METCAL™

Soldering Tips Care Guide

TOP 15 THINGS TO KEEP IN MIND TO KEEP YOUR TIPS SAFE

1. Do not "scrub" the lead. To maximize heat transfer, tin the tip and create a solder bridge.
2. Do not apply excessive pressure when soldering. To maximize heat transfer, tin the tip.
3. Do not use pliers to change tip cartridges. Use a Cartridge Removal Pad.
4. Do not drop or bang the tip or cartridges onto hard surfaces.
5. Select the largest tip possible for the lead being soldered.
6. Use the lowest possible temperature when soldering. Low temperature reduces oxidation.
7. Select lower activity fluxes where possible. RMA flux is best for maximum tip life.
8. Keep tips tinned when in use and during storage.
9. Turn the system off when not in use.
10. Use only clean, sulfur free sponges for cleaning tips to prevent tip de-wetting.
11. Ensure sponges are damp, not wet, with deionized water.
12. Do not routinely use tip tinners, as they erode the iron plating and hence reduce tip life.
13. Use Metcal´s brass brush and brass pads to clean heavily oxidized tips.
14. When it makes sense, choose a blunter tip over a sharper tip.
15. Remove the cleaning sponge’s plug and use the hole to collect the dross, away from the sponge surface. Use the sponge slot only after removing the dross, to avoid contamination.

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INTRODUCTION

In this guide, we'll discuss the construction of soldering tips, the various ways tip plating fails (cracking, wear, corrosion, and dewetting), how to diagnose each type of failure, and specific practices that will minimize or eliminate each.

Even under normal usage, the plating on all soldering tips will eventually fail. The lifespan of the plating depends on the soldering application, the types of solders and fluxes used, and operator technique.

Tip plating failures fall into four main categories:

1. Stress & Cracking
2. Corrosion
3. Dewetting
4. Wear & Abrasion

SOLDERING TIP CONSTRUCTION

Typically, a soldering tip is constructed of several layers of metal:

- A solid copper core
- A plated layer of iron
- A plated layer of nickel
- A plated layer of chrome

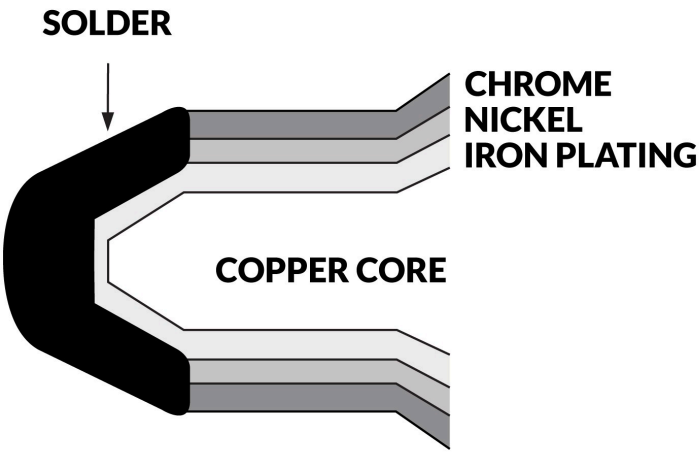

Figure 1: Soldering Iron Tip Cross-Section
(Not to Scale)

Copper is used at the core to ensure good heat transfer. The nickel layer is a non-wetting layer, which keeps the solder from wicking away from the tip's working surface and traveling up the tip toward the heat source. The chrome is an additional protective layer.

The key working layer, and the one that effects tip life the most, is the iron layer. Most plating failures are a failure of the iron.

STRESS & CRACKING FAILURES

Plating failure due to cracking is caused by too much stress being applied to the tip during soldering. Operators often apply too much pressure on the tip, believing that applying force will aid the heat transfer. This is not the case.

The best ways to ensure good heat transfer are:

- **Use the largest tip possible on the lead to maximize contact area**
- **Tin the tip well**
- **Use molten solder as a thermal bridge between the tip and the joint**

Do Not Use Too Much Force

While iron plating has many great properties, fracture resistance is not one of them. Too much force applied to the plating layer will cause cracking. This crack will propagate and spread all the way through to the tip's copper core, the same way that cracking a block of ice will make the block split. Because of this crack propagation, a thicker plating of iron will not solve the problem.

