
**Corrosion of metals and alloys —
Overview of metal corrosion
protection when using disinfectants**

*Corrosion des métaux et alliages — Vue d'ensemble de la protection
contre la corrosion des métaux lors de l'utilisation de désinfectants*

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Foreword

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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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This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

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.

Introduction

This document provides information on protection against metal corrosion risks when disinfectants are used in response to infectious diseases.

Governments, regulatory agencies and other professional organizations around the world have issued guidelines in response to pandemics, but these contain no specific information on metal corrosion protection when using disinfectants.

This document provides supplementary information intended to help organizations, families and individuals, as well as other stakeholders, take more effective actions to prevent users from being injured and reduce or avoid possible risks of metal corrosion during the use of disinfectants.

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Corrosion of metals and alloys — Overview of metal corrosion protection when using disinfectants

1 Scope

This document provides an overview of the corrosivity of disinfectants and corrosion protection when using disinfectants, including an overview of test methods that can be used to determine their corrosivity.

This document is generic and applicable to organizations of all sizes in all industries, as well as to families and individuals, and it is intended to assist in determining appropriate health and safety measures regarding the use of disinfectants.

The resolution of security issues related to the use of disinfectants is outside the scope of this document.

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 terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1 organization

company, corporation, firm, enterprise, authority or institution, person or persons or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administration

[SOURCE: ISO 30000:2009, 3.10]

3.2 risk

combination of the probability of occurrence of harm and the severity of that harm

[SOURCE: ISO 15188:2001, 3.6]

3.3 disinfectant

agent capable of causing disinfection

[SOURCE: ISO 15190:2020, 3.8]

3.4 corrosivity

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

[SOURCE: ISO 8044:2020, 3.14]

3.5

corrosion protection

modification of a corrosion system so that corrosion damage is reduced

[SOURCE: ISO 8044:2020, 5.1]

3.6

common areas

spaces and amenities provided for the use of more than one person

Note 1 to entry: Canteens, lifts/elevators, stairs, reception areas, meeting rooms, areas of worship, toilets, gardens, fire escapes, kitchens, fitness facilities, store rooms, laundry facilities.

[SOURCE: ISO/PAS 45005:2020, 3.11]

4 Overview

4.1 Disinfecting is an important process of defending against infectious diseases, which can corrode metals. When disinfecting, avoid corrosion, injury and, if possible, discomfort to individuals, damage to the environment that can affect public health and damage to baggage, cargo, containers, vehicles, articles and mailbags.

4.2 Guidance on disinfection for the prevention of infectious diseases provided by public health agencies can include information on the corrosivity to metals.

4.3 Professional disinfectant-related institutions can provide detection methods of metal corrosion caused by various types of disinfectants under different testing or application conditions, and reports on corrosion tests for commonly used metals for public use or reference.

4.4 Disinfectant manufacturers can test the corrosivity of their products to metals and clearly note it on their instructions, provide corrosion data of their products to commonly used metals and put forward protective measures for reference.

4.5 When disinfecting, organizations, families or individuals, use disinfectants according to the relevant guidance documents and product specifications on metal corrosivity. Corrosion risks cannot be neglected and effective measures are important to avoid corrosion hazards; disinfection service providers are commonly required to receive training in the safe and effective use of disinfectants to avoid corrosion.

5 Corrosivity and main properties of commonly used disinfectants

Commonly used disinfectants can be classified by active ingredients into alcohol disinfectants, halogen disinfectants, peroxide disinfectants, guanidine disinfectants, phenol disinfectants, quaternary ammonium disinfectants and other disinfectants; classified by use into object surface disinfectants, disinfectants for medical items, air disinfectants, hand disinfectants, skin disinfectant, mucous membrane disinfectants, and disinfectants for infectious focus; classified by the microorganism killing ability into high-level disinfectants, intermediate-level disinfectants and low-level disinfectants.

