Architectural Fittings & Components

white metal

Selecting & Caring for Stainless Steel

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Background

Stainless steel can provide an outstanding combination of aesthetic appeal, corrosion resistance, strength, durability and cleanability. It is commonly used for a wide range of indoor and outdoor applications. Although the vast majority of stainless steel applications work perfectly as intended by the designer and fabricator, there are a significant number of instances where someone, often the end-user, is disappointed by the performance of the material. To sum it up, it's all in the name:

REMEMBER IT IS STAINLESS STEEL, NOT STAINFREE STEEL!

Stainless steel depends on its passive layer for its corrosion resistance. This is a very thin chromium oxide layer formed on its surface when chromium is present at 10.5% or above. The underlying metal is not corrosion resistant. The passive layer forms spontaneously on a clean surface but can be damaged by iron contamination, airborne particles and particularly chlorides.

This document focuses on applications where the key issue is ensuring the product retains its initial finish throughout its life, rather than stress corrosion cracking.

Environment

The environment in which the stainless steel is used or installed plays a large part in the long term appearance of the product.

The environment cannot usually be defined precisely and it is also important to bear in mind that environmental change may occur during the design life of a product. I.e. pollution or temperature rise.

Additionally 'micro-climates' can influence the general categorisations and may be worth investigating for the proposed site before a final stainless steel grade selection is made. Microclimates can exist in coastal locations or near chemical plant chimneys, where unexpected acid condensates can form. The same grade of stainless can perform very differently situated very nearby, sometimes even on the same site.

Sub-divisions of the 'site-types' should also be considered.

Low temperatures and low humidity reduce the risks of corrosion and can mean that a steel grade perhaps not thought suitable for a particular site may be worth considering.

Applications can be designed to be washed when it rains, however in certain locations, polluted rain can cause more problems than it solves.

Two particularly corrosive environments are worth expanding on further:

Swimming Pool Environments

Swimming pool environments have changed significantly in recent years, most markedly in leisure pools. Higher water temperatures combined with an increase in the number of bathers, has led to higher levels of chemical disinfection. Chlorine-based disinfectants are the norm, which together with contaminants introduced by bathers, produce chloramines. These are thought to be the most important factor in the corrosion of stainless steel in a swimming pool environment.

The temperature of the air in pool halls is generally held about 1C above water temperature. High air temperatures significantly accelerate corrosion.

Stainless Steel will more likely discolour in a public swimming pool than a private one. This can most likely be attributed to bather's behaviour & what they leave in the water!

Atmospheric moisture in pool buildings comes from evaporation of pool water and the droplets from the turbulent water features that have become increasingly common in leisure pools. Higher levels of humidity can lead to condensation in cooler parts of the building and during the cool of the night. Recirculation of pool air (a common method of reducing energy cost) can increase humidity, as well as adding to the build up of contaminants in the atmosphere.

Consequently the atmosphere of indoor swimming pools is one of the most aggressive to be found in a building environment and the effects on the material are therefore more significant in the atmosphere than in areas where the stainless steel is continually being washed by pool water.

Coastal Environments

Marine sites are defined as areas where windborne sea spray or mist may be present. These contain chlorides which can also concentrate in condensates or as surface moisture evaporates. This is not uncommon to travel 25 miles inland.

So what is the Solution?

The causes of these disappointments by the performance of the material tend to fall into only a few basic categories. In nearly all cases, a little basic knowledge would have prevented or significantly improved the situation.

On the assumption that prevention is better than cure, this short article addresses these issues:

1. Select the right grade

This aspect almost goes without saying. But if the "wrong" grade has been chosen the consequences can be severe.

This table is intended as a guideline only and the specifier should take care and time to ensure the correct grade is selected for the actual site.

CATEGORY LOW

Application - Indoor locations, with little or no chance of the stainless steel getting wet or coming into contact with corrosive substances

SUITABLE GRADE - 304 GRADE

CATEGORY MEDIUM

Application - Outdoor locations, with moderate chlorine & sulphur dioxide levels

SUITABLE GRADE - 316 GRADE

CATEGORY HIGH

Application - Outdoor or indoor aggressive locations including swimming pool environments and coastal locations (less than 25 miles)

SUITABLE GRADE - 316 GRADE MIRROR POLISHED CAN BE USED WITH EXTREME CAUTION, PLEASE ENQUIRE.

2. Select the right surface finish

The lack of knowledge in this area is a major cause of problems. The surface finish on stainless steel has an important effect on its corrosion resistance. Mirror polished stainless steel can withstand corrosive environments to a much higher degree than satin or dull polished surface. In fact a rough surface finish can in effect lower the corrosion

resistance to that of a lower grade of stainless steel. If viewed under a microscope a dull polished finish has many deep grooves where chloride ions can accumulate and destroy the passive film. A dull polished surface also dramatically increases the surface area exposed to attack.

Our technical team are willing to discuss this and help you make the correct choice.

3. Post-fabrication treatments

Welds in stainless steel generally result in some degree of heat tint. Heat tint is essentially an oxidised surface which has a reduced corrosion resistance compared to the parent material. Good fabrication practice always includes post weld treatment. Failure to do so can give rise to unnecessary cost of rectification later on.

