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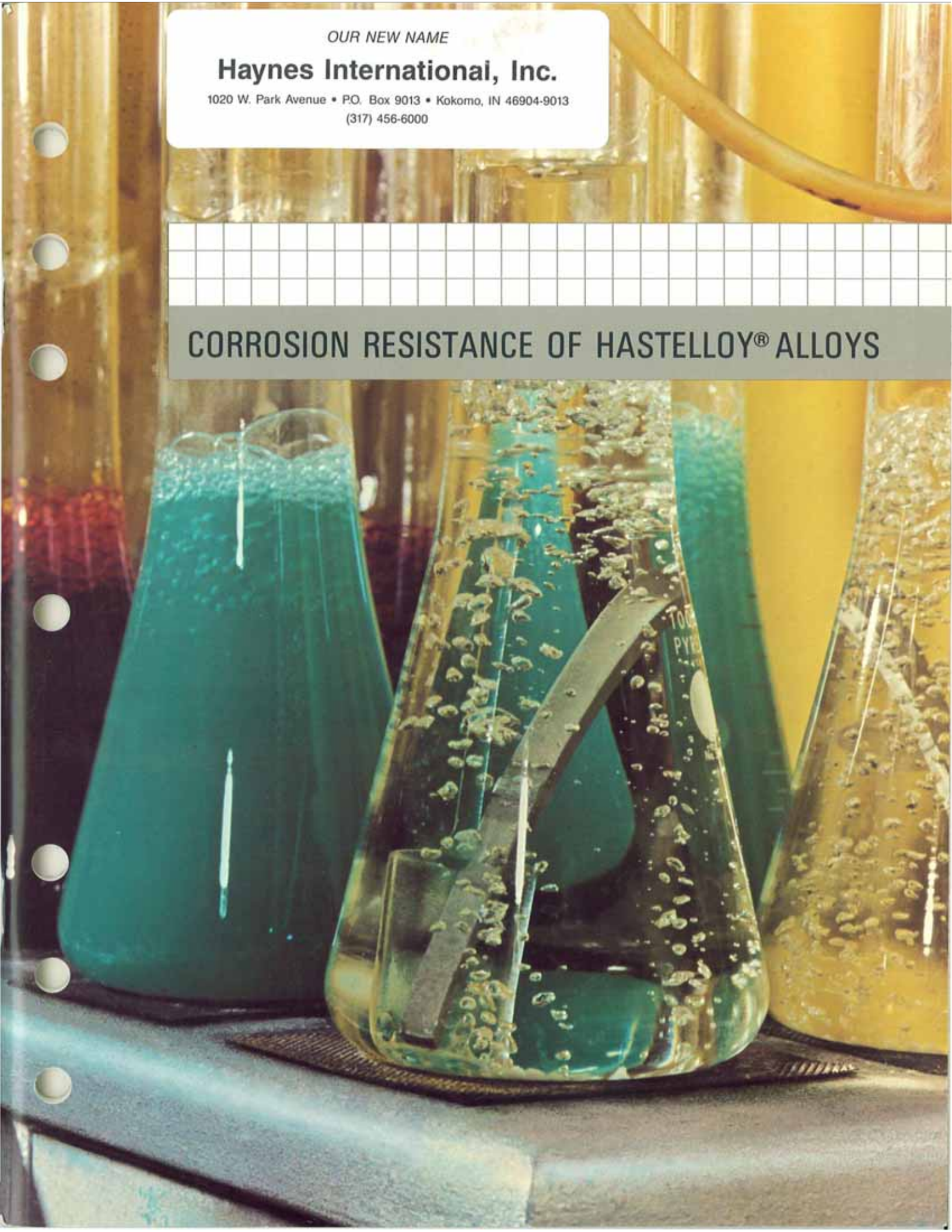
Haynes International, Inc.

1020 W. Park Avenue • P.O. Box 9013 • Kokomo, IN 46904-9013
(317) 456-6000

CORROSION RESISTANCE OF HASTELLOY® ALLOYS



Corrosion Resistance of HASTELLOY® Alloys

INDEX

PROPERTIES DATA — The properties listed in this booklet are average values based on laboratory and field test data from a number of sources. They are indicative only of the results obtained in such tests and should not be considered as guaranteed maximums or minimums. Materials must be tested under actual service conditions to determine their suitability for a particular purpose. All data represent the average of four or less tests unless otherwise noted. The secondary units (metric) used in this booklet are those of the SI system.

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COMPARATIVE CHEMICAL COMPOSITIONS, PERCENT†

Alloy	Ni	Co	Cr	Mo	W	Fe	Si	Mn	C	Others
HASTELLOY® alloy B-2	Balance	1.0*	1.0*	26.0-30.0	—	2.0*	0.10*	1.0*	0.01*	P-0.025* S-0.010*
HASTELLOY alloy C-22	Balance	2.5*	20.0-22.5	12.5-14.5	2.5-3.5	2.0-6.0	0.08*	0.50*	0.015*	V-0.35* P-0.025* S-0.010*
HASTELLOY alloy C-276	Balance	2.5*	14.5-16.5	15.0-17.0	3.0-4.5	4.0-7.0	0.08*	1.0*	0.01*	V-0.35* P-0.025* S-0.010*
HASTELLOY alloy G-3	Balance	5.0*	21.0-23.5	6.0-8.0	1.5*	18.0-21.0	1.0*	1.0*	0.015*	Cu-1.5-2.5 Cb + Ta-0.50* P-0.04* S-0.03*
HASTELLOY alloy G-30	Balance	2.0*	29.5	5.0	2.5	15.0	0.8*	1.0*	0.03*	Cu-1.7 Cb + Ta-0.7 P-0.03* S-0.015*
HASTELLOY alloy X	Balance	0.5-2.5	20.5-23.0	8.0-10.0	0.20-1.0	17.0-20.0	1.0*	1.0*	0.05-0.15	P-0.04*, B-0.008* S-0.03*, Al-0.50* Cu-0.50*, Ti-0.15*
HAYNES® alloy No. 25	9.0-11.0	Balance	19.0-21.0	—	14.0-16.0	3.0*	1.0*	1.0-2.0	0.05-0.15	P-0.030* S-0.030*
CABOT® alloy No. 625	Balance	1.0*	20.0-23.0	8.0-10.0	—	5.0*	0.50*	0.50*	0.10*	Cb + Ta-3.15-4.15 Al-0.40* Ti-0.40* P-0.015* S-0.015*
MULTIMET® alloy	19.0-21.0	18.5-21.0	20.0-22.5	2.5-3.5	2.0-3.0	Balance	1.0*	1.0-2.0	0.08-0.16	Cb + Ta-0.75-1.25 N-0.10-0.20

*Maximum
†The undiluted deposited chemical compositions of some of these alloys may vary in carbon, silicon, manganese, phosphorous and sulfur content beyond the limits shown.

COMPARATIVE AVERAGE PROPERTIES PROFILE AT ROOM TEMPERATURE — SHEET

Alloy	Density lb./in.³ (g/cm³)	Ultimate Tensile Strength, Ksi (MPa)	Yield Strength at 0.2% offset, Ksi (MPa)	Elongation in 2 in., (50.8 mm), percent	Rockwell Hardness
HASTELLOY® alloy B-2	0.333 (9.22)	132.5 (914)	57.5 (396)	55	B-98
HASTELLOY alloy C-22	0.314 (8.69)	116.3 (802)	58.5 (403)	57	B-90
HASTELLOY alloy C-276	0.321 (8.89)	114.9 (792)	51.6 (356)	61	B-90
HASTELLOY alloy G-3	0.300 (8.30)	99.0 (683)	44.0 (303)	53	B-83
HASTELLOY alloy G-30	0.297 (8.22)	100 (690)	47 (324)	56	B-88
HASTELLOY alloy X	0.297 (8.22)	109.5 (755)	55.9 (385)	45	B-92
HAYNES® alloy No. 25	0.330 (9.13)	140.6 (969)	64.6 (445)	62	C-24
CABOT® alloy No. 625	0.305 (8.44)	132.0 (910)	67.9 (468)	47	B-94
MULTIMET® alloy	0.296 (8.19)	118.1 (814)	58.0 (400)	49	B-92

ALLOY CHARACTERISTICS

HASTELLOY® alloy B-2 is a nickel-base wrought alloy with excellent resistance to hydrochloric acid at all concentrations and temperatures. It also withstands hydrogen chloride, sulfuric, acetic and phosphoric acids. The alloy has excellent resistance to pitting, to stress-corrosion cracking and to knife-line and heat-affected zone attack. It resists the formation of grain-boundary carbide precipitates ir the weld heat-affected zone, thus making it suitable for most chemical process applications in the as-welded condition.

Ask for Bulletin H-2006

HASTELLOY® alloy C-22 - a versatile nickel-chromium-molybdenum alloy with better overall corrosion resistance than other Ni-Cr-Mo alloys available today, including HASTELLOY alloy C-276 and C-4 and CABOT alloy No. 625. Alloy C-22 has outstanding resistance to pitting, crevice corrosion and stress-corrosion cracking. It has excellent resistance to oxidizing aqueous media including acids with oxidizing agents, wet chlorine and mixtures containing nitric acids or oxidizing acids with chloride ions. HASTELLOY alloy C-22 has outstanding resistance to both reducing and oxidizing media and because of its versatility can be used where "upset" conditions are likely to occur or in multipurpose plants.

Alloy C-22 also has exceptional resistance to a wide variety of chemical process environments, including strong oxidizers such as ferric and cupric chlorides, hot contaminated media (organic and inorganic), chlorine, formic and acetic acids, acetic anhydride, and seawater and brine solutions.

Ask for Bulletin H-2019

HASTELLOY® alloy C-276 has excellent resistance to pitting, stress-corrosion cracking, and oxidizing atmospheres up to 1900 deg. F (1038 deg. C). It has exceptional resistance to a wide variety of chemical process environments, including strong oxidizers such as ferric and cupric chlorides, hot contaminated media (organic and inorganic), chlorine, formic and acetic acids, acetic anhydride, and seawater and brine solutions. It resists the formation of grain-boundary precipitates in the weld heat-affected zone. Therefore, it too is suitable for most chemical process applications in the as-welded condition.

Ask for Bulletin H-2002

HASTELLOY® alloy G-3 is an improved wrought version of HASTELLOY alloy G. Alloy G-3 has the same excellent general corrosion resistance as alloy G, along with greater resistance to heat-affected zone attack and excellent weldability. It has outstanding resistance to hot sulfuric and phosphoric acids, and withstands the corrosive effects of both oxidizing and reducing agents and can handle both acid and alkaline solutions.

Alloy G-3 has excellent resistance to mixed acids, sulfate compounds, contaminated nitric acid, wet flue-gas desulfurization scrubber environments and hydrofluoric acid. The alloy's resistance to the formation of grain-boundary precipitates in the heat-affected zone makes it suitable for use in most chemical process applications in the as-welded condition.

Ask for Bulletin H-2009

HASTELLOY® alloy G-30 - a high chromium nickel-base alloy shows superior corrosion resistance over most other nickel- and iron-base alloys in commercial phosphoric acid and many complex environments containing highly oxidizing agents such as nitric acid.

Ask for Bulletin H-2028

HASTELLOY® alloy X is a nickel-chromium-iron-molybdenum alloy which has wide use in gas turbine engines for combustion zone components because of its exceptional combination of oxidation resistance, fabricability and high-temperature strength. It is also used in the chemical process industry for retorts, muffles, catalyst support grids, furnace baffles, tubing for pyrolysis operations and flash drier components.

Ask for Bulletin H-3009

HAYNES® alloy No. 25 is a cobalt-base alloy which combines good formability, wear and corrosion resistance with excellent high-temperature properties to 1900 deg. F (1038 deg. C). Alloy No. 25 is generally stronger than alloy X but is not quite as oxidation resistant.

Ask for Bulletin F-30,041

CABOT® alloy No. 625 is a nickel-chromium-molybdenum alloy with excellent corrosion resistance, high strength and oxidation resistance. It is resistant to a wide variety of corrosive media including phosphoric acid, organic acids, seawater and pollution control environments. Alloy No. 625 also resists stress-corrosion cracking, pitting and intergranular attack. It has high strength up to approximately 1800 deg. F (980 deg. C) coupled with good resistance to oxidizing atmospheres.

Ask for Bulletin H-1019

MULTIMET® alloy is an iron-base alloy for use in applications involving high stresses at temperatures up to 1500 deg. F (816 deg. C), and moderate stresses at up to 2000 deg. F (1093 deg. C). It has good oxidation resistance, ductility and is readily fabricated. Its high-temperature properties are inherent and are not dependent upon age hardening.

Ask for Bulletin H-3010

AVAILABLE FORMS

Alloy	Plate	Sheet & Strip	Billet	Bar	Wire	Covered Electrodes	Pipe	Tubing
HASTELLOY® alloy B-2	X	X	X	X	X	X	X	X
HASTELLOY alloy C-22	X	X	X	X	X	X	X	X
HASTELLOY alloy C-276	X	X	X	X	X	X	X	X
HASTELLOY alloy G-3	X	X	X	X	X	X	X	X
HASTELLOY alloy G-30	X	X	X	X	X	X	X	X
HASTELLOY alloy X	X	X	X	X	X	X	X	X
HAYNES® alloy No. 25	X	X	X	X	X	X	X	X
CABOT® alloy No. 625	X	X	X	X	X	—	X	X
MULTIMET® alloy	X	X	X	X	X	X	X	X

COMPARATIVE RESISTANCE OF HASTELLOY®, HAYNES® AND CABOT® ALLOYS TO VARIOUS CORROSIVE MEDIA

The charts on the following pages will serve as a rough guide in the selection of the proper alloy for a given type of corrosive service. The main value of these data is in narrowing down the choice of alloy. In the tables, the effects of complicating factors such as aeration, galvanic action, contamination, and erosion are not usually taken into account. Also, in some instances, data were compiled from only a few sources. For these reasons, the information in the tables is not to be construed as a recommendation either for or against using any alloy under any given conditions. The only reliable method for making a final choice of a material is, of course, actual field testing of the alloy.

Laboratory penetration rate data for HAYNES alloy No. 25 and MULTIMET alloy, in the more common corrosives such as hydrochloric acid, sulfuric acid, nitric acid, phosphoric acid, and organic acids, are given in the tables starting on page 85.

KEY

E	**Excellent**	**Less than 2 mils (0.05mm) penetration per year**
G	**Good**	**2 to 10 mils (0.05 to 0.25mm) penetration per year**
S	**Satisfactory**	**Over 10 to 20 mils (>0.25 to 0.51mm) penetration per year**
B	**Borderline**	**Over 20 to 50 mils (>0.51 to 1.27mm) penetration per year**
U	**Unsatisfactory**	**More than 50 mils (1.27mm) penetration per year**
—	**No Data**	

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Acetaldehyde	98	135	57	—	E	—	—	plus 2 percent low boiling material, 129 day test in top of tower
Acetic Acid	2.5M	212	100	—	—	E	E	immersed; aeration; lab test 41.6 days
Acetic Acid	2.5M	385	196	—	E	E	E	rack vertically resting on bottom, lab test 8.1 days, aeration
Acetic Acid	3	40-72	4-22	E	—	—	—	plus HCl to pH of 2.0 in streptomycin purification
Acetic Acid	4.5	347	175	—	E	—	—	plus 56 percent butane, 2 percent water, 10 percent nitrogen, 1 percent carbon dioxide, 27 percent other organics. Alloy C <0.1 mpy
Acetic Acid	10	75	24	E	—	—	—	plus HCl to pH of 2.0 in streptomycin purification
Acetic Acid	10	100-140	38-60	E	—	—	—	also HCl in starch conversion
Acetic Acid	10	214	101	G	—	—	E	immersed, comparison of heat transfer conditions with simple immersion test. Corrodent renewed every 48 hrs., total time: 95 hrs.
Acetic Acid	10	300	149	E	—	—	—	plus propionic and higher acids, 2 to 3 percent hardwood tar creosote oils
Acetic Acid	12	250	121	E	—	—	—	plus 1.5 to 4 percent formic acid
Acetic Acid	17	210	99	E	—	—	—	plus 1 percent formic acid
Acetic Acid	20	210	99	—	E	—	—	30 percent H_2O, balance acetaldehyde. Alloy C = 0.7 mpy
Acetic Acid	20	210	99	—	E	—	—	plus 50 percent acetaldehyde, test at top of tower
Acetic Acid	20.8	Boiling	Boiling	—	E	—	—	plus 0.02 percent salicylates 192-hr. test under reflux
Acetic Acid	21	239	115	—	G	—	—	plus 1 percent formic acid, 78 percent water. Alloy C = 8 mpy (violent agitation of solution)
Acetic Acid	23.4	212	100	—	E	—	—	plus 0.011 percent salicylic acid, 1380-hr. test in vapors
Acetic Acid	24	230	110	—	E	—	—	some chloride contamination. Alloy C = 0.6 mpy
Acetic Acid	25	220	104	—	E	—	—	plus 1.5 percent formic acid, 99-129-day test
Acetic Acid	25	220	104	—	E	—	—	plus 4 percent formic acid
Acetic Acid	30 30	100 110	38 43	— —	E E	— —	— —	plus 0.5 percent acetaldehyde, 129-day test, top of fractionating column. plus 3 percent acetaldehyde, 129-day test at bottom of tower
Acetic Acid	30	275	135	—	S	—	—	plus 8 percent formic acid. Alloy C = 12 mpy
Acetic Acid	30-40	230	110	—	E	—	—	plus 5.2 percent formic acid. Alloy C = 0.5 mpy
Acetic Acid	30-50	220	104	—	G	—	—	plus 2-10 percent formic acid and total 5 percent methyl formate, acetaldehyde, methyl acetate, ethyl acetate, acetone, methyl alcohol. Alloy C = 7 mpy
Acetic Acid	33	270	132	—	E	—	E	1.5 percent formic acid, 5902 hrs.
Acetic Acid	40	347	175	—	E	—	—	plus 20 percent butane, 5 percent pentane, 8 percent ethyl acetate, 5 percent methyl ethyl ketone, 6 percent propionic acid, esters, and ketones. Alloy C = 0.7 mpy
Acetic Acid	44	212	100	U	E	—	—	plus 34 percent amyl alcohol, trace of chlorides 792-hr. test. Alloy C = 1.0 mpy
Acetic Acid	45	183	84	—	E	—	—	plus 40 percent vinyl acetate, 13 percent acetaldehyde, 2 percent anhydrides. Alloy C = nil mpy
Acetic Acid	45-50	223	106	—	G	—	S	15 percent methyl formate, 2 percent formic acid, 3148 hrs.
Acetic Acid	45-50	225	107	—	G	—	B	5 percent methyl formate, 2 percent formic acid, 2328 hrs.
Acetic Acid	50	75	24	E	—	—	—	plus 50 percent H_2SO_4, vapor and liquid phase
Acetic Acid	50	158	70	—	E	—	—	Alloy C = nil mpy
Acetic Acid	50	356	180	—	E	—	—	plus 20 percent water, 12 percent esters, 10 percent CO, 8 percent hydrocarbons. Alloy C = 0.4 mpy
Acetic Acid	50	21[c]	102	G	—	—	E	immersed, comparison of heat transfer conditions with simple immersion test. Corrodent renewed every 48 hrs., total time: 96 hrs.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

M — Molar

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Acetic Acid	51	275	135	—	E	—	—	plus 30 percent propionic acid, 11.5 percent acetic anhydride, 7.5 percent propionic anhydride. Alloy C = 0.2 mpy
Acetic Acid	55.5	219	104	—	E	—	—	plus 0.016 percent salicylic acid, 1380-hr. test in vapors
Acetic Acid	57	100	38	—	E	—	—	plus 30.3 percent H_2SO_4, 12.3 percent H_2O, liquid and vapor phase
Acetic Acid	60	B.P.	B.P.	—	G	—	—	plus 10 percent salicylates, 1 percent naphtha. Alloy C = 4.6 mpy
Acetic Acid	60	221	105	—	E	—	—	plus 2 percent formic acid, 38 percent water. Alloy C = 1.2 mpy
Acetic Acid	60	356	180	—	E	—	—	plus 18 percent hydrocarbons, 9 percent esters, 8 percent CO, 5 percent water. Alloy C = 2 mpy
Acetic Acid	67	212	100	—	E	—	—	Alloy C = 0.7 mpy, 9504-hr. test.
Acetic Acid	67	273	134	—	E	—	—	plus 33 percent propionic acid. Alloy C = 0.2 mpy
Acetic Acid	72	267	131	G	G	—	—	tests for selection of material for an acetic acid recovery column for an acetaldehyde unit, 91 hrs.
Acetic Acid	75	258	126	—	E	—	—	plus 20 percent organics and 5 percent water. Alloy C = 0.3 mpy
Acetic Acid	80	195	91	G	G	—	—	plus 2-3 percent formic acid, 3-5 percent propionic acid, ethylacetate, small amount water (ethylacetate-acetic acid azeotrope distillation process). Alloy C = 4.0 mpy, 1126-hr. test.
Acetic Acid	85	167-257	75-125	—	E	—	—	plus ½ percent acetaldehyde, 5 percent water. Extensive aeration. Alloy C = 1.4 mpy
Acetic Acid	85	237-273	114-134	—	E	—	—	in acetic anhydride purification. Plus 10 percent acetic anhydride, 5 percent water, acetone, acetonitride, amines, etc. Alloy C = 0.1 mpy
Acetic Acid	89	257	125	U	S	—	—	plus 11 percent manganous acetate, 0.15 MnO_2, 58 ppm Cl^-, a trace of formic acid.
Acetic Acid	89	255	124	—	S	—	—	manganese acetate = 10.73 percent, manganese dioxide = 0.15 percent, water = 0.06 percent. 50 ppm Cl^-
Acetic Acid	90	225	107	—	E	—	—	plus 10 percent manganese acetate. Alloy C = 3 mpy
Acetic Acid	90	275	135	—	E	—	—	plus 10 percent propionic acid. Alloy C = 1 mpy
Acetic Acid	91.5	230-257	110-125	—	E	—	—	plus 2.5 percent formic acid 6 percent water. Alloy C = 0.3 mpy
Acetic Acid	91.6	250	121	—	E	—	—	plus 0.86 percent salicylic acid, 7.46 percent water, 891-hr. test in vapors
Acetic Acid	91.6	260	127	—	E	—	—	plus 8.4 percent salicylic acid, 891-hr. test in vapors
Acetic Acid	91.8	246	119	—	E	—	—	plus 0.95 percent salicylic acid, 1530-hr. test in vapors
Acetic Acid	94	257	125	—	E	—	—	plus 5 percent high boiling esters, 1 percent formic acid. Alloy C = 0.3 mpy, 11,160-hr. test
Acetic Acid	94.9	248	120	—	E	—	—	plus 2.1 percent propionic acid, 1.0 percent formic acid. Alloy C = 0.04 mpy
Acetic Acid	95	240	116	—	E	—	—	plus 5 percent high boiler.
Acetic Acid	95	252	122	—	E	—	—	plus 5 percent propionic acid. Alloy C = 0.6 mpy
Acetic Acid	96	170-284	77-140	—	E	—	—	plus 2 percent propionic acid, 1 percent butyric acid, 1 percent nitric acid. Alloy C = 0.9 mpy
Acetic Acid	96.4	248	120	—	E	—	—	plus 3.1 percent propionic acid, 0.5 percent acetic anhydride. Alloy C = 2 mpy
Acetic Acid	96.5-98	255	124	—	E	—	—	plus 1.5 percent formic acid, and 1.5 percent water. Alloy C = 0.3 mpy
Acetic Acid	97	248	120	—	E	—	—	plus 0.1 percent propionic acid, 0.6 percent formic acid. Alloy C = 0.5 mpy
Acetic Acid	99	272	133	—	E	—	—	plus 0.5 percent formic acid, 0.048 mpy for Alloy C in 5324-hr. test
Acetic Acid	99.5	234	112	—	E	—	—	plus 0.05 percent salicylic acid, 1022-hr. test in vapors
Acetic Acid	99.6	244	118	E	—	—	E	immersed, comparison of heat transfer conditions with simple immersion test. Corrodent renewed every 48 hrs, total time: 96 hrs.
Acetic Acid	99.6-99.9 (anhydrous)	216	102	—	E	—	—	0.7 mpy, plus 60 ppm sodium dichromate

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Acetic Acid	99.7	253	123	—	G	—	—	plus 1 percent manganese acetate, 2 percent water. Alloy C = 2 mpy
Acetic Acid	99.8	245	118	—	E	—	—	traces of water and propionic acid. Alloy C = 1 mpy
Acetic Acid	99.9	255	124	U	S	—	—	plus 0.02 percent formic acid and trace $KMnO_4$
Acetic Acid	99.9	Boiling	Boiling	—	E	—	—	360 hrs.
Acetic Acid	Conc.	90-190	32-88	U	E	—	—	plus peracetic acid.
Acetic Acid	All All	75 B.P.	24 B.P.	E S	E E	— —	— —	aerated or air free
Acetic Acid, Glacial	—	675	357	E	E	—	—	in vapors and catalyst during manufacture of acetic anhydride by pyrolysis. Alloy C = 0.1 mpy
Acetic Acid, Glacial	—	1247	675	E	E	—	—	vapor velocity, 175 ft./sec., 1776-hr. test. Spool exposed in inlet leg of reactor coil in acetic anhydride (99 percent acetic acid plus catalyst). Alloy C = 0.1 mpy
Acetic Acid Vapor	100	125-B.P.	52-B.P.	—	E	—	—	
Acetic Anhydride	50	297	147	—	E	—	—	plus 40 percent ethylene diamine tetra-acetic acid and 10 percent acetic acid
Acetic Anhydride	60	284	140	E	E	—	—	plus 40 percent acetic anhydride. Alloy C = nil mpy
Acetic Anhydride	95	252	122	—	E	—	—	plus 5 pecent acetic acid
Acetic Anhydride	95	266	130	—	E	—	—	$KMnO_4$ added for quality control
Acetic Anhydride	99	310	154	—	E	—	—	plus 1 percent acetic acid and violent agitation
Acetic Anhydride	100	273	134	—	E	—	—	Alloy C = 0.04 mpy
Acetic Anhydride	All	to B.P.	to B.P.	S	E	—	—	
Acetone	—	—	—	—	E	—	—	activated carbon used for absorbing plus traces of methylene chloride. Alloy C = 0.1 mpy
Acetone	60	176	80	G	—	—	—	plus 30 percent methyl acetate, 10 percent acetaldehyde pH 5-6.
Acetone	All	to B.P.	to B.P.	E	E	—	—	
Acetonitrite	4	376	191	G	—	—	—	in isopropyl chloride solution.
Acetophenone	67	302	150	E	—	—	—	plus 33 percent phenol.
Acetylene Tetrachloride (Crude)	—	108-120	42-49	—	E	—	—	excess Cl_2 = 10-21 grams/liter. Dissolved Fe = 0.15-1.65 grams/liter, HCl = 0.7-6.6 grams/liter
Acetylene Tetrachloride	90 90	205 223	96 106	S B	E E	— —	— —	at top and bottom of distillation column, in vapor and liquid
Acid Pulping (Ammonia Base)	—	165-175	74-80	—	E	—	E	
Aconitic Acid	—	185-194	85-90	—	E	—	—	plus NaOH, H_2SO_4, and sodium metabisulfide. Alloy C gained weight slightly.
Acrylic Acid	—	212	100	S	B	—	—	H_2SO_4, acrylic acid reactor condensor
Air, Exhaust	—	110	43	G	E	G	G	aeration, saturated with water and containing chlorinated solvents and other organic compounds
Air	—	180	82	—	E	—	G	$Ca(OCl)_2$, Cl_2 and H_2O. Duration of test — 204 days
Air and Steam	—	180	82	E	—	—	E	
Alcohol, Allyl	100 100	75 B.P.	24 B.P.	— —	S S	— —	— —	
Alcohol, Ethyl or Methyl	All	to B.P.	to B.P.	E	E	—	—	
Alkylamines	—	200	93	—	S	—	G	alkyl amines in aqueous solution containing small amounts of CO_2; pH 10-12
Alkylate, Butane and Lighter	—	128	53	E	E	—	—	during petroleum refining in depropanizer tower, vapor and liquid. Alloy C = 0.1 mpy
Alkylbenzene Sulfonate	71	140	60	G	—	—	U	24 hrs., lab test (vigorous stirring)
Alkyl Benzene-Sulfonic Acid	—	100-130	38-54	E	E	—	—	in settling tank and sulfonation tank during detergent manufacture. Alloy C = 0.6 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Alkylphenol — boron trifluoride complex	—	197-205	92-96	E	E	—	—	in alkaylation, mixing and distillation processes liquid and vapor phase. Alloy C = 0.4 mpy
Allyl Chloride	100	75	24	E	—	—	—	
Alumina Hydrate	—	140	60	B	S	—	—	plus phosphated alumina hydrate (60° Bé H_2SO_4), 65 percent alumina hydrate, 75 percent H_3PO_4
Aluminum Acetate	All	to B.P.	to B.P.	S	S	—	—	
Aluminum Brazing Flux	—	800-1300	427-705	E	S	—	—	LiF, NaCl, NaF, specimens were alternately exposed to air and molten flux over 10-day period
Aluminum Chloride	10-80	to B.P.	to B.P.	E	—	—	—	as in ethyl benzene production, isomerization, Friedel Crafts synthesis
Aluminum Chloride Sludge	90 90	125 250	52 121	E E	— —	— —	— —	plus HCl at 250 psi
Aluminum Chloride	—	360	182	—	S	—	—	$AlCl_3$ 85%, NaCl 12%, Al_2O_3 3%, $FeCl_3$ 700 ppm initially. $AlCl_3$ 35-60%, NaCl 8-9%, Al_2O_3 30-55%, $FeCl_3$ 0.5-1.5% final
Aluminum Chloride	Satr. Soln.	B.P.	B.P.	B	U	—	—	no aeration
Aluminum Fluoride	10	75	24	—	S	—	—	
Aluminum Fluoro Sulfate	15	60-80	16-27	S	E	—	—	$Al_2F_4SO_4$ to pH = 2.3. Alloy C = 0.4 mpy
Aluminum Fluoro Sulfate	15-35	180-235	82-113	U	B	—	—	Alloy C = 24 mpy
Aluminum Potassium Sulfate (Alum)	10	to 175	to 79	—	S	—	—	
Aluminum Sodium Sulfate	10	to B.P.	to B.P.	—	S	—	—	
Aluminum Sulfate	10 10 15 20* 20 30 40 50 55	to 130 175-B.P. 120 to 130 175-B.P. B.P. B.P. 130-B.P. 100	to 54 80-B.P. 49 to 54 80-B.P. B.P. B.P. 54-B.P. 38	— — — S — — — — —	E S E E S S S E E	— — — — — — — — —	— — — — — — — — —	*paper makers alum
Aluminum Sulfate	29-58	195-250	91-121	E	—	—	—	in coil descaling. Plus 0.01 percent ferric and 0.03 percent ferrous ions as Fe_2O_3, trace Cr_2O_3. Occasional exposure to NaOH cleaning solution
Amines	30	250	121	E	E	E	E	30% lactam, 20% organic acid, pH 10-11, polymerization kettle, 62 days
Amines	—	257	125	—	E	—	E	hot wash liquid. Reaction product of diphenylamine and acetone in HBR catalyst after addition to 50% NaOH to yield pH of 12-14. Moderate aeration
Amines (Secondary of Tallow)	80-85	160	71	—	E	E	E	dissolved in isopropyl alcohol. Methyl chloride added to MNTN press and 73% NaOH to keep neutral. Manufacture of fabric softener. Air free. Agitation violent, 251 days
Amine Hydrochlorides	30	290-360	143-182	B	U	G	S	ammonia 20%, water 50%. Liquid phase. 25.2 days, no agitation or aeration
Amine Hydrochlorides	30	290-360	143-182	—	U	—	E	ammonia 20%, water 50%. Liquid phase.
Amine Hydrochlorides	30	360	182	B	U	G	G	ammonia 20%, water 50%
Amine Hydrochlorides	40	302-482	150-250	—	U	U	U	ammonia 20%, water 40%, 4 days, agitation > 4ft/sec, aeration — none
Amine Hydrochlorides	40	302-482	150-250	—	U	—	G	ammonia 20%, water 40%. Liquid phase.
Amine Hydrochlorides	—	482	250	—	U	U	U	
3-Aminopyridine	3	144	62	—	E	—	E	3.25% NaOCl, 2% NaOH, 10% NACL, 69% H_2O, Balance inerts. pH 14; production of 3-Aminopyridine; Agitation — none; Air free; 74 days
Ammonia	12	80-90	26-32	G	S	—	—	plus 7 percent carbon dioxide and water in ammonia recovery stripper in urea plant.
Ammonia	27	122-194	50-90	—	E	E	E	6% CO_2, 66% water vapor (all by vol.), 131 days, test in heat exchanger, vapor zone. Aeration — slight, Agitation — slight
Ammonia	27	185	85	—	E	E	E	carbon dioxide 6%, water vapor 66%, air 0.5-1%, all by volume

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature deg. F	Temperature deg. C	HASTELLOY® alloy B/B-2	HASTELLOY® alloy C/C-276	HASTELLOY® alloy G/G-3	Type 316 Stainless Steel	Conditions
Ammonia	—	390-490	199-254	—	G	—	—	plus ammonium chloride, cuprous chloride, cupric chloride. Air-free. Alloy C = 2.21 mpy
Ammonia, Liquid	10	75	24	S	E	—	—	
	10	100-B.P.	38-B.P.	S	S	—	—	
	20	75	24	S	E	—	—	
	20	100-B.P.	38-B.P.	S	S	—	—	
	30	75	24	S	E	—	—	
	30	100-B.P.	38-B.P.	S	S	—	—	
	50	to B.P.	to B.P.	S	S	—	—	
	70	to B.P.	to B.P.	S	S	—	—	
	100	to 600	to 316	S	S	—	—	
Ammonia, Liquid	—	194	90	G	E	—	—	in outlet of methallymine reactor containing amines NH_4Cl, organic chlorides plus polymer. Alloy C = 0.1 mpy
Ammonium Bifluoride	10	77	25	—	E	—	—	Alloy C = 1.1 mpy
Ammonium Bifluoride	50 to anhydrous	77-392	25-200	—	G	—	—	Alloy C = 8.4 mpy
Ammonium Bifluoride	—	300	149	E	E	—	G	fused, 40 days
Ammonium Bisulfite	—	157-162	69-72	—	E	—	—	pulping liquor. Alloy C = 0.3 mpy
Ammonium Bromide	10	75	24	—	S	—	—	
Ammonium Carbonate	10	to B.P.	to B.P.	S	S	—	—	
	20	to B.P.	to B.P.	S	S	—	—	
	30	to 175	to 80	E	E	—	—	
	30	to B.P.	to B.P.	S	S	—	—	
	40	to 175	to 80	S	S	—	—	
	40	B.P.	B.P.	E	E	—	—	
	50	B.P.	B.P.	S	S	—	—	
Ammonium Chloride	6.22	266	130	—	B	—	U	0.07% nickel chloride, 2.95% ammonia, 5.55% ammonium carbonate, pH = 10.8, recovery of ammonia, 24 hrs.
Ammonium Chloride	11-14	194	90	E	—	—	—	plus H_2S, mercapans and non-abrasive solids in agitator.
Ammonium Chloride	14.7	86-176	30-80	—	E	E	E	8% NaCl;, 4.2% CO_2, 131 days, agitation and aeration — slight
Ammonium Chloride	26-31	180	82	—	E	G	G	fluxing stainless steel strip prior to soldering. Duration of test — 98 days, aeration — moderate, agitation — 2-3 ft./sec.
Ammonium Chloride	28-40	77-216	75-102	—	E	—	—	in evaporating tank. Alloy C = 0.02 mpy
Ammonium Chloride	35	221-230	105-110	—	E	—	—	plus less than 0.5 percent NH_3. Alloy C = 0.014 mpy
Ammonium Chloride	35-50	to 225	to 107	—	E	—	—	plus 35 percent $ZnCl_2$ for 2 percent of period, tank contained boiling solution of 50 percent NH_4Cl, 4 percent $ZnCl_2$, 0.15 percent $PbCl_2$. Alloy C = 0.1 mpy in both liquid and vapor phases.
Ammonium Chloride	to 40	to B.P.	to B.P.	S	S	—	—	
	All	to B.P.	to B.P.	—	S	—	—	
Ammonium Chloride	147 g/l	167	75	—	E	E	E	sodium chloride 78 g/l, carbon dioxide 42 g/l (combined as NH_4HCO_3, $(NH_4)_2CO_3$, $NaHCO_3$), ammonia 22 g/l (combined as NH_4HCO_3, $(NH_4)_2CO_3$ NH_4OH. Sulfide trace, organics possible trace
Ammonium Chloride	—	60-70	16-21	—	E	—	—	sole leather dye vat. NH_4Cl and enzymes dispersed in water
Ammonium Chloride	—	140	60	S	E	—	—	sodium sulfite mother liquors. Alloy C = 0.003 mpy in 336-hr. test
Ammonium Chloride	—	140-147	60-64	E	E	—	—	plus sodium sulfite mother liquor. Alloy C = 0.02 mpy
Ammonium Chloride	—	175-218	79-103	E	E	—	—	plus HCl and hydrocarbons in refinery coker bubble tower. Alloy C = 0.1 mpy
Ammonium Chloride	—	194	90	—	E	—	—	400 grams/liter NH_4Cl plus 3-5 grams/liter NH_3
Ammonium Chloride	—	625-652	329-345	—	G	—	—	Alloy C = 2.12 mpy
Ammonium Chloride	—	840	449	—	E	—	—	350 grams/liter NH_4Cl plus 1-2 grams/liter free NH_3. Alloy C = 0.06 mpy
Ammonium Di-hydrogen Phosphate	Satr. Soln.	82	28	E	E	—	—	Alloy C = 0.004 mpy
Ammonium Fluoride	15	60-200	16-93	S	E	—	—	plus excess NH_4OH
Ammonium Fluoride	20	175	80	—	E	—	—	plus 8 percent titanium fluoride in the separation of titanium from its ore
Ammonium Fluoride	45	230-266	110-130	—	—	—	—	plus suspended ferrous titanate (ilmenite)

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Ammonium Fluosilicate	18.5	90-110	32-43	—	E*	—	—	plus 1 percent free H_2SiF_6. *Slight weight gain
Ammonium Hydroxide	—	248	120	—	G	—	—	210 hours, 8% NH_3, 2% H_2S, 2% CO_2 and 0.3% HCN
Ammonium Hydroxide	Conc.	572	300	U*	S	—	—	contained 2 grams cupric chloride and sodium sulfate/gal, 159 hrs., lab test, no agitation. *Cracked
Ammonium Hydroxide	—	150	66	—	E	—	E	contains $(NH_4)_2CO_3$, $(NH_4)_2S$, NH_4Cl, NaCl
Ammonium Hydroxide, Ammonia, Carbamate	—	268-275	131-135	—	—	E	E	aeration
Ammonium Hydroxide Mixtures, Ammonia	27	122-194	50-90	—	E	—	—	carbon dioxide 6%, water vapor 66%, air 0.5-1%, all by volume, slight aeration
Ammonium Nitrate	10	75	24	—	E	—	—	
Ammonium Nitrate	12	32-212	0-100	B	E	—	—	plus ammonium hydroxylamine disulfonate SO_2, ammonium sulfates and nitrates. Alloy C = 0.3 mpy
Ammonium Nitrate Fertilizers	13-38	100	38	E	E	—	E	potassium chloride 11.6 to 30%, calcium phosphates, mono- and di-, 1% to 14%; water 20%, inerts 12%; pH 4.5 to 7.0, moderate aeration
Ammonium Oxylate	10	75	24	—	E	—	—	
Ammonium Perchlorate	All	to 160	to 71	—	S	—	—	
Ammonium Persulfate	10	75	24	—	E	—	—	
Ammonium Phosphate	5	75	24	—	E	—	—	
Ammonium Sulfate	All 45	to B.P. 190	to B.P. 88	— —	S S*	— —	— —	*liquid anhydrous NH_3, H_2SO_4, and $(NH_4)_2S$ added in process
Ammonium Sulfate	—	212-213	100	U	E	—	—	in dilute and saturated NH_4SO_4 plus 1.5 percent free H_2SO_4. Alloy C = 0.7 mpy
Ammonium Sulfate	—	156	69	—	E	—	—	plus SO_2 and other sulfur compounds. Alloy C = 0.06 mpy
Ammonium Sulfite	—	103	39	—	E	—	—	plus ammonium bisulfite, 3 percent total SO_2, pH = 6.2. Alloy C = 0.1 mpy
Ammonium Sulfite	45-46	—	—	—	E	—	E	NH_4HSO_3, pH 5.0 to 6.0
Amyl Acetate	—	275	135	—	S	—	—	during production of amyl acetate from amyl alcohol, glacial acetic acid, H_2SO_4
Amyl Alcohol	—	104	40	—	S	—	—	plus 44 percent acetic acid, 34 percent amyl alcohol, 2 percent sulfuric acid, balance water
Amyl Chloride	—	75	24	E	E	—	—	plus traces of NaCl, NaOH, $FeCl_3$, and water. Alloy C less than 0.1 mpy
Amyl Chloride	84	86	30	E	E	—	—	plus 16 percent dry HCl. Alloy C less than 0.3 mpy
Amyl Chloride	100 100	86 B.P.	30 B.P.	E E	E —	— —	— —	plus trace of HCl and water
Amyl Mercaptan	—	230	110	E	—	—	—	plus traces of ethanol, brine, amyl chloride, diamyl sulfide and H_2S. 1656-hr. test.
Amyl Mercaptan	—	to 320	to 160	E	E	—	—	in liquid and vapors of distillation column plus some other amyl compounds, water and a trace of H_2S.
Amyl Phenol	—	176	80	—	E	—	E	various organic syntheses: tertiary amyl phenol, amylene, ditertiary amyl phenol, trace BF3-ether; t-nonyl mercaptan, sulfur, hydrogen sulfide, ditertiary nonyl-polysulfide, magnesia, diphenylamine, monene, nonyldiphenylamine, styrene, trace 98% H_2SO_4, clay, vapor phase
Amyl Phenol	—	392	200	E	E	—	E	various organic synthesis: tertiary amyl phenol, amylene, ditertiary amyl phenol, trace BF_3-ether; t-nonyl mercaptan, sulfur, hydrogen sulfide, ditertiary nonyl-polysulfide, magnesia; diphenylamine, nonene, nonyldiphenylamine, styrene, trace 98% H_2SO_4
Aniline	100	75	24	—	S	—	—	
Aniline	—	392-518	200-270	E	E	—	—	plus CS_2, H_2S, mercaptobenzol, thiazole and others. Alloy C = 1.0 mpy
Aniline Sulfite	10 100	60 75	16 24	E* —	— E	— —	— —	*SO_2 blown into 10 percent aniline oil in water.
Anisole (Methyl Phenyl Ether), Boron Trifluoride	—	302	150	—	E	—	E	anhydrous, 32 days
Anodizing Solution, Aluminum	—	180	82	U	E	—	—	18.5 percent H_2SO_4 plus 3 percent H_2CrO_4 in lead-lined tank

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Antibiotic Fermentation Media	—	65-90	18-32	—	E	—	—	in processing tank before filtering after fermentation. Usually neutral but occasionally acidified to pH = 2.5 with HCl or H_2SO_4 or alkalized to pH = 10.5 with NaOH. Alloy C = nil mpy
Antimony Chloride	50	160	71	—	E	—	E	8% HCl, trace HF, balance CCl_4 and refrigerants
Antimony Chloride	50	170	77	—	E	—	E	8% HCl, 8% HF, balance CCl_4 and refrigerants
Antimony Fluorochlorides	—	150	66	—	G	U	U	Vapor over mixed antimony fluorochlorides $[SbFxCl(5-x)]$ refluxing condensate of aliphatic halocarbons, anhydrous hydrogen fluoride and hydrogen chloride.
Antimony Pentachloride	50	160	71	—	E	—	E	fluorochemical manufacture: Separation of $SbCl_5$ by distillation. Carbon tetrachloride and refrigerants 42%, hydrogen chloride 8% Duration of test — 341 days Aeration — slight Agitation — about 5 ft./sec.
Antimony Pentachloride	50	160	71	—	E	—	S	carbon tetrachloride and refrigerants 42%, hydrogen chloride 8%, hydrogen fluoride trace, slight aeration.
Antimony Salts	—	-58-212	-50-100	—	U	—	U	vapor over mixed antimony fluorochlorides $[SbFxCl(5-x)]$, refluxing condensate of aliphatic halocarbons, anhydrous hydrogen fluoride and hydrogen chloride
Antimony Salts	—	212	100	—	U	—	G	mixed antimony fluorochlorides $[SbFxCl(5-x)]$ and $[SbFyCl(3-y)]$, to which is alternately added anhydrous hydrogen fluoride and aliphatic organic chlorides.
Aqua Regia	—	B.P.	B.P.	U	U	—	—	25 percent HNO_3, 75 percent HCl
Aromatic Tar	—	482	250	E	—	E	—	distillation process, 167 hrs., welded samples
Aromatic Tar	—	482	250	—	—	E	—	distillation process, 264 hrs., welded samples
Atrazine	—	140	60	—	E	—	—	moderate aeration
Barium Chloride	20-25	140-212	60-100	—	E	—	—	Alloy C = 0.1 mpy
Barium Chloride	All 20 25	to B.P. B.P. B.P.	to B.P. B.P. B.P.	S S S	— E E	— — —	— — —	
Barium Chloride	Saturated	70	21	E	E	—	—	Alloy C = 0.1 mpy
Barium Hydroxide	All 100	B.P. 1500	B.P. 816	S E	S —	— —	— —	
Beeswax Bleach Solution	—	220	104	—	E	—	—	160 lb. H_3PO_4, 50 lb. K_2MnO_4 and 300 lb. H_2O per 1250 lb. of crude beeswax. Alloy C = 0.19 mpy
Benzene	50	80	27	B	B	—	—	plus 40 percent chlorinated benzene, 5 percent HCl, 5 percent H_2O
Benzene	90	80	27	B	E	—	—	plus 5 percent HCl, 5 percent H_2O and chlorinated benzene. Alloy B = 44 mpy, Alloy C = 0.2 mpy
Benzene	All	to B.P.	to B.P.	S	S	—	—	
Benzene, Chlorinated	100	266	130	E	E	—	—	Alloy C = 0.1 mpy
Benzene, Monochlor	—	60-80	16-27	S	E	—	—	in DDT production plus SO_2, Alloy C = 0.3 mpy
Benzene Sulfonic Acid	86.7	140 284	60 140	G S	S U	— —	— —	plus 3 percent H_2SO_4
Benzene Sulfonic Acid	90	329	165	S	B	—	—	process starts with 66° Bé H_2SO_4 and benzene. Final product is 90 percent benzene sulfonic acid and 4 percent H_2SO_4.
Benzene Sulfonic Acid	91.3	284	140	S	S	—	—	plus 3.8 percent H_2SO_4 Alloy C = 18 mpy
Benzene Sulfonic Acid	92	392	200	E	E	—	—	plus 5 percent sulfuric acid and 3 percent water
Benzene Tetrachlor	—	269-554	132-289	—	E	—	—	in still at three points. Alloy C = 0.2 mpy in liquid, 0.5 mpy in liquid-vapor interface, 0.7 mpy in vapor
Benzene, Wet	—	86-95	30-35	G	—	—	—	
Benzoic Acid	10	75	24	—	E	—	—	
Bismuth-Lead Alloy	Eutectic	to 464	to 240	S	S	—	—	both Alloys B and C considered good for long time use
Black Liquor	43-47	450	232	—	B	—	—	in production of dimethyl sulfide from black liquor
Bleach Liquor	100	to 125	to 52	—	E	—	—	containing available chlorine