Once the copper core is exposed, solder quickly dissolves it away, hollowing out the tip (Figure 2). Eventually, the iron plating, unsupported by the copper core, snaps. A sure sign of a stress/cracking failure is a hollowed out or jagged tip.

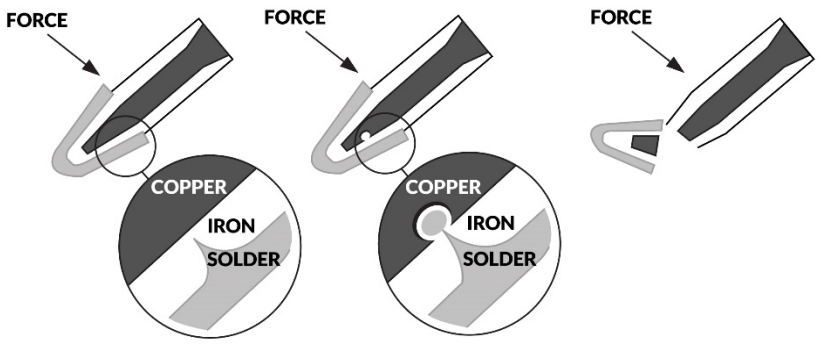

Figure 2: Pressure Failure

Use the Largest Tip for the Job

Cracked plating is most common on fine point tips, which are more vulnerable to the mechanical stresses that lead to cracks. This is another reason to always use the largest tip appropriate for the job (Figure 3).

Figure 3: Proper Size

Be Careful with Your Tips

Avoid banging your tips against hard objects or dropping them on a hard work bench or the floor. Never use tips for anything other than their intended use to avoid unnecessary stress to the iron plating.

CORROSION FAILURES

Corrosion to the tip's iron plating is a common type of failure, usually caused by interaction with corrosive fluxes or improper sponge use.

Tin Your Tips with Low Activity Flux Core Solder

Corrosion induced plating failures are primarily related to flux being used with the solder. Iron, like many metals, can be broken down when exposed to acids. Fluxes generally contain some form of halide additive or organic acid material. They are designed to chemically strip away iron oxides when brought to soldering temperatures.

Unfortunately, some of the more active fluxes will also attack iron. For instance, aqueous clean fluxes appear to cause a high incidence of corrosion failures since they are highly active and typically contain an organic acid like citric acid.

Strictly from the standpoint of tip plating corrosion, the less active the flux, the lower the chance the tip plating will be eaten away. Figure 4 shows an activity ranking of various flux types. RMA fluxes have proven to yield the best tip life.

