
Corrosion control engineering life cycle — General requirements

*Ingénierie du contrôle de la corrosion au cours du cycle de vie —
Exigences générales*

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Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principles	2
5 Objectives	2
6 Corrosion sources	2
7 Materials	2
8 Technology	3
9 Design	3
10 Research and development	4
11 Manufacturing	4
12 Construction	4
13 Storage and transportation	5
14 Installation and commissioning	5
15 Acceptance inspection	5
16 Operation	6
17 Maintenance	6
18 Repair	6
19 Scrap and disposal	6
20 Documents and records	7
21 Resource management	7
22 Comprehensive assessment	7
Annex A (informative) Example of a corrosion control engineering application	8
Bibliography	10

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 of 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 www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*, Subcommittee SC 1, *Corrosion control engineering life cycle*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Corrosion control engineering life cycle — General requirements

1 Scope

This document specifies the general requirements for control elements in the life cycle of corrosion control engineering.

It is applicable to all types of corrosion control engineering programmes.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

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

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

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

3.1

corrosion control engineering life cycle

entire process of corrosion control that starts from the identification of the *corrosion source* (3.2), and includes the selection of materials and techniques for corrosion control, system engineering design, construction, inspection, assessment and maintenance, through to the final disposal

3.2

corrosion source

element that alone or in combination has the potential to cause corrosion

3.3

optimum benefit

best situation that is based on a comprehensive consideration, and a coordinated and optimized selection

3.4

element

factor that can affect the achievement of the *optimum benefits* (3.3) of the *corrosion control engineering life cycle* (3.1)

3.5

component

sub-part, assembly, portion or process that is a part of, or contributes to, the final assembly

3.6

green plan

green environmental protection measure that comprehensively considers all related known factors, such as reducing resource consumption and engineering waste generation, recycling, etc.

4 Principles

4.1 This document defines the corrosion control activities conducted throughout the entire engineering life cycle, and identifies all related elements including the objectives, corrosion sources, materials, technology, design, research and development, manufacturing, construction, storage and transportation, installation and commissioning, acceptance, operation, maintenance, repair, scrap and disposal, documents and records, resource management, comprehensive assessments, etc. The requirements of those elements are specified in accordance with holistic, systematic, coordinated and optimized principles. The purpose of the requirements is to achieve the objectives (see 5.1) under the premise of ensuring human health, the safety of people's lives and property, national security and ecological environment safety (hereinafter referred to as "safety").

4.2 This document does not specify established procedures, professional management standards, specifications and test methods which are in relation to the links, nodes and elements.

4.3 All elements during the corrosion control process shall be identified and have established procedures.

5 Objectives

5.1 Corrosion control engineering efforts shall aim at improving the integration, systematization, mutual coordination and optimization of the main life cycle, so that corrosion can be effectively controlled, and achieving the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection.

5.2 The objectives (see 5.1) of corrosion control engineering shall be broken down into all elements of the life cycle. These objectives shall be communicated, implemented, maintained, regularly reviewed and continuously improved to ensure that the whole life cycle of corrosion control engineering is compatible with that of the protected main programme.

6 Corrosion sources

6.1 Corrosion sources shall include the following:

- a) internal corrosion sources, e.g. corrosion by an internal media;
- b) external corrosion sources, e.g. corrosion by the external environment.

6.2 All corrosion sources shall be identified systematically, comprehensively and accurately in accordance with the life cycle requirements of the main programme, including new corrosion sources unexpectedly developed during the construction processes.

6.3 Identifying corrosion sources should take into consideration the working conditions of the main programme and the corrosion control engineering effort.

6.4 Identified corrosion sources shall be subject to the acceptance of the established procedures to prevent any omission or wrong judgement.

7 Materials

7.1 The corrosion-resistant materials shall be selected to achieve the optimum performance of the equipment life cycle requirements regarding safety, cost-effectiveness, long-term operation and environmental protection.

NOTE For atmospheric corrosion, refer to ISO 11303.

7.2 The selected materials shall have the corresponding test method standards as the basis to support their selection, acceptance and use.

NOTE For corrosion of metals and alloys, refer to ISO 6509-1.

7.3 The selected materials shall have corresponding specific performance and supporting implementation cases as references to ensure that they can be adapted to other elements, links and nodes and meet the requirements of the main programme.

7.4 The selected materials shall be optimized in coordination with other elements in the programme.

7.5 The selected materials shall be subject to the acceptance of the established procedures. They shall be documented and archived.

8 Technology

8.1 The appropriate technique or multiple techniques including, but not limited to, electrochemical protection or corrosion inhibitor, shall be implemented for the corrosion control in accordance with the different corrosion prevention goals of the main programme.

NOTE For cathodic protection, refer to ISO 12696.

