EECS 192: Mechatronics Design Lab

Discussion 2: Lab Equipment, Project Proposals

GSI: Ducky Lin, Derek Chou

January 29, 2020 (Week 2)

- Car Critique
- Lab Equipment
- Soldering

Car Critique Presentations

Start by introducing yourselves

both as a team and as individuals

Then, talk about your car:

What did you like about your car? Why?

What did not not like about your car? Why?

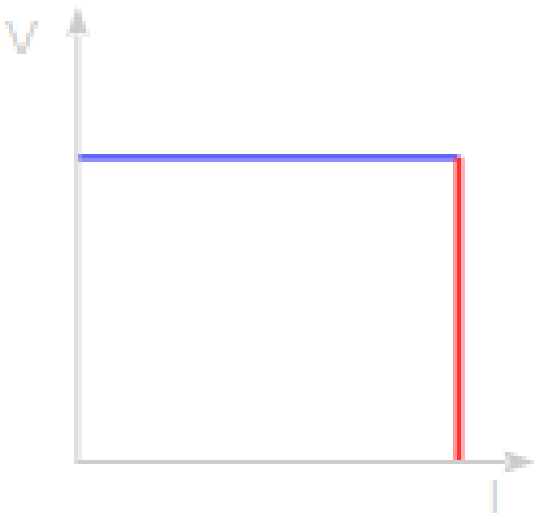
Did you see any good design philosophies?

Is there anything you would have done differently?

Lab Power Supply

Benchtop Power Supply Intro

- Provides a regulated power source
- Limits to the more restrictive of the voltage setpoint or current setpoint
- Or, a more helpful way to think about it:
  - Acts as a constant voltage supply
  - Until it hits the current setpoint (or "current limit"), then it regulates the voltage not to exceed the current limit
  - Set current limit to a known "shouldn't exceed" point to act as a fuse
- Caveat: source has internal capacitance and limiting has response time
  - May instantaneously exceed current limit



IV Curve

constant-voltage mode

current-limiting mode

Check your Understanding

So I've got a power supply set at V_{set}=5v, I_{set}=500mA and some $\frac{1}{4}$-watt resistors...

What will be the voltage across, current through, and power supply operating regime when loaded with:

100 Ω resistor

1 Ω resistor

10 Ω resistor

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why might this be a bad idea?

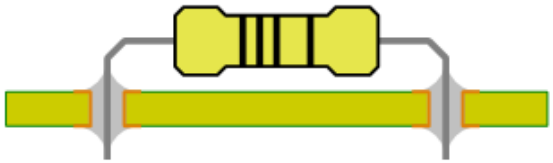
Soldering

Theory & Practice

Overview

- Soldering: joining (electrically and mechanically) metals using a separate fillter metal "*solder*"
- Electronics: bonding component pins/leads to circuit board through-holes or pads
  - Solder is usually a tin/lead alloy (e.g. 63/37) or lead-free tin-silver-copper alloy (e.g. SAC305)
- Note: many production boards today are surface-mount to save space

Example solder joints:



Through-hole

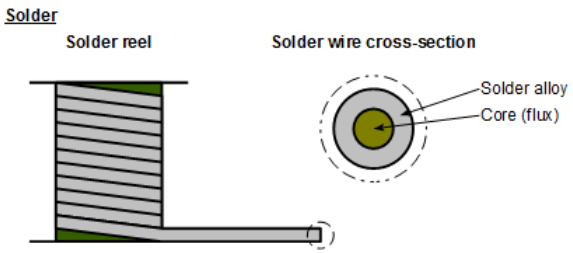
Surface-mount

Safety Precautions

- Soldering melts metal - IT'S HOT
  - Tips typically set at 700°F (371°C)
  - Irons cool slowly after turning off
  - Touching a hot tip is NOT fun
- Leaded solder contains ... lead
  - ... which is known to the state of California to cause cancer and reproductive harm ...
  - WASH YOUR HANDS AFTERWARDS
- Solder vaporizes flux, producing fumes
  - Regular exposure linked to asthma
  - DON'T BREATHE THIS
  - May also cause solder splatter: eyewear required (regular glasses ok)

