



THE GOAT

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Join our tour of Phil Everett's mining inspired On30 layout in this issue of *The Goat*.



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EDITORIAL COMMENTS

My time as editor of *The Goat* is nearing an end. I have worked on this publication for nearly two years and feel that it is time for someone else to provide the time and energy to keep moving our newsletter forward. I will assemble the first edition for the New Year (Volume 20, Issue 1) and will help a new editor with the spring edition. Further, I will be happy to help the new editor by providing some of the content for future newsletters.

What are the requirements for being the editor of *The Goat*? Foremost, you absolutely must enjoy writing ó both original composition and also editing the work of others. You also need time and computer skills. I put in about 40 hours for each edition ó but a lot of that time is creating content. The more help that you can find in the writing end of things, the easier it will be for you as editor. Unfortunately, I have found it difficult to obtain a *regular* source of material. I do thank those of you who have provided content and those who have worked with me to make my job a little bit easier.

I use Microsoft *Word* and an Adobe® product to create the final edition in a öPDFö format which I then sent to **Jim Trunzo** for posting on the Division's website. I don't own publishing software nor am I particularly interested in learning a new program. If you use *Word* or have other publishing software available to you, then you should be good to go. If you want to use *Word* I can provide a basic layout that I use as a template. I haven't gone so far as to create a true template nor have I created styles but if you are skilled in *Word* both of those could be useful.

The primary distribution channel for *The Goat* is the 5th Division's website. However, I do maintain a mailing list in a *Google* account that I can export for purposes of ödirect mailö I have never used my list for any purpose other than distribution of *The Goat* so if I give it to a new editor it must be used only as intended.

Finally, I have a list of contacts from which I ask for input before putting an issue öto bedö. Some of these contacts may respond with material and you will want to develop a relationship with them.

So, one more issue for me then the baton must be passed. If you want to become editor of *The Goat* you should contact Superintendent **Gary Thurow** at (509) 838-7174 or email to gathurow@cet.com.

I hope that I have met your expectations with regard to the quality of this newsletter. I have tried to establish a solid base to make the job of a new editor a little bit easier. Working on *The Goat* has been fun and sometimes frustrating but I am proud of what I have accomplished and for what I can pass on to a new editor. I sincerely hope that *The Goat* will continue to be a quality newsletter in the capable hands of a new editor.

Alan Ashton (Spokane, WA)
Editor, *The Goat*

The views and opinions stated in *Editorial Comments* are not intended to reflect those of the NMRA or regions or divisions thereof. As the editor of *The Goat*, I welcome your comments and opinions regarding the comments made above or any other statements made in this publication. Send your comments to Alan Ashton, Editor (PNR5DNews@gmail.com).

RAILROAD EXPERIENCE: BEING AN “OLD ROOKIE”

Contributed by Mike McGee (Juliaetta, ID)



The title of this may seem like an oxymoron, but attending my very first NMRA related (PNR) convention in June at Tacoma has caused me to reflect upon the experience and has made me feel as if I am an old rookie.

Like many of us I was sitting on the fence trying to make up my mind whether or not to attend the PSX 2014 PNR Convention. Around the first part of April I was looking at the PSX 2014 website studying the clinics, layout tours and prototype tours and I noticed a very familiar name of a longtime friend of mine on the coast who had signed up to conduct two clinics and curiosity got to me. I contacted this gentleman to confirm if it was him or not and that he was going to conduct these clinics in Tacoma. To my shock, low and behold it was him for a fact!

I have known this man since the mid 1990s. We had both worked on and operated each other's layouts prior to my relocation to Idaho in the fall of 2003. All of this time that we have known each other I had no clue that he was a NMRA member. I had joined the NMRA in 2009 even though I have been a model railroader since 1979. After I got off the phone with him it was quickly decided that I was going to Tacoma.

Prior to this event my only other exposure to any events related to the NMRA were two 5th Division Spring Meetings and the 5th Division Fall 2010 Mini-Meet that was held in Lewiston. That is where I succumbed to the arm twisting and opened up what I refer to as my half-baked N-Scale disaster downstairs for the layout tour. I had no idea what to expect or what was expected of me.

