Corrosion Resistance

We manufactures enclosures from a wide range of materials, offering varying degrees of resistance against chemical corrosion. All materials are affected by corrosion in some manner. Depending on the physical properties of the material and the environment to which it is exposed, chemical or electromechanical corrosion may occur. In order to select the appropriate material for your application, refer to the corrosion resistance table on the following pages.

Atmospheric Corrosion

Atmospheric corrosion occurs when a material is exposed to airborne liquids, solids, or gases. Some sources of atmospheric corrosion are moisture, salt, dirt, and sulfuric acid. This form of corrosion is typically worse outdoors, and especially near marine environments.

To combat the effects of atmospheric corrosion, the National Electrical Manufacturers Association (NEMA) has developed the NEMA 4X rating. An enclosure carrying the NEMA 4X rating meets certain minimum conditions of corrosion resistance. Specifically, the materials from which NEMA 4X rated enclosures are formed must withstand two hundred hours of salt spray with no more evidence of corrosive pitting than is exhibited by a concurrently tested sample of Type 304 stainless steel.

We offer metallic NEMA 4X rated enclosures in aluminum, and stainless steel Type 304 and Type 316L as well as a full line of NEMA 4X rated non-metallic enclosures.

Chemical Corrosion

Chemical corrosion takes place when a material comes into direct contact with a corrosive agent. The severity of chemical corrosion is affected by chemical concentration level, frequency of washing, and operating temperature. Refer to the chart below for a general overview of how different enclosures might perform when in contact with chemicals of varying pH. The chart is provided as a quick guide to how different materials might perform in your environment. We recommend consulting the detailed corrosion resistance table provided on the following pages to be sure that the appropriate material is selected.

Storage Corrosion

Wet storage stain (White rust) is caused by the entrapment of moisture between the surfaces of closely packed and poorly ventilated material for an extended period. Wet storage stain is usually superficial, having little affect on the properties of the material.

Proper handling and storage will help to assure stain free material. If a product arrives wet, it should be unpacked and allowed to dry before storage. Dry material should be stored in a well-ventilated, low-moisture environment to avoid the formation of condensation. Outdoor storage is undesirable and should be avoided whenever possible.

Galvanic Corrosion

Galvanic corrosion occurs when two or more dissimilar metals are in contact in the presence of seawater or another electrolyte. In this situation, an electrolytic cell is created and the metals become either an anode or a cathode. The anodic material will corrode and the cathodic material will be protected.

Whether a material is anodic depends on the relative positions of the interacting materials in the Galvanic Series Table (shown at left). For example: If zinc and steel are in contact, the zinc acts as the anode and will corrode while protecting the steel. If steel and copper are in contact, the steel is now the anode and will corrode while protecting the copper.

The rate at which galvanic corrosion occurs depends on several factors:

1. The amount and concentration of electrolyte present. An indoor, dry environment will support little or no galvanic corrosion relative to a wet atmosphere.
2. The relative amount of the materials. A small amount of anodic material in contact with a large amount of cathodic material will result in accelerated corrosion of the anodic material. Inversely, a large amount of anodic material in contact with a small amount of cathodic material will decrease the rate of corrosion.
3. The relative position of the materials in the Galvanic Series. The further apart the interacting materials are in the Galvanic Series, the greater the potential for corrosion of the anodic material.

	Solvent	Caustic	Acid
Preferred	Stainless Steel Type 316 Stainless Steel Type 304 Non-Metallic Aluminum Steel, Epoxy Powder Coated	Non-Metallic Stainless Steel Type 316 Stainless Steel Type 304	Non-Metallic Stainless Steel Type 316 Stainless Steel Type 304
Satisfactory	Non-Metallic	Non-Metallic	Non-Metallic Steel, Epoxy Powder Coated
Limited		Steel, Epoxy Powder Coated Aluminum	Aluminum

Note: The corrosion data given in the table on the following pages is for general comparison only. (Reference Corrosion Resistance Tables, Second Edition)
The presence of contaminates in chemical environments can greatly affect the corrosion rate of any material. B-Line strongly suggests that field service tests or simulated laboratory tests using actual environmental conditions be conducted in order to determine the proper materials and finishes to be selected. We offer no guarantee or warranty as to the suitability of a particular material for use in any specific environment which is beyond our control.

