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## Atlas Tech Note No. 5

### Cleaning, Care & Maintenance of Stainless Steels

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The attractive and hygienic surface appearance of stainless steel products cannot be regarded as completely maintenance free. All grades and finishes of stainless steel may in fact stain, discolour or attain an adhering layer of grime in normal service. To achieve maximum corrosion resistance the surface of the stainless steel must be kept clean. Provided the grade, condition and surface finish were correctly selected for the particular service environment, fabrication and installation procedures were correct and that cleaning schedules are carried out regularly, good performance and long life will be achieved. Frequency and cost of cleaning of stainless steel is lower than for many other materials and this will often out-weigh higher acquisition costs.

These principles apply whether the item concerned is a simple kitchen utensil or a large and complex architectural installation.

#### Why Maintenance is Necessary

Surface contamination and the formation of deposits are critical factors which may lead to drastically reduced life. These contaminants may be minute particles of iron or rust from other non-stainless steels used in nearby construction and not subsequently removed. Industrial, commercial and even domestic and naturally occurring atmospheric conditions can result in deposits which can be quite corrosive. An example is salt deposits from marine conditions.

Working environments can also create more aggressive conditions, such as the warm, high humidity atmosphere above indoor swimming pools. This particular environment has in a small number of instances been found to be highly aggressive, and specialist advice should be obtained.

Aggressive operating environments can increase the speed of corrosion and therefore require more frequent maintenance. Modern processes use many cleaners, sterilisers and bleaches for hygienic purposes. These proprietary solutions, if appropriate for use with stainless steel and when used in accordance with their makers' instructions are safe, but if used incorrectly (e.g. warm or concentrated) can cause discolouration and corrosion on the surface of stainless steels.

#### Maintenance During Installation

Cleaning of new fabrications should present no special problems, although more attention may be required if the installation period has been prolonged. Where surface contamination is suspected, immediate attention to cleaning will promote a trouble-free service life. Food handling, pharmaceutical and aerospace applications may require extremely high levels of cleanliness.

Strong acid solutions (e.g. hydrochloric acid or "spirits of salts") are sometimes used to clean masonry and tiling during building construction but they should never be permitted to come into contact with metals, including stainless steel. If this should happen the acid solution must be removed immediately by copious water flushing, but even if promptly removed the appearance of the steel may be unacceptably changed.

#### On-Going Maintenance

Advice is often sought concerning the frequency of cleaning of products made of stainless steel, and the answer is quite simply "clean the metal when it is dirty in order to restore its original appearance". A rule of thumb for many exterior building installations is to clean the stainless steel whenever the nearby glass needs cleaning. This may vary from once, to four times a year for external applications or it may be once a day for an item in hygienic or aggressive situations. In many applications the cleaning frequency is after each use.

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Suggested cleaning intervals are as in this table – these should be modified by experience. Note that natural rain is an effective cleaner – those items that are not washed by rainwater are likely to need more frequent maintenance cleaning.

Environment	Grade 304	Grade 316
Clean inland	3 – 6 months	6 – 12 months
Polluted urban or industrial	Not suitable	6 – 12 months
Coastal / Marine (not splashed)	Not suitable	3 – 6 months

### Good Housekeeping During Manufacture

Stainless steel can be contaminated by pick-up of carbon steel (“free iron”) and this is likely to lead to rapid localised corrosion. The ideal is to have workshops and machinery dedicated to only stainless steel work, but in a workshop also processing other steels avoid pick-up from:

- Tooling used with other metals
- Steel storage racks
- Handling Equipment
- Grinding wheels, wire brushes, finishing belts
- Contamination by grinding or welding sparks from adjacent carbon steel fabrication

### Cleaning Methods

Sections below give **passivation** treatments for removal of free iron and other contamination resulting from handling, fabrication, or exposure to contaminated atmospheres, and **pickling** treatments for removal of high temperature scale from heat treatment or welding operations.

#### Passivation Treatments

- Grades with at least 16% chromium (except free machining grade such as 303):  
*20-50% nitric acid, at room temperature to 40°C for 30-60 minutes.*
- Grades with less than 16% chromium (except free machining grades such as 416):  
*20-50% nitric acid, at room temperature to 40°C for 60 minutes.*
- Free machining grades such as 303, 416 and 430F:  
*20-50% nitric acid + 2-6% sodium dichromate, at room temperature to 50°C for 25-40 minutes.*

#### Pickling Treatments

- All stainless steels (except free machining grades):  
*8-11% sulphuric acid, at 65 to 80°C for 5-45 minutes.*  
**Note** – *Sulphuric acid treatment is only needed as a pre-treatment of significantly scaled items, to loosen the scale for subsequent HF/nitric acid.*
- Grades with at least 16% chromium (except free machining grades):  
*15-25% nitric acid + 1-8% hydrofluoric acid, at 20 to 60°C for 5-30 minutes.*
- Free machining grades and grades with less than 16% chromium such as 303, 410 and 416:  
*10-15% nitric acid + 0.5-1.5% hydrofluoric acid, at 20 to 60°C for 5-30 minutes.*

