White Paper

Chemical Resistance Guide

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Chemical Resistance Guide

Purpose

This guide was developed by Val-Matic® Valve and Manufacturing Corporation as a convenience to its customers and should be utilized only as a guide for the selection of valve materials. Mixtures and other chemical concentrations of chemicals are beyond the scope of this guide. Performances of materials in existing systems also offer valuable information in predicting valve performance.

Information given in the table consists of the maximum recommended temperature for the listed material in ºF or a letter designating:

A	=	resistant under normal conditions
B	=	conditional resistance, review performance
C	=	not recommended
blank	=	no data available

Val-Matic® offers no warranty or representation as to the accuracy or completeness of these tables. Use of these tables should be made under the direction of trained engineers or design professionals exercising independent judgment regarding the suggested use of the valve types and materials.

General Properties of Elastomers and Plastics

Aflas® is a fluoroelastomer compound that has excellent heat resistance with continues service temperature capability of 450°F and good chemical resistance, including resistance to strong acids and bases. Aflas® also has excellent oil resistance.

Buna-N (Nitrile, NBR, HNBR), or copolymer of butadiene and acrylonitrile has excellent resistance to petroleum products, lubricants, and water over a wide temperature range of –50 to 200°F. Nitrile is a widely used elastomer for hydraulic system O-rings. Buna-N does not have good resistance to outdoor exposure to ozone, sunlight, or weather. High Nitrile Buna-N (HNBR) is formulated for high strength and resistance to H_2S and other harsh fluids.

Chemraz® A high temperature perfluoroelastomer with superior physical properties and chemical resistance. The compound excels in dynamic applications and exhibits unparalleled performance in high temperature steam. Temperature range is from 0°F to 600°F.

Devlon® Devlon® is among the toughest and hardest wearing thermoplastic available. It was designed for the valve industry as a seat material to provide a wide temperature and pressure range. Its resistance to chemical and corrosion attack is well documented, due to its use in various applications throughout most industries, such as oil and gas. Pressures up to 6000psi and temperatures from -50 to 250°F can be obtained.

EPDM (Ethylene Propylene Diene Monomer) exhibits strong resistance to ozone, certain hydraulic fluids, brake fluids, steam, and water over a wide temperature range of –50 to 250°F. EPDM has gained increased use in the municipal water industry because of its resistance to water disinfected with chloramines. It has poor resistance to petroleum-based fluids, mineral oils, and solvents.

Hypalon (Chlorosulfonated Polyethylene, CSM) is similar to neoprene in chemical resistance and useful in the range of –50 to 200°F for acid and ozone resistance.

Kalrez (Perfluoroelastomer) is similar to Viton but is formulated for long-term exposure to the harshest chemical environments and temperatures above 600°F.

Markez® is a high performance perfluoroelastomer compound that offers a broad chemical and temperature resistance up to 600°F. For demanding sealing applications, in various industries, like Petrochemical and where harsh solvents are required. The temperature range is -5°F to 600°F.

Natural Rubber (Natural Polyisoprene, NR) is produced from various plants with excellent wear properties and resistance to brake fluid, water, sewage, but not petroleum products. Natural rubber is economical and commonly used for lining trucks, railroad cars, and valves for abrasion resistance. Natural rubber has been mostly replaced by synthetic elastomers for industrial seals.

Neoprene (Chloroprene, CR) is one of the first commercially available elastomers and is low in cost. Neoprene is unique with its moderate resistance to both petroleum products and oxygen over a wide temperature range of –50 to 200°F. Neoprene is a widely used elastomer for seals with exposure to refrigerants, petroleum oils, and mild acids. Neoprene does not have good resistance to solvents such as MEK and acetone.

Nylon (Polyamide) is one of the first thermoplastics used as rubber cords, belts, sports apparel, and structural parts such as valve bearings. Nylon has excellent resistance to oils and solvents, but limited resistance to alkalis and Acids. Its application is limited to a maximum temperature of 250°F.

PEEK (Poly Ether Ether Ketone, CFFP) is a high performance engineered thermoplastic. PEEK is considered a premium seat material that offers a unique combination of chemical, mechanical, electrical and thermal properties. Its excellent water/chemical resistance makes it unaffected by continuous exposure to hot water/steam. PEEK is good for temperatures of -70°F to 500°F. PEEK is non-porous, high strength for high pressure applications and is suitable for high corrosion environments. Carbon Fiber Filled PEEK (CFFP) is reinforced to withstand elevated temperatures to 600°F.

RPTFE (Reinforced Polytetrafluoroethylene), is a compound with a percentage of fiber glass or filler material to provide additional strength, stability and resistance to abrasive wear, cold flow and permeation in molded seats. Reinforcement such as glass fiber permits applications at higher pressures and temperatures than unfilled PTFE. RPTFE should not be used in applications that attack glass, such as hydrofluoric acid and hot /strong caustics. Temperature range for RPTFE is -320 to 450°F.

Viton® (Fluorocarbon, FKM, FKM AED, FF200) possesses a strong resistance to chemicals and air at high temperature applications to 400°F. Viton is high in cost and is used in aircraft, automotive applications where resistance to petroleum oils, silicone fluids, and acids is needed. Viton also has superior chloramine resistance for drinking water applications. FKM Anti-Explosive Decompression (AED) formulation has a structure that reduces gas permeation in extreme pressure service so that the sudden decompression in gas pressure will not cause damage to the seal. The Viton FF200 formulation is designed to withstand long term exposure to heat at 625°F.

General Properties of Metals

17-4 PH SS is similar to 304 SS except it is capable of being precipitation hardened (PH) using heat treatment, doubling its strength and making it a good choice for high performance valve trim. 17-4 PH withstands corrosive attack better than any of the 400 series stainless steels and in most conditions its corrosion resistance closely approaches that of 300 series stainless steel. 17-4 PH is primarily used as a stem material for high pressure butterfly and ball valves.

304SS is basic 18% chromium, 8% nickel austenitic stainless steel commonly used for valve trim. Its .08 max carbon content reduces intergranular corrosion usually associated with carbide precipitation that can occur during welding. It offers excellent resistance to a wide range of corrosives and atmospheric exposures.

