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

Part 7: Execution and supervision of paint work

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

Partie 7: Exécution et surveillance des travaux de peinture

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).

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 12944-7:1998), which has been technically revised.

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

— the normative references have been updated;

— the terms and definitions have been updated;

— a bibliography has been added;

— the text has been editorially revised.

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.

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 how paint work on steel structures is to be executed and supervised after the surface has been prepared in accordance with ISO 12944-4. Examples of protective paint systems suitable for this purpose are given in ISO 12944-5.

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

Part 7: Execution and supervision of paint work

1 Scope

This document deals with the execution and supervision of paint work on steel structures in the workshop or on site.

This document does not apply to

— the preparation of surfaces to be painted (see ISO 12944-4) and the supervision of such work,

— the application of metallic coatings, and

— pre-treatment methods, such as phosphating and chromating, and paint application methods, such as dipping, powder coating or coil coating.

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 1513, *Paints and varnishes — Examination and preparation of test samples*

ISO 8502-4, *Preparation of steel substrates before application of paints and related products — Tests for the assessment of surface cleanliness — Part 4: Guidance on the estimation of the probability of condensation prior to paint application*

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

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12944-1 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 http://www.iso.org/obp

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3.1
reference area
defined part of the structure where the coating system has been applied according to the specification and approved by all parties involved

3.2
reference specimen
object, preferably with a geometry that is representative of the structure, where the coating system has been applied according to the specification and approved by all parties involved

3.3
stripe coat
extra coat of paint applied only to edges, welds, fasteners and other irregular areas on steel structures usually before full coating

4 Preconditions for the execution of the paint work

4.1 Qualification

Companies contracted to apply protective paint systems to steel structures, and their personnel, shall be capable of carrying out the work properly and safely. Work requiring particular care with regard to its execution shall only be carried out by personnel having the appropriate qualification.

A method statement shall be provided which shows the ability of the contractor to achieve the specified quality level for each process.

NOTE Processes in the sense of this document are, for example, surface preparation, application of coating materials, drying and quality control.

If requested, the contractor shall provide the client with relevant execution and supervision documentation (templates).

4.2 Condition of the substrate

A protective paint system requires proper surface preparation, which depends on the initial and final condition of the surface. The respective requirements shall be specified in the painting specification and be capable of achievement.

Methods of surface preparation are described in ISO 12944-4. The prepared surfaces shall be assessed with regard to visual cleanliness, surface profile and chemical cleanliness, using the methods given in ISO 12944-4.

The requirements for the supervision of these aspects of the work, the frequency of assessment, and the location of the assessment work shall be agreed between the parties concerned.

If the condition of the surface differs from that described in the specification, the client shall be informed.

The temperature of the surface shall be unequivocally above the dew point of the surrounding air, unless otherwise specified in the paint manufacturer's technical data sheet.

4.3 Health and safety and environmental protection

The applicable requirements concerning health and safety and environmental protection shall be complied with. See ISO 12944-1 and ISO 12944-8.

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5 Coating materials

5.1 Supply

The coating materials shall be supplied in such a condition that they are ready for use by the application method specified at the time of ordering. Paint manufacturers' technical data sheets shall comprise all details which are necessary for their use.

If any testing is required, it shall be specified, indicating the methods to be used. Sampling and further processing of samples shall be in accordance with ISO 15528 and ISO 1513.

Any detail not included in the paint manufacturer's technical data sheet that could affect the application conditions or the final quality of the work shall be given by the manufacturer.

5.2 Storage

The manufacturer shall indicate on the container the date by which the coating materials should be used (shelf life). Unless other temperatures are indicated in the manufacturer's instructions or specified elsewhere, coating materials shall be stored at temperatures above +3 °C and under +30 °C. Water-borne coating materials, in particular, can become unusable after freezing.

Coating materials and any other materials used (solvents, thinners, etc.) shall be stored in a secured area.

Paint containers shall be kept sealed until the contents are prepared for use. Partly used containers can be re-sealed and used later, if not otherwise indicated in the paint manufacturer's technical data sheet. Partly used containers shall be clearly marked.

6 Execution of paint work

6.1 General

The surfaces to be treated shall be safely accessible and well-illuminated.

When using the coating materials, the manufacturer's technical data sheet shall be observed unless specifically stated otherwise in the painting specification.

Prior to and during the application, the coating materials shall be verified to ensure

— conformity of the container label with the specified product description,

— no skin formation,

— no irreversible settling, and

— usability under the given site conditions.

Any sediment present shall be easily redispersible.

Any viscosity adjustment, which can be necessary due to low application temperatures or different application methods, shall be made in accordance with the paint manufacturer's instructions. The client shall be informed, if required in the specification, of any such adjustment.

The application methods will depend on the type of coating material, the surface, the type and size of the structure and the local conditions. Unless otherwise specified, the application method shall be agreed.

The priming coat shall cover the entire surface profile of the steel surface. Each coat shall be applied as uniformly as possible and without leaving any areas uncovered.