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Bleach Solution	—	63	17	—	E	—	—	0.044 percent free Cl_2, 0.07 percent available Cl_2, 0.025 percent ClO_2 48-hr. test, Alloy C = 1.1 mpy
Boric Acid	All	to B.P.	to B.P.	E	E	—	—	
Boron Trichloride	—	77-212	25-100	E	—	—	—	in metal halide filter plus chlorine, ferric chloride, aluminum chloride, silicon tetrachloride.
Boron Trifluoride	1.4	140-284	60-140	S	G	—	—	plus 0.2 percent HF in low pressure still. Alloy C = 2.4 mpy (liquid), 1.9 mpy (vapor)
Boron Trifluoride Etherate	—	75-135	24-57	—	E	—	—	in hydrocarbon oil, both liquid and vapor phases. Alloy C = 0.1 mpy
Boron Trifluoride Etherate Catalyst	—	—	—	—	E	—	—	in phenol and water during alkylation. Alloy C = 0.2 mpy (vapor), <0.1 mpy (liquid)
Boron Trifluoride Etherate	4.4	104-212	40-100	—	E	—	—	Alloy C = 0.16 mpy
Brackish water	—	41	5	—	E	—	E	Newark Bay. Contains 0.70% NaCl, 1000 ppm Ca as $CaCO_3$, 60 ppm HCl. Moderate aeration, pH 6.7
Brass Pickling Solution	100	140	60	—	E	—	—	contains 19 to 28 percent H_2SO_4 and 1 to 4 percent $CuSO_4$. Completely immersed in solution in rubber-lined tanks
Brazing Flux	—	1090-1140	588-615	G	G	—	—	alkali fluorides in commercial dip brazing furnace. Alloy C = 5.6 mpy
Brine	2-9	115-125	46-52	—	E	—	—	plus glue and carbon black, H_2SO_4 added to release fatty acid from soap addition. pH = 2.0-2.9, Alloy C = 0.065 mpy
Brine	—	125-150	52-66	—	E	—	—	310 grams/liter NaCl brine plus trace Cl_2, pH = 10.4. Alloy C = nil mpy
Brine, Saturated	—	140	60	—	E	—	—	
Brine, Saturated	—	240-245	115-118	—	E	—	—	aeration
Brine Solution, Waste Stream	—	107	42	G	E	E	E	containing 23 g/l total disolved solids consisting of 10 g/l chloride and 4.4 g/l sulfate pH-1, 90 days
Brine Slurry	—	195	91	—	E	E	E	containing $MgSO4_4$, H_2SO_4, KCl, NaCl, $MgCl_2$, trace of S; pH 7.7, moderate to extensive aeration
Brine Slurry containing $MgSO_4$	—	196	92	—	E	E	E	also Na_2SO_4, KCl, NaCl, $MgCl_2$, trace of S, pH 7.7, moderate to extensive aeration
Bromine, Dry	100 100	to 150 150-700	to 66 66-371	— —	E S	— —	— —	
Bromine Gas	—	59	15	G	E	—	—	in equilibrium with 10% Br water solution. As-welded samples.
Bromine Gas	—	59	15	G	G	—	—	in equilibrium with Br liquid. As-welded samples.
Butane	28.5	158	70	G	B	—	—	also 50.2% H_2SO_4, 21.3% water, synthetic butyl acetate liquors
Butane	—	225-250	107-121	S	G	—	—	plus isobutane, hydrogen chloride. Alloy C = 10 mpy
Butanes (Catalyst Cracked)	—	120-140	49-60	E	—	—	—	plus 0.02 percent mercaptan sulfur
Butyl Acetate	—	220	104	E	E	—	E	sea water, distillation of butyl acetate, 64 hrs. field test
Butyl Acetate Dichlorophenoxy	100 100	75 140-171	24 60-77	G S	B S	— —	— —	Alloy C = 30 mpy
Butyl Acetyl Ricinoleate	—	140	60	—	E	—	—	plus charcoal and traces of acetic acid. Alloy C = nil mpy
Butyric Acid	95	239-284	115-140	—	E	—	—	plus 5 percent acetic acid. Alloy C = 0.3 mpy
Butyric Acid	100	230-265	110-130	S	E	—	—	plus traces of $MnSO_4$, $MgSO_4$ and water
Butyric Acid	All	to B.P.	to B.P.	S	E	—	—	
Calcium Bromide	38	60-140	16-60	E	—	—	—	plus 8.6 percent $CaCl_2$, 11.5 percent LiBr, 42 percent H_2O.
Calcium Carbonate	—	117	47	—	E	E	E	calcium carbonate, calcium sulfate, calcium sulfite, all suspended as 6-11% (by wt.) slurry, pH not specified, aeration
Calcium Carbonate	—	80	27	—	E	E	E	calcium carbonate, calcium sulfate, calcium sulfite and fly ash all suspended as about 20% (by wt.) slurry, pH not specified, aeration
Calcium Chlorate	All	to B.P.	to B.P.	—	S	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Calcium Chloride	12	75-85	24-29	G	—	—	—	plus 8 percent methyl ethyl ketone, 1 percent HCl, 0.5 percent aconitic acid
Calcium Chloride	20	220	104	—	E	E	E	10% KCl; concentrated brine in potash extraction pilot plant.
Calcium Chloride	29	167-194	75-90	E	E	—	—	plus 8.7 percent $MgCl_2$, 1 percent NaCl half in vapor - half liquid phase, Bittern Process. Alloy C = 0.08 mpy
Calcium Chloride	All 40-60	to B.P. 350	to B.P. 177	S E*	E E*	— —	— —	*slight gain in weight. Specimens in pilot plant evaporator
Calcium Chloride	40	180	82	—	E	—	E	zinc sulfate 40%, pH 2.8, 35% of time; aluminum sulfate 3-30%, pH 3, 15% of time; magnesium sulfate 40%, pH 3, 10% of time; zinc chloride 40%, pH 1.8, 5% of time, moderate aeration
Calcium Chloride	40	70-200	21-93	—	E	—	E	5 solutions, each singly: calcium chloride, pH 2, 35% of time; zinc sulfate 40%, pH 1.8, 35% of time; aluminum sulfate, 3-30%, pH 3, 15% of time; magnesium sulfate 40%, pH 3, 10% of time; zinc chloride 40%, pH 1.8, 5% of time. Moderate aeration.
Calcium Chloride	54	260	127	G	G	—	—	hydrogen chloride recovery, pH about 3 to 4 Duration of test — 305 hrs. = 12.71 days Aeration — moderate Agitation — 2-3 ft./sec.
Calcium Chloride	55	220	104	G	—	—	—	partially purified
Calcium Chloride	58	329	165	—	G	—	—	plus 1.0-1.3 percent NaCl, 0.10 percent $Ca(OH)_2$. Alloy C = 2.1 mpy
Calcium Chloride	62	310	154	G	G	—	—	
Calcium Chloride	73	350	177	G	—	—	—	partially purified
Calcium Chloride	—	175	79	E	—	—	—	140 g/l $CaCl_2$, 80 g/l NaCl, 2 g/l $Ca(OH)_2$
calcium Chloride	—	248-266	120-138	G	—	—	—	plus Na_2S, Na_2CO_3, elemental sulfur, in sulfur separator.
Calcium Chloride Brine	—	176-194	80-90	—	E	—	—	plus $MgCl_2$ brine, pH = 5.0
Calcium Hydroxide	18-20	70 75	21 24	—	E	—	S*	duration of test — 204 days, *severe pitting
Calcium Hydroxide	to 50	to B.P.	to B.P.	—	E	—	—	
Calcium Hydroxide	—	75	24	—	E	—	G*	duration of test — 42 days, *perforated
Calcium Hypochlorite	0-5	86-140	30-60	—	E	—	—	
Calcium Hypochlorite	0.5	86-140	30-60	—	U	—	—	chlorine absorption
Calcium Hypochlorite	2-3	86	30	—	S	—	—	Alloy C = 13.5 for 2 percent, 16.4 for 3 percent
Calcium Hypochlorite	6	95-212	35-100	—	E	—	—	Alloy C = 0.2 mpy
Calcium Hypochlorite	10 15 20 20	75 125 75 125	24 52 24 52	— — — —	S S E S	— — — —	— — — —	
Calcium Hypochlorite Bleach	—	65-86	18-30	—	E	—	—	spray drying (180 grams/liter $CaOCl_2$). Alloy C = 0.07 mpy
Calcium Hypochlorite Bleach Liquor	—	80	27	—	E	—	—	2-3 grams/liter available Cl_2. Alloy C = 0.1 mpy
Calcium Hypochlorite Liquor	—	72-80	22-27	—	E	—	—	220-230 grams/liter. Alloy C = 0.01 mpy
Calcium Hypochlorite (Lime Sludge)	—	60-100	16-38	—	E	—	—	free Cl_2 = 40 grams/liter, $CaCl_2$, $CaClO_3$, $CaCO_3$ and free lime in small amounts
Calcium-Magnesium Chloride Solutions	Conc.	212-220	100-104	S	G	—	—	plus free 0.63 percent HCl in condensate. Alloy C = 6.7 mpy
Calcium Pyridine Sulfonate	—	100-150	38-66	—	E	—	—	plus 1-5 percent H_2SO_4 and a trace of $HgSO_4$. Alloy C = 0.1 mpy
Calcium Sulfite	—	115	46	—	E	E	E	calcium sulfate, calcium carbonate, fly ash, all suspended as 30-50% (by wt.) slurry, pH not specified
Calcium Sulfite	—	117	47	—	E	E	E	calcium sulfate, calcium carbonate, fly ash, all suspended as 10-15% (by wt.) slurry, pH not specified, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Calcium Sulfate	10	to B.P.	to B.P.	S	S	—	—	
Candelilla Wax	—	96-221	36-105	—	E	—	—	plus $NaClO_3$, H_2SO_4 and HNO_3 (acid content about 25 percent of total). 100-hr. test
Caprolactone and Ammonia	—	—	—	—	S	—	G	664 hrs., production of caprolactum
Carbon Dichloride	65	250	121	—	E	—	—	plus 25 percent CCl, 10 percent heavy organic chlorides saturated with HCl and Cl_2, about 20-30 ppm H_2O. Alloy C = 0.05 mpy
Carbon Dioxide	10	150	66	—	E	—	—	in humidification process plus 0.2 percent SO_2, 2 percent CO and some O_2. Alloy C = 0.02 mpy
Carbon Dioxide	All 100	to 1000 to 1400	to 538 to 760	— E	E —	— —	— —	
Carbon Slurry	—	75	24	E	E	—	—	plus HCl to a pH of 1.5, Alloy C = 0.02 mpy. 11-week test
Carbon Tetrachloride	10 100 100	75 75 to 300	24 24 to 149	S S S	E E —	— — —	— — —	
Carbon Tetrachloride	85-87	85-167	30-75	B	G	—	—	plus 13-15 percent chlorinated high polymer, 0.08 percent chlorine, 0.1-0.2 percent HCl. Normally anhydrous. Alloy C = 2.2 mpy
Carbon Tetrachloride	87.5	185	85	U	G	—	—	plus 12 percent H_2O, 0.4 percent Cl_2, 0.1 percent HCl. Alloy C = 2.3 mpy
Carbon Tetrachloride	—	932-1112	500-600	G	G	—	—	CCl_4 carried in air stream
Carbonic Acid	15 100	75 75	24 24	E E	E E	— —	— —	
Caustic (mild)	0.6	40-212	4-100	—	E	—	—	plus tetra sodium phosphate, dilute NaOCl, some free Cl_2, dilute H_2SO4 (1.5 percent acid)
Caustic	6	80-90	27-32	B	—	—	—	absorption of Cl_2 and acidic material from reactor off-gases. Solution contains 1 percent NaOCl maximum
Caustic	2-17	60-110	16-43	E	E	—	—	plus 7 percent NaCl, 8 percent CH_3COOH, 12 percent organic salt and water in neutralization process. Alloy C = 0.1 mpy
Chestnut Wood Extract	—	150-200	66-93	—	E	—	—	plus organic and sulfurous acids and tannin
Chloracetic Acid	90	73	23	E	E	—	—	
Chloracetic Acid	100	158	70	E	E	—	—	
Chloracetic Acid	to 70 80 100	to B.P. 75 to 356	to B.P. 24 to 180	— E* E*	S E —	— — —	— — —	*monochloracetic acid
Chloracetic Acid, Mono	—	68	20	E	E	—	—	plus 15 percent dichloracetic acid and 15 percent acetyl chloride. Alloy C <0.1 mpy
Chloracetic Acid, Mono	—	160-180	71-82	G	S	—	—	Alloy C = 14 mpy
Chloracetic Acid, Mono	60 60 60 60	77 (1) 77 (2) 77 (3) 140 (1)	25 (1) 25 (2) 25 (3) 60 (1)	— E — S	E S — S	— — — —	— — — —	plus 38 percent acetic acid, 1.5 acetyl chloride, 0.5 percent H_2S in mother liquor (1) no agitation (2) slow agitation (3) fast agitation
Chloracetic Acid, Mono (Tech. Grade)	—	86	30	S	E	—	—	process is to dissolve 945 grams/liter solid MCA in water. Solution agitated with air. Alloy C = 0.2 mpy
Chloracetic Acid, Mono (Tech. Grade)	100	60-70	16-21	G	E	—	—	Alloy C = nil mpy
Chloralphenoxy-Acetic Acid, 2-4 Di	—	250	121	—	E	—	—	production of this acid from monochlorobenzene, dichlorophenol, monochloracetic acid, NaOH and H_2SO_4.
Chlorethylene, Tri	100	to B.P.	to B.P.	E	—	—	—	vapor and liquid — sometimes steam and ammonia present
Chloric Acid	3	75	24	U	E	—	—	4 percent H_2SO_4, 3 percent H_2O_2 carotting solution. Alloy C = 0.1 mpy. 47-day test.
Chlorinated Water	100 100	75 190	24 88	— —	E S	— —	— —	saturated
Chlorine	97	50-180	10-82	—	E	—	—	plus 3 percent inert gas (CO_2 H_2, etc.) water saturated. Alloy C = 0.07 mpy (50 deg. F), 0.9 mpy (180 deg. F)

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Chlorine	—	0	-18	—	E	—	E	duration of test — 139 days, dry chlorine gas
Chlorine	—	Ambient	Ambient	—	G	—	—	chlorine "sniff" scrubber, 400 hrs.
Chlorine	—	68	20	—	E	—	—	plus HCl and organic acid
Chlorine	—	76-86	24-30	B*	S*	—	B*	feed Cl_2 to dichloropropene at 5 psig, 672 hrs. *vapor phase in liquid, Alloy B = 30 mpy, Alloy C-276 = 13 mpy, Type 316 Stainless Steel = 32 mpy
Chlorine	—	77-90	25-32	—	E	—	E	dry chlorine gas
Chlorine	—	86	30	G	G	—	—	chlorination system in alkylbenzene unit samples in chloronator circulating loop, 3936 hrs.
Chlorine	—	120-135	49-57	—	E	—	—	above sodium cell in fumes containing sodium oxychloride, sodium chloride, sodium oxide smoke and moist air. Alloy C = 0.1 mpy, 0.001 in max. pitting
Chlorine	—	140	60	—	E	—	—	w/entrained 89.1% sulfuric acid and organic impurities
Chlorine	—	302	150	—	E	—	—	1000 ppm Cl_2 in vapor phase during dechlorination. Alloy C = 0.3 mpy. 1776-hr. test
Chlorine (Wet)	100	75	24	—	G	—	—	
Chlorine (Wet)	—	60-200	16-93	—	G	—	—	
Chlorine (Wet)	—	86	30	—	E	—	—	Alloy C = 1.1 mpy, 67.8 hr. test
Chlorine (Wet)	—	104	40	—	G	—	—	with some sea-water spray
Chlorine (Wet)	—	122	50	—	E	—	—	plus hydrochloric and hydrochlorous acid, chlorination of polyethylene, 72 hrs.
Chlorine (Wet)	—	170	77	—	E	—	—	organic solids, condensed water, slight attack under spacer. Duration of test — 67 days
Chlorine (Wet)	—	185	85	—	S	—	—	in vapor space of sulfur separator. Plus H_2O, S, and organic thio and chloride
Chlorine (Wet)	—	190	88	—	G	—	—	Alloy C = 4.5 mpy, 72 hrs.
Chlorine (Wet)	—	190	88	—	G	—	—	condensed water and organic solids, duration of test — 203 days, perforated
Chlorine (Wet)	—	190	88	—	U	—	—	duration of test — 28 days, perforated, salt brine spray
Chlorine (Wet)	—	190	88	—	G	—	—	duration of test — 74 days, severe pitting, salt brine spray
Chlorine (Wet)	—	190	88	—	G	—	—	duration of test — 18 days, moderate attack under spacer
Chlorine (Wet)	—	190	88	—	G	—	—	duration of test — 202 days, perforated
Chlorine (Wet)	—	190	88	—	S	—	—	condensed water and organic solids/spacer, duration of test — 18 days, moderate attack under spacer
Chlorine (Wet)	—	205	96	—	U	—	—	duration of test — 40 days, moderate pitting, salt brine spray
Chlorine (Wet)	—	205	96	—	B	—	—	duration of test — 203 days, salt brine spray
Chlorine (Wet)	—	225	107	—	E	—	—	in steam, HCl_2 cell liquor, tetrachloroethane bleach
Chlorine Saturated River Water	—	200	93	—	G	—	—	in vertical section overflow pipe. Alloy C = 2 mpy
Chlorine Saturated Water	—	205	96	—	E	—	—	
Chlorine Dioxide	0.01	50	10	—	E	—	—	residual amounts in bleached pulp. pH = 8-9. Alloy C = 0.1 mpy
Chlorine Dioxide	5	210	99	—	S	—	—	in steam
Chlorine Dioxide	8-10*	150	66	—	B	—	—	condensed chlorine dioxide solution, flow rate of 250 c.f.m., 350-hr. test *by volume.
Chlorine Dioxide	15	110	43	—	E	—	—	$HOCl$, Cl_2 and water
Chlorine Dioxide	—	35-40	2-4	—	G	—	—	in water saturated with ClO_2 (7 grams/liter). Alloy C = 3.7 mpy
Chlorine Dioxide	—	36	2	—	S	—	—	4-5 g/l, pH 2-3.5, 351-hr. test
Chlorine Dioxide	—	38	3	—	E	—	—	at top of absorber. Alloy C = 0.1 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Chlorine Dioxide	—	50	10	—	E	—	—	0-1.5 grams/liter ClO_2 plus trace SO_2, 0-9 grams/liter $NaClO_3$, 18-38 percent H_2SO_4 in spent liquor tank. Alloy C = 0.5 mpy
Chlorine Dioxide	—	135	57	—	S	—	—	78 percent H_2SO_4, 32 percent sodium chlorate and methanol aeration, flow rate of 60 g.p.m., 351-hr. test.
Chlorine Dioxide	—	150-170	60-77	—	E	—	—	ClO_2 water and gas, plus 0.2 grams/liter HCl in water, pH = 3.5. Alloy C = 0.1 mpy
Chlorine Dioxide	—	155	68	—	E	—	—	spent gas in vent line of bleach tower, 338-hr. test
Chlorine Dioxide	—	155	68	—	S	—	—	plus 45 percent H_2SO_4, 0.020 grams/liter sodium chlorate in pulp bleaching.
Chlorine Dioxide	—	155	68	—	E	—	—	pH = 6.5 spool exposed in headbox in No. 6 pulp washer. Kraft pulp stock plus residual ClO_2
Chlorine Dioxide	—	175-185	79-85	—	E	—	—	at top of bleach retention tower. Alloy C = 0.7 mpy
Chlorine (Mixtures)	—	59-86	15-30	—	E	—	U	cyanogen chloride, chlorine, water (all gas)
Chlorine (Mixtures)	—	68-85	20-29	—	E	—	B	cyanogen chloride (CNCl), chlorine, water vapor (about 1000 ppm)
Chlorine (Mixtures)	—	169-212	76-100	—	E	—	E	cyanogen chloride (CNCl) chlorine, carbon tetrachloride, water (trace)
Chlorine w/Nitrogen	—	180-205	82-96	E	E	—	—	
Chlorine Oxides	38	120	49	—	E	—	G	sodium chlorate 1.55%, sulfur dioxide 8% in air, sodium chloride 0.3%, extensive aeration
Chlorine Oxides	—	40	4	—	G	—	E	chlorine dioxide solution in water, part of time sulfur dioxide 6% in air, moderate aeration
Chlorinated Hydrocarbons, Amines, Ammonium Chloride	—	100-250	38-121	G	G	—	U	production of NIAX catalyst A-99. React chlorex with methylamine to make ammonium chloride then react w/diethanolamine; 275 hrs.
Chloroacrylic Acid	—	131	55	U	G	—	—	HCl, CuCl, $CuCl_2$, NaCl, production of defoliant; 204 hrs.
Chloroacrylic Acid	—	140	60	G	E	—	—	HCl, CuCl, CIS-3 Chloroacrylic acid extraction concentrated solution after stripping (tails) was used, 48 hrs. lab test
Chlorobenzene	60	40-100	4-38	E	E	E	E	40% chloral, pH 2.0, 96 days
Chlorobenzene	60	40-100	4-38	—	E	—	E	chloral 40% (trichloro acetaldehyde), water not over 0.5%, hydrogen chloride trace. (pH of water extract 2.0)
Chlorobenzene	—	250	121	—	E	—	—	commerical trichlorobenzene vapor, ammonia and chlorides, extensive aeration
Chlorobenzene, Mono	—	77-338	25-170	S	E	—	—	1114-lb. 3-chlorodiphenylamine, 311-lb. sulfur, 11-lb. iodine, 475-gal. monochlorobenzene. Alloy C = 1.5 mpy
Chloro Ethyl Ether, Ethylene Chlorohydrin	—	302	150	E	E	—	G	still system for cracking DI (2-chloroethyl) acetal to vinyl 2-chloroethyl ethers and ethylene chlorohydrin. Samples in kettle liquid, 300 hrs.
Chlorofluoromethanes	64	100-180	38-82	—	E	—	E	trichloromonofluoromethane and dichlorodifluoromethane, hydrogen chloride 20%; hydrogen fluoride 10%; carbon tetrachloride 1%; antimony pentachloride, oxygen, nitrogen, total 5% (all approx.) water not over 200 ppm.
Chlorofluoromethanes	60	100-180	38-82	—	E	—	E	dichloromonofluoromethane and monochlorodifluoromethane, hydrogen chloride 20%; hydrogen fluoride 10%; chloroform 5%, antimony pentachloride, oxygen, nitrogen, total 5% (approx.) water not over 200 ppm.
Chloroform	100	to B.P.	to B.P.	S	S	—	—	
Chloromethylphenoxyacetic Acid	99	300	149	—	E	—	—	4-chloromethylphenoxyacetic acid, small amts. hydrogen chloride, sodium chloride, water.
Chloromethylphenoxyacetic Acid	99	315	157	G	E	G	B	4-chloromethylphenoxyacetic acid, small amts. hydrogen chloride, sodium chloride, water.
Chloronaphthalenes	100 100	300-360 300	149-182 149	E* —	— E**	— —	— —	*vapor and liquid in neutralization of free HCl with lime **vapor and liquid phases
Chlorophenol	—	122-140	50-60	S	E	—	—	in liquid and vapor phase during chlorination of phenol. Contamination from HCl. H_2S, $FeCl_3$
Chlorophenol, Dichlorophenol	—	250	121	—	E	—	—	hydrogen chloride trace, water vapor trace, moderate aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Chloropicrin	—	203	95	—	E	—	—	plus water, calcium hypochlorite, lime, 8 percent calcium chloride and calcium carbonate, pH = 10-11
Chlorosulfonic Acid	10 45	75 75	24 24	— E*	S —	— —	— —	in smoke screen manufacturing. *plus 50 percent SO_3
Chlorosulfonic Acid	45	49-84	9-29	E	—	—	—	plus 50 percent SO_3. Alloy B = 0.02 mpy in liquid and vapor
Chlorosulfonic Acid	80	68-113	20-45	E	—	—	—	plus 20 percent oleic acid. 0.1 mpy in vapor, 0.3 in liquid
Chlorosulfonic Acid	100	185	85	G	E	—	G	163 hrs. lab test
Chlorosulfonic Acid	—	to B.P.	to B.P.	E	—	—	—	alkyl-aryl organics, HCl, and SO_2 in sulfonation vessel
Chlorosulfonic Acid — Ethyl Ether System	—	32	0	—	E	—	S	sulfonation reactor, 20 hrs.
Chloro-Trifluoro Ethylene	—	70-120	21-49	E	E	—	—	partially liquefied plus 1 percent or less HCl and water in trace amounts.
Chromic Acid	2	Boiling	Boiling	—	G	—	—	120 hr. lab test
Chromic Acid	10	Boiling	Boiling	—	U	U	—	120 hr. lab test
Chromic Sulfate (Basic)	to 30 50	to B.P. 125	to B.P. 52	S S	— —	— —	— —	
Chromium Sulfate (Basic)	50	130	54	G	E	—	—	Alloy C = 0.07 mpy, mild agitation
Chromium Sulfate (Basic)	55	150-250	66-121	—	B	—	—	480-hr. test
Chromium Potassium Sulfate	10	to B.P.	to B.P.	S	—	—	—	
Citric Acid	10	60-180	16-82	S	E	—	—	manufacture by aerobic fermentation — air sparging. Alloy C = 0.1 mpy
Citric Acid	10	80-170	27-77	B	G	—	—	manufacture by acid by fermentation with sucrose, made acid with HCl. Alloy C = 4 mpy
Citric Acid	10	Boiling	Boiling	—	E	—	—	
Citric Acid	to 58	130	54	U	G	—	—	concentration by boiling solution from 15° to 30° Bé. 120-hr. test, Alloy C = 4.5 mpy
Citric Acid	All	to B.P.	to B.P.	E	E	—	—	
Citric Acid	—	105	41	—	E	E	E	mixed fermentation tank effluent, some citric acid salt, 5 to 65% solids, 0.08 to 1.2% chloride, pH 5
Clarifier Liquid	—	180	82	—	E	E	E	clarifier liquid in municipal refuse incinerator. Water treated with calverts coagulant II and ammonia to nominal pH of 6, moderate aeration
Coagulation Solution, Synthetic Rubber	—	90	32	B	—	—	—	plus 0.01 percent H_2SO_4, 3.3 percent NaCl, pH = 3.3, in discharge weir of dewatering skimmer
Cooking Liquor	13.2	115	46	—	U	S	U	aeration
Cooking Liquor	13.2	115	46	U*	U*	—	G	aeration, *specimen corroded away or was lost
Cooking Liquor	13.2	300	149	B	B	—	B	aeration
Cooking Liquor	13.2	300	149	—	U*	G	G	aeration, *specimen corroded away or was lost
Copper Chlorides	—	455	234	—	E	—	U	cuprous chloride, cuprous cyanide, p-chloro phenol N methyl pyrrolidone, p-cyanophenol
Copper Cyanide	—	170	77	S	E	—	—	copper plating solution copper cyanide = 10 oz./gal. caustic soda = 4 oz./gal. sodium cyanide = 2 oz./gal.
Copper Smelting Gas	—	105	41	—	E	E	E	copper smelting gas containing 0.75-1% SO_2 and some sulfuric acid mist (25-100 ppm), extensive aeration
Copper Smelter Gas	—	135	57	—	E	E	E	copper smelter gas after cooling in a H_2O spray tower. Gas contains H_2O at 2.5 pH plus sulfuric acid mist (25-100 ppm), extensive aeration
Copper Smelter Gas	—	100	38	—	E	E	S	copper smelter gas and recycled cooling spray water (pH as low as 1.7 avg. 2.5) 1-1.5% SO_2 in gas plus particulate and SO_3, extensive aeration
Copper Sulfate	45	190	88	U	E	E	E	12% Cu avg., 0.5% H_2SO_4, 90 days, copper refining, moderate aeration
Copper Sulfate	88	160	71	U	E	—	E	12% sulfuric acid, air free, copper refining, 113 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Copper Sulfate	All	to B.P.	to B.P.	—	E	—	—	
Copper Sulfate	—	150	66	—	E	—	E	electrolyte, 194 g/l H_2SO_4, 49 g/l $CuSO_4$, 1 g/l CaO
Copper Sulfate	—	160	71	—	U	—	—	40-70 grams/liter $CuSo_4$, 3-6 grams/liter Ag_2SO_4
Corn Starch	1.5-1.7	300	149	—	E	—	E	corn starch acidified with HCl to pH of 1.5-1.7, steam injection at 150 psi
Creosote Oil	—	329	165	S	E	—	—	plus 7 percent acetic acid, 2-3 percent propionic acid and higher acids.
Cresylic Acid	All	to B.P.	to B.P.	S	S	—	—	
Cresylic Acid	—	86-356	30-180	—	S	—	U	cresylic acid, phosphorous oxychloride, tricresyl phosphates, hydrogen chloride, aluminum chloride 1%, pyridines less than 0.1%. Anhydrous.
Cresylic Acid	—	100	38	—	E	—	—	plus NaOH and water. Alloy C = 0.5 mpy
Cresylic Acid	—	113-266	45-130	—	E	—	E	cresylic acid, phenol, formaldehyde, sulfuric acid, ethylenediamine, phosphoric acid, sodium hydroxide, carbon dioxide, ammonia, barium hydroxide. Corrosive media varied from mixed phenol and sulfuric acid at 266°F to 20% sodium hydroxide at 212°F. (Batch-basis manufacture of phenolic resins and varnishes), moderate aeration
Cresylic Acid	—	266	130	—	E	—	E	cresylic acid, phenol, formaldehyde, sulfuric acid, ethylenedlamine, phosphoric acid, sodium hydroxide, barium hydroxide, carbon dioxide, ammonia, aeration
Cresylic Acid	—	284	140	E	E	—	U	phenol, phosphorus oxychloride, tricresyl phosphate, hydrogen chloride, aluminum chloride 0.5-1%, pyridines <1%. Anhydrous
Cresylic Acid	—	350	177	—	E	—	—	plus H_2S, H_2O and some organics in boiling solution. Alloy C <0.1 mpy
Cresylic Acid (Crude)	—	350	177	—	E	—	—	Alloy C = 0.04 mpy, some H_2S
Crude Oil	—	145	63	—	E	—	E	with oil field brine containing 15 ppm S
Crude Oil	—	750-780	399-416	E	—	—	—	mixed Louisiana crude; sulfur = 0.26 percent, salt content = 3-5 lb./1000 lb.
Crude Toluene	—	339	171	G	E	—	S	dimethylaniline hydrochloride refining crude toluene; 235 hrs.
Cumeme	—	140-160	60-71	U	—	—	—	plus phenol, acetone
Cumeme	75	207-221	97-105	E	—	—	—	plus 25 percent cumene hydroperoxide. In liquid phase. Manufacture of phenol from cumene.
Cumeme Hyperoxide	75	176-221	80-105	E	—	—	—	plus 25 percent cumene
Cupric Chloride	5	104	40	—	E	—	—	max. pitting = 0.001 in.
Cupric Chloride	to 50	to 75	to 24	—	S	—	—	
Cupric Chloride	—	60-80	16-27	—	E	—	—	plus $CuSO_4$ and NaCl in gasoline sweetening
Cupric Cyanide	10	to B.P.	to B.P.	—	S	—	—	
Cupric Nitrate	5 10 50 75 100	75 75 75 75 75	24 24 24 24 24	— — — — —	S S S S S	— — — — —	— — — — —	
Cuprous Chloride	—	455	235	U	E	—	U	cuprous cyanide, 48 hrs., agitaion — boiling action only
Cyanuric Chloride	5-20	115	46	E	E	—	G	in carbon tetrachloride or toluene, chlorine 0.5%, cyanogen chloride (CNCL) 0.3%, hydrogen chloride and phosgene (carbonyl chloride, $COCl_2$) traces, moderate aeration
Cyanuric Chloride	5-20	60-160	16-71	—	E	—	G	in carbon tetrachlorine or toluene, chlorine 0.5%, cyanogen chloride (CNCl) 0.3%, hydrogen chloride and phosgene (carbonyl chloride, $COCl_2$) traces, moderate aeration
Cyanuric Chloride	—	50	10	G	E	—	E	toluene, dichlorocyanuroisopropamide ($C_3N_3Cl_2NHCH(CH_3)_2$), sodium hydroxide, sodium chloride 10%; pH 11-13, moderate aeration
Cyanogen Chloride	—	77	25	—	E	—	B	chlorine water vapor (about 1000 ppm)
Cyanogen Chloride	—	176	80	E	E	—	E	chlorine, carbon tetrachloride, water (trace).
Cyanuric Chloride	—	221	105	E	E	—	E	toluene, carbon tetrachloride, traces of chlorine, cyanogen chloride, water
Cyanogan Chloride (Gas)	—	59-86	15-30	G	E	—	U	chlorine, water

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Detrose (Greens) Liquor	—	315-325	158-163	—	G	—	—	0.04 N HCl. Alloy C = 4.35 mpy
Di-basic Organic Acid and Thiourea	—	158	70	E	E	—	E	
Di-basic Organic Acid and Thiourea	—	158	70	E	E	—	E	aeration, H_2S in vapor phase
Dichlorethane	100	to 125	to 52	S	S	—	—	
Dichlorobenzene	—	355	180	E	E*	—	—	4-5% hydrogen chloride, duration of test — 53 days, *slight attack under spacer
Dichloromonofluoro-methane and monochloro-difluoro-methane	60	165	74	G	E	—	E	hydrogen chloride 20%; hydrogen fluoride 10%; chloroform 5%; antimony pentachloride, oxygen, nitrogen, total 5% (all approx.); water not over 200 ppm
Dichlorophenol	100	250	121	E	E	E	E	trace of hydrogen chloride and water vapor Duration of test — 36 days Aeration — moderate Agitation — none Process involved — dichlorophenol
Diethyl Malonate	—	77-212	25-100	G	E	—	—	2 cycles, liquid 72 hrs., vapor 130 hrs., malononitrile process (pilot plant test)
Diethyl Sulfate	—	180-194	82-90	G	E	—	U	Alloy B pitted in liquid. H_2SO_4 (small amt. probably). 153 hrs.
Dimethylaniline Hydrochloride	26	212	100	E	G	—	U	117 hrs. field test, aqueous DMA-HCl
Unsymetrical Dimethylhydrazine	—	86	30	E	E	—	E	testing rocket fuels, 28 days
Unsymetrical Dimethylhydrazine	—	146	63	E	E	—	—	testing rocket fuels, 7 days
Diphenylamine	—	212	100	E	E	—	E	hot wash liquid, reaction product of diphenylamine and acetone in HBr catalyst after addition of 50% NaOH to yield pH of 12-14, moderate aeration
Dodecylbenzene Sulfonic Acid	—	145-165	63-74	B	—	—	—	plus SO_2, SO_3, spent H_2SO_4 at bottom of sulfonator. Alloy B = 27 mpy (liquid), 32 mpy (vapor)
Duke's Mixtures	—	70	21	—	E	—	S	industrial waste: water, low but widely varying concentrations of hydrochloric, hydrobromic, sulfuric, sulfurous acids, alcohols, chlorinated organic solvents. pH about 1, moderate aeration
Electrolyte	—	150	66	S*	E	E	E	194 g/l H_2SO_4, 49 g/l $CuSO_4$, 1 g/l CaO. *specimen corroded away or was lost, air free
Epichlorhydrin	—	176-212	80-100	—	E	—	—	plus caustic soda, bisphenol, trichloroethylene, and sodium chloride brine. pH = 10-12 in resin manufacture. Alloy C <0.1 mpy
Esterification	—	—	—	—	E	—	E	
Ethanol	50-75	176	80	—	—	E	E	2-5% Diethyl Ether, .05-0.2% H_2SO_4, Balance primarily water. Phthalate ester manufacturing. Agitation. by 1100 lb./hr. flow, total days 146.
Ethanol	75	—	—	—	—	E	E	containing 0.81% ethyl acid pthalate and 0.405% sulfuric acid under reflux. Pthalate ester mfg.; total days 45.7
Ethanol	—	176-212	80-100	—	G	—	—	plus ethyl acetate, calcium acetate, H_2SO_4 in distillation of ethyl acetate. Alloy C = 7 mpy
Ethanol	—	258	125	U	E	—	—	ethanol acid system, 240 hrs.
Ether	100	75	24	—	E	—	—	
2-Ethoxyethyl Acetate	98	334	168	E	E	—	E	water 1%, acetic anhydride 0.2%, acetic acid 0.1%, non-volatile, 0.2%, moderate aeration
Ethyl Acetate	35	250	121	—	E	—	—	plus 32 percent benzene, 2 percent formic acid, 15 percent acetic acid, 9.5 low boilers. Alloy C = 0.78 mpy
Ethyl Acetate	100	75 to B.P.	24 to B.P.	—	S	—	—	
Ethyl Alcohol	56	122-171	50-77	G	E	—	—	plus 1-11 percent butyraldehyde, 5 percent ethyl acetate, 0.4 percent H_2SO_4. Alloy C = 0.8 mpy
Ethyl Benzene	—	240	116	—	E	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Ethyl Chloride	25 50 70 100	75 75 75 75	24 24 24 24	S S S S	S S S S	— — — —	— — — —	
Ethyl Cyanoacetate	—	77-212	25-100	G	E	—	—	lab test, agitation
Ethylene, Cracked Gases	—	160-170	71-77	E	E	—	—	contains some organic acids, CO_2, HCl, H_2O. pH = 5.0 approx., Alloy C = 0.127 mpy
Ethylene Diamine Hydrochloride	100	to B.P.	to B.P.	—	B	—	—	
Ethylene Diamine Hydrochloride	8-8.5	250-365	121-185	S	G	—	—	in 50 percent ammonia solution. Alloy C = 5.7 mpy
Ethylene Diamine Tetra-acetic Acid	50-60	183	84	—	E	—	—	plus 30-40 percent anhydride 0-20 percent solids. Alloy C = nil mpy, 16,800-hr. test.
Ethylene Dichloride	—	100-220	38-104	E	U	—	—	plus water, pella oil, and occasional traces of HCl. Alloy C = 72 mpy
Ethylene Glycols	20	Ambient to 320	Ambient to 160	—	E	—	—	sodium hydroxide diethylene glycol 80% forming sodium diethylene glycolate. Addition of dimethylamine, organic chloride, forming amide: strongly alkaline
Ethylene, Trichlor Crude	—	156	69	E	E	—	—	plus gaseous ammonia in distillation process. Alloy C = 0.03 mpy
Exhaust Air	—	170	77	—	E	—	E	saturated with water vapor containing chlorine (low concentration and in suspended droplets), sodium hydroxide, chromate and chromic wastes (low concentration) and chloride, extensive aeration
Exhaust Gases from evaporator	—	50-355	10-180	—	G	—	—	entrained phosphoric acid, sulfuric acid vapor, sulfur trioxide, nitrous acid, silicon tetrafluoride, water vapor; sprayed with water containing phosphoric acid 0.1%, sulfuric acid 0.06%, combined fluoride 0.1%, extensive aeration
Exhoxylates	—	94	35	G	E	—	B	36 hrs., samples in circulator line. Sulfonation of ethoxylates with chlorosulfonic acid. HCl evolved.
Fabric Softeners & Manufacture	80-85	160	71	—	E	—	—	secondary amines of tallow dissolved in isopropyl alcohol, methyl chloride added to MNTN press and 73% NaOH to keep neutral
Fabric Softener Rx Effluent	—	130	54	—	E	E	E	quaternary salt of tallow in isopropyl alcohol with 1-2% HCl to make slightly acid, 1% H_2O and Cl. Manufacture of fabric softener, agitation — lightening mixer, total days 235.0
Fatty Acids	90	220-240	104-116	—	E	—	—	plus 5 percent H_2SO_4, 3 percent sebacic acid, small amounts of Na_2SO_4, K_2SO_4 and H_2O
Fatty Acids	100 100	to 275 to 600	to 135 to 316	E E	E* E*	— —	— —	*liquid and vapor phases
Fatty Acids	—	210	99	—	E	—	—	in distillation from tall oil
Fatty Acids	—	455-473	235-245	—	E	—	—	during fractionation. Alloy C = 0.5 mpy
Fatty Acids	—	Room to 220	Room to 104	—	E	—	E	vapor over fatty acid (sebacic), sulfuric acid, pH 2-6, extensive aeration
Fatty Acids	—	250-450	121-232	G	E	—	—	plus iodine and rosin vapors. Alloy C = 0.5 mpy
Fatty Acids, Tall Oil	—	560-590	293-310	—	E	—	—	in Kraft pulp manufacture. Alloy C = 1.0 mpy in vapor phase, 0.1 mpy in liquid
Ferric Chloride	—	200	93	—	U	—	—	plating solution, 450 grams/liter $FeCl_3$, enough HCl to keep pH = 0.4
Ferric Chloride	—	216	102	—	E	—	—	plus ammonia and fatty acids. Alloy C <0.1 mpy
Ferric Chloride	5 10 15 45 50	75 150 75 75 to B.P.	24 66 24 24 to B.P.	U U U U U	E B E S —	— — — — —	— — — — —	
Ferric Nitrate	10	75	24	—	E	—	—	
Ferric Sulfate	2-4	160	71	B	E	—	E	ferrous sulfate 0-2%, sulfuric acid 0.5%, pH 1.2, hydrogen peroxide trace, aeration
Ferric Sulfate	—	235	113	—	—	E	E	slurry reaction mixture, lab test 68.7 days, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Ferric Sulfate	4	160-163	71-73	—	E	—	—	plus $Fe_2(SO_4)_3$, H_2SO_4 to pH = 2.5. Alloy C = 0.3 mpy
Ferric Sulfate	to 30	to 150	to 66	—	E	—	—	
Ferrous Ammonium Sulfate	—	212	100	—	—	E	—	1390 g/l
Ferrous Ammonium Sulfate	—	212	100	—	—	E	—	695 g/l
Ferrous Chloride	10	86	30	U	E	—	—	aeration, saturated.
Ferrous Chloride	Satr. Soln.	275	135	G	G	—	—	in evaporator with 0.09 percent HCl. Alloy C = 2.5 mpy
Ferrous Sulfate	Weak	450	232	U	B	—	—	plus traces of ferric sulfate and sulfuric acid. pH = 2.5-4.0 in crystallization process. Alloy C = 22 mpy
Ferrous Sulfate	5	65	18	U	E	—	—	Fe_2O_3 slurry. Alloy C = 0.03 mpy
Ferrous Sulfate	All	to B.P.	to B.P.	S	S	—	—	
Ferrous Titanite	55 55	to B.P. 375	to B.P. 191	— —	E E	— —	— —	during digestion and evaporation — 45 percent ammonium fluoride
Fertilizer, "Slurry mix"	6-12-18	30	-1	—	E	—	E	calcium acid phosphates, mono- and di-, approx. 21%, potassium chloride 19%, ammonium nitrate 17%, water 30%, inert materials approx. 12%, largely insoluble. pH 6.5 to 7.5, moderate aeration
Fertilizer, "Slurry mix"	6-12-18	40	4	B	E	—	E	calcium acid phosphates, mono- and di-, approx. 21%, potassium chloride 19%, ammonium nitrate 17%, water 30%, inert materials approx. 12%, largely insoluble. pH 6.5 to 7.5, extensive aeration
Fertilizer, "Slurry mix"	14-7-7	25	-4	E	E	—	E	ammonium nitrate, 40%, calcium acid phosphate, mono- and di- approx. 12%, potassium chloride 11%, water 30%, inert materials approx. 12%, largely insoluble. pH 3.5 to 4.5
Fertilizer, "Slurry mix"	—	200	93	—	G	—	B	nitric acid, phosphoric acid, sulfuric acid, phosphate rock reactants. Product: potassium chloride 9 to 18%; calcium acid phosphates, mono- and di- 6 to 14%; ammonium nitrate 6% to 14%. Water approx. 30%. Inerts approx. 12%, mostly solubles, moderate aeration
Fibers (Hardwood or Pine)	1	83	28	—	E	E	E	pH 5-6. Low concentrations of chlorides and sodium, trace chlorine dioxide. Kraft pulp bleaching; agitation 2 FPS; moderate aeration, total days — 379
Flue Gas	—	100	38	—	E	—	E	recirculating refuse incinerator scrubber water pH 6.1 ave., 1.8 min., 11.2 max. inhibited with 121 ppm LN 120 and pH adjustment with NaOH, moderate aeration
Flue Gas	—	120	49	—	E	—	E	containing sulfur dioxide, 100-500 ppm, saturated, 62.5 days
Flue Gas	—	130	54	—	E	—	E	containing sulfur dioxide, 100-500 ppm, 62.5 days
Flue Gas	—	140	60	G	S	—	S	particulates and gaseous emission from a glass frit smelter. Gases contain nitrogen oxide, fluorides, moderate aeration
Flue Gas	—	150	66	—	B	B	U	wet flue gas (spool 5950) after H_2O spray, scrubber slurry ($CaSO_3$) mainly, also $Ca(OH)_2$ or $CaCO_3$ plus $CaSO_4$ pH 3-12 during upsets
Flue Gas	—	150	66	B	E	E	S	incinerator scrubber, municipal wastes, excess air added during incineration, 85 days
Flue Gas	—	150	66	U	E	E	E	incinerator scrubber, municipal solid waste, excess oxygen added during incineration, 85 days
Flue Gas	—	150	66	B	E	—	E	
Flue Gas	—	160	71	G	E	—	S	scrubbed fumes from garbage incineration. Hot flue gas and suspended solids directly from furnace during bypass operation, extensive aeration
Flue Gas	—	160	71	E	—	E	E	neutralized mixed effluent from quench chamber and scrubber — neutralized with NaOH. pH about 6.0, 105 days, moderate aeration
Flue Gas	—	160	71	U	E	E	E	mixed effluent from quench chamber and scrubber — unneutralized pH 3-5, excess air added during incineration, 85 days, moderate agitation
Flue Gas	—	164	73	—	E	E	E	aeration
Flue Gas	—	169	76	—	E	E	E	aeration present from higher excess air
Flue Gas	—	170	77	—	E	E	E	from incineration of medicinal solid wastes and waste pathological animal remains. pH partially controlled near 7 but ranges to 1 or 2, 74 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Flue Gas	—	170	77	S	E	E	E	incinerator scrubber, municipal solid waste, excess air added during incineration, 85 days
Flue Gas	—	180	82	B	E	E	E	incinerator scrubber, municipal solid waste, excess air added during incineration, 85 days
Flue Gas	—	175-195	79-91	U	G	G	B	aeration: ~ 15% O_2
Flue Gas	—	200	93	—	E	—	E	water-scrubbed from combustion of municipal refuse; nearly saturated with water vapor, considerable aeration
Flue Gas	—	200-220	93-104	U	E	E	E	aeration: ~ 15% O_2
Flue Gas	—	200-250	93-121	—	E	E	E	aeration
Flue Gas	—	212	100	B	E	E	E	effluent from quench chamber incineration of garbage, excess in air added during incineration, 85 days
Flue Gas	—	300	149	B	E	E	S	incinerator scrubber, municipal solid waste, excess air added during incineration, 85 days
Flue Gas	—	305	152	B	E	—	S	water and water vapor, pH 2.0 to 4.0, aeration
Flue Gas	—	350	177	—	E	—	E	containing sulfur oxides, nitrogen oxides, CO, CO_2, HCl, O_2, N_2 and fly ash, pH 4.5, excess air to support
Flue Gas	—	370	188	—	E	E	E	750 ppm, CO_2 0.7%, H_2O 1-3%, bal. air
Flue Gas	—	400	204	—	G	—	S	carbon dioxide 15%, oxygen 4.7%, nitrogen 80.4%, (all dry basis) water vapor about 25%, suspended solids.
Flue Gas	—	100-800	38-427	E	—	—	—	plus 1-5 percent HCl by volume and CO_2
Flue Gas	—	1100	593	—	E	—	E	hot exhaust gases and steam from water sprays off refuse incinerator, extensive aeration
Flue Gas	—	—	—	—	E	—	E	stack gas from firetube boiler burning #4D oil (4% sulfur content) in cyclic operation
Flue Gas	—	—	—	—	E	G	S	from municipal refuse, aeration
Flue Gas	—	—	—	—	E	—	E	from municipal refuse incinerator
Flue Gas	—	—	—	—	E	E	E	with entrained H_2O and slurry (calcium sulfate, calcium sulfite), aeration
Fluegas, Power Plant	—	130-135	54-57	—	—	E	E	aeration
Fluegas, Power Plant	—	140	60	—	E	G	B	with entrained scrubbing liquor, aeration
Fluoboric Acid	32	149-176	65-80	E	—	—	—	plus 1.5 percent boric acid
Fluoboric Acid	—	90-100	32-38	—	E	—	—	40 grams/liter H_3BF_4 at pH 1.7 to 1.9 in gas washer. Possible traces of HF. Alloy C = 0.2 mpy
Fluoboric Acid	—	100-180	38-82	—	E	—	—	10 grams/liter H_3BF_4 at pH 3.2-3.4 in spent liquor tank. Alloy C <0.1 mpy
Fluoboric Acid	—	160-209	71-98	—	E	—	—	plus aluminum trihydrate slurry at pH 1.9 to 2.1. Alloy C = 0.4 mpy
Fluorine	100 100 100	75 150 950	24 66 510	G — —	— E E*	— — —	— — —	*furnace gas after lime water spray. Penetration rate varied from 0.7 to 2.6 mpy at lower temperatures. Alloy C gained weight slightly
Fluorides, Fused	—	1112	600	E	—	—	—	NaF-ZrF_4, fluorine purge 63 hrs., helium purge 153 hrs., fluorine flow rate 10 gal./hr.
Fluosilicic Acid	11-13	140-165	60-74	B	G	E	B	wet process H_3PO_4, liquid phase, 49 days, extensive aeration
Fluosilicic Acid	16	80-140	27-60	S	G	—	—	plus 0.3 percent H_2PO_4, 0.5 percent SiO_2, 83 percent water. Alloy C = 2 mpy
Fluosilicic Acid	20	130-140	54-60	—	G	—	—	in fume scrubber. Alloy C = 5 mpy
Fluosilicic Acid	25 50 70 100	75 75 75 75	24 24 24 24	S S S S	S S S S	— — — —	— — — —	
Formaldehyde	2	245	119	—	G	—	—	plus 0.2 percent formic acid, methanol, ketones and other aldehydes, 138-day test with agitation and no aeration.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Formaldehyde	10 10	220 243	104 117	— —	E E	— —	— —	plus traces of formic acid, calcium formate, and glycols, 87-day test in bottom of fractionating tower. 87-day test at center of tower.
Formaldehyde	12-15	275	135	—	G	—	—	plus 2 percent formic acid, 2 percent various alcohols, aldehydes and resins. Alloy C = 7 mpy
Formaldehyde	20 50 70 100	to B.P. to B.P. to B.P. to B.P.	to B.P. to B.P. to B.P. to B.P.	S S S S	S S S S	— — — —	— — — —	
Formaldehyde	20	275	135	—	E	—	—	plus 10-15 percent volatiles (ethanol, acrolein, acetone) and 0.1 percent formic acid, 71-day test with agitation and no aeration.
Formaldehyde	40	122	50	—	E	—	—	plus 10 percent methanol and 0.01 percent formic acid, 28-day test with moderate agitation and aeration. Alloy C = 0.04 mpy
Formic Acid	2	300	149	—	E	—	—	plus 0.5-1.5 percent formaldehyde, resins, higher glycols. Alloy C = 0.4 mpy
Formic Acid	10	214	101	G	—	—	G	immersed, 96 hrs.
Formic Acid	10	—	—	—	G	—	—	
Formic Acid	10 20 40 60 85	150 150 150 150 150	66 66 66 66 66	G G G G E	E E E E E	— — — — —	— — — — —	
Formic Acid	25	B.P.	B.P.	G	G	—	—	Alloy C = 8.1 mpy
Formic Acid	50	217	103	S	—	—	B	immersed, 96 hrs.
Formic Acid	84	230	110	—	E	—	—	
Formic Acid	88-90	217	103	E	—	—	S	immersed, 96 hrs.
Furfural	25 100	B.P. 75	B.P. 24	S* S	— —	— —	— —	*plus one percent acetic acid and one percent formic acid and a trace of acetaldehyde and CO_2
Furfural Residue	—	100	38	B	—	—	—	plus 40 percent H_2O, 3-4 percent H_2SO_4, traces acetic and formic acids.
Gallic Acid	10 100	B.P. B.P.	B.P. B.P.	— S	S S	— —	— —	
Gas	—	100	38	—	E	—	E	0.1 to 8.3% SO_2; 0.006% SO_3; 80% saturated, possible entrained sodium bisulfite solution; pH 4, extensive aeration
Gas, Exhaust	—	100	38	—	E	—	E	exhaust air, saturated with water and containing chlorinated solvents and other organic compounds, considerable aeration
Gas, Exhaust	—	142	62	—	E	—	E	gas up to 1.5% SO_2; 0.006% SO_3; 2 mg/5CF H_2SO_4 mist, 0 to 80% saturated; spray water -0.2 to 0.3% SO_2, 1.5 pH, extensive aeration
Gas, Exhaust	—	235	113	—	E	—	E	vapor — wet SO_2; approx. 90% H_2O; 10% SO_2 by weight; pH of condensed vapor = 1.5
Gaseous Stream	—	170-187	77-86	—	—	E	E	principally N_2, aeration, 23 ppm H_3PO_4
Gaseous Stream	—	284	140	—	—	—	S	containing 75-80% N_2, 4.5-5.0% O_2, 10-12% P_2O_5, 3-15% H_2O and a small amount of H_3PO_4 mist, extensive aeration
Gaseous Stream	—	302	150	—	—	E	E	containing 75-80% N_2, 4.5-5.0% O_2, 10-12% P_2O_5, 3-15% H_2O and a small amount of H_3PO_4 mist, aeration
Gasoline	100	325	163	E	E	—	—	straight run, crude, etc. in liquid and vapor phases. 630 A.P.I., 105 psig
Gasoline	—	140-225	60-107	E	—	—	—	low end-point containing HCl
Gasoline	—	200-375	93-191	E	—	—	—	high end-point containing HCl
Gelatin Solution	20-30	90-125	32-52	S	—	—	—	plus some NaCl, $CaSO_4$, $CaCl_2$. HCl at pH = 3.
Glutamic Acid	—	75	24	E	—	—	—	saturated, plus NaCl at a pH of 3.2
Glutamic Acid, Crude	—	75	24	—	G	—	—	some H_2O_2. Alloy C = 2.9 mpy
Glutamic Acid, Crude	—	176-194	80-90	—	E	—	—	plus H_2O_2 pH = 1.8. Alloy C = 1.3 mpy
Glutaric Acid	—	210	99	—	G	—	U*	143 hrs., lab test, production of glutaric anhydride. *5 mpy in vapor, 61 mpy in liquid

