

Technical Data

Corrosion resistance of electroless nickel-plating

[Camozzi fittings are plated at a thickness of 5-8 µm {microns}]



Substance	% Concentration	Temperature Degrees C	Resistance	Substance	% Concentration	Temperature Degrees C	Resistance
Acetic Acid	0-70	Ambient Temperature	C-B	Nitric Acid	2-100	Ambient Temperature	D
Acetone	100	54	A-B	Oleic Acid	100	Ambient Temperature	A
Acidic Well-Water	-	20-4	B	Oleum	20	Ambient Temperature	D
Aliphatic Acid	100	Ambient Temperature	B	Orange Juice		Ambient Temperature	A
Aluminum Chloride	saturated	Ambient Temperature	D	Oxalic Acid	saturated	Ambient Temperature	A
Aluminum Sulphate	saturated	Ambient Temperature	B	Palm Oil	100	Ambient Temperature	A
Ammonium Chloride	saturated	Ambient Temperature	B	Paraffin	100	Ambient Temperature	A
Ammonium Hydroxide	5-28	Ambient Temperature	C	Peanut Oil	100	Ambient Temperature	A
Ammonium Nitrate	saturated	Ambient Temperature	B	Phenol	100	90	A
Amyl Alcohol	100	Ambient Temperature	A	Phosphoric Acid	0-100	Ambient Temperature	0-10% C 10-80 % B
Amyl Chloride	100	Ambient Temperature	A	Picric Acid	100	Ambient Temperature	D
Aviation Gasoline	100	Ambient Temperature	A	Polymers	100	20...200	A
Barium Chloride	2-40	Ambient Temperature	A	Potassium Carbonate	saturated	Ambient Temperature	A
Barium Hydroxide	2-50	60	A	Potassium Chloride	saturated	Ambient Temperature	A
Beer	-	10	D	Potassium Hydrate	2-50	Ambient Temperature	A
Benzil Acid	saturated	Ambient Temperature	A	Potassium Ironcyanide	saturated	Ambient Temperature	B
Benzyl	100	Ambient Temperature	A	Propane	100	Ambient Temperature	A
Boiling Oil	100	Ambient Temperature	A	Rosin	100	@ boiling point	A
Borax	saturated	Ambient Temperature	B	Sea Water		Ambient Temperature	A
Boric Acid	saturated	Ambient Temperature	C	Silver Chloride	saturated	Ambient Temperature	D
Bromine	100	Ambient Temperature	B	Soap		95	A
Butane	100	25	A	Sodium Bicarbonate	saturated	Ambient Temperature	B
Butyl Alcohol	100	Ambient Temperature	A	Sodium Carbonate	saturated	Ambient Temperature	A
Calcium Chloride	saturated	Ambient Temperature	A	Sodium Chloride	saturated	Ambient Temperature	A
Calcium Hydroxide	saturated	60	A	Sodium Cyanide	5	Ambient Temperature	B
Calcium Nitrate	saturated	Ambient Temperature	A	Sodium Hydrate	2-73	> =60	A
Carbon Dioxide	100	Ambient Temperature	B	Sodium Nitrate	10	Ambient Temperature	A
Carbon Tetrachloride	100	@ boiling point	A	Sodium Phosphate	saturated	Ambient Temperature	A
Chlorine	100	Ambient Temperature	B	Sodium Sulphate	saturated	Ambient Temperature	A
Chloroform	100	@ boiling point	B	Sodium Sulphide	saturated	Ambient Temperature	A
Chloroform	100	Ambient Temperature	A	Steam		425	A
Chromic Acid	2-100	Ambient Temperature	D	Steam Condensate		80	A
Citric Acid	5	Ambient Temperature	A	Stearic Acid	saturated	Ambient Temperature	A