Corrosion Resistance Table

Chemical	Unpainted Metal Enclosures									Painted Steel Enclosures					
	Aluminum			Stainless Steel Type 304			Stainless Steel Type 316			Acrylic Electrocoat, ANSI 61 Gray			Polyester Powdercoat, ANSI 61 Gray		
	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot
Acetic Acid, 50%	R	L	U	R	R	L	R	R	R	U	U	U	R	R	U
Acetic Acid, 10%	R	L	U	R	R	R	R	R	R	U	U	U	R	R	R
Acetone	R	R	R	R	R	R	R	R	R	U	U	U	U	U	U
Aluminum Chloride	U	U	U	R	R	R	R	R	R	R	--	--	R	R	R
Aluminum Sulfate ,Saturated	R	R	R	R	R	R	R	R	R	R	--	--	R	R	R
Ammonia Gas	--	--	--	R	--	--	R	--	--	R	--	--	R	R	L
Ammonium Hydroxide, 10%	L	L	L	R	R	R	R	R	R	R	--	--	L	L	L
Amyl Acetate	R	R	R	R	R	R	R	R	R	U	U	U	L	U	U
Amyl Alcohol	R	R	R	R	--	--	R	R	R	R	--	--	R	R	R
Aniline	R	R	R	R	R	R	R	R	R	U	U	U	U	U	U
Aqua Regia	U	U	U	U	U	U	U	U	U	--	--	--	U	U	U
Benzene, Benzol	R	R	R	R	R	R	R	R	R	U	U	U	U	U	U
Benzoic Acid	L	L	U	R	R	R	R	R	R	U	U	U	R	R	--
Boric Acid	R	R	L	R	R	R	R	R	R	R	--	--	R	R	--
Bromine Water	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
Butyl Acetate	R	R	R	R	--	--	R	R	R	U	U	U	L	U	U
Butyl Alcohol, Tertiary	R	R	R	R	R	R	R	R	R	R	--	--	R	--	--
Butyric Acid	L	L	L	R	R	R	R	R	R	U	U	U	R	R	--
Calcium Chloride	L	L	U	R	R	R	R	R	R	R	--	--	R	R	R
Calcium Hydroxide	U	--	--	R	R	R	R	R	R	R	--	-	R	R	--
Calcium Nitrate	R	R	--	R	--	--	R	R	R	--	--	--	R	R	R
Carbon Dioxide, Wet	R	R	--	R	R	L	R	R	L	R	--	--	R	R	R
Carbon Disulfide (Bisulfide)	R	R	R	R	R	L	R	R	R	R	--	--	U	U	U
Carbon Monoxide	R	R	R	R	R	R	R	R	R	--	--	--	R	R	R
Carbon Tetrachloride	L	L	U	L	L	L	R	R	R	U	U	U	U	U	U
Chlorine, Liquid	--	--	--	R	L	--	--	--	--	--	--	--	--	--	--
Chlorine Water, Saturated	R	--	--	U	U	U	U	U	U	R	--	--	R	R	R
Chlorobenzene (Phenylchloride)	R	R	--	R	R	L	R	R	R	U	U	U	U	U	U
Chloroform	R	L	U	R	L	L	R	R	R	U	U	U	U	U	U
Chlorox Bleach Solution, 5.5% Chlorine	U	U	U	--	--	--	R	--	--	--	--	--	--	--	--
Chromic Acid, 10%	R	R	--	R	R	L	R	R	R	U	U	U	U	U	U
Citric Acid, 5%	L	L	L	R	U	U	R	R	R	R	--	--	R	R	R
Copper Chloride	U	U	U	U	U	U	U	U	U	R	--	--	R	R	R
Copper Sulfate	U	U	U	R	R	R	R	R	R	U	U	U	R	R	R
Cresol	R	L	--	R	R	--	R	L	--	U	U	U	U	U	U
Crude Oil	R	R	--	R	R	R	R	R	R	--	--	--	R	R	R
Diesel Fuels	R	--	--	R	--	--	R	--	--	--	--	--	R	R	--
Dimethyl Formamide	R	--	--	--	--	--	R	R	R	U	U	U	U	U	U
Dioxane	R	R	R	R	R	R	R	R	R	--	--	--	U	U	U
Ethyl Acetate	R	R	R	R	R	L	R	R	R	U	U	U	U	U	U
Ethyl Alcohol	R	R	R	R	R	R	R	R	R	U	U	U	R	--	--
Ethyl Chloride	R	R	R	R	R	R	R	R	R	U	U	U	--	--	--
Ethyl Ether	R	--	--	R	R	R	R	R	R	U	U	U	U	U	U
Ethylene Glycol	R	R	L	R	R	--	R	R	R	R	--	--	R	R	R
Ethylene Oxide	R	R	R	R	R	L	R	R	R	--	--	--	U	U	U
Ferric Chloride	U	U	U	U	U	U	U	U	U	R	--	--	R	R	--
Formaldehyde, 37% Solution	R	R	R	R	R	R	R	R	R	R	--	--	R	R	--
Formic Acid, 10%	R	R	--	R	R	U	R	R	R	U	U	U	--	--	--
Freon, F-22	R	--	--	R	--	--	R	R	R	--	--	-- --	--	--	
Gasoline, Unleaded	R	R	R	R	--	--	R	--	--	R	U	U	R	R	R
Heptane	R	L	--	R	R	R	R	R	R	--	--	--	R	R	R
Hexane	R	--	--	R	R	R	R	R	R	R	--	--	R	--	--
Hydrobromic Acid, Dilute	U	U	U	U	U	U	U	U	U	--	--	--	R	R	--

