



Corrosion resistance

General

Flexible metal elements are basically suitable for the transport of critical fluids if a sufficient resistance is ensured against all corrosive media that may occur during the entire lifetime.

The flexibility of the corrugated elements like bellows or corrugated hoses generally require their wall thickness to be considerably smaller than that of all other parts of the system in which they are installed.

As therefore increasing the wall thickness to prevent damages caused by corrosion is not reasonable, it becomes essential to

select a suitable material for the flexible elements which is sufficiently resistant.

Special attention must be paid to all possible kinds of corrosion, especially pitting corrosion, intercrystalline corrosion, crevice corrosion, and stress corrosion cracking, (see Types of corrosion).

This leads to the fact that in many cases at least the ply of the flexible element that is exposed to the corrosive fluid has to be chosen of a material with even higher corrosion resistance than those of the system parts it is connected to (see Resistance table).

Types of corrosion

According to EN ISO 8044, corrosion is the “physicochemical interaction between a metal and its environment that results in changes in the properties of the metal, and which may lead to significant impairment of the function of the metal, the environment, or the technical system, of which these form a part. This interaction is often of an electrochemical nature”.

Different types of corrosion may occur, depending on the material and on the corrosion conditions. The most important corrosion types of ferrous and non-ferrous metals are described below.

Uniform corrosion

A general corrosion proceeding at almost the same rate over the whole surface. The loss in weight which occurs is generally specified either in $\text{g/m}^2\text{h}$ or as the reduction in the wall thickness in mm/year .

This type of corrosion includes the rust which commonly is found on unalloyed steel (e. g. caused by oxidation in the presence of water).

Stainless steels can only be affected by uniform corrosion under extremely unfavourable conditions, e.g. caused by liquids, such as acids, bases and salt solutions.

Pitting corrosion

A locally limited corrosion attack that may occur under certain conditions, called pitting corrosion on account of its appearance. It is caused by the effects of chlorine, bromine and iodine ions, especially when they are present in hydrous solutions.

This selective type of corrosion cannot be calculated, unlike surface corrosion, and can therefore only be kept under control by choosing an adequate resistant material.

The resistance of stainless steels to pitting corrosion increases in line with the molybdenum content in the chemical composition of the material.

The resistance of materials to pitting corrosion can approximately be compared by the so-called pitting resistance equivalent ($PRE = Cr \% + 3.3 \cdot Mo \% + 30 N \%$), whereas the higher values indicate a better resistance.

Intergranular corrosion

These deposit processes are dependent on temperature and time in CrNi alloys,

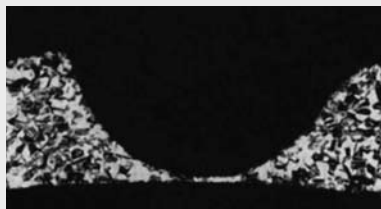


Fig. B.1: Pitting corrosion on a cold strip made of austenitic steel. Plan view (50-fold enlargement).



Fig. B.2: Sectional view (50-fold enlargement).

whereby the critical temperature range is between 550 and 650 °C and the period up to the onset of the deposit processes differs according to the type of steel. This must be taken into account, for example, when welding thick-walled parts with a high thermal capacity. These deposit-

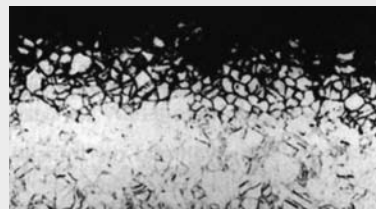


Fig. B.3: Intergranular corrosion (decay) in austenitic material 1.4828. Sectional view (100-fold enlargement).

related changes in the structure can be reversed by means of solution annealing (1000 – 1050 °C).

This type of corrosion can be avoided by using stainless steels with low carbon content ($\leq 0,03 \% C$) or containing elements, such as titanium or niobium. For flexible elements, this may be stabilized material qualities like 1.4541, 1.4571 or low-carbon qualities like 1.4404, 1.4306.

The resistance of materials to intergranular corrosion can be verified by a standardized test (Monypenny - Strauss test according to ISO 3651-2). Certificates to be delivered by the material supplier, proving

resistant to IGC according to this test are therefore asked for in order and acceptance test specifications.

Stress corrosion cracking

This type of corrosion is observed most frequently in austenitic materials, subjected to tensile stresses and exposed to a corrosive agent. The most important agents are alkaline solutions and those containing chloride.

The form of the cracks may be either transgranular or intergranular. Whereas the transgranular form only occurs at temperatures higher than 50 °C (especially in solutions containing chloride), the intergranular form can be observed already at room temperature in austenitic materials in a neutral solutions containing chloride.

At temperatures above 100 °C SCC can already be caused by very small concentrations of chloride or lye – the latter always leads to the transgranular form.

Stress corrosion cracking takes the same forms in non-ferrous metals as in austenitic materials.

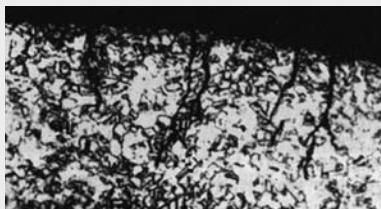


Fig. B.4: Transgranular stress corrosion cracking on a cold strip made of austenitic steel. Sectional view (50-fold enlargement).

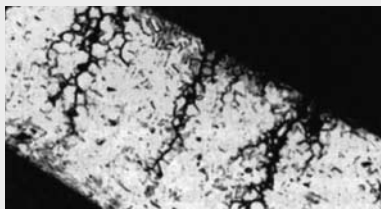


Fig. B.5: Intergranular stress corrosion cracking on a cold strip made of austenitic steel. Sectional view (50-fold enlargement).