Coal Oil	100	Ambient Temperature	A	Sulphuric Acid	20	Ambient Temperature	C
Coffee		@ boiling point	A	Sulphuric Acid	50-70	Ambient Temperature	C
Copper Chloride	saturated	Ambient Temperature	D	Sulphuric Acid	30-40	Ambient Temperature	C
Copper Nitrate	saturated	Ambient Temperature	D	Sulphuric Acid	90	Ambient Temperature	C
Copper Sulphate	2-30	Ambient Temperature	C	Sulphuric Acid	10	Ambient Temperature	D
Crude Oil	100	Ambient Temperature	A	Sulphuric Acid	80	Ambient Temperature	D
Dichloro Ethylene	100	@ boiling point	A	Sulphuric Acid	100	Ambient Temperature	D
Dichloro Ethanol	100	Ambient Temperature	A	Sulphurous Acid	2-60	Ambient Temperature	D
Dimethyl Benzol	100	Ambient Temperature	A	Tanning Solution	100	Ambient Temperature	A
Distilled Water		Ambient Temperature	A	Toluol	100	95	A
Drinkable Water		80	A	Trichlorethylene	100	95	A
Dry Chlorine	100	Ambient Temperature	A	Turpentine	100	Ambient Temperature	A
Ethyl Acid	100	Ambient Temperature	A	Urine	saturated	Ambient Temperature	A
Ethylene	100	Ambient Temperature	A	Vinegar	100	Ambient Temperature	B
Ethylic Glycol	100	Ambient Temperature	A	Vinyl Chloride	100	35	A
Exhaust Gas, Basic		260	D	Whiskey		Ambient Temperature	A
Exhaust Gas, Oxidative		540	A	Wine	100	Ambient Temperature	A
Ferrous Chloride	saturated	Ambient Temperature	D	Zinc Chloride	saturated	Ambient Temperature	B
Ferrous Nitrate	saturated	Ambient Temperature	D	Zinc Nitrate	saturated	Ambient Temperature	B
Ferrous Sulphate	saturated	Ambient Temperature	D				
Formaldehyde	37	Ambient Temperature	B				
Formic Acid	88	Ambient Temperature	B				
Fruit Juice		Ambient Temperature	A				
Gas	100	Ambient Temperature	A				
Glucose	saturated	Ambient Temperature	A				
Glycerine	100	Ambient Temperature	A				
Hydrochloric Acid	30	Ambient Temperature	D				
Hydrochloric Acid	conc.	Ambient Temperature	D				
Hydrochloric Acid	10	Ambient Temperature	D				
Hydrochloric Acid	20	Ambient Temperature	D				
Hydrofluoric Acid	2-100	Ambient Temperature	D				
Hydrogen Sulphide	100	Ambient Temperature	A				
Iron Chloride	saturated	Ambient Temperature	D				
Kerosene	100	Ambient Temperature	A				
Lactic Acid	85	Ambient Temperature	A				
Lactic Acid	10-50	Ambient Temperature	C				
Lead Acetate	saturated	Ambient Temperature	B				
Lead Nitrate	saturated	Ambient Temperature	A				
Linseed Oil	100	Ambient Temperature	A				
Lithium Chloride	saturated	Ambient Temperature	A				
Magnesium Chloride	2-50	Ambient Temperature	A				
Magnesium Hydroxide	2-50	Ambient Temperature	A				
Molasses		100	B				
Molasses		Ambient Temperature	A				
Methyl Alcohol	100	Ambient Temperature	A				
Methyl Chloride	100	Ambient Temperature	C				
Milk		Ambient Temperature	A				
Mineral Oil	100	Ambient Temperature	A				
Natural Resin	100	50	A				
Nickel Chloride	saturated	Ambient Temperature	C				
Nickel Sulphate	saturated	Ambient Temperature	C				