[Annex B](#) provides an overview of the physical and chemical properties, types, disinfection mechanisms, application scope and methods of disinfectants commonly used in infectious disease disinfection.

Usually, peroxide disinfectants and halogen disinfectants are highly corrosive to metals in the range of their disinfection concentration. In general, the corrosivity increases with the strength of oxidation and acidity.

The corrosivity, active ingredients, main properties, uses, application methods, etc., of commonly used disinfectants are shown in [Table 1](#).

Table 1 — Corrosivity and main properties of commonly used disinfectants

Type	Active ingredients of commonly used products	Oxidizability	Alkalinity or acidity ^a	Corrosivity to metals ^b	Main uses	Application methods
Aldehyde	Formaldehyde	No	Acidic	The presence of small amount of formic acid in formaldehyde solutions can corrode metals.	Disinfection of object surfaces and medical devices, etc.	Immersion Fumigation
	Glutaraldehyde	No	Acid, neutral or alkaline	Corrosive to carbon steel	Disinfection of medical devices, etc.	Immersion Wiping
Peroxide	Peracetic acid	Yes	Acidic	Slightly corrosive to stainless steel, alloy steel and chrome-plated metal, and heavily corrosive to common metals such as iron, copper and aluminium.	Disinfection of object surfaces, medical devices, air and infectious focuses, etc.	Immersion Wiping Spraying Fumigation
	Hydrogen peroxide	Yes	Acidic	Corrosive to metals	Disinfection of object surfaces, medical devices, skin and mucosa, air and infectious focuses, etc.	Immersion Wiping Spraying
	Ozone	Yes	Neutral	Corrosive to metals	Disinfection of object surfaces, medical devices, air and water, etc.	Immersion Wiping Spraying
	Chlorine dioxide	Yes	Acidic	Strong corrosive to aluminium, low alloy steel and carbon steel, and moderately corrosive to stainless steel.	Disinfection of object surfaces, medical devices, air and infectious focuses, etc.	Immersion Wiping Spraying
	Electrolyzed oxidizing water (EOW)	Yes	Acidic	Corrosive to copper, aluminium and carbon steel, and not obviously corrosive to stainless steel	Disinfection of object surfaces, medical devices, skin, hands and infectious focuses, etc.	Immersion Wiping Spraying
	Potassium monopersulfate	Yes	Acidic	Corrosive to metals	Disinfection of object surfaces, medical devices, skin, water and infectious focuses, etc.	Immersion Wiping Spraying

^a Alkalinity or acidity refers to that of commonly used disinfectant products.

^b Metal corrosivity is usually graded as no obvious corrosion, mild corrosion, moderate corrosion and heavy corrosion; there is no unified corrosion classification standard for disinfectants so far, which will be developed in the future; in the table, "corrosive to metals" only indicates the existence of metal corrosion, as a warning when using disinfectants; the specific corrosion classification is related to the standards used in the test, the type of metal materials used, test conditions and the basis for evaluation.

Table 1 (continued)