Care should be taken when re-graining or re-polishing stainless steel to ensure the medium being used isn't in fact contaminating the stainless steel.

4. Avoid carbon contamination

Often "rusting" of stainless steel turns out to be nothing of the kind. It is the rusting of carbon steel which has contaminated the surface of the stainless steel at some point in the products lifetime. Possible sources of contamination from carbon steel include tools, lifting gear, grinding dust, cutting sparks, wire brushes etc.

Wherever possible, stainless steel and carbon steel should be fabricated in separate areas of the workshop or better still in separate workshops. Where not possible it is important to clean down machines used for carbon steel before using them for stainless steel. Stainless steel surfaces should be protected with plastic coatings for as long as possible.

5. Avoid other contamination

Surface contamination and the formation of deposits on the surface of the stainless steel must be prevented. Industrial and even naturally occurring atmospheric conditions can produce deposits which can be just as corrosive as carbon deposits, e.g. salt deposits from marine conditions.

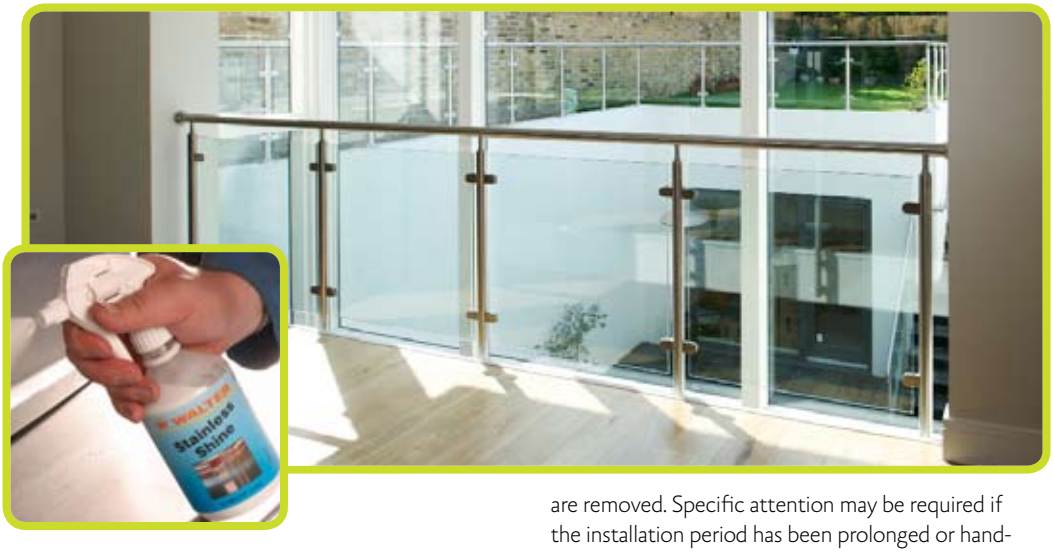
Modern processes use many cleaners, sterilizers and bleaches for hygienic purposes. Proprietary solutions, when used in accordance with the makers' instructions, should be safe, but if used incorrectly (e.g. warm or concentrated), may cause discolouration or corrosion on stainless steels.

Strong acid solutions are sometimes used to clean masonry and tiling of buildings. These acids should never be used where it is possible that they will come into contact with stainless steel.

If this happens, the acid solution must be removed immediately, followed by dilution and rinsing with clean water.

It is not uncommon for carbon steel dust from nearby factories to carry some distance in the wind, settling on installed stainless steel miles away and causing discoloration.

Magnified view of brown corrosion deposit spreading from a very small dot of contamination. The centre spec is smaller than a pinhead, but the discoloration covered a large area of the stainless steel.



Cleaning and Maintenance

This is the key to avoiding disappointment in the performance of stainless steel.

Some end users think that stainless steel's corrosion resistant surface somehow repels dirt and other contaminants.

Dependent on the service conditions, stainless steels will stain and discolour due to surface deposits and so cannot be assumed to be completely maintenance-free (just like any other surface). In order to achieve maximum corrosion resistance and aesthetic appeal, the surface of the stainless steel must be kept clean. Provided the grade of stainless steel and the surface finish are correctly selected, and cleaning schedules are carried out on a regular basis, good performance and long service life will result. The frequency of cleaning is dependent on the application - a simple rule is:

Clean the stainless steel when it is dirty in order to restore its original appearance!

This may vary from once a year to four times a year for normal external applications, but may be as much as daily in highly corrosive environments.

"Hand-Over" Cleaning

White Metal recommends that immediately following installation all products are cleaned thoroughly using proprietary gels, or 10% phosphoric acid solution (followed by ammonia and water rinses), or oxalic acid solution (followed by water rinse) to ensure all possible contaminates are removed. Specific attention may be required if the installation period has been prolonged or hand-over delayed. Immediate cleaning after site fixing goes a long way to avoiding problems later.