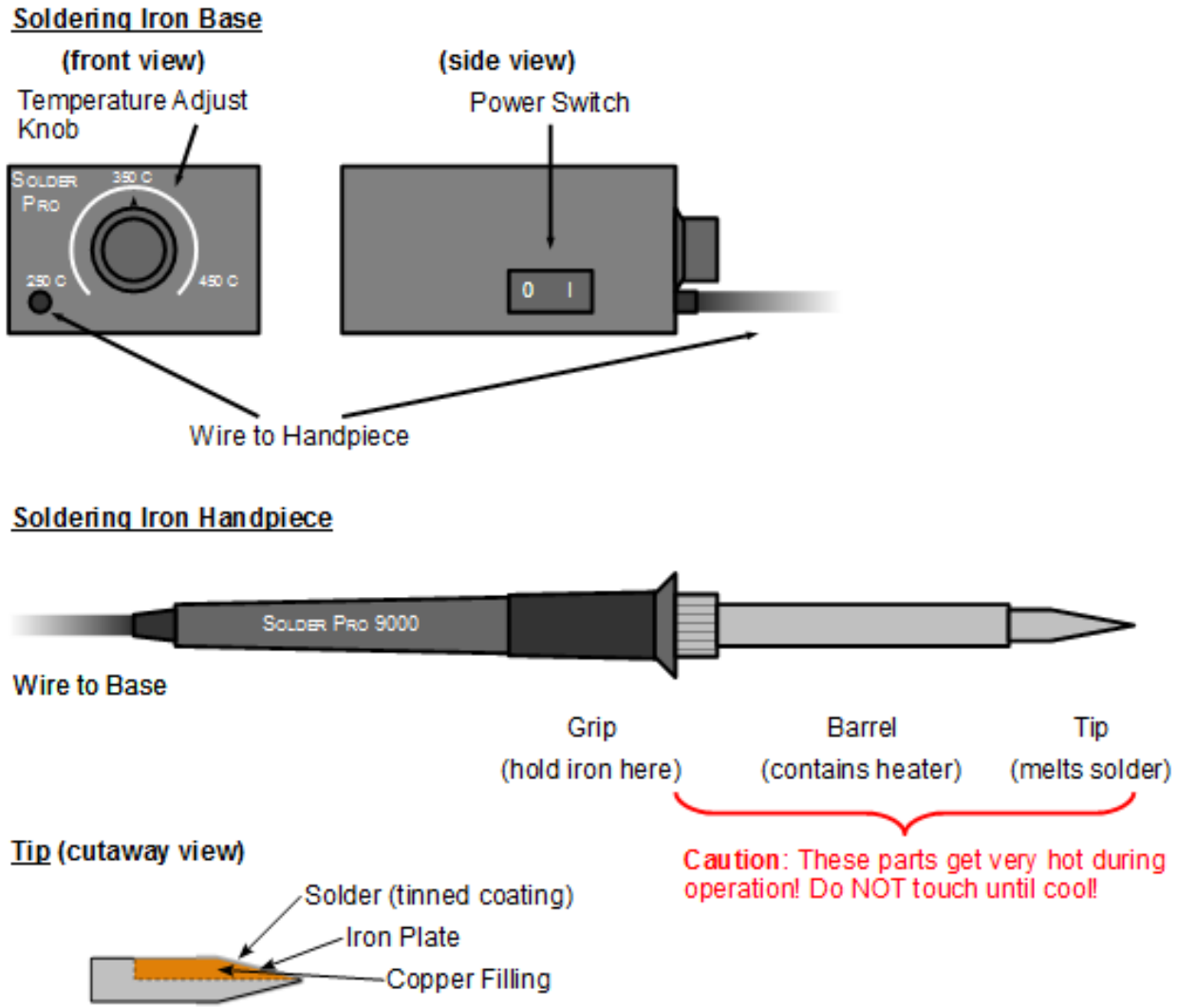
Oxidation

- Soldering depends on good thermal transfer from tip to solder / component / board
- Metals oxidize, forming an oxide layer
  - Oxides impede thermal transfer
  - Reactions faster at higher temperatures
- Flux provides chemical cleaning
  - Rosin flux is corrosive when heated
  - ... and is present in solder wire spools
  - ... but is "burned" upon use
- Just keep this in mind...



