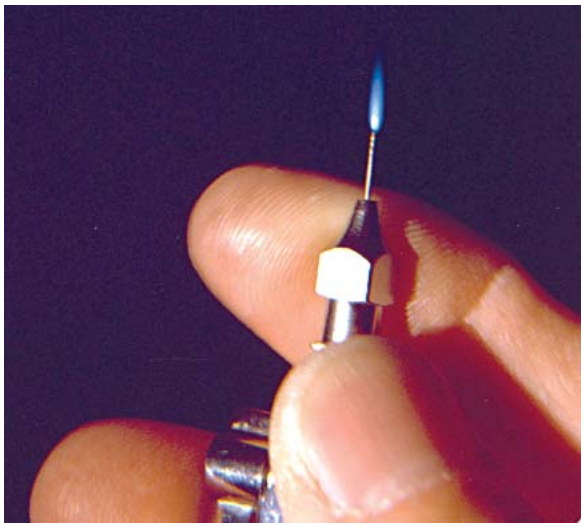
Microflame Soldering of Crimped Connections

Gary W. Miller, Senior Technical Advisor
Spirig Advanced Technologies, Inc. (SAT)
www.spirig.com

Hydrogen/oxygen generators, literally make fire from water. Because distilled or deionized water is a perfect mix of two parts hydrogen to one part oxygen, with the right technology, you can use water as fuel. Here's how it works: using a multicell generator, distilled or deionized water is added to an electrolytic liquid and then electrical energy is introduced. The water is then dissociated into hydrogen/oxygen gas. It can be modified as needed for the particular application and then put through small stainless steel hypodermic-like tubes, ignited and used as a very accurate, clean, fast, noncontact heat source.

With the patented development of Spirig's multicell technology, it is now possible to produce extremely accurate amounts of gas that can easily be used in automation. For automated systems, this greater accuracy and reliability is an absolute requirement. In automated systems, microflame soldering is usually one third to one half the cycle time of a soldering iron.



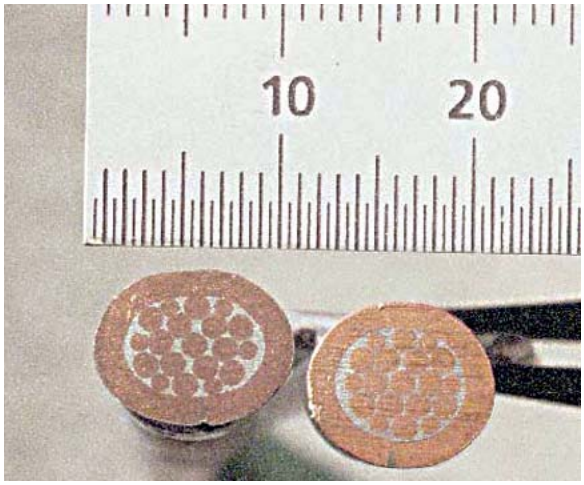
Flame in hand with Spirflame® technology.

The flame which comes from a Spirflame® hydrogen/oxygen generator is superior to other gas combinations we use today in other areas, because the flame is very intense in the axial direction only—lateral heat is minimal. In simple terms, all of the heat is out in front, with practically no heat generated on the sides. Multicell technology provides precise, stable flame sizes, with well-documented temperature accuracy's of ±1°. It is also common to generate microscopic flames needed for very small connections.

Soldering vs. Crimping

There has been ongoing discussion regarding soldering vs. crimping. I have never thought of these two processes as "competitive." I have always thought of these both being used together to significantly improve the quality of the connection needed to meet a customer's specific requirements. The reasons for microflame soldering to bond a terminal and wire after crimping are many. I have sorted these reasons by frequency, or how often they apply in our customer requests, from most often to the least. They include:

- **Significantly Increased Pull Strength**—often used to meet and insure high pull tests such as electrical cords on medical equipment. Sometimes the terminal is not crimped, or due to shielding or other factors, the crimp cannot be made as tightly as would be needed to meet the pull test. Occasionally, the wire and terminal used, although both required for the job, are not perfect together for crimping alone.
- **Complete Protection Against Moisture & Corrosion.** Many aerospace, aircraft, automotive, boating and military applications have had difficulty with corrosion weakening the joints between terminal and wire. This is often the case in difficult-to-access (closed) areas, like those found in airbag connections. The natural solution and perhaps the easiest is to solder, thereby seal the joint. Even with large terminals, microflame soldering can insure complete penetration and when properly integrated, eliminate the possibility of cold solder joints.



