1

Corrosion and Corrosion Protection

Peter Maaß

1.1

Corrosion

1.1.1

Causes of Corrosion

All materials or products, plants, constructions, and buildings made of such materials are subject to physical wear during use.

A general overview of different kinds of wear caused by mechanical, thermal, chemical, electrochemical, microbiological, electric, and radiation-related impacts is shown in Figure 1.1.

The technical and economic mastering of physical wear is difficult, since several causes are intertwined and mutually influence each other. The interaction with certain media of the environment results in undesired reactions of the materials that trigger corrosion, weathering, decaying, embrittlement, and fouling.

While mechanical reactions lead to wear, chemical and electrochemical reactions cause corrosion. Such processes emanate from the materials' surfaces and lead to modifications of the material properties or to their destruction. According to DIN EN ISO 8044, corrosion is defined as:

> "Physical interaction between a metal and its environment which results in changes of the metal's properties and which may lead to significant functional impairment of the metal, the environment or the technical system of which they form a part."

Note: *This interaction is often of an electrochemical nature.*

From this definition, included in the standard, further terms are derived:

- **Corrosion system:** A system consisting of one or several metals and such parts of the environment that affect corrosion.
- **Corrosion phenomenon:** Modification in any part of the corrosion system caused by corrosion.

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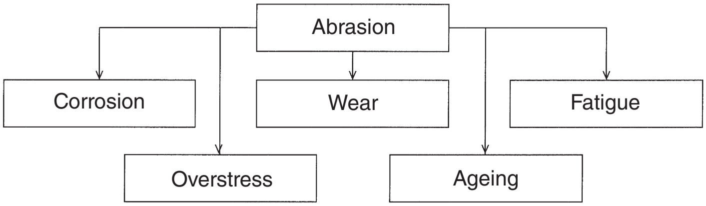


Figure 1.1 Types of wear of materials.

- **Corrosion damage:** Corrosion phenomenon causing the impairment of the metal function, of the environment or of the technical system of which they form a part.
- **Corrosion failure:** Corrosion damage characterized by the complete loss of operational capability of the technical system.
- **Corrosion resistance:** Ability of a metal to maintain operational capability in a given corrosion system.

When unalloyed or alloyed steel without corrosion protection is exposed to the atmosphere, the surface will take on a reddish-brown color after a short time. This reddish-brown color indicates rust is forming and the steel is corroding. In a simplified way, the corrosion process of steel progresses and is chemically based on the following equation:

$$\mathrm{Fe} + \mathrm{SO_2} + \mathrm{O_2} \rightarrow \mathrm{FeSO_4} \tag{1.1}$$

$$4\mathrm{Fe} + 2\ \mathrm{H_2O} + 3\mathrm{O_2} \rightarrow 4\mathrm{FeOOH} \tag{1.2}$$

The corrosion processes begins when a corrosive medium acts on a material. Since (energy-rich) base metals recovered from naturally occurring (low-energy) ores by means of metallurgical processes tend to transform to their original form, chemical and electrochemical reactions occur on the material's surface.

Two kinds of corrosion reactions are distinguished:

- **chemical corrosion**
  Corrosion excluding electrochemical reaction,
- **electrochemical corrosion**
  Corrosion including at least one anodic and one cathodic reaction.

1.1.2
Types of Corrosion

Corrosion does not only occur as linear abrasion, but in versatile forms of appearance. According to DIN EN ISO 8044, important variants for unalloyed or alloyed steel are:

- **Uniform surface corrosion**
  General corrosion occurring on the entire surface at nearly the same rate.
- **Shallow pit corrosion**
  Corrosion with locally different abrasion rates; caused by the existence of corrosion elements.
- **Pitting corrosion**
  Local corrosion resulting in holes, that is, in cavities expanding from the surface to the inside of the metal.
- **Crevice corrosion**
  Local corrosion in connection with crevices occurring in or immediately adjacent to the crevice area, which has developed between the metal surface and another surface (metal or nonmetal).
- **Contact corrosion (aka dissimilar metal corrosion)**
  Occurs at contact surfaces of different metals; the acceleratedly corroding metal area is the anode of the corrosion element.
- **Intergranular corrosion**
  Corrosion in or adjacent to the grain boundaries of a metal.

The standard mentioned above describes altogether 37 types of corrosion. These types of corrosion result in corrosion phenomena.

1.1.3
Corrosion Phenomena

EN ISO 8044 defines corrosion phenomena by corrosion-causing modifications in any part of the corrosion system.