The corrosion data given in this table is for general comparison only. (Reference Corrosion Resistance Tables, Second Edition)
The presence of contaminates in chemical environments can greatly affect the corrosion rate of any material.

R = Recommended L = Limited Use U = Unsatisfactory – = Information not available Cold = 50-80°F Warm = 130-170°F Hot = 200-212°F

Corrosion Resistance Table

Non-Metallic Enclosures			Door Gasket Materials				
Polyamide	Polycarbonate	Polyester	Foam-in-Place Polyurethane Sponge	Polyurethane Sponge	Neoprene Rubber Sponge	Silicone Rubber Sponge	Viton, Rubber Sponge
L	L	R	--	--	L	R	R
R	R	R	L	L	L	R	R
R	U	U	U	U	L	U	U
L	R	R	R	R	R	R	R
L	R	R	R	R	R	R	R
U	U	L	R	R	R	--	U
U	U	U	R	R	R	R	R
--	U	L	U	U	U	U	U
--	L	L	U	U	R	U	R
U	U	U	U	U	U	R	R
--	L	U	U	U	--	--	R
R	U	L	U	U	R	U	R
L	U	L	R	U	R	R	R
L	R	R	R	L	U	R	R
--	U	U	--	U	U	U	R
--	U	L	R	U	U	R	R
R	R	R	--	--	U	R	R
L	U	L	--	--	U	U	R
R	R	R	R	R	R	R	R
U	--	U	--	L	R	R	R
L	R	R	--	L	R	R	R
L	--	R	R	R	R	R	R
R	U	L	--	--	U	--	R
L	--	R	--	R	R	R	R
R	U	L	U	U	U	U	R
L	L	L	--	--	U	U	R
R	R	R	--	U	U	U	R
R	U	U	L	U	U	U	R
R	U	U	L	U	U	U	R
--	L	R	--	--	U	U	U
U	R	L	U	U	U	L	R
R	R	R	R	--	R	R	R
L	R	--	--	R	R	R	R
L	R	R	--	R	R	--	R
U	U	U	--	U	U	--	R
L	--	L	--	L	U	U	R
--	R	R	R	--	R	U	R
U	U	L	U	--	U	L	L
--	U	L	--	--	U	L	L
R	U	L	L	U	U	R	U
R	L	R	R	U	U	R	U
R	U	L	--	--	L	U	R
R	U	U	--	U	U	U	U
L	R	R	R	R	R	R	R
--	R	R	--	U	U	U	U
L	R	R	--	R	R	R	R
L	R	R	--	U	R	--	L
R	R	L	U	U	R	R	R
--	U	R	--	U	R	U	R
R	L	R	--	R	R	U	R
R	R	R	R	U	R	U	R
--	L	R	R	R	R	U	R
L	--	L	--	--	U	U	R

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The presence of contaminates in chemical environments can greatly affect the corrosion rate of any material.

