

# Dross and the Selective Soldering Process

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In the selective soldering process, dross can be detrimental. Dross (and I use this term to encompass all surface contamination) is created in conjunction with the presence of Oxygen in two different areas of the process, and by separate means. Each must be dealt with differently in order to prevent problems.

area. It then gets into the pumped solder as it is being delivered up into the nozzle. So it tends to collect, and therefore can contribute to the clogging of nozzles, especially small nozzles. The smaller the nozzle, the more susceptible it is to clogging with this material. Moreover, that black particulate matter, present in the solder flow, can also deposit itself onto the circuit board, even into the solder fillet itself. This is a concern not only in selective soldering, but also in wave soldering, where it is in both instances a product of the pumping process.

Conventional dross, as most people know it, is created when the solder basically tumbles back into the solder pot from the nozzle. As the solder flows back into the pot, down the drop area from the nozzle tip, it mixes with the atmosphere and oxidizes to create a chowder-like substance known as dross. This dross is usually a combination of oxidized solder alloy and spent flux. In lead-based alloys, this dross typically floats on top of the solder in the tank and doesn't cause any particular problems. The high density of the lead-based alloy (e.g., Sn63) ensures that it remains on top and won't be drawn down and into the pump, clogging the nozzle, or co-mingling with fresh solder being deposited onto the circuit board.

There is a second type of dross that is created by the spindle of the impeller pump driveshaft as it rotates in molten solder. This is actually the product of the metal to metal contact (even though the solder is liquidous), the product of essentially a burnishing operation, a rubbing and scrubbing of the metals. The rotating shaft creates an interaction with the molten solder and generates a residue which is typically a tin/lead oxide or a tin oxide, and it evidences itself in the form of a fine black powder that floats on top of the solder and around the drive shaft.

This black powder-like material can be detrimental to either lead or lead-free soldering because it can be drawn into the pump. As the spindle of the impeller rotates, depending on the volume of this black residue, the rotation can set up a vortex, or whirlpool, during which time the material can be sucked down into the impeller

To mitigate both of these issues, ACE has completely enclosed the solder pot and pumping assembly and fill the area above the solder and below the cover with superheated nitrogen. The nitrogen is only allowed to escape from the area surrounding the nozzle. What we

have done basically is inerted the entire solder delivery process, and the return area of the solder to the solder pot. By means of this, the formation of conventional dross is nearly prevented. Additionally, the black powder dross is totally mitigated both with the nitrogen and with the use of protective graphite sleeves around the pump shaft that act as a barrier, protecting the rotational effects of the pump impeller from interacting with molten solder.



*Dross can clog small nozzles if it gets into the solder flow..*

When using lead-free alloys, dross can be a little more problematic, due in part to the lower density of the lead-free alloy. For instance, a wrench will float on top of a solder pot full of Sn63, but it will quickly sink to the bottom of a pot of lead-free alloy.

Contamination that typically floats on top of a solder pot filled with lead-based alloy, and is therefore easy to remove, may not float on top of a pot of lead-free alloy, and can drop to the bottom and co-mingle with the pumped solder. Therefore, it is imperative that one spend more time on a daily basis ensuring that the surface of the solder is kept clean, and periodically pull the pump assembly and clean out the bottom of the solder pot, and do this with a frequency that is at least 4x as frequent as one would with a pot of Sn63.

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It's easy to test the effectiveness of this nitrogen-inerting approach. We perform a fairly simple empirical test to confirm nitrogen purity and performance and its effects on the wave. We simply tin the nozzle, set the appropriate level of N2 purity and flow and run the flowing solder at full production readiness for a fifteen-minute interval, during which time we observe the operation closely. We're not soldering a board at this time, but actually running in free air, with the nitrogen surrounding the nozzle. If no discoloration of the flowing solder is observed, we know that the volume and the purity setting of the nitrogen is sufficient to protect that nozzle and also mitigate the dross.



Typically, at the end of an 8-hour shift, one may expect to find about a tablespoon of residue floating on top of the solder pot. It's largely spent flux mixed with a little dross, and that's normal and also usually easy to remove. Dross in the bottom of the pot, particularly when using lead-free solders, can only be removed by periodic emptying of the pot. This interval can be determined by the user. In the beginning, more often is better; if, upon inspection of the emptied pot, it can be prudently determined that the frequency is too great (little or no residue), then that PM interval can be increased providing of course that throughput volume remains mostly static.

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Planned periodic emptying and cleaning of the solder pot and use of nitrogen will help reduce dross formation of both types, and minimize the potential for problems. With proper care and maintenance, along with experience and acquired know-how, the selective soldering process engineer can be extremely successful in mitigating dross, either in tin/lead or lead/free alloys, and ensuring optimum quality in the soldering process.