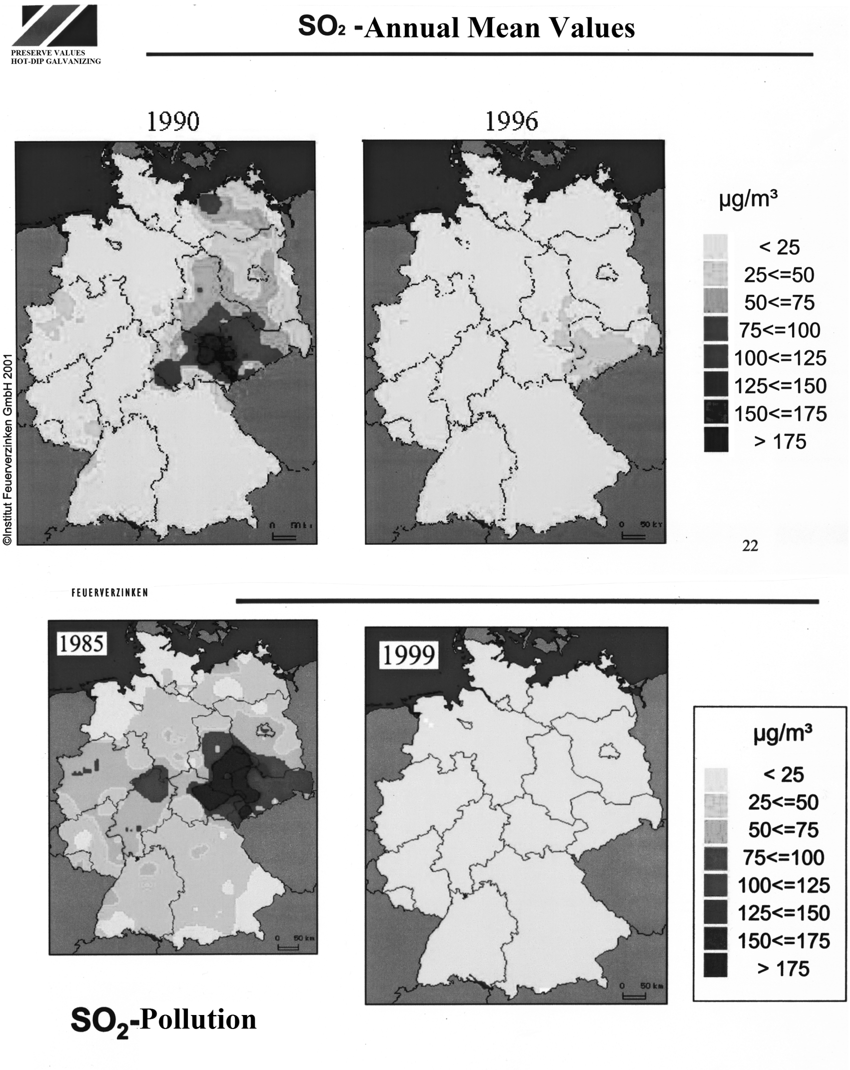
Major corrosion phenomena are:

- **Uniform surface attack**
  A form of corrosion where the metal material is almost uniformly removed from the surface. This form is also the basis for the calculation of the mass loss ($\mathrm{g\,m^{-2}}$) or the determination of the corrosion rate ($\mathrm{\mu m\,y^{-1}}$).
- **Shallow pit formation**
  A form of corrosion with irregular surface attack forming pits with diameters much larger than their depth.
- **Pitting**
  A form of corrosion with crater-shaped or surface-excavating pits or pits resembling pin pricks. The depth of the pitting spots usually exceeds their diameter.

It is very difficult to differentiate between shallow pit formation and pitting.

1.1.4
Corrosive Stress

According to DIN EN ISO 12944-2: All environmental factors enhancing corrosion (see Figure 1.2).



Source: Federal Environmental Agency

Figure 1.2 The reduction of SO_2 pollution in Germany over the last 20 years led to decisive reductions of the zinc-removal values (cf. Table 1.1).

1.1.4.1 Atmospheric Corrosion

The corrosion rate in the atmosphere is insignificant as long as the relative humidity on the steel surface does not exceed 60%. The corrosion rate increases, especially with inadequate ventilation,

- With increasing relative humidity.
- With condensate occurring (surface temperature < dew point).
- In the presence of precipitation.
- With increasing pollution of the atmosphere which may affect the steel surface and/or be deposited on it. Pollutants are gases, including sulfur dioxide, salts, chlorides, and sulfates. In connection with humidity, deposits like soot, dusts, salts, etc., on steel surfaces accelerate corrosion.

Temperature also, influences the corrosion process. The following criteria are decisive for the evaluation of the corrosive stress:

- climatic zone;
- cold climate;
- moderate climate;
- dry climate;
- warm, humid climate;
- sea climate;
- local climate.

Local climate is defined as what is prevailing within the radius of the object (up to 1000 m). The local climate and the pollutant content are the basis for the classification of atmospheric types.

- atmospheric types;
- room atmosphere;
- rural atmosphere;
- urban atmosphere;
- industrial atmosphere;
- marine atmosphere;
- microclimate.