Methods for the measurement of film thickness are described in ISO 2808. The procedure for measuring the dry film thicknesses (instruments, adjustment, and any allowance to be made for the contribution

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of the surface roughness to the result) and the acceptance criteria shall be according to ISO 19840, unless otherwise agreed.

Care shall be taken to achieve the nominal dry film thickness and to avoid areas of excessive thickness. It is recommended that the maximum dry film thickness not be greater than three times the nominal film thickness. In the case of excessive maximum dry film thickness, expert agreement shall be reached between the parties. For products or systems which have a critical maximum dry film thickness and in special cases, information given in the manufacturer's technical data sheet shall be observed.

All surfaces that are difficult to access, for example, edges, corners, welds and riveted and bolted connections, shall be painted with particular care.

If additional edge protection is required, a stripe coat extending across a reasonable width (approximately 25 mm) on both sides of the edge shall be applied.

To assist in achieving the required dry film thickness, the wet film thickness shall be periodically checked during application.

The time interval between the application of coats, and between application of the final coat and use, given in the manufacturer's technical data sheet for the coating material, or as otherwise required by the specification, shall be adhered to.

Defects in any paint coat which can lead to a reduction in the protection provided by the coat, or which have a significant effect on the appearance, shall be repaired prior to application of the next coat. To avoid damage, the coating shall be sufficiently hard before transporting and handling.

Areas which are not to be painted or are to be painted with a low film thickness only, for example, surfaces which will subsequently be welded and faying surfaces (those for which a close-tolerance fit is necessary) shall be identified to the contractor before painting commences.

6.2 Application conditions

In order to ensure the protection required from the coating, the ambient conditions on site shall be checked to ensure that they meet the requirements given in the paint manufacturer's technical data sheet for the particular coating material. This shall also apply to drying and reaction times.

During the planning stage before starting the work, measures shall be defined by which adverse effects on the environment can be avoided or reduced to a minimum.

During the execution of the corrosion protection work, care shall be taken that the work is not affected by any outside influences that could lead to a reduction in the quality of the coating. Paint work shall take place in an area separated or protected from the work of other trades (blast-cleaning, welding, etc.). If adverse weather conditions occur during application, the work shall be stopped and the freshly coated area protected as far as practical.

The lowest and highest permissible temperature of the surface to be coated and of the surrounding air shall be as stated in the manufacturer's technical data sheet.

Coating materials shall not be applied at temperatures below 3 °C above the dew point, determined in accordance with ISO 8502-4. Wet surfaces shall only be painted with those coating materials which are permitted in the technical data sheet or approved by the paint manufacturer.

When painting components are to be welded on site, such components shall be masked in all areas which will be subject to preheating and welding. In the case of multicoat systems, every coat shall be stepped back.

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6.3 Application methods

6.3.1 Brush application

Brushes shall be suitable for their intended use. This applies particularly to corners, rivet heads, bolt heads, and angles and areas which are difficult to access. Details shall be given in the specification.

6.3.2 Roller application

The coating materials used shall be suitable for this method of application and shall have good levelling properties. The type and size of the roller shall be appropriate to the particular job. Roller application is normally not recommended for the application of anticorrosive primers.

6.3.3 Spray application

The following spraying methods are among those commonly used:

— conventional, low-pressure air spray;

— airless spray;

— air-assisted airless spray;

— electrostatic spray.

The paint viscosity, spraying pressure, type of nozzle, temperature of paint material, distance to the surface to be coated and spraying angle shall be selected so that uniform and continuous coatings are produced.

When using these methods, suitable precautions shall be taken to avoid spray mist spreading over the surroundings.

If the required film thickness cannot be achieved on edges, in corners or in areas of the structure which are difficult to access (spray shadows), these areas shall be precoated by brushing, using a stripe coat, or spraying. The use of inorganic zinc dust primers materials is not recommended for this purpose.

For coating materials having a tendency to settle, the paint container shall be fitted with a mechanical stirrer.

6.3.4 Other application methods

If other methods are used, for example flow-coating, application of hot-melt coating materials or application of anticorrosive tapes, they shall be carried out in accordance with the manufacturer's instructions.

6.4 Evaluation before work commences

The application method specified shall be evaluated using the specified materials to ensure that they give the required protection. If the application method and/or the specified materials are found to be unsuitable, the specification shall be amended accordingly by the parties involved and any consequences, e.g. cost or time, shall be taken into consideration.

7 Supervision of the paint work

7.1 General

The execution of the work shall be supervised at all stages. Supervision shall be undertaken by suitable qualified and experienced people. The contractor shall be responsible for carrying out this supervision,

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but additional supervision by the client, even for corrosion protection work in the workshop, is advisable.

When coating materials with which the contractor is unfamiliar are to be applied, the manufacturer of the coating material shall be consulted.

The level of supervision will depend on the type and importance of the project, the degree of difficulty of the work and local conditions, and on the type of coating and its intended service life. This supervision will require appropriate technical knowledge and experience.

7.2 Measurement and test instruments

The instrument manufacturer's instructions for the use of their equipment shall be complied with. The instruments used shall be checked, calibrated and maintained at regular intervals and the results shall be recorded.

