What is Wetting and Dewetting

In order to provide an accurate description of the terms "wetting and dewetting" and how they relate to the condition of a soldering iron tip, it is necessary to briefly explain the manufacture of a soldering iron tip.

Soldering Tip Manufacture

Our standard soldering iron tip is manufactured from a copper bar, machined into a near net shape form. In the work zone of the tip, the copper substrate is electroplated with an iron coating. The purpose of this iron electroplate is twofold: 1^{st}, to provide a wear resistant surface to protect the softer copper substrate material from both the mechanical abrasion and the corrosive effects of the solder and fluxing agents, and 2^{nd}, to provide a surface that is readily wet by liquid solder. The iron-electroplated tip is machined to establish the final shape of the work zone. The shank of the tip, exclusive of the work zone, is nickel / chrome plated. This duplex layer provides a surface that is not readily wet by solder and minimizes the oxidation of the tip in the high temperature region of the soldering iron's heating element. The work zone of the tip is not nickel / chrome plated to allow it to be cleaned, fluxed and tinned [or wetted] with liquid solder.

Wetting

A description of wetting can best be described as follows:

' This concept of wetting with solder is not difficult to understand. If water is poured onto a greasy plate it will ball up and run off, leaving a dry surface. One of the advantages of the more popular car waxes is that the rain beads up and does not wet the body of the automobile. When the wax is washed off by the detergent used at the car wash, or the greasy plate is washed in the dishwasher, the water no longer beads up, but forms a thin film over the surface of the plate or the automobile. It wets the surface, and even when the surplus water is removed, the surface still stays wet. The water has become in some way more closely attached to the object and cannot be simply shaken off.

The only difference in the surfaces is that in one case they were covered with wax, or grease, and in the other they were clean. The clean surface could be wetted, the greasy one could not.

In a similar but more complex manner, solder will not wet the surface of a metal unless it is completely, chemically clean. If the solder is to bond, there must be a metal to metal contact between the solder and the base metal. Anything that prevents this contact, for example, grease (even a fingerprint) or corrosion (the thinnest invisible film of oxide) will also prevent the solder from bonding and forming an intermetallic compound.'[1]

‘When the metal surface is absolutely, chemically clean, not only visibly clean, the solder will wet the surface and flow out. When the solder has solidified, another difference will be found between the solder that wet the base metal and that which did not. The blob of solder that did not wet can be knocked off easily, leaving little or no solder adhering to the base metal. The solder that flowed out and wet the base metal, on the other hand, will be solidly bonded and can only be removed by scrapping or filing. Even if the base metal is heated so that the solder melts, although the surplus can be wiped off, a thin layer will be left, so tightly bonded to the base metal that no amount of wiping can remove it. The solder has become an integral part of the base metal. It has wetted the surface.’ [1]

[1] Handbook of Machine Soldering, Ralph W. Woodgate, 1983, John Wiley & Sons, Pages 14-17.

Dewetting

At the elevated operating temperature of the soldering iron, prolonged idling promotes the oxidation of the residual solder left on the tip. Once oxidized in air, the solder no longer protects the electroplated iron on the tip. The oxidation of this iron coating signals the onset of the dewetting of the tip. This oxide layer prevents the liquid solder from freely flowing over the surface of the tip [described as dewetting]. It causes the liquid solder to ball up and roll off the tip. It gives the tip a rough, spotty silver/black appearance. Further oxidation of the tip results in a more continuous black oxide film. Ultimately, when all solder and fluxing agents have burned off the tip, the tip will rust when returned to room temperature.

In a similar manner, the build-up of flux residues [i.e., oxidized and burned fluxes] and slag [i.e., abrasive grit from cleaning and particulate matter from the object to be soldered] will prevent the liquid solder from wetting the electroplated iron on the tip. These build-ups will provide a direct path for the oxidation of the electroplated iron on the tip and promote the onset of dewetting in these areas. If not immediately addressed, the de-wet area will continue to expand over the surface of the tip.

Minimizing the Dewetting Condition

To minimize the effect of dewetting, the soldering iron tip after use should be lightly wiped on a wet sponge to remove all contaminated solder, dirt particles and excess flux residue and re-tinned with an ample quantity of solder. This treatment should minimize the oxidation of the underlying iron.

The hotter the iron’s operating temperature, the shorter the interval in which the oxidation of the solder and iron will begin [the quicker the tip will dewet], when the iron is allowed to idle.

If using a temperature control device on the power supply of the iron, to control the operating temperature of the iron, the controller should be turned down to a lower setting if the iron is to be idled for any extended period of time. The lower temperature will minimize the oxidation of the liquid solder coating on the tip and lessen the likelihood that the tip will dewet.

DEM10/12/01

TIP RETINNING PROCEDURES

The following procedures have been utilized by some companies to clean and re-tin their tips. Of course, only tips with sufficient and unbroken iron plating can be processed.

<u>METHOD 1</u>

1. Tips are "tumbled" for initial cleaning.
2. Tips are preheated on a hot plate.
3. Tips are dipped into a flux (Alpha 200L or equal).
4. Tips are dipped in a pot containing solder at approximately 800°F up to a level of tinning desired.
5. Tips are put into a neutralizing solution of a type to neutralize the flux

<u>METHOD 2</u>

1. Tips are cleaned using polishing wheel made by 3M Company (Tycro Reinforced Code 5A Very Fine Grade).
2. Preheat tips.
3. Tips are dipped into a #30 Zinc Chloride flux (Superior-Columbus, Ohio or equal).
4. Tips are dipped into a solder pot containing pure tin solder (Alpha 3087-V-3514 or equal) at 800-900°F.

In Steps 3 and 4, tips are dipped only to the required tinning level.

<u>METHOD 3</u>

1. Preheat tip in iron.
2. Dip hot tip into Zinc Chloride.
3. Flush tip with large diameter (.060") 63/37 solder alloy with active flux.
4. Allow tip to cool and wash with water to remove all traces of Zinc Chloride.

<u>METHOD 4 (On Line)</u>

1. Remove oxidized tip from iron and let cool.
2. Remove oxidized coating and other residues from tip using a Hexacon TS-10 Tip Scrubber (original tinning should appear).
3. If tip is intact, return it into iron and allow it to come up to heat.
4. When tip reaches a solder melting temperature point, flood the tip with fresh solder and a newly tinned surface.