It certainly was relieving to me to be in the company of a longtime friend and many familiar faces at my first convention. I was able to attend the PNR Board Meeting, learn a whole bunch at the clinics I attended, got to take PNR President Walt Huston to lunch, meet folks that I have talked to on the phone and communicated with via email and finally put faces to the names that I recognized.

After many years of chasing the Mt. Rainier Scenic Railroad when I lived on the Coast, I finally got to go ride on it. It is much different riding on that train than chasing it down the highway from Elbe to Mineral. It was a very enjoyable trip. The folks that run that operation put on a great lunch, they were very warm, welcoming and open to answer any and all questions that were asked and were free to provide access for one to go have a look see.



I also enjoyed the tour Tacoma Rail conducted. I certainly did not expect to get put on a train to tour the Tacoma Rail system on the tide flats. It was very informative.

The guys at the PSMRE at the Washington State History Museum gave us a behind the scenes blue ribbon tour. I just had to go over there to compare their HO version of Lester/Stampede Pass to my N-Scale version that I am

modeling here at home. They do have their hands full with operating a very nice operating public display. I was very impressed.

I was surprised to meet fellow firefighters who are also model railroaders ó what is up with us firefighters being model railroaders, anyhow?

It was a very busy time attending PSX 2014. I even got to see two of my grand-daughters for their birthdays. I also got to finally complete an ongoing discussion with Bob Sample that he and I started at last October's Spokane Train Show. I had fun, enjoyed visiting with folks, the Banquet Dinner, seeing old friends and making new ones. This long time model railroader now has his first convention under his belt ó just being an old rookie.

*Editor's Note: Mike McGee is currently the president of the **Lewis Clark Train Club** that is located in Lewiston, Idaho.*

Picture Gallery ó PSX 2014 (Mike McGee Photos)



LAYOUT TOUR: PHIL EVERETT'S NARROW GAUGE



Phil Everett stays very busy with his many railroad interests. You have probably already recognized him from his involvement with the 5th Division since he has been the chairman of the Achievement Program for several years. Phil is an expert modeler and has achieved recognition for his work in the form of a *Master Model Railroader* (MMR) designation and an *Author Certificate*. Phil is particularly proud of his Author Certificate since it was his first and forced him outside of his normal comfort zone. Phil is also a member of the River City Modelers club in Spokane and has contributed a lot to the scenery that is enjoyed by visitors to the club's layout.

Phil's interest began with a train set that he received as a gift from his parents. He admits (reluctantly) that the train set didn't last long as it was somehow "wrecked." He didn't get another. Later, after he began working as a clerk for the Union Pacific Railroad, Phil's interest in modeling was kindled. His first of four layouts was undertaken while he lived in Seattle during the mid-1960s. A friend at the UP gave Phil some HO equipment and his interest took off from there. Like most of us, the time that Phil could devote to model railroading waxed and waned with work and family obligations but he has stuck with the hobby for the better part of fifty years.

Phil spent much of his life in Seattle but moved to Arizona in the mid-1990s. He lived there for about ten years and his interest in mining operations expanded. Phil says that he really liked the beautiful scenery and rich history of rail roads in that part of the country. Although he had a layout in Arizona, it was located in his garage which was too hot in the summer and too cold in the winter. It wasn't finished when he and his wife, Ann, moved to Spokane.

Most of Phil's modeling was in HO until recently. Spurred by his continuing interest in mining, Phil sold off most of his HO equipment, structures and supplies in favor of a new On30 layout. This layout, which we are touring today, began in 2007. Phil describes the layout this way: It is an "experimental" endeavor that started with benchwork that goes around the perimeter of his eight foot by 28 foot room and has no legs on the ground. It is supported by steel brackets that are bolted to the wall. A second aspect of his experimentation is his use of natural materials for scenery. Phil's layout is set in the southwest during the early 1970s but he doesn't model any particular place.