Damage caused by intergranular stress corrosion cracking can occur in nickel and nickel alloys in highly concentrated alkalis at temperatures above 400 °C, and in solutions or water vapour containing hydrogen sulphide at temperatures above 250 °C.

A careful choice of materials based on a detailed knowledge of the existing operating conditions is necessary to prevent from this type of corrosion damage.

Crevice corrosion

Crevice corrosion is a localized, seldom encountered form of corrosion found in crevices which are the result of the design or of deposits. This corrosion type is caused by the lack of oxygen in the crevices, oxygen being essential in passive materials to preserve the passive layer.

Because of the risk of crevice corrosion design and applications should be avoided which represent crevice or encourage deposits.

The resistance of high-alloy steels and Ni-based alloys to this type of corrosion increases in line with the molybdenum content of the materials. Again pitting resistance equivalent (PRE) (see Pitting corrosion) can be taken as criteria for assessing the resistance to crevice corrosion.



Fig. B.6: Crevice corrosion on a cold strip made from austenitic steel. Sectional view (50-fold enlargement).

Contact corrosion

A corrosion type which may result from a combination of different materials.

Galvanic potential series are used to assess the risk of contact corrosion, e.g. in seawater. Metals which are close together on this graph are mutually compatible; the anodic metal corrodes increasingly in line with the distance between two metals.

Materials which can be encountered in both the active and passive state must also be taken into account. A CrNi alloy, for example, can be activated by mechanical damage to the surface, by deposits (diffusion of oxygen made more difficult)

or by corrosion products on the surface of the material. This may result in a potential difference between the active and passive surfaces of the metal, and in material erosion (corrosion) if an electrolyte is present.

Dezincing

A type of corrosion which occurs primarily in copper-zinc alloys with more than 20% zinc.

During the corrosion process the copper is separated from the brass, usually in the form of a spongy mass. The zinc either remains in solution or is separated in the form of basic salts above the point of corrosion. The dezincing can be either of the surface type or locally restricted, and can also be found deeper inside.

Conditions which encourage this type of corrosion include thick coatings from corrosion products, lime deposits from the water or other deposits of foreign bodies on the metal surface. Water with high chloride content at elevated temperature in conjunction with low flow velocities further the occurrence of dezincing.

Contact corrosion

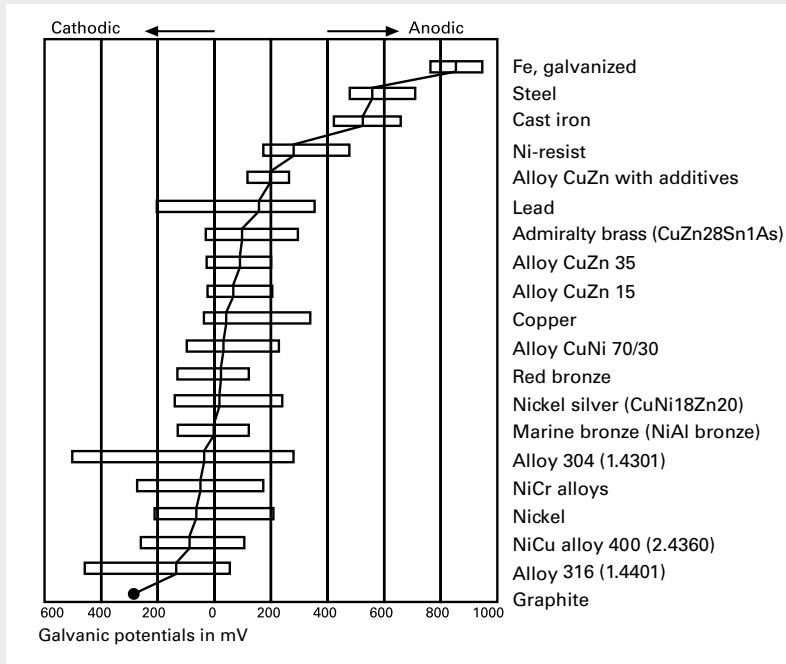


Fig. B.7: Galvanic potentials in seawater
Source: DECHEMA material tables

Resistance table

The table below provides a summary of the resistance to different media for metal materials most commonly used for flexible elements.

The table has been drawn up on the basis of relevant sources in accordance with the state of the art; it makes jet no claims to completeness.

The main function of the table is to provide the user with an indication of which materials are suitable or of restricted suitability for the projected application, and which can be rejected right from the start.

The data constitutes recommendations only, for which no liability can be accepted.

The exact composition of the working medium, varying operating states and other boundary operating conditions must be taken into consideration when choosing the material.

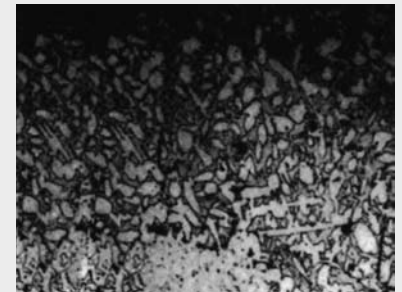


Fig. B.8: Dezincing on a Copper-Zinc alloy (Brass / CuZn37). Sectional view (100-fold enlargement).