The microclimate is the climate immediately at an individual component part. The local conditions, such as influences of humidity, dew-point shortfalls, local humidification and its duration, especially in connection with pollutants occurring at the location, have a significant impact on corrosion.

Table 1.1 shows the corrosive stress of atmospheric corrosion for different atmospheric types and corrosivity categories according to DIN EN ISO 12944-2.

1.1.4.2 Corrosion in the Soil

The corrosion behavior is determined by soil conditions and electrochemical parameters, such as element formation with other component parts and the influence of alternating and direct current.

Table 1.1 Corrosive stress – classification of environmental conditions acc. to DIN EN ISO 12944-2.

Corrosivity Class	**Thickness loss[a) in the 1st year (μm)**		**Examples of typical environments**	
	C-Steel	**Zinc**	**Outdoors**	**Indoors**
C 1 insign.	≤1.3	≤0.1	–	Insulated buildings ≤ 60% rel. humidity
C 2 low	>1.3–25	>0.1–0.7	Slightly polluted atmosphere, dry climate, e.g., rural areas	Uninsulated buildings with temporary condensation, e.g., store rooms, gymnasiums
C 3 moderate	>25–50	>0.7–2.1	S- and I-atmosphere with moderate SO_2-pollution or moderate coastal climate	Rooms with high rel. humidity and minor pollution, e.g., breweries, laundries, dairies
C 4 heavy	>50–80	>2.1–4.2	I-atmosphere and coastal atmosphere with moderate salt pollution	Chem. production halls, swimming pools
C 5 very heavy I	>80–200	>4.2–8.4	I-atmosphere with high rel. humidity and aggressive atmosphere	Buildings or areas with almost permanent condensation and heavy pollution
C 5 very heavy M	>80–200	>4.2–8.4	Coastal and offshore areas with high salt pollution	

a) Also reported as mass loss.

Corrosive stress is decisively determined by:

- the composition of the soil;
- changes of the soil condition at the object due to deposits present in the soil;
- additional electrochemical factors.

For further details, see EN 12501-1.

1.1.4.3 **Corrosion in Water**

Major conditions for corrosive stress in water are:

- the composition of the waters, such as oxygen content, kind and amount of dissolved substances in fresh water, brackish water and salt water;
- mechanical stress;
- electrochemical factors.

DIN EN ISO 12944-2 distinguishes between the underwater zone, the intermediate (fluctuating level) zone, the splash zone and humid zone.

1.1.4.4 Special Corrosive Stress

Corrosive stress at the location, in the application area or through production-related influences is a special load that has a decisive impact on corrosion. Mainly, chemical stress is concerned, like operation-related emissions (acids, alkaline solutions, salts, organic solvents, aggressive gases, and dusts and others). However, special stresses may also be mechanical stress, temperature stress and combined stresses – contemporaneous presence of mechanical and chemical stress, and all enhance corrosion.

1.1.4.5 Avoidance of Corrosion Damages

The following basic determinations are required for the avoidance of corrosion damage:

- determination of the corrosion exposure of the product, the plant, the structure or the building;
- knowledge of the service life: period of time in which the corrosion system meets the requirements for functionality (EN ISO 8044);
- knowledge of the protection period: expected service life of a coating system up to the first parts replacement (EN ISO 12944-1).

The determination of the corrosion exposure is relatively difficult since both the influence of the climatic zones, the local climate, the atmospheric types and the microclimate need to be taken into account. A corrosion protection corresponding to the service life has to be determined in order to minimize the expenses for costly repetitive maintenance measures.

1.2
Corrosion Protection

1.2.1
Procedures

All methods, measures, and procedures aimed at the avoidance of corrosion damages are called corrosion protection. Modifications of a corrosion system in so far as corrosion damages are minimized.

Figure 1.3 gives an overview.

1.2.1.1 Active Procedures

Active corrosion protection helps reduce or avoid corrosion by means of manipulation of the corrosion process, corrosion protection-related material selection, project engineering, design and manufacturing. But it is also a significant precondition for the effectiveness of passive corrosion-protection procedures. The following aspects are surveyed in this respect:

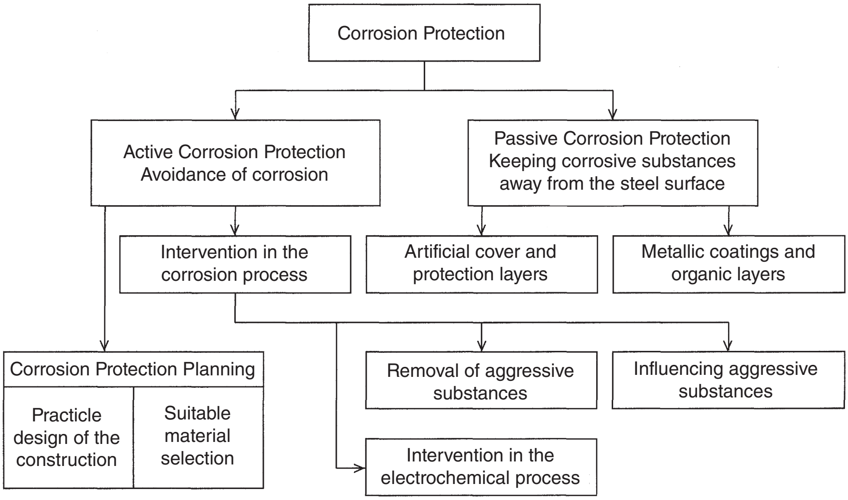


Figure 1.3 Methods, measures, and procedures of corrosion protection (*von Oeteren*, Korrosionsschutz-Fibel).