8.2 The process of choosing the technologies shall consider the influence of other elements. They shall be optimized in coordination with other elements, and achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection.

8.3 There shall be corresponding technical or test methods standards for the selected technologies for adapted technology.

8.4 The selected corrosion control technologies shall have corresponding successful performance and supporting implementation cases under the condition of meeting the requirements of the main programme.

8.5 The selected technologies shall be subject to the acceptance of the established procedures and meet the requirements of the main programme. They shall be documented and archived.

9 Design

9.1 All elements, links and nodes in the entire life cycle of corrosion control engineering shall be systematically designed to address the corresponding corrosion risks.

9.2 Relevant design in corrosion control engineering shall be considered in a holistic, systematic, coordinated and optimized way to ensure that all elements, links and nodes are harmonized and mutually supported.

9.3 Green plans shall be part of the design and shall be implemented.

9.4 The applicability of the design system shall be evaluated in accordance with the objectives of safety, cost-effectiveness, long-term operation and environmental protection. The design system shall be constantly improved to meet the requirements of the main programme.

9.5 The design documents shall be subject to the acceptance of the established procedures. They shall be documented and archived.

10 Research and development

10.1 All elements, links and nodes in the entire life cycle of corrosion control engineering shall be continuously researched, improved and developed during the implementation process to achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection.

10.2 The entire research and development process shall be carried out in accordance with established procedures and the principles of science, technology and economy.

10.3 Data documentation shall be established to ensure that all research and development programmes are traceable.

11 Manufacturing

11.1 Optimal corrosion-resistant items for a given manufacture programme shall be selected to achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection.

11.2 In order to achieve the requirements of the main programme, the component manufacturing or processing shall be optimized, coordinated and supported with other components and processes to ensure overall conformity.

11.3 The manufacturing of components shall be based on the corresponding standard that provides the optimal cost-effective construction.

NOTE For plastics piping systems, refer to ISO 15876-2.

11.4 Previous projects and the component manufacturing and processes shall be evaluated to determine if these practices are appropriate for current programmes.

11.5 All components and processes shall be subject to the acceptance of the established procedures. They shall be documented and archived.

12 Construction

12.1 Construction shall follow the optimal conditions and process to achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection.

12.2 The optimal construction shall have the corresponding criteria such as the corresponding standards, specifications, etc.

NOTE For thermal spraying, refer to ISO 2063-1.

12.3 The past performance and implementation cases of optimal construction approaches shall be examined and evaluated.

12.4 The construction shall be subject to the acceptance of the established procedures. It shall be documented and archived.

13 Storage and transportation

13.1 The optimal storage and transportation approach shall be selected and applied to protect the corrosion-critical devices and equipment from damage or destruction and to achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection.

13.2 When there are special storage and/or transportation requirements, the appropriate storage and transportation should be selected.

13.3 The storage and transportation approaches of all equipment and components shall be optimized in coordination with other equipment and components.

13.4 The optimal storage and transportation approaches shall be based on the corresponding standards, specifications, etc.

NOTE For raw natural and raw synthetic rubber, refer to ISO 7664.

13.5 The optimal storage and transportation approaches shall have corresponding specific performance or successful implementation cases.

13.6 Storage and transportation shall be subject to the acceptance of the established procedures. They shall be documented and archived.

14 Installation and commissioning

14.1 The optimal installation process of corrosion-critical systems shall be selected to meet the corresponding requirements of relevant conditions and to achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection. The installation shall be carried out in accordance with the installation requirements.

14.2 The optimal installation shall be based on the corresponding standards and specifications.

NOTE For on-land pipelines, refer to ISO 15589-1.

14.3 The optimal installation shall have corresponding specific performance and installation cases.

14.4 When commissioning is required (including cathodic protection and corrosion inhibitor), the optimal commissioning shall be selected in accordance with the principles of [14.1](#), [14.2](#), [14.3](#). The commissioning shall be carried out in accordance with the relative requirements.

14.5 The results of installation and commissioning shall be subject to the acceptance of the established procedures. They shall be documented and archived.

15 Acceptance inspection

The acceptance inspection of the corrosion control engineering programme shall be carried out during the process of the acceptance of the main programme. The acceptance inspection shall be carried out in accordance with the procedures specified in this document before the operation. It shall be documented and archived.

16 Operation

The operation parameter shall be set in accordance with the established procedures of operation and maintenance, and the outline of corrosion control engineering, to achieve the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection without adverse reactions to the environment, and to ensure a real-time forewarning by increasing monitoring during the operation of the corrosion control engineering life cycle on the basis of acceptance.

17 Maintenance

17.1 Maintenance shall be carried out in accordance with the corresponding maintenance manual, which should recognize and identify the essential nature of corrosion control.

17.2 When using an electrochemical protection device, persons shall be designated to monitor, commission and test online for the purpose of pre-control and early warning on potential accidents.