Type	Active ingredients of commonly used products	Oxidiz-ability	Alkalinity or acidity ^a	Corrosivity to metals ^b	Main uses	Application methods
Halogen	Sodium hypochlorite	Yes	Alkaline	Heavily corrosive to aluminium, steel and carbon steel, and moderately corrosive to stainless steel, which can cause hydrogen embrittlement or stress corrosion cracking of stainless steel.	Disinfection of object surface, water and infectious focuses, etc.	Immersion Wiping Spraying
	Calcium hypochlorite	Yes	Alkaline			
	Chlorinated sodium phosphate	Yes	Alkaline			
	Sodium dichloroisocyanurate	Yes	Acidic			
	Trichloroisocyanuric acid	Yes	Acidic			
	Iodophor	Yes	Alkaline	Slightly corrosive to aluminium and stainless steel	Disinfection of medical devices, skin and mucosa, etc.	Immersion Wiping
	Iodine tincture	Yes	Alkaline	Slightly corrosive to aluminium and stainless steel	Disinfection of medical devices, skin and mucosa, etc.	Immersion Wiping
	Dibromodimethylhydantoin (DBDMH)	Yes	Acidic	Slightly corrosive to copper, aluminium and carbon steel	Disinfection of object surfaces, medical devices, water and infectious focuses, etc.	Immersion Wiping Spraying
Bromochlorodimethylhydantoin (BCDMH)	Yes	Acidic	Slightly corrosive to copper, aluminium and carbon steel, and almost corrosion-free to stainless steel	Disinfection of object surfaces and water, etc.	Immersion Wiping Spraying	
Alcohol	Ethanol	No	Neutral	No obvious corrosivity	Disinfection of object surfaces, skin and hands, etc.	Wiping Spraying
	Isopropyl alcohol	No	Neutral	No obvious corrosivity	Disinfection of object surfaces, medical devices, skin and hands, etc.	Immersion Wiping
	Chlorhexidine-ethanol	No	Alkaline	No obvious corrosivity	Disinfection of object surfaces, medical devices, skin and hands, etc.	Immersion Wiping Spraying

^a Alkalinity or acidity refers to that of commonly used disinfectant products.

^b Metal corrosivity is usually graded as no obvious corrosion, mild corrosion, moderate corrosion and heavy corrosion; there is no unified corrosion classification standard for disinfectants so far, which will be developed in the future; in the table, "corrosive to metals" only indicates the existence of metal corrosion, as a warning when using disinfectants; the specific corrosion classification is related to the standards used in the test, the type of metal materials used, test conditions and the basis for evaluation.

Table 1 (continued)

Type	Active ingredients of commonly used products	Oxidiz-ability	Alkalinity or acidity ^a	Corrosivity to metals ^b	Main uses	Application methods
Phenol	Phenol	No	Acidic	No obvious corrosivity	Disinfection of object surfaces and skin, etc.	Immersion Wiping Spraying
	Halogenated Phenols	No	—	No obvious corrosivity	Disinfection of object surfaces, skin and hands, etc.	Immersion Wiping
Guanidine	Chlorhexidine	No	Acidic	No obvious corrosivity	Disinfection of object surfaces, skin, hands and mucosa, etc.	Immersion Wiping Spraying
	Polyhexamethylene guanidine (PHMG)	No	—	No obvious corrosivity	Disinfection of object surfaces, skin, hands, air and water, etc.	
Quaternary ammonium salt	Double-chain quaternary ammonium salt	No	—	Not obviously corrosive to copper and stainless steel sheets, and slightly corrosive to carbon steel and aluminium sheets.	Disinfection of object surfaces, medical devices, skin and mucosa, etc.	Immersion Wiping Spraying
	Single-stranded quaternary ammonium salt	No	—	Corrosive to metals		
Others	Ethylene oxide	No	Neutral	No obvious corrosivity	Disinfection of object surfaces, medical devices, skin, hands and mucosa, etc.	Fumigation
	Potassium permanganate	Yes	Alkaline	Corrosive to metals	Disinfection of object surfaces, skin and mucosa, etc.	Immersion Wiping
	Compound lysostaphin disinfectant	—	—	—	Disinfection of object surfaces, medical devices, skin, hands and mucosa, etc.	Immersion Wiping Spraying
	Plant extracts based disinfectant	—	—	—	Disinfection of object surfaces, air, skin and hands, etc.	Immersion Wiping Spraying

^a Alkalinity or acidity refers to that of commonly used disinfectant products.

^b Metal corrosivity is usually graded as no obvious corrosion, mild corrosion, moderate corrosion and heavy corrosion; there is no unified corrosion classification standard for disinfectants so far, which will be developed in the future; in the table, "corrosive to metals" only indicates the existence of metal corrosion, as a warning when using disinfectants; the specific corrosion classification is related to the standards used in the test, the type of metal materials used, test conditions and the basis for evaluation.