R = Recommended L = Limited Use U = Unsatisfactory -- = Information not available Cold = 50-80°F Warm = 130-170°F Hot = 200-212°F

Corrosion Resistance Table cont.

Chemical	Unpainted Metal Enclosures									Painted Steel Enclosures					
	Aluminum			Stainless Steel Type 304			Stainless Steel Type 316			Acrylic Electrocoat, ANSI 61 Gray			Polyester Powdercoat, ANSI 61 Gray		
	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot	Cold	Warm	Hot
Hydrochloric Acid, 20%	U	U	U	U	U	U	U	U	U	R	--	--	R	R	--
Hydroflouric Acid, 10%	U	U	U	U	U	U	U	U	U	--	--	--	R	--	--
Hydrogen Peroxide, 30%	R	R	R	R	R	R	R	R	R	--	--	--	R	--	--
Hydrogen Sulfide, Wet	R	--	--	U	U	U	R	R	R	R	R	--	R	R	--
Isopropyl Alcohol	R	--	--	R	R	--	R	R	R	--	--	--	U	U	U
Jet Fuels	R	R	--	R	--	--	R	R	R	R	--	--	R	R	--
Kerosine	R	R	--	R	R	R	R	R	R	R	--	--	R	R	--
Lactic Acid, 10%	R	--	--	R	R	L	R	R	R	U	U	U	R	R	R
Magnesium Chloride	U	U	U	L	L	L	R	R	R	R	--	--	R	R	R
Methyl Alcohol	R	L	--	R	R	L	R	R	R	--	--	--	R	R	--
Methyl Ethyl Ketone	R	L	--	R	L	--	R	R	R	U	U	U	U	U	U
Methylene Chloride	R	R	R	R	R	L	R	R	R	U	U	U	U	U	U
Mineral Oils	R	R	--	R	--	--	R	R	R	R	--	--	R	--	--
Naptha	R	--	--	R	R	--	R	--	--	R	U	U	R	R	R
Nitric Acid, 10%	U	U	U	R	R	R	R	R	R	R	--	--	R	R	U
Nitrobenzene	R	--	--	R	R	L	R	R	R	U	U	U	U	U	U
Oleic Acid	R	--	--	R	R	L	R	R	R	R	R	--	R	R	R
Oleum	R	--	--	R	--	--	R	--	--	U	U	U	U	U	U
Oxalic Acid, 10%	R	L	--	U	U	U	U	U	U	R	--	--	R	R	--
Oxygen	R	R	--	R	--	--	R	R	R	--	--	--	--	--	--
Ozone	R	R	--	R	R	--	R	R	R	--	--	--	--	--	--
Perchloroethylene	R	R	R	R	R	R	R	R	R	--	--	--	R	U	U
Phenol	R	R	R	R	R	R	R	R	R	R	--	--	U	U	U
Phosphoric Acid, 25%	U	U	U	R	R	L	R	L	U	R	--	--	R	R	R
Phthalic Acid	R	R	R	R	R	R	R	R	R	--	--	--	R	--	--
Potassium Chloride, 30%	U	U	U	R	R	R	R	R	R	R	--	--	R	R	R
Potassium Dichromate, 30%	R	R	L	R	R	R	R	R	R	R	--	--	R	R	R
Potassium Hydroxide, 10%	U	U	U	R	R	L	R	R	R	R	R	U	U	U	U
Potassium Nitrate, 50%	R	R	R	R	R	L	R	R	R	R	--	--	R	R	R
Potassium Permanganate, 10%	R	R	R	R	L	L	R	R	L	U	U	U	R	R	--
Pyradine	R	R	R	R	R	R	R	R	R	--	--	--	U	U	U
Sodium Bicarbonate, 20%	R	--	--	R	R	R	R	R	R	R	--	--	R	R	--
Sodium Bisulfite, 10%	U	U	U	R	R	L	R	R	R	R	--	--	R	R	--
Sodium Carbonate, 10%	U	U	U	R	R	L	R	R	R	U	U	U	R	R	U
Sodium Chlorate, 10%	R	R	R	R	R	R	R	R	R	R	--	--	R	R	--
Sodium Chloride, 10%	R	U	U	R	R	L	R	R	R	R	--	--	R	R	R
Sodium Hydroxide, 10%	U	U	U	R	R	R	R	R	R	R	--	--	R	U	U
Sodium Hypochlorite, 10%	R	L	L	R	L	U	R	--	--	R	R	--	U	U	U
Sodium Nitrate	R	R	R	R	R	U	R	R	R	R	--	--	R	R	R
Sodium Sulfate	R	R	L	R	R	U	R	R	R	R	--	--	R	R	U
Sulfur Dioxide	R	R	R	R	R	R	R	R	R	R	R	--	R	R	R
Sulfuric Acid, 5%	U	U	U	L	U	U	R	--	--	R	--	--	R	R	R
Tartaric Acid	L	U	U	R	R	R	R	R	R	--	--	--	R	R	R
Tetrahydrofuran	U	U	U	R	--	--	L	L	L	--	--	--	U	U	U
Toluene	R	R	R	R	R	R	R	R	R	U	U	U	R	U	U
Trichloroacetic Acid	U	U	U	U	U	U	U	U	U	--	--	--	R	R	U
Trichloroethylene	R	R	L	R	L	L	R	R	L	U	U	U	U	U	U
Trisodium Phosphate	U	U	U	R	R	--	R	R	--	--	--	--	R	R	U
Turpentine	L	--	--	R	R	--	R	R	L	R	--	--	R	R	--
Water	R	R	L	R	R	R	R	R	R	R	--	--	R	R	R
Xylene	R	R	R	R	R	R	R	R	R	--	--	--	R	--	--
Zinc Chloride	U	U	U	U	U	U	L	L	L	R	--	--	R	R	R
Zinc Sulfate	U	U	U	R	R	R	R	R	R	R	--	--	R	R	R