Design-Engineering Requirements The basic design-engineering requirements of the corrosion-protection-related design of steel structures are defined in the DIN EN ISO 12944-3:

- corrosion protection of steel structures by protective paint systems;
- basic rules for protective coating;
- EN ISO 14713;
- protection of iron and steel structures against corrosion–zinc and aluminum coatings.

In the figurative sense, they also apply to other products, unless these contain precise requirements determined in the respective DIN. In his engineering work, the design engineer has to consider the corrosive stress triggered by the corrosion types and phenomena. He has to depict a design engineering solution that is expected to provide an efficient protection period with optimal quality.

Here, essential aspects are:

- **Materials used**
  Knowledge of their properties and corrosion behavior are required.
- **Surface design**
  Preference to components with small corrosion-prone surfaces.
- **Profiles used**
  Preference to profiles forming the smallest number of edges. The angle profile ranks before the U-profile, the U-profile before the I-profile.

- **Component arrangement**
  Components and structures have to be arranged in a way to prevent or minimize the impact of aggressive media and to ensure an unimpeded circulation of air.

- **Component joining**
  The joining of components preferably requires smooth, closed surfaces. Fasteners require the same corrosion protection as the constructions, or an equivalent one with regard to the protection period.

- **Manufacturing requirements**
  The application of a passive corrosion-protection procedure entails the consideration of manufacturing criteria already in the design phase.

  The determination of a corrosion-protection procedure results, *inter alia*, in the demand for a design compatible with coating, hot-dip galvanizing, sputtering, enameling and galvanizing.

- **Maintenance-related requirements**
  The corrosion protection design has to allow for the possibility of efficient maintenance measures. Since the service life of components, constructions, products, plants and buildings differs from the protection period of the corrosion protection, repeated protection measures are usually required.

1.2.1.2 **Passive Procedures**

In passive corrosion protection, corrosion is prevented or at least decelerated through the isolation of the metal material from the corrosive agent by the applied protective layers. The technical preconditions of a corrosion layer are:

- the protective layer has to be pore-free;
- it must adhere firmly to the base material;
- it must be resistant to external mechanical stress;
- it must possess a certain ductility; and
- it must be corrosion resistant.

Essential preconditions for the effectiveness of corrosion-protection coatings are:

- Surface preparation to achieve the surface preparation degree Sa 2,5 or Sa 3 (blasting) or Be (pickling),
- Quality-oriented corrosion protection design.

Figure 1.4 shows the logical structure of DIN EN ISO 12944.

An overview of the procedures of passive corrosion protection is given in Figure 1.5 and Table 1.3 shows the available methods for protecting steel against corrosion with zinc.

This is the first time that the protection period has been defined in years (cf. Table 1.2).

On steel products exposed to corrosive stress for decades

- coatings such as paints, lacquers;
- metallic platings such as hot-dip platings, thermal-spray coatings;

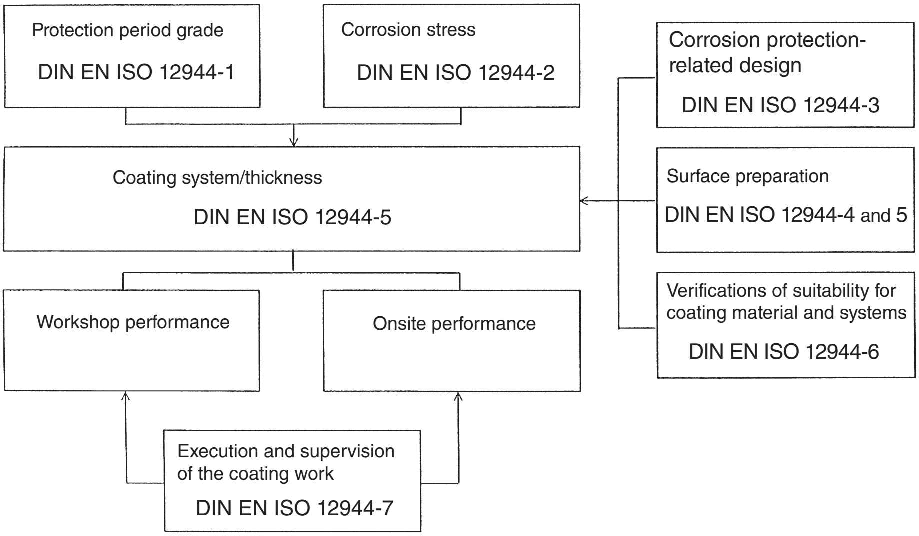


Figure 1.4 Short logarithm for the specification of coating systems according to DIN EN ISO 12944.