6 Good practice for metal corrosion protection when using disinfectants

6.1 General

6.1.1 It is important that relevant management and disinfection personnel, as well as the general public have adequate knowledge of the physical and chemical properties, corrosivity, corrosion protection measures and application methods of disinfectants.

6.1.2 Before planning and implementing disinfection, testers assess the corrosion degree of disinfectants to metals. This can be based on relevant international, regional, national or industrial standards. See also the overview of test methods that can be used to determine the corrosivity of disinfectants in [Annex A](#).

6.1.3 According to the assessment results and the importance of metal equipment or components in the disinfected area, corrosion risks can be assessed in order to take measures to reduce the corrosion hazards.

6.1.4 Before disinfecting important facilities, vehicles or equipment, personnel obtain the corrosivity data of the proposed disinfectants to the corresponding metals, or select appropriate methods to test their corrosivity. When disinfecting other metal objects, reference is made to the relevant disinfectant corrosivity description or data, or relevant experience of correct use of disinfectant.

6.1.5 Alternative measures to mitigate or eliminate corrosion risks, on the premise of satisfying the disinfection effect, include but are not limited to the following:

- replacement of disinfectants with less corrosive or non-corrosive ones;
- protection of the surface of the disinfected objects before disinfecting, such as plugging or coating the parts or cracks where disinfectants are easy to accumulate, or painting or spraying anticorrosive coatings;
- use of inhibitors that cause no damage to the disinfected objects during disinfecting;
- wiping or rinsing the surface of the disinfected objects with clean water to remove the residual disinfectant after the contact time of disinfection.

6.2 Corrosion hazards

6.2.1 Halogen and oxidizing disinfectants can cause serious corrosion hazards during disinfecting.

6.2.2 If the disinfected objects contain metals and alloys prone to stress corrosion or hydrogen embrittlement, halogen disinfectants are not permitted to disinfect key components in aviation industry and important facilities. In other cases, through technical and economic comparison, halogen disinfectants can be used with appropriate corrosion protection measures based on [6.1.5](#).

6.2.3 Oxidizing disinfectants usually corrode commonly used metals to varying degrees with incorrect usage.

6.3 Corrosion protection measures

6.3.1 Under normal circumstances, alternative corrosion protection measures can be used when disinfecting different metals.

6.3.2 Alloy steel is often used as a key component of vehicles or important facilities, while carbon steel is often used for guardrails in common areas, steel structure components or concrete reinforcement,

etc. When disinfecting alloy steel or carbon steel without a surface protective layer, the disinfectant can corrode it to varying degrees. Even if there is a surface protection layer, when there are defects on the surface of the protection layer (such as pinholes, cracks, or scratches) that exposes the substrate, the substrate can be corroded, eroded or interface corroded, leading to peeling and debonding, and finally affected by chemical corrosion. Commonly used anti-corrosion methods include using low-corrosive or non-corrosive disinfectants, setting up a complete and corrosion-resistant protective layer, and thoroughly rinsing after disinfection.

6.3.3 Aluminium alloys are commonly used in vehicle parts, building doors and windows, etc. Disinfectants usually corrode them to varying degrees. Generally, corrosive disinfectants are not used to disinfect the aluminium alloy parts of vehicles to avoid possible accidents; when used in other less hazardous environments such as building doors and windows, in addition to choosing less corrosive disinfectants, it can also be wiped or rinsed with clean water after the disinfectant contact time has passed.

6.3.4 Stainless steel is the commonly used type of metal. The classes of stainless steels have relatively good corrosion resistance, but some of them can also be corroded by exposure to some oxidizing or halogen disinfectants. Corrosion forms of stainless steels usually include but not limited to the following:

- Pitting corrosion can be caused by exposure to halide disinfectant solution. It is a kind of local corrosion, resulting in shallow to deep penetration. Halide-induced pitting corrosion is a typical corrosion phenomenon of corrosion-resistant austenitic stainless steel.
- Crevice corrosion occurs in small, shielded crevices, which are prone to corrosion when the equipment is immersed in the non-flowing corrosive disinfectant solution.
- Stress corrosion cracking and hydrogen embrittlement can cause serious harm. Increasing corrosion cracks on stainless steel are caused by residual stresses applied to the steel and exposure to the corrosive disinfectant solution. Relieving stress or reducing the corrosivity of disinfectants is helpful to slow down or avoid corrosion cracking.

