



# ENGINEERING BULLETIN

No. EB 40

Product: Cooling Towers, Closed Circuit Coolers and Evaporative Condensers Date: 7/03

## Maintaining and Cleaning Stainless Steel

EVAPCO has promoted the use of Type 304 and Type 316 stainless steel as a material upgrade for many years and is the leading supplier of stainless steel in the evaporative cooling industry. Stainless steel is the *most cost effective material* of construction available to extend the life of a cooling tower, closed circuit cooler or evaporative condenser.



By definition, stainless steel is a group of iron-based alloys which contain a minimum of 10.5% chromium.<sup>1</sup> The stainless steel sheet material utilized by EVAPCO is Type 304 and Type 316 with a No. 2B unpolished finish. Type 304 stainless steel is a basic chromium-nickel austenitic stainless steel and is suitable for a wide range of applications. It is readily available throughout the world and easy to form during the fabrication process. Type 316 stainless steel offers more corrosion resistance than Type 304 due to the addition of molybdenum and a higher nickel content, which provides greater resistance to pitting and crevice corrosion in the presence of chlorides. As a result, Type 316 stainless steel is desirable in heavy industrial and marine environments.

Stainless steel provides its superior corrosion resistance by developing a surface film of chromium oxide during the manufacturing process. In order to ensure maximum corrosion protection, stainless steel must be kept clean and have an adequate supply of oxygen to combine with the chromium in the stainless steel to form “chromium-oxide”, a protective passivation layer. The protective layer of chromium-oxide develops during routine exposure to the oxygen content in the atmosphere. This occurs during the milling process and continuously as the stainless is formed and shaped into its final use.

It is a common misconception that stainless steel is stain and rust proof making surface maintenance minimal or not required at all. This is simply not true! Like mill galvanized steel, stainless steel is most effective when kept clean. This is especially true when located in atmospheres with chloride salts, sulfides or other rusting metals. In these environments, stainless steel can discolor, rust or corrode.

The following sections of this engineering bulletin address the proper care and maintenance of stainless steel to help keep a shiny and brand new appearance, while extending the life of your evaporative cooling equipment. ***This bulletin will also address how to restore your stainless steel unit if rust or other discoloration develops.***

### **Preventing Iron Contamination During the Manufacturing Process<sup>2</sup>**

EVAPCO follows tight control procedures for protecting stainless steel sheet when it arrives from our suppliers. The Type 304 and Type 316 stainless steel are protected by a layer of plastic (different colors for 304 or 316 stainless), that remains attached throughout the manufacturing process. Stainless steel is separated from black/galvanized steel in the shop, anti-spatter spray is used on sheet-metal to be welded, welds are cleaned using stainless steel brushes or pickling compounds and machining is performed using stainless steel tooling.

### **Steps to Follow to Maintain your Stainless Steel Finish**

Once the unit arrives in the field, the most effective way of maintaining your stainless steel finish is to keep it clean! At a minimum, the unit should be washed down annually to reduce any residual dirt or surface deposits on the stainless steel. In addition, this wash down will keep the stainless steel components free from the corrosive elements in the atmosphere including chlorides and sulfides which are damaging to stainless steel.

Follow these steps to keep your stainless steel STAIN-less!

#### **Step 1) Routine Maintenance-Mild Cleaning**

**Simple pressure washing (sheet metal only), using household cleaners, detergents or ammonia annually (more frequently in marine or industrial environments) will help maintain the finish and keep it free of atmospheric contaminants.**

#### **Step 2) Minor Surface Dirt-Mildly Aggressive Cleaning**

##### **Typical Procedure for removing dirt or other contaminants:**

- a) Sponge or Bristle Brush with cleaner (Non-abrasive cleaners, household soaps or 1% ammonia solution, Soft Scrub)
- b) For more aggressive cleaning add vinegar to the cleaner.
- c) Rinse with WARM water from a hose or pressure washer
- d) Towel dry
- e) Finish cleaned area with a good car wax (Mother's) to provide extra protection.