Since Phil's earlier layouts used DC and since he still has a couple of locomotives that he wants to use for service to specific industries, a small part of the layout is still DC only. The larger part features DCC cab control using Model Rectifier Corporation's *Prodigy Advance* throttles.



The lonely figure that waits upon a bluff overlooking Phil's layout is a reminder that we have only a limited time to complete our layouts. So, AFTER you finish reading this issue of *The Goat*, get back to work!



Phil's layout is still a work in process and the track work is about 95 percent complete. Phil's personal interests tend to be focused on scenery, including scratch building many of the structures found around the layout. He says that the scenery is about 60 percent complete.



Here is the Old Town ore loading facility. A small gas driven switcher has pushed a loaded hopper into place on the loading trestle.



This Bachmann 2-4-4 locomotive is heading into the industry track that services the Monolith Ore Processing Company. Monolith rock is seen in the background.

The rock, so the story goes, was found at a mining operation near Anaconda, Montana. Phil picked it up while visiting the mine (he says that he had permission to be on the site though maybe not to take a sample). He thought that the color might indicate the type of minerals inside but, upon closer inspection, once he was back home, it turned out to be just a rock. But what about the color, you ask? It was simply naturally weathered by its surroundings at the mine.



This is another angle of the Monolith Ore Processing plant. The building was completely scratch build including the window panes. (Or, are they really window panes? Phil didn't elaborate.) Overall, Phil says that about half of the structures are from kits and the other half are scratch built.



This is the *Silver Queen Mine*. Although not intended to represent any part of its namesake, the Silver Queen was one of the richest silver mines in Arizona and is located not far from Superior (AZ).



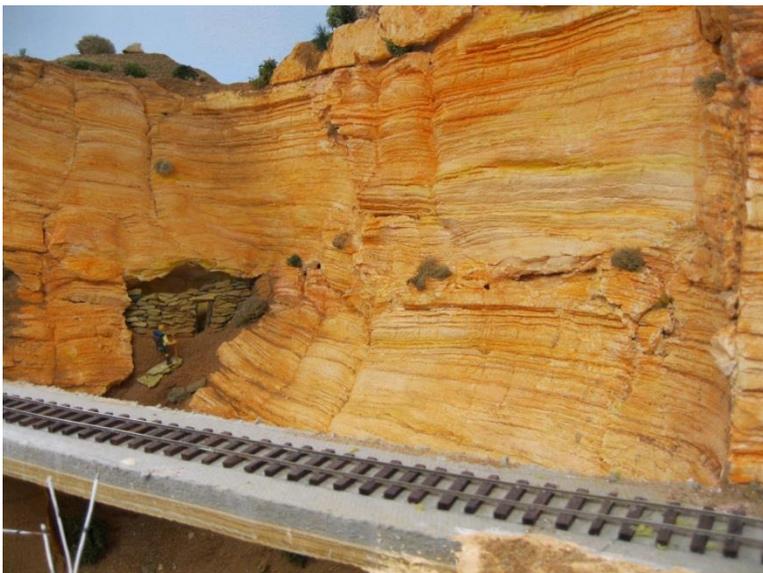
This is the *Lucky Friday Mine*. The small ore car (exiting the mine) was made from an N-scale gondola.



A nicely detailed drover caboose was found at the Steptoe station. Notice the fine weathering on the structure. Phil inherited this building (in pieces) from a friend. He isn't sure about where it originally came from but it makes a very realistic and interesting focal point for this part of the layout.



Phil has a locomotive roster of approximately 10 engines, mostly steam era. His rolling stock inventory of about 25 cars is mostly for freight and mine service but Phil also has a couple of passenger cars.



Phil's enjoyment of southwest scenery lead him to use a *Bragdon Enterprises* latex mold (sandstone). The mold proved to be too large for the space that Phil had available for this formation so he had to bend, fold, break and mutilate until it fit. The color and texture really look great!



Phil explains some of the things that he likes about working in his shop space which is located in a separate room from the layout. On this day he was working on a section of retaining wall.



