Troubleshooting, otherwise referred to by some of us as fire fighting, hoping to lead to fire prevention in the care and handling of surgical instrumentation. The most common problems with instruments are discoloration, pitting, staining, spotting or actual rusting. In the event of chrome instrumentation it is literally the cracking, fissures, and popping off of segments of the chrome finish. In any of the above instances it leads to a short life of surgical instrumentation. It is necessary to endeavor to find the cause and the cure for the problem. What we at Pilling hope to do in this chapter is to help you identify some of the problems its cause and solution for the problem.

**Light Colored Spotting**

*Cause:* Spotting literally can come from water droplets, residuals of mineral deposits within the water (sodium, calcium, magnesium) drying onto the surface of the instrument.

*Solution:* If it is happening after the washer-sterilizer, it could be the final rinse cycle needs adjusting. Follow the autoclave manufacturer’s instructions if it happens after a sterilization cycle, it may need filtration on the stream line, and you do not see it after the washer-sterilizer cycle. If it is hand washing, one needs to look at making the final rinse in distilled water or reverse osmosis if that is not already being done.

**Dark Colored Spotting**

*Cause:* Again, could be from the water, or the cleaning, disinfecting, rinsing process. Not having the correct measurement of solutions could also be a cause.

*Solution:* Prepare all solutions for cleaning, rinsing and disinfecting correctly using distilled or demineralized water as the final rinse, free of chloride with a pH value as close to 7.0 as possible.

**Rust Colored Film**

*Cause:* Water softeners, dust or a dust-like film under certain conditions, if there has been hospital construction where debris from piping has been left on the inside of the steam pipes during installation of new lines, tampering with the lines can virtually leave a residual. This should be alleviated after a while. If the area in the country the facility is located in has a tendency to have a high iron compound within the water, the iron is likely to be deposited on the instrumentation.

*Solution:* Filtration of the water or steam lines coming into the mechanical washers or sterilizers. Contacting the hospital engineering staff and your water supply district to identify the exact reasoning for the discoloration, whether it is water softeners, debris or iron and getting it out of your water supply or at least the sinks and areas where instruments are processed.

**Brownish Stain**

*Cause:* Brownish stain or a dull blue-brown cast to the instrument frequently is some type of chromic oxide film that can be caused by some type of copper deposits or from detergents or cleaning agents high in poly-phosphates which cause a copper solubilizing action in the parts of the sterilizer or cleaning equipment.

*Solution:* This can be eliminated by experiment with another compound that does not contain a poly-phosphate, measure the quantities more accurately and fill with cold water if you have copper water pipes. Oxidation tints may be removed by rubbing and thoroughly cleaning or placing the instrument in an acid type cleaning agent for a short period of time and thoroughly rinsing.
SURGICAL INSTRUMENT TROUBLESHOOTING

Blue-Gray Stain

*Cause:* Many times come from cold sterilizing agents.

*Solution:* Changing the solution frequently so as not to have any evaporation change in concentration, making sure that it contains a rust inhibitor to minimize the discoloration of the instrument and definitely making sure the instrument is even allowed by manufacturers recommendation to be cold sterilized. Many metals are not able to withstand cold sterilizing agents. Make sure when using cold sterilizing agents, distilled water is used in the final rinse or sterile water if going straight to a patient. This should also help, if the instrument is being put into storage to eliminate discoloration as we neutralize the pH of the metal surface.

Yellow-Brown Discoloration

*Cause:* This may be protein residuals, improperly cleaned surface, proteins left on the surface for a long period of time and then not thoroughly cleaned.

*Solution:* Proper cleaning, using a good detergent and considerable rubbing but not done with an abrasive or anything that will scratch the surface of the instrument.

Purple-Brown (Iridescent) Discoloration

*Cause:* Exposure to ammonia. Amine crystals within the steam line. Instrument detergents that contain ammonia in the compound makeup can be the problem. Saline solutions, blood plasma, potassium chloride and a number of other compounds can be a cause. Detergents with a high pH can cause discoloration.

*Solution:* Use distilled and demineralized water in the final rinse. Check the amine exposure in the steam coming into the sterilizer, filtration may be a solution. Changing the type of detergent from an ammonia base to one of a non-ionic detergent may be a solution depending on the manufacturer’s recommendations. Maintain a detergent with a neutral pH. Separate metal in the cleaning and operation of any ultrasonic, washer-sterilizer, or washer-decontaminator so that electrolysis does not take place and avoid detergents with a chloride base.

Pitting

*Cause:* Pitting can be caused by the instrument being exposed to high saline solutions, chlorides, iodides, tincture of iodides, improper or impure disinfectants in cleaning agents solution can also cause pitting, which is actually removing, of part of the passivation surface which eventually will lead to rust, none of which of the above instruments can be used again in a surgical procedure without refinishing and in some instances replacement.

*Solution:* Being conscious of what instruments are being exposed to an minimizing the duration of that exposure as much as possible. For example, in the Operating Room, just as a surgical scrub wipes down the instrument prior to handing it back to the surgeon making sure the instruments are minimally exposed to sodium chloride for irrigation, exposed to body secretions that again contain sodiums and chlorides in order to minimize any kind of pitting or corrosion to the instrument over a long period of time.
Corrosion
There are many different types of corrosion. Corrosion can start in an instrument when the natural protective passivation surface or coating of the stainless steel instrument is destroyed by some means, usually chemically, elemental exposure or some type of contact exposure. We are going to identify each one of the types of corrosion; be it surface corrosion, stress, abrasive corrosion, or mishandling to help you in identifying the means in which to eliminate any further problem with your facility’s instrumentation.

Each one of the types of corrosions will be identified and some of the ways they can be minimized:

Stress Corrosion
An instrument whose passivation layer has been destroyed by the influence of strong acids or caustics or the influence of a heavy metal. Anodized aluminum instruments in trays are particularly susceptible to this type of process.

Cause: Both highly acid and highly alkaline solutions or those containing caustics are those causing the surface corrosions that you see on anodized aluminum sets or instruments. It also can be caused in the manufacturing process but can also be a result of poor handling of the instrumentation.

Solution: To avoid the damage, it is imperative that the properties of the steam are analyzed so they do not contain high quantities of chloride ion as in small quantities in the water can cause the formation of stress corrosion and cracks as shown in the box-locks and ratchets. Note: The appearance of the stress corrosion crack may be mistaken for a forced stress crack due to the over-stressing of the instrument, however the history would have to be known that there was not misuse of the instrument.

Crevice Corrosion
Crevice corrosion looks like rust blisters in small crevices of the instrument or where parts are joined together. It is usually localized and most times will be identified when sent back to the manufacturer for analysis.

Abrasive Corrosion
Abrasive corrosion is a friction type of corrosion caused by improper cleaning. It occurs in places such as box-lock, where either insufficient cleaning or lack of lubrication on instrumentation that do need lubrication in the joints. Very fine metal roughness causes abrasive rubbing of metal, damaging the passivation of the instrument and again causing a corrosion.

Prep Blades
Prep blades will rust if left in a moist environment. The blades are made of carbon steel not out of stainless. This is due to carbon steel will keep sharpness for a longer period of time. If you need to sterilize and leave for long period of time. They can be ETO sterilized. Do not sterilize with the blade inside handle, the blade will rust and will be unable to remove from handle.