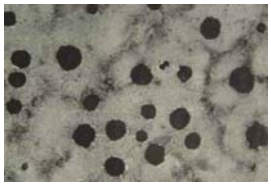
316SS is chemically similar to 304 SS except with the addition of molybdenum providing better corrosion and pitting resistance and higher strength at elevated temperatures. It is non-magnetic with greater ductility than 400SS. 316SS has excellent corrosion resistance in a wide range of environments, is not susceptible to stress corrosion cracking, and is not affected by heat treatment. Most common uses in valves are stem, body and ball materials.

Aluminum Bronze is the most widely accepted disc material used in many valves for liquid service. Aluminum bronze is heat treatable, is lead free and has the strength of steel. Formation of an aluminum oxide layer on exposed surfaces makes this metal very corrosion resistant.

Bronze is one of the first copper alloys developed in the bronze age and is generally accepted as the industry standard for pressure-rated bronze valves and fittings. Bronze has a higher strength than pure copper, is easily cast, has improved machinability, and is very easily joined by soldering or brazing. Bronze is very resistant to pitting corrosion, with general resistance to most chemicals less than that of pure copper. Historically, bronze alloys have contained lead to improve machinability and leak tightness, but recently are being improved with the release of lead-free alloys for drinking water applications such as CA87600, Silicon Bronze.

Carbon Steel has very good mechanical properties, good resistance to stress corrosion and sulfides. Carbon steel has high and low temperature strength, is very tough, and has excellent fatigue strength. Steel can be easily cast or forged in making ANSI Pressure-Temperature rated valve bodies or structural parts for applications up to 850°F.

Ductile Iron has a chemical composition similar to gray iron, but special treatment during the casting process enhances its metallurgical graphite structure to yield higher mechanical properties and improved ductility similar to steel. It is standard material for bodies and bonnets of ASME Class 150 and 300 valves.



Gray Iron is an alloy of iron, carbon and silicon; easily cast; and has good pressure tightness in the as-cast condition. Because gray iron contains flakes of graphite, it is brittle but exhibits excellent dampening properties and is easily machined. It is standard material for bodies and bonnets of ASME Class 125 and 250 valves. Gray iron has corrosion resistance that is improved over steel in certain environments.

Inconel is nickel-copper-molybdenum alloy with excellent corrosion resistance in a wide range of corrosive media and is especially resistant to pitting and crevice corrosion. Like Monel, it is a favorable choice for seawater applications but with far greater strength. Inconel is a common material for corrosion resistant springs.

Monel is a nickel-copper alloy used primarily as interior trim on valves. It is one of the most specified materials for corrosion resistance to sea and salt water. Monel is also very resistant to strong caustic solutions.

Nickel is an elemental metal common for chemical processing applications because of its corrosion resistance. Nickel is used for valve seats because of its good welding ability and lack of brittleness.

Nitronic 60 is a high-performance stainless steel alloy with excellent gall and wear resistance with corrosion resistance falling between 304SS and 316SS but with approximately twice the yield strength. Nitronic 60 is used for valve trim when extreme wear resistance or strength is required.

Chemical Resistance Guide

Val-Matic® Chemical Resistance Guide for Valves

CHEMICAL	ELASTOMERS AND PLASTICS												METALS										
	Buna-N	Neoprene	EPDM	Viton®	Hypalon	Natural Rubber	PTFE/ RPTFE	Nylon	PEEK	Devlon®	AFLAS®	Chemraz® Kalrez® Markez®	Carbon Steel	Nickel	Cast Iron	Bronze	Alum. Bronze	304 SS	17-4 PH SS	316 SS	Nitronic 60	Monel	Inconel
Acetic Acid (25%)	C	C	140	C	200	C	350	B	B	B	C	A	C	B	C	C	C	A	A	A	A	A	B
Acetic Anhydride	70	B	C	C	200	B	350	C	C		B	A	C	C	C	C	C	B	B	B	B	B	B
Acetone	C	C	130	C	B	B	350	70	A	A	C	A	A	200	A	A	A	A	A	A	A	A	A
Acetyl Chloride	C	C	C	185	C	C	200	C	B		A	A	A	A	C	A	A	A	A	A	A	A	
Acetylene	140	70	200	200	70	70	250	70	A	A	A	A	A	A	A	C	C	A	A	A	A	A	
Aluminum Acetate	B	C	200	C	C	70	350				A	A	C	B	C	C	C	B	B	A	B	B	
Alum (10%)	140	140	200	200	70	70	275	70	A		B	A	C	A	C	B	B	A	A	A	A	A	B
Aluminum Chloride	70	160	210	250	200	70	280	C	A		A	A	C	C	C	C	C	B	C	A	B	B	C
Aluminum Fluoride	180	160	210	250	200	B	250	B			A	A	C	B	C	C	C	B	C	B	B	A	B
Aluminum Hydroxide	180	100	210	200	70	70	250	B		A	A	A	C	200	B	C	C	A	A	A	A	B	B
Aluminum Nitrate	180	100	210	100	100	70	250				A	A	C	B	C	C	C	A	A	A	A	C	
Ammonia Anhydrous	C	100	200	C	B	C	250	70	A		B	A	A	500	A	C	C	A	A	A	A	A	A
Ammonia Liquid	B	70	210	C	70	C	400	70	A	A		B	A		A	C	C	B	A	A	A	A	A
Ammonium Bifluoride	180	140	200	200		B	400					A	C	50	C	C	C	C	B	B	C	B	B
Ammonium Carbonate		140	210	250	140	70	400	70	A	A	A	A	A	C	B	C	C	B	B	B	B	B	A
Ammonium Chloride	180	160	210	250	200	70	400	70	B		A	A	C	B	C	C	C	C	C	B	C	B	A
Ammonium Hydroxide (30%)	B	70	210	70	200	B	400	70	B	A	B	B	C	C	C	C	C	A	A	A	A	B	A
Ammonium Nitrate	180	160	250	100	200	150	400	70	B	A	A	A	B	50	B	C	C	A	A	A	A	A	A
Ammonium Phosphate	100	140	210	185	140	150	400	70	A	A	B	A	C	B	B	C	C	A	A	A	A	B	A
Ammonium Sulfate	180	160	210	200	200	150	400	70	A	A	A	A	C	B	B	C	C	B	B	B	B	B	A
Ammonium Sulfite	140	160	210	C	200	70	350	A				A	C	C	C	C	C	B	B	B	B	B	C
Aniline	C	C	140	C	70	C	200	C	A	C	B	A	C	B	B	C	C	A	A	A	A	B	B
Aniline Hydrochloride	C	C	B	1185	C	B	212	C			A	A	C	C	C	C	C	C	C	C	C	A	B
Arsenic Acid	160	180	185	200	200	150	400	70			A	A	C	B	C	C	C	A	B	A	A	A	C
Barium Carbonate	180	160	250	250	200	70	400	A	A			A	B		B	A	A	B	A	A	A	A	A
Barium Chloride	180	160	250	300	200	70	400	190	B	A	A	A	C	B	B	A	A	A	A	A	A	A	A
Barium Hydroxide	180	140	200	300	200	70	400	70	A		A	A	C	200	B	C	C	B	A	A	B	A	A
Barium Nitrate	180	160	200	300	200	C	250	A				A	A	B	A	C	C	B	B	A	B	B	B
Barium Sulfate	100	160	200	300	200	70	400	A	A	A	A	A	A	B	B	B	B	B	A	A	B	A	A
Barium Sulfide	C	160	140	300	200	70	400	B	A		A	A	C	50	B	C	C	B	A	A	B	A	A
Beer	70	140	200	200	200	70	300	140	A	B	A	A	C		C	A	A	A	A	A	A	A	A
Beet Sugar Liquor	100	160	210	185	200	70	70	A			A	A	B		B	C	A	A	A	A	A	A	A
Benzene	C	C	C	150	C	C	250	100	A	A	B	A	A	200	A	A	A	A	A	A	A	A	A
Benzyl Alcohol	C	B	C	B	140	C	400	C	B		B	A	B	50	B	A	A	A	A	A	A	A	A
Black Liquor	180	70	180	200	70	B	225				B	B	B	B	B	C	C	B	B	A	A	B	B
Bleach (5%)	C	C	140	185	70	C	200	C	B			A	C		C	C	C	B	B	A	B	A	A
Borax	140	140	210	185	200	185	300	70		A	A	A	B		A	A	A	A	A	A	A	A	A

