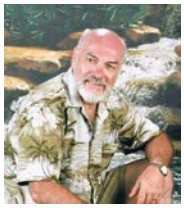
## Keep it Together



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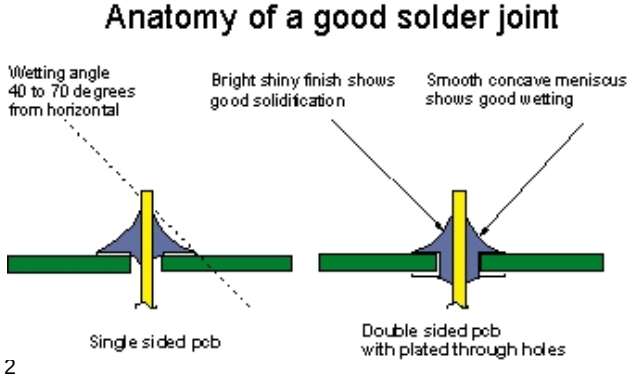
In my day to day work I am often asked to travel to several base workshops and field work sites around the world.
During these visit, they request that I look over the shop and assist wherever I can. In all of these years, there is one area that I frequently find myself stopping the work to offer some guidance. This guidance is in soldering mechanics. In the following article, I will iterate some basic concepts without delving too deeply into all of the physics involved as soldering can be quite an involved process. To start with, things that you will need to consider in soldering are soldering iron wattage, solder types a good "wet" sponge, appropriate wire handling tools, and good lighting. There are additional extras like heat sinking clips, solder suckers, solder wick and more that I leave for you to research on your own.
More often than not one of the big mistakes that I find people do, is brush the hot iron across the wires, in effect trying to *paint* the solder on. Soldering is NOT a coating but it is a chemical thermal physical process, which take place. I believe many people fail to realize this crucial and critical understanding of the process.
Soldering is a physically altering process. In proper soldering, the metal, mostly copper, undergoes a physical change caused by the heat, fluxes, and the solder alloy mix. Each part must work with the other, to effectively bond the metal to one another. In a proper solder joint the solder acts as a quasi heat induced super-glue if you will and molecularly attaches one wire to the other. It's not welding per say but close to it. If you have ever tried to take a good, solder connection apart without heat you likely gave up and cut the wire; or broke it. Some day when you get the chance, cut through a good solder joint with sharp side cutters. Look at the joint cross section. You will notice that the metal has in essence melded together. Likely, you will only see pure copper in the very center. There will be a transition from the edge from silver, (solder) to lighter gray/brown until it turns to copper material and color.
A good soldering practice is, if possible first provide a good mechanical joint. It is not always possible but if you can twist the wires around each other or the connection post. This will give your connection additional mechanical strength up and above the soldering process. Most solder purchased these days have a flux core. The flux IS required to appropriately remove the metal oxides, which have formed on the metal surfaces. The oxides have been created from environmental influences on the metal surfaces. The flux in the solder wire is there but for the most part, is of an insufficient amount to properly clean the area to be soldered. It is always best to add flux as a paste or liquid to cover the complete area you plan to solder. In the offshore subsea industry, this is even more critical as a good portion of electronic boards find themselves immersed in oil for pressure compensation. Next, you need to ensure that you have the correct tip size and wattage value for the job at hand.
One thing that many tech fail to realize is that "solder" runs TO the heat. This means that solder once melted will travel to the heat source and therefore will travel uphill AND through things. Another thing that you MUST realize for a good solder joint is solder will NOT adhere to cold surfaces. This is why that preparation before the heat is applied is most critical.
Once you have the right tip and soldering heat setting setup, mechanical joints and flux have all been applied your ready for heat. If you do not have to "hold," the joint you will have both hands free to do a good soldering job.
First, apply the heat on one side of the joint. Wait until you can see that the flux has melted. Give it a "bit" of time to do its job. After some practice it will be quite evident how much time that is. Now start to apply the

solder on the "*opposite*" side of the heat. That will cause the melted solder to run to the heat and coat/meld with all the copper parts.
Remove the solder but keep the iron in place for just a few moments longer. Again, that time becomes much more apparent with practice. A note here, which must be said, is that a good solder joint will show the wire forms and curves. You do not want a "***bubble***" of solder floating above the wires waiting to cool.
Once you remove the heat source, "DO NOT" move the joint. It is best to let it cool naturally. In essence, you want the heat to escape from the core before the edges cool. Yes, we have all blown on the solder joint to cool it down but letting it cool on its own is still best practice. Another tip to watch for is as you pull your iron away from the work, if the solder follows; giving you, a sharp needle like tip, then likely your iron temperature is too hot. Use a smaller iron or reduce the temperature selection on your station if you happen to have one.
Once the joint has cooled look for a shinny surface. You should be able to determine the meniscus[1] of the solder to wire transition.
Now tug on the wire, you should see NO movement on the joint or its parts.
Check the surrounding area, assuming you are soldering on a circuit board, and ensure that none of the lands or pc boards components have lifted due to having too much heat applied.
If nothing can be seen, you have completed a good solder joint.



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In closing, a good soldering job demands much practice. It demands a close observation of the physical process and of materials being worked with. You need to consider which part will require the most heat and which part can "absorb" the most heat safely.
These few words of course is by no stretch of the imagination all that there is to know about soldering. I hope that I have planted in your mind that, to do the job well you need to understand the process and "hopefully" will research the matter further.
As a final note, it is critical to realize that in our offshore subsea industry a bad solder joint can have dire consequences. The equipment can be a long distance away from you when it fails and much time effort and money can be spent getting the equipment back to a point where you can work on it. Equally, we can be dealing with very high voltages which if a wire lets go it can have a catastrophic effect on neighboring parts. Keep it clean and mechanically sound and you will be the hero. Even if no one acknowledges to you that fact, you will know that a client's job was completed because you did your job correctly.

*Sidebar note*:
Should you ever want a "good" project to learn how to solder I would gladly outline the one we had to do….when the dinosaurs roamed the earth. I guarantee you will know how to do it when once completed…perhaps for another time

[1] The **meniscus** (plural: *menisci*, from the Greek for "crescent") is the curve in the upper surface of a liquid close to the surface of the container or another object, caused by surface tension

[2] Images from web search/general