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Stainless Steel

Overview

Stainless steel is often thought of as a wonder material which is strong, durable, highly sanitary, and forever corrosion free. Though highly versatile, stainless steel products must be specified and applied carefully to ensure performance expectations, including long term corrosion resistance are met.

Stainless steel is a steel alloy containing 10% to 25% chromium. Chromium reacts with water and oxygen to form a thin oxide film called passivation which is highly stable and non-reactive and protects the underlying metal from further corrosion.

Stainless steel is used in a myriad of applications in laboratory and animal research facilities, including sinks, casework, countertops, ductwork, piping, and many kinds of equipment. Depending on its use and location, stainless steel may be exposed to cleaning products, solvents, fumes and a range of chemicals which may react with a particular alloy, resulting in corrosion. It is important to consider the characteristics of the many different types of stainless steel so that the correct type is used for each application. Chromium, nickel, molybdenum primarily determine the characteristics of the steel, including strength and corrosion resistance.

Types of Stainless Steel

The American Iron and Steel Institute (AISI) categorizes stainless steel in over 100 grades, many of which are used in specialty industrial and commercial applications. For most biomedical building-related applications types 304 and 316 (or 304L/ 316L) are used.

304 grade is a general-use austenitic stainless steel which does not readily corrode when exposed to common environmental conditions or a wide range of commonly used cleansers and organic chemicals. Type 304 is used in food-service applications, architectural hardware, flashings, railings and other items exposed to the weather. 304 is susceptible to corrosion from chloride solutions and industrial solvents, however, so it is not appropriate for most wet laboratory applications including laboratory sinks and piping. 304 may discolor and pit if exposed to salts, bleach, chlorine cleansers and disinfectants or solvents. Type 304 stainless that has been cast (instead of wrought) is known as Type CF8.

304L grade is a low-carbon variation of 304 which has slightly lower strength but has better welding and formability characteristics. 304L is additionally used in complex fabrications. Type 304/304L are the minimum acceptable grades for handwash and scrub sinks. Type 304L stainless that has been cast is known as Type CF3.

316 grade stainless steel has more nickel and molybdenum than 304, which gives it greater resistance to higher temperatures, mild chloride solutions and solvents. Type 316 is used for laboratory casework, countertops, surgical instruments and other items exposed to harsh chemicals, mild salt solutions, repeated wash-down and other corrosive conditions. Type 316 stainless that has been cast is known as Type CF8M.

316L is a low-carbon variation of 316. 316L has better welding and formability characteristics. Type 316 or 316L is the minimum grade for lab sinks and is sometimes used for potable water piping. Corrosion resistance is generally equivalent to slightly better than type 316, but much lower than special stainless steel formulations such as Type 904L and Duplex Alloys. Type 316 stainless that has been cast is known as Type CF3M.

Other Considerations

For laboratories using a high concentration of chlorides alternate materials are often required. Examples include epoxy resin for sinks, high silicon cast iron, Hastelloy C22, and various plastics such as *polyvinylidene fluoride* (PVDF) for piping, and fiberglass or PVDF for trench drain grates. Elevated temperature, can significantly influence the corrosion resistance of stainless steel.

Special care must be taken when welding and fabricating stainless steel. Dedicated tools must be used, and stainless steel must be protected from contact with graphite, chlorides construction dust, and other contaminants. The passivation process, which involves submerging the stainless steel in aggressive citric or nitric acid solutions to restore the chemical resistant oxide layer; must be performed as part of fabrication post-welding to maintain corrosion resistance. Passivation should be performed by firms especially qualified for the application or by the original manufacturer, Passivation must be performed in accordance with ASTM A967[1] and ASTM A380[2].

Sinks in cagewash areas and sanitary spaces should be NSF-certified, or approved equivalent. This ensures corrosion-resistant, sanitary construction and that corners and edges are appropriately radiused.

The minimum thickness (gauge) for any commercial sink is 18 gauge. Free standing type sinks and any sinks susceptible to potential impact (e.g. vivarium) should be 16 gauge or thicker. Drains for stainless steel sinks should be stainless steel of at least the same grade as the sink.

Welds can be a corrosion point in a stainless steel assembly if not performed correctly. Welders should be specially qualified when fabricating stainless components. Full penetration welds that are completely smooth and free of cracks and crevices should be specified.

References

[1]ASTM A967 *Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts*

[2]ASTM A380 *Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems*

Additional Information

American Iron and Steel Institute (AISI), www.steel.org

Specialty Steel Industry of North America (SSINA), http://www.ssina.com

NSF (formerly the National Sanitation Foundation), http://www.nsf.org

Nickel Institute, www.nickelinstitute.org