- as well as the duplex system – hot-dip galvanizing plus coating.

are applied.

While Figure 1.5 gives an overview of passive corrosion methods, Table 1.4 shows corrosion-protection methods for steel with zinc.

Essential decision-making aids for the choice of a corrosion-protection method are:

- important parameters of corrosion-protection methods for steel with zinc; (Table 1.4);
- advantages and disadvantages of different methods of metallic coating; (Table 1.5);
- limitation of use of the methods, determined by their characteristics (Table 1.6).

1.2.2
Commercial Relevance

The demands placed on components, constructions, products, plants, and structures of steel are *inter alia*,

- high operational reliability;
- long service life;
- good decorative design;

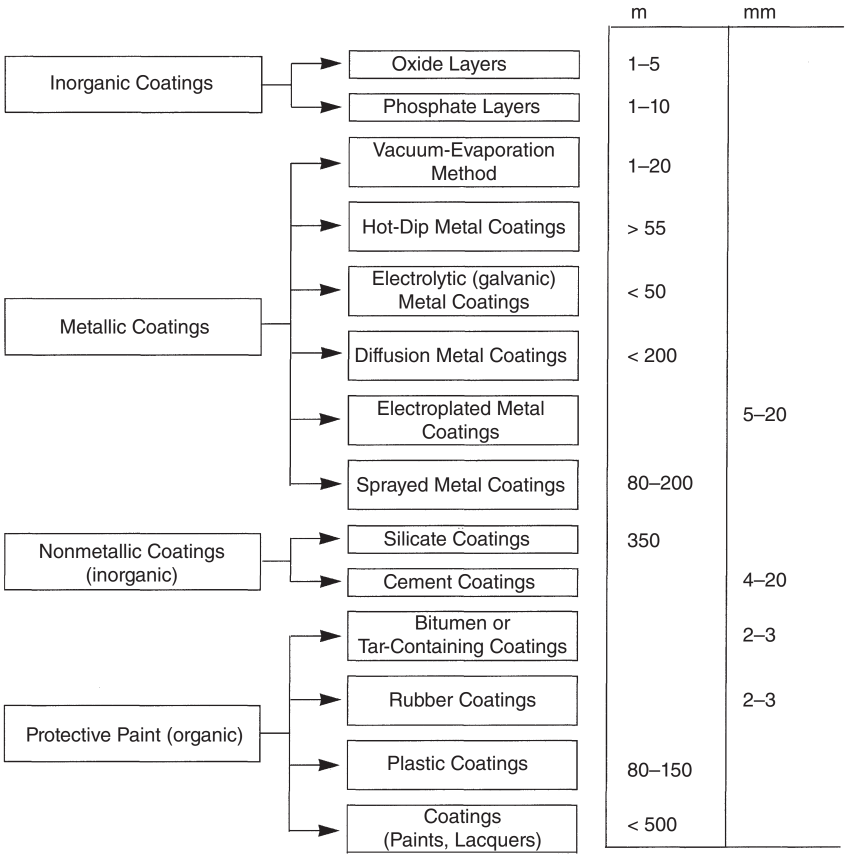


Figure 1.5 Overview of passive corrosion-protection procedures (*von Oeteren,* Korrosionsschutz-Fibel).

Table 1.2 Protection period for coating systems according to DIN EN ISO 12944-1 and -5.

Protection period	
Class	**Years**
Short	2–5
Medium	5–15
Long	>15

The protection period for a coating system chosen in dependence on the corrosive stress is regarded to be the expected service life until the first repairs. Unless otherwise agreed, the first replacement of parts for reasons of corrosion protection will be necessary as soon as the coating system has reached the degree of rustiness Ri 3 acc. to ISO 4628-3. The protection period is no “warranty period”, but a technical term that may help the contractor determine a maintenance program.

Table 1.3 Corrosion-protection processes.

Hot-dip galvanizing

a) Batch galvanizing

Discontinuous protection method in which the parts to be galvanized are individually immersed in molten zinc (batch galvanizing acc. to DIN EN ISO 1461/tube galvanizing acc. to DIN EN ISO 10240).

b) Continuous galvanizing

Protection method for continuously hot-dip galvanized sheet metal or steel strips of mild steels for cold forming 78 (DIN EN 10142) and continuously hot-dip galvanized sheet metal and steel strips of constructional steels (DIN EN 10147) as well as wire (DIN EN ISO 10244-2), which are coated with molten zinc in a continuous process in automatic plants.