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Boric Acid (5%)	140	140	210	185	200	185		C	A	B	A	A	B	50	C	B	B	B	B	A	B	A	A
Brine	180	160	250	300	180	70	400	A	A		A	A	C	B	C	A	A	B	B	A	B	A	A
Bromine Water	C	C	C	185	70	C	300	C	A		B	A	C	50	C	C	C	C	C	C	C	C	C
Butadiene	C	140	C	185	B	C	350	C	A	A	B	A	A	200	A	A	A	A	A	A	A	A	A
Butyl Acetate	140	C	C	C	C	C	175	140	B		C	A	B	300	B	B	B	A	A	A	A	A	A
Butyl Alcohol	B	140	200	200	140	A	300	B		A	A	A	A	A	A	B	B	A	A	A	A	A	A
Butylene	70	C	C	100	C	C	400	B	A		B	A	A	A	A	A	A	A	A	A	A	A	A
Butyl Stearate	100	C	C	185	C	C	250		A		A	A	B	B	B	A	A	A	A	A	A	A	A
Butyric Acid		C	140	70	C	C	300	C	A	B	A	A	C	C	C	A	A	A	A	A	A	A	A
Calcium Bisulfite	70	70	C	185	200	C	350	70	A		A	A	C	C	C	C	C	B	B	A	B	C	
Calcium Carbonate	100	70	210	300	70	A	350	A	A		A	A	B	B	B	C	C	A	A	A	A	A	A
Calcium Chlorate	70	70	140	185	70	A	350					A	B	B	B	B	B	A	A	A	A	A	A
Calcium Chloride	100	160	210	250	200	A	350	70	A	B	A	A	C	300	A	B	B	B	B	A	B	A	A
Calcium Hydroxide	140	70	210	250	200	A	250	120	B		A	A	C	B	C	C	C	A	A	A	A	A	A
Calcium Hypochlorite	C		70	185	140	C	200	C	B		A	A	C	C	C	C	C	B	B	B	B	C	
Calcium Nitrate	180	100	210	200	100	70	200	70	B		A	A	C	B	B	B	B	A	A	A	A	A	A
Calcium Sulfate	180	160	210	200	200	B	200	C	B			A	B	200	A	B	B	A	A	A	A	A	A
Camphor	100	C	210	250	70		350		A		A	A	B	B	B	B	B	A	A	A	A	B	
Cane Sugar	180	160	250	200	100	A	400	C			A	A	A	A	A	A	A	A	A	A	A	A	A
Carbitol	70	70	70	100	70		20				A	A	B	B	B	B	B	B	B	B	B	B	B
Carbon Dioxide (wet)	180	160	200	200	200	B	400	A	A		A	A	A	150	A	A	A	A	A	A	A	A	A
Carbon Monoxide (gas)	70	70	250	250	200	C	400	70	A			B	B	C	A	A	A	A	A	A	A	A	A
Carbon Tetrachloride	C	C	C	185	C	C	350	C	B	B	C	A	A	200	C	A	A	A	A	A	A	A	A
Carbonic Acid	180	70	210	200	70	C	350	70	A	B	A	A	B	B	B	C	C	A	A	A	A	A	A
Castor Oil	140	100	10	140	150	A	350	A	A		A	A	A	A	A	A	A	A	A	A	A	A	A
Caustic Potash- KOH	180	160	200	C	200	B	350	C	A		A	A	B	450	B	C	C	B	B	B	B	B	B
Caustic Soda-NaOH (20%)	C	160	180	C	140	70	350	A	A		B	B	B	300	B	B	C	A	A	A	A	A	A
Chloramine (5%)	B	B	A	A	B	70						A	C	50	C	B	B	B	B	B	B	B	
Chloric Acid (10%)		140		140	200		140	C				A	C	C	C	C	C	C	C	B	B	C	C
Chlorinated Water (10ppm)	140	C	210	185	B	B	400	C	A	B		A	C	A	B	B	C	A	A	A	A	A	A
Chlorinated Water (Sat)	C	C	70	185	B	C	400	C	A	B		A	C	A	C	C	B	B	A	A	A	B	B
Chlorine (Liq)		C	C		B	C		C	C			B	C	C	C	B		C	C				
Chloroacetic Acid (50%)	C	C	70	C	200	C	200	C	A		B	A	C	B	C	C	C	C	C	C	C	B	
Chlorobenzene	C	C	C	70	C	C	200	C	A	A	B	A	B	B	C	A	A	A	A	A	A	A	A
Chloroform	C	C	C	70	C	C	200	A	A	C	C	A	C	A	C	A	A	A	A	A	A	A	A
Chlorosulfonic Acid	C	C	C	C	C	C	200	C	C	C	C	A	C	C	B	C	C	C	C	C	C	A	