LEGEND:

- A: Very satisfactory result, rate of removal from corrosion less than 2.5 microns per year.
- B: Useful result, rate of removal from corrosion less than 12.5 microns per year.
- C: To be decided in each case individually, rate of removal from corrosion less than 25 microns per year.
- D: Application not recommended for long periods, rate of removal from corrosion more than 25 microns per year.

Technical Data

Corrosion resistance of electroless nickel-plating



Corrosion resistance table for various foods

Substance	pH Value	Test Volume (ML)	Test Time (HRS)	Penetration (microns/yr)
Apple Juice	3.1	850	1702	1.2
Bean Soup		500	1702	0.7
Canadian Whiskey	5.2	150	3910	1.6
Canned Corn	6.2	250	1702	0.7
Canned Peaches	3.5	400	1681	0.2
Canned Peas	6.1	450	1702	0.2
Canned Pineapple		500	1681	0.3
Canned Potatoes	5.8	350	1681	1.9
Cherry	3.8	150	3910	6.4
Chicken Broth	6	200	312/502	1
(3 tests @ 95 degrees C)				
Chocolate Candy		250	1681	
Coffee	5.3	700	1729	9.9
Coffee	4.8	200	312/554	4.7
(4 tests @ 95 degrees C)				
Cooked Onions		450	1702	0.8
Cranberry Juice		950	1702	0.5
Eggs	8.3	300	1248/1633	0.2
(2 tests @ 2 degrees C)				
Gin (2 tests)	7.5	150	3910	0.02
Grape Juice	4	800	1702	1.8
Grapefruit Juice	3.2	900	1702	0.5
Lemon Juice	2.3	800	1702	1
Lemonade		950	1702	11.4
Molasses		350	1702	0.2
Margarine (2 degrees C)		200	1633	
Mayonnaise	3.7	470	1681	0.2
Meat Gravy		400	16581	0.6
Milk	6.4	950	1248/1633	0.04
(2 tests @ 2 degrees C)				
Mushroom Soup		250	1702	0.3
Mushrooms		150	1681	0.6
Peanut Butter		450	1702	
Peeled Tomatoes	4.2	400	1681	0.5
Plum Juice		1000	1702	1
Pork and Beans	5.5	350	1681	0.3
Quark Cheese		300	1248/1633	0.4
(2 tests @ 2 degrees C)				
Rum	5.8	150	3910	0.2
Sardines in Soybean Oil		30 (oil)	1681	
Scotch Whiskey	5.3	150	3910	1.8
Sliced Radishes	5.2	400	1681	1.8
Sour Kraut	3.5	150	1681	4.4
Spanish Olives	3.7	250	1702	0.3
Tea	2.6	750	1729	4.2
Tea	2.6	200	312/554	9
(4 tests @ 95 degrees C)				
Tequila (2 tests)	4.8	150	3910	0.4
Tomato Juice (2 tests)	4.2	710	1321/1336	0.5
Tomato Soup		250	1702	0.5
Tomato Soup	3	200	502	6.1
(2 Tests @ 95 degrees C)				
Tropical Punch		950	1702	1.3
Vegetable Oil		470	1729	
Vegetable Soup		250	1702	1.2
Vinegar	2.9	470	1729	7
Vodka	8.2	150	3910	

Substance	Test Volume (ML)	Test Time (HRS)	Penetration (microns/yr)
Acacia 1%, 4.4 pH	500	5570	0.2
Acetic Acid, 5% CH3COOH (2 tests)	500	2616	13.7
Alum, 5% (Al2SO4) 3	450	1609	4.3
Ammonia, 28% NH4OH	500	3624	12.6
Asorbic Acid, 10% C4H6O5	500	2660	16.7
Asorbic Acid, 5% C6H8O6	500	4990	6.6
Carbon Dioxide 5% Fenol	450	4891	4.3
Citric Acid, 5% C6H8O7	500	2660	14.7
Deionized Water	200	211	
(2 tests @ 95 degrees C)			
Deionized Water, (1MΩ-cm% tests)	900	4536/5089	1.9
Dextrine, 1%, 3.8 pH	500	5570	0.1
Drinkable Water, 8.0 pH (4 tests)	900	4536/5089	0.05
Fecula, 1%	500	3839	0.5
Lactic Acid, 85% C3H6O3	500	1337	1.3
Phosphoric Acid, 1% H3PO4 (2 tests)	450	2599/2618	12.6
Potassium Carbonate, 25% K2CO2	450	2302	0.2
Saline Water, 26% NaCl (2 tests)	450	1337/3478	2
Saline Water, 40% CaCl2 (2 tests)	450	1198/3335	0.1
Salt, 5% NaCl, 6.3 pH	450	1198	0.5
Sea Water, Artificial, 8.2 pH (2 tests)	500	1272	1
Sodium Bicarbonate 2% NaHCO3	500	3839	6.4
Sodium Hydroxide, 1% NaOH	500	5042	0.2
Sodium Hypochlorite, 1% NaOCl	450	460	0.5
Sodium Nitrate, 42% NaNO2	450	574	12
Sodium Nitrate, 47% NaNO3	450	1198	
Water 700mg/1CO2, 3.9 pH (2 tests)	450	404	7.9

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Tubing chemical resistance guidelines



The following ratings are very general guidelines, designed ONLY to be used as an initial screening tool. Bear in mind that dynamic vs. static application, temperature, chemical mixtures, and the specific tubing compound selected can significantly affect or change these ratings either positively or negatively. Careful testing under actual conditions is essential. Accuracy for these ratings is not given or implied.

N = Nylon
PUR = Polyurethane
P/E = Polyethylene
PVC = Polyvinylchloride (vinyl)

RATINGS:
SOLVENT/CHEMICAL
 1 = little or no effect
 2 = minor effect
 3 = moderate effect
 4 = severe effect
 - = no tested data available