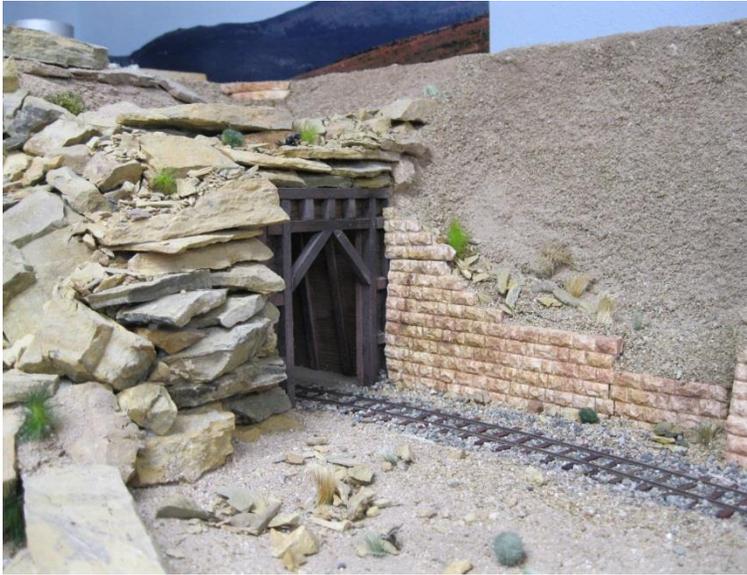
Later, we checked out another project that Phil is working on. It is another ore tibble; one that has more recently been moved to the layout. The positioning is temporary, however, because the elevation isn't quite right for the ore cars to be loaded. "I'll get back to that, eventually." Phil says.

Note the glass on the workbench (the tape protects the edges). Phil likes to do much of his work on the smooth glass surface. You will also see that there is a cutting mat under the glass so it's easy to align material for gluing. If you accidentally glue something to the surface it's easy to get it up using a one-sided razor blade. You can clean the surface of the work area without damaging anything. The glass also provides a very flat surface to work on.

Fact Sheet

Scale and Gauge	On30
Room Size	8 feet by 28 feet
Mainline run	Approximately 40 feet
Roadbed construction	Hand laid track on Homasote®
Minimum radius	Phil doesn't specify. His track is all hand laid and, as Phil says: "It just goes where it needs to go. I don't think too much about the radius or grade."
Maximum grade	Most of the DCC parts of the layout are essentially "on the flat." The DC portion that serves a mine has a pretty steep grade but Phil didn't measure it.
Number of turnouts	Three on the DC portion of the layout and 14 on the DCC parts.

A picture gallery from our tour of Phil Everett's On30 layout:



WORKBENCH PROJECTS: AN “INDUSTRIAL” POLE LIGHT (HO)

Contributed by Alan Ashton (Spokane, WA)



Here is an easy way to build street or industrial lights that are located on a telephone pole. The project involves inexpensive and readily available parts and can be completed in an hour or so.

The parts that you will need include the following:

- 3mm white LED (T-1)
- 270 Ω resistor (for a single lamp)
- Plastic coffee stir sticks (round, hollow)
- Fiber washer that fits over stir stick
- Shade made from furniture upholstery nail
- Hook-up wire (30 AWG)

Most of the parts will be available through local sources. I was able to find some plastic coffee stir sticks at a coffee bar but similar material could probably be purchased at a grocery store. If you can't locate stir sticks then opt for tube styrene with a suitable diameter.

The fiber washer was located in the open stock bins at a local Ace Hardware store. I just went in with a stir stick and browsed the stock drawers until I found what I was looking for. If you want a quick alternative you could cut out a semi-round piece of cardboard, cut an

X at the center with an X-Acto knife and push the tube through. Glue it in place and you have a base to work with. More on this later.

A fellow modeler located the furniture upholstery nails at a nearby Fred Meyer store. The manufacturer and part number might be helpful: Hillman part #532689.

