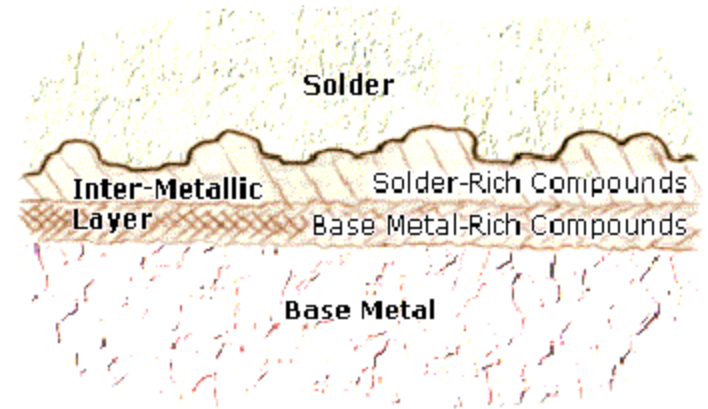


Soldering for Model Railroads

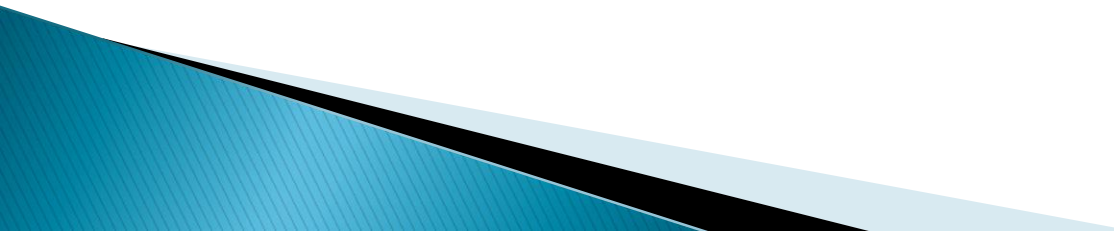
Derry Model Railroading Fun Night
October 11, 2013
Bill Poor

What is soldering ?

- ▶ The focus of this presentation is on soldering for electrical connections
 - There are other uses for soldering in Model Railroading such as structures, locomotives, and rolling stock
- ▶ Soldering provides...
 - Electrical continuity
 - Mechanical connection
- ▶ Soldering is a chemical bond
 - Occurs around 350°F
 - At the molecular level, the solder actually bonds to the wire... but this bond is not very strong



What is soldering ?

- ▶ Why solder wires ?
 - Excellent electrical continuity vs. mechanical bonding
 - ▶ What is the process of soldering ?
 - Soldering iron heats the metal of the wire
 - Flux promotes the adhesion of the solder to the base metals
 - Solder flows between the heated metals and joins them
 - ▶ A big problem Model Railroaders have to contend with when soldering... often you are soldering close to plastic parts
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Soldering Irons

▶ Pencils vs. Stations...

- How much do you want to spend ?
- How much soldering do you need to do ?
- Pencils provide a fixed amount of heat
- Stations can vary the amount of electricity and can precisely control that heat



▶ Wattage

- Small – 25 watts – light wiring
- Medium – 60 watts – bus and rail wiring
- Large – 100 watts (and up) – that is a lot of heat !!!



▶ Resistance soldering stations, guns, and torches



Other Tools

- ▶ Iron holder
 - Keeps hot soldering iron safe
 - Commercially available or home made
- ▶ Third hands
 - To hold wires when soldering
- ▶ Tip cleaner
 - A moistened sponge is most preferred
 - Brass wire sponge
- ▶ Surface cleaners
 - Fiberglass pen
 - Fine sandpaper
 - Scotchbrite pad



Other Tools

▶ Wire strippers

- Mechanical strippers
- “Cutter” type
- Knives
- Nicking the wire is a concern with any stripper