Wire terminal cross-section.

- **Pretinning Wire**—even the smallest diameters or most delicate configurations. Our noncontact process does not touch the wire to heat it, so if properly integrated, even the most delicate connections and smallest sizes (microscopic) can be soldered.

- **Prevention of Damage or Opening of Smaller Crimped Connections.** This can often happen through a number of different conditions. I usually think of rough handling during servicing or from vibrations such as those caused in automobiles, or even by radios, speakers and voice coils.
- **Electrical Conductivity.** For the assurance of uniform electrical conductivity.
- **Elimination of Transitional Resistance.** Electrical resistance from component to component often caused by a lack of uniform connection can be improved. This is common when multiple wires and components are placed into a single crimp.

Why should you use microflame solder over other methods? Again, I have sorted these reasons by frequency, or how often they apply in our customer requests, from most often to the least. They include:

- **More Control & Uniformity**. Microflame is a noncontact process allowing greater heating control and uniformity of solder volume. There is no contamination or dross from contact. Solder volumes are always the same. An exact uniform temperature means production results are always repeatable, especially important for small or delicate parts.
- **Very fast.** Even with high mass or heavy parts, the average cycle time is usually one third to one half less than a soldering iron or dipping, with more uniform joint penetration for greater productivity.
- **Accuracy.** Microflame soldering allows extremely well controlled and accurate placement of the heat and heating. There is no drop in temperature such as with an iron that fluctuates (cold joints). This insures accurate solder flow, uniform volume and placement for clean, shiny, uniform, class-one joints.
- **Low Operating Costs.** Max costs of US$0.19/hour, US$1.52/eight-hour day and US$4.56/24-hour day.
- **Low Maintenance Costs**—especially when compared to bottled gases, irons, lasers, reflow, dipping and ovens. There are also significantly lower consumables costs.
- **Easy Adjustments.** Flexible, easy adjustments are possible for different parts, from very large to small. Quick, simple conversions back and forth from one wire/terminal configuration to another are possible allowing repeatable results, in small or large batches, even if the job is not run for a long time.

Equipment Compatibility

It would be nice if you could solder on the same equipment you are already processing your wire and terminals on. It would also be nice if you could solder quickly as you process and crimp, instead of soldering with other secondary methods such as dipping or soldering by hand. It would also be nice if this was fairly inexpensive to do.

We do these three things very well, which is why there has been a steady increase in requests for microflame terminal soldering. The rules and theory of soldering apply for microflame soldering as they would for any other method. Our noncontact heat source and ability to precisely deliver significant amounts of heat into very small areas, gives us significant advantages in a number of areas. It is not impossible to alter small portions of the soldering process to take advantage of those factors. But with the standard practice the flame is always directed towards the most massive (heat consuming) object of the parts to be soldered (solder always flows to where it is hottest). The temperature the part is heated to is controlled by the size of the flame, the distance from the part and the time the heat is on the part. Each of these make a difference, so there are a number of good ways to "fine tune" the heating.

Solder is released only when the temperature of the heated parts reaches the flow temperature of the solder. This means there is a preheat with the flame applied before the solder. The preheat time could in some applications be only a few hundredths of a second.

The flame is usually retracted before solder wire is fed to the object. This insures the solder is melted by the heat stored in the object and not by the flame heat itself. This procedure insures a cold joint cannot be made. But in many cases, there is an overlap of flame and solder. This is often done to shorten a cycle time.

If the flame/solder location and orientation of the part allows, it is best to heat one side of the part (bottom) and supply solder from the other (top). This is one of many "tricks" to insure a cold joint does not occur. It is also the most common, easiest method to implement in wire processing applications. There is usually also a heating overlap on very small parts to compensate for the heat absorbed by the solder volume itself.

This is not a new technology. Microflame soldering is something our firm has been doing for over 30 years, in a number of different areas and industries. As electrical systems and connections become more complex, cost reductions become more critical, specifications more demanding and both automotive requirements and voltages increase, there will be a greater demand for our microflame soldering processes and technology. To learn more, contact the author or **Circle 210.**

Company & Author Profiles...

Spirig Advanced Technologies, Inc. (SAT) is the North American office for **Spirig**, Switzerland.

Gary W. Miller is Senior Technical Advisor for SAT, and is a "Swiss employee," currently responsible for operations in North America. Since October 1995, Miller has been involved exclusively with microflame applications in North America directly or through Spirig's group of Approved Integrators and Spirflame® Sales Reps.