On-going maintenance

Stainless steel is easy to clean. Washing with soap or mild detergent and warm water followed by a clear water rinse is usually quite adequate for domestic and architectural products. Where stainless steel has become extremely dirty with signs of surface discolouration (perhaps following periods of neglect, or misuse) alternative methods of cleaning can be used, as outlined on the next page. Additional treatments are available if required; please contact one of our technical team for more information.

Summary

Stainless Steel continues to be the most suitable material for a wide range of applications. With care taken during the specification and design stage, and with regular cleaning and maintenance, stainless steel will continue to retain its initial finish throughout its life.

Our technical team will be happy to discuss your requirements, and work with you to make your project a success!

Contact us
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0845 108 7770

Material for this document has been taken from BSSA & other documents taken from the BSSA website.

REQUIREMENT	SUGGESTED METHOD (NOTE 1, 2)	ADDITIONAL INFORMATION
Routine cleaning of light soiling	Soap, detergent or dilute (1%) ammonia solution in warm clean water. Apply with a clean sponge, soft cloth or soft-fibrebrush then rinse in clean water and dry (Note 6)	Satisfactory on most surfaces
Fingerprints	Detergent and warm water, alternatively, hydrocarbon solvent	Proprietary spray-applied polishes available to clean and minimise remarking
Oil and grease marks	Hydrocarbon solvents (methylated spirit, isopropyl alcohol or acetone) 2	Alkaline formulations are also available with surfactant additions
Stubborn spots, stains and light discolouration. Water marking. Light rust staining	Mild, non-scratching creams and polishes. Apply with soft cloth or soft sponge and rinse off residues with clean water and dry (Notes 6, 7)	Avoid cleaning pastes with abrasive additions 3. Suitable cream cleansers are available with soft calcium carbonate additions or with the addition of citric acid. Do not use chloride solutions 8,9.
Localised rust stains caused by carbon steel contamination	Proprietary gels, or 10% phosphoric acid solution (followed by ammonia and water rinses), or oxalic acid solution (followed by water rinse). (Note 6)	Small areas may be treated with a rubbing block comprising fine abrasive in a hard rubber or plastic filler. Carbon steel wool should not be used, nor should pads that have previously been used on carbon steel. A test should be carried out to ensure that the original surface finish is not damaged.
Burnt on food or carbon deposits	Pre-soak in hot water with detergent or ammonia solution. Remove deposits with nylon brush and fine scouring powder if necessary. Repeat if necessary and finish with 'routine cleaning'.	Abrasive scouring powder can leave scratch marks on polished surfaces.
Adherent hard water scales and mortar / cement splashes	10-15 volume % solution of phosphoric acid. Use warm, neutralise with dilute ammonia solution, rinse with clean water and dry (Note6). Alternatively soak in a 25% vinegar solution and use a nylon brush to remove deposits.	Proprietary formulations available with surfactant additions. Take special care when using hydrochloric acid based mortar removers 8,9.
Heating or heavy discolouration	a) Non-scratching cream or polish (Note 1) b) Nylon-type pad, e.g. 'Scotchbrite' (Notes 3,4,5)	a) Creams are suitable for most finishes. Some slight scratching can be left. b) Use on brushed and polished finishes along the grain.
Badly neglected surfaces with accumulated grime deposits	A fine, abrasive paste as used for car body refinishing, e.g. 'T-cut' rinsed clean to remove all paste material and dried (Note 1).	May brighten dull finishes. To avoid a patchy appearance, the whole surface may need to be treated.
Paint, graffiti	Proprietary alkaline or solvent paint strippers, depending upon paint type. Use soft nylon or bristle brush on patterned surfaces.	Apply as directed by manufacturer.

NOTES

1. The products referenced in this information sheet are understood to be suitable for stainless steels. However, no endorsement of the products or their manufacturers is implied and it is acknowledged that other manufacturing companies may provide products of equal or better quality
2. Cleaning agents should be approved for use under the relevant national environmental regulations and, in addition, prepared and used in accordance with the manufacturers or suppliers' health & safety instructions. Solvents should not be used in enclosed areas.
3. Nylon abrasive pads should be adequate for dealing with most deposits. If a more severe treatment is needed to mask coarse scratches or physical damage on a surface, use the finest abrasive medium consistent with covering the damage marks. With directional brushed and polished finishes, align and blend the new "scratch pattern" with the original finish, checking that the resulting finish is aesthetically acceptable. Silicon carbide media may be used, especially for the final stages of finishing. Avoid using hard objects such as knife blades and certain abrasive/souring agents as it is possible to introduce surface scuffs and scratches.
4. If wire brushes are used, these should be made of a similar or better grade of stainless steel. Ensure that all abrasive media used are free from sources of contamination, especially iron and chlorides.
5. When cleaning a surface with any chemical preparation or abrasive medium, a trial should be done on a small, unobtrusive hidden or non-critical area of the surface, to check that the resulting finish matches with the original.
6. To avoid water marks, use clean rinsing water, such as reasonable quality potable (tap) water. Drying marks may be avoided using an air blower or wiping with clean disposable wipes.
7. Rust marks or staining on stainless steels is unlikely to be the result of corrosion to the stainless steel itself (similar marks may also be found on porcelain and plastic sinks). These marks are likely to result from small particles of carbon steel contamination.