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Chromic Acid (10%)	C		70	100	140	B	350	C	B	C	A	A	C	C	C	C	C	C	B	A	B	B	
Citric Acid	70	140	210	200	140	A	200	A	A	C	A	A	C	B	C	C	C	A	A	A	A	B	
Coconut Oil (5%)	70	100	C	185	B	C	400		A	A	A	A	B	A	C	B	B	A	A	A	A	B	
Coffee	100		140	200		A		A			A	A	C	A	C	A	A	A	A	A	A	A	A
Coke Oven Gas	B		70	185	140		400				A	A	A		A	B	B	A	A	A	A	B	
Copper Acetate	180	160	100	140	C		350		B		C	A	C	B	C	C	C			A	A	B	
Copper Chloride	180	160	210	200	200	C	350	C	A		A	A	C		C	C	C	C	C	B	B	B	
Copper Cyanide (25%)	180	160	210	185	C	A	350	C	B		B	A	C		C	C	C	B	B	A	B	B	
Copper Nitrate	B	160	210	200	200	C	A	C	B		B	A	C	C	C	C	C	A	A	A	A	C	
Copper Sulfate (5%)	180	160	210	200	200	C	A	C	B	A	A	A	C	B	C	C	C	A	A	A	A	C	
Corn Oil	180	C	C	300	C	C	400	A	A		A	A	B	A	B	B	B	A	A	A	A	B	
Cottonseed Oil	180		C	185	200	C	400	B	A		A	A	B	A	B	B	B	A	A	A	A	B	
Creosote	73	C	C	73	73	C	350	C	B		B	A	A	B	A	B	B	A	A	A	A	A	A
Cresylic Acid	C	C	C	185	C	C	200	C	B	C	A	A	B		A	A	A	A	A	A	A	A	A
Crude Oil	70	B	C	200	C	C	400	100	B	A	A	A	B	A	C	C	C	A	A	A	A	B	
Cyclohexane	C	C	C	185	C	C	300	A	B	A	A	A	A	B	B	C	C	A	A	A	A	A	A
Cyclohexanone	C	C	70	C	C	C	200	A	B		B	A	B	B	B	B	B			A		B	
Detergents	180	160	250	210	200	B	400	A	A	A		B	A	A	A	A	A	A	A	A	A	A	A
Dextrose	180	160	140	200	140		400					A	A	200	A	A	A	A	A	A	A	A	A
Diacetone Alcohol	C	C	70	C	A		350	70			C	A	A	A	A	A	A	A	A	A	A	A	A
Diesel Fuel	70	C	C	183	C	C	350	A	B	A		A	A	A	A	A	A	A	A	A	A	A	A
Diethylamine	70	A	70	C	C	A	200	A	A	A	C	A	B	B	A	C	C	A	A	A	A	B	B
Dimethyl Formamide	100	C	C	C	100	C	250	A	A		B	A	B		B	B	B	A	A	A	A	A	A
Dioxane	C	C	70	C	C				B	A	C	A	A	A	A	A	A	A	A	A	A	A	A
Disodium Phosphate	100		210	70	140	70	400	400						A	B	B	B	A	A	A	A	B	
Ether	C	C	C	C	C	C	A	A	A	A	C	A	B	A	B	A	A	A	A	A	A	A	A
Ethyl Acetate	C	C	70	C	C	C	200	200	B	A	C	A	A	A	A	A	B	A	A	A	A	A	A
Ethyl Alcohol- Ethanol	180	70	170	A	200	A	300	300			A	A	A	200	A	A	A	A	A	A	A	A	A
Ethyl Benzene	C	C	C	70	C	C	350				B	A	B	200	B	B	B	A	A	A	A	A	A
Ethyl Chloride	C	B	B	140	70	B	350	A	A		B	A	A	A	A	A	B	A	A	A	A	A	A
Ethylene Bromide	C	C	C	B	C	C	350					A	A		A	A	A	A	A	A	A	A	A
Ethylene Chloride	C	C	C	70	C	C	350	A	A	B		B						B	B	A	A	A	A
Ethylene Dichloride	C	C	C	120	C	C	350	70	A	B	A	A	A	B	A	A	A	A	A	A	A	A	A
Ethylene Glycol	180	160	210	250	200	A	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A
Ethylene Oxide	C	C	C	C	C	C	400	70	B	A			B	A	A	A	A	A	A	A	A	B	B
Fatty Acids	140	140	C	185	C	C	400	70	A	A	A	A	C	A	C	C	C			A		A	