7.3 Assessments of the coating

Coatings shall be assessed for compliance with the specification, for example

— by visual assessment, e.g. for uniformity, colour, hiding power and defects such as holidays, wrinkling, cratering, air bubbles, flaking, cracks and curtains,

— by means of instruments for compliance with the following characteristics of the dry film, if required:

  — dry film thickness, generally by non-destructive methods [see ISO 19840 and a) below],

  — adhesion by destructive methods (see ISO 16276-1 and ISO 16276-2), and

  — porosity: by low or high-voltage detectors (see ISO 29601).

For dry film thickness measurements, the parties concerned shall agree on the following:

a) the method to be used, the measurement instrument to be used, details of the adjustment of the measurement instrument, and how to take into account the contribution of the surface profile to the result;

b) the sampling plan — how and how many measurements are to be made for each type of surface;

c) how the results are to be reported and how they are to be compared with acceptance criteria.

Dry film thicknesses shall be checked at each critical stage, and when the complete system has been applied. A critical stage is, for example, when there is a change in the responsibility for the paint work or when a long time elapses between application of priming coats and subsequent coats.

The coating on contact surfaces of preloaded bolted connections, for example high-strength fitted bolts in friction-grip connections and high-strength bolts in shear-type bearing connections, shall be checked for conformity with the agreements made in the contract.

If destructive testing is necessary, notch-cutter measurements are acceptable. Such instruments can be used to check the thickness of individual coats and that of the complete system, and the sequence of the coats can also be checked. When testing for pores, the instrument and test voltage used shall be agreed between the parties concerned. Any coating damage shall be repaired in accordance with the specification. See ISO 12944-8.

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8 Reference areas and reference specimens

8.1 General

Reference areas are suitable areas on the structure, while reference specimens are representative specimens used in order to establish a minimum acceptable standard for the work, to check that data provided by a manufacturer or contractor are correct, and to enable the performance of the coating to be assessed at any time after completion. Reference areas are normally not used for guarantee purposes but can be used for this purpose if agreed between the contracting parties.

If reference areas are required, they shall be prepared in locations in which the corrosive stresses are typical for the structure concerned. All surface preparation and paint application work on reference areas shall be carried out in the presence of representatives of all parties concerned, who shall give their agreement in writing when the reference areas are in accordance with the specification. All reference areas shall be accurately documented and may also be permanently marked on the structure itself (see ISO 12944-8).

If reference specimens are required, they shall be pre-treated, coated and cured/dried under the same conditions and in the same way as for the structure and shall be traceable to a location on the structure. They shall remain at the location of the structure.

The size and number of reference areas or reference specimens shall be in reasonable proportion, both practically and economically, to the area of the complete structure. See Annex A; see also ISO 12944-8.

8.2 Previously coated surfaces

8.2.1 General

In the particular case of previously coated surfaces (old coatings or coatings applied recently by other contractors), the surface preparation and paint system and application shall be agreed by the parties involved. Two types of reference area (A and B) may be prepared. Such previous coatings may be either old coatings or coatings applied recently by other contractors.

8.2.2 Type A reference area

Surface preparation and application of coatings *is* in accordance with the specification.

8.2.3 Type B reference area

All existing paint is removed to the bare metal and the complete paint system is then applied, all in accordance with the specification.

8.3 Reference area records

The contractor shall keep records on the preparation of reference areas for each step of the work (for recommended form, see ISO 12944-8:2017, Annex B). The records shall include all relevant data and shall be approved by all parties concerned.

8.4 Assessment of coating

The coating shall be assessed by methods agreed between the parties concerned, preferably using international or national standards.

Defects in the coating can occur at the following locations:

— on the structure but not in the reference area(s);

— both on the structure and in the reference area(s);

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— in the reference area(s) only.

If reference areas are used for guarantee purposes, possible causes of the defects shall be determined by suitably qualified and experienced personnel approved by the parties concerned.

If reference areas have been damaged, the defects shall be carefully repaired but these repaired parts are no longer valid as reference areas.

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Annex A
(informative)

Number of reference areas

This annex gives recommendations for the number of reference areas depending on the size of the structure. See Table A.1.

Table A.1 — Number of reference areas

Size of structure (painted area) m^2	Recommended maximum number of reference areas	Recommended maximum percentage of reference area relative to total area of structure %
≤ 5 000	1	0,3
> 5 000 ≤ 10 000	2	0,3
> 10 000 ≤ 25 000	3	0,2
> 25 000 ≤ 50 000	4	0,15
> 50 000	5	0,1

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Bibliography

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

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

[3] 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*

[4] ISO 16276-1, *Corrosion protection of steel structures by protective paint systems — Assessment of, and acceptance criteria for the adhesion/cohesion (fracture strength) of a coating — Part 1: Pull-off testing*

[5] ISO 16276-2, *Corrosion protection of steel structures by protective paint systems — Assessment of, and acceptance criteria for, the adhesion/cohesion (fracture strength) of a coating — Part 2: Cross-cut testing and X-cut testing*

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