Zinc electroplating or electrolytic galvanizing

Method of protection through the application of a zinc coating by means of electrodeposited metal coating.

Thermal spraying with zinc or zinc spraying (DIN EN 1403, see References)

Method of protection for which the molten coating metal is sprayed onto the surface to be protected. Different processes are combustion wire spraying, combustion powder flame spraying, electric arc wire spraying and plasma spraying DIN EN 22063

Metallic coatings with zinc powder

(Mechanical plating/sheradizing)

Protection methods using zinc powder that achieve zinc coatings or Fe + Zn alloy layers on suitable workpieces through mechanical plating or diffusion (sheradizing).
DIN EN ISO 12683

Zinc powder coating

Protection method for which coating materials pigmented with zinc powder are applied onto steel components as protection layers.

Cathodic corrosion protection

Protection method for steel through contact with a zinc anode in presence of an electrolyte. In this process, the more ignoble metal (sacrificial anode of zinc) is dissolved while the steel (as cathode) will not be attacked.

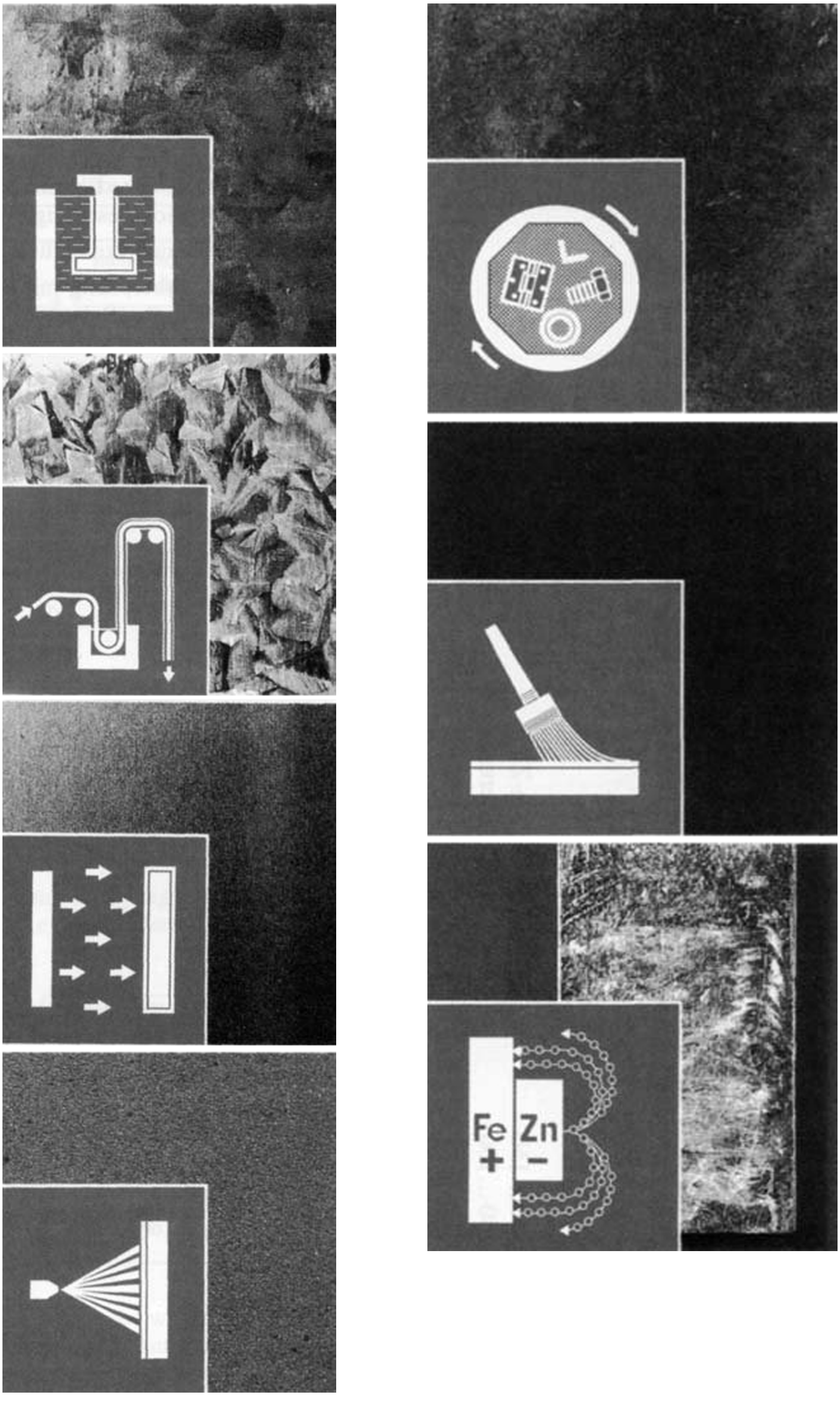

Fe
+
Zn
–

Table 1.4 Important parameters for corrosion-protection methods for steel and zinc (Beratung Feuerverzinken).