7.2 | Corrosion resistance

Table keys

Assessment	Corrosion behaviour	Suitability
0	resistant	suitable
1	uniform corrosion with reduction in thickness of up to 1 mm/year	restricted suitability
P	risk of pitting corrosion	
S	risk of stress corrosion cracking	
2	hardly resistant, uniform corrosion with reduction in thickness of more than 1 mm/year up to 10 mm/year	not recommended
3	not resistant (different forms of corrosion)	unsuitable

Meanings of abbreviations:

dr:	dry condition	cs:	cold-saturated (at room temperature)
mo:	moist condition	sa:	saturated (at boiling point)
hy:	hydrous solution	bp:	boiling point
me:	melted	adp:	acid dew point

7.2 | Corrosion resistance

Resistance tables

Medium	Materials																							
	Designation Chemical formula	Concentration %	Temperature °C	Stainless steels			Nickel alloys				Copper alloys		Pure metals											
				Non-/low- alloy steels	Ferritic steels	Austenitic steels	Austenitic + Mo steels	2.4888 / alloy 600	8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-246	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver			
																						0	0	0
Acetanilide (Antifebrine) C ₆ H ₅ NO		<114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetic acid CH ₃ COOH or C ₂ H ₄ O ₂	5 20 50 80 96 98	20 bp 20 bp 20 bp	3 0 3 3 3 3	0 3 3 3 3 3	0 0 0 P 3 3	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 0 1 0	0 0 0 0 0 0	0 1 0 0 0 1	1 0 0 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 3 3 3 3 3	0 0 0 0 0 0	0 3 3 3 3 3	0 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 3 0 0 0	0 0 1 0 0 0	0 0 1 0 0 0	
Acetic acid vapour	33 100 100	20 >50 <bp	3 3 3	1 3 3	1 3 3	0 0 0	0 1 3	0 0 0	0 1 3	3 3 3	0 0 0	0 3 3	0 0 0	0 0 0	0 3 3	0 3 3	0 0 0	0 0 0	0 0 0	1 3 3	0 0 0	0 0 0	0 0 0	0 0 0
Acetic aldehyde CH ₃ -CHO	100	bp	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetic anhydride (CH ₃ -CO) ₂ O	all 100 100	20 60 bp	1 0 3	0 3 0	0 0 0	0 0 0	1 0 3	0 0 0	1 0 0	1 0 0	3 1 1	0 1 1	0 0 0	0 0 0	0 1 1	0 1 1	0 0 0	0 0 0	0 0 0	0 1 3	0 0 0	0 1 0	0 0 0	0 0 0
Acetic anilide (Antifebrine)		<114	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetone CH ₃ COCH ₃	100	bp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acetyl chloride CH ₃ COCl		20	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	0	1	0
Acetylene H-C≡C-H	dr dr	20 200	0 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	3 3	3 3	3 3	3 3	3 3	0 3	0 3	0 0	0 1	0 3	0 1	0 3	0 3
Acetylene dichloride 2H ₂ Cl ₂	hy dr	5 100	20 20	0 0	P P	P P	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0 0	0 0	C
Acetylen tetrachloride CHCl ₂ -CHCl ₂		100 100 bp	20 0 1	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 3 3	0 1 1	0 0 0	0 1 1	0 0 0	0 3 3	0 1 1	0 3 3	0 3 3	0 0 0
Adipic acid HOOC(CH ₂) ₄ COOH		all	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alcohol see ethyl or methyl alcohol																								

7.2 | Corrosion resistance

Resistance tables



Medium		Concentration		Temperature		Materials													
						Stainless steels			Nickel alloys			Copper alloys		Pure metals					
						Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy 8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-246	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum
Non-/low- alloy steels	%	°C																	
Allyl alcohol CH ₂ CHCH ₂ OH	hy	100	bp																
Allyl chloride CH ₂ =CHCH ₂ Cl	hy	100	25																
Alum KAl(SO ₄) ₂	hy hy	100 10 10	20 20 <80	1 0 1	1 0 1	0 0 0	0 0 0	0 0 1	0 0 0	1 1 1	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	1 0 1			
Aluminium Al	me		750	3	3	3	3				3				3	3			
Aluminium acetate (CH ₃ -COO) ₂ Al(OH) hy	hy sa	3	20	3	0	0	0	0			0				0	0	0	1	
Aluminium chloride AlCl ₃	hy	5	20	3	3	3	P	1	1	0	0	0	1	3	3	1	3	1	0
Aluminium fluoride AlF ₃	hy	10	25	3	3	3	3				1	1			1	1	0	3	1
Aluminium formate Al(HCOO) ₃				1	0	0	0	0	0	0	0	0			0	1	0	0	0
Aluminium hydroxide Al(OH) ₃	hy	10	20	1	3	0	0	0	0	0	0	0	1	0		0	0	0	1
Aluminium nitrate Al(NO ₃) ₃				0	0	0	0	0	0	0	0	0	0			0	0	1	
Aluminium oxide Al ₂ O ₃			20	1	1	0	0	0	0	0	0	3	0	0	0	0		0	3
Aluminium potassium sulphate see alum																			
Aluminium sulphate Al ₂ (SO ₄) ₃	hy hy	10 15	<bp 50	3 3	3 3	3 3	1	0	1	0	1	1	1	3	3	3	1	1	0
Ammonia NH ₃	dr hy hy sa	10 2 20 20	20 40 40 bp	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 1 1	0 0 0 0	0 0 0 0	1 0 1 1	3 0 3 3	S S S S	S S S S	0 3 3 3	0 0 0 0	0 0 0 0	0 0 0 0	

