Technical Note

Soldering Faster At Lower Temperatures:

A Performance Comparison

Technical Note

Table of Contents

okinternational

OKi

www.okinternational.com

Abstract: Why Lower-Temperature Soldering?

Today's soldering trends are leading to lower temperatures for the following reasons:

- Lower temperatures minimize the potential for thermal damage to delicate components and assemblers.
- The higher themal demands of lead-free soldering create a greater risk of thermal damage.
- Lower temperatures are needed to successfully solder with No-Clean flux and solder formulations.

However, production demands are higher. Thick, multilayer PCBs with heavy ground planes make it almost impossible to solder faster without significantly raising soldering iron temperatures. What's the answer? The key to higher throughput and lower temperature soldering lies not in how hot the soldering iron tip can get, but how much thermal energy the soldering iron can deliver to the solder joint and how quickly it can be delivered. Although partially a function of temperature, it's really a question of heat delivery.

In studies and tests of comparative soldering iron thermal performance at low temperatures, OK International's SmartHeat® direct power soldering technology was compared to conventional stored energy soldering irons manufactured by leading manufacturers.

The results prove that direct power soldering with OKi SmartHeat® technology can dramatically increase throughput at substantially lower temperatures.

Soldering Irons Tested

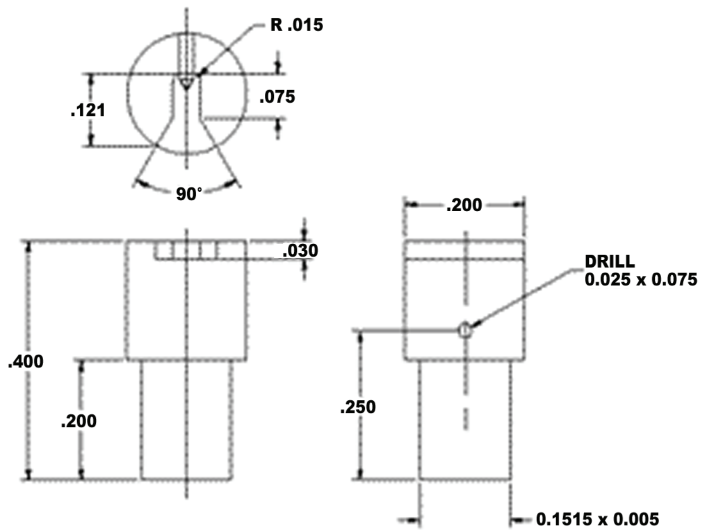
Four current model soldering irons were tested:

- Metcal® SP200 by OK International
- Competitor “P”
- Competitor “W”
- Competitor “H”

All four irons used a 1/16" chisel tip from the manufacturer. The soldering irons and tip cartridges were new. All four irons have some form of temperature feedback control (closed rather than open loop).

Experiment Set-up and Procedure

Ten identical thermal loads were machined from copper. The loads were selected to represent a heavy soldering load that would create a trade-off situation between low soldering temperature and high throughout. An actual production example would be soldering to ground planes.



These loads were set into the test fixture shown in the illustration above. The base material is a thermal insulator to prevent heat conduction between loads. A type K thermocouple was connected to each load. These thermocouples were plugged into a computer data acquisition system that recorded the temperature profiles of each load.

To monitor tip temperature, a hole was drilled into each tip, 0.125" from the end. A type K thermocouple was inserted into the hole and secured to the tip to ensure good thermal contact and comparable recorded temperatures. The tip temperature profile was recorded by a computer data acquisition system.

To minimize tip measurement error and ensure uniform thermal contact, the test fixture was designed to ensure that each soldering iron tip made contact with the thermal load at a 15 degree angle relative to the horizontal.

Prior to each test run, the loads were cleaned of residual solder and flux and a small but consistent bead of RMA solder paste was applied. The purpose of the paste was to maximize the heat transfer between the soldering iron tip and the load. The loads were allowed to cool to 70° F prior to each run.

Study #1: Throughput at a Given Temperature

The purpose of this study was to determine relative speed of soldering with all irons set at the same low temperature.

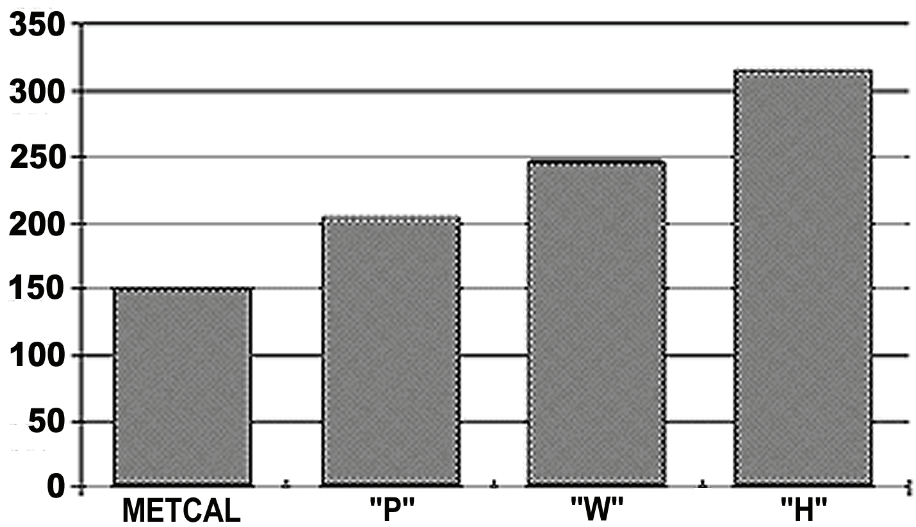
For this series of test runs, each soldering iron was set to an idle tip temperature of 625° F as measured by the temperature meter. Prior to each test run, the soldering iron was allowed to stabilize at equilibrium.