▶ Pliers

- To form wires

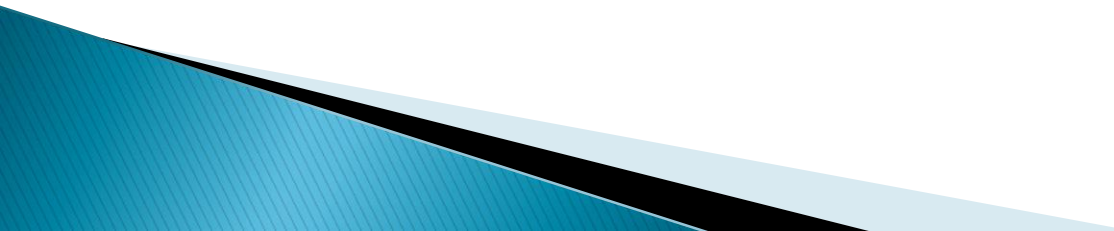


Solder

- ▶ Solder is an alloy, typically of Tin (Sn) and Lead (Pb)
 - Available in different composition percentages – 60/40 , 63/37
 - The higher the lead content the lower temperature the solder will melt
 - Lead is a hazardous material, but with reasonable precautions, solders with lead can be safely used
 - Lead free solder is available – typically will require more heat and can be more difficult to get a good solder joint
- ▶ Silver Solder – a small amount of silver is added to the mix to promote solder flow – **Highly recommended for fine soldering !!!**
- ▶ Solder comes in many diameters – 0.015", 0.031", 0.062", and up



Flux

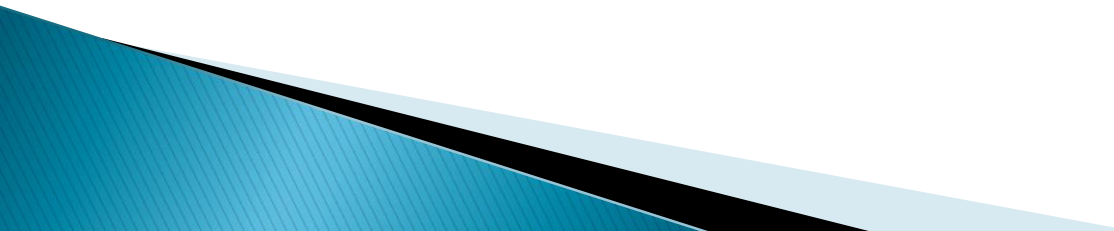
- ▶ What is Flux ?
 - When applied to a metal surface to be soldered, then heated, forms a barrier to oxidation and promotes the 'flow' of solder
 - ▶ Flux comes in different forms
 - Liquid
 - Gel
 - Paste
 - ▶ Rosin vs. Acid flux
 - Rosin fluxes are based on organic materials, usually tree sap and are the primary fluxes used in electrical soldering
 - Acid based fluxes should never be used in electrical soldering
 - ▶ Solder is also available with a core of flux manufactured in, eliminating the need for additional flux... maybe !
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Soldering Iron Care

- ▶ Never use anything abrasive on the iron tip
 - The tip is made of copper, with a thin metal coating, usually nickel
 - Abrading the tip will cause that coating to fail and the tip will wear out prematurely
- ▶ “Tin” the tip... often
 - Tinning refers to applying a thin layer of solder on the tip
 - Tinning protects the tip from corrosion due to metal oxidation
 - Brand new tips should be tinned immediately as soon as the iron warms up sufficiently
 - Before making a solder joint, wipe the tip on a damp sponge and re-tin the tip with solder
 - After completing the solder joint, wipe the tip on a damp sponge and re-tin the tip with solder
- ▶ Cleaning the tip
 - Use a damp sponge... not dripping wet
 - Cutting slices halfway through the thickness of the sponge before getting it wet will improve its effectiveness in cleaning the tip
 - A damp rag will also work
- ▶ The biggest reason people have a hard time soldering is because the soldering iron tip is not clean

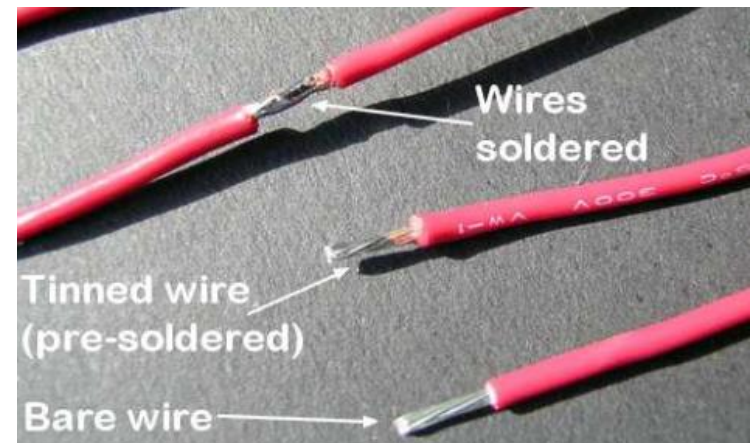
If you are having trouble getting the solder to melt, clean that tip!

