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Corrosion of metals and alloys — Guidelines for selection of protection methods against atmospheric corrosion

Corrosion des métaux et alliages — Lignes directrices pour le choix des méthodes de protection contre la corrosion atmosphérique

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11303 was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

Corrosion of metals and alloys — Guidelines for selection of protection methods against atmospheric corrosion

1 Scope

This International Standard gives guidance on the selection of methods of protection against atmospheric corrosion of metals and alloys. It is applicable for technical equipment and products made of structural metals and used under atmospheric conditions. In a rational selection of protection methods, the corrosivity of the atmospheric environments is one of the important factors. These guidelines use the atmospheric corrosivity classification defined in ISO 9223.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 8044:1999, *Corrosion of metals and alloys — Basic terms and definitions*

ISO 9223:1992, *Corrosion of metals and alloys — Corrosivity of atmospheres — Classification*

ISO 9224:1992, *Corrosion of metals and alloys — Corrosivity of atmospheres — Guiding values for the corrosivity categories*

ISO 12944-2:1998, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

3 Terms and definitions

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

3.1
corrosion system
system consisting of one or more metals and those parts of environment that influence corrosion

[ISO 8044]

3.2
corrosion damage
corrosion effect that causes impairment of the function of the metal, the environment or the technical system of which these form a part

[ISO 8044]

3.3
corrosivity
ability of an environment to cause corrosion of a metal in a given corrosion system

[ISO 8044]

3.4
corrosion protection
modification of a corrosion system so that corrosion damage is reduced

[ISO 8044]

3.5
serviceability (with respect to corrosion)
ability of a system to perform its specified function(s) without impairment due to corrosion

[ISO 8044]

3.6
service life (with respect to corrosion)
time during which a corrosion system meets the requirements for serviceability

[ISO 8044]

3.7
durability (with respect to corrosion)
ability of a corrosion system to maintain serviceability over a specified time when the specified requirements for use and maintenance have been fulfilled

[ISO 8044]

3.8
maintenance
complex of activities, securing functions of a protection system during a planned service life

3.9
atmosphere
mixture of gases, and normally also aerosols and particles, that surrounds a given object

[ISO 12944-2]

4 Procedure for selection of a corrosion protection method

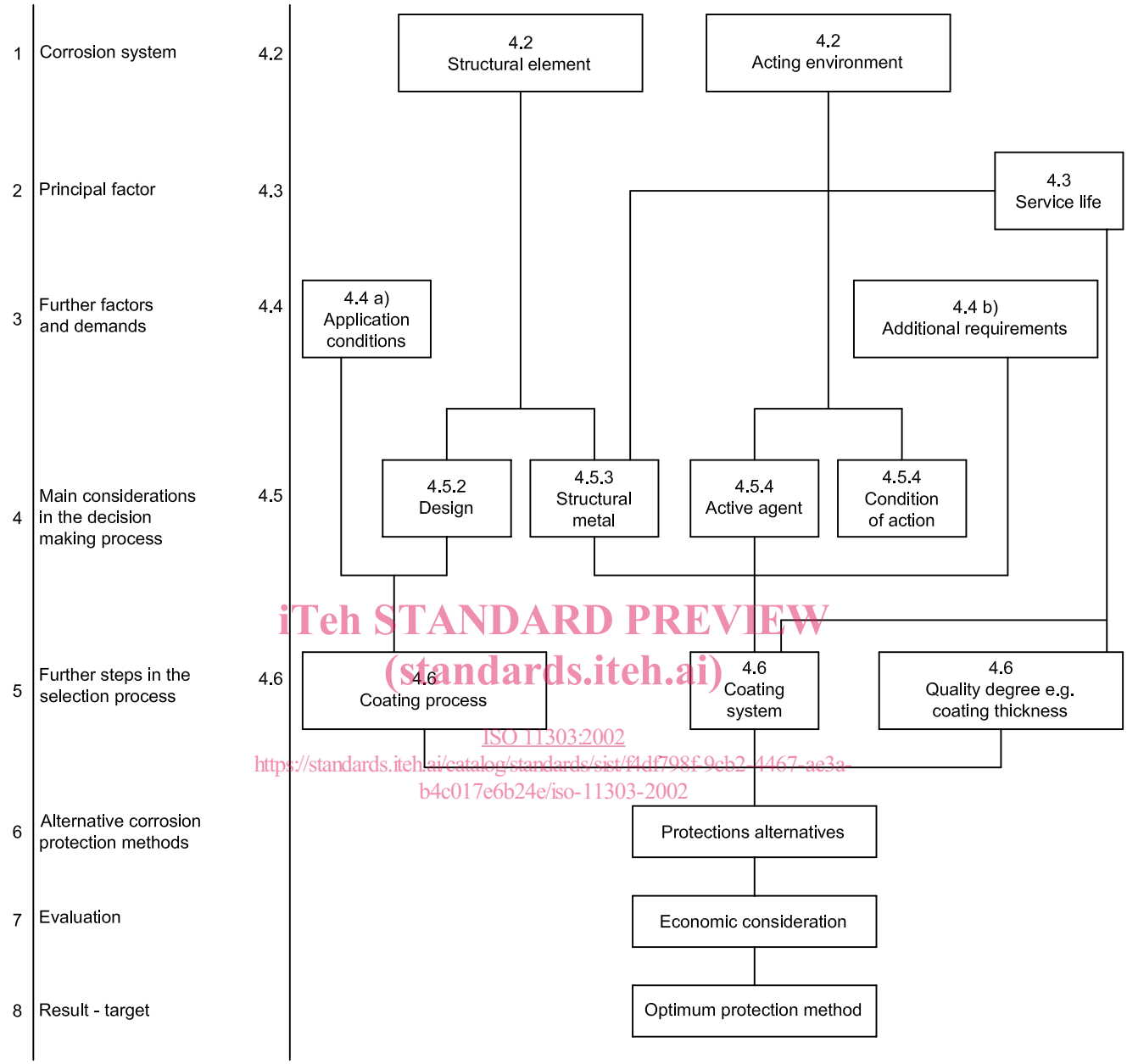
4.1 General

In general, protection against atmospheric corrosion can be achieved by the selection of suitable material, the design of the product with respect to protection against corrosion, by reducing the corrosivity of the environment and by covering the product with appropriate protective coatings.