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Glycerine	100	75	24	E	E	—	—	
Glyoxal	30-35	266	130	G	G	—	S	1% formic acid; 2% glycolic acid; 3% formaldehyde; 10% ethylene glycol, 505 hrs., lab test, glyoxal stripping system
Hexamine	25-30	140	60	—	E	—	—	plus 0.5 percent methanol, 0.5 to 2.0 percent formaldehyde, 0-0.3 percent NH_3 pH = 11. Alloy C = 0.02 mpy
Hexamine	20 30 40 80	140 140 130 140	60 60 54 60	— — — —	E E E E	— — — —	— — — —	
Hexamine	80	140	60	—	E	—	—	plus 0.1 percent formaldehyde, 0.1 percent NH_3. Alloy C = 0.3 mpy
Hexane Vapor	—	257	125	—	E	—	—	low boiling vapor from tall oil plus 0.3 percent SO_2, 5 percent H_2O. Alloy C <0.1 mpy
Hexone	—	Room	Room	E	E	—	—	2 mols/liter HCNS
Hexone	—	Room	Room	S	S	—	—	with 2 mols/liter HCNS, production of HF (Zr free), 2-5 days
Hydrobromic Acid	48	B.P.	B.P.	S	—	—	—	
Hydrocarbons, Short-chain	—	90	32	E	—	—	E	ethylene methane, acetylene, ethane, propylene, propane, some butane and higher hydrocarbons; hydrogen, carbon monoxide, carbon dioxide, hydrogen sulfide; oxygen, nitrogen, water, heating oil, moderate aeration
Hydrochloric Acid	Dilute	50-90	10-32	—	E	—	—	plus ammonium sulfate in enzyme bath. Alloy C <0.1 mpy
Hydrochloric Acid	<1	70-150	21-66	G	—	—	—	plus organic acid, phosphates, sulfur compounds in pepsin extraction.
Hydrochloric Acid	<1	320	160	S	E	—	—	plus $FeCl_3$ and other salts pH = 3.5-5, Alloy C = nil mpy
Hydrochloric Acid	1	80	27	—	B	—	—	Cl_2, CO & CO_2, 22 days
Hydrochloric Acid	1	Boiling	Boiling	E	G	U	U*	*dissolved. Lab test
Hydrochloric Acid	2M	—	—	E	E	—	—	containing approximately 1 mol NH_4CNS per liter
Hydrochloric Acid	2M	Room	Room	E	E	—	—	production of HF (Zr free)
Hydrochloric Acid	2	140-176	60-80	G	G	—	U	in ethanol, ethyl silicated reactor, 120 hrs.
Hydrochloric Acid	5	150	66	S	S	U	U*	*dissolved. Lab test
Hydrochloric Acid	5	150	66	—	S	U	—	120 hrs., lab test
Hydrochloric Acid	5	200	93	B	U	—	—	aeration
Hydrochloric Acid	5	200	93	—	U	—	—	ferric chloride, (conc. not stated), considerable aeration
Hydrochloric Acid	5	Boiling	Boiling	S	U	—	—	240 hrs., lab test
Hydrochloric Acid	5-30	77	25	B	E	E	S	sulfuric acid 10 to 40%, nitric acid 10 to 25%, sodium hydroxide 1 to 40%, sodium carbonate, dichlorobenzene 2 to 5%, pomalus acid and fumaric acid <5%, mono- and dinitrobenzenes and aniline traces, moderate aeration
Hydrochloric Acid	10	72	23	U	G	—	U	with 5% sodium nitrate, production of nitrophenol; 47 hrs., lab test
Hydrochloric Acid	10	150	66	—	B	U	—	120 hrs., lab test
Hydrochloric Acid	10	158	70	—	B	—	—	5% sodium nitrite, 4% HNO_3, 48 hrs., lab test, production of nitrophenol
Hydrochloric Acid	10 10	176 176	80 80	— —	B B	— —	— —	7 days, liquid 7 days, vapor
Hydrochloric Acid	10	176	80	S	U	—	—	240 hrs., lab test
Hydrochloric Acid	10	207	97	B	—	—	—	plus 5 percent isopropyl alcohol with isopropyl chloride bubbled through. Alloy B = 10 mpy (vapor) and 32 mpy (liquid)
Hydrochloric Acid	10	Boiling	Boiling	—	U	—	—	with 1% $FeCl_3$, 6% H_2O
Hydrochloric Acid	15	95	35	B	U	—	—	chlorine traces, unidentified traces, moderate aeration
Hydrochloric Acid	17	100	38	—	G	—	—	Cl_2O and Cl_2, test 203 days
Hydrochloric Acid	20	220-230	105-110	G	U	—	—	38% HCl added to ferro chrome powder, final solution acidity approx. that of 20% HCl; 77 hrs., lab test

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Hydrochloric Acid	27	60-216	16-102	—	S	—	—	plus chromium chloride dye, corn syrup, water, sodium dichromate
Hydrochloric Acid	27	125	52	U	E	—	—	plus 6-10 ppm free CXL_2, 6 percent inert organic liquid, 3.5 ppm Fe, balance water. Alloy C = 1.7 mpy
Hydrochloric Acid	35	160-170	71-77	S	B	—	—	230 hrs.
Hydrochloric Acid	36	Ambient	Ambient	U	—	—	—	test 163 days, specimen consummed. Chlorine present.
Hydrochloric Acid	40	76	25	E	—	—	—	processing of glycerol mono- and dichlorohydrin, 150 hrs., lab test
Hydrochloric Acid	—	Room	Room	—	G	—	—	from vent system of HCl absorber. Alloy C = 5 mpy
Hydrochloric Acid	—	Ambient	Ambient	G	B	—	—	108 hrs., field test, exposed in vapor section of autoclave
Hydrochloric Acid	—	60-212	16-100	E	E	—	—	HCl to pH of 1.5 in conversion of corn starch to corn syrup plus some HCl and SO_2. Alloy C = 0.1 mpy
Hydrochloric Acid	—	104	40	—	E	—	S	assorted concentrations; separate waste solutions: hydrochloric acid 5 to 30%, sulfuric acid 10 to 40%, nitric acid 10 to 25%, sodium hydroxide 1 to 40%, sodium carbonate, dichlorobenzene 2 to 5%, pomalus acid and fumaric acid less than 5%, mono- and dinitrobenzenes and aniline, trace, moderate aeration
Hydrochloric Acid	—	140	60	E	E	—	E	Cu Salts; chloroacrylic acid; 48 hrs., chloroacrylic acid extracted w/toluene
Hydrochloric Acid	—	140	60	—	E	—	—	saturated HCl brine, 183 days
Hydrochloric Acid	—	200-800	93-427	—	G	—	B	wire insulation decomposition, incl. PVC. 220 hrs., agitation considerable
Hydrochloric Acid	—	200	93	U	E	—	B	and hypochlorides in water, varying amounts of ethylene dichloride, Cl_2, NaCl, NaOH, and NaOCl, pH 3-12
Hydrochloric Acid	—	212	100	U	E	—	S	sodium hypochlorite in water, ethylene dichloride, Cl_2, NaCl, NaOH, 24 days, air free
Hydrochloric Acid	—	212	100	—	E	—	S	unspecified concentrations; sodium hypochlorite in water, varying amounts of ethylene dichloride, Cl_2, NaCl and NaOH. (pH 3-12)
Hydrochloric Acid	—	226	108	E	E	—	—	fumes above hydrolizing kettle in mono sodium glutamate production. Alloy C = 0.1 mpy
Hydrochloric Acid	—	662	350	—	S	—	B	oxidizing agents, 6 days, vinyl chloride production
Hydrochloric Acid	—	800-1000	427-538	—	E	—	E	sulfuric acid 0.008%, incinerator scrubber water, aeration
Hydrofluoric Acid	5	Room	Room	G	E	—	—	
	25	Room	Room	G	G	—	—	
	40	75	24	S	—	—	—	
	40	120	49	E	—	—	—	
	45	Room	Room	G	G	—	—	
	55	75	24	E	—	—	—	
	90	90	32	S	—	—	—	
	90	110	43	S	—	—	—	
	All	to B.P.	to B.P.	—	S	—	—	
Hydrofluoric Acid	8	Room	Room	G	—	—	—	plus some fluosilicic acid in tube washing and etching machine.
Hydrofluoric Acid	10	140	60	U	B	—	—	plus H_2SiF_6 and H_2PO_4 impurities. Alloy C = 33.7 mpy
Hydrofluoric Acid	14	115	46	—	U	—	—	plus 13% chromic acid, 96 hrs.
Hydrofluoric Acid	22	100	38	G	S	—	—	plus 35 percent H_2SiF_6 and 0.06 H_2SO_4 in HF acid production
Hydrofluoric Acid	50	140	60	—	B	—	—	35 days, nitrogen purge in vapor phase
Hydrofluoric Acid	65	140	60	—	G	—	—	35 days, vapor phase purged with nitrogen
Hydrofluoric Acid	70	60-140	16-60	—	S	—	—	dissolution of columbite ore. Alloy C = 11 mpy
Hydrofluoric Acid	99.5	140	60	—	E	—	G	SO_2 0.275%, H_2SiF_6 0.005%, H_2SO_4 0.010%, H_2O 0.11%, plus approx. 5% air, moderate aeration
Hydrofluoric Acid	99.5	150	66	—	E	—	G	SO_2 0.275%, H_2SiF_6 0.005%, H_2SO_4 0.010%, H_2O 0.11%, plus approx. 5% air, aeration
Hydrofluoric Acid	0-100	300	149	B	B	—	G	anhydrous hydrofluoric acid 0 to 100%; sulfuric acid concentration 100 to 0%
Hydrofluoric Acid	—	Room	Room	S	G	—	—	plus H_2SO_4 and gypsum dust

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Hydrofluoric Acid	—	140-165	60-74	—	G	—	U	11-13% fluosilicic acid plus undescribed impurities from wet process phosphoric acid. Liquid phase, extensive aeration
Hydrofluoric Acid (Anhydrous)	0-100	-10 to 300	-23 to 149	B	B	—	S	H_2SO_4, 100-0%
Hydrofluoric Acid — Barium Fluoride	— —	68 248	20 120	— —	B B	— —	— —	HF-BF_3 (as catalyst) plus liquid aromatic hydrocarbons
Hydrofluoric Acid (Boron Trifluoride Catalyst)	—	-6 68 176 248	-21 20 80 120	— — — —	G B B B	— — — —	— — — —	plus liquid aromatic hydrocarbons (ortho-, para-, and metaxylene plus ethyl benzene)
Hydrofluoric Acid, Chemical pure	60	Boiling	Boiling	—	S	—	—	4 days, vapor phase purged with 1% oxygen, rest nitrogen.
Hydrofluoric Acid Conditions	10 20 48	Ambient Ambient Ambient	Ambient Ambient Ambient	— — —	G G G	— — —	— — —	30 days
Hydrofluoric Acid Mixtures	—	176	80	—	E	—	G	(except HNO_3-HF) polymerization of a proprietary organic in an aromatic solvent with a BF_3 catalyst. HF & possibly fluoborates present. Open to moisture and air. HF attacked glass in vapor area and glass has spalled from surface during 350 hrs. of actual exposure, extensive aeration
Hydrofluoric Acid Mixtures	40	65	18	—	G	—	S	40% H_2SO_4, 20% H_2O. moderate aeration
Hydrofluoric Acid Mixtures	—	-10 to 300	-23 to 149	—	B	—	G	(except HNO_3-HF) anhydrous hydrofluoric acid 0 to 100%; sulfuric acid, concentration 100 to 0%
Hydrofluosilicic Acid	9	120	49	B	G	—	B	spool failed
Hydrofluosilicic Acid	10-11	160	71	—	—	E	—	impurities from wet process phosphoric acid.
Hydrofluosilicic Acid	12-13	160	71	—	—	G	—	impurities from wet process phosphoric acid.
Hydrofluosilicic Acid	30	100	38	S	—	—	—	plus 22 percent hydrofluoric acid and 0.06 percent H_2SO_4 in hydrofluoric acid production
Hydrofluosilicic Acid	35	80	27	—	G	—	—	plus 4.7 percent NaCl solution becomes saturated with Na_2SiF_6. Alloy C = 3.2 mpy
Hydrofluosilicic Acid	—	165	74	B	G	G	B	12-13%, with impurities from wet process phosphoric acid, some suspended
Hydrofluosilicic Acid	—	—	—	U	G	E	U	10-11%, with impurities from wet process phosphoric acid, some suspended, aeration
Hydrofluosilicic Acid Fumes	—	55	13	—	G	—	G	salt water (from estuary), silicon tetrafluoride, phosphoric acid, air; pH 1 to 2
Hydrogen	100	to 700	to 371	—	E	—	—	
Hydrogen Chloride	—	200-800	93-426	—	G	—	—	HCl resulting from the decomposition of all types of wire insulation, including polyvinylchloride-cooling water spray.
Hydrogen Chloride	95	0 to 50	-18 to 10	G	G	—	—	plus 3 percent acetyl chloride and 2 percent acetic acid vapors. Alloy C = 7.6 mpy
Hydrogen Chloride	100	to 800	to 427	S	—	—	—	
Hydrogen Chloride	—	289	143	S*	E	—	—	plus anhydrous organo-chlorosilanes and amines, *Alloy B = 1.6 mpy in liquid and 15 mpy in vapor.
Hydrogen Chloride, Dry	—	572	300	E	E	—	—	plus caustic soda in plastic synthesis. Alloy C = 0.01 mpy
Hydrogen Chloride	—	75	24	—	E	—	—	moisture in gases evolved, concentration low but not specified. Industrial atmosphere, considerable aeration
Hydrogen Chloride	—	110	43	E	—	—	G	vapor (almost all HCl) feed to fractionator is normally 0.4% HCl. 70% phosgene ($COCl_2$) and 23.6% monochlorobenzene.
Hydrogen Chloride and other gases and vapors, unidentified	—	600	316	—	G	—	—	
Hydrogen Chloride and other gases and vapors, unidentified	—	800	427	—	G	—	B	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Hydrogen Chloride and other gases and vapors, unidentified	—	800	427	—	S	—	U	
Hydrogen Chloride and other gases and vapors, unidentified	—	1300	704	—	U	—	—	
Hydrogen Cyanide, Hydrocyanic Acid	— —	122 224	50 107	— —	E G	— —	S G	HCN stripping still feed line and tails line, 372 days feed, 672 hrs. tails
Hydrogen Fluoride	100	to 1000	to 537	—	S	—	—	
Hydrogen Fluoride, Dry	—	930	499	G	—	—	—	in Zircex Process for dissolving fuel elements.
Hydrogen Fluoride, Slurry	1	140	60	G	—	—	—	plus some sulfur compounds, 0.2 percent solids.
Hydrogen Fluoride, Wet	—	932-1112	500-600	E	E	—	—	7 lb. HF gas per hour at 4 psi in laboratory furnace. Alloy C = 0.3 mpy
Hydrogen Iodide	31	150	66	—	U	—	—	hydroiodic acid plus elemental iodine 36%, water 33%
Hydrogen Peroxide	100	75	24	—	E	—	—	suitable for repeated short-time exposures. Alloy tends to decompose solution
Hydrogen Sulfide	—	75	24	—	E	—	—	with CS_2 in rayon spinning bath atmosphere
Hydrogen Sulfide	—	40-215	4-102	E	E	—	—	plus SO_2 and CO_2 above liquid end of leaching tank. Alloy C = 0.1 mpy
Hydrogen Sulfide	—	150-160	66-71	—	E	—	—	plus phenols, alifatic acids, sulfates, and sulfites. pH maintained at 4.5 with soda ash. Alloy C = 0.1 mpy
Hydrogen Sulfide	—	275	135	S	—	—	—	plus some CO_2 and sulfur — gas phase of sulfur processing
Hydrogen Sulfide Gas and De-aerated Fresh Water	—	77	25	—	E	—	E	
Hydrogen Sulfide	—	100-170	38-77	E	E	—	—	saturated with water, Alloy C = 0.1 mpy
Hydroiodic Acid	All	to B.P.	to B.P.	S	—	—	—	
Hydroiodic Acid	31 31 31	150 150 150	66 66 66	— — —	U E* E*	— — —	— — —	plus 36 percent iodine and water plus $ZnCl_2$ and water plus $CdCl_2$ and water *Alloy C = 2 mpy
Hypochlorite Bleach	—	110-130	44-54	—	E	—	—	0.1 grams/liter CaOCl, 1.5 grams/liter $CaCl_2$, pH = 7, extensive aeration. Alloy C = 0.1 mpy
Insulin Extract	—	to 100	to 38	E	E	—	—	plus some protein, fats, HCl, ammonia salts, H_2SO_4 and NaCl. Alloy C = 0.04 mpy
Iodine	All	to B.P.	to B.P.	—	S	—	—	
Iodine	—	572	300	E	G	—	—	pressure of iodine 400 mm Hg
Iodine	—	842	450	S	—	—	U	pressure of iodine 400 mm Hg
Iodine vapor	—	572 842	300 450	E S	E —	— —	— —	24 hrs. 24 hrs.
Iron Ore Sinter, Plant Flue Gas and Scrubbing Liquors	—	105-180	41-82	—	E	E	E	aeration
Isopropyl Alcohol	11	72	22	—	E	—	—	plus 9.3 percent iodine, 2 percent non-ionic detergent. Alloy C <0.1 mpy
Isopropyl Chloride	50	95	35	B	—	—	—	air bubbled through solution. Alloy B = 9.0 mpy in vapor and 32.0 mpy in liquid
Isopropyl Chloride	80	95	35	G	—	—	—	plus 20 percent isopropyl alcohol. HCl bubbled through liquid.
Kraft Fibers, (Hardwood or Pine) at 1% Consistency.	—	83	28	—	E	E	E	pH 5-6, low concentration of chlorides and sodium, trace chlorine dioxide, moderate aeration
Lactic Acid	1	60-75	16-24	S	E	—	—	plus 0.01 percent methylene blue and possible Cu ++ ions. Alloy C <0.1 mpy
Lactic Acid	10	Boiling	Boiling	—	G	—	—	
Lactic Acid	17	Boiling	Boiling	G	G	—	—	10% ammonium chloride; 0.4% NaCl; 115 hrs., lab test, proposed lactic acid service
Lactic Acid	All 25-60	to B.P. 130	to B.P. 54	S —	— E	— —	— —	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Lactic Acid	50	Boiling	Boiling	G	G	—	G	proposed lactic acid service, 115 hrs., lab test
Lactic Acid	85	Boiling	Boiling	—	E	—	—	
Lactic Acid	90	Boiling	Boiling	G	G	—	S	proposed lactic acid service, 115 hrs., lab test
Lanolin Bleach	—	210	99	E	E	—	—	plus dilute H_2SO_4, HCl, alcholic caustic solutions, H_2O_2 and strong NaOCl bleaches. Alloy C = 0.141 mpy
Lead-Bismuth Alloy	Eutectic	to 464	240	S	S	—	—	
Lead, Lead Chloride	—	982-1000	526-537	B B B	U U U	U U U	U U U	argon atmosphere. Top — lead, middle — lead chloride, bottom — lead chloride upper phase
Levulinic Acid	95	80-110	27-43	E	—	—	—	
Lime Slurry and Caustic Soda	—	184	85	—	E	—	E	added to organic polymer containing excess sulfuric acid
Limestone Slurry	8	120	49	—	E	E	E	$CaCO_3$ $CaSO_3$, $CaSO_4$ and fly ash, pH 5.0-6.0, moderate aeration
Limestone Slurry	—	89	32	—	E	E	E	15% $CaCO_3$ in water, pH 6.3-7.9
Limestone Slurry	—	107	42	—	E	E	E	15% solids, $CaCO_3$ plus $CaSO_3$ and a small amount of $CaSO_4$, pH 3.7-6.7, avg. 5.6, moderate aeration
Limestone Slurry	—	127	53	—	—	E	E	flue gas containing 2 lbs./min. of SO_2. pH 3.5-6.3 avg. 5.7, 91 days, scrubbing liquor for SO_2 removal from power plant
Limestone Slurry	—	254	123	—	—	E	E	scrubbing liquor for SO_2 removal from power plant flue gas, 91 days, moderate aeration
Liquid leaving bottom of Fractionator	—	265	129	E	—	—	E	virtually free of HCl, mostly phosgene and monochlorobenzene
Lithium Chloride	30	260	127	—	—	E	—	bal. H_2O, 2000 hrs., LiCl production, one sample out of four showed shallow pitting, 1.5 mils deep.
Lithium Chloride	90	300	149	—	—	E	—	bal. H_2O, 2000 hrs., LiCl production
Manganese Sulfate	—	60-145	16-63	—	E	—	—	manganese ore leaching (anoxide and sulfide) plus sulfuric and sulfurous acids. Alloy C = 0.1 mpy
Magnesium Carbonate	10	to B.P.	to B.P.	S	S	—	—	
Magnesium Chloride	10 25 40 50	75 to B.P. 175-B.P. to B.P.	24 to B.P. 79-B.P. to B.P.	E E E E	E E E E	— — — —	— — — —	
Magnesium Chloride	30-40	273	134	—	E	—	E	with small amounts of $MgSO_4$, NaCl, KCl, LiCl, traces of Br, 3-4% solids of $MgSO_4$, 1.25 H_2O, extensive aeration
Magnesium Chloride	51	330	166	G	E	—	—	1% NaCl, 1% KCl, 2% LiCl, vapor phase, 120 hrs., aeration and agitation moderate
Magnesium Chloride	51* Cl_2	330-335	166-168	—	E	—	—	*100 hrs. with $MgCl_2$ brine only. 1% NaCl, 1% KCl, 2% LiCl as concentrated from natural Bonneville brines of 33% solubles. Liquid phase exposure, moderate to considerable aeration
Magnesium Chloride	53	345	174	E	E	—	—	vapor phase above with 8,000-10,000 ppm HCl in condensate
Magnesium Chloride	55	345	174	G	E	—	—	with 1% NaCl, 1% KCl, and 2% LiCl, as concentrated from natural Bonneville brines of 33% solubles.
Magnesium Chloride	85 100	266 334	130 168	S E	E E	— —	— —	in open-pan evaporator. Concentration expressed as $MgCl_2 .6H_2O$. Alloy C = 0.1 mpy (85 percent) 0.3 mpy (100 percent)
Magnesium Chloride	—	310	154	—	G	—	—	in vapor phase — vapors over 50% $MgCl_2$ with 500 to 4,000 ppm HCl in condensate and 1,000 ppm $MgCl_2$. In liquid phase — 50% $MgCl_2$ solution, plus 1% NaCl, 1% KCl, 2% LiCl. Concentration of natural Bonneville brine from 33% solubles to 50%.
Magnesium Chloride	—	335-355	168-179	—	E	—	—	53% magnesium chloride with 1% NaCl, 1% KCl, and 2% LiCl, as concentrated from natural Bonneville brines of 33% solubles, moderate to considerable aeration
Magnesium Hydroxide	—	150	66	—	—	E	E	absorption liquid for SO_2. Generates bisulfite cooking acid w/pH of 5.4, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Magnesium Oxide Slurry	—	120	49	—	E	E	E	flue gas scrubbing liquor for SO_2 removal, 238 days, moderate aeration
Magnesium Sulfate	25 50	to B.P. 125-B.P.	to B.P. 52-B.P.	E E	S S	— —	— —	
Magnesium Sulfate	—	198	92	—	E	—	E	brine slurry containing $MgSO_4$, Na_2SO_4, KCl, NaCl, $MgCl_2$, trace of S^-, pH 7.7, moderate to extensive aeration
Maleic Acid	10 10 100	to 175 B.P. to B.P.	to 79 B.P. to B.P.	E S S	— — —	— — —	— — —	
Maleic Acid Liquor	10-18	32-40	0-4	U	E	—	—	plus small amounts of alpha naphtha quionone, phthalic acid. Alloy C = 0.2 mpy
Maleic Anhydride	—	400-545	204-285	E	E	—	—	plus phthalic anhydride, 1090-hr. test in vapor velocity of 7 ft./sec. at top tray of fractionating column
Mercuric Chloride	10	to 175	to 80	—	S	—	—	
Mercuric Chloride Vapors	—	620-750	326-398	B	E	—	—	air-free nitrogen atmosphere. Mercuric chloride is present as 10 percent weight percent of varying amounts of activated carbon. Alloy C = 1.1 mpy
Mercury	All 100	to 800 to 700	to 426 to 371	S —	— E	— —	— —	
Methanol	All	to B.P.	to B.P.	E	E	—	—	
Methanol	—	Boiling	Boiling	—	E	—	—	N_2 atmosphere, methanol recovery column stock solutions sent to lab for test
Methyl Acetate	20	to 144	to 62	S	E	—	—	plus 20 percent ethyl acetate, 18 percent methyl ethyl ketone, 15 percent acetone, 6 percent acetaldehyde, 14 percent low boilers, trace acetic acid. Alloy C =0.01 mpy
Methyl Acetate	60	to B.P.	to B.P.	—	E	—	—	with 10 percent acetaldehyde, 5 percent H_2O, 2 percent acetic acid, traces of acetone and alcohols
Methyl Alcohol	60	165	74	E		—	—	plus 15 percent methyl acetate, 23 percent acetone, 0.03 percent acetic acid. Slight pitting.
Methyl Alcohol	95	203	95	—	U	—	—	plus 4 percent HCl, CH_3Cl bubbled through. Vapor phase = 16 mpy, liquid phase = 55 mpy
Methyl Chloride	100	95-113	35-45	—	E	—	E	
Methyl Chloride	—	95-113	35-45	—	E	—	E	containing 100 ppm hydrogen chloride and 30 ppm water
Methyl Chloride	—	100	38	G	—	—	—	bubbling through water, 2.0 mpy in vapor phase, 3.0 in liquid phase
Methyl Ethyl Ketone	1	210	99	—	E	—	—	Alloy C <0.1 mpy
Methyl Ethyl Ketone	77	90-100	32-38	S	—	—	—	plus 15 percent aconitic and 8 percent H_2O, trace of TiCl
Methyl Isopropanol Ketone	44	230	110	E	—	—	—	plus 1 percent phosphoric acid, 3 percent diamer, 1 percent vinyl isopropl ketone, 1 percent alcohols
Methylene Chloride	22.5	100-250	38-121	G	E	—	—	plus 2.5 percent methanol. Alloy C = 0.2 mpy
Methylene Chloride	40	to B.P.	to B.P.	—	S	—	—	
Methylene Chloride	50	140-200	60-93	E	E	—	—	plus 50 percent methanol.
Methylene Chloride	70	120-140	49-60	E	E	—	—	plus 30 percent methanol. Alloy C = nil mpy
Methylene Chloride	75	275	135	G	E	G	B	HCl 20%, H_2O 5%, 27 days in vapor above solution, moderate aeration
Methylene Chloride	90	100-212	38-100	E	E	—	—	plus 10 percent methanol. Alloy C = nil mpy
Methylene Chloride	—	180-250	82-121	—	E	E	E	contaminated w/H_2O, aeration
Methyldichlorophosphine (Anhydrous)	—	195-225	91-107	E	E	—	E	CH_3PCl_2; lower concentrations methoxydichlorophosphine, phosphorus trichloride, phosphorus oxychloride, triethylphosphate, 76 days, aeration — none, agitation — rapid
Methylenedioxybenzene Reaction Mixture	—	221-248	105-120	—	E	E	E	aeration
Moist Air	—	Ambient	Ambient	—	E	—	—	containing Cl_2, 166 days
Moist Air	—	Ambient	Ambient	—	E	—	—	trace Cl_2, 195 days
Molybdic Acid	10	75	24	—	S	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Molybdic Acid	—	300	149	—	B	S	S	formed by reaction of MoS_2, oxygen and 5% HNO_3. H_2SO_4 conc. goes to 20%. Jacketed vessel allows heating-cooling. Extensive aeration
Mono Phosphates	10	to B.P.	to B.P.	S	—	—	—	sodium, potassium, or ammonium
Monoethanolamine Hydrochloride	30	150	65	E	E	—	—	in methanol, 72 hrs., lab test
Monoethanolamine Hydrochloride	—	204	95	E	E	—	—	N_2 atmosphere, 72 hrs., lab test
Monomer & Dimer Fatty Acids from Tall Oil Purification	—	537-550	281-288	—	E	E	E	aeration
Morpholine Reaction Mixture	— —	156 392	125 200	G B	B U	— —	— —	88 hrs., lab test
Morpholine Sulfate	—	374	190	B	B	—	—	141 hrs., lab test, valves for morpholine sulfate service
Municipal Garbage Incinerator Flue Gas	—	170	77	—	E	E	E	from secondary chamber after passing through scrubber marble bed plus entrained liquor at pH 3-4, extensive aeration
Municipal Garbage Incinerator Scrubbing Liquor	—	160	71	—	E	E	E	water draining from marble scrubbing bed plus direct spray of neutral H_2O. pH = 2.0-3.5. Municipal garbage incinerator flue gas scrubbing; moderate agitation; extensive aeration. 51 days
Naphtha	100	75	24	S	—	—	—	
Naphtha, Solvent	96	160-180	71-82	E	—	—	—	in vapor space of still column. Some nitrogen oxides possibly evolved.
Naphthalene	—	180	82	—	G	—	S	organic condensation product
Naphthalene Chloride	— —	110 392	43 200	E E	— —	— —	— —	production of naphthalene and HCl vapor, in vapor phase.
Naphthalene Sulfonic Acid	—	180	82	—	G	—	E	formaldehyde, condensation product of; $Ca(OH)_2$, NaOH, $CaSO_4$, Na_2SO_4, natural aeration through agitation
Naphthalene Sulfonic Acid	— —	B.P. 300	B.P. 149	E —	E E	— —	— —	also formaldehyde in condensation reaction.
Napthenic Acid	—	650-750	343-398	E	E	—	—	in distillate from heavy asphalt containing crude oil in flash section of vacuum tower. Alloy C = 0.1 mpy
Nickel Chloride	10 10 20 30 80	to B.P. 140 to B.P. to B.P. 200	to B.P. 60 to B.P. to B.P. 93	E — E E —	— E — — E	— — — — —	— — — — —	
Nickel Chloride	25	554	290	U	B	—	U	nickel chloride feed tubes to converters in an Aminco bomb, pH 3.4, unstressed specimens
Nickel Chloride	—	428	220	—	S	—	—	nickel carbonyl, nickel hexammine chloride, ammonium carbonate, ammonia, H_2, CO, CO_2, CO-CO_2 pressure 2500 psig — specimens metallic-arc welded and stressed; 243 hrs.
Nickel Nitrate	10	75	24	—	S	—	—	
Nickel Plating Bath	—	140	60	E	—	—	—	chloride type
Nickel Sulfate	0-60	to B.P.	to B.P.	—	S	—	—	
Nitric Acid	1.92M	75	24	U	E	—	U	1.08M hydrofluoric acid, 0.08M hydroxylamine nitrate, 0.11M sulfamic acid, 0.02 ascorbic acid; welded
Nitric Acid	10	120	49	U	G	—	—	plus 2 percent HF for descaling stainless steel products. Alloy C = 5 mpy
Nitric Acid	10	Boiling	Boiling	—	G	E	—	120 hrs., lab test
Nitric Acid	20	Boiling	Boiling	—	B	G	—	120 hrs., lab test
Nitric Acid	35	185	85	—	—	E	—	2000 ppm chloride ions, 96 hrs.
Nitric Acid	40	Boiling	Boiling	—	U	G	—	120 hrs., lab test
Nitric Acid	49	177-183	81-84	—	—	G	—	37% phosphate rock, 4% H_2SO_4
Nitric Acid	50	Boiling	Boiling	—	—	G	—	1000 ppm chloride ions, 96 hrs.
Nitric Acid	53	177-183	81-84	—	—	E	—	37% phosphate rock, 4% potassium sulfate

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Nitric Acid	63	120	49	—	E	—	G	15% by wt. (20% by vol.) 40° Bé or 2% sodium dichromate (dihydrate)
Nitric Acid	65	150	66	—	S	E	—	120 hrs., lab test
Nitric Acid	65	Boiling	Boiling	—	U	B	—	120 hrs., lab test
Nitric Acid	72	177-183	81-84	—	—	E	—	6% H_2SO_4
Nitric Acid Mix	25	177-183	81-84	—	—	E	—	25% phosphate rock, 24% H_3PO_4, 4% H_2SO_4
Nitric-Sulfuric Acid Mixtures	—	365	185	—	B	—	B	20% by vol. of 50% H_2SO_4 - 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and later dried at 170 deg. C in 10% ClO_2.
Nitric-Sulfuric Acid Mixtures	—	365	185	—	B	—	U	20% by vol. of 50% H_2SO_4 - 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 16.5% NaOCl at 170 deg. C
Nitric-Sulfuric Acid Mixtures	—	392	200	—	B	—	B	20% by vol. of 50% H_2SO_4 - 50% HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 20% by vol. of 50% HNO_3-50% $HClO_4$ added to H_2O and heated to 200 deg. C for 12 hrs.
Nitriding Gases	All	1000	538	E	E	—	—	
Nitrobenzene	85	212	100	U	G	—	—	plus chlora-beta methyl quinone, copper chloride, 5 percent HCl in stripping nitrobenzene from organic solution. Alloy C = 2.6 mpy
Nitrosyl Chloride	—	Room	Room	—	G	—	—	during production from reaction of HCl, nitrous oxide, and isopropyl alcohol, Alloy C = 2.5 mpy
Nitrous Oxide	10	780	416	E	E	E	E	corrosion rack test (in plant), balance O_2, H_2O, N_2
Nonylphenol	60-75	340	171	G	G	—	U	dinonylphenol 0.6%, water 0.1% max., nonyl and dinonylphenol sulfide 67-73% and process oil 25%, hydrogen chloride a few percent. (Compositions of liquid phases)
Oil-Water Emulsion	—	75	24	—	—	E	E	containing dilute sulfuric acid (pH 1.8) and possibly some carbon dioxide, 90 days, moderate aeration
Oleic Acid	100	to B.P.	to B.P.	S	—	—	—	
Oleum	20	125	52	E	—	—	—	1.32 parts to one part dodecyl benzene and SO_2
Oleum	20	125-150	52-66	E	—	—	—	vapors plus pyridine vapors in sulfonation of pyridine.
Oleum	20	125-150	52-66	B	—	—	—	plus pyridine and 2.5 percent water in sulfonation of pyridine.
Oleum	25	50-90	10-32	E	E	—	—	in detergent manufacture. Alloy C = 0.1 mpy
Oleum	40	to 140	to 60	—	E	—	—	plus 4 percent HNO_3
Oleum	75-120	86-248	30-120	—	—	G	—	25 to 98% HNO_3, trace HF
Orange Juice	—	100-125	38-52	—	E	—	—	with pectin liquor
Organic Chlorides	All	to B.P.	to B.P.	S	—	—	—	
Orthoformyl Benzene-sulfonic Acid	6.75	85	29	E	E	—	E	
Oxalic Acid	10	Boiling	Boiling	—	G	—	—	
Oxalic Acid	20	110	43	—	E	—	—	to which is added 93% H_2SO_4 (approx. 10% when diluted), pH less than 1, plus calcium oxalate and calcium sulfate, moderate aeration
Oxalic Acid	45	140	60	—	E	—	E	slurry, 35% sulfuric acid, calcium oxalate, calcium sulfate, pH 1, moderate aeration
Oxalic Acid	Satr. Soln.	B.P.	B.P.	G	S	—	—	
Oxalic Acid	All	to B.P.	to B.P.	S	S	—	—	
Oxalic Acid	—	140	60	S	E	E	E	slurry, 35% sulfuric acid, calcium oxalate, calcium sulfate, pH 1, moderate aeration
Oxidizing Gases	100	to 1800	to 982	—	E	—	—	
Paper, Acid Pulping	—	285	141	—	G	—	E	cooking liquors: acid sulfite, sodium base; alkaline, Kraft
Paper, Alkaline Pulping Cooking Liquor	1.5M	323	162	—	G	—	B	oxygenated sodium hydroxide pulp digester liquor, extensive aeration
Paper Bleaching	1	114	46	—	E	—	E	0.01% chlorine. trace chlorine dioxide. pH 5.5 to 6.0, moderate aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Paper Bleaching	1	132	56	—	E	—	E	atmosphere over a 1% slurry of paper pulp; 0.05 chlorine, trace chlorine dioxide, pH 7.0, moderate aeration
Paper Bleaching	1	145	63	—	E	—	E	paper pulp 1% slurry; 0.01% chlorine, trace chlorine dioxide, pH 5.2, moderate aeration
Paper Bleaching	1	150	66	—	E	—	E	atmosphere over a 1% slurry of paper pulp; 0.01% chlorine, trace chlorine dioxide, pH 5.2
Paper Pulp, Bleached	1.5	135-165	57-74	—	E	—	E	calcium chloride 0.3%, residual chlorine dioxide .002%, pH 5.5 to 6.0, extensive aeration
Paper Pulp, Bleached	—	135-165	57-74	S	E	—	E	1.5% CaCl, pH 5.5 to 6.0, 95 days, aeration and agitation extensive
Paper Pulp Slurry	1	114	46	—	E	—	E	Chlorine — .01%, pH 5.5 to 6.0 Duration of test — 58 days Aeration — moderate Agitation — moderate Type of test — field Process involved — paper pulp bleaching
Paper Stock	—	75	24	—	E	—	—	0.15 g/l HCl, 0.02 g/l free chlorine
Paper Stock	—	155	68	—	E	—	—	Kraft pulp stock, pH 9.5-10, moderate aeration, flow rate of 4500 g.p.m., 337-hr. test
Peanut Oil	—	to 125	to 52	E	—	—	—	sulfonation of peanut and corn oil
Pentane	—	70	21	G	E	—	—	plus traces of HCl, moisture and air. Alloy C = 0.8 mpy
Pepsin	—	to 150	to 66	S	—	—	—	extraction of pepsin with one percent HCl and organic acids, pH 4.8-7.0
Perchloric Acid	72	75-212	24-100	—	G	—	U	
Perchloroethylene — Carbon Tetrachloride	—	250	121	—	E	—	—	HCl and Cl_2, duration of test — 47 days
Perchloryl Fluoride	—	86	30	—	E	—	E	519 hrs., lab test, tank placed in air cabinet
Phenol	95	302-320	150-160	E	—	—	—	plus 5 percent acetophenone, mildly boiling solution
Phenol	— —	125 125	52 52	S E	E E	— —	— —	chlorination process, exposed 19 days in liquid phase exposed 19 days in vapor phase.
Phenol Di-Carbonate	90	380	193	E	—	—	—	plus 11 percent phenol and 1 percent $AlCl_3$
Phenol Formaldehyde	—	212	100	E	E	E	U	sulfuric acid, phosphoric acid, lime, caustic, moderate aeration
Phenol Formaldehyde	—	265	129	G	E	E	E	Duration of test — 107 days Aeration — present Agitation — present Type of test — field Process involved — phenolic resin Remarks — vapors present intermittently during operating cycle.
Phenol, Paratertiary Butyl	—	500	260	—	E	—	—	plus formaldehyde, turpentine, boron trifluoride, and oxalic acid in kettle. Alloy C = 0.2 mpy
Phenol Sulfonic Acid	30 30	75 250	24 121	E E	— —	— —	— —	during production from phenol and concentrated sulfuric acid.
Phenolpthalein	100	175	79	E	—	—	—	fusion of phenolpthalein
Phenyl Piperazine	—	176-436	80-225	G	S	—	—	245 hrs., production of phenyl piperazine from aniline, hydrogen chloride, and diethylanolamine.
Phosgene	5	307	153	E	E	—	E	chlorobenzene 70%; polyisocyanate 25%; phenyl isocyanate (trace).
Phosgene	50	45	7	—	E	—	E	monochlorobenzene 40%, HCl 10%, traces of isocyanate, liquid phase, air free
Phosgene	—	250	121	E	E	—	E	HCl and chlorinated solvents
Phosgene Gas	—	752	400	S	S	—	—	
Phosgene Vapor	—	122	50	E	E	—	G	984 hrs., lab test
Phosphoric Acid	0.5	60	16	S	—	—	—	H_3PO_4 catalyst plus organics
Phosphoric Acid	3-14	150	66	—	E	—	—	small amounts of fluorine compounds