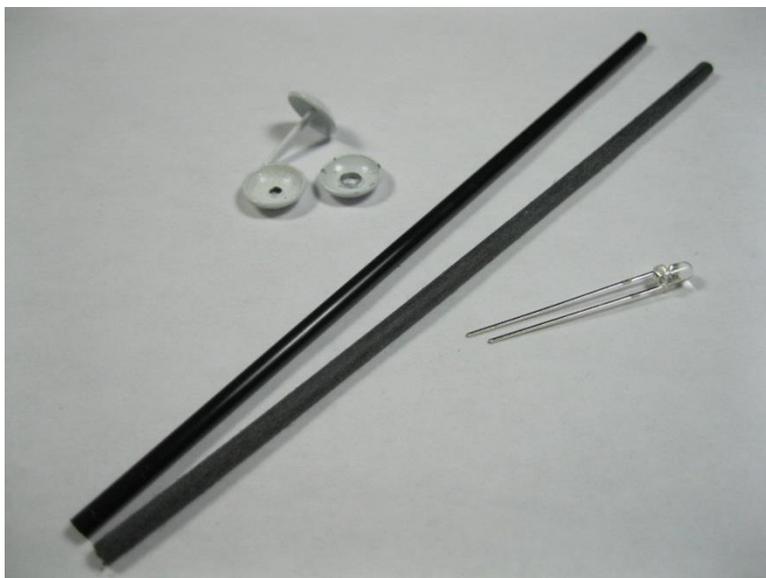
The wire can be 28 or 30 gauge and can be found on-line or at a local Radio Shack store. The 30 gauge wire that I like to use is sometimes referred to as wire wrap but I'm not sure what that refers to. I purchased my wire at Jameco.com. The product is called *Kynar* wire wrap. The red is part number 22631 and the black is 22577.

Electronic suppliers including Radio Shack, AllElectronics.com, Jameco.com, DigiKey.com and others can supply you with the LEDs and resistors. I used an ultra-bright white from AllElectronics.com (part # LED-83). With a 9-volt power supply, a 270 Ω resistor will work but you can go to a higher value without diminishing the output (within reason). I used a 510 Ω since I had quite a few in my supply drawer.

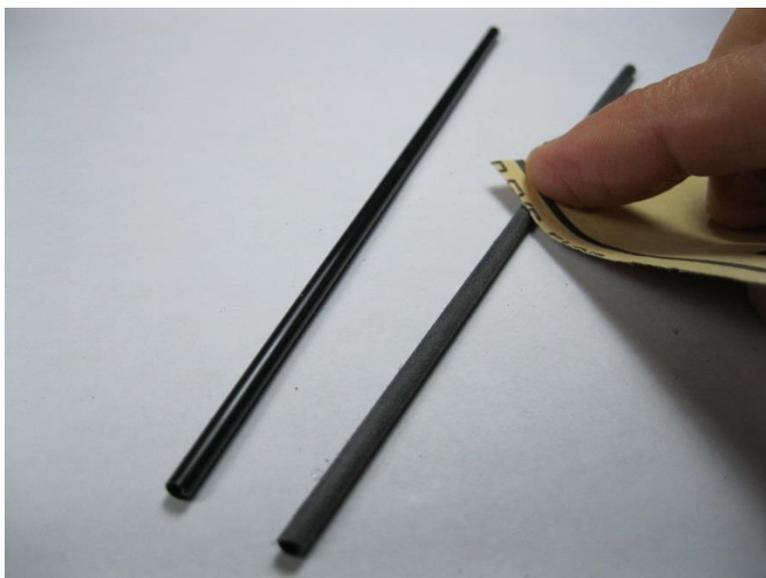
You will also need a few supplies:

- X-Acto knife (#11 blade works well)
- Liquid tape (insulating)
- Sand paper
- 1/8" twist drill
- Small twist drill and pin vise
- Modelers putty
- Acrylic paint (white, black, shades of brown, modeler's choice)

The liquid tape can be found at local hardware stores (I used one manufactured by Gardner Bender). It is used to help provide insulation between the LED leads and the metal shade and to block light that would otherwise leak from the top of the LED. I used Green Putty from MMD but other fillers could easily substitute. Any brand of acrylic paint should suffice.