Chemical Resistance Guide

Val-Matic® Chemical Resistance Guide for Valves

CHEMICAL	ELASTOMERS AND PLASTICS												METALS										
	Buna-N	Neoprene	EPDM	Viton®	Hypalon	Natural Rubber	PTFE/ RPTFE	Nylon	PEEK	Devlon®	AFLAS®	Chemraz® Kalrez® Markez®	Carbon Steel	Nickel	Cast Iron	Bronze	Alum. Bronze	304 SS	17-4 PH SS	316 SS	Nitronic 60	Monel	Inconel
Ferric Chloride (sat)	180	160	225	200	200	A	400	A	A		B	B	C	C	C	C	C	C	C	C	C	C	C
Ferric Hydroxide	100	100	180	180	100		400		A			A	C		C	C	C	C		A		A	
Ferric Nitrate	180	160	210	200	140	A	400	70	B		A	A	C	A	C	C	C	B	A	A	A	C	
Ferric Sulfate	140	140	210	185	140	A	200	70	B		A	A	C	C	C	C	C	B	A	A	A	C	
Ferrous Chloride	180	2	200	200	A	A	400	C	B	C			C	C	C	C	C	C	C	C	C	C	C
Ferrous Nitrate	180	160	180	200	140		400		B									A	A	A	A		
Ferrous Sulfate (5%)	180	160	200	200	140	B	400	C	A			A	C	C	C	C	B	A	A	A	A	A	A
Fish Oil	70		C	300								A	A	A	A	A	A	A	A	A	A	A	A
Flue Gas	180		C	300									A	A	A	A	A	A	A	A	A	A	A
Fluoboric Acid	160	160	140	140	140	A	350	C				A	C	50	C	B	B	A	A	A	A	A	A
Fluorine (wet)	C		70	100		C	C	C	C				C	A	C	C	C	A	A	A	A	A	A
Fluorosilic Acid (25%)	100	100	140	210	200	A	300	C	C		A	A	C	50	C	B	B	B	B	B	B	A	B
Formaldehyde (40%)	C	140	140	C	200	B	300	C	B	B	C	A	B	200	C	A	B	C	C	A	B	A	A
Formic Acid	C	140	200	C	70	C	300	C	A	C	B	B	C	200	C	C	B	B	A	A	A	A	A
Freon	70	C	C	70	130	C	300	C	B				B	A	B	A	A	A	A	A	A	A	A
Fructose	140	160	175	225	140	C	300	A					A	A	A			A	A	A	A	A	
Furfural	C	70	140	C	70	C	300	B	A	A	C	B	A	B	A	A	A	A	A	A	A	A	A
Gallic Acid	C	70	70	185	70	A	300	A	B		A	A	C		C	B	B	A	A	A	A	A	A
Gasoline	70	B	C	100	70	C	200	A	B		B	A	A	A	A	A	A	A	A	A	A	A	A
Gasahol	70	B	C	100	70	C	200	A				A	A	A	A	A	A	A	A	A	A	A	A
Gelatin	180	160	200	250	200	A	300	70	A			A	C	A	C	C	C	120	A	C	C		
Glucose	180	160	250	300	200	A	400	A			A	A	A	A	A	A	A	A	A	A	A	A	A
Glue	140	160	100	250	200	A	400	120					A	A	A	A	A	A	A	A	A	A	A
Glycerin	70	160	200	300	200	A	400	70	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Glycol	140	160	200	250	200		300		B		A	A	A	A	A	A	A	A	A	A	A	A	A
Glycolic Acid	C	70	A	C	C	C	200		A			A	C	B	C	B	B	A	A	A	A	B	
Grease	150	100	C	200	C	C	A					A	A	A	A	C	C	A	A	A	A	A	A
Gypsum	180	160	210	200	200	C	350	A					A	A	A	B	B	A	A	A	A	A	A
Heptane	70	70	C	185	70	C	300	A	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A
Hexanol	70	B	C	160	70		300						A	A	A	A	A	A	A	A	A	A	A
Hydraulic Oil	160	70	C	250	70	C	300	70	B			A	A	A	A	A	B	A	A	A	A	A	A
Hydrazine	70		70	C	70	C	250		B		A	B	C	C	C	C	C	A	A	A	A	A	
Hydrobromic Acid (20%)	C	B	140	185	100	A	250	C	C		A	A	C	C	C	C	C	C	C	C	C	C	C
Hydrochloric Acid (35%)	C		70	100	100	A	250	C	B		A	A	C	C	C	C	C	C	C	B	C	C	C
Hydrocyanic Acid (10%)	70		200	185	200	B	250	B	B		A	A	C	50	C	C	C	C	B	A	B	A	C
Hydrofluoric Acid (20%)	C	70	70	150	150	B	300	C	B			B	C	B	C	C	C	C	C	C	C	A	C

Chemical Resistance Guide

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	Buna-N	Neoprene	EPDM	Viton®	Hypalon	Natural Rubber	PTFE/ RPTFE	Nylon	PEEK	Devlon®	AFLAS®	Chemraz® Kalrez® Markez®	Carbon Steel	Nickel	Cast Iron	Bronze	Alum. Bronze	304 SS	17-4 PH SS	316 SS	Nitronic 60	Monel	Inconel
Hydrogen (Gas)	180	160	250	300	200	B	300	120			A	A	A	A	A	A	A	A	A	A	A	A	A
Hydrogen Peroxide (50%)	C	C	100	185	200	C	300	C	B	C	A	A	C	C	C	C	C	A	A	A	A	A	A
Hydrogen Sulfide (Gas)	140	140	140	C	70	70	A	C	A	B	A	A	B	B	B	B	C	C	B	A	B	A	A
Hydrogen Sulfide (Wet)	C	70	140	C	70	70	A	C	A	B	A	A	C	B	C	C	C	C	C	A	B	B	A
Hydroquinone	70	C	C	185	C	A	300	C			B	B	A	A				B	A	A	A	A	
Hypochlorous Acid (10%)	C	A	70	70			300					A	C	C	C	C	C	C	C	C	C	C	C
Ink	70	70	70	70		C	300	C				A	C	A	C	A	A	C	C	A	B	A	A
Iodine	70	C	70	70	70	C	200	A	B		A	A	C	A	C	C	C	C	B	B	B	A	A
Isobutane	70	C	C	B	C	C	140	B	A			A	A	A	A	A	A	A	A	A	A	A	A
Isobutyl Alcohol	70	70	140	140	70	A	300	A			A	A	B	A	A	A	A	A	A	A	A	A	A
Isooctane (5%)	70	70	C	185	200	70	300	70	A		B	A	A	A	A	A	A	A	A	A	A	A	A
Isopropyl Acetate	C	C	70	C	C	C	200	B	A		C	A	A	A	A	A	A	A	A	A	A	A	A
Isopropyl Alcohol	70	70	140	200	200		300						A	A	A	A	A	A	A	A	A	A	A
Isopropyl Ether	70	C	C	C	C	A	140	70	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A
Jet Fuel JP-4	70	C	C	185	C	C	200	C	A		B	A	A	A	A	A	A	A	A	A	A	A	A
Kerosene	140	70	C	300	C	C	250	A	B		B	A	A	A	A	A	A	A	A	A	A	A	A
Ketchup	140		210	200	B		250		A				C	A	C	C	C	A	A	A	A	A	A
Ketones	C	C	C	C	C	A	200	120	A	B			A		A	A	A	A	A	A	A	A	A
Lactic Acid (25%)		140	70	70	140	A	300	B	B			A	C	B	B	C	C	A	A	A	A	A	A
Lard Oil	140	70	C	85	C	C	300	70			A	A	B	A	B	C	C	A	A	A	A	B	
Latex	70	100	70	70	C	B	200	70					A	A	A	A	A	A	A	A	A	A	A
Lead Acetate	70	160	210	C	100	A	300	A	B	B	C	A	C	B	C	C	C	A	A	A	A	A	B
Lead Nitrate	188	140	175	225	A	70	300				B	A	A	B	A	A	A	A	A	A	A	A	A
Lead Sulfate	180	140	210	225	200	70	300	B					C	B	C	B	B	B	B	B	B	B	B
Lemon Oil	A	140	C	200	100	C	300						C	B	C			A	A	A	A	A	A
Lime Slurry	100	100	100	70	160	A		70	B				A	A	A	A	A	A	A	A	A	A	A
Linoleic Acid	B		C	140	C	C	300		A		A	A	C	C	C	C	C	B	B	A	A	A	
Linseed Oil	180	70	B	250	200	C	300	B	A	A	A	A	A	B	A	A	A	A	A	A	A	A	A
Lithium Chloride	70	70	100	140	B	B	125	A	A			A	C	C	B	B	B			A		A	
Lubricating Oil	180	70	C	150	C	C	350	70	B	A	B	A	A	A	A	A	A	A	A	A	A	A	A
Magnesium Carbonate	140	140	170	210	140	70	225	70	A				B	B	B	B	B	A	A	A	A	A	A
Magnesium Chloride	180	160	170	170	200	A	400	70	B	A	A	A	C	C	C	B	B	C	C	C	C	A	
Magnesium Hydroxide	180	160	170	225	200	A	300	B	B	A	A	A	A	A	A	C	C	A	A	A	A	A	A
Magnesium Nitrate	70	160	140	225	140	A	300	70	A				B	B	A	C	C	A	A	A	A	B	
Magnesium Sulfate	180	160	175	200	140	B	300	70	B	A		A	A	A	A	A	A	A	A	A	A	A	A
Maleic Acid	C	C	70	200	C	B	250	A	A		A	A	C	B	C	C	B	B	B	A	B	B	