17.3 The problems caused by corrosion, such as localized pitting, shall be tracked and dealt with promptly to reduce the corrosion risk of the main programme.

17.4 The monitoring equipment shall be maintained in a good condition.

18 Repair

18.1 The repair of corrosion-related damage shall be carried out in accordance with the relevant provisions, to ensure the safety and operation of the main programme and that corrosion control engineering is not affected.

18.2 The repair process of corrosion-related damage shall not affect or damage the function of other elements but shall coordinate and optimize with other elements to select the optimal repair.

18.3 The repair risk shall be evaluated. The optimal repair measure shall be selected so that risk can be managed and controlled, and its repair performance and experience can be reviewed.

18.4 The optimal repair of corrosion-related damage shall be based on the appropriate selection criteria such as standards and specifications.

18.5 The optimal repair of corrosion-related damage shall be subject to the acceptance of the established procedures. It shall be documented and archived.

19 Scrap and disposal

19.1 A green plan for decommissioning, abandonment, or scrap and disposal should be developed and implemented.

19.2 For any scrapped recyclable equipment, the appropriate entity for recycling shall be selected.

19.3 In order to protect the environment from pollution, a detailed plan for scrapping and disposing the equipment shall be prepared and approved by the responsible entity.

19.4 The results of the scrap and disposal of equipment shall be subject to the acceptance of the established procedures. They shall be documented and archived.

20 Documents and records

20.1 The documents and records shall be traceable and supportive for all elements, nodes and links covering the life cycle of corrosion control efforts.

20.2 Documents and records of corrosion control engineering shall be audited regularly to ensure the corrosion control information has been completed.

21 Resource management

All elements, links and nodes shall be managed by responsible and competent personnel, suitable technology and process equipment, relevant testing equipment, a dedicated working place and adequate supervision.

22 Comprehensive assessment

22.1 The above elements associated with the corrosion control effort shall be comprehensively evaluated in accordance with the requirements of each corresponding link and node.

22.2 The evaluation of the corrosion control effort requires a written evaluation report, which can be used to guide the improvement of the engineering design of the life cycle of corrosion control engineering.

22.3 [Annex A](#) provides an example of a corrosion control engineering application.

Annex A (informative)

Example of a corrosion control engineering application

This example concerns a desulfurization tower in a flue gas desulfurization device. Each procedure and each element in the corrosion control engineering life cycle is analysed in accordance with the general requirements of the corrosion control engineering life cycle in combination with the targets of the flue gas desulfurization device corrosion control engineering programme.

The flue gas desulfurization device includes the following corrosion control elements:

- a) Target: to effectively control the flue gas desulfurization device, aiming at achieving the optimum benefits of safety, cost-effectiveness, long-term operation and environmental protection. The elements below are designed and implemented based on this target.
- b) Corrosion sources: different gas compositions and desulfurizers exert different influences on the desulfurization tower inner surface. The corrosion sources change as the operating status (e.g. the temperature) changes. Therefore, all the corrosion sources including the gas composition, type of desulfurizer and worst working status are identified.
- c) Materials: the selection of materials is based on two criteria:
 - 1) The materials chosen are anti-corrosive. They are able to survive any corrosion caused by the gas composition, type of desulfurizer and worst working status.
 - 2) The materials chosen are suitable for a safe, economic, long-life operating and environmental-friendly project execution and operation. The material selection is based on the actual application and meets relevant standards to ensure that the material has been verified by a real project.

After consideration of the above requirements, the glass flake is chosen.

- d) Technology: the technology is chosen based on the corrosion sources, material and the main programme. In this project, the glass flake can be integrated well with the inner side of the tower, and the process is mature and has economical advantage. Therefore, the glass flake coating technology is chosen.
- e) Design: after deciding the material and technology, the system design is carried out by following two steps based on the tower corrosion control engineering system and tower construction, and the operational corrosion risk. In the first step, the information on the upstream gas composition (including normal and abnormal), temperature and work status, tower internal corrosion status monitoring, and tower outlet normal and fault monitoring (avoiding the negative influence on the downstream system) is collected. Then, in the second step, the optimal design is created for the design of the device, dimension, process, key knot measuring point and warning system.
- f) Research and development: when the chosen material and technology are not performing well in the application or a new operating situation appears, new materials, technologies and processes are researched and adopted based on the actual needs.
- g) Manufacturing: material and equipment manufacturers conform to the relevant standards. Since the material and technology in this project are mature, only the acceptance criteria have to be met.
- h) Construction: a detailed construction proposal is approved before construction. The glass flake requires professional workers to operate and carry out standard processes. The construction environment, surface processing, bottom coating, and glass flake inner and outer part conform to the relevant standards. In China, the glass flake construction needs to apply HG/T 2640.