Corrosion Guide for Type 304 Stainless Steel

Type 304 Stainless Steel

Type 304 stainless steel is the most versatile and most widely used stainless steel. High strength and excellent corrosion resistance make Type 304 stainless steel useful for a wide range of applications. However, it should be noted that NO stainless steel is completely unaffected by corrosion. While Type 304 resists corrosion under even harsh environments, it may not be 100% "corrosion-proof" in some applications.

All stainless steels contain varying amounts Chromium (Type 304 is typically around 18%). When chromium comes in contact with oxygen, it forms a natural barrier of chromium-oxide called a "passive film". This invisible and inert film is self-repairing, and is the barrier that prevents further attack on the material. However, if this passive film is degraded or becomes damaged, corrosion can occur.

Types of Corrosion

Below is a brief description of some types of corrosion that can affect stainless steels and the substances/environments that typically cause them.

General corrosion can occur when there is an overall breakdown of the passive film described above. Certain chemicals can penetrate the passive film, and make the surface of the metal show a sponge-like appearance. Some of the more aggressive examples of such chemicals are known as Halogens. These halogens are sometimes recognized as ending with _ine, such as fluorine, chlorine, bromine, and iodine.

Stress Corrosion Cracking is a type of localized corrosion characterized by fine cracks, which can spread quickly, and generally lead to failure. It is usually caused by Chlorides – probably the single biggest enemy of stainless steel. In most environments, the chloride concentration is so low the effects are minute. Type 304 stainless steel is considered resistant to water with up to about 150 ppm at 140°F (swimming pool water is typically about 30-50 ppm). But in extreme environments where chloride concentration is high, stainless steel members are under tensile stress, and they are not cleaned/maintained regularly, the effects can be significant. In such environments, stainless steel parts should be examined for stress corrosion cracking carefully.

Galvanic Corrosion occurs when dissimilar metals contact each other in an electrolyte, producing an electrical current. The current flows from one metal to the other, removing material from the first metal. One example of the necessary electrolyte is seawater. Thus, galvanic corrosion is a common problem in marine environments. Type 304 stainless steels may experience accelerated galvanic corrosion in marine or salt-water environments. In these applications Type 316 should be considered as an alternative.

All 304 stainless steels contain a small amount of carbon. **Intergranular Corrosion** occurs at extremely high (welding) temperatures as the carbon forces local chrome to form chromium carbide around it, starving adjacent areas of the chrome needed for corrosion protection. You may choose to consider low carbon alternatives such as Type 304L or Type 316L if parts are to be welded.

Selective Corrosion can occur when De-ionized or de-mineralized fluids leach a select component of an alloy from the material. In the case of stainless steel, chromium is removed (on a microscopic scale) leaving the material unable to reform the chromium-oxide passive film.

Ways to Combat Corrosion

The simplest and best method to combat corrosion is cleaning. One simple example of the effectiveness of cleaning is a stainless steel kitchen sink. The kitchen sink is exposed to some of the most hostile chemicals in a home. But the constant flow of fresh water and regular wiping down prevents those chemicals from damaging the passive film. The more hostile the environment, the more regular cleaning is essential to maintain maximum resistance to corrosion.

No metal, except for gold and platinum in their natural state, is completely corrosion proof. But stainless steel has proven, in thousands of applications, to be one of the most economical solutions to resisting the ever-present problem of corrosion.