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Corrosion Resistance Table

Non-Metallic Enclosures			Door Gasket Materials				
Polyamide	Polycarbonate	Polyester	Foam-in-Place Polyurethane Sponge	polyurethane Sponge	Neoprene Rubber Sponge	Silicone Rubber Sponge	Viton, Rubber Sponge
L	L	L	R	R	R	R	R
L	R	L	--	--	R	U	R
--	R	R	--	--	U	R	R
L	R	R	--	--	R	L	U
R	R	R	--	U	U	U	U
R	L	R	--	U	U	U	R
R	R	R	--	U	R	U	R
L	R	R	--	--	R	R	R
L	R	R	R	R	R	R	R
R	L	L	U	U	R	U	U
R	U	L	U	U	U	U	U
R	U	U	U	U	--	--	R
L	R	R	R	R	R	R	R
--	R	R	--	R	U	U	R
L	R	L	U	U	U	U	R
L	U	L	--	U	U	U	R
L	R	R	R	R	L	U	R
U	--	U	--	U	L	U	R
L	R	R	--	--	U	R	R
L	R	R	--	--	U	R	R
--	U	L	R	--	L	R	R
R	--	U	U	U	U	U	R
L	U	U	--	U	R	U	R
L	L	L	--	--	R	--	--
L	--	R	--	--	R	R	R
--	R	R	R	R	R	R	R
U	--	L	--	R	R	R	R
L	U	U	--	R	R	L	R
L	R	R	--	--	R	R	R
U	R	L	--	--	R	--	R
L	U	--	--	--	L	R	R
U	R	R	--	--	R	R	R
--	R	R	--	--	R	R	R
U	R	R	--	--	R	R	R
--	R	R	--	--	R	L	R
L	R	R	R	R	R	R	R
R	U	L	--	--	R	R	R
U	R	L	--	--	L	R	R
L	U	R	--	--	R	U	R
L	R	R	--	R	R	R	R
L	L	R	--	--	R	R	R
L	L	L	U	U	U	U	R
L	R	R	--	R	R	R	R
--	U	U	U	--	U	U	U
L	U	L	L	U	--	R	R
--	R	U	--	--	U	U	L
L	--	L	L	U	U	U	R
U	L	--	--	R	R	R	R
--	L	R	R	U	U	U	R
R	R	R	R	R	U	--	R
--	U	L	L	U	U	U	R
L	R	R	--	--	R	R	R
L	R	R	--	--	R	R	R

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