



Troubleshooting Surgical Instrument Staining

Technical Bulletin 1-013 Boiler Systems

General Complaint Scenario

Surgical instruments are stained or dirty to the point doctors reject the surgical pack. Central Supply passes the complaint on to Engineering. The Sterilizer Representative is called and reports the equipment is working properly. Engineering suspects the problem might be related to the boiler, so the Water Treatment Representative is called to help solve the problem. The actual chain of events may vary, but the end result is the same: cause(s) of the staining must be found and corrected before improvement is realized.

Important Things to Remember

1. Stainless steel instruments look dirty due to surface corrosion and/or failure to clean instruments during preparation for sterilizing.
2. Corrosion of stainless instruments requires moisture, corrosive agent, and temperature.
3. Wrapped instruments cannot be stained by rust or boiler water from the steam line without first staining the outside of the wrapping.

Suggested Troubleshooting Procedure

1. Look at dirty instruments with a magnifying glass (10x power is good).
 - If spotted, does spot rub off easily and leave bright metal surface? If yes, then it's a water spot.
 - Does spot have rusty color?
 - Does spotted surface look etched? If yes, then most it's likely surface corrosion.
 - Look into hard to clean areas, such as fulcrum of scissors and hemostats, serrated teeth, etc. Is there an obvious accumulation of deposit material? If yes, then it may be dried blood or tissue. In some cases, repeated corrosion has occurred with buildup of corrosion products.
2. Get a detailed history of the problem: frequency of occurrence, when first noted, are all autoclaves affected?, does problem occur with flash sterilizers?, etc. Discuss the problem with all departments concerned.
3. Obtain a surgical pack known or suspected to have dirty instruments. THIS IS IMPORTANT. Examine outside of pack and then examine wraps in contact with instruments.
 - Is outside of pack stained? Disregard stains caused by heat sensitive tapes used.
 - Does instrument wrap show staining on side in contact with instruments? Can you see a stained outline of an instrument on the wrap? If yes, then corrosion of instrument surfaces is indicated.
 - Save this wrap for additional testing.
4. Ask to have the operator/nurses go through all instrument and autoclave preparation and cleaning procedures.
 - Note each type of material used and each step. Look at product labels and Safety Data Sheets (SDS), especially for ingredients containing chlorides (quaternary ammonium compounds, saline solutions, hydrochloric acid-based cleaners).
 - Pay particular attention to final processing before instruments are ready for wrapping. Are they given final rinse in DI Water? Is a "milk" rinse (lubricant) the final step?
 - Listen carefully to comments from all parties.

If Rust or Surface Corrosion is Suspected

Perform the following test on the wrap used with the dirty instruments

1. Place in a beaker or clean container and add 200-300 mL distilled water (enough to cover wrap when compressed).
2. Put beaker on hot plate and boil water for 10 minutes, moving wrap with a pair of hemostats or tongs to leach out soluble salts.
3. Remove wrap carefully, allowing water to drain back into beaker. Squeeze the wrap between two instruments to get as much as practical.
4. Boil water in beaker down to 25-50 mL.
5. Allow to cool and then check the pH and chloride level of concentrate.
6. If pH is low (below 5.0) and chlorides are high, suspect a corrosive agent is a major source of the problem. Chlorides and fluorides are corrosive to stainless steel, especially if an acidic condition exists.
7. If cloth wraps are used, the source of acid and halide (chloride, fluoride, bromide, iodide) is probably too much sour in laundry final rinse. Sour is usually sodium fluoride and is acidic. It is used to neutralize soap and prevent the staining of linen.



8. If paper wraps are used, the halide content is likely from a quaternary ammonium compound impregnated in paper.

Excessive sour residual is a laundering problem. Investigate the laundering procedure for surgical linen.

1. Has there been any change in equipment or personnel that could coincide with instrument problems?
2. Any change in sour material?
3. Is sour in final rinse? Do they check sour residual on cloth before drying? They may have a pH indicator that they drop on white cloth.

The presence of a corrosive agent is only half the problem of corroded instruments. There must be moisture present for the corrosive agent to work. Moisture can only come from steam.

1. Examine the autoclave for adequate trapping of the steam line at the autoclave.
2. Have the autoclave turned on after being idle for some time and observe sterilizing chamber for in-rush of water initially. If yes, then the condensate is collecting in the jacket or steam line.
3. Make certain the vacuum system is working during drying cycle. This is used to prevent moisture accumulation or retention in the pack after sterilizing time has been completed. Does the pack feel damp or wet when removed from autoclave? If yes, then drying is not adequate.

If Improper Cleaning is Suspected

Check the cleaners used for both instruments and autoclaves. If autoclaves are cleaned with agents containing chlorides, residual chlorides can cause a corrosive environment inside the autoclave when steam is injected.

Improper cleaning of instruments during preparation falls into two main categories: (1) failure to remove all materials from the instrument that contacted it during surgical use and handling and (2) failure to remove stain or corrosion products formed during previous sterilization under corrosive conditions.

1. Use of magnification makes residual deposits, such as tissue, blood, fibers, and general accumulated debris, stand out dramatically. It looks quite different from surface corrosion products, pitting, etching, etc. Remember to examine hard-to-clean areas.
2. Failure to clean previous corrosion leads to the belief that instrument staining is continuous, although it may not be. A few dirty instruments in a pack make the whole pack suspicious in the operating room. Cleaning of such stains or surface deposits is not easily done. It generally requires an abrasive and elbow grease.

Testing To Help Pinpoint the Cause

The following test helps eliminate factors that can cause corrosion under actual autoclaving conditions.

1. Take four cloth wraps as received from laundry.
 - Put two aside just as received.
 - Rinse the other two wraps in tap water, followed by a distilled water rinse. Dry these rinsed wraps.
2. Take four new instruments or instruments that show no spotting/staining. Instruments should be the same kind.
 - Run all four through normal preparation procedures.
 - Rinse two of the prepared instruments thoroughly in distilled water and then dry them.
3. Make the following combinations of wraps and instruments, taking care to mark each
 - Wrap one normally prepared instrument in a wrapper as received from laundry.
 - Wrap one normally prepared instrument in wrapper rinsed in distilled water.
 - Wrap one distilled water rinsed instrument in a wrapper as received from laundry.
 - Wrap one distilled water rinsed instrument in a wrapper rinsed in distilled water.
4. Have all four wraps autoclaved exactly as they do instruments for surgery. Run all cycles at their normal times, including the drying cycle.
5. Carefully examine each instrument with a magnifying glass, looking for evidence of spotting and surface corrosion.
 - If all instruments are water spotted, excessive moisture is indicated.
 - If stain spots appear on combinations one and three, laundry wrap is indicated to be the problem.
 - If stain spots appear on combinations one and two, preparation is suspect.
 - Combination four is a control and should only show water spotting if excess moisture is present or will show no effect on the instrument.

The above discussion of surgical instrument staining should give a basis to investigate the problem. The majority of cases we have examined have been a combination of moisture and corrosive halides. Carryover or iron oxides from steam line can coat the surface of the autoclave itself and complicate autoclave operation (wet steam from carryover), but cannot selectively affect the wrapped instruments only. Also, carryover will make the wrapper alkaline, not acid.