7.2 | Corrosion resistance

Resistance tables



Medium		Concentration		Temperature		Materials													
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Non-/low- alloy steels	%	°C																	
Ammonia bromide NH ₄ Br	hy	10	25	3	P	P	P	0											
Ammonium acetate CH ₃ -COONH ₄				1	0	0	0											0	0
Ammonium alum NH ₄ Al(SO ₄) ₂	hy	cs	20			0	0											3	0
Ammonium bicarbonate (NH ₄) ₂ HCO ₃	hy			0	0	0	0	0	1	3				3	3			3	0
Ammonium bifluoride NH ₄ HF ₂	hy hy	10 100	25 20	3 3	3 3	3 0	3 0							0	0			3	0
Ammonium bromide see ammonia bromide																			
Ammonium carbonate NH ₄ ₂ CO ₃	hy hy	1 50	20 bp	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0 1	1 1	1 1	0 0
Ammonium chloride NH ₄ Cl	hy hy hy	1 100 50	20 100 bp	1 P P	P P P	P P P	P P P	0 0 0	0 0 0	0 0 0	0 0 1	0 0 1	0 0 1	1 S S	1 S S	1 1 1	1 1 1	0 0 1	1 1 1
Ammonium fluoride NH ₄ F	hy hy	10 hg 20	25 70 80	1 3 3	1 0 3	0 0 3	0 0 3								0			3	0
Ammonium fluosilicate (NH ₄) ₂ SiF ₆	hy	20	40	3	1	0	0	0	0	0	0	0	0					0	
Ammonium formate HCOONH ₄	hy hy	10 10	20 70	1	0	0	0	0	0	0	0	0	0					0	0
Ammonium hydroxide NH ₄ OH		100	20		0	0	0	0	0	0	0	0	0	0	3	3		3	0
Ammonium nitrate NH ₄ NO ₃	hy hy	5 100	20 bp	3 3	0 0	0 0	0 0	0 0	0 0	0 0	1 0	0 3	3 3	3 3	3 3	3 3		0 0	0 0
Ammonium oxalate (COONH ₄) ₂	hy hy	10 10	20 bp	1 3	1 3	0 1	0 0				1 1	0 0	1 1	1 1			1	0	0
Ammonium perchlorate NH ₄ ClO ₄	hy	10	20		P	P	P				1							0	

7.2 | Corrosion resistance

Resistance tables

HYDRA

Medium				Materials																
Designation Chemical formula	Concentration	Temperature	Non-/low-alloy steels																	
			Stainless steels			Nickel alloys				Copper alloys		Pure metals								
	%	°C	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy	8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver	
Calcium hypochlorite Ca(OCl) ₂	hy hy	2 cs	20 3	3 3	3 3	P P	0 3	0 0	0 0	0 0	0 0	0 0	0 0	3 3	0 0	0 0	0 0	0 0	0 0	0 0
Calcium nitrate Ca(NO ₃) ₂			20 100	3 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Calcium oxalate (COO) ₂ Ca	mo		20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Calcium oxide CaO			20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Calcium sulphate CaSO ₄	mo mo		20 bp	1 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 1
Calcium sulphite CaSO ₃	hy hy	cs sa		0 0	0 0	0 0									1 1	0 0	0 0	0 0	1 1	
Carbolic acid C ₆ H ₅ (OH)	hy		20 bp bp	0 3 3	0 3 3	0 3 3	0 0 0	1 1 0	0 1 0	0 1 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 3 3	
Carbon dioxide CO ₂	dr dr mo mo		100 100 20 100	<540 1000 25 25	0 3 1 3	1 0 0 0	0 0 0 0	0 3 0 0	0 0 0 0	0 0 0 1	0 0 0 0	0 0 0 0	0 0 0 0	3 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	3 3 3 3	
Carbon monoxide CO			100 100	<540 20	0 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 3
Carbon tetrachloride CCl ₄	dr dr mo mo		20 bp bp bp	0 1 0 3	0 0 1 1	0 0 0 1	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 3 3 3	
Carbonic acid see carbon dioxide																				
Caustic-soda solution see sodium hydroxide																				
Chilean nitrate see sodium nitrate																				
Chloral CCl ₃ -CHO			20					0												0 3

7.2 | Corrosion resistance

Resistance tables

HYDRA

Medium				Materials																
Designation Chemical formula	Concentration	Temperature	Non-/low-alloy steels																	
			Stainless steels			Nickel alloys				Copper alloys		Pure metals								
	%	°C	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy	8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver	
Chloramine				3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chloric acid HClO ₃	hy		20	3	3	3	3	0		0		0						0	0	3 3
Chlorinated lime see calcium hypochlorite																				
Chlorine Cl ₂	dr dr mo mo		100 100 100 150	200 300 400 20	0 3 3 3	0 3 3 3	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 3 3	
Chlorine dioxide ClO ₂	hy		0.5	20	3	3	3	3		1		3		3				0	0	
Chloroacetic acid CH ₂ Cl-COOH	hy		all 30	20 80	3 3	3 3	3 3	L 3	3	1	1	3	3	3	3	3	3	1	0	0 3 3
Chlorobenzene C ₆ H ₅ Cl	dr mo		100	20	0	0	P	P	P	0	0	0	0	0	0	0	0	0	0	0 1 1
Chloroethane C ₂ H ₅ Cl			0	S	S	S	0	0	0	1	0	0	0	1	1	1	0	0	0 1 0	
Chloroform CHCl ₃	dr mo				1 3	1 P	1 P	1 P	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0 3	
Chloronaphthalene C ₁₀ H ₇ Cl					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0 0	
Chlorophenol C ₆ H ₄ (OH)Cl					1	0	0	0												
Chlorosulphonic acid HOSO ₂ Cl	hy mo		100	20	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0 3 3	
Chrome alum KCr(SO ₄) ₂	hy	cs sa	1	20	3	3	0	0	0	0	0	0	0	1	0	1	3	0	0 1 3 3	
Chromic acid Cr ₂ O ₃ (H ₂ CrO ₄)	hy hy hy hy hy hy		5 5 10 10 50 60	20 90 20 65 bp bp 20	3 3 3 3	3 3 3 3	0 0 0 0	0 0 0 0	1 1 3 3	3 3 3 3	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	1 1 3 3	