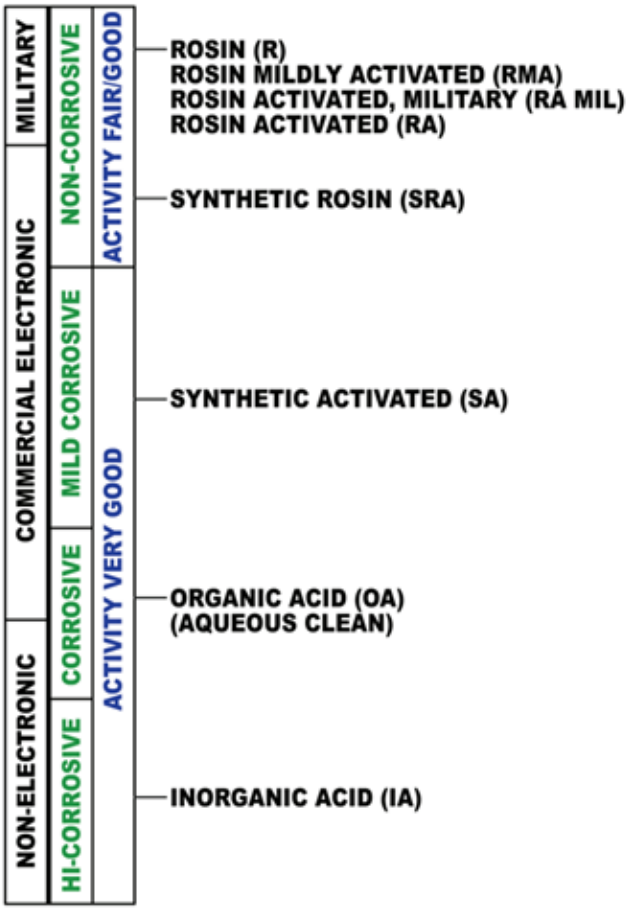

Figure 4: Flux Types

When tinning a tip for storage, use an RMA or other low activity flux core solder. Do not use aqueous clean or organic acid flux core solders, as these will corrode the tip during storage.

Clean Your Tips with Clean, Sulfur-free Sponges

Corrosion related failures can be reduced by making sure the sponges used to clean the tips are sulfur free. Only use sponges designed for soldering clean up. Regular store-bought sponges often contain sulfur or plastic materials that form corrosive by-products when the sponges are heated to soldering temperatures.

Dirty sponges collect contaminants which can react at high temperature, forming corrosive by-products as well.

Dirty sponges also collect solder dross that contains heavy metals. This dross can adhere to the iron plating of the tip, forming a non-wetting surface. Hard water also contains element which can form a bonded, non-wetting surface. To prevent this, use only clean, damp sponges wet with deionized water.

The properly clean dross from the tip, remove the cleaning sponge's plug, and use the hole to collect the dross, away from the sponge surface. Then use the sponge slot, but only after removing the dross, to avoid contamination.

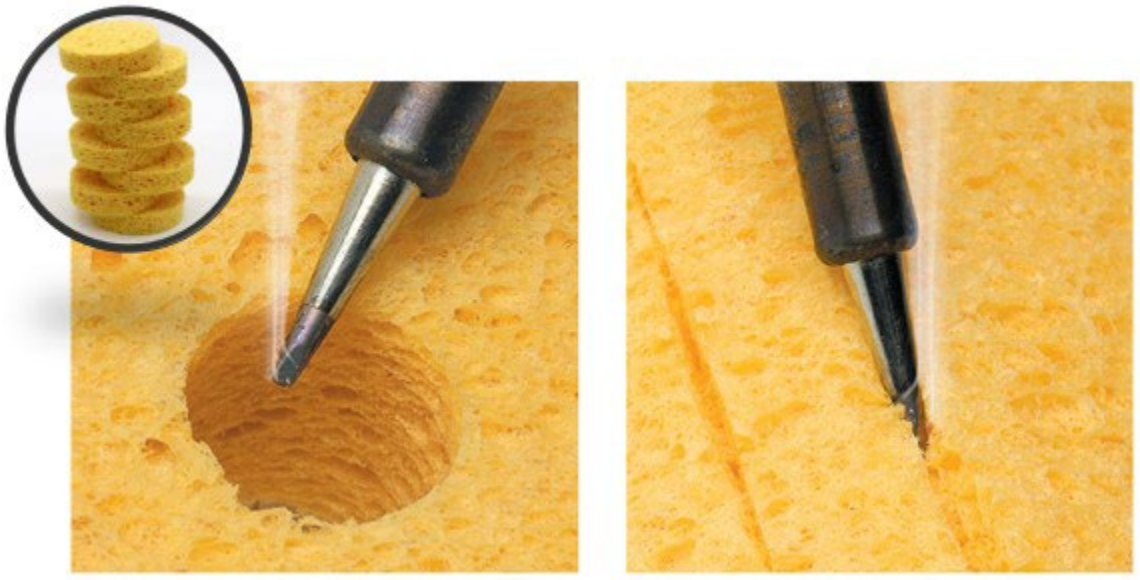

Figure 5: Proper sponge use

DEWETTING FAILURES

Dewetting is the most common form of plating failure and is preventable, for the most part, with proper daily tip care. Thermal dewetting is caused by oxidation of the iron plating to iron oxide. Iron oxide is non-wetting.

