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WHITE PAPER: Stainless Steel Enclosures and Industrial Applications

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Executive Summary

The need to place electrical equipment within corrosive environments necessitates protection beyond which painted carbon steel enclosures can provide. Enclosures made of stainless steel fill this void with superior strength and corrosion resistant properties, satisfying application requirements across a broad spectrum of industries. However, there are common criteria that must be considered to ensure that the proper stainless steel enclosure is chosen for a given application.

Here you'll find some of the technical aspects of stainless steel that are crucial to the selection of industrial enclosures including composition, distinguishing properties of different grades, chemical resistances, suitable applications and general benefits offered by stainless steel when compared to carbon steel enclosures.

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Grade

A Grade 304 stainless steel is comprised of 18% chromium and 10% nickel. Sometimes referred to as ‘18-8’, this is the standard type of stainless steel used in the enclosure industry — filling the widest range of applications. Limitations of Type 304 stainless steel include use in outdoor applications near large bodies of saltwater where airborne salt can come into contact with the surface of the enclosure. A rule of thumb is that Type 304 stainless steel should not be used within 5 miles of the coast, but the true distance at which corrosion can occur is dependent upon local weather patterns. Cold climate regions where chlorides are used as de-icing agents may also cause significant pitting in Type 304 stainless steels. For these reasons, Type 304 stainless steel is not recommended in these situations without a regular cleaning regimen.

Stainless Steel Grade 316L - contains 17% chromium, 12% nickel and 2% molybdenum. 316L Stainless Steel has a higher percentage of nickel and the addition of the alloy molybdenum (2-3%). The molybdenum provides better resistance to pitting and crevice corrosion, particularly in chloride-rich environments. Type 304 stainless steel can resist corrosion in waters containing up to about 100 ppm chloride while Type 316L stainless steel will exhibit this resistance up to 1000 ppm chloride.

Industries using Stainless Steel Enclosures

Industry	Sub-Industry	Typical Stainless Steel
Food & Beverage	General Food Processing	304 or 316 SS
	Milk & Dairy	304 or 316 SS
	Brewery and Wine	304 or 316 SS
	Bottling	304 or 316 SS
	Bakeries	304 or 316 SS
Chemical	Pharmaceutical	316 SS
	Petrochemical	316 SS
Marine	Offshore Drilling	316 SS
	Shipping	316 SS
Water	Waste Water Treatment	304 or 316 SS
	Portable Water Treatment	304 or 316 SS
	Desalination	316 SS
	Distribution	304 or 316 SS
Materials	Pulp	316 SS
	Paper	304 or 316 SS
	Rubber	316 SS
	Plastic	304 or 316 SS
Mining	Ore	304 or 316 SS
	Salt	316 SS
	Coal	304 or 316 SS

It is important to note that neither Type 304 nor Type 316L stainless steel will resist the chemical corrosion caused by hydrochloric acid. The acid will destroy the passivity, leaving the surface of the metal defenceless. The following chart shows how Type 304 and Type 316L stainless steels react with some of the chemicals present in common application environments.

Chemical Resistance Table (Room Temperature)

Group	Compound	304	316
Inorganic Acids	Hydrochloric Acid	Poor	Poor
	Sulfuric Acid (<10%)	Poor	Good
	Nitric Acid	Excellent	Good
	Phosphoric Acid (<40%)	Poor	Fair
	Sulfurous Acid	Good	Good
	Carbonic Acid	Good	Good
Organic Acids	Acetic Acid	Poor	Good
	Formic Acid	Good	Excellent
	Lactic Acid	Good	Good
	Citric Acid	Good	Excellent
	Fatty Acids	Good	Excellent
Bases	Ammonium Hydroxide	Excellent	Excellent
	Sodium Hydroxide (50%)	Good	Good
	Potassium Hydroxide	Good	Excellent
Misc	Fresh Water	Excellent	Excellent
	Sea Water	Poor	Fair

Stainless Steel finishes

Standard mill finishes can be applied to flat rolled stainless steel directly by the rollers and by mechanical abrasives. Steel is first rolled to size and thickness and then annealed to change the properties of the final material. Any oxidation that forms on the surface (mill scale) is removed by pickling, and a passivation layer is created on the surface. A final finish can then be applied to achieve the desired aesthetic appearance.

Grain of the abrasive material:

- Is oriented on the mesh count of a screen per inch
- The larger the number, the finer the grain
- Brushed (grinded) finish 220: average roughness value Ra approx. 1.7 µm
- Brushed (grinded) finish 400: average roughness value Ra approx. 0.8 µm

Further Benefits

In addition to better corrosion resistance, stainless steel enclosures possess superior hygienic qualities when compared to their carbon steel counterparts. Bacteria and germs have difficulty adhering to and growing on stainless steel (provided that a sufficient finish is maintained) and the smooth, hard surface of stainless steel allows for a much easier, more thorough cleaning.
Other material properties of stainless steel enclosures offer advantages when compared to carbon steel models as well. A greater strength-to-weight ratio results in increased rigidity in larger enclosures, plus, stainless steels' superior hardness provides an increased ability to withstand damage.

When total life cycle costs are taken into consideration, stainless steel enclosure costs may be equal to, or in some cases, less than that of carbon steel. Although the acquisition cost of stainless steel is usually greater than that of carbon steel, this is often offset by lower maintenance costs and a longer life expectancy. Once the serviceable life of the enclosure is over, stainless steel also delivers yet another benefit versus carbon steel — a better return as scrap metal

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