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Phosphoric Acid	7	50	10	—	E	—	E	n-Propylalcohol 18%, sodium chloride 5%, aluminum chloride 0.4%, ether chlorides totaling 0.8%; cupric, ferric, zinc, manganous, cobalt. Water 70%, pH about 1.5, furnace process
Phosphoric Acid	10	214	101	B	—	—	E	immersed 96 hrs.
Phosphoric Acid	15	165-185	74-85	—	G	—	—	plus 20 percent H_2SiF_6, 1 percent H_2SO_4. Alloy C = 2 mpy
Phosphoric Acid	16 30.7	65-80 72	18-27 22	— —	E E	— —	— —	plus iodine, non-ionic detergent (nonyl phenyl ether of polyethylene glycol), and water. Alloy C <0.1 mpy
Phosphoric Acid	27	122-161	50-72	—	—	E	E	H_2SO_4 and gypsum impurities, aeration
Phosphoric Acid	30	165	74	—	G	—	U	4% sulfuric acid; 4% silica. Traces of iron, aluminum and fluorine, moderate aeration
Phosphoric Acid	31.4	113-140	45-60	B	E	—	—	in manufacture of ammonium phosphate. Plus 1.64 percent H_2SO_4, 1.46 percent H_2SiF_6
Phosphoric Acid	35	350	177	—	B	—	—	plus newsprint in 3-4 hrs. heating cycle
Phosphoric Acid	36	100-111	38-44	—	—	E	—	2.9 percent H_2SO_4, 350 ppm chloride, some hydrofluosilicic acid
Phosphoric Acid	36	172	78	—	—	E	—	2.9 percent H_2SO_4, 350 ppm chloride, some HF, 30 percent gypsum
Phosphoric Acid	40	158	70	—	G	—	G	(29% P_2O_5), sulfuric acid 2-3%, slurry contains 2-3% calcium sulfate dihydrate (gypsum), 0.5% fluorine compounds as hydrofluosilicic acid, metallic compounds
Phosphoric Acid	40-80	225	107	U	E	—	—	plus 10-20 percent HNO_3, 10-20 percent ZnO, 10-20 percent Na_2ClO_3, 5 percent Na_2SO_4. Alloy C = 0.4 mpy
Phosphoric Acid	45	77-266	25-130	—	—	B	—	sulfuric acid 45 percent, water 10 percent
Phosphoric Acid	45	145-155	63-68	E	G	—	—	half in vapors, half immersed. Alloy C = 7.9 mpy
Phosphoric Acid	45	266	130	—	E	E	—	sulfuric acid 45%, water 10%
Phosphoric Acid	50-55	200-300	93-149	U	B	—	—	in wet vapors containing HF. Alloy C = 24 mpy
Phosphoric Acid	50	230	110	G	—	—	G	immersed 96 hrs.
Phosphoric Acid	52.5	113	45	—	G	E	G	H_3PO_4 (P_2O_5 equivalent 35%), sulfuric acid 2.9%, chloride 400 ppm, hydrofluosilicic acid trace, ferric phosphate trace, moderate aeration
Phosphoric Acid	53	250	121	U	G	—	—	plus 1-2 percent H_2SO_4, 1.2 to 1.5 percent HF. Alloy C = 5 mpy
Phosphoric Acid	54	260	127	U	U	—	—	in fume hood of defluorinator plus 1 percent H_2SO_4,SiF_4, and HF
Phosphoric Acid	54†	310-335	154-168	—	—	U	—	1.4 percent, 4.3 percent H_2SO_4, 48 hours exposure, hot wall
Phosphoric Acid	55	175-185	79-85	—	G	E	U	some fluorides, calcium sulfate, hydrofluosilicic acid.
Phosphoric Acid	55	221-261	105-127	—	U	—	U	(40% P_2O_5), sulfuric acid 3.0% (2.5% SO_3), calcium sulfate (hemihydrate) slurry; fluorine compounds. Liquid phase, gases containing H_2O and SiF_4 are evolved. Foam distribution process
Phosphoric Acid	55	221-261	105-127	—	—	B	—	sulfuric acid 3.0 percent (2.5 percent SO_3), calcium sulfate (hemihydrate slurry), fluorine compounds
Phosphoric Acid	55	228	109	—	B	—	—	reagent grade plus 0.8% hydrofluoric acid
Phosphoric Acid	55	228	109	—	—	G	—	0.8 percent HF
Phosphoric Acid	55	237	114	U	U	B	U	(40% P_2O_5), sulfuric acid 3.0% (2.5% SO_3), calcium sulfate (hemihydrate) slurry; fluorine compounds. Liquid phase, gases containing H_2O and SiF_4 are evolved.
Phosphoric Acid	56.2	72	22	—	E	—	—	plus iodine, non-ionic detergent (nonyl phenyl ether of polyethylene glycol), and water. Alloy C <0.1 mpy
Phosphoric Acid	61	176	80	—	G	—	U	(44% P_2O_5), filtered, containing small concentrations of sulfuric acid and hydrofluosilicic acid
Phosphoric Acid	69	81	27	—	E	—	S	(50% P_2O_5), sulfuric acid 3-4%, calcium sulfate 3-4%, traces hydrofluosilicic acid, aluminum compounds, pH about 1.8
Phosphoric Acid	69	212	100	—	B	—	U	(50% P_2O_5), filtered, containing small concentrations of sulfuric acid and hydrofluosilicic acid

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

† — percent P_2O_5

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Phosphoric Acid	70-100	200-212	93-100	—	E	—	—	acid mist (0.04-.35 grains 100% H_3PO_4 per "standard cubic foot" or 0.10-.86 grams 100% H_3PO_4 per cubic meter (STP)). Chloride (20-30 ppm) in city water used in scrubber liquor, extensive aeration
Phosphoric Acid	75	68-212	20-100	—	—	E	G	pH below 1,140 ppm AS_2O_3 as impurity. Furnace process to produce phosphoric acid. Moderate aeration; total days — 375, agitation — 590 fpm velocity
Phosphoric Acid	75	100	38	—	—	E	G	pH below 1,140 ppm As_2O_3 impurity, moderate aeration
Phosphoric Acid	75	185	85	—	E	—	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	194	90	—	E	—	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	203	95	—	G	—	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	212	100	—	—	B	—	30 days approx., 726-793 hrs., agitation — acid velocity 895 ft./min.
Phosphoric Acid	75	212	100	—	—	G	—	164 hours
Phosphoric Acid	75	221	105	—	G	—	—	48 hours
Phosphoric Acid	75	240-260	116-127	U	S	—	—	HF, 30 percent Ca ($CaSO_4$ plus H_2O plus SiO_2), half in vapors, half immersed
Phosphoric Acid	82-87	190-215	88-102	E	—	—	—	lower oxides of phosphorous present as impurities
Phosphoric Acid	85-95	165-185	74-85	—	E	—	—	small amounts of fluorine compounds
Phosphoric Acid	85-95	212-239	100-115	—	B	—	—	small quantities of fluorine compounds in mist. Alloy C = 21 mpy
Phosphoric Acid	86	208	98	E	—	—	S	immersed 96 hrs.
Phosphoric Acid	87-90	176-230	80-110	G	E	—	E	furnace process, 102 days, trace NaCl and HCl, aeration moderate, agitation none
Phosphoric Acid	87-90	194	90	G	E	—	E	furnace process (63 to 65% P_2O_5), trace HCl and NaCl, moderate aeration
Phosphoric Acid	93	260	127	U	—	—	—	
Phosporic Acid	93.5	375-410	190-210	—	U	—	U	vapor above phosphoric acid 93.5% (67% P_2O_5), wet process, containing about 4.3% sulfuric acid and 4.4% iron and aluminum oxides. Fluoride is present below 1.5%, moderate aeration
Phosphoric Acid	98	390-460	199-238	—	—	G	—	(71 percent P_2O_5) sulfuric acid 4-6 percent, iron and aluminum 2.8-3.0 as trioxides, fluorine compounds 0.5-1.0 percent
Phosphoric Acid	101	300	149	—	—	G	—	solids 1.17 percent, 0.4 percent fluorine
Phosphoric Acid	103	300	149	B	—	—	—	H_3PO_4 as catalyst in polymerization reaction, 1000 hrs., mol esters/mol acid = 0.1
Phosphoric Acid	117	140	60	E	—	—	—	85 percent P_2O_5
Phosphoric Acid	118	485	251	S	B	—	—	
Phosphoric Acid	—	60-650	16-343	—	E	—	—	gases containing HF, SiF_4, SO_2, with entrained H_3PO_4, 99% (72% P_2O_5), H_2SO_4 3.7%, (3.0% SO_3), extensive aeration
Phosphoric Acid	—	230	110	—	—	E	E	75-105% by wt., aeration, 126 days
Phosphoric Acid, Commercial	75	172 194 208 221	78 90 98 105	— — — —	E E E G	— — — —	— — — —	Alloy C = 1 mpy Alloy C = 1.4 mpy Alloy C = 1 mpy Alloy C = 4.6 mpy
Phosphoric Acid, Dehydrated	—	320	160	S	G	—	—	plus acrylic acid and betapropriolactone. Alloy C = 5 mpy at top of acrylate unit.
Phosphoric Acid Fumes	75	122	50	G	—	—	—	some P_2O_5 and H_2S
Phosphoric Acid Mist	100	200-212	93-100	G	E	E	—	.04-.35 grains/ft_3, 78 days, aeration extensive, agitation 5-12 fps, pit depth, alloy B = 4 mils, alloy C = 0, alloy G = 0
Phosphoric Acid Mist	—	206	97	G	E	E	—	0.04-.35 grains 100% H_3PO_4 per "standard cubic foot" or 0.10-.86 grams 100% H_3PO_4 per cubic meter (STP)). Chloride (20-30 ppm) in city water used in scrubber liquor, extensive aeration
Phosphoric Acid Mixtures	39	170-183	77-84	—	G	—	U	(28% P_2O_5), sulfuric acid 2%, hydrofluosilicic and hydrofluoric acids in trace amounts; total fluoride equivalent about 1.2% suspended gypsum 30% of suspension weight. Liquid phase, moderate aeration
Phosphoric Acid Pickling Solution	22	180-200	82-93	U	G	—	—	for removing scale from parts to be bonderized. Alloy C = 2.5 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Phosphoric Acid, Production gases and vapors	—	130	54	G	S	—	B	silicon tetrafluoride approx. 0.31-0.44 lb./1000 cu. ft.; carbon dioxide approx. 0.47-0.68 lb./1000 cu. ft.; P_2O_5 equivalent 0.00033-0.00048 lb./100 cu. ft. Possibly very small amount H_3PO_4 as spray, moderate aeration
Phosphoric Acid Slurry	20	170-200	77-93	U	G	—	—	in digester during production of wet process H_3PO_4. Plus $CaSO_4$, 40 percent H_2O, 2 percent H_2SO_4, 1 percent fluorine. Alloy C = 7.9 mpy
Phosphoric Acid and Sulfuric Acid (0.4%)	0.1	122-248	50-120	E	E	E	E	Duration of test — 64 days (56 in H_3PO_4, 8 in H_2SO_4) Aeration — air free Agitation — extensive Type of test — field Process involved — syntheses of tertiary and secondary amylphenols Remarks — unwashed
Phosphoric Acid and Sulfuric Acid (0.3%)	0.1	122-347	50-175	E	E	E	E	Duration of test — 43 days (25 in H_3PO_4, 18 in H_2SO_4) Aeration — air free Agitation — extensive Type of test — field Process involved — syntheses of tertiary and secondary amylphenols Remarks — unwashed
Phosphoric Acid, Wet Process	14.5	158	70	—	E	—	—	plus 0.381 percent, HNO_3 in acid. Alloy C = 0.1 mpy
Phosphoric Acid, Wet Process	28	180-230	82-110	U	G	—	U	42 days, 20-22% H_2SO_4, 1-1.5% fluosilicic acid, aeration moderate.
Phosphoric Acid, Wet Process	28	180-230	82-110	—	G	—	U	P_2O_5 20%, sulfuric acid 20-22%, fluoride about 1-1.5%, probably as fluosilicic acid, moderate aeration
Phosphoric Acid, Wet Process	30†	185	85	—	—	G	—	2 percent F, 4.5 percent H_2SO_4 (110 hours exposure), liquid
Phosphoric Acid, Wet Process	30†	250	121	—	—	G	—	2 percent F, 4.5 percent H_2SO_4 (110 hours exposure), hot wall
Phosphoric Acid, Wet Process	30†	185	85	—	—	G	—	2.4 percent F, 3 percent H_2SO_4, 1.2 percent ferrous oxides. 1.1 percent solids (96 hours exposure), liquid
Phosphoric Acid, Wet Process	30†	250	121	—	—	G	—	2.4 percent F, 3 percent H_2SO_4, 1.2 percent ferrous oxides. 1.1 percent solids (96 hours exposure), hot wall
Phosphoric Acid, Wet Process	36	104	40	—	G	E	B	P_2O_5 equivalent 26%, sulfuric acid 2.9%, chloride 350 ppm, hydrofluosilicic acid trace, aluminum phosphate trace, ferric phosphate trace, moderate aeration
Phosphoric Acid, Wet Process	36	172	78	—	G	E	U	P_2O_5 equivalent 26%, sulfuric acid 2.9%, chloride 350 ppm, hydrofluoric acid, trace water. Suspended matter: calcium sulfate dihydrate 30% of suspension weight, calcium phosphate 0.1%, moderate aeration
Phosphoric Acid, Wet Process	39	170-183	77-84	—	—	E	—	2 percent H_2SO_4, total fluorides 1.2 percent, gypsum 30 percent
Phosphoric Acid, Wet Process	39	170-183	77-84	U	G	E	U	96 days, liquid phase, 2% H_2SO_4, HF and H_2SiF_6 trace, aeration moderate, agitation strong
Phosphoric Acid, Wet Process	39	183	84	U	G	E	U	28% P_2O_5, sulfuric acid 2%, hydrofluosilicic and hydrofluoric about 1.2%. Suspended gypsum 30% of suspension weight, aeration
Phosphoric Acid, Wet Process	53.8	121-149	49-65	—	E	—	—	in evaporation of H_3PO_4 plus 1.62-1.70 F_2, 1.5-2.5 H_2SO_4, 2 percent $CaSO_4$ in thickener. Alloy C = 1.7 mpy
Phosphoric Acid, Wet Process	55	180	82	—	G	G	U	H_3PO_4 (40% P_2O_5), containing combined fluorine, calcium sulfate, hydrofluosilicic acid.
Phosphoric Acid, Wet Process	55	232	111	U	U	—	U	40% P_2O_5 equivalent, containing 3% sulfuric acid and suspended calcium sulfate; slurry. Gases containing water and fluorine compounds are evolved at the exposure area.
Phosphoric Acid, Wet Process	56†	190-230	88-110	—	—	E	—	2 percent H_2SO_4, 1 percent F, 1.5 percent ferrous and aluminum oxides, 4 percent solids (48 hours exposure), liquid
Phosphoric Acid, Wet Process	56†	225-245	107-118	—	—	G	—	2 percent H_2SO_4, 1 percent F, 1.5 percent ferrous and aluminum oxides, 4 percent solids (48 hours exposure), hot wall
Phosphoric Acid, Wet Process	56†	300	149	—	—	B	—	2 percent H_2SO_4, 1 percent F, 1.5 percent ferrous and aluminum oxides, 4 percent solids (48 hours exposure), hot wall
Phosphoric Acid, Wet Process	56† 66† 66†	330 325 340	166 163 171	— — —	— — —	U B U	— — —	small amounts of Co, MgO, Fe, Al_2O_3, SiO_2, Na_2O, Cl. No fluorides or H_2SO_4 present (48 hours exposure), hot wall
Phosphoric Acid, Wet Process	69	490 to 550	254 to 287	B	B	—	—	highly concentrated, aerated acid, 69% P_2O_5, static and agitated

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

† — percent P_2O_5

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Phosphoric Acid, Wet Process	70-100	60-600	16-315	—	B	—	—	H_3PO_4 (72% P_2O_5), sulfuric acid 3.7% (3.0% SO_3); fluoride 0.5%, moderate aeration
Phosphoric Acid, Wet Process	70	200	93	E	E	—	E	highly concentrated, unaerated acid, 70.3% P_2O_5, static and agitated
Phosphoric Acid, Wet Process	70	300	149	E	E	—	S	highly concentrated, unaerated acid, 70.3% P_2O_5, static and agitated
Phosphoric Acid, Wet Process	93.5	398-410	203-210	—	—	B	—	(67.8 percent P_2O_5), containing about 4.3 percent sulfuric acid and 4.4 percent iron and aluminum
Phosphoric Acid, Wet Process	96.6	410	210	—	E	—	G	70% as P_2O_5, 35% ortho, 35% non-ortho; sulfuric acid about 4%, hydrofluoric acid about 0.3%, calcium about 0.2%
Phosphoric Acid, Wet Process	98	390-460	199-238	—	S	—	—	(71% P_2O_5), sulfuric acid 4-6%, iron and aluminum 2.8-3.0% as trioxides, fluorine compounds 0.5-1.0% (calculated as fluoride), extensive aeration
Phosphoric Acid, Wet Process	98	400	204	B	B	B	—	ammonium bisulfate 3.8%, hydrofluoric acid 0.4%, 23 days
Phosphoric Acid, Wet Process	98	460	237	U	S	G	—	71% P_2O_5, sulfuric acid 4-6%, iron and aluminum 2.8-3.0% as trioxides, fluorine compounds 0.5-1.0% (calculated as fluoride), aeration
Phosphoric Acid, Wet Process	—	300	149	G	G	G	B	nominal analysis: H_3PO_4 equivalent 101.0%; total P_2O_5 73.19% ortho P_2O_5 27.58%; total solids 1.17%; CaO 0.59%; SO_4 1.97%; F 0.40%; Fe_2O_3 2.05%; Al_2O_3 1.56%; MgO 0.75%, aeration
Phosphoric Acid, Wet Process	—	300-350	149-177	—	G	—	S	superphosphoric acid, 94.8% (as ortho acid). Total P_2O_5 68.54%; ortho P_2O_5 51.08%; Fe_2O_3 = 2.30%; SO_4 = 2.19%; Al_2O_3 = 1.92%; Fe = 0.33%. Concentration gradually reduced to 80% H_3PO_4 (54% P_2O_5), each day 1/40 of acid was replaced with 54% P_2O_5 acid (80% H_3PO_4 equivalent)
Phosphoric Acid, Wet Process	—	410	210	U	U	B	U	vapor above phosphoric acid 93.5% (67% P_2O_5), containing about 4.3% sulfuric acid and 4.4% iron and aluminum oxides. Fluoride is present below 1.5%, aeration
Phosphorous Chlorides	—	-45 to -30	-43 to -34	—	E	—	E	phosphorus trichloride; methyl dichlorphosphine, CH_3PCl_2; lower concentrations phosphorous oxychloride, $POCl_3$; methoxydichloro phosphine, CH_3OPCl_2; triethyl phosphate, $(C_2H_5O)_3$ PO; chlorine. Anhydrous.
Phosphorous, Elemental	—	149-158	65-70	—	E	—	—	storage. Alloy C = 0.2 mpy
Phosphorous Pentoxide	13	285-300	141-149	G	U	—	—	contains approx. 250 ppm F_2
Phosphorous Pentoxide	—	1472	800	U	—	—	—	
Phosphorous and Phosphoric Acid	—	—	—	—	G	—	—	phosphorus pentoxide, iodine, chlorine and water
Phthalic Anhydride	—	60	16	E	E	—	S	unspecified alcohol, phthalate ester, sulfuric acid <1%
Phthalic Anhydride	—	60-275	16-135	—	E	—	S	phthalic anhydride, unspecified alcohol, phthalate ester, sulfuric acid less than 1%.
Phthalic Anhydride	—	70-302	21-150	—	E	—	—	plus methyl CELLOSOLVE, dimethoxyethyl phthalte. Alloy C = 0.3 mpy
Phthalic Anhydride Liquid	—	335-500	168-260	E	E	—	—	plus small amounts of maleic benzoic acid and naphthaquinone
Phthalic Anhydride Vapors (Crude)	—	400-550	204-288	E	E	—	—	plus maleic acid and water. Vapors 7 ft./sec. Alloy C = 0.05 mpy
Phthalic Anhydride, (Vapor off Reaction of)	—	60	16	E	E	—	E	unspecified alcohol with sulfuric acid <1%, forming phthalate seter.
Phthalate, Dipropyl	78	245	118	—	S	—	—	plus 17.4 percent propyl alcohol, 3 percent benzene, 1 percent phthalic anhydride, 1 percent H_2SO_4, 0.1 percent water
Pickling Solution, Prague	—	B.P.	B.P.	—	E	—	—	88 percent NaCl, 6 percent $NaNO_2$, 5 percent $NaNO_3$, and small amounts of dextrose glycerine. Alloy C <0.1 mpy
Plating Solutions, Lead, Tin, Antimony	—	68-72	20-22	E	—	—	—	in plating tank
Polyamine	—	360	182	E	E	—	E	air free
Potassium Bicarbonate	10 20 30 40	to B.P. to B.P. to B.P. B.P.	to B.P. to B.P. to B.P. B.P.	S S S S	— — — —	— — — —	— — — —	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Potassium Bisulfite	—	130	54	—	E	—	E	about 50% water; pH 6.5 to 4.5, moderate aeration
Potassium Bisulfite	—	145	63	S	E	—	E	about 50% water; pH 6.5 to 4.5, aeration
Potassium Bromide	75	180	82	—	E	—	—	plus potassium bromate, KOH, Br_2, trace of iron. Alloy C = 1.1 mpy
Potassium Carbonate	All	to B.P.	to B.P.	S	S	—	—	
	100	1500	816	S	—	—	—	
Potassium Chloride	10	to B.P.	to B.P.	S	S	—	—	
	20	125 to B.P.	52 to B.P.	S	—	—	—	
	28	150	66	E*	E	—	—	*during manufature of electrolytic potassium hydroxide
	28	175	79	E	—	—	—	
	28	B.P.	B.P.	B	—	—	—	
Potassium Chloride	10	220	104	—	E	—	E	concentrated brine in KCl, 20% $CaCl_2$ (extraction pilot plant; some iron chloride present as contaminant)
Potassium Chloride	10	230	110	—	E	E	E	plus 20% calcium chloride (some iron chloride present as contaminant), slight aeration
Potassium Chloride	99	325	163	E	E	E	E*	sodium chloride 1%, acetic acid Duration of test — 93 days Aeration — extensive Agitation — extensive Type of test — field Process involved — anti-caking treatment of fine granular KCl *stress-corrosion cracked
Potassium Chloride	99	325	163	—	E	—	E	sodium chloride 1%, solid, acetic acid vapor, water vapor, amine acetate-water emulsion was added to salt mixture, extensive aeration
Potassium Chloride	—	85-105	29-41	—	E	—	E	saturated KCl-NaCl brine with small amounts of $MgCl_2$ and H_2O. Possible traces of copper.
Potassium Chloride	—	95	35	—	E	E	E	saturated KCl-NaCl brine
Potassium Chloride	—	195-198	91-92	—	E	—	S	saturated KCl-NaCl brine with small amounts of $MgCl_2$ and H_2O. Possible traces of copper.
Potassium Chloride	—	196	91	—	E	G	S	saturated KCl-NaCl brine with small amounts of $MgCl_2$ and H_2O. Possible traces of copper.
Potassium Chloride Brine	—	140	60	—	E	—	—	KCl = 325 grams/liter, KOH = 2 grams/liter, K_2CO_3 = 0.2 grams/liter. Alloy C = 0.002 mpy
Potassium Chloride — Sodium Chloride Brine	Saturated	85-105	29-41	—	E	E	E	small quantity of $MgCl_2$ and H_2S. 113 days, agitation .1 to .3 fps
Potassium Chloride — Sodium Chloride Brine	Saturated	196	91	—	E	G	S	small amounts $MgCl_2$ and H_2S. 42 days, agitation .1 to .3 fps
Potassium Chloride — Sodium Chloride Brine	Saturated	200	93	—	—	E	E	impurities $MgSO_4$, $CaSO_4$, $MgCl_2$. 36 days
Potassium Chromate	10	75	24	E	E	—	—	
Potassium Cyanide	10	75	24	S	—	—	—	
Potassium Dichromate	10	100	38	—	S	—	—	
	15	100	38	—	S	—	—	
	25	100	38	—	S	—	—	
Potassium Ferrocyanide	5	75	24	S	—	—	—	
Potassium Ferricyanide	10	75	24	S	—	—	—	
	30	75	24	S	—	—	—	
Potassium Hypochlorite	50	200	93	E	E	—	—	plus 50 percent NaOH. Alloy C = 0.03 mpy
Potassium Hypochlorite	All	to B.P.	to B.P.	—	S	—	—	
Potassium Hydroxide	10	to B.P.	to B.P.	S	S	—	—	
	20	to B.P.	to B.P.	S	S	—	—	
	30	to B.P.	to B.P.	S	S	—	—	
	40	to B.P.	to B.P.	S	S	—	—	
	50	to B.P.	to B.P.	S	S	—	—	
	60	B.P.	B.P.	S	—	—	—	
	90	to 125	to 52	S	—	—	—	
Potassium Hydroxide	20	203	95	—	E	—	—	in isopropanol and isopropanol solution of hexachlorpentadiene. Alloy C = 0.09 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Potassium Hydroxide	40	Room	Room	—	E	—	—	
Potassium Iodide	—	203	95	—	E	—	—	in preparation of KI by neutralizing iron iodide (40° Bé, pH = 2) with K_2CO_3. Max. pit = 0.001. Alloy C <0.1 mpy
Potassium Nitrate	All	to B.P.	to B.P.	—	S	—	—	
Potassium Perchlorate	25 50 75	75 75 75	24 24 24	— — —	S S S	— — —	— — —	
Potassium Permanganate	25 50 75	75 75 75	24 24 24	— — —	E E S	— — —	— — —	
Potassium Persulfate	4	75	24	—	E	—	—	catalyst for synthetic rubber production. Alloy C = 0.1 mpy
Potassium Sulfate	10 20	75 to 125	24 to 52	— S	S —	— —	— —	
Potassium Sulfite	—	140	60	—	E	—	G	potassium bisulfite, about 50% water; pH 6.0-5.0, sulfur dioxide in flue gas, extensive aeration
Potassium Sulfite	—	145	63	—	E	—	E	potassium bisulfite, about 50% water; pH 5.9-7.2, moderate aeration
Potassium Sulfite	—	145	63	—	E	—	E	potassium bisulfite, about 50% water; pH 6.0-7.2
Potassium Sulfite	—	180	82	G	E	—	E	potassium bisulfite, about 50% water; pH 5.9-7.2
Potassium Sulfite	—	180	82	U	E	—	G	potassium bisulfite, about 50% water; pH 6.0-7.0, sulfur dioxide in flue gas, aeration
Potassium Sulfite	—	180	82	S	E	—	E	potassium bisulfite, about 50% water; pH 6.0-7.2
Potassium Sulfite	—	230	110	—	E	—	E	potassium bisulfite, about 50% water; pH 6.5-5.0, sulfur dioxide in flue gas
Potassium Sulfite	—	270	132	—	G	—	E	potassium bisulfite, about 50% water; pH 6.8-5.5
Potassium Sulfite	—	280	138	S	E	—	E	potassium bisulfite, about 50% water; pH 6.5 to 5.0, sulfur dioxide in flue gas
Potassium Sulfite	—	300	149	B	G	—	E	potassium bisulfite, about 50% water; pH 6.8 to 5.5
Propanol	47	356	180	—	E	—	G	3% formic acid, balance water, 24 hrs. lab test
Propanol	—	110	43	E	E	—	—	plus free SO_2 and H_2SO_4, pH = 2.5-5. Alloy C = 0.1 mpy
Propionic Acid	60-65	311	155	—	E	—	—	plus 10-12 percent butyric acid, 4-7 percent acetic acid. Alloy C <0.1 mpy
Propionic Acid	64	500	260	B	S	—	U	35% propionic anhydride; 1% nickel acetate, 7 hrs., lab test, continuous feed 2000 cc per hour
Propionic Acid	80	212-338	100-170	—	E	—	—	plus 2.5 percent butyric acid, 2 percent nitric acid, 0.1 percent acetic acid. Alloy C = 0.7 mpy
Propionic Acid	90	248-320	120-160	—	E	—	—	plus 4 percent butyric acid, 1 percent nitric acid, acetic acid. Alloy C = 0.5 mpy
Propionic Acid	94	85-356	30-180	—	E	—	—	plus 2 percent butyric acid, 3 percent boiling esters, 1 percent acetic acid during nitric acid treatment. Alloy C = 0.1 mpy
Propionic Acid	97	288	142	—	E	—	—	plus 3 percent acetic acid. Alloy C = 0.07 mpy
Proprietary Compounds	—	284	140	—	E	—	G	proprietary acid chlorides, toluol and VMP naphtha. Also methanol N, 1-3% HCl during a cleaning cycle, occasionally DMF also to clean.
Proprietary Compounds	—	329	165	—	E	—	G	proprietary acid chlorides, toluol and VMP naphtha. Also methanol N, 1-3% HCl during a cleaning cycle, occasionally DMF also to clean.
Protein Hydrolysate	—	100-115	38-46	—	E	—	—	plus HCl to pH of 1.5 and some SO_2 mixing digestion tank. Alloy C = 0.6 mpy
2 Pthoxyethyl Acetate	96	331	166	E	E	—	E	acetic anhydride 0.4%, acetic acid 0.2%, water unknown, extensive aeration
Pyridine	6	100-120	38-49	E	E	—	—	plus 5 percent NaCl, 2 percent CH_2Cl_2, 1 percent NaOH, and water. Alloy C <0.1 mpy
Pyridine	50	80-100	27-38	E	E	—	—	plus traces of HCl, CH_2Cl_2 and acetone in separation of pyridine from water. Alloy C <0.1 mpy. At 200 deg. F, alloy C <0.1 mpy
Pyridine	9M	572	300	U	U	—	—	plus 1M ferric chloride; also a mixture of pyridine, pyridine hydrochloric and ferric chloride, 6 to 48 hrs., lab test

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point
M — Molar

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Pyrogallic Acid	All	to B.P.	to B.P.	S	S	—	—	
Rayon	—	122-167	50-75	—	E	—	S	rayon "spin" bath — 5-10% sulfuric acid; 1-8% zinc sulfate; 10-15% sodium sulfate. Free carbon bisulfide present and saturated with hydrogen sulfide. Amines and ethylene oxide condensation products present to 1%.
Rayon	—	208	98	—	E	—	B	rayon "cascade" bath — 1.5-5% sulfuric acid; 1-3% zinc sulfate; 10-15% sodium sulfate; free carbon bisulfide present and saturated with hydrogen sulfide.
Rayon Bleach	—	210	99	—	G	—	—	plus 0.1 percent sodium chlorite, 0.03 percent sodium carbonate, 0.1 percent synthetic detergent, 0.035 percent H_2O_2, 0.07 percent acetic acid. Alloy C = 3 mpy
Rayon Spin Bath	—	125	52	E	E	—	—	10 percent H_2SO_4 — spinning bleach, hardening etc. Vapor and liquid phases.
Rayon Spin Bath	—	100-210	38-99	S	G	—	—	extensive aeration. Alloy C = 4 mpy
Rayon Spin Bath	—	122	50	—	E	—	—	11 percent H_2SO_4, 24 percent SO_4, saturated with H_2S
Rayon Spin Bath, Dilute	—	Room	Room	—	G	—	—	in splash zone H_2SO_4 10 percent to less than 0.001 percent. From 0.500 ppm of CS_2 and H_2S. Alloy C = 3 mpy
Rayon Spin Bath, Spent	—	203	95	S	E	—	—	H_2SO_4 = 0.25 percent, Na_2SO_4 = 0.25 percent in casting machine. Alloy C = 0.1 mpy
Resin (Alkyd, Polyester, Amine Types)	—	25	-4	E	E	—	E	sodium hydroxide cleaning solutions (6% boiling). Various raw materials include phthalic and maleic anhydrides, isopthalic acid, glycerol, pentacrythritol; linseed, soy, castor and tall oils, vinyltoluene, propylene and ethylene and other glycols.
Rosin and Rosin Oil	—	572	300	—	E	—	—	in boiling solution at still bottom and in vapors. Alloy C = 0.1 mpy
Rubber	—	72	22	—	E	—	—	elastomer dissolved in aliphatic solvent to which bromine was added. pH 7.4, tested in absence of any light source, moderate aeration.
Rubidium	100	1400 1500 1600	760 815 871	S B S	— — —	— — —	— — —	lab test, 500 hrs., 1400°F-IG cracking, 1500°F-IG cracking, 1600°F-no cracking
Salicylic Acid	—	77-258	25-126	U	E	—	—	production of acid. pH varies from 12 to 2. Alloy C = 1.73 mpy
Salt Water, Clean	—	38	3	G	E	—	E	
Scrubbed Boiler Fluegas	—	120	49	—	—	E	E	15% CO_2, 3% O_2, 400 ppm SO_2, NOX and fly ash being scrubbed in slurry of 7% $CaSO_3$, 2% $CaSO_4$, .5% CaCO, pH 5. Scrubbing of SO_2 and fly ash from power plant flue gas Aeration — moderate Agitation — 200,000 ACFM gas Total days — 158
Scrubbed Boiler Fluegas	—	120	49	—	E	E	E	limestone slurry, 1750 ppm SO_2, 2-3% fly ash, 3% $CaCO_3$, 2-3% $CaSO_3$ plus $CASO_4$, pH 6-6.6, 2000-3000 ppm Cl, moderate aeration
Scrubbed Boiler Fluegas	—	120	49	—	—	E	E	15% CO_2, 3% O_2, less than 100 ppm SO_2. Liquid spray with some dissolved solids present, pH 6-7. Scrubbing of SO_2 and fly ash from power plant flue gas. Aeration — moderate Agitation — by gas flow Total days — 158
Scrubbed Boiler Fluegas	—	190	88	—	E	E	E	0-400 ppm SO_2, 10% water vapor, fly ash after limestone slurry scrubbing, moderate aeration
Scrubber Effluent Gas	—	110-115	43-46	—	E	E	E	aeration
Scrubber Environment	—	300	149	—	E	E	E	for municipal refuse incinerator. Hot, acid chloride environment, pH range about 1-6, extensive aeration
Scrubber Environment	—	400	204	—	E	—	E	for municipal refuse incinerator. Hot, acid chloride environment, pH range about 1-6, extensive aeration
Scrubbing Liquor Boiler Fluegas	—	120	49	—	—	E	E	4.4% $CaSO_3$, 2.5% $CaCO_3$, 0.5% fly ash, 0.1% $CaSO_4$, pH 6-7. Scrubbing of SO_2 and fly ash from power plant flue gas Aeration — moderate Agitation — by gas flow Total days — 158
Scrubbing Liquor	—	150	66	—	E	E	E	portable steam generator flue gases containing SO_2, NOX, N, CO_2 and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, 21 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Scrubbing Liquor	—	160	71	—	E	E	E	portable steam generator flue gases containing SO_2, NOX, N, CO_2 and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, 20 days, moderate aeration
Scrubbing Liquors Incinerators	—	105	41	—	E	—	E	flue gas scrubbing liquor containing fly ash and dissolved chlorides, sulfur oxides, nitrogen oxides, carbon dioxide and carbon monoxide, pH 4.5, extensive aeration
Scrubbing Liquors Incinerators	—	160	71	—	E	—	E	flue gas containing chlorides, sulfur oxides, nitrogen oxides, carbon dioxide, carbon monoxide, extensive aeration
Scrubbing Liquors Incinerators	—	160	71	—	E	—	E	flue gas, municipal, saturated with water vapor.
Scrubbing Liquors Incinerators	—	164	73	—	E	—	E	flue gas from furnace incinerator after scrubbing, water saturated, high excess air (100-200%), extensive aeration
Scrubbing Liquors Incinerators	—	185	85	—	E	—	E	clarifier liquid in municipal refuse incinerator. Water treated with Calverts coagulant 11 and ammonia to nominal pH of 6, moderate aeration
Scrubbing Liquors Incinerators	—	200	93	—	E	—	E	municipal refuse incinerator flue gas effluent after H_2O scrubbing environment. Should be mainly steam with entrained impurities; extensive aeration
Scrubbing Liquors Incinerators	—	200	93	—	E	—	E	scrubber water effluent from prequench chamber of municipal refuse incinerator scrubber. pH about 1
Scrubbing Liquors Incinerators	—	300	149	—	E	—	G	scrubber water, pH 2.53; chloride 175 ppm, sulfate 75 ppm, moderate aeration
Scrubbing Liquors Incinerators	—	400	204	—	E	—	G	municipal refuse incinerator water quenched flue gas hot, acid chloride environment, pH range about 1-6, extensive aeration
Scrubbing Liquors Incinerators	—	800	426	—	E	—	E	hydrochloric acid 0.018%, sulfuric acid 0.008%. Incinerator scrubber water pH 2.53, moderate aeration
Scrubbing Liquors Incinerators	—	—	—	—	G	—	S	flue gas from municipal refuse incinerator
Scrubbing Liquors Pollution Control	—	100	38	—	E	—	E	gas — 0.1 to 0.3% SO_2; 0.006% SO_3; 80% saturated, entrained sodium bisulfite solution; pH = 5 to 6. Extensive aeration
Scrubbing Liquors Pollution Control	—	134	57	—	E	—	E	scrubber stack gas saturated with scrubber liquor containing 0.0084 grains P_2O_5/SCF and 0.14 mg F/SCF.
Scrubbing Liquors Pollution Control	—	155	68	—	G	—	U	scrubber water in defluorination system. HF solution 0.6% as F, 2000 ppm P_2O_5, 700 ppm SO_4, pH 3.0.
Scrubbing Liquor, Power Plant Fluegas Double-Alkali SO_2	—	115-125	46-52	—	E	E	E	aeration
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	E	E	E	7% $CaSO_3$, 2% $CaSO_4$, 1% chloride, pH 5.8-6.1. Joy Hi liquid energy limestone scrubbing process for SO_2 and fly ash removal Aeration — extensive Agitation — gas and liquid flow Total days — 173
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	—	E	E	SO_2 300-800 ppm, 14% CO_2, 3% O_2, pH of liquor 5-5.5. Scrubbing of SO_2 and fly ash from power plant flue gas. Aeration — extensive Agitation — 5-10 ft./sec. Total days — 135.6
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	E	E	E	inlet flue gas, aeration
Scrubbing Liquor, Power Plant Fluegas	—	120	49	—	E	E	E	
Scrubbing Liquor, Power Plant Fluegas	—	122	50	—	E	—	E	7% $CaSO_3$, 2% $CaSO_4$, 1% chloride, pH 5.8-6.1. Gas in 2000-2400 ppm SO_2. Joy Hi liquid energy limestone scrubbing process for SO_2 and fly ash removal Aeration — extensive Agitation — gas and liquid flow Total days — 100
Scrubbing Liquor, Power Plant Fluegas	—	122	50	—	E	—	E	7% $CaSO_3$, 2% $CaSO_4$, 1% $CaCO_3$, 1% Chloride, pH 5.8-6.1. Gas in 2000-2400 ppm SO_2 extensive aeration
Scrubbing Liquor, Power Plant Fluegas	—	130-135	54-57	—	—	E	E	aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Scrubbing Liquor, Power Plant Fluegas	—	145	63	—	E	G	S	aeration
Scrubbing Liquor, Power Plant Fluegas	—	150-350	66-177	—	G	G	G	aeration
Scrubbing Liquor, Power Plant Fluegas	—	176	80	—	E	E	E	H_2S sparged into citric acid $NaCO_3$ plus absorbed SO_2 solution to put sulfur, pH 4-5. Citrate process for sulfur dioxide removal (and sulfur recovery) Aeration — none Agitation — violent Total days — 91
Scrubbing Liquor, Power Plant Fluegas	—	176	80	—	E	E	E	SO_2 being absorbed in solution of citric acid, 80 g/l Na_2CO_3; pH 4.0-5.0. Citrated process for sulfur dioxide removal (and sulfur recovery) Aeration — moderate Agitation — by liquid flow Total days — 91
Scrubbing Liquor, Power Plant Fluegas	—	176	80	—	E	E	E	recycled and makeup 190 g/l citric acid, 80 g/l Na_2CO_3, pH 4-5. Citrate process for sulfur dioxide removal (and sulfur recovery) Aeration — none Agitation — agitated Total days — 91
Scrubbing Liquor, Power Plant Fluegas	—	240	116	—	—	E	E	SO_2 1600-2000 ppm, 14% CO_2, 3% O_2, exposed to liquor spray at pH 10 containing solids. Scrubbing SO_2 and fly ash from power plant flue gas. Aeration — extensive Agitation — 5-10 ft./sec. Total days — 135.6
Scrubbing Liquors Smoke and Fluegas	—	70	21	—	E	—	B	hydrochloric acid, sulfuric acid, sulfurous acid, hydrobromic acid, organic solvents, some chlorinated, pH approx. 1, moderate aeration
Scrubbing Liquors Smoke and Fluegas	—	117	47	—	E	—	E	calcium sulfite, calcium sulfate, calcium carbonate, fly ash, all suspended as 10-15% (by wt.) slurry, pH not specified
Scrubbing Liquors Smoke and Fluegas	—	130	54	—	E	—	E	flue gas containing sulfur dioxide. Entrained potassium sulfite-bisulfate solution, pH about 4.0, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	135	57	—	E	—	E	flue gas scrubbing liquor containing fly ash and dissolved chlorides, sulfur oxides, nitrogen oxides, carbon dioxide and carbon monoxide, pH 4.5, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	140	60	—	E	—	—	flue gas containing wetted fly ash. Scrubber liquor containing sulfuric acid 0.19%, hydrochloric acid 0.057%, pH 2 to 5, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	160	71	—	E	—	E	water scrubber; pH 2.53; chloride 175 ppm, sulfate 75 ppm, moderate aeration
Scrubbing Liquors Smoke and Fluegas	—	164	73	—	E	—	E	flue gas from incinerator, scrubbed
Scrubbing Liquors Smoke and Fluegas	—	170	77	—	E	—	E	water from incinerator scrubber. Chlorides 900-1000 ppm, iron 24 ppm. pH 1.95-2.03, extensive aeration
Scrubbing Liquors Smoke and Fluegas	—	175	79	—	G	—	B	flue gas containing H_2O, SO_2, SO_3, HCl, H_2S and NaOH
Scrubbing Liquors Smoke and Fluegas	—	175	79	—	E	—	G	flue gas containing H_2O, SO_2, SO_3, HCl, H_2S and NaOH
Scrubbing Liquors Smoke and Fluegas	—	200	93	—	E	—	E	flue gas containing H_2O, SO_2, SO_3, HCl, H_2S and NaOH
Scrubbing Liquors Smoke and Fluegas	—	200	93	—	E	—	E	flue gas, water-scrubbed, from combustion of municipal refuse; nearly saturated with water vapor, considerable aeration
Scrubbing Liquors Smoke and Fluegas	—	280	138	—	E	—	S	flue gas containing sulfur dioxide and sulfur trioxide. Considerable liquid water and water vapor, pH 2.0 to 4.0, entrained, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	80	27	—	E	—	E	calcium carbonate, calcium sulfate, calcium sulfite, and fly ash all suspended as about 20% (by wt.) slurry. pH not specified, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	89	32	—	E	—	—	limestone slurry 15% $CaCO_3$ in water. pH 6.3-7.9
Scrubbing Liquors Sulfur Dioxide	—	93	34	—	E	—	—	5% H_2SO_4 scrubbing solution for smelter gas containing 2-10% O_2, less than 500 ppm sulfur dioxide and 160 ppm chlorides, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	100	38	—	E	—	—	copper smelter gas and recycled cooling spray water (pH as low as 1.7 average 2.5) 1-1.5% SO_2 in gas plus particulate and SO_3, extensive aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Scrubbing Liquors Sulfur Dioxide	—	105	41	—	E	—	—	copper smelting gas containing .75-1% SO_2 and some sulfuric acid mist (25-100 ppm), extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	105	41	—	E	—	—	smelter gas in TCA scrubber and limestone slurry (15%, pH 5.2-7) which is converted to $CaSO_3$ and some $CaSO_4$ by SO_2 in the gas, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	107	42	—	E	—	—	limestone slurry 15% solids, $CaCO_3$ plus $CaSO_3$ and a small amount of $CaSO_4$, pH 3.7-6.7, ave. 5.6, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	115	46	—	E	—	E	calcium sulfite, calcium sulfate, calcium carbonate, fly ash, all suspended as 30-50% (by wt.) slurry. pH not specified
Scrubbing Liquors Sulfur Dioxide	—	117	47	—	E	—	E	calcium carbonate, calcium sulfate, calcium sulfite, all suspended as 6-11% (by wt.) slurry, pH not specified, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	117	47	—	E	—	E	flue gas containing entrained H_2O and slurry (calcium sulfate, calcium sulfite, calcium carbonate), moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	—	magnesium oxide slurry scrubbing liquor for SO_2 removal from power plant flue gas, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	boiler flue gas, 0-400 ppm SO_2, 10% water vapor, fly ash after limestone slurry scrubbing, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	8% limestone slurry, $CaCO_3$, $CaSO_3$, $CaSO_4$ and fly ash. pH 5.0-6.0, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	boiler flue gas and limestone slurry, 1750 ppm SO_2, 2-3% fly ash .3% $CaCO_3$, 2-3% $CaSO_3$ plus $CaSO_4$, pH 6-6.6, 2000-3000 ppm Cl, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	120	49	—	E	—	E	sodium sulfate scrubber liquor. Gas from oil fired sodium sulfate flash drying system. Liquor contains dilute Na_2SO_4, H_2SO_3, pH 2-3, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	122	50	—	E	—	E	power plant flue gas scrubbing liquor 7% $CaSO_3$, 2% $CaSO_4$, 1% $CaCO_3$, 1% chloride, pH 5.8-6.1 Gas in 2000-2400 ppm SO_2 extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	122	50	—	E	—	E	power plant flue gas scrubbing liquor 7% $CaSO_3$, 2% $CaSO_4$, 1% $CaCO_3$, 1% chloride, pH 5.8-6.1 Gas in 2000-2400 ppm SO_2 extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	122	50	—	E	—	E	scrubbed power plant flue gas containing 300-500 ppm SO_2 and 15% H_2O, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	125	52	—	E	—	E	SO_2 gas scrubbing, 800 ppm SO_2, 15% H_2O, 12% CO_2, 68% N_2, 5% O_2, chlorides, 2000 ppm fluoride, some SO_3, pH 3, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	125	52	—	E	—	E	power plant flue gas after limestone slurry scrubbing containing 0.1 lb./min. of residual SO_2. Effluent of absorber section of scrubber, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	131	55	—	S	—	B	SO_2 scrubber gas, 5% SO_2, 3% SO_3, 7% O_2, balance N_2 saturated with H_2O. Possible splashing with solution containing 1-3 g/l Cu, pH 6
Scrubbing Liquors Sulfur Dioxide	—	135	57	—	E	—	—	copper smelting gas after cooling in a H_2O spray tower. Gas contains H_2O at 2.5 pH plus sulfuric acid mist (25-100 ppm), extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	140	60	—	G	—	—	scrubbed roaster gas; SO_2 100-2000 ppm, H_2SO_4 100-1500 ppm, balance wet air; heavy loading H_2O droplets, containing Ca salts and ore dust
Scrubbing Liquors Sulfur Dioxide	—	143	62	—	E	—	E	wet venturi scrubbing stream removing fly ash from boiler burning corn cobs. Gas 83% N_2, 360 ppm SO_2, 80 ppm H_2SO_4. Ash 6% Cl, extensive aeration
Scrubbing Liquors Sulfur Dioxide	—	150	66	—	E	—	E	scrubbing liquor for portable steam generator flue gases containing SO_2, NOX, N, CO_2, and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	150	66	—	B	—	—	wet flue gas after H_2O spray, scrubber slurry ($CaSO_3$ mainly, also $Ca(OH)_2$ or $CaCO_3$ plus $CaSO_4$, pH 3-12) during upsets.
Scrubbing Liquors Sulfur Dioxide	—	160	71	—	E	—	E	scrubbing liquor for portable steam generator flue gases containing SO_2, NOX, N, CO_2, and O_2. Liquor alkaline oil field H_2O with 5000 ppm Cl, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	167	75	—	E	—	—	dimethylaniline containing SO_2 steam and sulfur dioxide
Scrubbing Liquors Sulfur Dioxide	—	176	80	—	G	—	B	SO_2 scrubber gas. 5% SO_2, 6.5% O_2 and 88.5% N_2 (dry basis) saturated with water vapor, extensive aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Scrubbing Liquors Sulfur Dioxide	—	176	80	—	E	—	E	power plant flue gas scrubbing liquor. Recycled and makeup 190 g/l citric acid, 80 g/l Na_2CO_3, pH 4-5
Scrubbing Liquors Sulfur Dioxide	—	176	80	—	E	—	E	power plant flue gas scrubbing liquor. H_2S sparged into citric acid, sodium carbonate plus absorbed SO_2 solution to ppt sulfur. pH 4.5
Scrubbing Liquors Sulfur Dioxide	—	190	88	—	E	—	E	boiler flue gas, 0-400 ppm SO_2, 10% water vapor, fly ash after limestone slurry scrubbing, moderate aeration
Scrubbing Liquors Sulfur Dioxide	—	200	93	—	E	—	E	power plant flue gas scrubbing. Decanted scrubbing liquor after removal of sulfur and during removal of Na_2SO_4 by-product by XTALZN.
Scrubbing Liquors Sulfur Dioxide	—	235	113	—	E	—	E	power plant flue gas scrubbing. Molten sulfur phase
Scrubbing Liquors Sulfur Dioxide	—	235	113	—	E	—	E	power plant flue gas scrubbing. Sulfur slurry phase of sulfur decanter containing 30-50% solids
Scrubbing Liquors Sulfur Dioxide	—	235	113	—	E	—	E	power plant flue gas scrubbing. Citrate solution phase of sulfur decanter. (Dilute and impure sodium citrate)
Scrubbing Liquors Sulfur Dioxide	—	370	188	—	E	—	—	flue gas from a metallurgical roaster, typical .02 grains/cu. ft. dust, SO_2 1500 ppm, SO_3 750 ppm, CO_2 .7% H_2O 1-3%, bal. air
Scrubbed Power Plant Fluegas	—	115-125	46-52	—	E	E	E	containing droplets of dbl. alkali scrubbing liquor, aeration
Scrubbed Power Plant Fluegas	—	120	49	—	E	E	E	aeration
Scrubbed Power Plant Fluegas	—	122	50	—	E	—	G	containing 300-500 ppm SO_2 and 15% H_2O. Joy Hi liquid energy limestone scrubbing process for SO_2 and fly ash removal Aeration — extensive Agitation — gas and liquid flow Total days — 100
Scrubbed Power Plant Fluegas	—	135-145	57-63	—	E	E	E	dbl. alkali process, aeration
Scrubbed Power Plant Fluegas	—	160-165	71-74	—	—	E	E	saturated with H_2O and SO_2, aeration
Scrubbing Power Plant Fluegas	—	176	80	—	E	E	E	vapor phase of 190 g/l citric acid, 80 g/l Na_2CO_3, solution for absorption of SO_2. pH 4-5 Aeration — moderate Agitation — by gas flow Total days — 91
Scrubbing Power Plant Fluegas	—	176	80	—	E	E	E	SO_2 being absorbed into solution of 190 g/l citric acid, 80 g/l Na_2CO_3, pH 4.0-5.0, moderate aeration
Scrubbing Power Plant Fluegas	—	200	93	—	E	E	E	decanted scrubbing liquor after removal of sulfur and during removal of Na_2SO_4 by-product by XTALZN. Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbing Power Plant Fluegas	—	235	113	—	E	E	E	citrate solution phase of sulfur decanter, (dilute and impure sodium citrate). Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbing Power Plant Fluegas	—	235	113	—	E	E	E	molten sulfur phase. Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbing Power Plant Fluegas	—	235	113	—	E	E	E	sulfur slurry phase of sulfur decanter containing 30-50% solids. Citrate process for sulfur dioxide removal (and sulfur recovery), 91 days
Scrubbed Recovery Boiler, Fluegas	—	165	74	—	E	—	E	N_2, O_2, water vapor, CO_2, traces of CO, H_2S, SO_2, methyl mercaptan plus slight liquor carryover. Scrubbing of recovery boiler flue gas firing kraft process black liquor Aeration — extensive Agitation — 10-12 ft./sec. Total days — 67
Scrubber Fluegas, Incineration of Sewage Sludge	—	240	116	U	E	E	E	Aeration — extensive Agitation — by gas flow Total days — 65.9
Scrubber Liquor for Recovery Boiler Fluegas	—	165	74	—	E	—	E	20.5 g/l Na_2CO_3, 21.5 g/l $NaHCO_3$, 3.1 g/l chloride solids, 15% traces $Na_2S_2O_3$. Scrubbing of recovery boiler flue gas firing kraft process black liquor Aeration — extensive Agitation — moderate-violent Total days — 67.0