Resistance tables

Medium	Concentration		Temperature		Materials																	
					Stainless steels			Nickel alloys				Copper alloys		Pure metals								
					Non-/low- alloy steels	Ferritic steels	Austenitic steels	Austenitic + Mo steels	2.4858 / alloy steels	8252.4816 / alloy 600	2.4856 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver
%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C			
Chromic-acid anhydride see chromium oxide																						
Chromium oxide CrO ₃					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Chromium sulphate Cr ₂ (SO ₄) ₃	cs	sa			3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cider			20 bp		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Citric acid C ₆ H ₈ O ₇	hy	all	<80 bp		3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Combustion gases free from S or H ₂ SO ₄ and Cl with S or H ₂ SO ₄ and Cl			≤400 >adp and ≤400		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Copper (II) acetate Cu ₂ (CH ₃ COO) ₄	hy	hy	20 bp		3	0	0	0	0	0	1	0	0	0	1	3	3	3	1	0	0	3
Copper (II) chloride CuCl ₂	hy	cs	1 20		3	3	P	P	3	3	1	0	3	3	3	3	3	3	3	0	0	3
Copper (II) nitrate Cu(NO ₃) ₂	hy	hy	1 50 bp		0	0	0	0	0	0	3	3	3	3	3	3	3	0	0	0	3	3
Copper (II) sulphate CuSO ₄	hy	cs	sa		3	0	0	0	0	0	3	3	0	3	3	3	3	3	3	0	0	3
Cresol C ₆ H ₄ (CH ₃)OH	all	all	20 bp		3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Crotonaldehyde CH ₂ =CH-CHO			20 bp		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyclohexane (CH ₂) ₆					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diammonium phosphate see ammonium phosphate																						

Resistance tables

Medium	Concentration		Temperature		Materials																	
					Stainless steels			Nickel alloys				Copper alloys		Pure metals								
					Non-/low- alloy steels	Ferritic steels	Austenitic steels	Austenitic + Mo steels	2.4858 / alloy steels	8252.4816 / alloy 600	2.4856 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver
%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	%	°C	
Dibromethane CH ₂ Br-CH ₂ Br																						
Dichloroflourmethane CF ₂ Cl ₂	dr	mo																				
Dichloroethane CH ₂ Cl-CH ₂ Cl	dr	mo	100	20	0	P	P	P	1	0					0	1	1	0	0	0	1	1
Dichloroethylene see acetylene dichloride																						
Diethyl ether (C ₂ H ₅) ₂ O					0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ethane CH ₃ -CH ₃					20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ether see diethyl ether																						
Ethereal oils					20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethyl alcohol C ₂ H ₅ OH	all	all	20 bp		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethylbenzene C ₆ H ₅ -C ₂ H ₅					1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ethyl chloride C ₂ H ₅ Cl					0	S	S	S	0	0	0	1	0	0	1	1	1	0	0	0	1	0
Ethylene CH ₂ =CH ₂					20	0	0	0	0													0
Ethylene dibromide see dibromethane																						
Ethylene dichloride see dichloroethane																						
Ethylene glycol CH ₂ OH-CH ₂ OH					100	20	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	0
Exhaust gases see combustion gas																						

7.2 | Corrosion resistance

Resistance tables

HYDRA

Medium			Materials																		
Designation Chemical formula	Concentration	Temperature	Non-/low- alloy steels																		
			Stainless steels			Nickel alloys				Copper alloys			Pure metals								
	%	°C	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4858 / alloy	8252.4816 / alloy 600	2.4856 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver		
Fats			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fatty acid C ₁₇ H ₃₃ COOH	100 100 100 180 100	20 60 150 180 300	0 3 3 3 3	0 3 3 3 3	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	1 1 1 1 1	1 1 1 1 1	1 1 1 1 1	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0
Fixing salt see sodium thiosulphate																					
Flue gases see combustion gases																					
Fluorine F	mo dr dr dr	20 200 500 100	3 0 0 3	3 0 0 3	3 0 0 P	3 0 0 P				0 0 0 0	0 0 0 0	3 3 3 3	3 3 3 3	0 0 0 0	0 0 0 0	3 3 3 3	0 0 0 0	3 3 3 3	0 0 0 0	0 0 0 0	0 0 0 0
Fluorosilicic acid H ₂ (SiF ₆) vapour	100 25 70	20 20 20	3 3 3	3 3 3	P 3 3	P 3 3	1 1 1	1 1 1	1 3 1	1 3 1	1 3 1	1 3 1	1 3 1	0 0 0	0 0 0	3 3 3	3 3 3	0 0 0	0 0 0	0 0 0	0 0 0
Formaldehyde CH ₂ O	hy dr hy	10 40 all	20 3 3	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	3 3 3	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	1 1 3	0 0 0
Formic acid HCOOH	10 10 80 85	20 bp bp 65	3 3 3 3	3 3 3 3	1 3 3 3	1 3 3 3	0 0 0 0	1 0 0 1	0 0 0 2	1 0 0 0	1 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	1 3 3 3
Fuels Benzine Benzene Benzine-alcohol-mixture Diesel oil		20 bp 20 bp 20	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0
Furfural		100 100	25 3	1 1	1 1	1 1				0 0	0 0	3 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Galic acid C ₆ H ₂ (OH) ₃ COOH	hy	1 100 100	20 3 3	0 0 0	0 0 0	0 0 0				0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0