**NOTE: THE WATER MUST BE WARM IN ORDER TO BE MOST EFFECTIVE!**

### Step 3) More Aggressive Cleaning-Removal of Fingerprints and Grease

- a) Repeat Step 1-2 then use a hydro-carbon solvent like Acetone or alcohol.\*
- b) Other cleaner options include:

- Household glass cleaner
- Mother's Wire Wheel Mist Cleaner
- Spic n' Span
- 3M stainless steel cleaner and polish, Arcal 20, Lac-O-Nu or Stainless Shine.<sup>1</sup>

### Step 4) Aggressive Cleaning-Removing Stains or Light Rust

If iron contamination or surface staining is suspected (see photographs below), the following steps should be taken to remove it and to restore the stainless to its original finish.



**Unit located next to an airport  
(Atmospheric Corrosion)**



**Unit located at a textile plant  
(Weld Spatter)**

Immediately remove the stain or rust by using a chrome, brass, silver cleaner or Mother's Wire Wheel Mist Cleaner. The use of mild non-scratching creams and polishes are also recommended.

Recommended non-scratching cleaners are:

- Jif, Shiny Sinks, 3M Stainless Steel Cleaner, Twinkle, Liquid Nu Steel, Cameo Copper Cleaner, Zud.<sup>1</sup>

If a more aggressive program is required see Step 5. Again, when the cleaning procedure is finished in this area, use a good car wax for added protection.

## **Step 5) Most Aggressive Cleaning-Removing Heavy Rust Deposits, Iron Contamination, Spot Weld Discoloration and Weld Spatter using Acids\*\***

1) First try Steps 1 thru 4. If the stains or rust are not removed, the following procedures should be followed *as a last resort*.

- a) Rinse the surface to be cleaned with ample hot water.
- b) Use a saturated solution of oxalic or phosphoric acid(10-15% acid solution) (applied with a soft cloth and allowed to stand for a few minutes (no rubbing or abrading). This acid should etch out the iron particles.<sup>3,4</sup>
- c) Follow by an ammonia and water rinse.
- d) Rinse the surface again with hot water.
- e) Finish with Mother's Wax or other good car wax in the area cleaned.

2) If **procedures 1a) to 1e)** do not produce the results you expect, a more aggressive acid treatment may be required.

A combination of hydrofluoric and nitric acid is commonly used to clean welds, and should be used according to the suppliers directions. EVAPCO uses a product called Pickling Compound produced by Bohler Thyssen USA for our welding preparation. It is comprised of 7% or less of Hydrofluoric acid and 20% or less of Nitric acid.<sup>2</sup>

**\* As with any hydro-carbon solvent, caution must be taken when using this product. Do not use in confined spaces or while smoking. Keep solvents out of contact with hands and skin.**

**\*\*Use extreme caution when working with acids! Synthetic rubber gloves should be used, goggles and aprons are advisable.**

As a minimum, these guidelines should be followed to maintain and clean your stainless steel. Please consult the referenced publications for more information.

When cleaning stainless steel:

- 1) **NEVER** use coarse abrasives or steel wool.
- 2) **NEVER** clean with mineral acids(especially hydrochloric acid or bleaches) bleaches contain sodium hypochlorite which will stain and pit the stainless.
- 3) **NEVER** leave stainless in contact with iron or carbon steel.

### References

1 The Care and Cleaning of Stainless Steel-Specialty Steel Industry of North America

[www.ssina.com](http://www.ssina.com) 1-800-982-0355.

2 EVAPCO Manufacturing Procedure #123 dated 11/30/01-Stainless steel cleaning and handling

3 Iron Contamination and Rust Staining on Stainless Steel- British Stainless Steel Association, [www.bssa.org.uk](http://www.bssa.org.uk).

4 ASTM A 380-99 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.