Chemical Resistance Guide

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CHEMICAL	ELASTOMERS AND PLASTICS												METALS										
	Buna-N	Neoprene	EPDM	Viton®	Hypalon	Natural Rubber	PTFE/ RPTFE	Nylon	PEEK	Devlon®	AFLAS®	Chemraz® Kalrez® Markez®	Carbon Steel	Nickel	Cast Iron	Bronze	Alum. Bronze	304 SS	17-4 PH SS	316 SS	Nitronic 60	Monel	Inconel
Malic Acid	100	70	C	200	70	B	250	A	B	A	A	A	C	B	C	B	B	A	A	A	A	A	A
Manganese Sulfate	180	160	175	200	140	120	300	120	A			A	A	B	A	A	A	A	A	A	A	A	A
Mercuric Chloride	140	140	210	185	140	A	300	C	B	C	A	A	C	C	C	C	C	C	C	C	C	C	C
Mercuric Cyanide	70	70	70	70	140	70	300	120	B			A	C	C	C	C	C			A			
Mercurous Nitrate	C	C	70	70	B	B	300		B				C	C	C	C	C	A	A	A	A	C	
Mercury	140	140	210	185	140	A	300	A	B	A	A	A	A	A	A	C	C	A	A	A	A	A	A
Methane	180	70	C	185	70	C	300	A	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A
Methanol	140	140	100	100	140	A	300	B	B		A	A	A	A	A	A	A	A	A	A	A	A	A
Methyl Acetate	C	C	B	C	C	C	300	120	A	A	C	A	B	B	B	B	B	A	A	A	A	A	A
Methyl Amine	B	70	70	100	70	70	300			A			A	A	A	C	C			A		C	
Methyl Bromide	70	C	C	185	C	C	300	B	B		B	A	B	B	C	C	B	A	B	A	A	B	
Methyl Chloride	C	C	C	70	C	C	250	B		C	C	A	A	A	A	A	C	A	A	A	A	A	A
Methyl Ethyl Keytone	C	C	70	C	C	C	200	70	B		C	A	A	A	A	A	A	A	A	A	A	A	A
Methyl Formate	C	70	100	C	C	C	70	C			C	A	C	B	A	A	A	A	A	A	A	A	A
Methylene Chloride	C	C	C	70	C	B	250	C	B	C	B	A	B	B	B	B	B	A	A	A	A	A	B
Milk	180	160	250	300	200	A	400	A	A	A	A	A	C	C	C	B	B	A	A	A	A	A	A
Mineral Oil	140	70	C	300	B	C	300	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Molasses	150	150	100	185	150	A	300	120	A			A	A	A	A	A	A	A	A	A	A	A	A
Monochloroacetic Acid (50%)	70	C	C	70	C	B	200	C				B	C		C	C	C	C	C	C	C	B	
Motor Oil	180	B	C	250	B		350	120	A			A	A	A	A	A	A	A	A	A	A	A	A
Morpholine	C	C	70	C	C	70	200	120				A	B	A	B	B	B	B	B	B	B	B	B
Naphtha	140	C	C	150	C	C	200	A	B	A	B	A	A	200	A	A	B	A	A	A	A	A	A
Naphthalene	C	C	C	170	C	C	250	70	B	A	C	A	A	400	A	A	B	A	A	A	A	A	A
Natural Gas	140	140	C	185	140	C	300	B	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Nickel Chloride	180	160	210	210	200	A	400	C	B		A	A	C	200	C	C	B	A	A	A	A	C	B
Nickel; Nitrate	180	120	210	250	C	70	400	70	B			A	C	400	C	C	C	A	A	A	A	C	C
Nickel Sulfate	70	160	210	300	200	B	400	70	B	A	A	A	C	200	C	C	B	B	B	A	A	B	A
Nitric Acid (10%)	C	C	70	185	100	C	250	C	B	B	B	B	C	C	C	C	C	A	A	A	A	C	B
Nitrobenzene	C	C	C	70	C	C	400	B	B	C	A	A	A	B	A	B	B	A	A	A	A	A	A
Nitrogen (Gas)	140	140	140	185	100	A	300	A	B		A	A	A	A	A	A	A	A	A	A	A	A	A
Nitromethane	C	C	B	C		C	300	B			B	A	B	C	B	B	B	A	A	A	A	B	
Nitrous Acid	C	C	A	100		C	400		B			A	C	C	C	C	C	B	B	B	B	C	B
Nitrous Oxide	C	C	A	70	B	A	400	C	B		B	A	C	C	B	B	B	A	A	A	A	C	C
Oleic Acid	100	B	B	185	70	C	250	A	B	A	A	A	C	A	B	B	A	A	A	A	A	A	A
Oleum Acid	C	C	100	70	C	C	150	C	C		A	A	C		C	C	C	A	A	A	A	C	
Olive Oil	140	140	C	150	B	C	350	70	A		A	A	A		A	A	A	A	A	A	A	A	A