7.2 | Corrosion resistance

Resistance tables

HYDRA

Medium			Materials																		
Designation Chemical formula	Concentration	Temperature	Non-/low- alloy steels																		
			Stainless steels			Nickel alloys				Copper alloys			Pure metals								
	%	°C	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4858 / alloy	8252.4816 / alloy 600	2.4856 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver		
Gelatine		20 80	0 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Glacial acetic acid CH ₃ CO ₂ H see acetic acid																					
Glass me		1200	1		1	1															
Glauber salt see sodium sulphate																					
Gluconic acid CH ₂ OH(CHOH) ₄ -COOH		100	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glucose hy		20		0	0	0											0	1	0	0	0
Glutamic acid HOOC-CH ₂ -CH ₂ - CHNH ₂ -COOH		20 80	1 3	P P	P P	0 0	0 1	0 0	1 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1
Glycerine CH ₂ OH-CHOH-CH ₂ OH		100 100	20 bp	0 1	0 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1
Glycol see ethylenglycol																					
Glycolic acid CH ₂ OH-COOH		20 bp	3 3	1 3	1 3	1 3											0	0		0	1
Glystantine see antifreeze																					
Hexachloroethane CCl ₃ -CCl ₃		20		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Hexamethylene-tetramine (CH ₂) ₆ N ₄	hy hy	20 80	60 60	1 3	0 0	0 0											0	0			1
Household ammonia see ammonium hydroxide																					
Hydrazene H ₂ N-NH ₂		20	0	0	0	3	3	3											3		1

7.2 | Corrosion resistance

Resistance tables



Medium		Materials																				
		Concentration		Temperature		Stainless steels			Nickel alloys			Copper alloys		Pure metals								
						Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4858 / alloy 8252.4816 / alloy 600	2.4856 / alloy 625	2.4610.2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver	
Designation	Chemical formula	%	°C	Non-/low- alloy steels	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4858 / alloy 8252.4816 / alloy 600	2.4856 / alloy 625	2.4610.2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver		
Nitric acid HNO ₃		1	20	3	0	0	0															
		1	bp	3	0	0	0															
		5	20	3	0	0	0	0	3													
		5	bp	3	1	0	0	0														
		10	bp	3	1	0	0	0														
		15	bp	3	1	0	0	0														
		25	bp	3	3	0	0	0														
		50	bp	3	3	0	0	0	0	3		3										
		65	bp	3	3	0	0	0	0	3		3										
		65	bp	3	3	0	0	0	0	3		3										
		99	bp	3	3	0	0	0	0	3		3										
	20	290	3	3	0	0	0	0	3		3											
	40	200	3	3	0	0	0	0	3		3											
Nitrobenzene C ₆ H ₅ (NO ₂) _y	hy			0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
Nitrobenzoic acid C ₆ H ₄ (NO ₂)COOH	hy		20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Nitroglycerine C ₃ H ₅ (ONO ₂) ₃	hy		20	0	0	0	0													0		
Nitrogen N		100	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
		100	900	1												0	3					
Nitrous acid HNO ₂ similar to nitric acid																						
Oleic acid see fatty acid																						
Oleum see sulphur trioxide																						
Oxalic acid C ₂ H ₂ O ₄	hy hy hy	all 10 sa	20 bp 3	3 3 3	3 3 3	0 3 3	0 3 3	1 1 1	1 0 1	0 1 1	0 1 1	0 1 1	1		1	3 3	0 3	0 3	0 0	0 3	0 3	
Oxygen O			500	1	0	0	0	0	0	0	0	0		3	3					0	3	
Ozone				0	0	0	0	0	0	0	0				1		0		0			
Paraffin C _n H _{2n+2}	me		20 120	0 0	0 0	0 0	0 0						0	0	0	0	0	0	0	0	0	

7.2 | Corrosion resistance

Resistance tables



Medium		Materials																			
		Concentration		Temperature		Stainless steels			Nickel alloys			Copper alloys		Pure metals							
						Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4858 / alloy 8252.4816 / alloy 600	2.4856 / alloy 625	2.4610.2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver
Designation	Chemical formula	%	°C	Non-/low- alloy steels	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4858 / alloy 8252.4816 / alloy 600	2.4856 / alloy 625	2.4610.2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver	
Perchloroethane see hexachlorethane																					
Perchloric acid (60%) HClO ₄		10 100	20 20	3 3	3 3	3 3	3 3											0 0		3	
Perchloroethylene C ₂ Cl ₄ mo			20 bp	0 3	0 P	0 P	0 P							0 1	0 1	0 0	0 0			0 3	
Perhydrol see hydrogen superoxide																					
Petroleum			20 bp	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	1 1	0 0	0 0	0 3	0 0	0 0	0 0	0 0
Petrol see benzene (benzene)																					
Phenol see carboic acid																					
Phloroglucinol C ₆ H ₃ (OH) ₃			20		0	0	0	0	0	0	0							0	0	0	0
Phosgene COCl ₂	dr		20		0	0	0	0	0	0	0							0	0	0	
Phosphoric acid H ₃ PO ₄	hy hy hy hy hy	1 10 30 60 80 80	20 20 bp 3 20 bp	3 3 3 3 3	0 3 3 3 3	0 0 1 3 3	0 0 1 3 3	0 0 1 1 0	0 0 1 1 3	0 0 1 1 3	0 0 1 1 3	1 1 1 1 3	3 1 1 1 3	2 1 1 1 3	1 3 1 3 3	3 3 3 3 3	0 0 3 3 3	0 0 0 0 0	0 0 0 0 0	3 3 0 0 0	0 3 0 0 1
Phosphorous P	dr		20		0	0	0														
Phosphorous penta- chlorite PCl ₅	dr	100	20	0	0	0				0						0	1				
Phtalic acid and phtalic anhydride C ₆ H ₄ (COOH) ₂	dr		20 200 bp	0 0	0 3 0	0 0 0	0 0 0			0 0 0				0 0 0	0 0 0	0 0 0	0 0 0		0 0 0	0 0 0	0 0 0