Methods	**Common thickness of the coating or layer in μm**	**Alloy with the substrate**	**Structure and composition of coating or layer**	**Process technology**	**After-treatment**	
					Common	**Possible**
A Coatings						
Hot-dip galvanizing						
a) discontinuously						
• batch galvanizing DIN 50976	>20	Yes	Iron-zinc-alloy layers on the steel surface, usually with a covering zinc layer	Immersion in liquid zinc bath	—	Coating and, to a small extent, from galvannealing[a)]
• tube galvanizing DIN 2444	>50	Yes			—	
b) continuously						
• continuous sheet galvanizing DIN 17162	15–25	Yes		Passing through liquid zinc bath	Chromating	
• continuous hot-dip strip galvanizing	20–40	Yes			—	
• wire galvanizing DIN 1548	5–30	Yes			—	
Thermal spraying						
Metal spraying of zinc DIN 8565	80–200	No	Zinc coating	Spraying of molten zinc	Sealing through penetrating coating	Coating
Zinc electroplating or electrolytic galvanizing				Zinc deposition through electric current in aqueous electrolytes		
• single baths DIN 50961	<50	No	Lamellar zinc coating		Chromating	Coating
• continuous galvanizing	2.5–5	No				
Metallic coatings with zinc powder						

Table 1.4 (*Continued*)

Methods	**Common thickness of the coating or layer in μm**	**Alloy with the substrate**	**Structure and composition of coating or layer**	**Process technology**	**After-treatment**	
					Common	**Possible**
a) sheradizing	15–25	Yes	Iron-zinc alloy layers	Diffusion steel-zinc below Zn-melting temperature	—	Coating
b) mechanical plating	10–20	No	Homogeneous zinc plating, if applicable, on copper intermediate layers	Zinc-powder application by means of crystal balls	Partly chromating	Coating
B Coating						
Zinc-powder coating	Thin-layered 10–20 Normal-layered 40–80 Thick-layered 60–120	No	Zinc-powder pigment in binder	Application through coating, rolling, spraying, immersing	Cover layer on priming coating	–
C Cathodic corrosion protection	Zinc anodes of high purity (99.995%) to prevent self-polarization are self-regulating and optimally aqueous electrolytes of medium and high conductivity. Impressed current systems require limited protection potential and safeguarding against overmodulation. The power capacity per dm^2 of zinc anode density is contingent on the state and the external (motion) conditions. The optimum is the cathodic protection intervening actively in the corrosion process in connection with a coating.					

a) Conversion of a zinc coating through targeted heat treatment, especially in strip galvanizing.

- high corrosion resistance;
- high performance; and
- high environmental compatibility.

Here, a permanent task is the reduction in material input, size, nonrecurring, and regular costs.

This goal determines the application of corrosion-protection methods as well as the development trend and direction of corrosion protection.

Table 1.5 Advantages and disadvantages of different metallic coating methods.

Assessment criteria	Fire 1	Galv 2	Spray 3	Diff 4	Zinc-powder coating[a]
Alloy formation with steel through diffusion	++	–	–	++	–
Adhesion	++	++	+...++	++	+...++
Density of total layer	++	+	+	+	+
Evenness of the layer	++	++	+...++	++	+...++
Decorative appearance	+	++	–	–	–
Surface hardness	++	++	++	++	–
Wear resistance	++	+	++	+	+
Bending strength	–...++	–...+	–	–	+
Corrosion protection in dependency of the economically achievable layer thickness	++	–	–...++	+	+
Water resistance	++	+	+...++	–	+
Technical reliability of the method	++	++	+	+	+
Practical test and control possibility	++	++	++	–	++
Limitation through dimension and mass	+	–	++	–	++
Possibility of deformation	–...++	–...++	–	–	+
Correction possibilities	+	+	++	–	++
Possibilities for automation	++	++	++	+	++
Hot-dip galvanizing	++ very good, particularly suitable, very favorable				
Zinc plating	+ good, acceptable, favorable				
Spray galvanizing	– moderate, less suitable, unfavorable				
Diffusion galvanizing (sheradizing)	––very bad, unsuitable, very unfavorable				

a) In comparison.

Corrosion protection is not considered an end in itself, but part of the product development, manufacturing and utilization, and sometimes even part of the base materials or semifinished products. In view of corrosion damages in the amount of 50 bn Euro the German economy sustains every year, exclusive of corrosion damages in the private sector, the implementation of the research findings on corrosion protection and their consequent application allow for annual reductions of approx. 15 bn Euro. The aim of the continuous information efforts is to achieve corrosion protection not as good as possible, but as good as required.

Table 1.6 Limitation of use of the methods determined by their characteristics (cf. Table 1.3)[a].