SOLVENT/CHEMICAL	P P P U / V			SOLVENT/CHEMICAL	P P P U / V			SOLVENT/CHEMICAL	P P P U / V						
	N	R	E C		N	R	E C		N	R	E C				
Acetic Acid	-	4	1 4	Chloroform	3	4	3 4	Mecury	1	1	1 2	Sucrose Solution	-	4	- -
Acetic Acid 30%	-	4	1 4	Chlorox	-	4	- -	Methane	1	3	- -	Sulfuric Acid (dilute)	-	3	1 1
Acetone	-	4	2 4	Chromic Acid	4	4	1 1	Methyl Acetate	1	4	2 4	Sulfuric Acid (conc.)	-	4	3 4
Acetylene	-	4	1 1	Citric Acid	1	1	1 2	Methyl Acrylate	-	4	- -	Sulfuric Acid (20% oleum)	-	4	- -
Alkazene	-	4	- -	Coal Tar	-	3	- -	Methyl Alcohol	1	4	1 1	Sulfurous Acid	-	3	2 1
Aluminum Chloride (aq)	-	3	2 1	Coconut Oil	-	2	- 1	Methyl Butyl Ketone	-	4	- 1	Tannic Acid	-	1	2 1
Aluminum Nitrate (aq)	-	3	- -	Cod Liver Oil	-	1	- 1	Methyl Chloride	3	4	3 4	Tetrochloroethylene	-	4	2 4
Ammonia Anhydrous	-	4	2 1	Coke Oven Gas	-	4	- -	Methylene Chloride	-	4	3 4	Toluene	1	4	3 4
Ammonia Gas (cold)	-	3	- -	Copper Chloride (aq)	-	1	2 1	Methyl Ethyl Ketone	1	4	2 4	Transformer Oil	-	1	- -
Ammonia Gas (hot)	-	4	- -	Copper Cyanide (aq)	-	1	2 1	Methyl Isobutyl Ketone	1	4	- -	Transmission Fluid Type A	-	1	- -
Ammonium Chloride (aq)	-	1	1 1	Corn Oil	-	1	3 2	Milk	1	4	1 1	Trichloroethane	3	4	- 3
Ammonium Sulfate (aq)	-	1	1 1	Cotton Seed Oil	-	1	2 2	Mineral Oil	1	1	2 1	Trichloroethylene	3	4	3 4
Amyl Alcohol	-	4	2 1	Creosol	4	4	3 4	Naphtha	1	2	1 3	Turbine Oil	-	1	3 1
Amyl Naphthalene	-	4	- -	Cyclohexane	1	1	2 4	Naphthaline	1	2	1 4	Turpentine	1	4	3 2
Animal Fats	-	1	- -	Denatured Alcohol	-	4	- -	Natural Gas	-	2	- -	Varnish	-	3	3 4
Aqua Regia	-	4	2 3	Detergent Solution	-	4	1 1	Nitric Acid (conc.)	4	4	3 4	Vinegar	1	4	2 1
Arsenic Acid	-	3	2 1	Diesel Oil	-	3	3 1	Nitric Acid (dilute)	4	3	- 4	Vinyl Chloride	-	4	- -
Asphalt	-	2	1 1	Dioxane	-	4	- -	Nitroethane	-	4	- -	Water	1	1	1 1
ASTM Fuel A	-	2	- -	Dowtherm Oil	-	3	- -	Nitrogen	-	1	- -	"Whiskey, Wines"	1	2	3 1
ASTM Fuel B	-	3	- -	Dry Cleaning Fluids	-	4	- -	N-Ocane	-	4	- -	White Oil	-	1	- -
ASTM Fuel C	-	3	1 1	Ethane	-	3	- 4	Oleic Acid	1	2	3 3	Wood Oil	-	3	- -
Barium Chloride (aq)	-	1	1 1	Ethyl Acrylate	-	4	- -	Oleum Spirits	-	3	4 4	Xylene	2	4	3 4
Beer	1	2	1 1	Ethyl Alcohol	3	4	- -	Olive Oil	-	1	1 3	Zinc Acetate (aq)	-	4	- -
Beet Sugar Liquors	-	4	1 1	Ethyl Benzine	-	4	- -	Oxygen-cold	1	1	- -	Zinc Chloride (aq)	1	1	1 1
Benzene	1	3	3 3	Ethyl Cellulose	-	2	- -	Oxygen (200-400 Degrees F)	-	4	- -				
Benzine	-	2	- -	Ethyl Chloride	-	2	- -	"Paint Thinner, Duco"	-	4	- -				
Blast Furnace Gas	-	4	- -	Ethyl Chloride	-	3	- -	Perchloric Acid	-	4	- -				
Bleach Solutions	-	4	- 1	Ethyl Ether	-	3	- -	Perchloroethylene	3	4	4 3				
Borax	-	4	1 2	Ethyl Chloride	-	4	3 4	Petroleum-Below 250 degrees	-	2	- -				