Resistance tables

Medium	Concentration		Temperature		Materials														
					Stainless steels			Nickel alloys				Copper alloys			Pure metals				
	Designation	Chemical formula	%	°C	Non-/low- alloy steels														
					Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy 8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-246	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium
Picric acid	hy	3	20	3	0	0	0	0	3	3	0	3	3	3	3	3	0	1	0
Chemical formula	hy	cs	150	3	0	0	0	0	3	3	0	3	3	3	3	3	0	3	0
Potassium dichromate	hy	10	40	3	0	0	0	0	1	1	1	1	1	1	1	0	3	3	3
Chemical formula	hy	cs	25	3	0	0	0	0	1	1	1	1	1	1	1	0	3	3	3
Potassium ferricyanide	hy	1	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Chemical formula	hy	cs	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Potassium ferrocyanide	hy	1	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Chemical formula	hy	cs	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Potassium fluoride	hy	25	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Chemical formula	hy	bp	25	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Potassium hydroxide	hy	10	20	0	0	0	0	0	1	1	1	1	1	1	0	0	3	0	0
Chemical formula	hy	bp	20	0	0	0	0	0	1	1	1	1	1	1	0	3	0	0	0
Potassium bisulphate	hy	5	20	3	3	2	0	0	3	3	3	3	3	3	3	3	3	3	3
Chemical formula	hy	5	90	3	3	3	3	0	3	3	3	3	3	3	3	3	3	3	3
Potassium bitartrate	hy	cs	3	3	0	0	0	0	3	3	3	3	3	3	3	3	3	3	3
Chemical formula	hy	sa	3	3	3	1	0	0	3	3	3	3	3	3	3	3	3	3	3
Potassium bromide	hy	5	30	3	P	P	P	0	1	0	0	1	0	0	0	0	0	0	3
Chemical formula	hy	30	3	P	P	P	0	1	0	0	1	0	0	0	0	0	0	0	3
Potassium carbonate	hy	50	20	1	0	0	0	0	0	0	0	1	3	1	1	0	0	0	3
Chemical formula	hy	bp	3	3	0	0	0	0	0	0	0	1	3	1	1	0	0	0	3
Potassium chlorate	hy	5	20	3	0	0	0	0	0	1	0	0	3	1	1	1	0	0	1
Chemical formula	hy	sa	3	0	0	0	0	0	0	3	0	0	3	1	1	3	0	0	1
Potassium chloride	hy	10	20	3	3	P	P	0	0	0	0	0	3	1	3	0	1	1	0
Chemical formula	hy	bp	3	3	P	P	0	0	0	0	0	0	3	1	3	0	1	1	0
Potassium chromate	hy	10	20	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Chemical formula	hy	bp	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Potassium cyanide	hy	10	20	3	0	0	0	0	0	3	0	1	3	3	3	3	0	3	3
Chemical formula	hy	bp	3	0	0	0	0	0	0	3	0	1	3	3	3	0	3	3	3

Resistance tables

Medium	Concentration		Temperature		Materials														
					Stainless steels			Nickel alloys				Copper alloys			Pure metals				
	Designation	Chemical formula	%	°C	Non-/low- alloy steels														
					Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy 8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-246	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium
Potassium dichromate	hy	10	40	3	0	0	0	0	1	1	1	1	1	1	0	3	3	3	3
Chemical formula	hy	cs	25	3	0	0	0	0	1	1	1	1	1	1	0	3	3	3	3
Potassium ferricyanide	hy	1	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Chemical formula	hy	cs	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Potassium ferrocyanide	hy	1	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Chemical formula	hy	cs	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Potassium fluoride	hy	25	20	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Chemical formula	hy	bp	25	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Potassium hydroxide	hy	10	20	0	0	0	0	0	1	1	1	1	1	1	0	0	3	0	0
Chemical formula	hy	bp	20	0	0	0	0	0	1	1	1	1	1	1	0	3	0	0	0
Potassium hypochlorite	hy	all	20	P	P	P	3	3	0	3	3	0	3	3	3	3	3	3	3
Chemical formula	hy	all	bp	P	P	P	3	3	0	3	3	0	3	3	3	3	3	3	3
Potassium iodide	hy	20	0	P	P	P	0	1	1	1	0	3	0	0	0	0	3	0	0
Chemical formula	hy	bp	0	P	P	P	0	1	1	1	0	3	0	0	0	0	3	0	0
Potassium nitrate	hy	all	20	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
Chemical formula	hy	all	bp	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
Potassium nitrite	hy	all	bp	1	0	0	0	0	1	0	0	0	0	0	1	1	1	1	1
Chemical formula	hy	all	bp	1	0	0	0	0	1	0	0	0	0	0	1	1	1	1	1
Potassium permanganate	hy	10	20	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0
Chemical formula	hy	all	bp	3	1	1	1	0	1	1	1	0	1	0	0	0	0	0	0
Potassium persulphate	hy	10	50	3	3	0	0	0	0	0	0	3	3	3	3	3	3	3	3
Chemical formula	hy	50	3	3	0	0	0	0	0	0	0	3	3	3	3	3	3	3	3
Potassium silicate	hy	20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Chemical formula	hy	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Potassium sulphate	hy	10	25	3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Chemical formula	hy	all	bp	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1

