



American Hakko Products, Inc.

Hakko and Pb free soldering tips

Starting in May of 2004 all soldering tips and desoldering nozzles manufactured by Hakko Corporation were tinned with a lead-free (Pb-free) coating. This change was implemented to enable our customers to meet the growing demand for Pb-free processes. The Pb-free coating is 100% tin (Sn).

Customers that continue to use Pb based solders may use these tips with little to no change in the process. However, be sure to immediately re-tin these tips with your Sn/Pb solder as soon as they reach soldering temperatures. The Sn coating will oxidize faster than typical Sn/Pb coatings. By flooding the tip with solder the operator will prevent oxides from forming on the tinned tip surface. Heavy oxidation will affect the heat transfer ability of the tip by preventing solder from wetting to the tip. By tinning new tips with Sn/Pb solder four to five times, wiping the tip on a damp sponge or 599 tip cleaner between solder applications, the tip will perform the same as tips tinned with Sn/Pb solder. Operators must be sure to feed solder over the entire tinned surface of the tip.

Customers using Pb-free solders will need to pay particular attention to tip maintenance. The spread characteristics (wetting) of lead-free solders are very poor in comparison with Sn/Pb solders. Pb-free solders wet slower than Sn/Pb solders. Poor spreading is characteristic of all Pb-free solders as the absence of lead reduces the flowability of the solder. This poor spreading occurs not only with respect to boards and components but also with respect to the soldering iron tip. The melting point of lead-free solders is 20°C to 45°C (35°F – 70°F) higher than that of conventional Sn/Pb solders. In many applications this may mean an increase in the soldering tip temperature. Raising the tip temperature should always be done cautiously. Tips wear out rapidly at high temperatures and the flux is activated faster than the solder can wet. For more information on Pb-free soldering, please refer to the Hakko web site at www.hakkousa.com and click the "Lead Free" button on the sidebar tower.

Solder tips are made of copper (Cu) due to its superior thermal conductivity. Since Cu will quickly go into dissolution with Sn (forming Cu/Sn intermetallic) and it will oxidize/corrode when exposed to high temperatures, its surface is covered with iron (Fe) plating to extend the life of the tip. Fe will form intermetallics with Sn but at a slower rate than Cu/Sn. The rate of intermetallic formation becomes faster at higher tip temperatures and this tendency is particularly marked at temperatures above 400°C (750°F).

Tips soldered with Pb-free solder have higher susceptibility to non-wetting caused by oxidation (see figure 1). The tip surface will appear black or dark blue and solder will not wet to the surface.



Figure 1

A tip blackened in this manner has lost its wettability and cannot supply heat to the part being soldered. Solder held on the tip serves as a heat transfer medium and supplies heat to the part being soldered. If the tip does not have good wettability, it will only contact the part over a tiny area and will not be able to transfer heat efficiently.

The wetting problems are caused by:

- Carbonized flux and other residues attach onto the plating of the tip.
- The plating of the tip is then exposed to air (oxygen) and undergoes high temperature oxidation.
- The tin in the solder undergoes high temperature oxidation.
- Intermetallic formation between tin and iron begins to consume the tin coating on the tip.
- Alloy of tin and iron undergoes high temperature oxidation.

Sometimes these processes take place individually but they often occur in combinations of two or more. In short, oxidation occurs easily when soldering with lead-free solder because the surface temperature of the tip is higher and the solder does not contain lead. Lead improves the wetting action of solder.

To improve the life of tips when using Pb-free solder follow these recommendations:

- Do not leave the soldering iron on for long periods of time without making solder connections.
- Do not set the tip temperature over 400°C (750°F).
- Use a flux that has an aggressive activation level and long activation window.
- Keep the entire tip surface tinned with a coating of solder when not soldering.
- If the tip becomes oxidized or blackened and solder will not wet to the tip, use the Hakko FS-100 Chemical Paste to re-tin the tip. The FS-100 Chemical Paste is Pb-free and is specifically designed to remove heavy tip oxides without using corrosive chemicals such as zinc chloride. The FS-100 can be used in conjunction with the FT-700 Tip Polisher to restore solderability to many dewet tips.

Hakko is continuously striving to create soldering equipment that will meet all the challenges of not just Pb-free soldering but all soldering applications. Even so, it is unlikely that any soldering iron will eliminate all the problems associated with lead-free solders. It will be important for workers to thoroughly understand the properties of the solder alloy to be used before conducting solder operations. If lead-free solder is used for manual soldering in the same manner as Pb-Sn solder, numerous problems will occur. Reliable solder joints can be obtained if the properties of lead-free solders are understood, soldering basics are strictly observed, and good tip maintenance is practiced.