Once stabilized, the soldering iron was applied to the thermal load. The temperature of each load was raised from 70 to 450° F, the temperature recommended to form a high quality solder connection using 63/37 Sn/pb solder. Once the load reached 450° F, the soldering iron was moved immediately to the next load and the process repeated until all 10 loads were completed. The time to bring all 10 loads to 450° F was recorded.

Each soldering iron was tested at least twice to ensure repeatability. The average time to bring all 10 loads to 450° F is recorded in **Table 1**.

Table 1.

Soldering Iron	Tip Iron Temp	Time to Solder Loads
Metcal SP200 by OKi	625° F	150 seconds
Competitor “P”	625° F	204 seconds
Competitor “W”	625° F	245 seconds
Competitor “H”	625° F	316 seconds



SOLDERING SPEED AT TIP IDLE: SECONDS AT 625°F

For this test at 625° F, the Metcal SP200 soldered 25% faster than the nearest competitive iron.

Study #2: Temperature at a Given Throughput

The purpose of this study was to determine high throughput capability.

The same thermal loads as in Study #1 were used. The shortest soldering time from Study #1 (150 seconds) was selected as the benchmark.

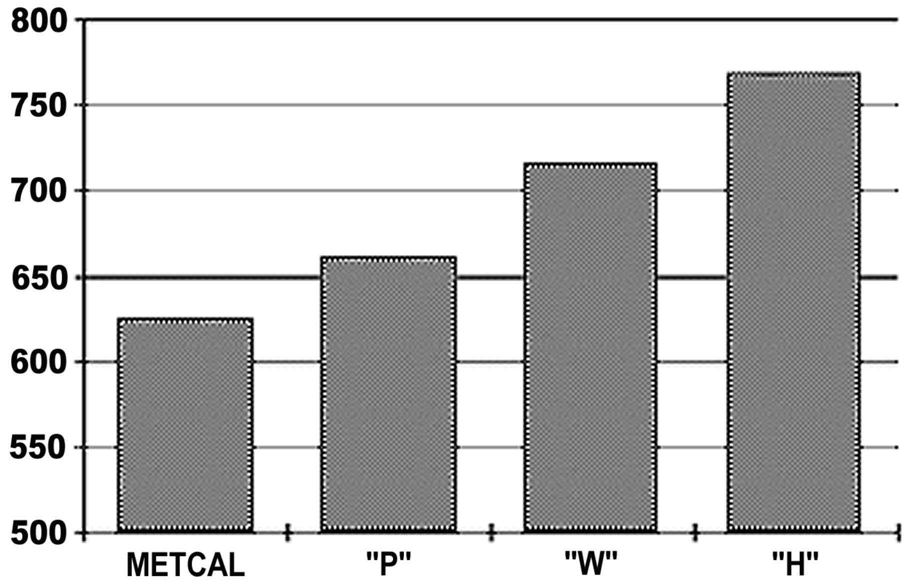
Again, prior to each run, the idle temperature of the soldering iron being tested was allowed to stabilize. The iron was then applied to the loads as before. The temperature of each load was raised from 70 to 450° F at which point the iron was applied to the next load. This process was repeated for all 10 loads. The time to bring all 10 loads to 450° F was recorded and compared against the benchmark time of 150 seconds.

If the soldering time was longer than the benchmark, the idle temperature of the soldering iron was increased, the iron allowed to stabilize and the test repeated. This process was continued until a soldering time of 150 seconds for ten loads was reached. The corresponding tip idle temperature was then recorded.

Each iron was put through this procedure at least twice to ensure repeatability. The average tip temperature is recorded in **Table 2**.

Table 2.

Soldering Iron	**Time to Solder Loads**	**Tip Idle Temp.**
Metcal® SP200 by OKi	150 seconds	625° F
Competitor "P"	150 seconds	661° F
Competitor "W"	150 seconds	716° F
Competitor "H"	150 seconds	768° F



TIP IDLE TEMPERATURE: °F AT 150 SECONDS

For this test, the tip temperature required to maintain the same throughput was 35° F lower for the Metcal SP200 than for the next nearest competitive iron and over 100° F lower than for the Hakko unit.

For more information about these tests and their results, contact your local OKi/Metcal representative or distributor.