Resistance tables

Medium		Materials																							
		Concentration		Temperature		Non-/low- alloy steels		Stainless steels		Nickel alloys				Copper alloys		Pure metals									
								Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy 8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver		
Designation	Chemical formula	%	°C																						
Protein solutions				20	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pyridine	dr	all	all	20	bp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Pyrogallol		all	all	20	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Quinine bisulphate	dr			20	3	3	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
Quinine sulphate	dr			20	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
Quinol				3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	
Salicylic acid	dr mo hy	100 100 cs	20 20 3	1 3 3	0 0 0	0 0 0	0 0 0	0 1 0	0 0 0	0 1 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
Salmiac	see ammonium chloride																								
Salpetre	see potassium nitrate																								
Seawater	at flow velocity v (m/s) 0 < v ≤ 1.5 1.5 < v < 4.5																								
				20	1	P	P	P	P	P	P	0	0	P	1	0	0	0	0	0	0	0	0	0	
Siliceous flux acid	see fluorsilicic acid																								
Silver nitrate	hy hy hy hy me	10 10 20 40 100	20 bp 60 20 250	3 3 3 3 3	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 1 1 1 1	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0
Soap	hy hy hy	1 1 10	20 75 20	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
Sodium (O₂ ≤ 0.005 %)	me	200 600	0 3	0 1	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	

Resistance tables

Medium		Materials																						
		Concentration		Temperature		Non-/low- alloy steels		Stainless steels		Nickel alloys				Copper alloys		Pure metals								
								Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy 8252.4816 / alloy 600	2.4866 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver	
Designation	Chemical formula	%	°C																					
Sodium acetate	hy hy	10 sa	25 3	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Sodium aluminate	hy	100 10	20 25	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Sodium arsenate	hy	cs		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sodium bicarbonate	hy hy hy	100 10 cs sa	20 20	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
Sodium bisulphate	hy hy	all bp	20 3	3 3	3 3	3 3	0 1	0 1	1 1	1 1	1 1	3 3	3 3	1 1	1 1	1 1	1 1	1 1	1 1	1 1	0 0	0 0	0 0	0 0
Sodium bisulphite	hy hy hy	10 50 50	20 20 bp	3 3 3	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	
Sodium borate	hy me	cs		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sodium bromide	hy hy	all all	20 bp	3 3	3 3	3 3	P P																	
Sodium carbonate	hy hy hy me	1 all	20 bp 400 900	3 3 3 3	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	
Sodium chloride	hy hy hy hy	0.5 2 cs sa	20 20	3 3	P P P P	P P P P	P P P P	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	
Sodium chlorite	dr hy hy hy	100 5 5 10	20 20 bp 80	3 3	P 3 3 3	P 3 3 3	P 3 3 3	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	
Sodium chromate	hy	all	bp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

7.2 | Corrosion resistance

Resistance tables



Medium		Materials																			
Designation Chemical formula	Concentration	Temperature	Stainless steels			Nickel alloys				Copper alloys			Pure metals								
			Non-/low- alloy steels			Copper alloys				Pure metals											
	%	°C	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy	8252.4816 / alloy 600	2.4856 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver		
Spirits		20 bp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Steam O ₂ < 1 ppm; Cl < 10 ppm O ₂ > 1 ppm; Cl < 10 ppm O ₂ > 15 ppm; Cl < 3 ppm		< 560 < 315 > 450	1	1	1	0		0						0	0						
Stearic acid CH ₂ (CH ₂) ₁₆ COOH		100 20 100 95 100 180	1	0	0	0	0	0	0	0	1	0	0	0	1	1	3	1	0	0	0
Succinic acid HOOC-CH ₂ -CH ₂ -COOH		bp	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphur S	dr me mo	100 60 130 1 240 3 20 2	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	3
Sulphur dioxide SO₂	dr dr dr mo mo mo	100 20 100 60 100 400 100 800 100 20 100 60 100 70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sulphuric acid H₂SO₄		0.05 20 0.05 bp 0.1 20 0.2 bp 0.8 bp 1 20 3 bp 5 bp 7.5 20 10 bp 25 20 25 bp 40 20 40 bp 50 20 50 bp	3	1	0					1	0	0	0	0	0	0	0	0	0	0	0

7.2 | Corrosion resistance

Resistance tables



Medium		Materials																		
Designation Chemical formula	Concentration	Temperature	Stainless steels			Nickel alloys				Copper alloys			Pure metals							
			Non-/low- alloy steels			Copper alloys				Pure metals										
	%	°C	Ferritic steels	Austenitic steels	Austenitic + Mo	steels 2.4888 / alloy	8252.4816 / alloy 600	2.4856 / alloy 625	2.4610, 2.4819 / alloy C-4, C-2.46	2.4360 / alloy 400	2.0882 / alloy CuNi 70/30	Tombac	Bronze	Copper	Nickel	Titanium	Tantalum	Aluminium	Silver	
Sulphuric acid H₂SO₄		60 20 80 20 90 20 96 20	3	3	3									0	1	3	3	3	3	3
Sulphurous acid H₂SO₃	hy cs sa	1 20 3 20 3 20	3	3	0								1	0	3	3	3	3	3	3
Sulphur trioxide SO₃	hy dr	100 20 100 20	0										2	3	0	3	2	0	0	0
Tannic acid C₇₆H₅₂O₄₆	hy hy hy	5 20 25 100 50 50	3	0	0								0	0	0	1	0	0	0	0
Tar		20	0	0	0										0	1	0	0	0	0
Tartaric acid	hy hy hy hy hy hy	10 20 10 bp 25 20 25 bp 50 20 50 bp	1	0	0								0	1	0	0	1	3	0	0
Tetrachloroethane see acetylen tetrachloride																				
Tetrachloroethylene	pure pure mo mo	100 20 100 20 20 3 20 3	0	0	0										0	0	0	0	0	0
Tin chloride SnCl₂; SnCl₄	sa	5 20 3 3	3	3	3								3	3	0	1	3		1	0
Toluene C₆H₅-CH₃		100 20 100 bp	0	0	0										0	0	0	0	0	0
Town gas			0	0	0								0	0	0	1	1	0	0	1
Trichloroacetaldehyde see chloral																				
Trichloroethylene CHCl=CCl₂	pure bp mo mo	100 20 100 20 20 3 20 3	0	0	0										0	0	1	3	1	1