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Scrubber Liquor, Sodium Sulfate	—	120	49	—	E	E	E	gas from oil fired sodium sulfate flash drying steam. Liquor contains dilute Na_2SO_4, H_2SO_3, pH 2-3, extensive aeration
Scrubbed Municipal Garbage Incinerator Fluegas	—	170	77	—	E	G	G	90% water saturated, downstream of scrubber and demister. pH 3-4. Municipal garbage incinerator flue gas scrubbing; agitation high, aeration extensive; 51 days
Scrubbed Power Plant Fluegas & Condensate	—	143	63	—	—	E	G	gas 10% CO_2, 13% O_2, Bal N_2 (H_2O Satd). Fly ash carryover, pH below 0. Scrubbing of SO_2 and fly ash from power plant flue gas. Aeration — extensive Agitation — 5-10 ft./sec. Total days — 135.6
Scrubbing Solution & Quenched Boiler Stack Gas	—	110-115	43-46	—	E	E	E	plus fly ash, aeration
Scrubber Water	—	155	68	S	G	E	U	defluorination system. HF solution 0.6% as F, 2000 ppm P_2O_5, 700 ppm SO_4, pH 3.0, 92 days
Scrubber Water Effluent	—	200	93	—	E	E	E	from prequench chamber of municipal refuse incinerator scrubber. pH about 1
Seawater Mixtures	—	240	116	—	E	—	E	hydrogen sulfide gas with mist of de-aerated sea water
Sea Water	—	196	91	—	E	—	—	5 months, flow rate — 5 gpm
Sea Water and Diesel Fuel Exhaust Products	—	Ambient	Ambient	—	E	—	—	containing chlorides, sodium, sulfur, carbon
Sebacic Acid	10 10	90 B.P.	32 B.P.	B B	E E	— —	— —	plus small amounts of H_2SO_4, Na_2SO_4 and K_2SO_4
Sebacic Acid	10	90-220	32-104	S	E	—	—	plus 0.05-2 percent max. H_2SO_4 and traces of Na_2SO_4, K_2SO_4, H_2O balance. Alloy C = 0.4 mpy
Sebacic Acid (Crude)	—	428	220	—	E	—	—	in still. Alloy C = 0.4 mpy
Secondary Discharge Effluent	—	170	77	—	E	E	E	municipal garbage incinerator flue gas from secondary chamber after passing through scrubber, marble bed plus entrained liquor at pH 3-4. Agitation moderate; aeration extensive, 51 days
Secondary Discharge Effluent	—	200	93	—	E	E	E	municipal refuse incinerator flue gas effluent after H_2O scrubbing. Environment should be mainly steam with entrained impurities, extensive aeration
Secondary Discharge Effluent	—	300	149	—	E	E	G	municipal refuse incinerator water quenched flue gas, acid chloride environment, pH range about 1.6, extensive aeration
Separate Water Solutions	—	55-104	13-40	B	E	E	S	5-30% HCl, 10-40% H_2SO_4, 10-25% HNO_3, 1-40% NaOH, 127 days, aeration and agitation moderate
Sewage Gas	—	85-95	29-35	E	—	—	—	moisture laden gas from anaerobic digestion of packing house waste. 63 percent CO_2, 36 percent CH_4 and 1 percent H_2S, pH = 7.4 approx.
Sewage, Raw and Processed	—	240	116	—	E	—	—	avg. composition of brine: NH_3 5 ppm, Cl 100 ppm. B.O.D. 200 mg/l, moderate aeration, pH 6.0
Sewage (Scrubbed) Sludge Incinerator Fluegas	—	100-160	38-71	E	E	E	E	aeration
Sewage Sludge Incinerator Fluegas	—	66-72	19-22	G E	E E	E E	E E	sewage sludge incinerator flue gas being scrubbed by once thru water plant effluent water, aeration
Sewage Sludge Incinerator Fluegas	—	100-210	38-99	E E	E E	E E	E E	sewage sludge incinerator flue gas being scrubbed by once thru water plant effluent water, aeration
Sewage Sludge Incinerator Fluegas and Scrubbing Liquor	—	150	66	—	E	—	E	extensive aeration
Sewage Sludge Incinerator Fluegas	—	190-220	88-104	E E	E E	E E	E E	sewage sludge incinerator flue gas being scrubbed by once thru water plant effluent water, aeration
Silica, Acidified	—	700-900	371-482	E	E	—	—	in deacidification of silica by rotary kiln. Alloy C = 0.04 mpy
Silicon Tetrachloride	100	140	60	E	E	—	—	with dry HCl and Cl_2 bubbled through. In production of high purity silica of pigment. Alloy C = 0.1 mpy
Silicon Tetrafluoride	—	113	45	—	G	—	G	acid spray of droplets containing phosphoric acid, hydrofluosilicic acid, phosphate rock dust, water.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Silicon Tetrafluoride	—	131	55	—	E	—	G	acid spray containing hydrofluoric acid, phosphoric acid, hydrofluosilicic acid
Silicon Tetrafluoride	—	167	75	—	S	—	B	acid spray containing phosphoric acid (69% H_3PO_4, 50% P_2O_5), hydrofluosilicic acid, phosphate rock dust, water
Silicon Tetraiodide	—	285-300	140-149	G	—	—	—	plus 2 percent free iodine under reflux half immersed
Silver Bromide	10	75	24	S	—	—	—	
Silver Chloride	10	75	24	—	S	—	—	
Silver Fines (Wet, Grey)	—	212	100	B	U	—	—	very dilute $FeCl_3$ bleaching powder and muratic acid solution, aeration none, agitation by boiling. Alloy C — 12 days
Silver Nitrate	10 20 40	75 75 75	24 24 24	S S S	— — —	— — —	— — —	
Silver Refining	—	220	104	—	E	—	E	acid leach slimes of silver refinery containing Cu, Au, Ag, Se, Te, Pt and Pd, moderate aeration
Silver Refining	—	220	104	S*	E	E	E	acid leach slimes of silver refinery containing Cu, Au, Ag, Se, Te, Pt and Pd, *specimen corroded away or was lost, aeration
Silver Salt	—	70	21	—	E	—	E	possibly nitrate, aqueous solution; concentration unknown
Slurry	45	60	16	—	—	—	B	100 mesh and finer, 2% H_2SO_4, saturated with SO_2, pH 1.0-1.5
Soap Coagulating Serum	—	100-125	38-52	S	E	—	—	strong NaCl solution plus dilute H_2SO_4, rubber, soap and traces of auxiliary solution. Rubber contains 30 percent carbon black pH = 3.5 avg. Alloy C = 0.17 mpy in conversion tank
Soap Fat	—	465-480	240-249	E	E	—	—	steam, fatty acid, glycerol
Sodium Acetate	10	75	24	—	S	—	—	
Sodium Acid Fluoride	8	160	71	G	U	—	—	in agitated crystallizer
Sodium Acid Fluoride	8	140-180	60-82	S	U	—	—	
Sodium Acid Fluoride	—	60-120	16-49	—	B	—	—	in manufacture of fluosilicates. Alloy C = 20.3 mpy
Sodium Aluminate	10	75	24	S	—	—	—	
Sodium Bicarbonate	10 20	to B.P. 110-B.P.	to B.P. 43-B.P.	S S	S S	— —	— —	
Sodium Bisulfate	20	180	82	—	E	—	—	treated under vacuum with sulfuric acid to drain off SO_2 contaminants. Solution decomposed to Na_2SO_4. Alloy C = 0.3 mpy
Sodium Bisulfate	All	to B.P.	to B.P.	S	S	—	—	
Sodium Bisulfite	3-6	—	—	—	E	—	—	in quebracho bisulfiting tanks. Alloy C = 0.1 mpy
Sodium Bromide	All	to B.P.	to B.P.	S	S	—	—	
Sodium Carbonate	10 20 30 100	to B.P. 100-B.P. 100-B.P. 1500	to B.P. 38-B.P. 38-B.P. 816	S S S S	— — — —	— — — —	— — — —	
Sodium Carbonate	1	100	38	—	E	—	G	Na_2CO_3 7-12 g/l, $NaHCO_3$ 2-7 g/l, $NaClO_3$ 40 g/l, NaOCl 5-10 g/l, NaCl 10-40 g/l
Sodium Chlorate	55	230	110	—	E	—	—	plus 7 percent NaCl in vacuum evaporation in manufacture of $NaClO_3$. Alloy C = 0.1 mpy
Sodium Chlorate	Saturated	160-240	71-116	—	E	—	—	sodium chloride solution plus 2-5 grams/liter of sodium hypochlorite. Alloy C = 0.1 mpy
Sodium Chlorate	—	70-220	21-104	—	E	—	—	in crystallizer saturated with NaCl. No hypochlorites present. pH = 6.7. Alloy C = nil mpy
Sodium Chloride	0-10	107	42	—	E	—	E	brine solution waste stream containing 23 mg/l total dissolved solids consisting of 10,000 mg/l chloride and 4,400 mg/l sulfate, pH 1.
Sodium Chloride	7	375	191	—	E	—	—	containing 53% NaCl, 198 days, slight attack under spacer
Sodium Chloride	10	75	24	S	—	—	—	manufacture of sodium fluosilicate, 3.5 percent H_2SiF_6
Sodium Chloride	14	167	75	—	E	—	—	plus 2 grams/liter free chlorine. Alloy C = 0.001 mpy
Sodium Chloride	15	150	66	—	E	E	E	10% calcium chloride; feed brine in potash extraction pilot plant

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sodium Chloride	15	160-170	71-77	E	E	—	—	1030 hrs.
Sodium Chloride	18	176	80	—	E	—	—	plus 10 percent $MgCl_2$. Allox C = 0.1 mpy
Sodium Chloride	20	165	74	—	E	—	—	NaCl brine, 73 days, severe pitting, severe attack under spacer
Sodium Chloride	20	190	88	—	B	—	—	saturated with Cl_2, 28 days, severe attack under spacer
Sodium Chloride	20	200	93	—	B	—	—	saturated with Cl_2, 204 days, perforated
Sodium Chloride	20	205	96	—	U	—	—	saturated with Cl_2, 40 days, perforated
Sodium Chloride	24	140	60	G	—	—	—	plus 2 percent isopropanol and NaOH added to keep pH = 10. Alloy B = 2 mpy (vapor) 4 mpy in liquid
Sodium Chloride	26	80	27	—	E	—	E	satruated brine Duration of test — 447 days Aeration — extensive Agitation — rapid Type of test — field
Sodium Chloride	26	80	27	—	E	—	G	saturated brine, traces calcium chloride and calcium sulfate, pH 6.8-7.0, extensive aeration
Sodium Chloride	35	158	70	—	E	E	E	in water plus undesignated amines and a small amount of sodium carbonate.
Sodium Chloride	35	85-195	29-91	—	—	E	E	in water plus undesignated amines and a small amount of sodium carbonate.
Sodium Chloride	98	140	60	E	—	—	—	plus 2 percent methyl alcohol. pH adjusted to 10 with NaOH
Sodium Chloride	Saturated	220	104	B	E	G	B	plus acid, oxidizing impurities, pH about 6, 272 hrs.
Sodium Chloride	—	70	21	—	E	—	—	saturated NaCl brine, 208 days
Sodium Chloride	—	85	29	—	E	—	E	assorted concentration NaCl liquor containing $MgSO_4$, KCl, $MgCl_2$, moderate aeration
Sodium Chloride	—	86	30	—	E	E	E	NaCl liquor containing $MgSO_4$ KCl, $MgCl_2$, moderate aeration
Sodium Chloride	—	131	55	U	E	—	—	plus sulfonated waxes, pH = 5-8. Alloy C = 0.1 mpy
Sodium Chloride	—	135	57	—	E	—	—	saturated NaCl brine, 125 days
Sodium Chloride	—	140	60	—	E	—	—	saturated NaCl brine, 169 days
Sodium Chloride	—	158-165	70-74	—	E	—	—	NaCl = 320 grams/liter, NaOH = 0.1 grams/liter, Na_2CO_3 = 0.6 grams/liter, Na_2SO_4 = 8.0 grams/liter. Alloy C = 0.02 mpy
Sodium Chloride	—	160	71	—	E	—	—	saturated NaCl brine, 163 days
Sodium Chloride	—	187-191	86-88	—	E	—	—	sodium chloride brine. Liquid phase.
Sodium Chloride	—	191	88	—	E	—	—	
Sodium Chloride	—	210-255	99-124	—	E	—	—	assorted concentrations NaCl brine, pH approx. 7.5, liquid phase. Impurities: 1.6-16 gm/l $CaCl_2$; 15-100 gm/l $CaSO_4$; 0.2-20 gm/l $MgCl_2$, moderate aeration
Sodium Chloride	—	221-227	105-108	—	E	—	—	sodium chloride brine. Liquid phase.
Sodium Chloride	—	225	107	—	E	—	—	saturated brine containing 5-15% NaCl, aeration
Sodium Chloride	—	227	108	—	E	E	—	
Sodium Chloride	—	230-250	110-121	—	E	—	—	saturated NaCl brine
Sodium Chloride	—	240	116	—	E	—	—	NaCl brine saturated
Sodium Chloride	—	240-242	116-117	—	E	—	—	saturated brine (NaCl), aeration
Sodium Chloride	—	250-255	121-124	—	E	—	—	saturated sodium chloride brine, pH 8.5-10.0, with small amounts of: sodium sulfate, magnesium sulfate, magnesium chloride, sodium carbonate, sodium hydroxide, extensive aeration
Sodium Chloride	—	255	124	—	E	E	—	saturated sodium chloride brine, pH 8.5-10, with small amounts of sodium sulfate, magnesium sulfate, magnesium chloride, sodium carbonate, sodium hydroxide, extensive aeration
Sodium Chloride	—	255	124	—	E	E	—	NaCl Brine, pH approx. 7.5. Impurities: 1.6-16 g/l $CaCl_2$, 15-100 g/l $CaSO_4$, 0.2-20 g/l $MgCl_2$, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sodium Chloride	—	255	124	—	E	—	—	saturated brine (NaCl), containing 10% NaCl in suspension and 20 g/l $CaSO_3$, pH 6.5 Brine purification — salt production Aeration — 1.5 ppm O_2 Agitation — 6 ft./sec. Total days — 33
Sodium Chloride	—	258-260	126-127	—	E	—	—	saturated brine (NaCl), aeration
Sodium Chloride	—	265	129	—	E	E	—	saturated with 5-15% suspended NaCl solids plus some suspended $CaSO_4$, pH 7.5-8.0, moderate aeration
Sodium Chloride	—	265	129	—	E	—	—	saturated sodium chloride solution with 5-15% suspended NaCl solids plus some suspended $CaSO_4$, pH 7.5-8.0, moderate aeration
Sodium Chloride	—	522	272	—	E	—	—	in rotary kiln drier. Alloy C = 0.2 mpy
Sodium Chlorite	10	75	24	—	S	—	—	
Sodium Dialkyl Orthocarbonate	—	41-96	5-36	—	E	—	—	in oxidation reactor during production of tetra alkyl thiuram disulfide, liquid phase plus $NaNO_3$, HCl, NaCl, HNO_2. Alloy C = 0.02 mpy
Sodium Ferricyanide	10	75	24	S	—	—	—	
Sodium Flormaldehyde Sulfoxylate Liquor	25-60	176	80	E	E	—	—	in preconcentrator, Alloy C = 0.006 mpy
Sodium Fluoride	10	75	24	S	—	—	—	
Sodium Fluosilicate Dust	—	80-110	27-43	G	—	—	—	96 percent air, 3 percent H_2O, 0.06 percent HCl, sodium fluosilicate in rotary drier
Sodium Fluosilicate Slurry	—	130	54	—	E	—	—	in reaction tank with turbine agitator. Alloy C = 1.6 mpy
Sodium Glutamate, Mono	—	68-140	20-60	E	—	—	—	saturated with NaCl at pH of 5.0-6.4
Sodium Glutamate, Mono	—	75	24	E	—	—	—	saturated with NaCl at a pH of 5 to 6.4
Sodium Hydrosulfide	5-12	230	110	E	E	—	—	plus sodium sulfide and polysulfides as impurities in unknown amounts
Sodium Hydroxide Pulp Digester Liquor	1.5M	323	162	—	G	G	B	oxygenated, 7 hours, extensive aeration
Sodium Hydroxide	2-3	110	43	E	E	—	E	organic intermediate aluminum salts; pyridine, water
Sodium Hydroxide	2-3	102	83	—	E	E	E	water, ethanol and other fermentation products (esters, organic acids, fuel oil, carbon dioxide), sodium carbonate 1%, sulfur dioxide; pH normally 10 to 11. Cleaned occasionally with 4-8% acetic acid.
Sodium Hydroxide	10-15	90	32	—	E	E	E	plus NaCl and Na_2CO_3 Duration — 150 days Aeration — moderate Agitation — normal flow Type of test — field Process involved — reaction of HCl and $COCl_2$ with NaOH
Sodium Hydroxide	10 40	Room Room	Room Room	— —	E E	— —	— —	
Sodium Hydroxide	15	to 230	to 110	S	B	—	—	plus monochlortoluene saturated with approx. 2 percent each of HCl and Cl_2. Alloy C = 23 mpy
Sodium Hydroxide	—	90	32	—	S	—	—	10 to 15% NaOH, NaCl and Na_2CO_3, HCl, $COCl_2$, moderate aeration
Sodium Hydroxide	—	100	38	—	E	—	—	plus cresylic acid. Alloy C = 0.5 mpy
Sodium Hydroxide	—	160	71	—	E	—	E	dilute, chromate and chromic wastes, chlorides, all low concentrations
Sodium Hypochlorite	0.5 0.5 0.5	95 140 212	35 60 100	— — —	E E E	— — —	— — —	Dakin's solution. Alloy C = 0.1 mpy
Sodium Hypochlorite	1	140	60	—	G	—	—	Alloy C = 4.8 mpy
Sodium Hypochlorite	1-2	70	21	—	E	—	E	plus unidentified components. pH near 7
Sodium Hypochlorite	5	65	18	—	E	—	—	bottom of bleach make-up tank. Alloy C <0.1 mpy
Sodium Hypochlorite	10 10	75 125	24 52	— —	E S	— —	— —	
Sodium Hypochlorite	15	86	30	—	E	—	—	plus 3 percent caustic soda. Alloy C gained weight slightly

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)
M — Molar

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sodium Hypochlorite	to 16	60-80	16-27	—	E	—	—	plus NaOH and Cl_2. Alloy C = 0.1 mpy
Sodium Hypochlorite	—	Room	Room	—	E	—	—	plus sodium silicate inhibitor. Alloy C = nil mpy
Sodium Hypochlorite	—	80	27	U	B	—	—	HCl, vent scrubber, 29 days
Sodium Hypochlorite	—	85-115	29-46	—	E	—	—	plus 6 percent Cl_2, 45 percent H_2SO_4 and sulfate turpentine oil
Sodium Hypochorite	—	90	32	U*	E	E	G	excess caustic soda. NaOCl concentration 94.3-110.6 grams/liter. Excess NaOH 6-21 grams/liter. *Specimen corroded away or was lost, aeration at surface
Sodium Hypochlorite	—	212	100	—	E	—	—	in wash tank for cellphane film with up to 1 percent NaCl. Alloy C <0.1 mpy
Sodium Hyposulfite	All	to B.P.	to B.P.	S	S	—	—	
Sodium Metasilicate	10 30	75 75	24 24	S S	— —	— —	— —	
Sodium Nitrate	10 30	75 75	24 24	— —	S S	— —	— —	
Sodium Nitrate (Crude)	12-68	234	112	—	E	—	—	in evaporater. pH = 5.5-7.6 plus NaCl, Na_2SO_4, and magnesium. Alloy C = 0.04 mpy
Sodium Oleate	58	338	170	—	E	—	—	also exposed to 12 percent amyl alcohol, 10 percent amyl chloride, 2 percent amylene, 18 percent water, 25 percent sodium chloride, 1 percent sodium hydride, and 0.1 percent sodium oleate. Alloy C = 0.2 mpy
Sodium Perchlorate	—	176	80	G	E	—	—	in reactor vessel during production. Alloy C = 0.13 mpy
Sodium Perborate	10	to B.P.	to B.P.	S	—	—	—	
Sodium Peroxide	10	to B.P.	to B.P.	S	S	—	—	
Sodium Phenolate	—	248	120	—	E	—	—	containing about 20 percent by volume of acids. Total alkalinity 20 percent by weight as NaOH. Alloy C = nil. In lower well of phenol tower.
Sodium Phosphates	—	125	52	—	E	—	E	saturated vapor from rotary dryer containing sodium phosphate, NaCl, Na_2SO_4, CO_2 and H_2O. pH varies from 1 to 11, extensive aeration
Sodium Phosphates	—	180	82	—	E	—	E	saturated vapor from rotary dryer containing sodium phosphate, NaCl, Na_2SO_4, CO_2 and H_2O. pH varies from 1 to 11, extensive aeration
Sodium Phosphate Tri-Basic	10 25	to B.P. to 125	to B.P. to 52	S E	— —	— —	— —	
Sodium-Potassium Alloys	—	32-1400	0-760	S	S	—	—	
Sodium Silicate	10	to B.P.	to B.P.	S	—	—	—	
Sodium Sulfate	18	235	113	—	E	E	—	1% H_2SO_4, hot wall test, 144 hours
Sodium Sulfate	25	100-140	38-60	E	—	—	—	plus 5-10 percent H_2SO_4 and traces of H_2S in neutralization of spent refining caustic.
Sodium Sulfate	All to 30	to B.P. to B.P.	to B.P. to B.P.	S S	— S	— —	— —	
Sodium Sulfate	Saturated	170	77	—	E	—	—	20 percent crystalline sulfate. pH = 9.10. Alloy C = 0.02 mpy
Sodium Sulfate	—	77-95	25-35	—	E	—	—	plus organic sulfonic acids, SO_2, 2 percent HCl, trace of acetic acid. pH = 1.5-2.0. Alloy C = 0.03 mpy
Sodium Sulfide	10	Room	Room	E	E	—	—	in storage tank. Alloy C = 0.1 mpy
Sodium Sulfide	10 20 30 40 50	to B.P. B.P. B.P. B.P. B.P.	to B.P. B.P. B.P. B.P. B.P.	B B B B B	— — — — —	— — — — —	— — — — —	
Sodium Sulfide	20	125	52	E	E	E	E	
Sodium Sulfide	50-60	338	170	—	U	—	U	
Sodium Sulfide	60	338	170	E	U	—	—	immersed in flaker food tank.
Sodium Sulfite	20	125	51	—	E	—	E	sodium hydroxide averaging 2.0%. pH 9.5 to 10.5
Sodium Sulfite	20	150	66	—	E	—	E	pH = 7 to 11

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sodium Sulfite	—	90	32	—	E	—	E	bisulfite solution (30% $NaHSO_3$-70% H_2O); pH 4 to 5, moderate aeration
Sodium Sulfite	—	230	110	—	E	—	—	plus 1 percent $ZnSO_4$. pH = 8.5-9 in evaporator. pH adjusted with NaOH for conversion of Glaubers salts. Alloy C = 0.1 mpy
Sodium Sulfite	—	235	112	—	E	—	E	slurry, 30% solids (Na_2SO_3, Na_2SO_4); 70% liquid (30% Na_2SO_3, 5% Na_2SO_3, 5% Na_2SO_4, 5% Na_2SO_3); pH = 5.7
Sour Gas Condensate	—	150	66	—	E	—	—	above top tray in crude oil stabilizer. Alloy C = 0.1 mpy
Soy Protein	18	190	88	G	E	E	E	concentrate 18% aqueous slurry pH 4.2 with hydrochloric acid, moderate aeration
Stack Gases	—	105	41	—	E	E	E	smelter gas in TCA scrubber and limestone slurry (15%, pH 5.2-7) which is converted to $CaSO_3$ and some $CaSO_4$ by SO_2 in the gas, extensive aeration
Stack Gases	—	130	54	—	E	—	E	containing chlorides, sulfates, fly ash, water. Saturated, aeration
Stack Gases	—	134	57	—	E	E	E	saturated with scrubber liquor containing 0.0084 grains P_2O_5
Stack Gases	—	140	60	—	E	—	G	containing chlorides, sulfates, fly ash, water.
Stack Gases	—	150	66	—	E	—	G	containing chlorides, sulfates, fly ash, water.
Stack Gases	—	158	70	—	E	E	E	from phosphate dryer. 35% H_2O, 16.5% O_2, 2.5% CO_2 plus some phosphate dust, chloride, NOX, balance nitrogen; furnace process to produce phosphoric acid; agitation — 18500-26500 ACFM; extensive aeration. Total days — 283
Stack Gases	—	300	149	—	E	E	E	containing SO_4, SO_3, S^-, Cl^-, H_2O
Stack Gases	—	610-620	321-327	—	E	E	E	containing 1300 ppm SO_2 and fly ash, aeration
Stannous Bisulfate	10	to B.P.	to B.P.	S	—	—	—	
Stannic Chloride	10	158	70	—	S	—	—	plus 10 percent HCl. Alloy C = 15 mpy
Stannic Chloride	10 to 50 50	to B.P. to 160 to B.P.	to B.P. to 71 to B.P.	S — —	— S —	— — —	— — —	
Stannous Chloride	All 100	to B.P. to 700	to B.P. to 371	S S	— —	— —	— —	
Starch	—	425	218	E	—	—	—	plus HCl in conversion process.
Steam	—	430	221	—	E	—	E	trace NH_3, NaOH, $NaClO_3$, NaCl, 129 days
Stearic Acid	0.2-20	150-300	65-148	—	E	—	—	in esterification kettle with sebacic acid, adipic acid, phthalic anhydride, and toluene sulfonic acid. Alloy C = 2 mpy in liquid, 1.2 mpy in vapors.
Stearic Acid	100 100	200 to 700	93 to 371	E* S	E —	— —	— —	*plus oleic acid and methyl and isobutyl stearates and oleates
Streptomycin Media	100	86	30	E	—	—	—	during sterilization with steam at 275 deg. F. Contains 1 percent cerelose, 1 percent alpha protein, 0.5 percent fermentable solids, 0.5 percent NaCl, 0.1 percent $CaCO_3$.
Strontium Chloride	33	160-210	71-99	B	—	—	—	plus some sodium chromate.
Sucrose	62	200	93	—	E	—	—	4.3% brown sugar; 1.3% salt (NaCl); 14.3% coconut oil; 18.2% water, pH 5.8, moderate aeration
Sugar	—	250-300	121-149	S	E	—	—	plus HCl, NH_4SO_4, NH_4Cl to pH = 0.5 in pressure vessel. Alloy C = 0.4 mpy
Sugar Syrup	4-60	160	71	—	—	E	E	hydrochloric acid, sulfurous acid, pH 4.2, 168 days
Sulfanilamide	—	75	24	E	E	—	—	mother liquor. Alloy C = nil mpy
Sulfite Liquor	100	260	127	—	E	—	—	8.23 percent SO_2 at a pH of 1.32
Sulfite Pulping Vapors	—	180	82	E	—	—	—	in vent line of sulfite blow tank containing large quantities of wet SO_2 and magnesium-base liquor.
Sulfoacetic Acid	—	167	75	E	—	—	E	16 hrs., lab test
Sulfoacetic Acid	—	212	100	G	—	—	U	1 hr. lab test, conc. 95% H_2SO_4 slowly added to acetic anhydride in a 2-liter beaker (1 mil H_2SO_4 to 1.5 mols acetic anhydride)
Sulfated Detergent	50	125	52	—	E	—	—	