Boric Acid	-	1	1 1	Ethyl Glycol	2	4	1 1	Petroleum-Above 250 degrees	4	4	- -				
Brake Fluid	-	4	- -	Ethylene Oxide	1	4	3 3	Phenol	4	3	2 3				
Brine	-	2	4 3	Ethylene Trichloride	-	4	- -	Phenyl Ethyl Ether	-	4	- -				
Bromine Water	4	4	- -	Ferric Chloride (aq)	-	1	1 1	Phosphoric Acid 45%	2	1	2 2				
Bunker Oil	-	2	- -	Ferric Nitrate (aq)	-	1	2 1	Pickling Solution	-	4	- -				
Butane	1	1	3 3	Ferric Sulfate (aq)	-	1	1 1	Ploric Acid	3	2	- 4				
Butter	-	1	- -	Flourine (liquid)	4	4	3 4	Potassium Acetate (aq)	-	4	- -				
Butyl Alcohol	3	4	1 2	Formaldehyde (RT)	-	4	3 1	Potassium Chloride (aq)	-	1	1 1				
Butylene	-	4	1 1	Formic Acid	3	3	2 1	Potassium Cynaide (aq)	-	1	1 1				
Calcium Chloride (aq)	1	1	2 1	Freon 11	-	4	3 1	Potassium Hydroxide (aq)	3	4	1 1				
Calcium Hydroxide (aq)	-	1	2 1	Freon 12	1	1	3 1	Producer Gas	-	1	1 1				
Calcium Nitrate (aq)	1	1	- -	Freon 22	1	4	- 2	Propane	1	3	3 1				
Calcium Sulfide (aq)	-	1	- -	Fuel Oil	-	2	3 1	Propyl Alcohol	-	4	- -				
Cane Sugar Liquors	-	4	- 1	Furlural Glucose	-	4	1 1	Propylene	-	4	- -				
Carbolic Acid	-	3	2 3	Glue	-	1	1 3	Propylene Oxide	-	4	- -				
Carbon Dioxide	-	1	3 1	Glycerin	1	1	1 1	"Pyraul, 10E, 29 ELT"	-	4	- -				
Carbonic Monoxide	-	1	2 1	Glycols	1	4	- -	"Pydraul, 30E, 50E,65E"	-	4	- -				
Carbon Tetrachloride	3	4	2 2	Green Sulfate Liquor	-	1	- -	"Pydraul, 115E"	-	4	- -				
Castor Oil	-	1	- 1	Hexane	-	2	3 2	"Pydraul, 23DE,312C, 540C"	-	4	- -				
Chlorine (dry)	4	4	2 1	Hydraulic Oil	-	1	1 1	Rapseed Oil	-	2	- -				
Chlorine (wet)	4	4	- -	Hydrochloric Acid (cold) 37%	-	4	2 2	Red Oil (MIL-H-5808)	-	1	- -				
				Hydrochloric Acid (hot) 37%	-	4	- -	RJ-1 (MIL-F-23338 0)	-	1	- -				
				Hydrochloric Acid hot	-	4	- -	RP-1 (MIL-F-25578 C)	-	1	- -				
				Hydrogen Gas	1	1	1 1	Salt Water	1	2	1 1				
				Isobutyl Alcohol	-	4	- -	Sewage	-	4	- -				
				Isooctane	-	2	- -	Silicate Esters	-	1	- -				
				Isopropyl Acetate	-	4	2 4	Silicone Oils	-	1	1 1				
				Isopropyl Alcohol	1	3	- -	Silver Nitrate	-	1	2 1				
				Isopropyl Ether	-	2	1 2	Skydrol 500	-	4	- -				
				Kerosene	1	1	3 4	Skydrol 700	-	4	- -				
				Lacquers	-	4	2 3	Soap Solutions	1	3	3 1				
				Lacquer Solvents	-	4	2 3	Sodium Chloride (aq)	1	1	1 1				
				Lard	-	1	2 1	Sodium Hydroxide (aq)	2	4	2 1				
				Lavender Oil	-	4	- -	Sodium Peroxide (aq)	-	4	1 2				
				Lead Acetate (aq)	-	4	1 1	Sodium Phosphate (aq)	-	1	- -				
				Linseed Oil	1	2	3 1	Sodium Sulfate (aq)	-	1	1 1				
				Liquified Petroleum Gas	-	-	- -	Soy Bean Oil	-	2	1 1				
				Lubricating Oils	-	2	4 2	Steam Under 300 degrees	4	4	- -				
				Lye	-	4	- -	Steam Over 300 degrees	4	4	- -				
				Magnesium Chloride (aq)	1	1	1 1	Stoddard Solvent	-	1	3 3				
				Magnesium Hydroxide (aq)	-	4	1 1	Styrene	-	3	- 4				