Stainless steel

Introduction

Stainless steel is the common name for a range of steel alloys, about 11-12% of chromium by mass to have a degree of resistance to corrosion. They may also contain several other alloying materials, in varying amounts, such as nickel and molybdenum.

Most stainless steels have good resistance to atmospheric corrosion. The most common grades are the austenitic or 300 series, which reportedly make up about 70% of all stainless steel production. Very common in this group are the 304 and 316 grades, which contains 18% chromium and 8% nickel.

A layer of chromium oxide (Cr_2O_3) layer, forms on the surface in the presence of oxygen and protects the stainless steel for further oxidation. If the stainless steel grade is correctly chosen, the oxide layer is passive and, in many ways, self-protective, preventing surface corrosion.

In addition, stainless steel is resistant to a wide range of chemicals making it a suitable choice for tanks and constructions requiring good chemical resistance.

However, in some environments the protecting oxide layer can degrade and the stainless steel will corrode if not protected.

Furthermore stainless steel exhibits two special issues not uncounted in mild steel:

- Chloride induced stress corrosion cracking
- Liquid metal embrittlement.

This has some implications for coating specification.

Stainless steel may also be coated for cosmetic purposes or marking.

Safety

Use adequate personal safety equipment and follow sound procedures. Apply only in well-ventilated areas. Observe safety labels on packaging and paint containers and consult Hempel's Safety Data Sheets for the products to be applied.

Surface preparation

Degrease with detergents free of chlorides, followed by washing with fresh water before the residues of the degreaser has dried on the surface. Alternatively, steam cleaning followed by thorough freshwater washing should be carried out.
When heavy-duty coatings are specified, stainless steel is generally treated similar to mild steel. However, when surfaces are prepared by abrasive blasting certain precautions need to be taken as regards blasting media as well as paint systems used.

As mentioned, stainless steel is susceptible to attack by chlorides and zinc. Therefore, it is essential that abrasives used for cleaning stainless steel are free of zinc and chlorides. Furthermore, abrasives with metallic iron should be avoided due to the risk of discolouration when abrasive particles are deposited on the surface.

Suitable abrasives are corundum, aluminium oxide, garnet and ordinary silica sand. Other non-metallic abrasives of the grit type, including various slags, are acceptable, provided they are metal free.

Dry abrasive blast cleaning in accordance with SSPC-SP 16. Abrasive sweep blasting should leave the surface a uniform matt grey with a dense surface profile and no un-swept/blasted areas should be visible at 10x magnification. In general, the same surface profile for a given paint system should be used for stainless steel as for ordinary steel.

To assist visual detection of the progress of blasting it might be an advantage to apply a thin layer of "marking paint" prior to blasting (e.g., a quick drying alkyd). The blasting process is accomplished when the marking paint is completely removed.

Application of the coating must take place immediately after surface preparation to avoid oxidation. As stainless steels do not show a visible "turning" of the surface as for steel, it is recommended not to leave the surface unprotected longer than an abrasive blasted steel surface, depending on temperature and relative humidity.

When sweep blasting is not possible
In some situations, sweep blasting is not necessary or possible. In such cases care should be taken to achieve the best possible roughness with the available methods. E.g. sanding in a cross pattern. Avoid polishing.

Furthermore the effect of reduced roughness may to some extend be compensated by the use an epoxy primer with chemically enhanced adhesion properties (sometimes called adhesion primers) e.g., Hempadur 15553, Hempadur 15554 or Hempel's epoxy primer HV 15410. A full system can be built by applying one or more layers on top.

In moderately aggressive environments this may offer long durability of the coating system and be a good solution to cover the surface with the required colour. However, in aggressive environments the absence of a suitable anchor profile created by abrasive blasting will always increase the risk of detachment. While adhesion primers are the best available option for this they can never fully compensate for the missing roughness.

Selection of paint

When selecting paint products for the coating of stainless steel, focus should be on chloride free materials and this applies to the entire paint system.
(A practical maximum limit for leachable chlorides in paints is 200 mg/kg in accordance with ASTM C 871. Epoxy resin will typically contain maximum 10 mg/kg, see NACE SP 108-2008).
In general, Hempel's coatings are manufactured from raw material with no relevant level of leachable chloride. Furthermore, an external laboratory has analysed the level of leachable chlorides in these products:

- HEMPADUR QUATTRO 17870
- HEMPADUR MULTI-STRENGTH 45703
- HEMPADUR MULTI-STRENGTH 45753
- VERSILINE CUI 56990
- HEMPADUR 85671

Also according to NACE SP 108-2008, the use of primers, containing metallic zinc should be avoided. Such paints may result in so-called "liquid metal embrittlement" and cracking of the stainless steel, if exposed to stress at high temperature. Although zinc containing pigments (e.g. zinc phosphate) should not lead to this effect, many prefer to avoid their use.

If oxidatively or physically drying paints are to be used a coat of HEMUCRYL TI-COAT 18200 should be applied at a dry film thickness of 20 µm/0.8 mils.

If two-pack paints are to be used for decorative purposes (polyurethane finishes), a thin coat of an epoxy primer (free of metallic zinc), may be used followed by the thinnest possible topcoat, e.g. HEMPATHANE TOPCOAT 55210/55610, totalling 80-120 µm/3.2-4 mils dry film thickness.