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfated Oils	—	125	52	E	—	—	—	5 percent H_2SO_4, NaCl and Na_2SO_4
Sulfonation of Fats and Oils	—	70	21	G	E	—	E	sulfonations of castor, soya, sperm and red oils, mineral oil and various other fatty acids, fats and oils with 96 Baume H_2SO_4, pH 1-4. Moderate aeration, agitation — 84 rpm turbine.
Sulfonation	98	248	120	G	B	—	U	sulfuric acid 98%, ammonia anhydrous, or sodium hydroxide 33%, formaldehyde, moderate aeration
Sulfonation Reactions	—	176-320	80-160	—	B	—	—	sulfuric acid 98%, ammonia anhydrous, or sodium hydroxide 33%, formaldehyde, moderate aeration
Sulfonation Acid (Spent)	—	272	133	—	G	G	U	11 days below liquid level
Sulfonation Acid (Spent)	—	341	172	—	B	G	B	8 days below liquid level
Sulfonation Acid (Spent)	—	392	200	—	G	E	E	10 days below liquid level
Sulfonation Acid (Spent)	—	392	200	—	G	G	S	start — 25% pct. SO_3, 6% $HFSO_3$, 3% I_2, 3% HI, 63% H_2SO_4. End — 6% $HFSO_3$, 4% I_2, 3% HIO_3 and 87% H_2SO_4, 56.5 days
Sulfonation Acid (Spent)	—	482	250	—	G	E	G	28 days below liquid level
Sulfonic Acid	50	60-250	16-121	B	—	—	—	plus 45 percent solvent naphtha, 5 percent water and trace of H_2SO_4 at bottom of still
Sulfur	—	74-284	23-140	—	E	—	—	plus some H_2SO_4, H_2S, SO_2, H_2SO_3 and water vapor in melting tank. Sample half in vapor, half in liquid. Alloy C = 0.52 mpy
Sulfur	—	850	454	—	G	—	—	plus selenium. 11.7 day test, 7.8 days of boiling. Alloy C = 2.8 mpy (liquid) 5.1 mpy (vapor)
Sulfur, Molten	— — — —	775 300-315 284-302 265-295	412 149-157 140-150 129-146	— G* — S	E E* E S	— — — —	— — — —	*plus aerated water at pH of 1.5 to 3.5, 11-day test period in surface pipe line between well and gathering station. Alloy C = 0.9 mpy. 6-day test period agitated, plus air and impurities including sulfuric acid, and ferric sulfate. Tested up to 12 days
Sulfur Dioxide	0.077	220	104	—	E	—	—	balance H_2O. Alloy C = 0.19 mpy
Sulfur Dioxide	1.8	55	13	G	E	—	—	in sea water plus 1.7 percent NaCl. Alloy C = 0.6 mpy
Sulfur Dioxide	3.6	106-118	41-48	—	E	—	—	about one-half saturated with spray water in scrubber tower. Alloy C = 0.2 mpy
Sulfur Dioxide	4-5	185-200	85-93	—	E	—	—	plus selenious acid mist and some sulfuric acid in slimes boiling kettle. Alloy C = 0.9 mpy
Sulfur Dioxide	4.7-5.0 (by volume)	70	21	U	E	—	—	plus 3.4 percent calcium bisulfite in sulfite acid settling tank. Alloy C = 0.1 mpy
Sulfur Dioxide	5	200-500	93-260	—	E	—	—	plus 15 percent O_2, balance N_2 (dew point 125 percent). In gas offtake wet windbox. Alloy C = 0.8 mpy
Sulfur Dioxide	5	400	204	—	G	—	—	in nickel convertor. Alloy C = 2.6 mpy
Sulfur Dioxide	10	85-95 125-135	29-35 52-57	U U	E G	— —	— —	saturated with water in bottom of scrubber. Recycle liquor containing H_2SO_4 in range of 0.30-0.75 percent. Alloy C = 0.1 mpy (90°F), 3 mpy (130°F)
Sulfur Dioxide	18	500-700	260-371	—	E	—	—	plus 3 percent O_2, trace SO_3 and moisture. Alloy C = 0.1 mpy
Sulfur Dioxide	—	60	16	—	E	—	—	plus S_2O_7 in compressor condensate for alkylation unit. Alloy C = 0.03 mpy with less than 1.0 mil pitting.
Sulfur Dioxide	—	115-170	46-77	G	E	—	E	gas up to 1.5% SO_2 aeration
Sulfur Dioxide	—	125	52	—	E	E	E	1000 ppm chloride, 2000 ppm fluoride, some SO_3 and pH 3, 800 ppm SO_2, 15% H_2O, 12% CO_2, 68% N_2, 5% O_2, moderate aeration
Sulfur Dioxide	—	130	54	—	—	E	E	in gas stream with spray from cooling tower containing H_2SO_3, aeration
Sulfur Dioxide	—	131	55	U*	S	—	B	*specimen corroded away or was lost, aeration, 5% SO_2, 3% SO_3, 7% O_2, balance N_2 saturated with water. Possible splashing with solution containing 1.3 g/l Cu, pH 6
Sulfur Dioxide	—	132	56	U	E	—	E	in flue gas from No. 6 fuel oil, shale dust, water
Sulfur Dioxide	—	140	60	—	G	E	E	SO_2 100-2000 ppm, H_2SO_4 100-500 ppm, balance wet air, heavy loading H_2O droplets, containing Ca salts and ore dust
Sulfur Dioxide	—	140	60	—	—	E	E	in gas stream with spray from cooling tower containing H_2SO_3, aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfur Dioxide	—	145	63	—	E	G	B	burning coal with 3% S plus 940 ppm Cl, 19 days, field test, moderate aeration, violent agitation
Sulfur Dioxide	—	160	71	—	—	E	E	and MgO (scrubbing products of combustion from MgO recovery system), aeration
Sulfur Dioxide	—	176	80	U*	G	—	B	*specimen corroded away or was lost, extensive aeration, 5% SO_2, 6.5% O_2 and 88.5% N_2 (dry basis) saturated with water vapor.
Sulfur Dioxide	—	176	80	U*	B	S	B	*specimen corroded away or was lost, extensive aeration, 5% SO_2, 6.5% O_2 and 88.5% N_2 (dry basis) saturated with water vapor.
Sulfur Dioxide	—	230	110	G	E	—	—	in hydrocarbon alkylate plus sulfuric acid. Alloy C = 0.01 mpy
Sulfur Dioxide	—	300-350	148-177	G	G	—	—	elemental sulfur mist O_2, H_2O and traces of sulfuric acid. In precipitator for recovery of sulfur from pyrite gas. Alloy C = 5.0 mpy
Sulfur Dioxide, Moist	—	180	82	—	E	—	—	occasional splashing of Na_2SO_4 and H_2SO_4. Alloy C = 0.15 mpy
Sulfur Oxides (Di & Tri)	—	350	177	—	E	—	E	SO_2 16.2%, SO_3 1.8%, H_2O 2.0%, O_2 1.4%, moderate aeration
Sulfur Substituted Amylphenol	—	257	125	G	G	B	U	HCl (pH-2), unreacted chlorine amyl-phenol, sulfur monochloride and sulfur dioxide in trace quantities, extensive aeration
Sulfur Trioxide	—	100	38	B	E	—	—	plus SO_2, N_2, CO_2 at top of Jennson towers in exhaust gas. Alloy C = 0.1 mpy
Sulfuric Acid	0-3	200	93	S	E	—	—	plus 0-5 percent Na_2SO_4, 0-0.5 percent $ZnSO_4$, 0-0.2 percent CS_2, trace of H_2S. Alloy C = 1.0 mpy
Sulfuric Acid	0-4	140	60	—	E	—	G	hot sulfuric acid solution (pH 3.0) containing tungsten and molybdenum salts with 2-3 g/l fluorides, moderate aeration
Sulfuric Acid	0.1	164-177	73-81	U	E	—	—	plus 0.04 percent SO_2 and varying amounts of carbon on bottom tray of SO_2 scrubber in regeneration of alkylation acid. Alloy C = 0.8 mpy
Sulfuric Acid	0.19	140	60	—	—	E	E	hydrochloric acid 0.057%, pH 2 to 5, 2360 hrs., incineration of municipal waste
Sulfuric Acid	0.26	Room	Room	—	E	—	—	spent pickle solutions. Cold wash water with salts picked up in steel pickling (0.097 percent ferrous, 0.003 percent ferric). Alloy C = 0.05 mpy
Sulfuric Acid	0.4-8.0	170-220	77-104	—	E	—	—	plus copper sulfate to saturation. Alloy C = 0.6 mpy
Sulfuric Acid	1-5	220	104	—	E	—	—	plus vegetable, fats, greases. Alloy C = nil mpy
Sulfuric Acid	1 to 23	302	150	—	B	U	—	as scrubbing liquid, moderate aeration
Sulfuric Acid	2	118-126	48-52	E	—	—	—	max. pitting = 14 mpy. Saturated with NaCl
Sulfuric Acid	2.5	200-250	93-121	—	G	—	—	plus 0.1 percent copper sulfate and some alcohols. Alloy C = 8.2 mpy
Sulfuric Acid	2.8-9.3	83	28	S	E	—	E	aluminum sulfate 0.8-5.3%, potassium chromium sulfate 0-0.3%, water, moderate aeration
Sulfuric Acid	5	70-85	21-29	E	E	—	—	plus 20 oz. $Na_2Cr_2O_7$ per 18 gal. Alloy C = 0.07 mpy
Sulfuric Acid	5	90	32	S	—	—	—	plus $FeSO_4$ and 0.05 percent TiO_2 (0.008 percent solids)
Sulfuric Acid	5	90	32	—	E	—	E	3-4% zirconyl sulfate, 15 days
Sulfuric Acid	5	122	50	G	E	—	—	plus sulfate oils, traces of NaCl and Na_2SO_4. Alloy C = 0.3 mpy
Sulfuric Acid	5	137-153	58-67	—	E	E	S	aeration, lab test 29.5 days
Sulfuric Acid	5	175-185	80-85	U	E	—	—	plus 0.50 to 0.56 oz./gal. of copper. Alloy C = 1.9 mpy
Sulfuric Acid	5	180	82	S	E	—	—	plus ore containing MnO and MnO_2
Sulfuric Acid	5-15	113-131	45-55	—	E	—	—	plus 15-25 percent Na_2SO_4, 1-5 percent organic salts. Alloy C = 0.16 mpy
Sulfuric Acid	5 to 150 g/l	160	71	—	E	—	E	copper-10 to 60 g/l-ave. 40, silver 0 to 12 g/l-ave. 3.5. Solids consist of precious metals, silica, lead sulfate, and a few % or less of selenium, tellurium, arsenic, antimony and bismuth.
Sulfuric Acid	6-9	155-175	68-79	—	B	—	—	plus 0.35 oz/gal. $NaNO_3$. Alloy C = 34 mpy
Sulfuric Acid	7-8	155-165	68-74	—	G	—	—	plus 0.8-0.9 oz./gal. $NaNO_3$ in pickling tank. Alloy C = 2.1 mpy
Sulfuric Acid	7.5-8	200-210	93-99	—	E	—	—	plus 3 percent aluminum sulfate, 1 percent ferric sulfate plus traces of calcium and magnesium sulfates. Alloy C = 1.6 mpy
Sulfuric Acid	8	120-140	49-60	G	G	—	—	steel pickling tank. Alloy C = 4.7 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfuric Acid	9	80-120	27-49	U	E	—	—	plus 1 percent HF, 3 percent Na_2SO_4, 1 percent SiO_2, $2H_2O_2$, 0.5 percent Na_2SiF_6, balance water in separation of Na_2SiF_6. Alloy C = 1.2 mpy
Sulfuric Acid	10	113	45	E	E	—	—	plus Na_2SO_4 and glucose in rayon spin bath. Alloy C = 0.2 mpy
Sulfuric Acid	10	158	70	—	S	—	—	plus 10 percent cupric sulfate. Alloy C = 15 mpy
Sulfuric Acid	10	158	70	—	U	—	—	plus 10 percent sulfate.
Sulfuric Acid	10	158	70	—	G	—	—	plus 10 percent Na_2SO_4. Alloy C = 8 mpy
Sulfuric Acid	10	158	70	—	B	—	—	plus 10 percent ferrous sulfate. Alloy C = 34 mpy
Sulfuric Acid	10	100 150 200 Boiling	38 65 93 Boiling	U B U G	E G B U	E E E U	— — — —	sulfur dioxide purge
Sulfuric Acid	10	175	80	—	—	E	G	3% chromic acid in deionized water
Sulfuric Acid	10	175-180	80-82	—	—	E	E	3% chromic acid in deionized water
Sulfuric Acid	10	200	93	U	S	—	—	672 hrs.
Sulfuric Acid	10	Boiling	Boiling	—	S	S	—	120 hrs., lab test
Sulfuric Acid	10	225	107	G	U	—	U	nickel sulfide impurities. 240 hrs.
Sulfuric Acid	10-12	660	349	E	E	—	—	plus 10-12 percent sodium sulfate. Alloy C = 0.1 mpy
Sulfuric Acid	10-15	234	112	—	G	E	U	reacts with ferric oxide to produce ferric sulfate, field test, 10 days, aeration — moderate, agitation — 6 ft./sec.
Sulfuric Acid	10-20	186	86	U	S	E	E	10% $CuSO_4$, 52 ppm Cl^-, Avg. Baume 28.7, pH = 1, 90 days
Sulfuric Acid	12	105-195	85-91	—	G	—	—	at top of acid spray section of conveyor-type spray pickling machine. Alloy C = 4 mpy
Sulfuric Acid	13	80-210	27-99	—	S	—	—	plus 13 percent by volume $MnSO_4$ and Mn_2O_3 in process for leaching crude MnO_2. Alloy C = 18 mpy
Sulfuric Acid	14-16	175	79	—	S	—	U	saturated with SO_2, slight aeration
Sulfuric Acid	15	248	120	G	—	—	—	plus sugar from digestion of tuber barbasco. Process is for obtaining steriod used in hormone production.
Sulfuric Acid	15	238-266	115-130	S	B	—	—	dicyclopentadiend hydrate reaction 220 hrs., pilot plant
Sulfuric Acid	16	165	74	U	S	—	G	to 5% (final before discarding), ferrous sulfate 0.09% (original) to 0.54% (final). Inhibited with Activol 3591.
Sulfuric Acid	18	170-180	77-82	—	E	—	—	in pickling stainless foil with 3 percent HCl added. First pickle is followed by 15 min. in 10 percent cold HNO_3. Alloy C = 1 mpy
Sulfuric Acid	19-28	140	60	—	E	—	—	plus 1.6 to 4.8 percent copper sulfate for flash pickling of brass parts. Alloy C = 1.6 mpy
Sulfuric Acid	20	Room Temp.	Room Temp.	E	E	—	—	Zr-HF separation
Sulfuric Acid	20	59-194	15-90	B	S	—	—	plus cobalt sulfate, ferrous sulfate, traces of copper sulfate. Alloy C = 12 mpy
Sulfuric Acid	20	125	52	U	E	E	E	12% CO, 90 days, copper refining, moderate aeration
Sulfuric Acid	20	125	52	U	E	E	E	1-2% Cu, 7000 oz./ton Ag, 200 oz./ton Au, 0.5% Sb, 0.5% Co, 1.0% 12% Te, 2% Cu. Trace Ag, Au, Sb, Co, 90 days
Sulfuric Acid	20	140	60	G	G	—	E	saturated with copper sulfate. Pickling copper and brass, 120 days, aeration, moderate agitation
Sulfuric Acid	20	145	63	S	E	E	E	8% $CuSO_4$, 52 ppm Cl, 90 days, copper refining
Sulfuric Acid	20	170-180	77-82	—	S	—	—	plus 2 percent Fe (ferrous and ferric in spray pickling machine). Alloy C = 17.1 mpy
Sulfuric Aiid	20-30	170-180	77-82	—	S	—	—	plus 0.5-3.5 percent $CuSO_4$ and abrasive anode mud from electrolytic copper refining. Alloy C = 15 mpy
Sulfuric Acid	24	66-70	19-21	E*	—	—	—	plus 9.6 percent ferrous sulfate 12 percent Ti as sulfate. *Max. pitting = 3 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfuric Acid	25	150	66	—	E	E	—	120 hrs., lab test
Sulfuric Acid	25	Boiling	Boiling	—	B	G	—	340 g/l sodium sulfate
Sulfuric Acid	25-40	158	70	—	U	—	—	10-15% phosphoric acid, 0.5% fluorides, phosphate fertilizer plant. agitation and aeration — high
Sulfuric Acid	28	135.5	57.5	G	G	G	—	hydrofluoric acid 5.9%
Sulfuric Acid	28	267	131	G	G	—	B	tests for selection of material for an acetic acid recovery column for an acetaldehyde unit, 23 hrs.
Sulfuric Acid	30 30 30 30	100 150 200 Boiling	38 65 93 Boiling	B B U G	G U U U	E E G U	— — — —	sulfur dioxide purge
Sulfuric Acid	30	125-135	52-57	G	E	—	—	acid regeneration of resin. Alloy C = 0.8 mpy
Sulfuric Acid	30	190-210	88-99	B	E	—	—	plus 22 percent H_3PO_4 in ion exchanger. Alloy C = 0.3 mpy
Sulfuric Acid	30.3	104	40	—	E	—	—	plus 57.5 percent acetic acid, 12.3 percent H_2O at liquid-vapor interface. Alloy C = 0.1 mpy
Sulfuric Acid	31.6	110	43	—	E	—	E	(480 g/l), sodium sulfate 18.2% (277 g/l), sodium chlorate 1.3% (20 g/l), sodium chloride 0.2% (3.6 g/l), moderate aeration
Sulfuric Acid	35-38	70	21	—	E	—	—	plus nitric acid in paper parchmentizing solution.
Sulfuric Acid	36	130-160	54-71	S	E	—	—	plus 28 percent oxalic acid, 32 percent water, 4 percent ash. Alloy C = 0.5 mpy
Sulfuric Acid	39	120	49	—	E	—	—	recovery of sulfuric acid used in papermaking in evaporator. Alloy C = 1.3 mpy
Sulfuric Acid	40	65	18	—	E	—	G	distillation of H_2O from HF. 40% HF, 20% H_2O, 240 days, moderate aeration
Sulfuric Acid	40	Ambient	Ambient	—	E	—	—	saturated with Cl_2, 17 days
Sulfuric Acid	40-45	Room	Room	—	E	—	—	saturated with Cl_2. Alloy C = 1.6 mpy
Sulfuric Acid	40	176	80	—	U	G	—	28 day immersion test (plant) and various organics.
Sulfuric Acid	40	176	80	—	U	G	U	acetate fiber production, field test — 28 days
Sulfuric Acid	40	176-194	80-90	S	S	—	—	Zr-HF separation
Sulfuric Acid	40	257	125	G	U	—	—	20% ethanol, 1% ethyl ether, balance water, 432 hrs. lab test
Sulfuric Acid	41-63	68-203	20-95	U	B	—	—	plus propylene. Alloy C = 24 mpy
Sulfuric Acid	43 50 60 85	Ambient Ambient Ambient Ambient	Ambient Ambient Ambient Ambient	— — — —	E E E E	— — — —	— — — —	saturated with Cl_2, 8 day test
Sulfuric Acid	45	Ambient	Ambient	—	E	—	E	Cl_2, 113 days
Sulfuric Acid	45	Boiling	Boiling	—	E	—	—	plus 1% CP hydrofluoric acid; also 45% CP sulfuric acid both with nitrogen purge, 4 days
Sulfuric Acid	50	Ambient	Ambient	—	G	—	U	Cl_2, 3 days, lab test
Sulfuric Acid	50	Ambient	Ambient	—	E	—	—	40 days
Sulfuric Acid	50	Ambient	Ambient	—	G	—	U	saturated with N_2, 3 days, lab test
Sulfuric Acid	50	70	21	U*	E	—	—	109 days, saturated with Cl_2, *welded and annealed
Sulfuric Acid	50	70	21	— —	E* E**	— —	— —	saturated with Cl_2, *as-welded **welded and annealed Duration of test — 132 days Agitation — 4.1 ft./sec.
Sulfuric Acid	50	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	50	80	27	—	E	—	—	welded sample in acid saturated with chlorine. Alloy C = 0.6 mpy
Sulfuric Acid	50	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	50	158	70	—	E	—	U	saturated with Cl_2, 66 days, 4.1 ft./sec. flow rate
Sulfuric Acid	54	Ambient	Ambient	—	E	—	—	Cl_2, 36 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfuric Acid	54	—	—	—	E	—	—	saturated with Cl_2 containing high percentage of gunk. Alloy C = 0.7 mpy
Sulfuric Acid	55	122-144	50-62	—	G	—	—	plus isopropyl alcohol and other solvents. Alloy C = 10 mpy (test sample welded)
Sulfuric Acid	55	158	70	B	G	—	—	ethanol, ethanol generator tails, 360 hrs.
Sulfuric Acid	55	158	70	U	S	—	—	ethanol, 240 hrs., samples exposed in hydrolizer transline.
Sulfuric Acid	55	158	70	—	S	—	—	ethanol, ethanol generator, 480 hrs.
Sulfuric Acid	55	230	110	U	B	—	—	ethanol, velocity appreciable, field test — 72 hrs.
Sulfuric Acid	55	230	110	S	U	—	U	ethanol, static, 48 hrs., lab test
Sulfuric Acid	55-60	167	75	—	B	—	—	in spent parchmentizing solution. Alloy C = 41 mpy
Sulfuric Acid	56.7	167	75	—	S	—	—	0.34% ethanol, 1% carbon, 90 hrs., lab test
Sulfuric Acid	60	Ambient	Ambient	—	E	—	—	8 days
Sulfuric Acid	61	Ambient	Ambient	—	G	—	—	Cl_2, 132 days
Sulfuric Acid	62	60	16	—	E	—	—	plus Cl_2. Alloy C = 0.4 mpy
Sulfuric Acid	62	Ambient	Ambient	—	E	—	—	Cl_2, 116 days
Sulfuric Acid	63-98	140-223	60-106	G	—	—	—	in batch type sulfonator of alkylated aromatic.
Sulfuric Acid	64	Ambient	Ambient	—	E	—	—	8 days, saturated with Cl_2
Sulfuric Acid	65-69	60	16	S	E	—	—	plus nitric acid in paper parchmentizing solution.
Sulfuric Acid	65-68	18	-8	U	B	—	—	plus some NO_3 and $CaSO_4$ in parchmentizing process after nitrate bath.
Sulfuric Acid	66	160-200	71-93	G	—	—	—	in tank dissolving metallic zinc in acid.
Sulfuric Acid	68-70	180-195	82-91	—	S	—	—	plus calcium sulfates in evaporator. Alloy C = 15 mpy
Sulfuric Acid	70	60	16	—	E	—	—	saturated with Cl_2
Sulfuric Acid	70	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	70	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	70 75	140 86	60 30	S E	— —	— —	— —	lab test
Sulfuric Acid	70	245	118	S	U	U	—	considerable free carbon, static test did not consider the cold tube wall, one week
Sulfuric Acid	70	245	118	S	U	U	—	one week static test (plant)
Sulfuric Acid	71-100	200	93	—	G	—	G	sulfuric acid mist, air effluent containing 8% O_2, traces of SO_2, moderate aeration
Sulfuric Acid	72	Ambient	Ambient	—	E	—	—	Cl_2, 25 days
Sulfuric Acid	72	—	—	—	E	—	—	saturated with Cl_2. Alloy C = 0.9 mpy
Sulfuric Acid	75	200	93	E	—	B	—	one week, lab test
Sulfuric Acid	75	250	121	G	—	U	—	one week, lab test
Sulfuric Acid	75	300	149	S	—	U	—	one week, lab test
Sulfuric Acid	78 78	80-110 100-130	26-43 37-54	— E	E E	— —	— —	plus alkyl benzene sulfuric acid in detergent manufacture. Alloy C = 0.9 mpy
Sulfuric Acid	78	135	57	—	S	—	—	plus 32 percent sodium perchlorate and ClO_2 gas during pulp bleaching
Sulfuric Acid	79-93	50-90	10-32	E	E	—	—	phosphine, ammonia, and H_2S percent as impurities. Alloy C <0.1 mpy
Sulfuric Acid	80	220	104	G	S	—	—	in zinc sulfate production with basic $ZnCO_3$ and sulfur-bearing slurry. Alloy C = 5.3-13 mpy
Sulfuric Acid	82	Ambient	Ambient	—	E	—	—	Cl_2, 129 days
Sulfuric Acid	82	122	50	—	E	—	—	plus Cl_2. Alloy C = 0.21 mpy
Sulfuric Acid	84	Ambient	Ambient	—	G	—	—	Cl_2, 132 days
Sulfuric Acid	85	Ambient	Ambient	—	E	—	—	8 days, saturated with Cl_2
Sulfuric Acid	85-94	75	24	G	G	G	B	6-15% HF, 130 days

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfuric Acid	85	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	85-94	95	35	S	S	G	U	6-15% HF, 130 days
Sulfuric Acid	85	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	86	—	—	G	E	E	E	hydrofluoric acid 10%, water 4%
Sulfuric Acid	87	60	16	—	E	—	E	79 days, saturated with Cl_2
Sulfuric Acid	87	Ambient	Ambient	—	E	—	E	Cl_2, 3 days, lab test
Sulfuric Acid	87	60	16	— — —	E* E** E***	— — —	E* E** —	saturated with Cl_2, 79 days, *wrought **welded ***welded and annealed
Sulfuric Acid	87	80	27	—	E	—	—	saturated with chlorine. Alloy C = 0.2 mpy
Sulfuric Acid	87	158	70	—	E	—	E	saturated with air, 66 days, 4.1 ft./sec. flow rate
Sulfuric Acid	90	60	16	G	E	E	E	hydrofluoric acid 7%, water 3%
Sulfuric Acid	90	to 125	to 52	E	—	—	—	plus 9 percent acetic anhydride in liquid and vapor phases
Sulfuric Acid	93	68-140	20-60	E	—	—	—	plus peanut oil, corn oil, alkyl benzene, sulfuric acid monohydrate.
Sulfuric Acid	93	78-94	26-34	—	E	—	—	plus animal grease in sulfonation tank. Alloy C = 0.7 mpy
Sulfuric Acid	94	80	27	E	E	G	B	6%, HF, 130 days
Sulfuric Acid	96	Ambient	Ambient	—	E	—	—	Cl_2, 132 days
Sulfuric Acid	96	77	25	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	96	80-118	27-48	—	E	—	—	during quick sulfonation of vegetable oils. Final solution is 5-10 percent aqueous solution of fatty acids and acetic anhydride. Alloy C = 0.4 mpy
Sulfuric Acid	96	122	50	—	E	—	—	saturated with chlorine, lab test
Sulfuric Acid	98	60-215	16-102	—	B	—	—	plus sodium nephathanate to 3° Bé. Alloy C = 44 mpy
Sulfuric Acid	98	64-106	18-41	E	—	—	—	plus 1 percent acetic anhydride. Alloy B = 0.2 mpy in vapor, 0.7 mpy in liquid
Sulfuric Acid	98	70-302	21-105	—	B	—	—	in sulfonation. Alloy C = 22 mpy (liquid), 30 mpy (vapor)
Sulfuric Acid	98	275	135	B	B	E	—	2% HF, 130 days
Sulfuric Acid	Conc.	100-160	38-71	E	G	—	—	plus anhydrous HCl. Alloy C = 2.1 mpy
Sulfuric Acid	6.0M	Boiling	Boiling	—	U	—	—	24 hrs., processes for the aqeuous reprocessing of spent fuel elements. Sulfex and Thorex processes
Sulfuric Acid	—	120	49	—	—	E	E	produced from electrolysis of sodium sulfate solution. Product of SO_2 scrubbing. 1.0 N H_2SO_4 with 17% Na_2SO_4, 218 days
Sulfuric Acid	—	338	170	—	B	U	U	20% by volume of 50% H_2SO_4 - 50%, HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 16.5% NaOCl at 170 deg. C
Sulfuric Acid	—	338	170	—	B	S	B	20% by volume of 50% H_2SO_4 - 50%, HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and later dried at 170 deg. C in 10% ClO_2
Sulfuric Acid	—	392	200	—	B	B	B	20% by volume of 50% H_2SO_4 - 50%, HNO_3 added to H_2O and heated to 200 deg. C for 18 hrs. then cooled and exposed in 20% by vol. of 50% HNO_3. 50% $HClO_4$ added to H_2O and heated to 200 deg. C for 12 hrs.
Sulfuric & Acetic Acids	Dilute	325	163	—	E	E	E	263 days
Sulfuric Acid Fumes	—	80-230	27-110	G	—	—	—	during manufacture of superphosphate. The fumes from mixture of fluoride phosphate rock and H_2SO_4.
Sulfuric Acid Mist	—	200	93	B	G	G	G	containing 8% O_2, traces of SO_2, moderate aeration
Sulfuric Acid Mixtures	0-4	143	62	—	E	—	E	gas up to 1.5% SO_2, 0.005% SO_3, 2 mg/scf H_2SO_4 mist, extensive aeration
Sulfuric Acid Mixtures	10-20	175	79	—	E	—	G	sulfuric acid 10%, chromic acid 3%, in deionized water
Sulfuric Acid Mixtures	21-50	121-176	49-80	—	G	—	U	sulfuric acid 28%, hydrofluoric acid 5.9% (pickling bath for silicon steels)
Sulfuric Acid, Saturated with Chlorine	40 54 61 72 96	Room Room Room Room Room	Room Room Room Room Room	— — — — —	E E E E E	— — — — —	— — — — —	Alloy C = 0.97 mpy Alloy C = 0.69 mpy Alloy C = 0.17 mpy Alloy C = 0.89 mpy Alloy C = 0.32 mpy

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

M — Molar
† — percent P_2O_5

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Sulfuric Acid Sludge	10-15	150-200	66-93	G	—	—	—	in large volume of oil.
Sulfuric Acid Sludge	16-22	180	82	S	—	—	—	
Sulfuric Acid Sludge	80-98	190	88	S	S	—	—	
Sulfuric Acid Vapors	—	200	93	B	E	—	—	plus 2 percent air, 5 percent CS_2, 0.2 percent H_2S, 93 percent H_2O. Alloy C = 0.2 mpy
Sulfuric Acid Vapors	—	60-120	16-49	E	—	—	—	plus H_2S in two stage neutralizer vented in atmosphere
Sulfurous Acid	All	to B.P.	to B.P.	—	S	—	—	
Sulfuryl Chloride	100	70	21	—	G	—	—	plus trace water. Alloy C = 2 mpy
Superphosphate Dust	—	to 325	to 163	E	E	—	—	over exhaust stack containing H_3PO_4, H_2SO_4, H_2SiF_6 air and moisture. Alloy C = 0.3 mpy
Superphosphoric Acid	94.8	340	171	G	G	G	S	wet process (as ortho acid). Total P_2O_5 68.54%; ortho P_2O_5 51.08%; Fe_2O_3 = 2.30%; SO_4 = 2.19%; Al_2O_3 = 1.92%; F = 0.33%. Concentration gradually reduced to 80% H_3PO_4 (54% P_2O_5)
Superphosphoric Acid	—	155	68	—	—	E	E	wet process. P_2O_5 70.5%, (H_3PO_4 equivalent 97.3%), SO_4 4.78%, Al_2O_3 3.05%, Fe_2O_3 1.67%, MgO 1.11%, SiO_2 0.72%, CaO 0.44%, F 0.25%
Superphosphoric Acid	—	400	204	—	B	—	—	wet process acid, concentrating to 70% P_2O_5.
Tall Oil	1 (by volume)	200	93	—	E	—	—	plus 0.5-1.0 percent H_2SO_4, 2-3 percent lignin in acid discharge line. Alloy C = 0.2 mpy
Tall Oil	—	300	149	G	E	—	—	during successive esterifications, amidizations and sulfurizations in high-temperature reactor. Alloy C = 0.1 mpy liquid and vapor phases
Tall Oil	—	300-550	149-288	G	E	—	—	during successive esterifications, amidizations, and sulfurizations of tall oil, 421 hours (liquid and vapor phase)
Tall Oil	— 100	to 554 550-650	to 290 288-343	S* —	E* E	— —	— —	*and its glycerolesters, amids and sulfurized products (liquid and vapor phases)
Tanning Liquor	—	75	24	—	E	—	—	40 percent chestnut extract, 30 percent bisulfated quebracho, 30 percent hemlock liquor
Tar Acid	—	212-392	100-200	—	E	—	—	plus benzoic acid, H_2SO_4, Na_2SO_4, at pH = 4 for 11 days then 76 days with tar acids containing Na_2SO_4, Na_2CO_3 at pH = 8, Alloy C <0.1 mpy
Tar Acid	—	212-392	100-200	—	E	—	—	washed cresylic acid distillation plus Na_2SO_4, $NaCO_3$ as impurities, pH = 6.8. Alloy C <0.1 mpy
Tar Acid	—	356	180	E	E	—	—	in distillation. Alloy C = 0.026 mpy
Tartaric Acid	All	to B.P.	to B.P.	S	S	—	—	
Tetrachloroethane	—	140-158	60-70	—	E	—	—	plus some dichloroethane, H_2O, HCl, Cl_2, acetylene and air in chlorination of acetylene. Alloy C <0.1 mpy
Textile Bleach	—	125	52	—	E	—	—	$NaClO_2$, NaO, $NaHCO_3$, NaOCl
Tin Chloride	—	240	116	S	G	—	—	$SnCl_4$
Tin Tetrachloride	—	220-240	104-116	—	G	—	—	plus small amounts of free Cl_2 in still. Alloy C = 8.7 mpy
Titanium Sulfate	10	to B.P.	to B.P.	S	—	—	—	
Toluene Sulfonic Acid	94	122-257	50-125	E	E	—	—	plus phthalic acid, alcohols, water, weak H_2SO_4, activated carbon, CO_2 in esterification of phtalic anhydride. Alloy C <0.1 mpy
Toluic Acid, Meta	72.5	250	121	—	E	—	—	plus 22 percent paratoluic acid, 2.6 orthotoluic acid, 2.6 benzoic acid. Alloy C <0.1 mpy
Triaryl Phosphate	220	500	260	E	E	—	U	phenols, phosphorous oxychloride and .1 to .3 wt. %. $MgCl_2$ as a catalyst, 168 hrs. field test
Trichloroacetic Acid	50	Boiling	Boiling	—	E	—	—	
Trichloroacetic Acid	All	to B.P.	to B.P.	S	S	—	—	
Trichlorobenzene Vapor, (Commerical) Ammonia & Chlorides	—	302	150	—	E	—	E	aeration
Trichloroethylene	90 100	to B.P. to B.P.	to B.P. to B.P.	S S	— E	— —	— —	vapor and liquid

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Trichloroethylene	—	212	100	E	E	—	—	alternately exposed to primary and secondary media in steam distillation and rectification of crude trichloroethylene. Alloy C = 0.08 mpy
Trichloroethylene	—	Boiling	Boiling	—	E	—	—	plus 1% water
Trichloroethylene (Crude)	—	212	100	E	E	—	—	plus steam in vapor phase during distillation process. Alloy C = 0.08 mpy
Trichloromonofluoro-methane and Dichlorodi-fluoro-methane	64	160	71	S	E	—	E	hydrogen chloride 20%; hydrogen fluoride 10%; carbon tetrachloride 1%; antimony pentachloride, oxygen, nitrogen, total 5% (all approx.); water not over 200 ppm.
Tricresyl Phosphate	88-90	580	304	—	E	—	—	plus 5 percent triphenyl phosphate, traces of HCl and organic chlorides. Alloy C = 0.1 mpy
Tricresyl Phosphate	88-90	700	371	—	E	—	—	plus 5 percent cresylic acid, 1 percent $MgCl_2$, 5 percent thiophenols. Traces of HCl, organic compounds, residue tar tank cleaned intermittently by sand blasting. Alloy C = 0.1 mpy
Tricresyl Phosphate	89-90	700	371	—	E	—	—	plus 5 percent cresylic acid, 5 percent thiophenols, traces of HCl , $MgCl_2$ and organic chlorides, 43-day test exposure. Alloy C = 0.2 mpy
Tricresyl Phosphate, Crude	—	570	299	E	—	—	—	90 days in distillation column
Tricresyl Phosphoric Acid, Crude	—	176	80	—	E	—	—	trace of cresylic acid. Alloy C = 0.05 mpy, 13,800-hr. test
Triethanolamine Hydrochloric Acid Slurry	—	90-220	32-104	S	E	—	—	30 percent HCl is added to triethanolamine in steel tank
Trifluoromethyl Diphenylamine	—	300	149	—	G	—	—	in thionation process plus some sulfur, iodine and monochlor benzene. Alloy C = 9 mpy
Thiocarbamide, Hydrochloric Acid	—	139	59	S	U	U	—	an aldehyde (unspecified), acetic acid (concentration unspecified). Mix neutralized with 23% sodium hydroxide.
Uranium Ore	—	113	45	—	E	—	—	pulped uranium ore containing 60 percent solids; 28-55 grams/liter H_2SO_4, 5-10 grams/liter ferric ions, some ferrous ions, about 0.1 percent $NaClO_3$. Alloy C = 1.3 mpy
Urea	28	355-360	179-182	—	S	—	—	plus 32.2 percent ammonia, 20.5 percent water, 19 percent CO_2, 0.3 percent inerts, plus air. In liquid urea reactor 3 ft. below top head. Alloy C = 17 mpy
Urea	58.4	350	177	—	B	—	G	ammonia 16.8%, carbon dioxide 14.8%, water 9.9%, aeration
Vagh Resin Solution	—	86	30	B	B	—	U	samples in 3-inch line to storage tank, 1440 hrs.
Vagh Varnish	—	140-158	60-70	S	S	—	U	Cl_2-H_2O (hydrochloric and hydrochlorous acid) production of Vagh varnish, 1608 hrs.
Vapor, Saturated	—	180	82	—	E	E	E	rotary dryer containing sodium phosphate, NaCl, Na_2SO_4, CO_2 and H_2O. pH varies from 1 to 11, 57 days, extensive aeration
Vapor, (Saturated) from Rotary Dryer	—	125	52	—	E	E	E	containing sodium phosphate, NaCl, Na_2SO_4. pH varies from 1 to 11, extensive aeration, 89 days, 200-269 fpm
Vapor from Top of Fatty Acid Still	—	512-525	267-274	—	E	E	E	tall oil purification, aeration
Vegetable Tanning Liquor	100	125-175	52-79	—	E	—	—	
Venturi, (Wet), Scrubbing Stream Removing Fly Ash from Boiler Burning Corn Cobs	—	143	62	—	E	E	E	gas; 83% N_2, 360 ppm SO_2, 80 ppm H_2SO_4. Ash; 6% Cl^-, extensive aeration
Vinyl Acetate	75	300	149	—	E	—	—	plus 24 percent acetic acid, 1 percent acetaldehyde, anhydride. Alloy C = nil mpy
Vinyl Chloride	100	60-80	16-27	S	E	—	—	containing unsettled droplets of sodium bisulfite; normal range 4-8 percent, maximum 15 percent. Tests made in scrubbed vinyl monomer phase. Alloy C <0.1 mpy
Vinyl Chloride	—	200	93	E	E	—	—	mixture of residues (tar), 3720 hrs., field test. Recovery of vinyl chloride
Vinyl Chloride Latex	—	75-140	24-60	E	E	—	—	plus small amounts of oxidizing persulfate in coagulation (0.2 percent chloride solution moderator, 10 percent of the time)

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Vinyl Chloride Liquid and Vapor	—	70	21	E	E	—	—	impurities — oxygen .05 -2.0%, N_2 up to 10%, HCl 0-10 ppm, H_2O 0-11%, formaldehyde 0-5 ppm, aeration
Vinyl Chloride Vapor	— —	122-248 225	50-120 107	— E*	E E*	— —	— —	above alumina bed in drier. Alloy C = 0.1 mpy. *Plus methyl methyl ethyl ketone. Alloy C = nil mpy
Wash Solutions for Phosphor & Yttrium Oxysulfides	—	—	—	—	E	E	E	complex solution, exact comp. unknown, Na_2SO_4 present, pH 12.86 except during 0.1 N HNO_3 wash. Production of TV tube phosphors. Aeration moderate, adjustable
Waste Gas	—	200	93	—	B	—	—	containing Cl_2, 98 days, moisture droplets with NaOH, NaCl
Waste Gas	—	200	93	—	G	—	—	containing Cl_2, 167 days, moisture droplets with NaOH, NaCl
Water, Brackish	—	—	—	—	E	—	—	in exhaust fumes aft of muffler of 40-ft. utility boat in New York harbor. 28-day test. Alloy C = 0.1 mpy
Water, Brackish	—	45	7	—	E	—	E	Newark Bay. Contains 0.70% NaCl, 100 ppm Ca ++ as $CaCO_3$, pH 6.7, 60 ppm HCl, moderate aeration
Water, Cold (Fresh)	—	54	12	—	E	—	E	at treatment plant. Aluminum sulfate 20 ppm; chlorine 2.0 ppm; potassium permanganate 0.3 ppm; clay 5 ppm; starch 1.0 ppm. Turbidity 5.0-50.0 units. pH 7.3 to 8.0
Water, Cold (Potable)	—	54	12	E	E	—	E	at treatment plant. Chlorine 0.8-1.0 ppm; aluminum sulfate 0.2 ppm; suspended alum floc (aluminum hydroxide) containing manganese dioxide. pH 7.3 to 7.6, saturated
Water, Distilled and Degassed	—	600	315	—	E	—	—	Alloy C <0.1 mpy. Only very slight discoloration
Water Purification Solution	—	68	20	—	—	E	G	water purification solution, 1000 grams ground carbon, 2.5 gal. water (2.5% HCl)
Water, Residues of Insecticides and Breakdown Products	—	85	29	—	E	—	E	including parathion, inorganic salts including ammonium and sodium chlorides, organic reagents including urea, solvents; pH range 1.5 to 13.5, usually above 8, moderate aeration
Water, River and Lake	—	52	11	—	E	—	E	Lake Ontario, pH 8.0 to 8.5 contains algae, small fish, lake debris. Turbidity 5.0 to 50.0 units
Water, Saturated with Carbon Dioxide	—	400-425	204-218	—	E	—	—	plus 0.008 percent SO_2 and traces of dissolved air. Alloy C = 0.6 mpy (liquid), 0.3 mpy vapor phase
Water, Incinerator scrubber	—	170-190	77-88	E	E	—	E	aeration
Water, Scrubbed Sewage Sludge Incinerator Gases	—	—	—	—	E	—	E	
Water, Scrubber	—	140-165	60-74	S	E	—	E	aeration
Water, Scrubber	—	160-180	71-82	G	E	—	E	aeration
Water, Scrubber	—	300-400	149-204	B	E	—	G	aeration
Water, Sea	—	60-95	16-35	G	E	—	—	plus 1.8 percent total solids, 1-2.5 percent SO_2 absorbed with water in absorption sump. Alloy C <0.1 mpy
Water, Sea	—	75	24	S	—	—	—	scrubber strong liquor, 1.8 percent SO_2, 1.7 percent NaCl
Water, Sea	—	82	28	E	E	—	—	20,000 ppm, Cl ions at a pH of 6.6. Contains from 2.5 to 104.5 mg O_2 per liter. Test at suction end of pump casing under high agitation
Water, Sea	—	95-500	35-260	U	E	—	—	in asphalt plant gas scrubber. Plus O_2, SO_2, hydrocarbons. Alloy C = 0.8 mpy
Water, Sea	—	203	95	—	G	—	—	saturated with Cl_2. Alloy C = 3 mpy
Water, Sea	—	325	163	—	E	—	—	in discharge line of tubular heat exchanger. Velocity = 5 ft. per sec.
Water, Steep	—	125-135	52-57	—	E	—	—	plus 0.10-0.14 percent SO_2. Alloy C <0.1 mpy (liquid and vapor).
Water, Steep	—	150	66	G	—	—	—	plus 0.02 percent SO_2, 0.5-1.0 percent lactic acid. pH 3.5-4.5
Wash Water from Rayon Staple Bleach Machine	—	145-150	63-66	—	E	E	E	aeration
Wash Water from Rayon Staple Bleach Machine	—	162-168	72-75	—	E	E	E	aeration

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Waste Effluent	—	78	26	—	—	E	—	containing sulfuric acid, esters, lime, waxes, oils, formaldehyde, moderate aeration
Whey Salts	—	176-212	80-100	—	E	—	—	plus lactic acid, NaCl, and lactose in 70 percent ethyl alcohol. Alloy C = nil mpy
Wood Fractions	—	70-100	21-38	E	—	—	—	alternately: crude pine tar oil, pyroligneous acid (2-5 percent acetic acid: 1 percent methanol; phenols)
Xylene	—	194-302	90-150	G	E	—	—	in maleic acid dehydration column. Plus impurities such as benzene, 1 percent maleic acid as maleic anhydride and traces of water. Alloy C <0.1 mpy
Xylene	—	325-350	163-177	G	E	—	—	effluent mixture containing water, acetic acid, benzoic acid, toluic acid, tolualdehyde, acetophenone and hydrocarbons as primary constituents under 25-in. vacuum. Alloy C = nil mpy
Xylol Solvent Vapors	—	77-293	25-145	E	—	—	—	plus 2 percent PCl_3 and HCl
Zeolite Water Softener	—	—	—	—	E	—	—	300 ppm chlorides, 10-38 ppm carbonates, 0.6 ppm bicarbonates in dome of deaerator in steam. Extensive aeration and high agitation. Alloy C = 0.1 mpy
Zinc Carbonate Slurry	—	70-180	21-82	E	E	—	—	2 lb. per gallon $ZnCO_3$ plus 10 percent Na_2CO_3, sulfides and sulfuric acid as impurities. Process is conversion of Na_2CO_3 to Na_2SO_4. Alloy C = 0.03 mpy
Zinc Chloride	71	225	107	—	E	—	—	
Zinc Chloride	80	Boiling	Boiling	—	E	—	—	
Zinc Chloride	All 100	to B.P. to 700	to B.P. to 371	S S	— —	— —	— —	
Zinc Chloride, Chromated	5	to 260	to 127	E	B	—	—	solution made by mixing 80 percent $ZnCl_2$ and 20 percent Na_2CrO_7. Maximum pitting = 2 mpy
Zinc Chloride Flux	25	75-80	24-27	U	E	—	—	in reservoir tank prior to welding. Alloy C = 0.007 mpy
Zinc Di-hydrogen Phosphate	Conc.	Room	Room	—	E	—	—	plus small amount nitrosyl chloride. Alloy C = 0.16 mpy
Zinc Fluosilicate	30 30 36 50	75 150 75 150	24 66 24 66	— — — —	E U E U	— — — —	— — — —	plus 1 to 10 percent free H_2SiF_6
Zinc Fluosilicate	—	100-116	38-47	U	E	—	—	above steam chest of single stage evaporator. Plus ½ to 1 percent HCl, 1 percent free H_2SiF_6. 40-day period
Zinc Hydrosulfite	4.5 lbs./gal.	232	111	—	E	—	—	in manufacture. Alloy C = 0.1 mpy
Zinc Sulfate	30-34	100-220	38-104	U	E	—	—	$Na_2Cr_2O_7$, H_2O and lead peroxide added to remove iron and manganese. Alloy C = 1.5 mpy
Zinc Sulfate	34	232	111	—	E	—	—	as $ZnSO_4$ $6H_2O$ plus 8.8 percent $ZnCl_2$, 1 percent ferrous sulfate, and water. Alloy C gained weight slightly.
Zinc Sulfate	to 40	to B.P.	to B.P.	S	S	—	—	
Zinc Sulfate, Acid Solution	—	68-122	20-50	—	E	—	—	plus (at start) 252 g/l H_2SO_4, 56.6 g/l Zn, 0.04 g/l Fe. At finish: 213 g/l H_2SO_4, 48.3 g/l Zn, 0.41 g/l Fe and 0.46 g/l Cu.
Zinc Sulfate, Anhydrous	—	219-232	103-111	—	E	—	—	2.42 lb. anhydrous $ZnSO_4$ plus 1.04 lb. $ZnCl_2$ per gallon of water. Alloy C = 0.03 mpy
Zinc Sulfate Drier Fumes	—	110	43	G	—	—	—	above rotary drum drier
Zinc Sulfate Monohydrate	40	—	—	E	E	—	—	plus traces of Fe, Na, Cd, Cu, considerable O_2. In flash evaporator for concentration of food liquor. Alloy C = 0.5 mpy
Zinc Sulfate Monohydrate	—	220	104	S	E	—	—	93 percent H_2SO_4 plus 34 percent $ZnSO_4$
Zinc Chloride	—	269-293	132-145	E	E	E	U	aeration
Zircex Liquid Phase Hydrochlorination	—	795	424	U B	U S	— —	— —	$AlCl_3$, NH_4Cl plus gaseous HCl, 7 days, in liquid in vapor

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

B.P. — Boiling Point

Corrosive Media	Concentration, percent	Temperature		HASTELLOY® alloy			Type 316 Stainless Steel	Conditions
		deg. F	deg. C	B/B-2	C/C-276	G/G-3		
Zirconium Chloride	25.5	145-185	63-85	U	E	—	—	plus 0.52 percent fluorides, 1.44 percent ammonia, 20.9 percent phosphate, 2.4 percent uranium, balance water in phosphate filter. Alloy C <0.1 mpy
Zirconium Chloride	—	Room	Room	E	E	—	—	contains HCNS, production of HF (Zr free) 2-5 days
Zirconium Tetrachloride Fumes	—	60-110	16-43	E	E	—	—	atmospheric fumes during manufacture containing some HCl and Cl_2. About 7 ft. from fume outlet. Alloy C <0.1 mpy
Zircex Solutions	0.5M	Boiling	Boiling	U	S	—	—	0.5 M HNO_3, 0.4 M UCl_3, Alloy B tested for 3 hours, Alloy C tested for 669 hours
Zircex Solutions	3M	Boiling	Boiling	G	G	—	—	Alloy C tested for 161 hours, Alloy B for 3 hours
Zircex Solutions	3M	Boiling	Boiling	U	U	—	—	3M H^+, 0.4 UCl_3, 2.8 M NO_3^-, Alloy C tested for 161 hours, Alloy B for 3 hours
Zircex Solutions	5M	Boiling	Boiling	—	U	—	—	3M H^+, 0.4 UCl_3, 2.8 M NO_3^-, 160 hours.

E — Less than 2 mpy (0.05 mm/y)
G — 2 mpy (0.05 mm/y) to 10 mpy (0.25 mm/y)
S — Over 10 mpy (0.25 mm/y) to 20 mpy (0.51 mm/y)
B — Over 20 mpy (0.51 mm/y) to 50 mpy (1.27 mm/y)
U — More than 50 mpy (1.27 mm/y)

M — Molar

ISOCORROSION DIAGRAMS

The isocorrosion diagrams shown on subsequent pages were plotted using data obtained in laboratory tests in reagent grade acids. These data should be used only as a guide. It is recommended that samples be tested under actual plant conditions.

Only one heat was tested in each case, but the material is typical of standard production material. Test coupons 0.125 x 1 x 2 inches (3 x 25 x 50 mm) were cut from mill annealed sheet and surface ground wet on 120 grit SiC paper. One sample each was exposed to 1 liter of solution in an Erlenmeyer flask that was closed with a reflex condenser. Duplicate samples were tested in each case to ensure reproducibility. Corrosion rates were determined by the weight loss method and based on an average of four 24-hour test periods. The exceptions to this were as follows:

1. Corrosion rates <1 mil (<0.03 mm) per year were based on one 96-hour test period.

2. Corrosion rates >1000 mils (>25.4 mm) per year were based on one 24-hour test period.

3. Corrosion rates in chloride-contaminated sulfuric acid were based on one 48-hour test period.

All test solutions were prepared using reagent grade chemicals and distilled water. Chloride-contaminated sulfuric acid solutions were prepared by the addition of reagent grade sodium chloride to give 200 mg/l (ppm) chloride concentration. No attempts were made to either aerate or deaerate the test solutions except for those hydrochloric acid tests so noted. Any solution agitation occurred only as a result of the boiling action or thermal convection. Solution temperatures were maintained to with ± 2 deg. F (± 1 deg. C).

HYDROCHLORIC ACID

HASTELLOY® alloy B-2 is particularly well suited for equipment handling hydrochloric acid at all concentrations and temperatures including the boiling point.

It is important to note that corrosion behavior is affected by oxidizing chemicals. The presence of ferric or cupric ions in solution greatly accelerates attack, as can aeration of the hydrochloric acid. Even dissolved oxygen is sufficient to increase the corrosion rate for alloy B-2.

HASTELLOY alloy C-276 is resistant to all concentrations of hydrochloric acid at room temperature, and is used successfully up to about 120 deg. F (49 deg. C). Dissolved oxygen is not a strong enough oxidizer to passivate alloy C-276, and a decrease in rates is observed when oxygen is removed from the system.

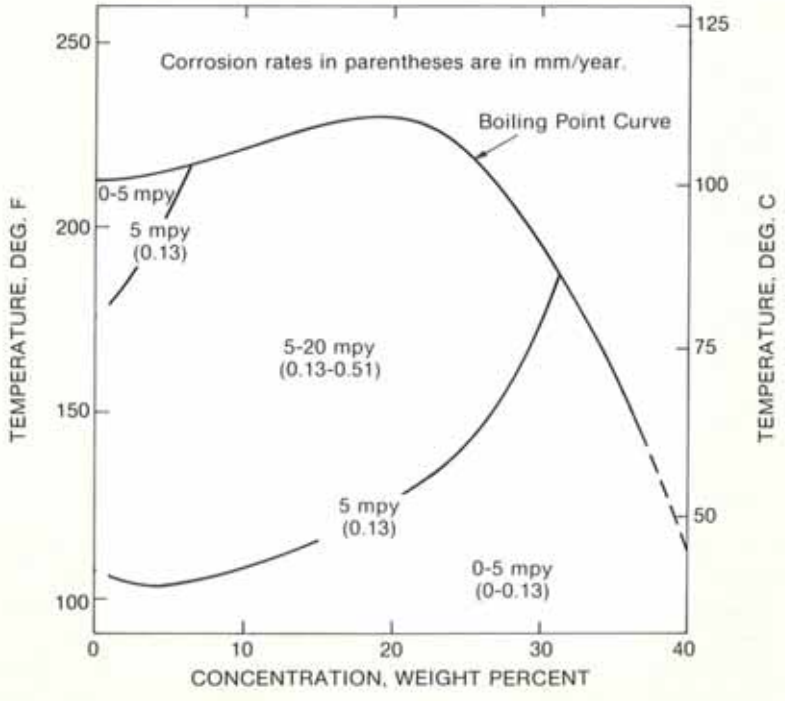
HASTELLOY alloys G-3 and G-30 have only limited usefulness in hydrochloric acid service. Acceptable corrosion behavior is exhibited in dilute concentrations, but at concentrations greater than 5 percent, the upper limit of utility is reduced to about 100 deg. F (38 deg. C).

HAYNES® alloy No. 25 and MULTIMET® alloy are resistant to hydrochloric acid in all concentratrions at room temperature. (See page No. 86.)

