General notes on 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. However, 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 has limited resistance to pitting corrosion by chloride contamination in a marine environment or to road salting. In these environments, a corrosion preventive coating is required – examples are LNG (liquefied natural gas) plants, where stainless steel pipes are used because of resistance to cryogenic temperatures, and process plants working at high temperatures. Otherwise, painting is limited to that of cosmetic requirements, allowing stainless steel constructions to blend in with mild steel constructions - or purely for identification purposes.

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, stainless steel is not resistant to all types of corrosion attack and any crevices in the structure will inevitably lead to crevice corrosion. In most such cases, paint coatings cannot remedy the failure of a stainless steel tank or process equipment.

Stainless steel has 2 special issues: Chloride induced stress corrosion cracking and liquid metal embrittlement. This has some implications for coating specification

Characteristic of stainless steel: chromium oxide (Cr_2O_3) layer, which forms in the presence of oxygen and remains integral with base metal. If the stainless steel grade is correctly chosen, the oxide layer is passive and, in many ways, self-protective, and can usually minimize staining, prevent surface corrosion, and minimize corrosion attack on the base metal.

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

If necessary, 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 in a similar 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, due to the nature of this substrate.

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 these metals and chlorides. Furthermore, abrasives with metallic iron must not be used due to the risk of discolouration when abrasive particles are deposited on the surface.

Suitable abrasives are corundum and ordinary silica sand. Aluminium oxide, garnet, or other nonferrous abrasives shall be use for blasting stainless steel. Aluminium oxide normally produces a very clean surface finish with very little abrasive particle embedment.

Other non-metallic abrasives of the grit type, including various slags, are acceptable, provided they are metal free.

Abrasive sweep blasting - or abrasive blasting, if an anchor pattern is required - is the recommended method of surface preparation, suitable for all subsequent types of paint and essential prior to the application of epoxy and other two-component paints.

Abrasive sweep blasting should leave the surface a uniform matt grey with a dense surface profile and no unswept/blasted areas should be visible at 10x magnification.

Dry abrasive blast cleaning in accordance with NACE No.2/SSPC-SP 10 (Sa2 1/2) or NACE No.1/SSPC-SP 5 (Sa3)

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 "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.

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

Stainless steel does not need to have a thick coating film with low permeability to oxygen and moisture.

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 temperatures such as welding. Although zinc containing pigments (e.g. zinc phosphate) should not lead to this effect, many of the major oil companies prohibit 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.