6.3.5 Titanium has outstanding corrosion resistance, and conventional disinfection concentration does not cause titanium metal corrosion.

6.3.6 When disinfecting other metals, the corrosivity of the disinfectant is a major factor to consider, including confirmation that its corrosion does not cause safety hazards, or the corrosion does not affect its appearance or function.

6.3.7 When disinfection is conducted in different environments, alternative protection measures can be taken based on the possible risk levels caused by corrosion, including but not limited to the following.

- When disinfecting aircraft including its components, corrosivity tests of disinfectants are carried out according to aviation-related standards and disinfectants are selected that meet the industry requirements or disinfectants without obvious corrosivity.
- When disinfecting other vehicles (such as ships, trains and automobiles), related standards and technically and economically feasible disinfectants are selected. See also the overview of test methods that can be used to determine the corrosivity of disinfectants in [Annex A](#).
- When disinfecting metal parts of important infrastructures or structures that can affect safety (such as steel structure bridge and their metal accessories, airports, stadiums, amusement facilities and other metal structures, etc.), non-oxidative or non-halogen or non-obvious corrosive disinfectants are preferred, or other corrosion protection measures as listed in [6.1.5](#) are taken.
- When disinfecting metal parts of medical apparatus and instruments or important equipment, appropriate disinfectants and disinfection methods are selected that are comprehensively in

accordance with the corrosion resistance of the metal material to be disinfected, the corrosivity of disinfectants, disinfection methods and other conditions. When there is no reference data or experience, a specific test evaluation is required.

- When disinfecting other environments or objects with less risk of corrosion (such as common areas, streets, shopping malls, hospitals, tourist attractions, non-motor vehicles, etc.), oxidation disinfectants or halogen disinfectants or non-obvious corrosive disinfectants can be used without causing health hazards and corrosion safety hazards. When using oxidizing or halogen disinfectants, clean water is used to wipe or rinse after the disinfection contact time has passed, or less corrosive disinfectants are chosen, or alternative measures are adopted as mentioned in [6.1.5](#).

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Annex A (informative)

Overview of test methods to determine the corrosivity of disinfectants

An overview of test methods used to determine the corrosivity of disinfectants is given in [Table A.1](#).

Table A.1 — Test methods to determine the corrosivity of disinfectants

No.	Test method	Scope of application
1	Full immersion	a) Use full immersion to disinfect metal products, such as immersion disinfection of medical instruments or other articles. b) Factory inspection of disinfectants. c) Evaluation of corrosivity of chemical agents involved in transportation. d) Disinfectant corrosivity comparison experiment, etc.
2	Spraying	The environment in which metal products are disinfected by spraying, such as the disinfection of an enclosed space or an open environment (e.g. airplane, vehicle, road, steel structure, and public area).
3	Fumigation	The metal products are disinfected in a closed environment by fumigation with disinfectant.
4	Wiping	a) Corrosion test when metal products are disinfected by wiping b) Corrosion test of disinfection towel
5	Corrosion evaluation	Evaluation of corrosion degree based on the test results of various disinfectants
6	Study on corrosivity test of disinfectants	It is useful to study corrosion behaviour or test corrosion data of various disinfectants under different test conditions, so as to provide a reference for the prevention and control of infectious diseases when using disinfectants.
7	Other methods	Other situations where test methods can be developed for specific purposes. For example, for ships, high-speed railways, motor vehicles and other transportation tools, as well as important infrastructure or structures.
NOTE It is useful to consider and include limiting values, such as disinfectant effective concentration, test parameters, dosage of disinfectants, treatment time and metal corrosion rate.		