Construction elements	Fire	Galv	Spray	Diff	Zinc-powder coating[b]
	1	2	3	4	
Endless strips, wires etc.,	++	++	–	–	–
Sheets	++	–	+	–	+
Tubes, inside and outside, flanges and the like	++	–	–	+	–
Profiled parts, hollow parts and the like	++	–	–	–	–
Welded parts	+	–	–	–	–
Steel gratings and the like	++	–	–	–	–
Bolts and other mass parts for external stress	++	–	–	+	–
Bolts and other mass parts for normal stress	++	++	–	+	–
Linings for refrigerated lorries	++	–	+	–	–
Installations for farming, greenhouses, etc.	++	–	+	–	+
Installations for air and cooling technology	++	–	–	–	+
Steel construction and metal lightweight components	++	–	+	–	+
Heat exchangers	++	–	–	–	–
Domestic appliances	++	++	–	–	+
Thin sheet parts, warping due to exposure to heat, not strongly profiled	–	++	–	–	+
Mass parts for low corrosive stress, not exceeding 0.5 m^2	+	++	–	++	–
New constructions and repairs at bridges and handrails, roofs, etc. (repeated protection)	–	–	++	–	+

a) Explanations see Table 1.5.
b) In comparison.

Decisive for the efficiency of corrosion protection is not the initial protection cost, but the annual or specific corrosion protection costs in consideration of the protection period of the respective corrosion protection system and the service life of the products.

More attention should be paid to the connection between product development, product quality, material handling, maintenance, environmental protection, and corrosion protection, which should take into account corrosion-damage protection in the planning and design phase – despite all influencing factors – as well as static safety against breakage, stability of buildings and operational safety regarding performance and service life.

1.2.3
Corrosion Protection and Environmental Protection

Corrosion has its roots in the environment. With the limitation and impediment of corrosion, corrosion protection relieves the environment in a number of ways and becomes a decisive measure for environmental protection. Yes, one can say "corrosion protection is environmental protection."

The protection of steel against corrosion by means of hot-dip galvanizing or the duplex method is particularly effective, lasts for decades, and is efficient in comparison to other methods. Moreover, it is a convenient corrosion-protection method since the reduction in corrosion does not only impede the loss of steel as a material, but contributes to the saving of resources and the avoidance of waste. After its utilization, steel or hot-dip galvanized steel is 100% recyclable. The recycling of material is an important contribution to environmental protection.

From the environmental protection point of view, much importance is attached to corrosion protection ex works, as is practiced in the case of hot-dip galvanizing. The technology is measurable, testable and controllable. In former times, the hot-dip galvanizing industry polluted the environment, but new environmental protection laws and their acceptance by the galvanizing industry has contributed much to the industry's considerable investments in housings, filtration plants, water pollution control, etc.

> "Corrosion protection can only be sold as environmental protection by someone who does not ruin the environment himself." (Seppeler, K.: Feuerverzinken, Faszination der Zukunft – Magazine "Feuerverzinken" 18 (1989) 3, p. 34).

This leitmotif should be the aim of the industry's policy, which includes image building and constant staff qualification.

Appendix 1.A

Basic Standards for Corrosion Protection of Steel Structures

Corrosion of metals and alloys
EN ISO 8044 Basic terms and definitions
DIN EN 150 12944 Coating material – Corrosion protection of steel structures by protective paint systems.

Part 1: General Introduction

- Protection period of coating systems.
- General statement on health protection, work safety and environmental protection.

Part 2: Classification of environmental conditions

- Corrosivity classes in the atmosphere.
- Categories of environmental conditions in water and soil.
- Special corrosive stress.

Part 3: Basic design rules

- Treatment of crevices, composite construction.
- Measures against sediments and accumulation of water.
- Boxes and hollow construction elements.
- Edges, recesses, reinforcements.
- Avoidance of contact corrosion.
- Handling, transport and assembly.

Part 4: Surface types and surface pretreatment

- Surface types and methods of surface pretreatment
- Surface pretreatment qualities and their testing

Part 5: Coating systems

- Basic types of coating materials.
- Example for coating systems in dependence of corrosivity class and assessed protection period.

Part 6: Laboratory tests for the evaluation of coating systems
Part 7: Execution and monitoring of the coating work

- General statements on the execution of coating work.
- Methods for the application of coating materials.
- Monitoring of coating work, manufacturing of control surfaces.

Part 8: Development of specifications for new work and maintenance

DIN 55928 Corrosion protection of steel structures from corrosion by organic and metallic coatings

Part 8: Protection of supporting thin-walled building components from corrosion

Part 9: Composition of binders and pigments

Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates

DIN EN ISO 8503

Part 1: Specifications and definitions for ISO surface profile comparators for the assessment of abrasive blast-cleaned surfaces

Part 2: Method for the grading of surface profiles of abrasive blast-cleaned steel – Comparator procedure

Part 4: Stylus instrument procedure

ISO 8501-1 and ISO 8501-2

Visual assessment of surface cleanliness (rust grades, preparation grades).