ISOCORROSION DIAGRAM*

HASTELLOY® Alloy B-2

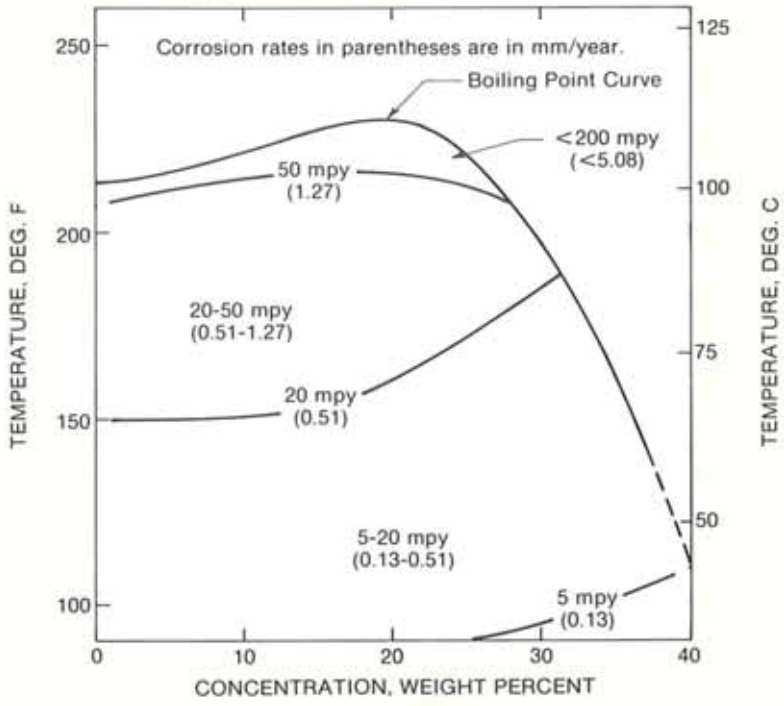
Resistance to Hydrochloric Acid



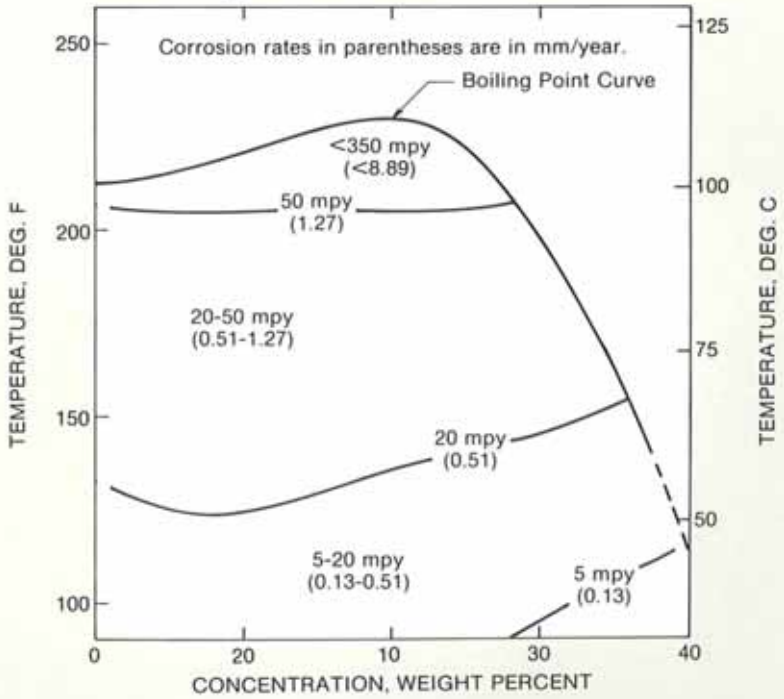
*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy B-2
Resistance to Hydrochloric Acid with 50 ppm Ferric Ions



HASTELLOY® Alloy B-2
Resistance to Hydrochloric Acid with 100 ppm Ferric Ions

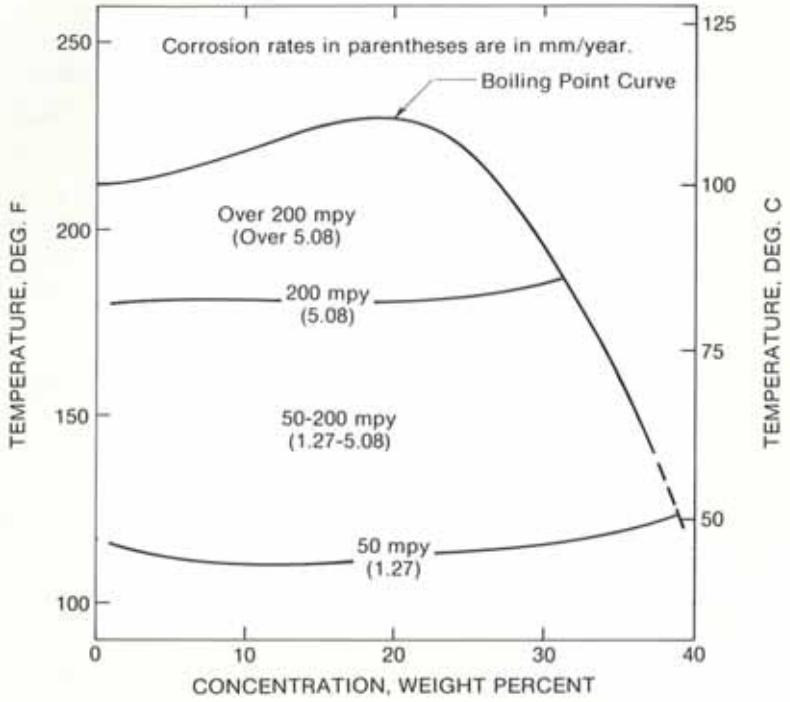


*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

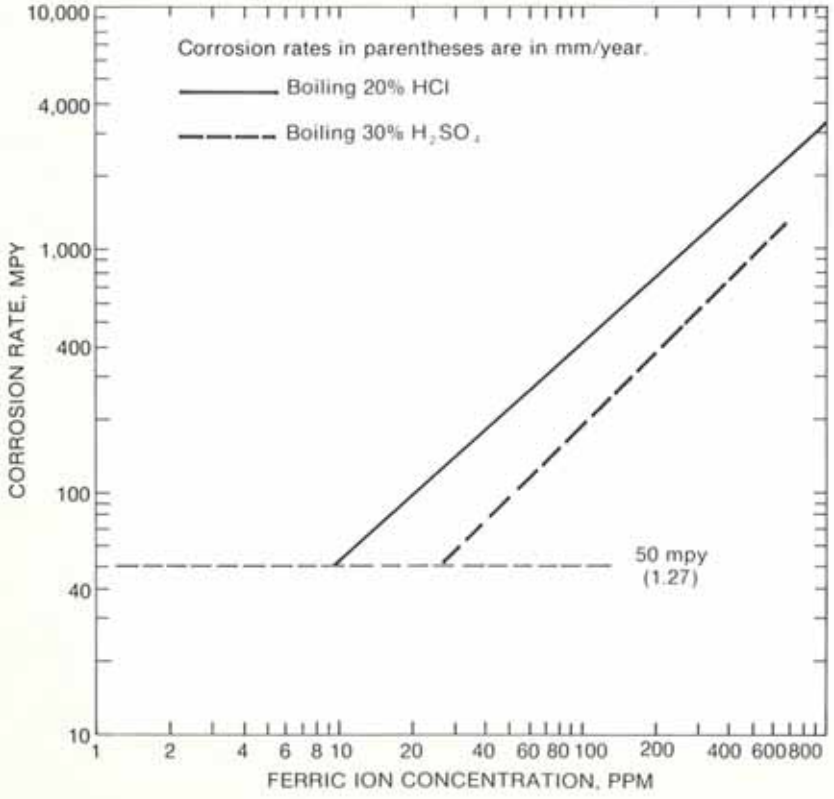
HASTELLOY® Alloy B-2

Resistance to Hydrochloric Acid with 500 ppm Ferric Ions



HASTELLOY® Alloy B-2

Effect of Ferric Ion Concentration on Corrosion Rate of Alloy B-2

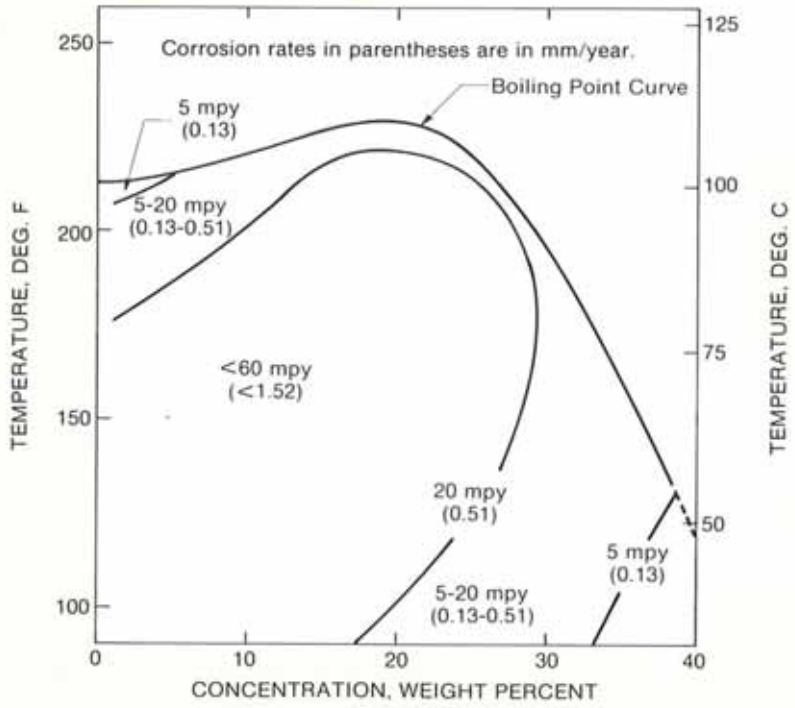


*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

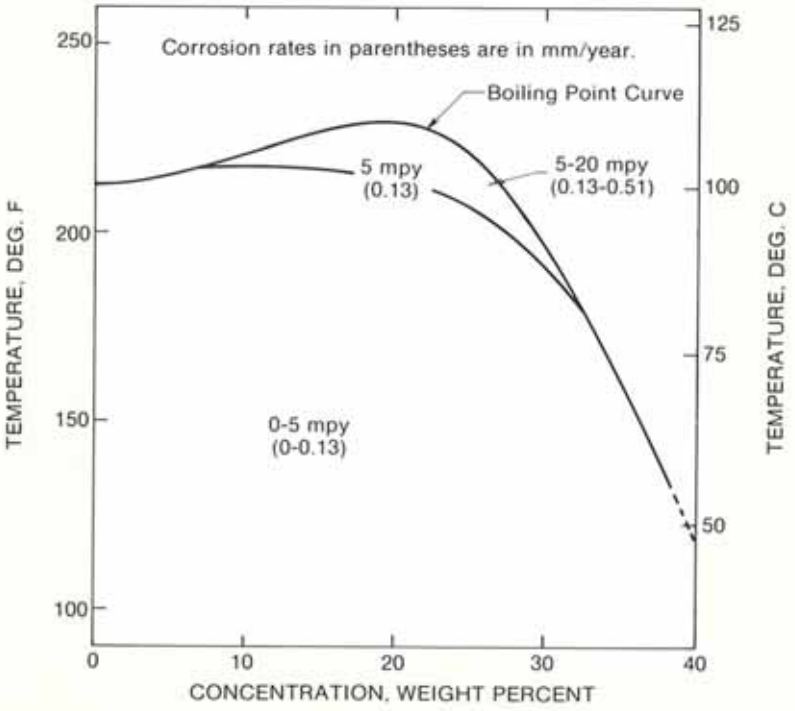
HASTELLOY® Alloy B-2

Resistance to Hydrochloric Acid, Purged with Oxygen



HASTELLOY® Alloy B-2

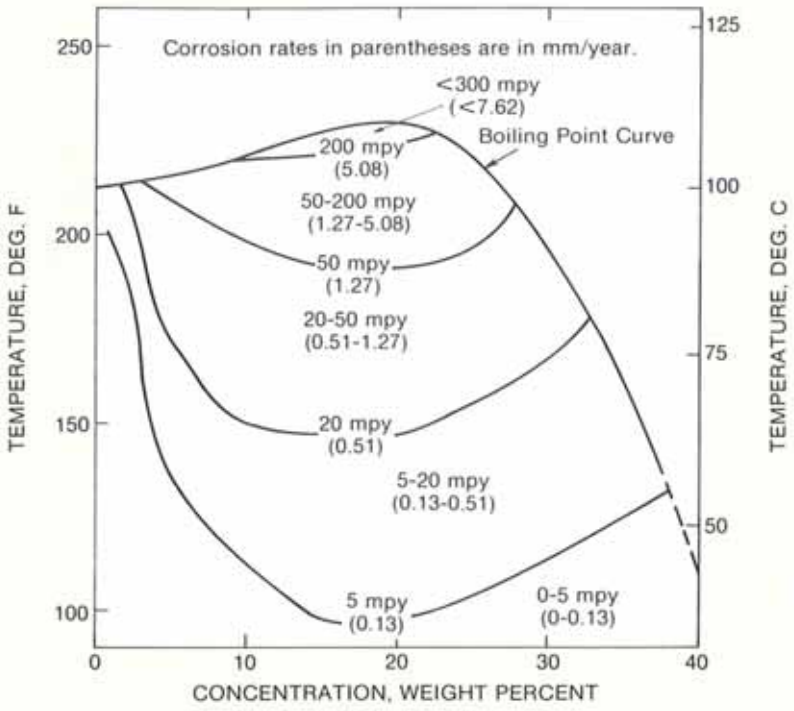
Resistance to Hydrochloric Acid, Purged with Nitrogen



*All test specimens were solution heat-treated and in the unwelded condition.

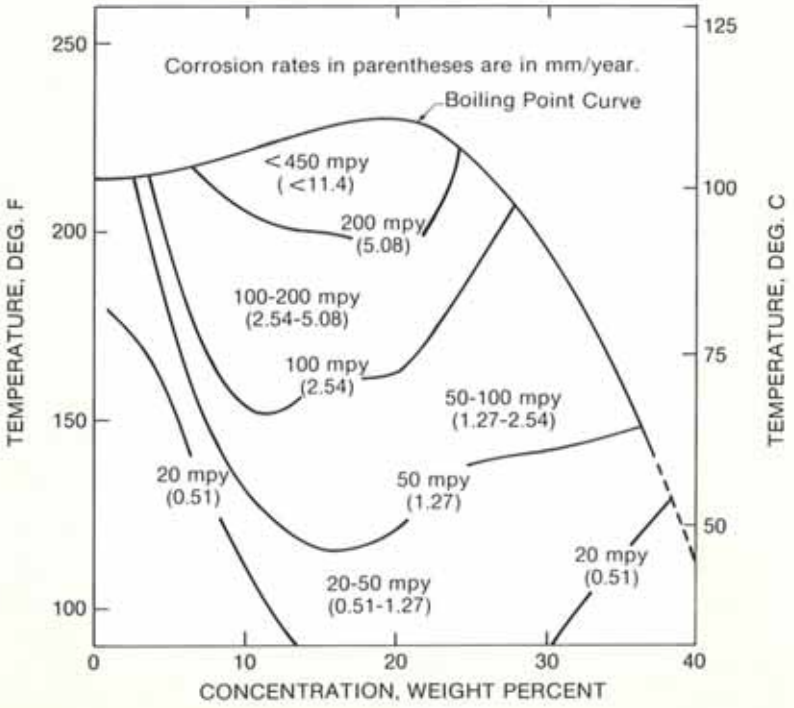
HASTELLOY® Alloy C-276

Resistance to Hydrochloric Acid



HASTELLOY® Alloy C-276

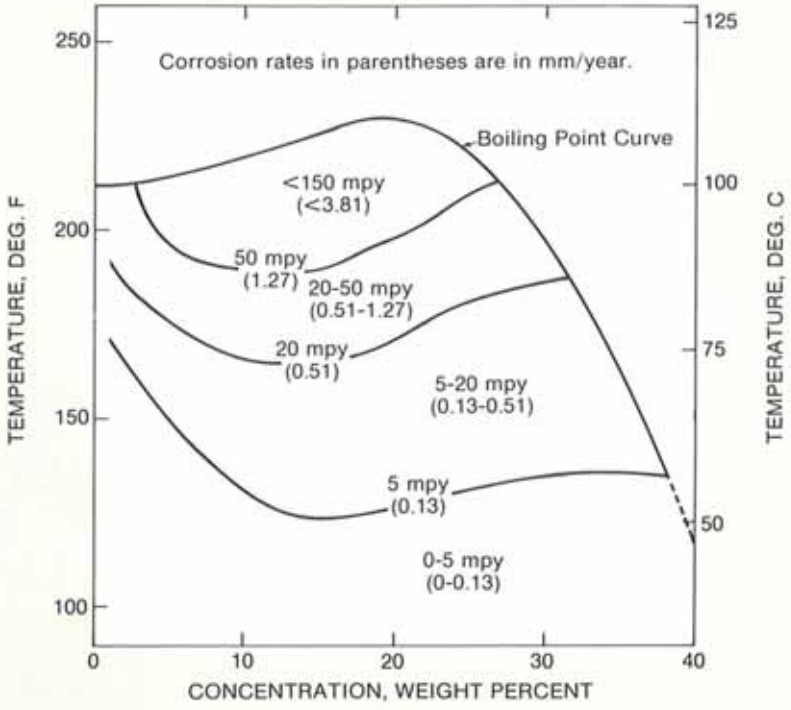
Resistance to Hydrochloric Acid, Purged with Oxygen



*All test specimens were solution heat-treated and in the unwelded condition.

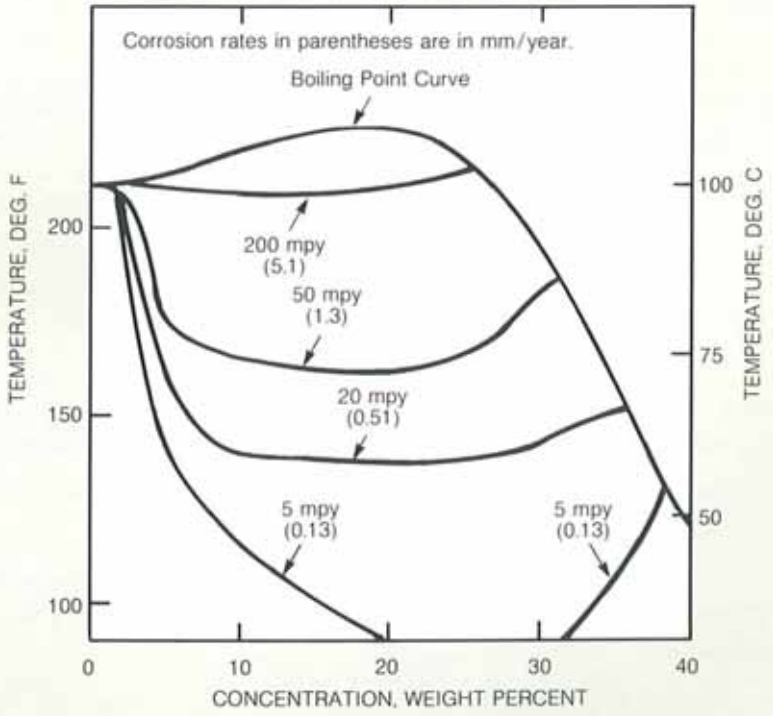
HASTELLOY® Alloy C-276

Resistance to Hydrochloric Acid, Purged with Nitrogen



HASTELLOY® Alloy C-22

Resistance to Hydrochloric Acid

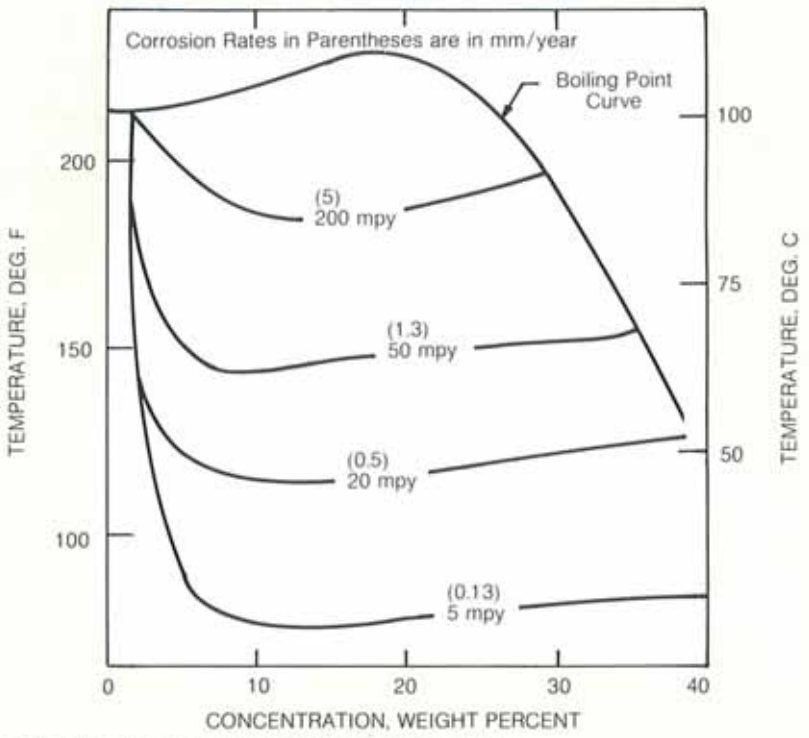


*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAM*

HASTELLOY® Alloy G-30

Resistance to Hydrochloric Acid



*All test specimens were solution heat-treated and in the unwelded condition.

NITRIC ACID

Nitric acid is a strong oxidizing acid. Stainless steels are quite commonly used to resist corrosion from this media. Corrosion is controlled in the passive region of those chromium containing alloys by reduction of the acid. Impurities in the acid, however, can often cause problems of general or localized corrosion of stainless steels.

HASTELLOY alloys G-3 and G-30 have excellent resistance to nitric acid over a wide range of acid concentrations and temperatures.

HASTELLOY alloy C-276 shows only limited corrosion resistance to nitric acid. Alloy C-22 has somewhat improved resistance, however, the molybdenum content of both alloys limits their usefulness in this media.

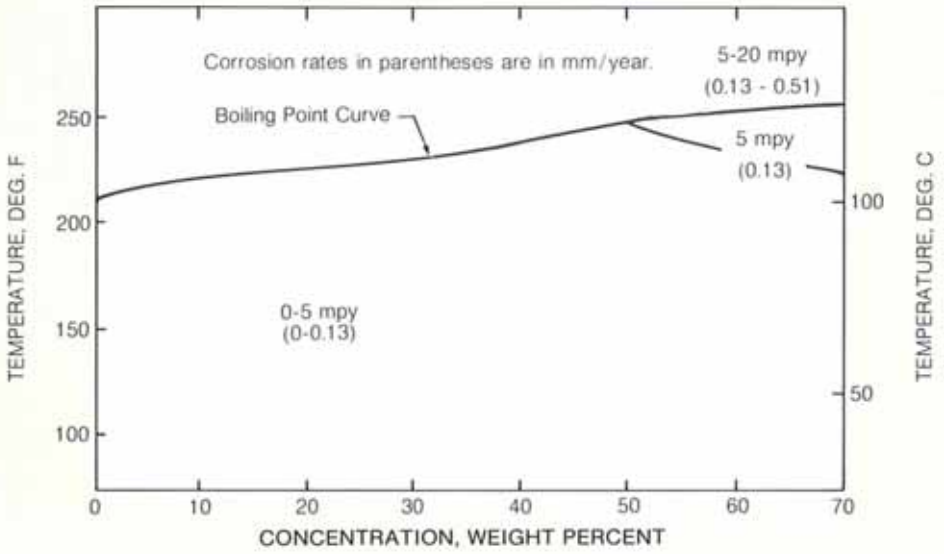
HASTELLOY alloy B-2 is not recommended for service in nitric or other strongly oxidizing acids.

HAYNES cobalt-base alloy No. 25 has shown good resistance to boiling nitric acid in concentrations up to 40 percent and satisfactory resistance up to 60 percent. (See page No. 86.)

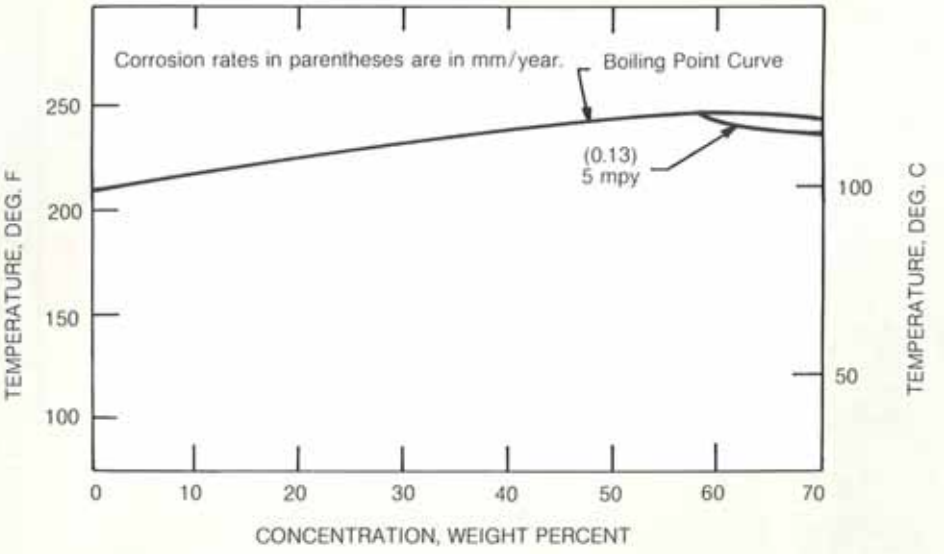
MULTIMET® alloy is resistant to nitric acid concentrations up to 70 percent at temperatures up to the boiling point. (See page No. 86.)

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy G-3
Resistance to Nitric Acid



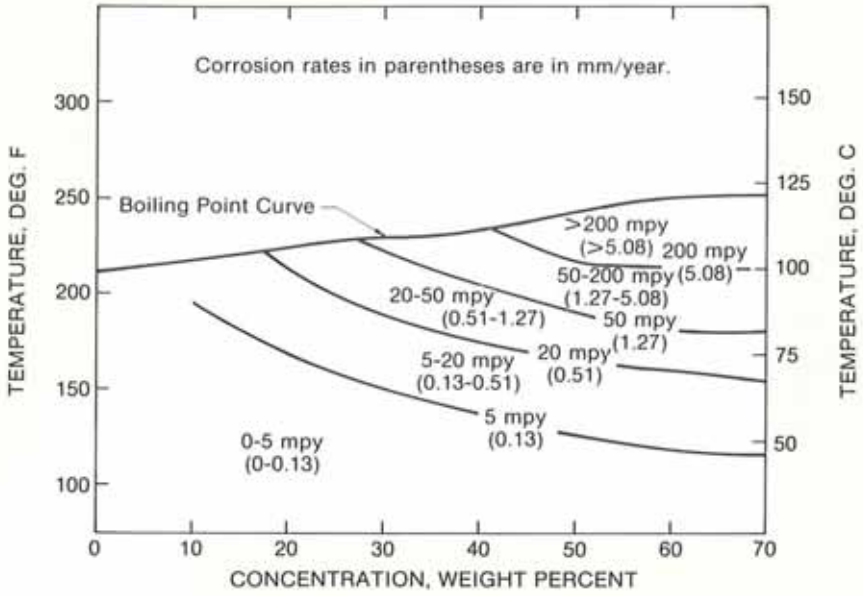
HASTELLOY® Alloy G-30
Resistance to Nitric Acid



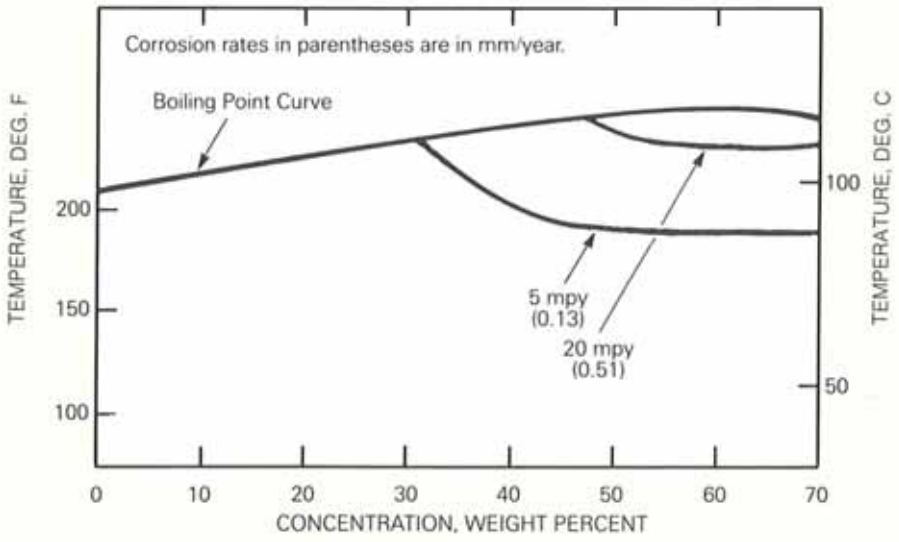
*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy C-276
Resistance to Nitric Acid



HASTELLOY® Alloy C-22
Resistance to Nitric Acid



*All test specimens were solution heat-treated and in the unwelded condition.

PHOSPHORIC ACID

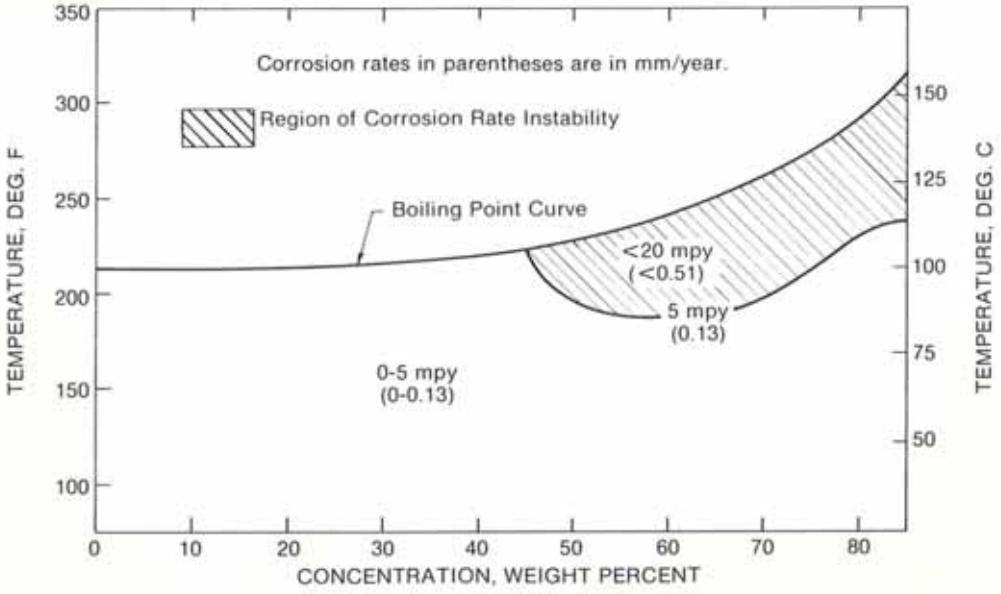
HASTELLOY® alloys B-2, C-276, C-22, G-3, G-30 and HAYNES® alloy No. 25 have acceptable corrosion resistance at most concentrations and temperatures. The maximum rates were observed in boiling 85 percent acid for all of these alloys.

Commercial grades of phosphoric acid encountered during the production of wet process or superphosphoric acid quite frequently contain numerous impurities. These impurities, basically fluorides and ferric salts, serve to change the basic character of the acid. Alloys G-3 and G-30 have demonstrated excellent resistance to wide variety of acid compositions, presumably because of their high chromium contents.

ISOCORROSION DIAGRAMS*

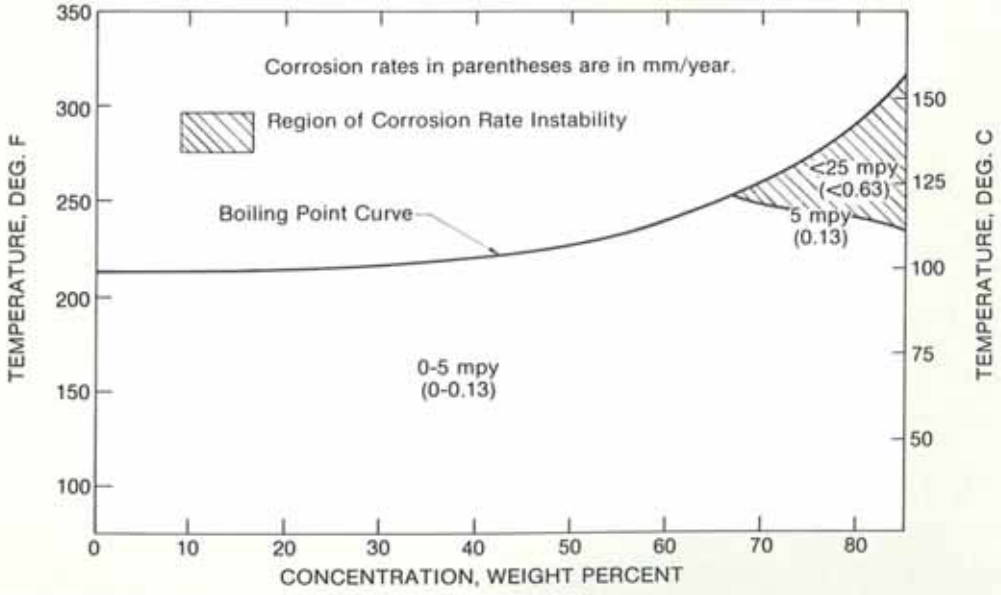
HASTELLOY® Alloy B-2

Resistance to Phosphoric Acid



HASTELLOY® Alloy C-276

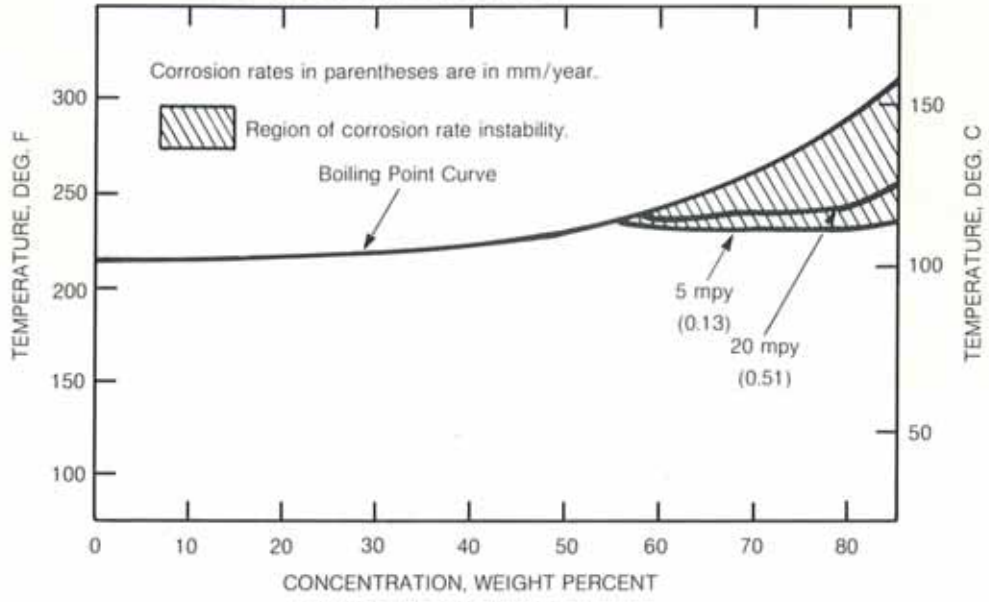
Resistance to Phosphoric Acid



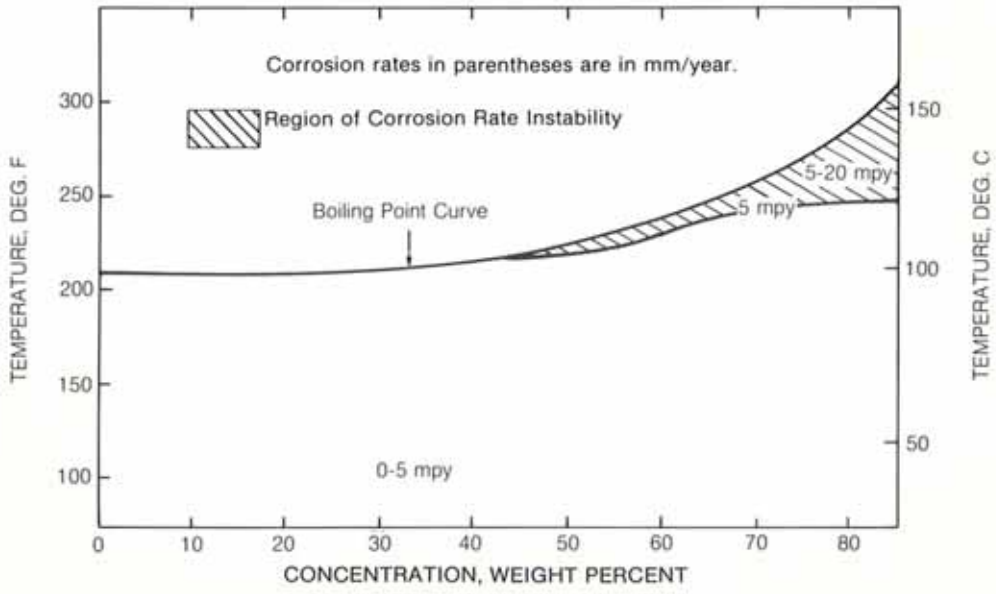
*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy C-22
Resistance to Phosphoric Acid



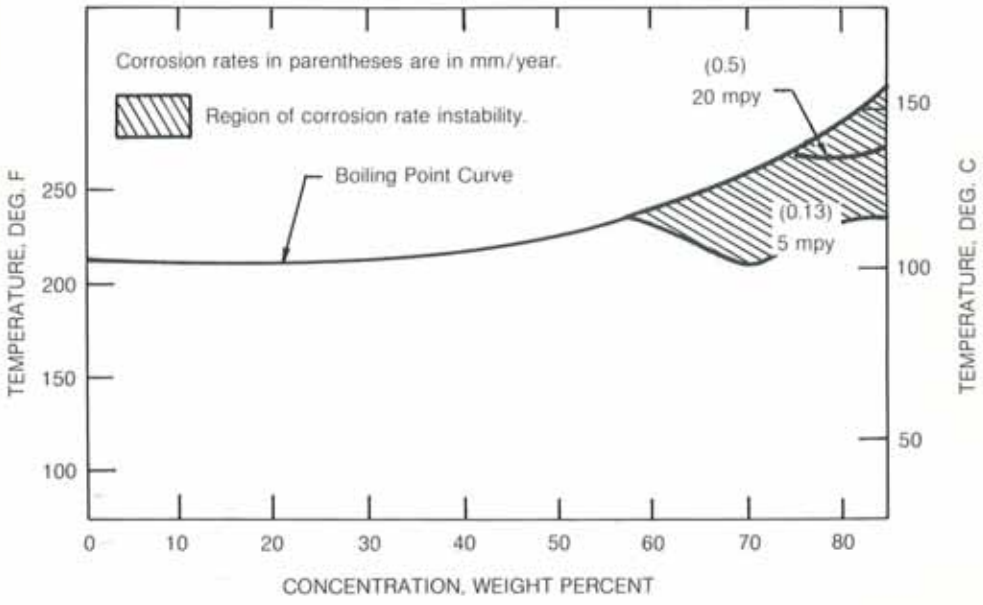
HASTELLOY® Alloy G-3
Resistance to Phosphoric Acid



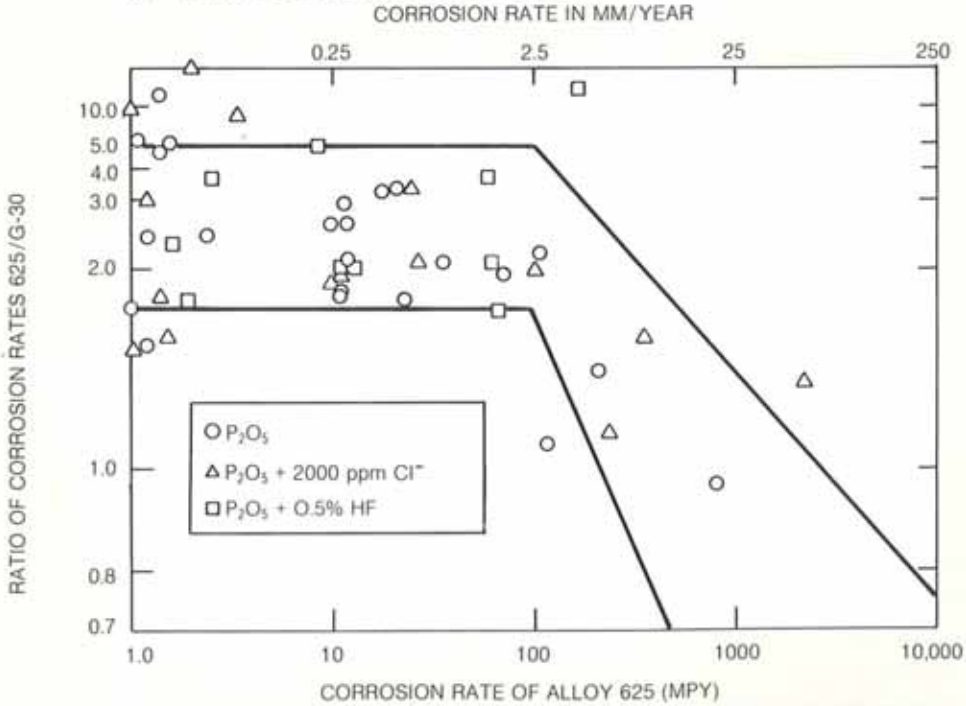
*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy G-30
Resistance to Phosphoric Acid



Comparison of HASTELLOY® Alloy G-30 and Alloy 625 in Commercial Phosphoric Acid*



The corrosion resistance of HASTELLOY alloy G-30 in a variety of environments is shown in this chart. The corrosivity of commercial phosphoric acid is a result of several variables such as concentration, temperature, impurity levels (manufacturer) and origin of the phosphate rock. Wide variations in corrosion rates are possible in acids of the same concentration but from different sources. Hence, corrosion tests were conducted in acids from a number of suppliers and the performance of alloy G-30 relative to alloy 625 is shown as a function of the corrosion rate of alloy 625. Within certain severity of the acid, alloy G-30 shows 2-3 times better corrosion resistance than alloy No. 625. In acids of high severity all the alloys exhibit corrosion rates in excess of 2.5mm/yr (100 mpy).

*All test specimens were solution heat-treated and in the unwelded condition.

SULFURIC ACID

HASTELLOY® alloy B-2 has outstanding resistance to pure sulfuric acid. Even in the 70 to 80 percent acid concentration range, where other alloys have significantly higher rates, alloy B-2 exhibits good resistance. It has a corrosion rate of less than 5 mpy (0.13mm/yr) over a wide range of temperatures. Alloys C-276 and C-22 have acceptable rates over a relatively extensive range of concentrations and temperatures. HASTELLOY alloys G-3 and G-30 behave similarly to alloys C-276 and C-22, but in dilute acid applications (< 30 percent) the former alloys rates are slightly lower.

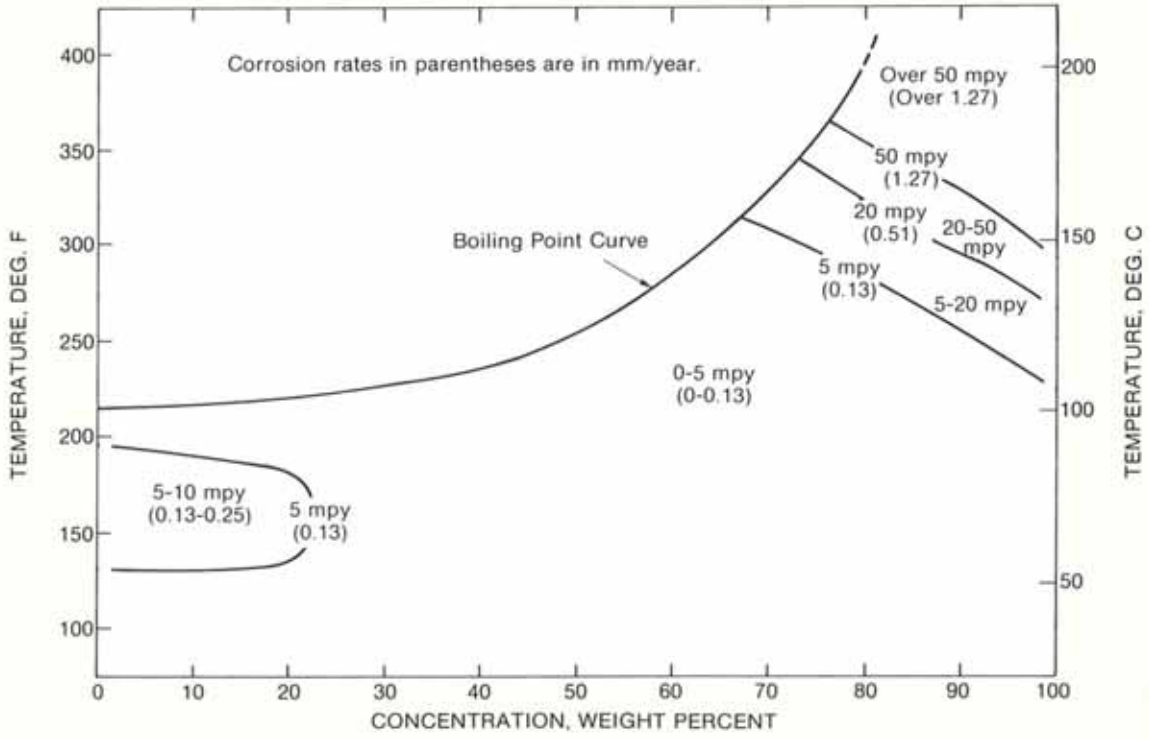
HAYNES alloy No. 25 is resistant to sulfuric acid in all concentrations at room temperature. At 150 deg. F (66 deg. C) it can be used in concentrations up to 60 percent. (See page No. 87.)

Chloride contamination of sulfuric acid tends to increase the rate of attack at all acid concentrations for HASTELLOY alloys B-2, and C-276, but has a lesser effect on alloys G-30 and G-30.