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	Buna-N	Neoprene	EPDM	Viton®	Hypalon	Natural Rubber	PTFE/ RPTFE	Nylon	PEEK	Devlon®	AFLAS®	Chemraz® Kalrez® Markez®	Carbon Steel	Nickel	Cast Iron	Bronze	Alum. Bronze	304 SS	17-4 PH SS	316 SS	Nitronic 60	Monel	Inconel
Oxalic Acid	C	100	150	100	C	B	300	B	B	C	A	A	C		C	C	C	A	A	A	A	A	A
Oxygen (Gas)	C	140	210	185	140	B	400		B	A	C	A	A		A	A	A	A	A	A	A	A	A
Ozone (Gas)	C	C	210	185	140	C	300	C	B	C	A	A	A		A	A	A	A	A	A	A	A	A
Palm Oil	140	C	C	70	C	C	200		A				C		C	C	C	A	A	A	A	A	A
Palmitic Acid	100	C	70	185	70	B	300	A	A	A	A	A	B	B	B	B	B	A	A	A	A	A	A
Peanut Oil	100	B	C	150	B	C	250				A	A	A		A	A	A	A	A	A	A	A	A
Perchloric Acid	C	70	70	70	70		250	C	B		A	A		C		B		C		A	B		
Perchloroetylene	C	C	C	200	C	C	200	C	B	B	C	A	B	A	B	B	B	A	A	A	A	A	A
Phosphoric Acid	70	140	140	200	200	B	300	B	A	B	B	A	C	50	C	C	C	A	A	A	A	C	
Picric Acid (10%)	C	70	140	140	70	C	300	C	B			A	C	C	C	C	C	C	A	A	B	C	
Potash-KOH (180)	70	140	200	180	B	400	C	A					B	A	B	B	A	A	A	A	A	A	A
Potassium Bicarbonate	70	160	170	200	200	A	400	70	B			A	A	B		B		B	B	B	B		
Potassium Bisulfate	180	140	170	200	140	70	400	B				A	C	B	C	B	B	A	A	A	A	C	
Potassium Bromate	180	140		250	140	70	400	B				B	A		A			A	A	A	A	A	A
Potassium Bromide	180	160	170	200	200	A	400	70	B	A		A	C	B	C	B	B	A	A	A	A	A	A
Potassium Carbonate	180	160	170	200	200	A	400	A	B	A		A	A	B	A	B	B	A	A	A	A	A	A
Potassium Chlorate	B	100	140	140	140		400	C	B			A	A	C	A	B	B	A	A	A	A	A	A
Potassium Chloride	180	160	210	200	200	A	400	70	B	A	A	A	C	B	B	A	B	A	A	A	A	A	A
Potassium Cyanide	180	160	140	185	200	A	400	70			A	A	B	B	B	C	C	A	A	A	A	A	B
Potassium Hydroxide	B	160	210	140	140	B	400	C	B	B	A	A	B	A	B	C	C	A	A	A	A	A	A
Potassium Nitrate	180	140	210	250	140	A	400	B	B	A	A	A	B	B	B	A	B	B	A	A	A	A	A
Potassium Permanganate	C	200	210	140	100	70	400	C	B	C		A	A	B	A	B	B	A	A	A	A	A	A
Potassium Sulfate	140	140	210	250	140	A	200	70	B	A	A	A	A	B	A	B	B	A	A	A	A	A	A
Potassium Sulfide	100	70	A	100	B	B	300	A	B	A		A	C	C	C	C	C	B	B	B	B	C	A
Potassium Sulfite	70	70	140	200	B	B	300	B		A		A	C	C	C	B	B	A	A	A	A	B	
Propane	70	70	C	70	B	C	300	70	B	A	A	A	A	200	A	A	A	A	A	A	A	A	A
Propyl Alcohol	140	140	140	250	140	70	350	C					A	200	A	A	A	A	A	A	A	A	A
Rosin Oil	70	70		100	70		200	A	A			A	C	A	C	C	C	A	A	A	A	A	A
Salicylic Acid	C	C	210	185	70	A	300	70	C	C	A	A	C	200	C	B	B	A	A	A	A	B	B
Silicone Oil	140	70	140	185	140	C	350	70	B	A	A	A	A		A	A	A	A	A	A	A	A	A
Silver Cyanide	C	70	140	140		70	350		A			A	C		C	C	C			100		A	
Silver Nitrate	140	160	210	250	200	A	350	70	B	A	A	A	C	C	C	C	C	B	B	A		C	A
Soap	180	140	210	250	140	B	400	70	A	A	A	A	B	200	B	B	A	A	A	A	A	B	A
Sodium Acetate	C		170	C	70	A	400	B	B	B	B	A	C	A	B	A	B	A	A	A	A	A	
Sodium Aluminate	180	140	200	200	140	B	300	70	A			A	A	B	B	C	B	A	A	A	A	A	A
Sodium Bicarbonate	180	160	250	300	200	A	400	A	B	A	A	A	C	200	A	A	B	A	A	A	A	A	A

