see ISO 1461) or steel with a thermal-spray metallic coating (see ISO 2063). The surface preparation shall be as agreed between the interested parties. Suitable surface preparation methods are given in ISO 12944-4.

5.2 Sampling of paints

Take a representative sample of the product to be tested (or of each product in the case of a multi-coat system), as described in ISO 15528. Examine and prepare each sample for testing, as described in ISO 1513.

5.3 Number of test panels

A minimum of three panels shall be prepared for each test.

5.4 Paint systems

5.4.1 Application and conditioning/drying/curing

The test panels shall be dry and free of dust, grease and any other foreign matter immediately prior to paint application.

The panels shall be coated (preferably by spraying) and cured in strict accordance with the paint manufacturer's recommendations. Protect the backs and edges of the test panels with appropriate means of protection.

Each coat shall be homogeneous in dry film thickness and appearance and shall be free from surface defects, e.g. runs, sags, misses, pinholes, wrinkling, gloss variations, cissing, particle inclusions, dry overspray and blisters.

Unless otherwise agreed, condition the coated test panels for three weeks in standard atmosphere (23 ± 2) °C/(50 ± 5) % relative humidity or (20 ± 2) °C/(65 ± 5) % relative humidity, as defined in ISO 554, before testing.

5.4.2 Dry film thickness (DFT)

After each coat has hardened sufficiently, measure the dry film thickness of the coating on the test face of the panel at five locations (centre and each corner, 15 mm to 20 mm from the panel edge). Record the minimum, the maximum and the mean thickness in the test report (see Clause 8). The method used to measure the dry film thickness shall be in accordance with ISO 19840 for rough surfaces and in accordance with ISO 2808 for smooth and galvanized surfaces, unless otherwise agreed between the interested parties.

The maximum dry film thickness (see Note) of each coat on each panel shall be:

— less than 1,5 × the NDFT if the NDFT is ⩽ 60 µm;

— less than 1,35 × the NDFT if the NDFT is > 60 µm

NOTE The maximum dry film thickness of the last coat applied is calculated as the maximum measured thickness minus the mean measured thickness of the previous coat(s).

5.4.3 Over-coating time

For each coat, the over-coating time shall comply with the paint manufacturer's instructions.

The over-coating time, air temperature and humidity during application shall be recorded.

5.5 Scribe line

When testing coatings on steel substrates, a scribe line shall be produced as specified in Annex A for the salt spray test (ISO 9227) and for the cyclic exposure test (see ISO 11997-2). The scribe line shall cut through the paint coating down to the steel substrate.

When testing coatings on hot-dip-galvanized steel, no scribe line shall be produced, irrespective of the test to be carried out.

5.6 Reference system

It is recommended that a paint system that has been in successful use for several years on site, and whose performance as indicated by laboratory testing is well known, is used as a reference system. This system shall be as similar as possible in composition and/or generic type and dry film thickness to the paint system being tested.

6 Test procedures

6.1 Test regimes

Two types of test regime are defined, as follows:

— test regime 1: when the paint system is tested by more than one different test method (see Table 2);

— test regime 2: when the paint system is tested by a cyclic exposure test (see Table 2).

The test regime to be used for each corrosivity category and for each required durability range is given in Table 1. When a choice is possible (1 or 2), the test regime to be used shall be agreed between the interested parties. In such cases, there is no difference in choice of test regime or exposure time between steel substrates with a thermally sprayed metal coating and hot-dip-galvanized steel substrates. However, no scribe line (see Annex A) is made for hot-dip-galvanized substrates.