Keys to making good solder joints

- ✓ Clean and shiny soldering iron tip
 - ✓ Clean and shiny surfaces to be soldered
 - ✓ Heat the surfaces to be soldered
 - ✓ Apply solder to the hot surface, not the iron tip
 - ✓ Allow the solder to “flow” and “wet” the surfaces
 - ✓ Do not move the connection until everything cools down
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So how do you actually solder two wires together ?

- ▶ Clean all wires to be soldered
 - Everything must be shiny clean... this is where you can and should use something abrasive
- ▶ Form the wires together to make a mechanical connection
 - This makes it easier to hold the wires together and not burn your fingers 😊
- ▶ Apply heat to the formed wires
- ▶ Feed solder into the connection
- ▶ Remove the heat and allow to cool



Soldering wires to something other than wire

- ▶ What else do you solder wires to ?

- Circuit boards
- Lugs, plugs, etc.
- Rails... more on that later...

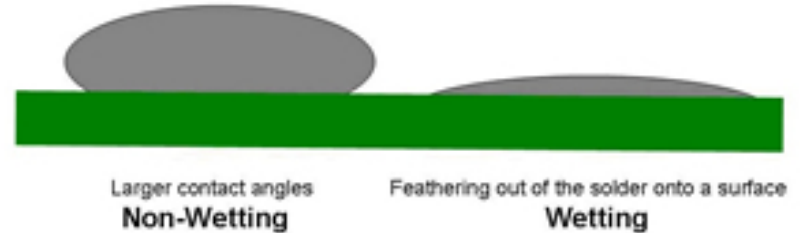


- ▶ The need for cleanliness still applies... for all surfaces
- ▶ Tin the wire and tin the other surface
 - Apply a little flux
 - Heat the surface
 - Apply solder to the surface and allow it to flow all over the surface
- ▶ Assemble the connection, mechanically secure it if possible
- ▶ Apply heat to the surfaces
- ▶ Feed solder into the connection
- ▶ Remove the heat and allow to cool


What's a good solder joint look like ?

- ▶ The solder has to “flow” and “wet” the surfaces of the materials being soldered
- ▶ The solder joint should be shiny
- ▶ If it has wrinkles, waves, frosted, or appears dull, you probably have a cold solder joint
- ▶ If the wire is loose or wiggles, you definitely have a bad solder joint
- ▶ If you tug on it — which you should do to test it — and it comes loose or apart, you don't have a good solder joint

Solder Non-Wetting versus Wetting



Tips to making better solder joints

- ▶ Did I mention that everything should be clean and shiny ?
 - ▶ Make a good mechanical contact
 - Make sure the wire you are soldering is not "swinging in the breeze."
 - Twist or crimp wires, use a "third hand" to hold the work
 - Failure to have a good mechanical connection causes two problems:
 1. A cold solder joints
 2. Poor heat transfer, causing more heat to be applied putting nearby plastic parts at risk of melting
 - ▶ Heat the work, not the solder
 - It's tempting to heat the solder to get it melted and flowing.
 - You must heat the items that you intend to solder together... otherwise you will get a cold solder joint.
 - Try to position the soldering iron tip so that it touches both things you are trying to solder at the same time
 - Then add the solder. Initially the solder won't melt. A few seconds may be necessary until everything heats up.
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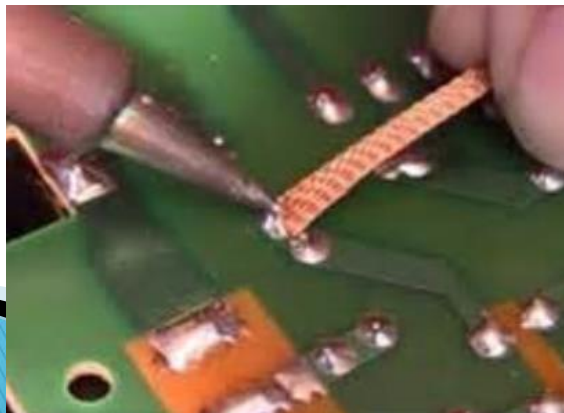
More tips