When trying to use a dewettted tip, solder will not flow evenly across the working surface. Instead, the solder applied to the tip will tend to ball up, like mercury from a broken thermometer.

In addition to shortening tip life, dewetting impairs heat transfer. The oxide build-up acts as a thermal insulator. Frequently the complaint that a tip isn't hot enough is a dewetting issue.

Tin Your Tips

Because oxidation is a function of temperature and exposure to oxygen in the air, the way to minimize oxidation is to keep the tip tinned. Tinning your tips protects the iron plating with a protective blanket of solder. A thicker iron plating on the tip would not fix this dewetting problem, as it is the surface of the plating that oxidizes.

Solder at Lower Temperatures

Using the lowest temperature possible during soldering will reduce oxidation and extend tip life. There is a tendency to solder at higher temperatures than needed. Not only does this shorten tip life, but it also needlessly increases the risk of PBC damage. With Metcal soldering systems, many customers have found that shifting to a lower temperature cartridge results in no loss in throughput and a significant increase in tip life.

Turn Your System Off When Not in Use

The single most effective way to minimize oxidation and extend soldering iron tip life is to simply turn the system off when not in use. The rate of oxidation at room temperature is negligible compared to soldering temperatures. Turning your system off during breaks or adjusting your sleep timer can result in an immediate 10-15% increase in tip life.

Use Active Flux When Soldering

Dewetting can also occur if the flux used is not active enough (or if no flux is used). This is typically the case with "No-Clean" solders. The most common plating failure associated with No-Clean solders is dewetting. Tip dewetting while using No-Clean solder is not a problem caused by the soldering iron tip. It is a problem with the soldering process, due to the interaction between the tip, flux, solder, and heat.

Consider a Tip Tinner as a Last Resort

Should your tip become detinned, it can be restored by use of a commercial tip tinner. These products contain an abrasive used to strip the oxide and can squeeze a bit of extra life out of a ruined tip. Unfortunately, the same abrasive will also remove some of the iron plating from the tip as well as the oxide, shortening the tip life. Therefore, the best practice is not restoration but prevention.

And never use any abrasive material like sandpaper, emery cloth, rags, or dry sponges to clean a tip. Use a clean, damp, sulfur-free sponge.

If there is buildup on the tip, you may use a brash brush like the Metcal AC-BRUSH to clean the buildup.

WEAR & ABRASION FAILURES

Plating failure due to wear is the only unpreventable failure experienced by all soldering iron tips. In a way, plating wear is the only "proper" form of failure for a tip. The other failure modes discussed above are preventable with care. Normal wear is caused by the scraping away of the iron plating as the tip comes into contact with solder joints. A worn tip will typically show a hole on its working surface.

Choose a Blunter Tip When Possible

Plating thickness is limited by tip geometry and thermal responsiveness. Too thick a layer of plating can limit a tip's thermal responsiveness. While this is less of an issue with conventional, stored energy type soldering irons which inherently have sluggish response times, it is an issue with Metcal systems, which rely more on speed of thermal response that stored energy to achieve good heat delivery and control.

Additionally, fine point and slim tips cannot carry as much iron plating as blunter tips without losing their sharp profiles. Tip life can often be extended by simply selecting a blunter tip over a sharper tip whenever possible. Resist the common tendency to pick the finest tip. Often the blunter tip is the right tip.

Don't Scrub or Drag Solder

Wear can be minimized by not applying excessive force during soldering, and by not "scrubbing" the tip against the joint. Operators often believe that scrubbing aids in heat transfer. It does not.

Drag soldering will also cause tips to wear out faster. Drag soldering is the equivalent of running your soldering tips across a metal file. Not only does drag soldering wear out tips, it results in poor quality solder joints. Because the solder tip spends almost no time on the lead, the joint may not have enough time at the proper temperature to make a strong solder bond, resulting in weak, brittle, or cold joints.

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