ISOCORROSION DIAGRAM*

HASTELLOY® Alloy B-2

Resistance to Sulfuric Acid

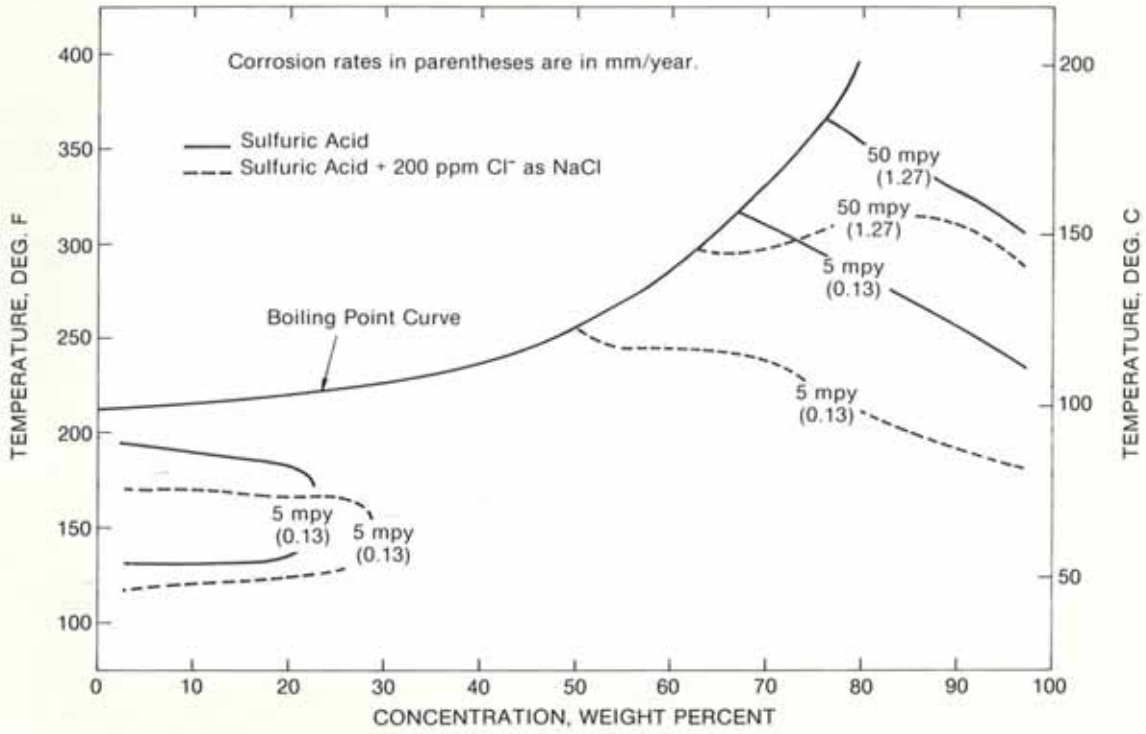


*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

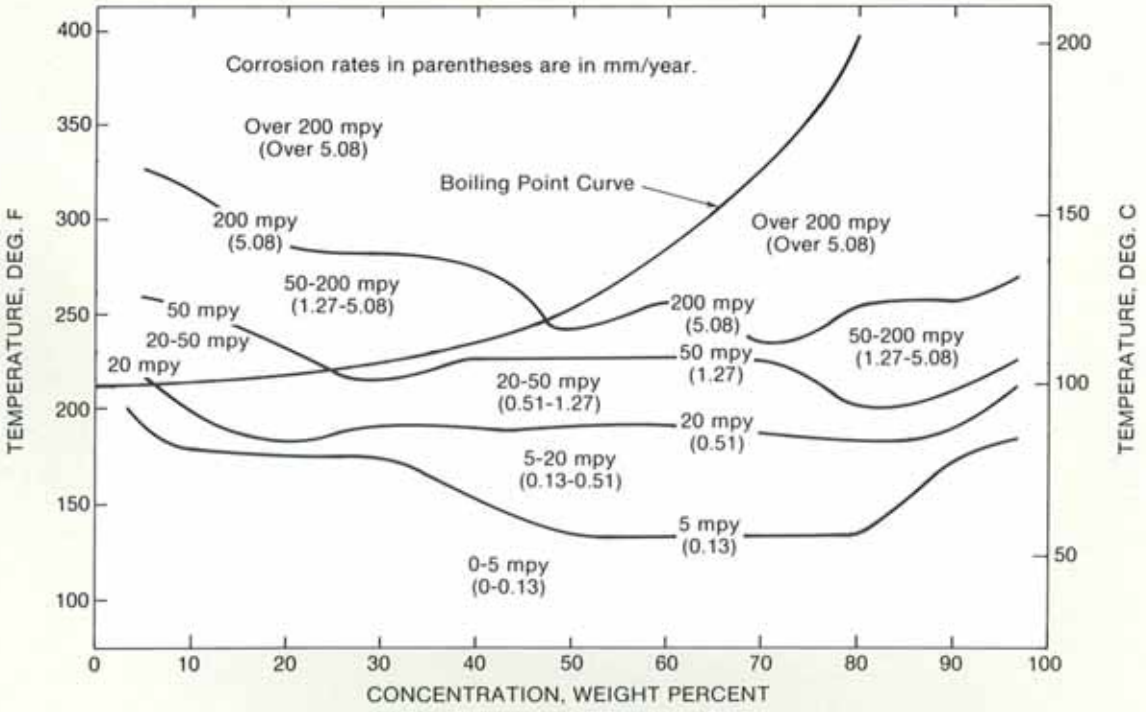
HASTELLOY® Alloy B-2

Resistance to Sulfuric Acid with 200 ppm Chloride Ions



HASTELLOY® Alloy C-276

Resistance to Sulfuric Acid

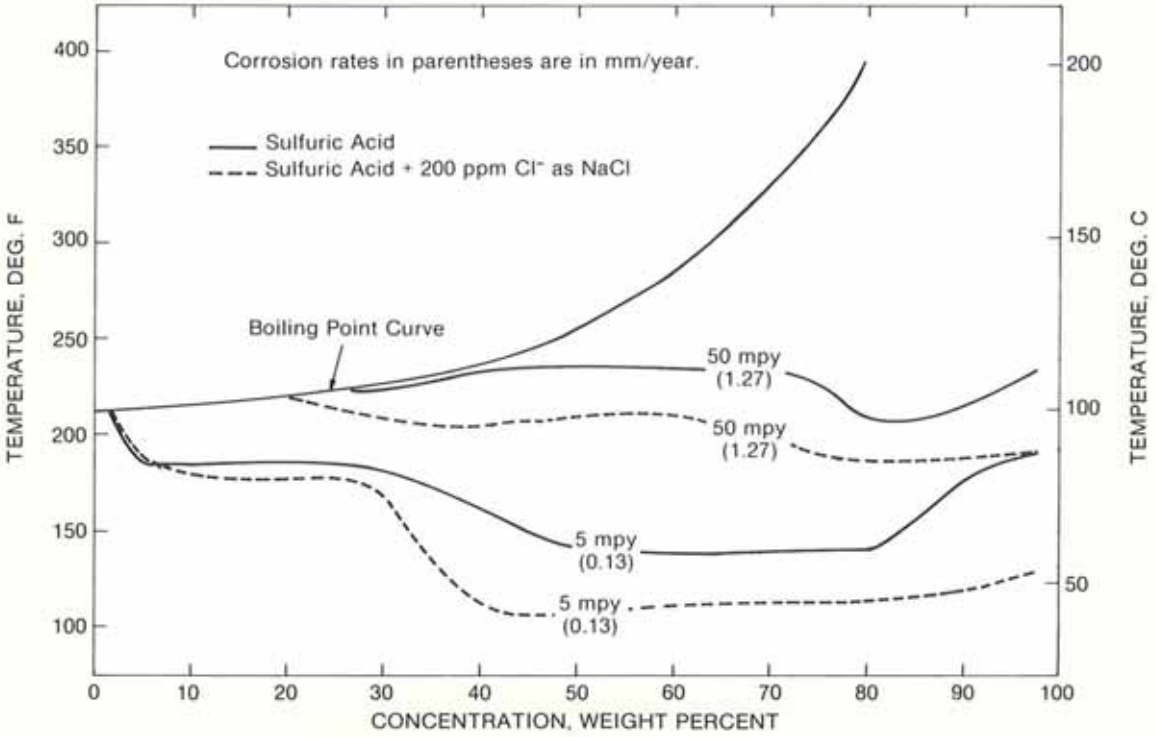


*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

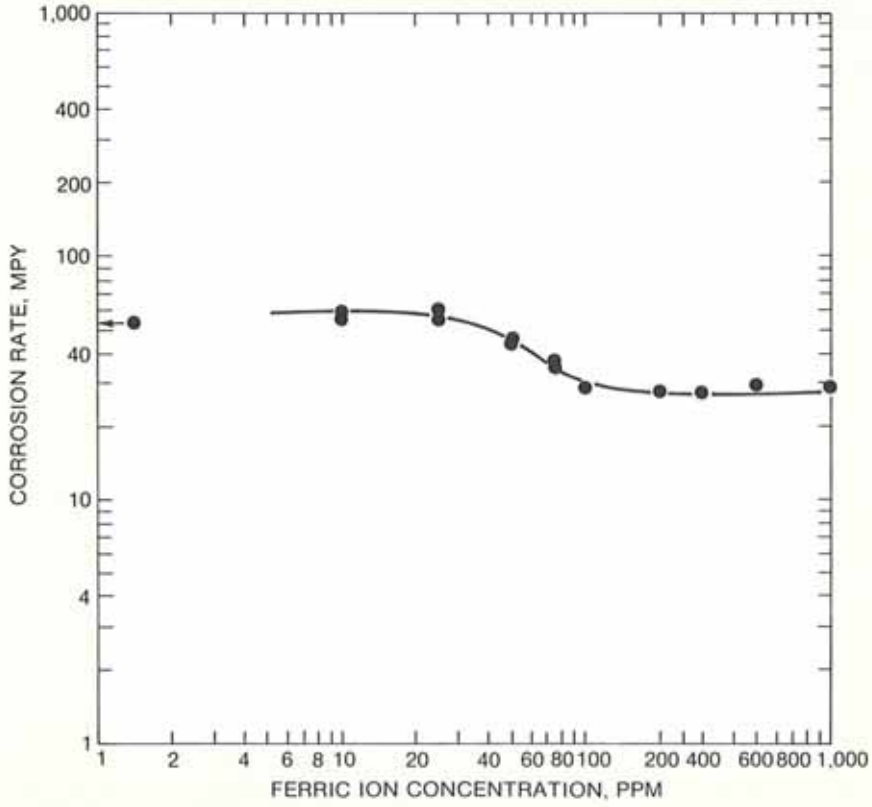
HASTELLOY® Alloy C-276

Resistance to Sulfuric Acid with 200 ppm Chloride Ions



HASTELLOY® Alloy C-276

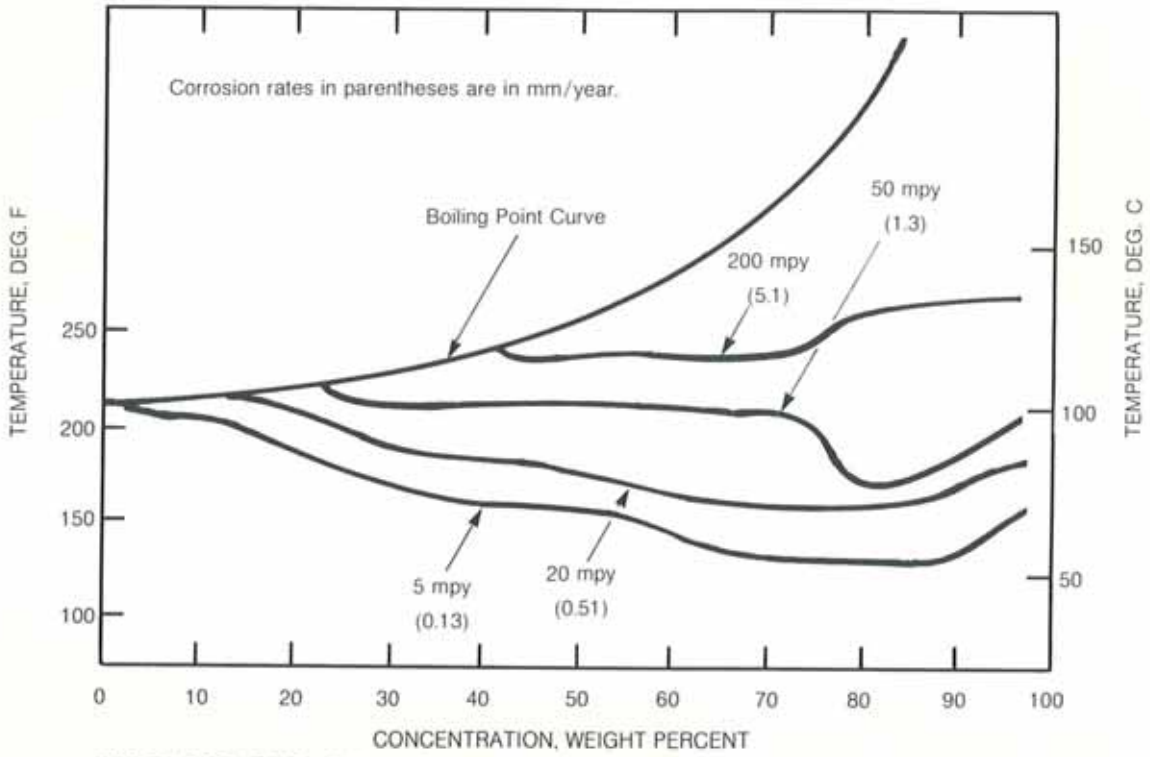
Effect of Ferric Ion Concentration on Corrosion Rate in Boiling 30% Sulfuric Acid



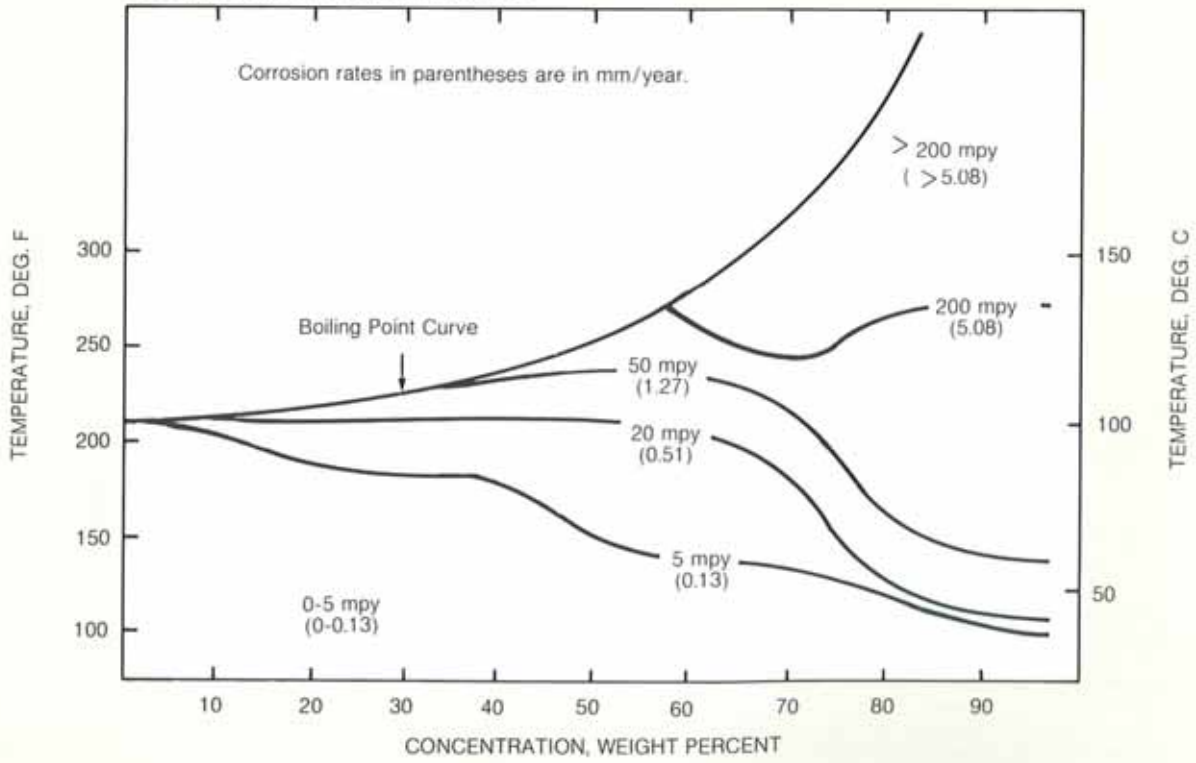
*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy C-22
Resistance to Sulfuric Acid



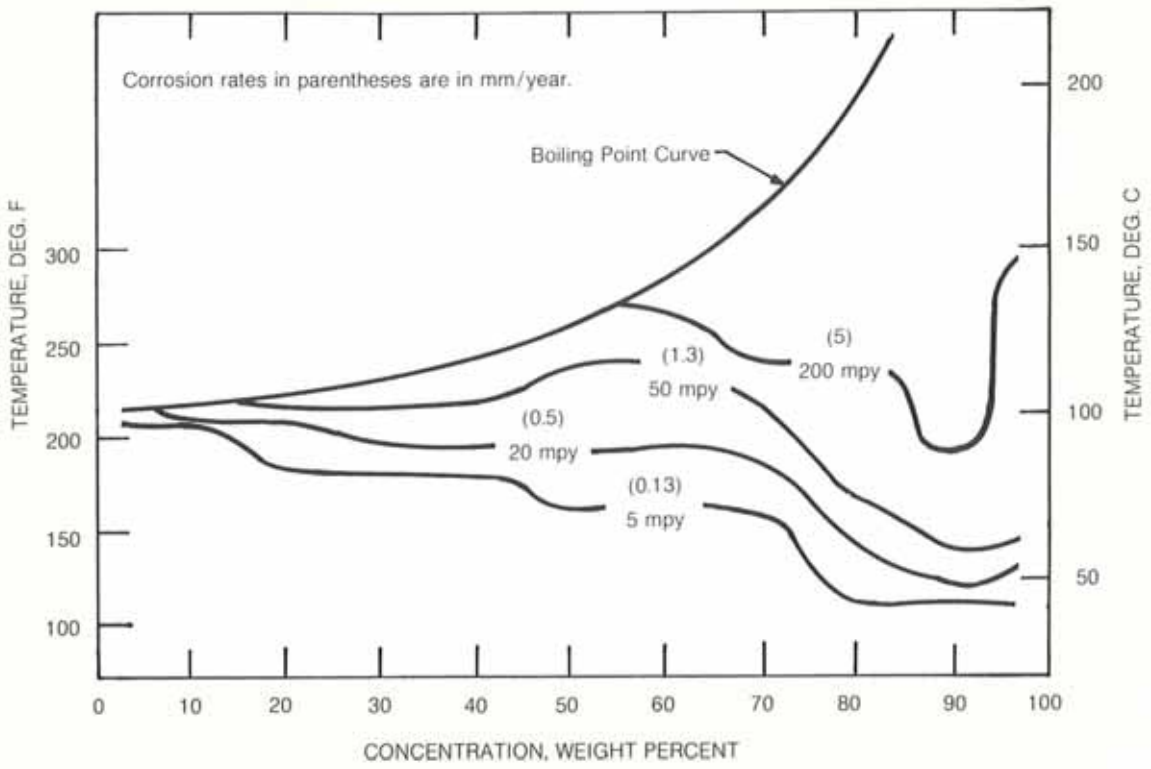
HASTELLOY® Alloy G-3
Resistance to Sulfuric Acid



*All test specimens were solution heat-treated and in the unwelded condition.

ISOCORROSION DIAGRAMS*

HASTELLOY® Alloy G-30
Resistance to Sulfuric Acid



*All test specimens were solution heat-treated and in the unwelded condition.

ACETIC AND FORMIC ACIDS

Acetic and formic acids are two of the more common organic acids. These acids are non-oxidizing in nature and all the Cabot Wrought Products Division alloys described offer good resistance. Corrosion problems often arise, however, because of the presence of impurities such as oxygen and halide ions.

HASTELLOY® alloys B-2, C-276 and C-4, HAYNES® alloy No. 25 and MULTIMET® alloy have excellent resistance to acetic acid at all concentrations and temperatures.

Alloy No. 25 and MULTIMET alloy have excellent resistance to formic acid at room temperature and 150 deg. F (66 deg. C).

HYDROFLUORIC ACID

Hydrofluoric acid is one of the most corrosive chemicals. Corrosion is promoted by the presence of oxidizers in the acid solutions. Alloys with good corrosion resistance in HF solutions generally form a fluoride film and are therefore, susceptible to accelerated corrosion under conditions of high velocity.

HASTELLOY alloys G, G-3 and C-276 have been used, successfully, as linings for hydrofluoric acid kilns. Alloy G also has been used for condenser tubes which handle the hydrofluoric gas after it leaves the kiln.

Alloys C-276, G and G-3 have good resistance to abrasion and corrosion from sulfuric acid, fluorspar and hydrogen fluoride gas — even at high temperatures.

CHLORINE AND HYPOCHLORITES

HASTELLOY® alloy C-276 is one of the few metallic materials possessing adequate resistance to chlorine dioxide, hypochlorites, and other solutions containing free chlorine in appreciable concentrations, such as those used for bleaching purposes. However, the alloy may be attacked in solutions above room temperature, especially at temperatures over 150 deg. F (66 deg. C).

Alloy C-276 has been successfully and extensively employed for handling chlorine, both wet and dry, in such parts as valves, piping, vessels, cracking tubes, and feed pipes. It has been used with excellent results in various types of chlorinating equipment, such as are used in swimming pools and city water-purification units. At room temperature, the rate of penetration in wet chlorine gas is less than one mil (0.03 mm) per year; at higher temperatures, however, local attack may occur. HAYNES® alloy No. 25, a high-temperature alloy, has also shown excellent resistance to wet chlorine gas at room temperature. Tests have shown a penetration rate of less than one mil (0.03 mm) per year in this medium.

SALTS

Alloys B-2 and C-276 are highly resistant to acid chlorides, such as ammonium or zinc chloride. Alloy C-276 resists acid sulfates, such as aluminum or ammonium sulfate, and acid phosphates.

Alloy C possesses unusual resistance at temperatures up to 150 deg. F (66 deg. C) to such strongly corrosive oxidizing salts as solutions of cupric chloride, and ferric and cupric sulfate; and also to mixtures of oxidizing salts, such as chromates and nitrates, in sulfuric or hydrochloric acid. Ferric chloride is one of the most corrosive chemicals likely to be encountered in the field of oxidizing acid salts. HASTELLOY alloy C-276 will resist this salt at room temperature and can be recommended for use with concentrations up to 40 percent at 150 deg. F (66 deg. C).

SEAWATER

HASTELLOY alloy C-276 has outstanding resistance to seawater, even when it is polluted. Alloy C-276 is used extensively for heat exchangers to cool hot concentrated acid in sulfuric acid plants using seawater as the cooling media because of its resistance to both seawater and sulfuric acid.

Corrosion samples of HASTELLOY alloy C, a predecessor of alloy C-276, have been exposed to the sea atmosphere on an Atlantic Ocean beach for over 41 years and still retain their luster and reflectivity. Since alloy C-276 has improved resistance to pitting, crevice corrosion and stress-corrosion cracking, it should have even better resistance than alloy C under similar conditions.

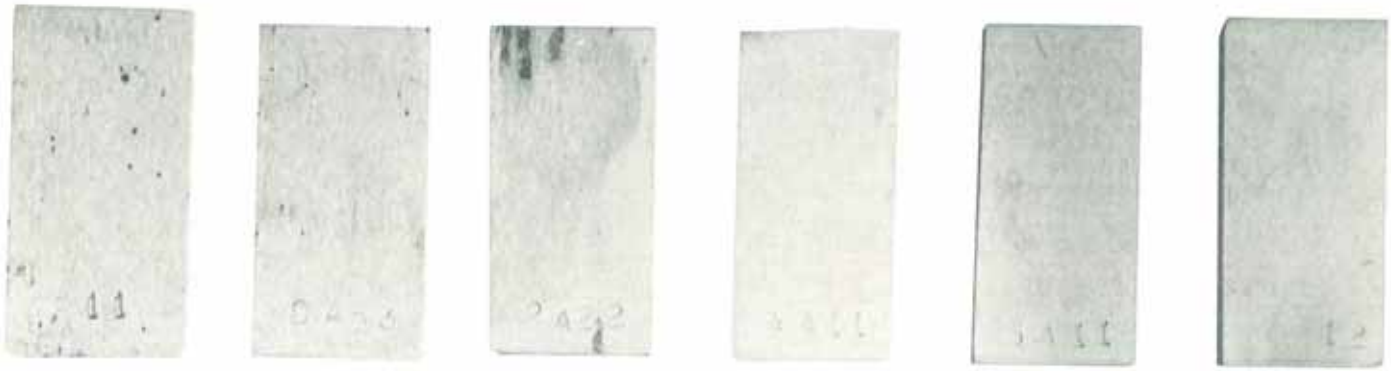
LOCALIZED CORROSION

The good-to-excellent resistance of HASTELLOY alloys G, G-3, C-276 and CABOT® alloy No. 625 to localized corrosion attack such as pitting, crevice corrosion and stress-corrosion cracking is shown in the tables and charts which follow.

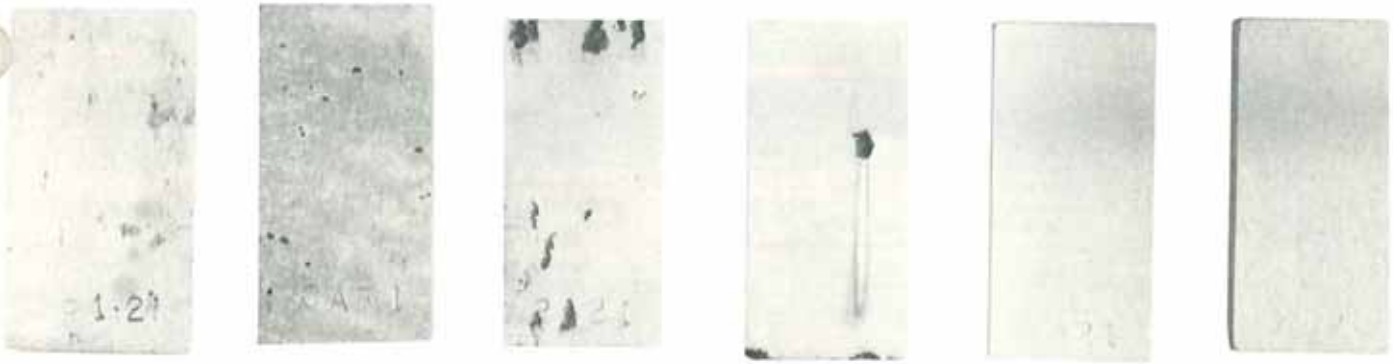
EFFECT OF TEMPERATURE ON PITTING RESISTANCE IN A SEVERELY OXIDIZING ENVIRONMENT*

77 DEG. F (25 DEG. C)

Type 316L Stainless Steel	20 Cb-3** alloy	Alloy 825	HASTELLOY® alloy G	Alloy 625	HASTELLOY alloy C-276



158 DEG. F (70 DEG. C)



216 DEG. F (102 DEG. C)

*24-hr. exposure in 7 vol. % H_2SO_4 + 3 vol. % HCl + 1% $CuCl_2$ + 1% $FeCl_3$

**Trademark of Carpenter Technology Corporation

COMPARATIVE IMMERSION PITTING AND CREVICE-CORROSION TEMPERATURES IN OXIDIZING NaCl-HCl SOLUTION

The chemical composition of the solution used in this test is as follows: 4% NaCl + 0.1% $Fe_2(SO_4)_3$ + 0.01M HCl. This solution contains 24,300 ppm chlorides and is acidic (pH2).

In both pitting and crevice-corrosion testing the solution temperature was varied in 5 deg. C increments to determine the lowest temperature at which pitting corrosion initiated (observed by examination at a magnification of 40X of duplicate samples) after a 24-hour exposure period (Pitting Temperature), and the lowest temperature at which crevice-corrosion initiated in a 100 hour exposure period (Crevice-Corrosion Temperature).

Alloy	Pitting Temperature, deg. C	Pitting Temperature, deg. F	Crevice-Corrosion Temperature, deg. C	Crevice-Corrosion Temperature, deg. F
HASTELLOY® alloy C-276	150	302	80	176
CABOT® alloy No. 625	101	214	25	77
HASTELLOY alloy G-3	75	167	25	77
HASTELLOY alloy G-30	75	167	25	77
Alloy No. 904L	45	113	20	68
Type 317LM Stainless Steel	35	95	15	59
Type 317L Stainless Steel	25	77	10	50
CABOT alloy No. 825	25	77	⩽ -5	⩽ 23
20 Cb-3 alloy	20	68	⩽ -5	⩽ 23
Type 316 Stainless Steel	20	68	⩽ -5	⩽ 23

COMPARATIVE STRESS-CORROSION CRACKING DATA

Alloy	Time, hrs. to crack in boiling 42% Magnesium Chloride
Type 304 Stainless Steel	1-2
Type 316L Stainless Steel	1-2
20 Cb-3 alloy	22
Alloy 825	46
CABOT® alloy No. 625	No Cracks—1000
HASTELLOY® alloys G-3/G-30	No Cracks—1000
HASTELLOY alloy C-276	No Cracks—1000

COMPARATIVE CREVICE-CORROSION TEST DATA IN 10% FERRIC CHLORIDE

Alloy	Average Corrosion Rate, mils (mm) per year*		
	77 deg. F (25 deg. C)	122 deg. F (50 deg. C)	167 deg. F (75 deg. C)
HASTELLOY® alloy C-276	0.2 (<0.01)	0.2 (<0.01)	1.4 (<0.04)
HASTELLOY alloy C-4	0.3 (<0.01)	0.5 (<0.02)	20 (0.51)
CABOT® alloy No. 625	1.5 (0.04)	124 (3.1)	510 (13)
HASTELLOY alloy G	14 (0.36)	85 (2.2)	550 (14)
20 Cb-3 alloy	205 (5.2)	380 (9.7)	700 (17.8)
Type 316L Stainless Steel	312 (7.9)	460 (11.7)	780 (19.8)
Alloy 825	730 (18.5)	707 (18)	680 (17.3)

* Average corrosion rate on duplicate samples even though most corrosion occurred under crevice. Tests were for 100 hours with grooved block.

CREVICE-CORROSION DATA IN 10% FERRIC CHLORIDE AT ROOM TEMPERATURE FOR 10 DAYS

Alloy	Number of Attacked Crevices*	Maximum Depth of Penetration, mils	mm
HASTELLOY® alloy C-276	0	0	0
CABOT® alloy No. 625	11	3	0.08
HASTELLOY alloy G-3	11	13	0.33
HASTELLOY alloy G	16	17	0.43
Type 317LM Stainless Steel	20	12	0.30
Alloy No. 904L	23	19	0.48
Type 317L Stainless Steel	16	77	2.0
20 Cb-3 alloy	24	76	1.9
Type 316 Stainless Steel	24	76	1.9 (Perforated)
CABOT alloy No. 825	24	125	3.2 (Perforated)

*Maximum possible number of crevices was 24.

MODIFIED WICK TEST DATA*

Media → 1000 ppm Sodium Chloride and 500 ppm Ferric Chloride at 190 deg. F (88 deg. C) for 30 days

Alloy ↓	General Corrosion	Average depth of Crevice Attack, mils (mm)**	Average depth of Pitting Attack, mils (mm)**	Stress-Corrosion Cracking
HASTELLOY® alloy C-276	None	One crevice at weld—2 (0.05)	None	None
HASTELLOY alloy G	None	3 (0.08)	3 (0.08)	None
Alloy 625	None	3 (0.08)	3 (0.08)	None
Alloy 825	Slight	8 (0.20)	8 (0.20)	None
Type 316L Stainless Steel	Heavy	18 (0.46)	18 (0.46)	Cracked on both sides

*In this test, a U-bend, stressed specimen is in contact with a wick material which is wetted by the media shown. The media evaporates from the specimen's surface during the test simulating wet/dry areas in a scrubber. In these areas, heavy deposits of scale and salts often are observed which promote localized corrosion.

**Maximum crevice and pitting attack occurred at the salt line.

LOCALIZED CORROSION RESISTANCE IN PULP AND PAPER INDUSTRY ENVIRONMENTS

Alloys	Ammonia-Base Spent Sulfite Liquor* pH ≃ 1.9, Cl^- — 200 ppm, T ≃ 155 deg. F (69 deg. C)		First Stage Bleach Unit Environment* pH ≃ 1.8, Cl_2 + HCl + H_2SO_4, T ≃ 95 deg. F (35 deg. C)	
	Exposure — 246 Days		Exposure — 258 Days	
	Smooth Areas	Creviced Areas	Smooth Areas	Creviced Areas
Type 316 Stainless Steel	Pitting	Crevice Attack	Pitting	Severe Crevice Attack
Alloy 825	No Pitting	Crevice Attack	No Pitting	Severe Crevice Attack
HASTELLOY® alloy G	No Pitting	No Attack	No Pitting	Slight Crevice Attack
CABOT® alloy No. 625	No Pitting	No Attack	No Pitting	Incipient Localized Attack
HASTELLOY alloy C-276	No Pitting	No Attack	No Pitting	No Attack

*Actual Field Test Results, U-Bend Specimens T — Temperature

FACTORS FOR CONVERTING PENETRATION RATE INTO LOSS OF WEIGHT

To convert penetration in mils per year into	HASTELLOY® alloy B-2	HASTELLOY alloy C-276	HASTELLOY alloy C-4	HASTELLOY alloys G-3/G-30	HASTELLOY alloy X	HAYNES® alloy No. 25	MULTIMET® alloy
Loss in weight in g per cm^2 per hr., multiply by . . .	0.00000267	0.00000258	0.00000250	0.00000240	0.00000238	0.00000264	0.00000237
Loss in weight in mg per dm^2 per day, multiply by . . .	6.42	6.19	6.01	5.78	5.73	6.35	5.71

To convert penetration in mm per year into	HASTELLOY alloy B-2	HASTELLOY alloy C-276	HASTELLOY alloy C-4	HASTELLOY alloys G-3/G-30	HASTELLOY alloy X	HAYNES alloy No. 25	MULTIMET alloy
Loss in weight in g per cm^2 per hr., multiply by . . .	0.000105	0.000101	0.0000984	0.0000944	0.0000937	0.000104	0.0000933
Loss in weight in mg per dm^2 per day, multiply by . . .	252.64	243.87	236.75	227.71	225.51	250.18	224.69

BOILING POINTS IN DEG. F (DEG. C) VS. CONCENTRATION

	MEDIA					
Concentration Percent by Weight	Hydrochloric Acid	Sulfuric Acid	Nitric Acid	Phosphoric Acid	Acetic Acid	Formic Acid
10	219 (104)	215 (102)	217 (103)	212 (100)	213 (101)	214 (101)
20	230 (110)**	219 (104)	222 (105)	—	—	215 (102)
30	—	226 (107)	228 (108)	215 (102)	—	216 (102)
40	—	237 (114)	234 (112)	—	—	218 (103)
50	—	253 (123)	242 (117)	226 (107)	217 (103)	—
60	—	284 (140)	249 (121)	—	—	222 (105)
65	—	304 (151)	251 (122)	—	—	—
70	—	329 (165)	250 (121)*	—	—	—
80	—	395 (202)	—	—	—	—
85	—	437 (225)	—	316 (157)*	—	222 (105)*
90	—	491 (255)	—	—	—	—
96	—	554 (290)	—	—	—	—
98	—	626 (330)*	—	—	—	—
99	—	—	—	—	243 (118)*	—

CORROSION RESISTANCE OF HAYNES® ALLOY NO. 25 AND MULTIMET® ALLOY

NOTE: The figures in the following tables were determined in laboratory tests, using ordinary laboratory reagents in glassware. As it is impossible to duplicate plant conditions by laboratory tests, it is obvious that these results cannot be translated directly into plant performance. However, they will serve as a guide for selecting an alloy for an application.

All results are expressed in mils (mm) penetration per year. Acid strengths are given in percent by weight. In some instances, no measurable penetration could be observed. These instances are noted by the word, "Nil." All data are steady-state as calculated from a minimum of five 24-hr. test periods.

All data were obtained using corrosion specimens prepared from 12-gage, solution heat-treated sheet.

TYPICAL PENETRATION RATES IN CORROSIVE MEDIA, Mils (mm) Per Year

	ACETIC ACID			CHROMIC ACID			FORMIC ACID					
	10%	50%	99%	2%	10%	20%	10%	20%	30%	40%	60%	89%
HAYNES alloy No. 25												
Room	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.1 (<0.01)	—	0.1 (<0.01)	0.1 (<0.01)	0.1 (<0.01)
150 deg. F (66 deg. C)	Nil	Nil	Nil	Nil	5.0 (0.13)	21 (0.53)	Nil	0.1 (<0.01)	—	Nil	Nil	0.1 (<0.01)
Boiling	0.1 (<0.01)	0.1 (<0.01)	Nil	3.0 (0.08)	41 (1.04)	165 (4.19)	8.0 (0.20)	10 (0.25)	—	15 (0.38)	20 (0.51)	6.0 (0.15)
MULTIMET alloy												
Room	Nil	Nil	Nil	Nil	Nil	Nil	Nil	0.1 (<0.01)	—	0.1 (<0.01)	0.1 (<0.01)	Nil
150 deg. F (66 deg. C)	Nil	Nil	Nil	Nil	8.0 (0.20)	91 (2.31)	Nil	0.1 (<0.01)	—	Nil	0.1 (<0.01)	Nil
Boiling	0.1 (<0.01)	0.1 (<0.01)	0.1 (<0.01)	6.0 (0.15)	358* (9.09)	>1000 (>25.4)	4.0 (0.10)	6.0 (0.15)	—	8.0 (0.20)	6.0 (0.15)	3.0 (0.08)

*Rate is for the fifth (24-hour) test period, not steady state rate.

	CUPRIC CHLORIDE					FERRIC CHLORIDE			
	2%	2% + 5% NaCl	5% + 10% NaCl	10%	10% + 10% NaCl	2%	2% + 5% NaCl	5% + 10% NaCl	10%
HAYNES alloy No. 25									
Room	Nil	—	—	0.2 (<0.01)	—	Nil	—	—	Nil
150 deg. F (66 deg. C)	—	Nil	Nil	—	Nil	—	Nil	Nil	—
Boiling	—	0.1 (<0.01)	0.5 (<0.02)	—	—	—	Nil	—	—
MULTIMET alloy									
Room	Nil	—	—	Nil	—	Nil	—	—	Nil
150 deg. F (66 deg. C)	—	160 (4.06)	Nil	—	Nil	—	193 (4.90)	>1000 (>25.4)	—
Boiling	—	919 (23.3)	>1000 (>25.4)	—	—	—	>1000 (>25.4)	—	—

*Rate is for the fifth (24-hour) test period, not steady state rate.

TYPICAL PENETRATION RATES IN CORROSIVE MEDIA, Mils (mm) Per Year

	HYDROCHLORIC ACID								WET CHLORINE
	1%	2%	5%	10%	15%	20%	25%	37%	
HAYNES® alloy No. 25									
Room	0.1 (<0.01)	0.1 (<0.01)	24 (0.61)	25 (0.64)	29 (0.74)	6.0 (0.15)	4.0 (0.10)	2.0 (0.05)	0.1 (<0.01)
150 deg. F (66 deg. C)	Nil	0.1 (<0.01)	474 (12.0)	420 (10.7)	552 (14.0)	268 (6.81)	144 (3.66)	68 (1.73)	—
Boiling	400 (10.2)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	—	—	—
MULTIMET® alloy									
Room	0.1 (<0.01)	0.1 (<0.01)	17 (0.43)	13 (0.33)	15 (0.38)	8.0 (0.20)	6.0 (0.15)	11 (0.28)	180 (4.57)
150 deg. F (66 deg. C)	Nil	Nil	343 (8.71)	572 (14.5)	431 (10.9)	424 (10.8)	687 (17.4)	>1000 (>25.4)	—
Boiling	370 (9.40)	934 (22.7)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	—	—	—

	HYDROCHLORIC — NITRIC ACID MIXTURES	
	11.8% HCl + 13.3% HNO_3 (by weight) 30% vol. 15% vol.	15.2% HCl + 17.2% HNO_3 (by weight) 40% vol. 20% vol.
HAYNES alloy No. 25		
160 deg. F (71 deg. C)	2.0 (0.05)	15 (0.38)
190 deg. F (88 deg. C)	11 (0.28)	33 (0.84)

	NITRIC ACID							
	10%	20%	30%	40%	50%	60%	65%	70%
HAYNES alloy No. 25								
Room	Nil	Nil	Nil	Nil	Nil	Nil	—	Nil
150 deg. F (66 deg. C)	Nil	Nil	0.3 (<0.01)	0.5 (<0.02)	0.8 (0.02)	2.0 (0.05)	—	2.0 (0.05)
Boiling	0.5 (<0.02)	2.0 (0.05)	4.0 (0.10)	9.0 (0.23)	18* (0.46)	34* (0.86)	41* (1.04)	46* (1.17)
MULTIMET alloy								
Room	Nil	Nil	Nil	Nil	Nil	Nil	—	Nil
150 deg. F (66 deg. C)	Nil	Nil	Nil	0.1 (<0.01)	0.3 (<0.01)	0.4 (0.01)	—	0.8 (0.02)
Boiling	0.3 (<0.01)	0.8 (0.02)	2.0 (0.05)	4.0 (0.10)	6.0 (0.15)	10 (0.25)	12 (0.30)	14 (0.36)

*The rates for the fifth (24-hour) test period, not steady state rates.

TYPICAL PENETRATION RATES IN CORROSIVE MEDIA, Mils (mm) Per Year

	PHOSPHORIC ACID				HYDROFLUORIC ACID			SODIUM HYDROXIDE		
	10%	30%	50%	85%	5%	25%	45%	5%	25%	50%
HAYNES® alloy No. 25										
Room	Nil	Nil	Nil	Nil	5.0 (0.13)	12 (0.30)	20 (0.51)	Nil	Nil	Nil
150 deg. F (66 deg. C)	0.1 (<0.01)	Nil	0.1 (<0.01)	0.1 (<0.01)	—	—	—	Nil	Nil	Nil
Boiling	0.2 (<0.01)	2.0 (0.05)	4.0 (0.10)	562 (14.3)	—	—	—	Nil	—	—
MULTIMET® alloy										
Room	Nil	Nil	Nil	Nil	5.0 (0.13)	37 (0.94)	52 (1.32)	Nil	Nil	Nil
150 deg. F (66 deg. C)	Nil	0.1 (<0.01)	0.1 (<0.01)	0.1 (<0.003)	—	—	—	Nil	Nil	Nil
Boiling	0.1 (<0.01)	0.3 (<0.01)	3.0 (0.08)	303 (7.70)	—	—	—	Nil	—	—

	SULFURIC ACID										
	2%	5%	10%	25%	50%	60%	77%	80%	85%	90%	96%
HAYNES alloy No. 25											
Room	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
150 deg. F (66 deg. C)	Nil	Nil	Nil	11 (0.28)	30 (0.76)	29 (0.74)	55 (1.40)	61 (1.55)	91 (2.31)	123 (3.12)	104 (2.64)
Boiling	49 (1.24)	52 (1.32)	92 (2.34)	203 (5.16)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	>1000 (>25.4)	735 (18.7)	318 (8.08)

CORROSION TEST SAMPLES

Standard spool-type specimens are available for testing under actual plant conditions. Samples of wrought HASTELLOY® alloys B-2, C-276, C-22, G-3, G-30, X, HAYNES® alloy No. 25 and MULTIMET® alloy are available from stock in the annealed condition.

As-welded specimens can be obtained from stock in all these alloys except MULTIMET® alloy. Corrosion test racks containing up to 20 samples of Cabot Wrought Products Division alloys and other metals are available for installation in any plant where corrosion is a concern.

To obtain corrosion coupons or test racks, contact your local Cabot Wrought Products Division sales representative or any of the locations shown on the back cover of this booklet.

OUR NEW NAME

Haynes International, Inc.

1020 W. Park Avenue • P.O. Box 9013 • Kokomo, IN 46904-9013
(317) 456-6000

Condensed Product List

ALLOYS

High-Performance Alloys
HASTELLOY® alloy B-2
HASTELLOY alloy C-4
HASTELLOY alloy C-276
HASTELLOY alloy G
HASTELLOY alloy G-3
HASTELLOY alloy N
HASTELLOY alloy S
HASTELLOY alloy W
HASTELLOY alloy X
HAYNES® alloy No. 25
HAYNES alloy No. 31
CABOT® alloy No. R-41
CABOT alloy No. 75
HAYNES alloy No. 188
CABOT alloy No. 214
CABOT alloy No. 263
HAYNES alloy No. 556
CABOT alloy No. 625
CABOT alloy No. 718
CABOT alloy No. X-750
MULTIMET® alloy
WASPALOY alloy

Nickel Alloys
CABOT alloy No. 200
CABOT alloy No. 201
CABOT alloy No. 400
CABOT alloy No. R-405
CABOT alloy No. K-500
CABOT alloy No. 600
CABOT alloy No. 800
CABOT alloy No. 800H
CABOT alloy No. 825

Beryllium Containing Alloys
BERYLCO® alloy 10
BERYLCO alloy 14
BERYLCO alloy 25
BERYLCO alloy 33-25
BERYLCO alloy 165
BERYLCO alloy 440

Super Stainless Steels
FERRALIUM® alloy 255
CABOT alloy No. 904L

Titanium and Titanium Alloys
CABOT Ti-25
CABOT Ti-40
CABOT Ti-55
CABOT Ti-70
CABOT Ti-3Al-2.5V
CABOT Ti-6Al-4V

Electrical/Magnetic/ Expansion Alloys
CABOT alloy No. 4-79L
CABOT alloy No. 4-79S
CABOT alloy No. 22-3
CABOT alloy No. 29-17
CABOT alloy No. 36
CABOT alloy No. 49L
CABOT alloy No. 49R
CABOT alloy No. 49S
CABOT alloy No. 72

FORMS

Flat Products
Coil
Plate
Sheet
Slit Strip

Shaped Products
Billet
Castings
Contoured Shapes
Covered Electrodes
Extrusions
Fabricated Forms
Forgings
Hexagons
Rectangles
Rod
Round Bar
Squares
Wire
Wire Redraw Stock

Tubular Products
Seamless Pipe and Tubing
Welded Pipe and Tubing

For More Information Contact:

Kokomo, Indiana 46901
1020 W. Park Avenue
Tel: 317-456-6000
Telex: 272280

Reading, Pennsylvania 19603
P.O. Box 1296
Tel: 215-921-5000

Anaheim, California 92806
Stadium Plaza
1520 South Sinclair Street
Tel: 714-978-1775

Arcadia, Louisiana 71001
Highway 80 West
P.O. Box 265
Tel: 318-263-2002

Elkhart, Indiana 46514
52800 Higgins Boulevard
P.O. Box 3100
Tel: 219-262-3451

Elmsford, New York 10523
14 Hayes Street
Tel: 914-592-3146

Houston, Texas 77041
4650 S. Pinemont Street,
Suite 130
Tel: 713-462-2177

Brazil
Cabot do Brasil
Comércio e Indústria Ltda.
Avenida Paulista 2001
Conj 1704, 01311 São Paulo-SP
Tel: 289-0900 and 289-0622
Telex: 11 22510

Canada
Cabot Carbon of Canada, Ltd.
45 Sheppard Avenue East,
Suite 218
Willowdale, Ontario M2N 5X1
Tel: 416-226-5600
Telex: 06966753

Cabot Carbon of Canada, Ltd.
5757 Cavendish Boulevard,
Suite 103
Montreal, Quebec H4W 2W8
Tel: 514-489-1425
Telex: 05566181

England
Cabot Alloys (UK) Ltd.
P.O. Box 10
Parkhouse Street
Openshaw
Manchester, M11 2ER
Tel: (61) 223-1371
Telex: 667611

France
Berylco-Cabot
Metaux Speciaux
76-78 Champs Elysees
75008 Paris
Tel: (1) 359-2795
Telex 280966

Cabot Alloys France
Zone Industrielle
de la Pilaterie
Rue des Châteaux
59290 Wasquehal
Tel: (20) 72 51 56
Telex: 160040

Switzerland
Nickel Contor A.G.
Gotthardstrasse 21
CH-8022 Zurich
Tel: (1) 201 73 22
Telex: 54765

West Germany
Deutsche Beryllium GmbH
Postfach 1620
6370 Oberursel
Tel: (61) 715-2088
Telex 410741

Nickel Contor
Deutschland GmbH
Taunusanlage 21
D-6000 Frankfurt/Main 1
Tel: (611) 72 75 48
Telex: 4189163

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