Solder cross-section showing flux core

Equipment Overview

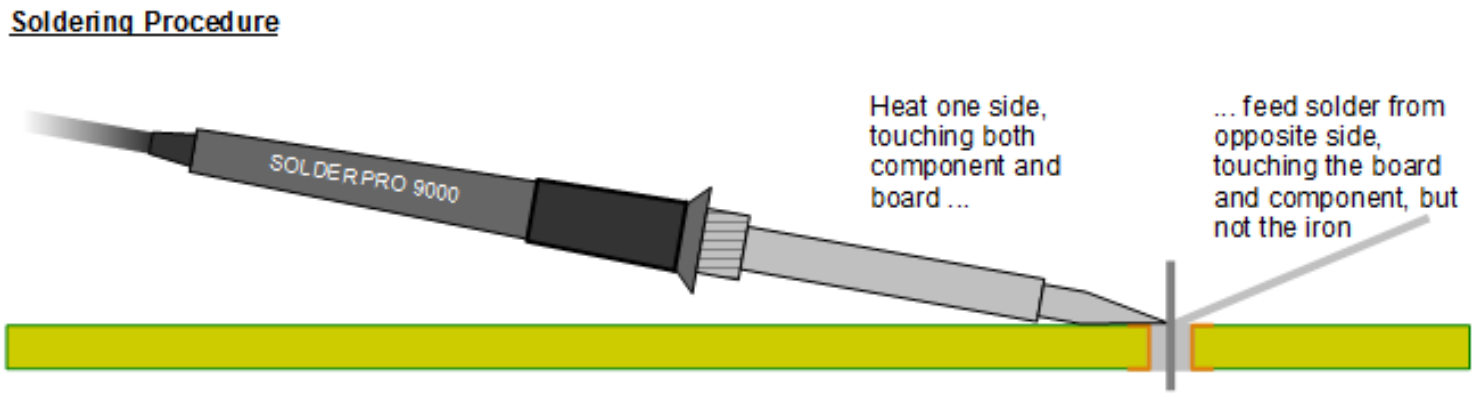


Tip Maintenence

- The tip is what heats things up
  - Want to maximize thermal transfer!
- Keep the tip "tinned" with solder
  - Provides better thermal transfer
  - Sacrificial layer preventing tip oxidation, which destroys the tip
- Must be occasionally refreshed
  - The solder oxidizes, accelerated by heat
  - Cleaning: wipe on brass or wet sponge
  - Immediately re-tin (apply solder layer)

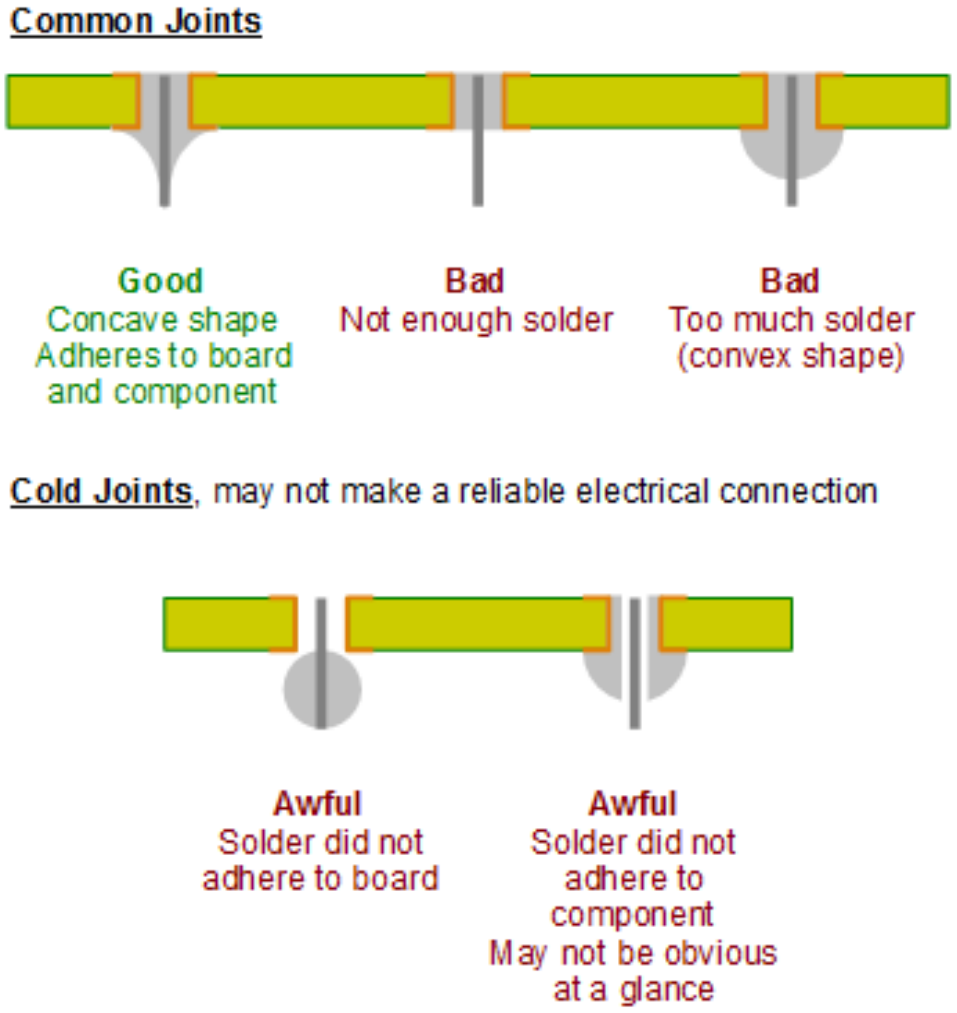
Procedure

- Beginner's tip: use iron to heat up component and board, not solder
  - Feed solder in through the other side
  - Solder only melts when component and board sufficiently hot
- Maximizing heat transfer
  - Point tips: solder using "side" of tip, not point
  - Chisel tips: use the broad flat end



Joint Inspection

Optimal joint shape is a "solder volcano"



Soldering

Demo