The goals of this tutorial are to help you understand how soldering works, make you aware of good soldering practice, and show you how to inspect your work.

A eutectic alloy has just the right ratio of ingredients to minimize the melting point. If the mixture isn’t eutectic, then the ingredients will melt at different temperatures, resulting in a partially melted or paste phase.

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Pragmatic Soldering

- **Material Science Review**
- **Tools and Supplies**
- **Applying the Heat - Soldering**
- **How’d I do? - Inspection**

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Review of Material Science

- **Alloy** - a substance composed of two or more metals
- **Eutectic** - the ability of an alloy to transition from solid to liquid without a paste phase
- **Diffusion** - the process whereby particles of liquids, gases, or solids intermingle as the result of their spontaneous movement caused by thermal agitation
- **Soldering** - method of making a permanent electrical and mechanical connection between metals[1]
The nodes in this circuit are assumed to be perfect conductors, with no resistance. It is necessary that the nodes exhibit low parasitic resistance (and capacitance and inductance) so that they do not add undesired elements to the circuit. This is the primary purpose of soldering, is to provide a reliable method of producing a low-resistance connection between elements.
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Tools and Supplies

- Soldering iron
- Wet sponge
- Solder
- “Helping hand” (or scotch tape)
- Needle nose pliers
- Side cutters
- Flux remover
- Acid brush
- Burn Cream
Solder

- Sn/Pb 60/40 Resin Core
- Sn/Pb 63/37 Resin Core (eutectic)
- Silver Solder

Note that the eutectic solder has a single, well-defined melting point rather than a range.

I do not recommend lead-free solders for electrical work. Many of them will spontaneously form metallic whiskers as they age, causing short circuits and erratic performance.

(Preforms are bits of solder in special shapes that conveniently fit particular applications.)
Flux

Flux provides several benefits:

- Cleans the base metal (copper trace)
- Protects the solder and base metal from oxidizing during the soldering process.
- Promotes wetting action of the melted solder

But using flux represents some trade-offs:

- Can become entrained in the joint
- Is corrosive and so must be removed

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Soldering Methods

- Wave soldering
- Solder pot
- Reflow
- Hand soldering

Soldering Recipe

- Prepare joint
  - Tin wires and connectors when needed
  - Make a good mechanical connection
  - Install heat sinks if required
  - Apply flux if required
  - Clean soldering iron tip
- Solder
  - Apply heat to both parts to be bonded
  - Apply solder sufficient to coat joint
- Clean joint (remove flux)
- Inspect
THT (Through Hole Technology)

SMT (Surface Mount Technology)

Proper joints
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The Good, the Bad and the Ugly

Right amount of solder, and the copper is thoroughly wetted indicating a good connection.

Too much solder, yet the connection looks doubtful.
The solder hasn't wetted the copper beneath this surface mount component. It'll probably fall off.

Nobody gets it right all the time. Fortunately, we have tools to remove solder.
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References