- ▶ Work quickly... don't apply any more heat than necessary.
 - Ensuring clean surfaces and iron tip, and having good mechanical contact are the most important things to ensuring you don't apply any more heat than necessary
 - Applying too much heat melts nearby plastic parts... and your fingers.
 - Once the solder flows over the work, remove the soldering iron and make sure not to move the connection until the solder hardens
- ▶ It is okay to apply a tiny amount of solder to the iron tip before you start.
 - Often the shapes being soldered are irregular and this little bit of solder helps make good contact for the heat.
 - Don't "transfer" solder from the iron to the joint
- ▶ Make sure the solder joint has **COMPLETELY** cooled before moving it.
 - If the wire moves, you will get a cold solder joint
- ▶ Cleaning the solder joint
 - After the joint has cooled, you can clean the flux residue with alcohol or similar solvent
 - Cleaning is not really necessary when using Rosin based fluxes

With a little practice, you will be making great solder joints !!

Removing Solder

- ▶ So what do you do when you need to take a soldered connection apart ?
- ▶ Reheat the connection and pull it apart
- ▶ Remove any excess solder
 - Reheat solder, wipe with rag or sponge
 - Solder wick – heavily fluxed copper braid
 - Solder suckers – mechanically removes molten solder

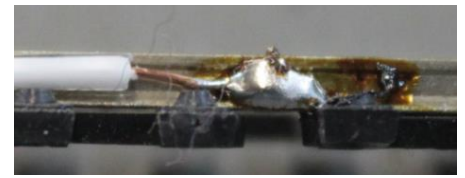


Insulating your solder connections

► Materials

- Heat shrink tubing – slide tubing over connection, and shrink tubing with heat
 - 2:1 and 3:1 shrink ratios are common
- Liquid insulation – brush on, handy in awkward situations
- Tape – easy to use, but often comes apart (especially if it gets warm) and leaves sticky residue

Soldering feeder wires to rails

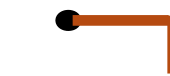
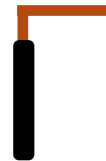


- ▶ Soldering feeder wires to rails presents one of the biggest challenges in Model Railroading
 - Tight spaces, large heat requirements and close proximity to plastic ties
- ▶ Remember, all surfaces must be clean

- ▶ Start by tinning both the feeder wire and the rail

- ▶ Form the wire with pliers

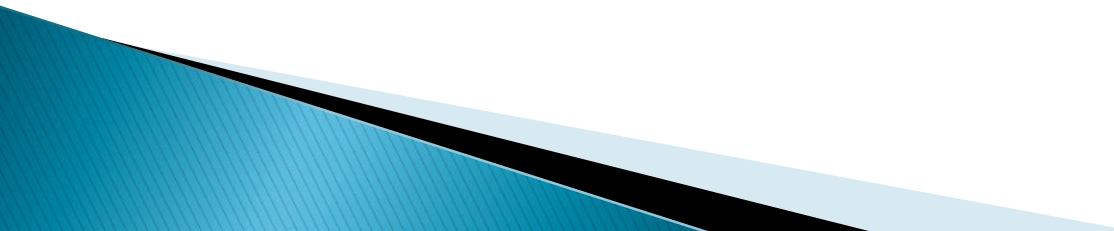
First bend



Second bend

- ▶ It is ok to cheat a little and “transfer” a little solder as long as all the parts have been properly tinned

Demos and hands-on

- ▶ Maintenance of Soldering Iron tip
 - ▶ Stripping a wire
 - ▶ Tinning a wire
 - ▶ Soldering two wires
 - ▶ Soldering a feeder wire to a bus wire
 - ▶ Soldering a feeder wire to rail
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Thanks for Coming Tonight

See you for the next Derry Model Railroading
Fun Night on November 8th for a discussion
on the NMRA Achievement Program