## 1. Basic information

Stainless steel contains more than 50 % pure iron and unprotected corrodes in water and oxygen to rust. Fe, Ni, Mo, Cr alloys create an oxide layer (called passivation layer), on all surfaces protecting the stainless steel surfaces from corrosion. An analogue surface protection happens with aluminium-magnesium alloys.

## 2. Reasons for corrosion

- If this passivation layer is damaged by mechanical force or chemical treatment, corrosion occurs also on surfaces of stainless steel. The composition of stainless steels differs very much, so that the risk of corrosion depends also on the quality of stainless steel.

- If acidic RO-water (see below) is used for steam generation, rust is created in iron steam pipes, which enters as flash rust into steam sterilizers and settles on instruments. At first the flash rust is only on the surface. If not removed, around the rust particle additional corrosion occurs by chemical influences.

- Using flash rust filters in steam pipes is not suitable, because the reason for corrosion is not eliminated but only the symptom rust is retained. In addition there is the problem that the steam transfers the acidic components on the instruments by water/steam distillation and therefore also in the steam sterilization process a dissolution of the of the passivation layer may occur on instruments.

- Aluminum-magnesium alloys create with air a natural oxidation layer (passivation layer) protecting the metals from corrosion in water. Those passivation layers are easily dissolved by weak acids or bases and the surface is corroding creating white powders. Therefore the use of detergents of a pH > 9 or < 5 is not recommended for those alloys to prevent corrosion.

## 3. Reasons for the dissolution of stainless steel passivation layers

- During water softening treatment sodium chloride is used to regenerate the used cation-exchanger to exchange $Ca^{2+}$ + $Mg^{2+}$ against $Na^{+}$. If the cartridges are not flushed correctly, sodium chloride solution enters the WD chambers and the chloride anions inside dissolve the passivation layer on all stainless steel surfaces.

- The desalination is often done with Reversed Osmosis (RO). The membranes hold back all dissolved salts, however air and $CO_2$ dissolved in water pass through the membrane and reacts with water to carbonic acid, which reduces the pH to 5,5 – 6,5 because of the low buffer capacity of the demineralized water. The low pH in the water is also able to dissolve passivation layers.

Therefore it is recommended to remove the carbonic acid after the RO-treatment by a mixed-bed ion-exchanger to neutralize the feeding water preventing corrosion in pipes and on instrument surfaces.

- If alkaline detergents are used, at the end of the cleaning process a neutralization process with acid is necessary. Too strong acids can dissolve the passivation layer and cause corrosion.

  If the passivation layers are dissolved, they can be recovered using oxidizing passivation solutions.