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Sulfamic Acid	C	70	C	C	70	B	70		C			A	C		C	B	B			A		B	
Sodium Bisulfate	180	140	200	250	100	A	A	70	A	B	A	A	C	B	C	C	C	C	C	A	B	A	B
Sodium Bisulfite	180	140	200	250	200	A	400	C			A	A	C	C	C	B				A		C	B
Sodium Bromide	70	70	210	250	B	70	300	B		B		A	C	B	C	B	A	A	A	A	A	A	A
Sodium Carbonate	140	140	140	140	300	A	400	B	B	A	A	A	A	200	A	A	B	A	A	A	A	B	A
Sodium Chloride	140	160	140	200	100	A	350	70	B	A	A	A	C	B	B	A	B	B	B	B	B	A	A
Sodium Dichromate (20%)	C	C	140	200	200	B	300	C					B		B	C	C	A	A	A	A	B	A
Sodium Fluoride	70	70	140	140	140	70	350	B	A			A	C	B	C	A	B	A	A	A	A	A	B
Sodium Hydroxide (15%)	140	160	210	B	200	70	400	A	A	B	A	A	A	A	A	A	A	A	A	A	A	A	A
Sodium Hypochlorite	C	C	70	140	150	C	350	C	B	C	A	A	C	C	C	C	C	C	C	A	B	A	C
Sodium Metaphosphate	70		70	70	70	A		70	A		A	A	C	B	C	C	C	A	A	A	A	B	
Sodium Nitrate	140	140	210	225	140	B	400	70	B	A	A	A	A	200	A	A	B	A	A	A	A	A	A
Sodium Perborate	70	70	70	70	70	B	350	B	A	B	A	A	B	B	B	C	C	A	A	A	A	A	A
Sodium Peroxide	B	70	140	185	200	B	250	70	B		A	A	C	B	C	C	C	A	A	A	A	A	A
Sodium Phosphate	140	140	170	200	200	70	400	70	A	A	A	A	B	A	B	B	B	A	A	A	A	A	A
Sodium Silicate	140	140	200	200	200	A		70	B	A	A	A	A	A	A	C	B	A	A	A	A	A	A
Sodium Sulfate (SAT)	140	140	140	200	140	B	400	A	B	B		A	A	B	A	A	B	A	A	A	A	A	A
Sodium Sulfide	180	140	140	200	200	B	350	70	B	A		A	C	B	B	C	C	A	A	A	A	A	A
Sodium Sulfite	140	140	140	200	140	B	350	C	B	A	A	A	B	B	B	A	C	A	A	A	A	C	A
Sodium Thiosulphate	140	160	200	200	200	B	350	B	A	A		A	C	B	C	B	C			A	A	A	
Soybean Oil	140	70	C	250	200	C	400	A			A	A	B		A	A	B	A	A	A	A	A	A
Stannic Chloride	140	C	100	200	70	A	350	B	B			A	C	C	C	C	C	C	C	C	C	C	C
Stannous Chloride	140	160	70	200	200	A	350	C	B		A	A	C	C	C	C	C			A		C	B
Starch	180	160	170	200	200	A	300	70	A			A	B		B	B	B	A	A	A	A	A	A
Steam	C	C	B	C	C	C	400	C	A	C		B	A	A	A	A	A	A	A	A	A	A	A
Stearic Acid	140	70	C	100	70	B	350	B	A	A	A	A	C	350	C	A	C	A	A	A	A	A	A
Sugar	100	140	140	200	140	A	350	70	B				A	A	A	A	A	A	A	A	A	A	A
Sulfur (Gas)	C	70		250	70	B	350		A	B			C	300	B	C	C	A	A	A	A	A	A
Sulfur Chloride	C	C	C	70	70	C	350	C	B		A	A	A	C	A	B	A	A	A	A	A	A	A
Sulfur Dioxide (Dry)	C	C	70	100	200	B	350	C	A	B	B	A	A	C	A	B	A	A	A	A	A	A	A
Sulfuric Acid (30%)	C	100	140	200	100	C	250	C	B	C		A	C	C	C	C	C	C	B	A	B	A	C
Tannic Acid	100	100	70	100	100	A	250	C	B		A	A	C	A	B	A	A	A	A	A	A	A	A
Toluene	C	C	C	70	C	C	200	A	B		C	A	A	A	A	A	A	A	A	A	A	A	A
Tomato Juice	C	70	200	200	C		350	70	A				C		C	B	C	A	A	A	A	A	A
Tributyl Phosphate	C	C	70	C	C	B	300	B			B	A	B	B	A	B	B	A	A	A	A	A	A
Trichloroethylene	C	C	C	185	C	C	200	C	B	B	C	A	B	A	B	A	A	A	A	A	A	A	A

Chemical Resistance Guide

Val-Matic® Chemical Resistance Guide for Valves

CHEMICAL	ELASTOMERS AND PLASTICS												METALS										
	Buna-N	Neoprene	EPDM	Viton®	Hypalon	Natural Rubber	PTFE/ RPTFE	Nylon	PEEK	Devlon®	AFLAS®	Chemraz® Kalrez® Markez®	Carbon Steel	Nickel	Cast Iron	Bronze	Alum. Bronze	304 SS	17-4 PH SS	316 SS	Nitronic 60	Monel	Inconel
Trisodium Phosphate	70	70	70	185	185	A	350	A	A			A	B		B	C	C	A	A	A	A	A	A
Turpentine	70	C	C	150	C	C	A	B	B	A	A	A	A	B	A	A	A	A	A	A	A	A	A
Urea	140	140	210	185	140	70	A	A	B	A		A	C	B	C	B	B	A	A	A	A	B	
Urine	140	140	210	70	140	C	400	B					C		C			A	A	A	A	A	A
UV Radiation	C	B	B	A	A	C	A	A					A	A	A	A	A	A	A	A	A	A	A
Varnish	70	C	C	70	C	C	350	A	A		B	A	C		C	A	B	A	A	A	A	A	A
Vegetable Oil	70	70	C	200	70	C	300	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Vinegar	C	70	140	C	200	B	300	A	A	C		A	C		C	C	C			A		A	A
Vinyl Acetate	70	C	70	C	C	D	350		A		C	A	B	A	B	B	B	A	A	A	A	A	A
Water, Acid Mine	180	160	200	70	180	B	400	A					C	B	C	C	C	A	A	A	A	B	B
Water, Brackish	180	160	250	200	200	A	400	A					C	C	C	B	C	B	A	A	B	A	B
Water, Deionized	70	160	200	70	200	A	400	A	A				C	C	C	B	C	A	A	A	A	A	A
Water Potable	180	160	250	A	200	A	400	A	A				B	A	B	A	A	A	A	A	A	A	A
Water, Chloramines	B	B	200	300		B	400	A					B	A	B	A	A	A	A	A	A	A	A
Water, Sea	180	160	250	200	200	A	400	A	B		A	A	C	B	C	B	C	B	A	B	B	A	B
Water, Waste	200	180	200	70	70	70	400	A					B	A	B	B	B	A	A	A	A	A	A
Whiskey	140	140	200	140	140	A	350	70	A	B	A	A	C		C	C	B	A	A	A	A	A	A
Wine	140	140	170	140	140	A	350	70	A	B	A	A	C		C	C	C	A	A	A	A	A	A
Xylene	C	C	C	150	C	C	350	120	B	A	C	A	A	A	A	A	A	A	A	A	A	A	A
Zinc Acetate	70	70	180	160	70	70	70				B	A	C		C	C	C	C	A	A	A	A	A
Zinc Chloride	70	160	180	200	200	A	400	A	B		A	A	C	B	C	C	C	C	B	B	B	A	B
Zinc Sulfate	140	140	180	200	200	B	400	A	B		A	A	C	B	C	C	B	A	A	A	A	A	A

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