*"Pickling Paste" is a commercial product of hydrofluoric and nitric acids in a thickener - this is useful for pickling welds and spot contamination, even on vertical and overhanging surfaces.*

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#### Recommendations for Cleaning of Specific Products

Stainless steel is easy to clean compared to many other materials. Washing with soap or a mild detergent and warm water followed by a clean water rinse is usually quite adequate for domestic and architectural equipment. An enhanced appearance will be achieved if the cleaned surface is finally wiped dry. Specific methods of cleaning are as in the table. These are recommendations only; there are uncertainties in all cleaning operations. All such treatments must be evaluated by the user; a trial clean of an inconspicuous location is strongly recommended to prove both effectiveness and acceptability of appearance.

Problem	Cleaning Agent	Comments
Routine cleaning. All finishes	Soap or mild detergent and water. (preferably warm)	Sponge, rinse with clean water, wipe dry if necessary. Follow polish lines.
Fingerprints. All finishes	Soap and warm water or organic solvent (e.g. acetone, alcohol, methylated spirits)	Rinse with clean water and wipe dry. Follow polish lines.
Stubborn stains and discolouration. All finishes.	Mild cleaning solutions. Ensure any proprietary cleaners state compatibility with stainless steel. Phosphoric acid cleaners may also be effective.	Use rag, sponge or fibre brush (soft nylon or natural bristle. An old toothbrush can be useful). Rinse well with clean water and wipe dry. Follow polish lines.
Lime deposits from hard water.	Solution of one- part vinegar to three parts water.	Soak in solution then brush to loosen. Rinse well with clean water.
Oil or grease marks. All finishes.	Organic solvents (e.g. acetone, alcohol, methylated spirits, proprietary "safety solvents"). Baked-on grease can be softened beforehand with ammonia.	Clean after with soap and water, rinse with clean water and dry. Follow polish lines.
Rust and other corrosion products. Embedded or adhering "free iron".	Very light rust stains can be removed by 10% nitric acid. More significant rust or embedded iron will require pickling. See also previous sections on Passivating and Pickling. Sand or glass-bead blasting is another option.	Wear PPE as appropriate. Afterwards rinse well with clean water. Mix in acid-proof container, and be very careful with the acid. (see Precautions for acid cleaners)
Routine cleaning of boat fittings.	Frequent washing down with fresh water.	Recommended after each time the boat is used in salt water.
Cooking pot boiled dry.	Remove burnt food by soaking in hot water with detergent, baking soda or ammonia.	Afterwards clean and polish, with a mild abrasive if necessary. See comments re steel wool.

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Problem	Cleaning Agent	Comments
Dark oxide from welding or heat treatment.	“Pickling Paste” or pickling solutions given on previous page.	Must be carefully rinsed, and use care in handling (see Precautions for acid cleaners).
Scratches on polished (satin or brushed) finish.	Slight scratches – use impregnated nylon pads. Polish with polishing wheel dressed with iron-free abrasives for deeper scratches. Follow polish lines. Then clean with soap or detergent as for routine cleaning.	Do not use ordinary steel wool - iron particles can become embedded in stainless steel and cause further surface problems. Stainless steel and “Scotchbrite” scouring pads are satisfactory.

### Precautions

**Acids** should only be handled using personal protective equipment as detailed in relevant Safety Data Sheet (SDS) and other product-specific information. Care must be taken that acids are not spilt over adjacent areas. All residues must be flushed to a treated waste stream (refer to local water authorities for regulations and assistance). Always dilute by adding acid to water, not water to acid. Use acid-resistant containers, such as glass or plastics. If no dulling of the surface can be tolerated a trial treatment should be carried out; especially for pickling operations. All treatments must be followed by thorough rinsing.

**Solvents** should not be used in confined spaces. Smoking must be avoided when using solvents.

**Chlorides** are present in many cleaning agents. This entails risk of pitting corrosion of stainless steel. If a cleaner containing chlorine, chlorides, bleaches or hypochlorite’s is used it must afterwards be promptly and thoroughly cleaned off.

### References for Further Reading

- ASTM A380, “Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems”, American Society for Testing and Materials.
- ASTM A967, “Chemical passivation treatments for stainless steel parts” American Society for Testing and Materials.
- “Successful use of Stainless Steel Building Materials”, Japan Stainless Steel Association (Nickel Institute publication 12 013).
- “Cleaning of Stainless Steels”, Outokumpu Information 17800GB.
- ASSDA Technical Bulletin 2, “Preventing coastal corrosion (tea staining)”, Australian Stainless Steel Development Association.

#### **Limitation of Liability**

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