The selection of the appropriate corrosion protection method comprises several steps respecting characteristics of the product, its designed service life and other demands connected with its use, the corrosive environment and other factors outside the corrosion system e.g. cost. The relations are shown in Figure 1. The steps of the corrosion protection selection defined in 4.2 to 4.6 are marked on this schematic diagram.

4.2 Corrosion system

In the sense of this International Standard, the corrosion system encompasses both the structural metallic element and its environment, i.e., the atmosphere in contact with it. The term atmosphere includes corrosive atmospheric components (gases, aerosols, particles).



NOTE References to the procedures described in clause 4.

Figure 1 — Procedure for the selection of a corrosion protection method

4.3 Principal factor in selection of corrosion protection method

The designed service life is the principal factor in the process of selecting the protection method for structural elements. Service life of a component or product is derived in relation to its most important functional property, e.g. thickness of an element, non-corroded surfaces, colour or gloss. If the service life cannot be attained because of shorter life of the selected optimum protection method, it shall be necessary to apply one or several maintenance cycles.

4.4 Further factors and demands

Further factors to be taken into account in selecting the protection method are:

a) application conditions, i.e. technical feasibility of applying the protection method;

b) additional requirements derived from the use of the structural element to be protected, e.g. colour shade, mechanical or electrical properties, light reflection.

4.5 Considerations in the decision-making process

4.5.1 General

With respect to the component to be protected the main considerations are:

a) its design (4.5.2);

b) structural metals (4.5.3).

With respect to the environment the main considerations are:

c) active agent,e.g. gaseous pollution and particles (4.5.4);

d) conditions of action, e.g. humidity, temperature, level and changes, etc. (4.5.4).

4.5.2 Design

The shape, size and other design factors of the structural element exert an important influence on the selection of the optimum protection method. This cannot be described in a generalized form. The influence of the design shall always be considered individually.

In the corrosion system the design of the structural element affects the severity of atmospheric effects on individual surfaces, e.g. by different time of wetness, exposure categories or accumulation of corrodants.

4.5.3 Structural metals

The most important structural metals are:

a) carbon steel;

b) low-alloy weathering steel;

c) stainless steel;

d) aluminium (and Al-alloys);

e) copper (and Cu-alloys);

f) zinc (and Zn-alloys).

NOTE The sensitivity to atmospheric corrosion and characteristics of attack in these metals varies greatly.

The surface conditions of a basis metal, e.g. presence of corrosion products, salts and surface roughness, exert a decisive influence on the durability of the corrosion protection.

4.5.4 Environmental conditions

Many factors influence the corrosivity of the atmosphere.

ISO 9223 provides a means for classifying the corrosivity of atmospheres based on four standard metals (carbon steel, zinc, copper and aluminium). The controlling factors are time of wetness and the deposition of chlorides and

sulfur dioxide (airborne corrodants). Other important factors of the environment are radiation from the sun and temperature extremes.

4.6 Further steps in the selection process

In general, the selection of a coating process may be limited by the design of the structural element (e.g. accessibility may limit use of a spray process and size may limit the use of a hot dip galvanizing process).

The quality degree of the protection method should preferably be derived from the required service life. Durability of the selected protection system changes with the severity of the environment.

If the selection of an optimum corrosion protection method for the given corrosion system does not lead to satisfactory results, it is possible to improve acceptability by changing the corrosion system (change of material or design of structural element, modification of environment).

5 Significance of the corrosivity classification for selection of protection method

The need for protective measures is based on the application of corrosivity categories.

The basis for deriving corrosivity categories is represented either by corrosion losses of standardized specimens of four basic structural metals (carbon steel, zinc, copper and aluminium) after a one year atmospheric exposure, or by yearly arithmetic means of the three most important environmental characteristics affecting atmospheric corrosion, i.e. time of wetness, deposition rate of sulfur dioxide and/or chlorides. The measured values are ranked into different classification categories and generalize certain ranges of environmental effects on those metallic materials.

Provided that similar corrosion mechanisms apply, the corrosivity categories yield useful information about the corrosion behaviour of related alloys. The corrosivity categories are not applicable to stainless steels for which data shall be derived directly by taking the main factors of environment and the specific behaviour of these steels into account.

Corrosion losses determined after one year of exposure shall not be used for prediction of corrosion losses after longer periods because corrosion losses are not linear with time. However, these measurements can be used to establish the appropriate corrosion category. Then the corrosion losses after longer periods can be estimated from the guiding values outlined in ISO 9224.

Structural elements include components differing from standardized surfaces used for specification of the corrosivity categories. The orientation of the surface affects corrosion losses. The corrosivity information based on sheltered and indoor rooms may be helpful.

6 Durability of the protection system

Requirements for the quality of protection systems become more stringent the higher the corrosivity category and the stricter the durability requirements.

The durability of a given protective system generally increases with its thickness within limits specific for that system.

NOTE Detailed information for the selection of a protection system for a structural metal and its durability should be taken from the relevant specifications of the individual protection method, e.g. for details of corrosion protection of steel structures by protective paints systems see ISO 12944-1 to -8 and by metal coatings see ISO 14713.