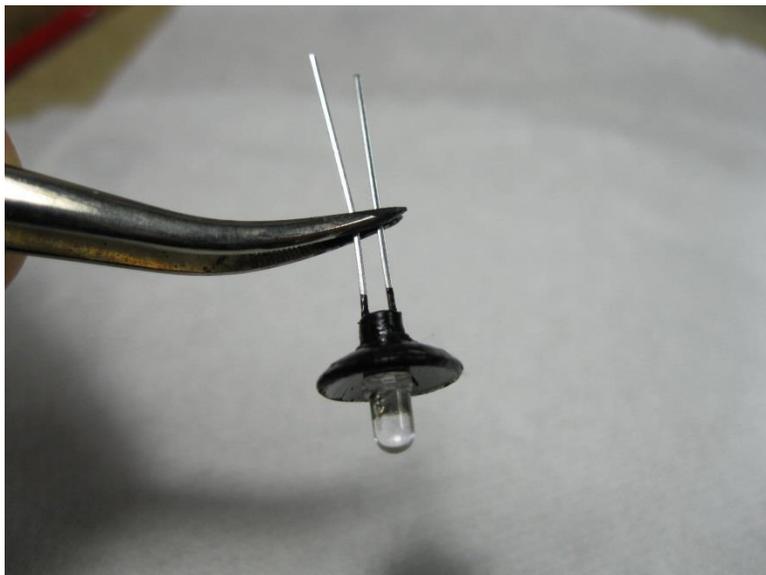
Gather the materials and prepare the shade. I found that tapping the nail point with a hammer while holding the upholstery tack upside down on the slightly open jaws of my shop vise easily knocked it out. This technique provided a very clean hole although not big enough for the LED leads. I used a 1/8" twist drill to enlarge the hole. If you wind up with some flash you should use a file or Dremel tool to clean it before proceeding. Other types of upholstery tacks may also work but you may find it necessary to drill out the hole if the nail cannot be knocked out. The picture at left shows the tack, before and after the nail was knocked out and then again after the hole was enlarged to 1/8".



Next, I prepared the pole. The coffee stir stick was smooth and shiny so I roughed it with course sandpaper. A primary coating of paint can be applied at this point but you will probably want to add more later on.

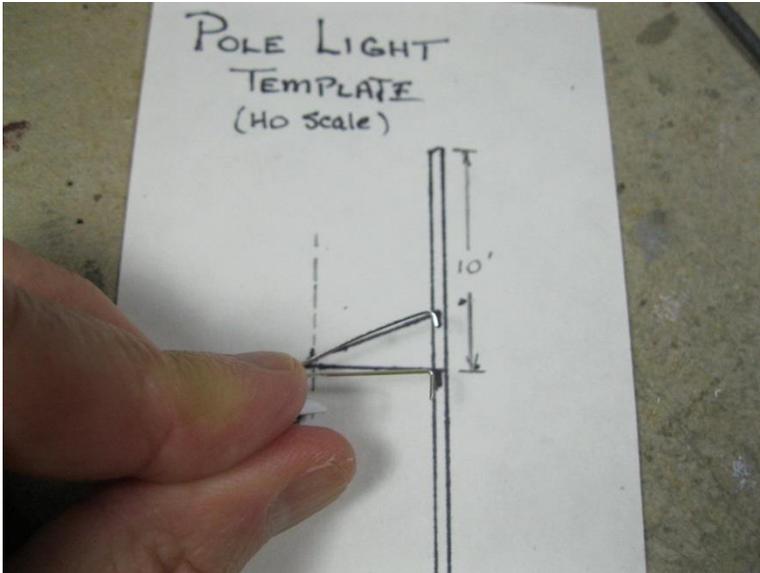
I also cut off a short piece of the stir stick for the next step. About 3/16" should work but precision isn't necessary here.

You can see in the photo that the stir stick on the right has a dull appearance compared to the shiny stick to the left. A closer examination would show a grainy appearance that is a satisfactory approximation to wood. It will look good when painted in a later step.



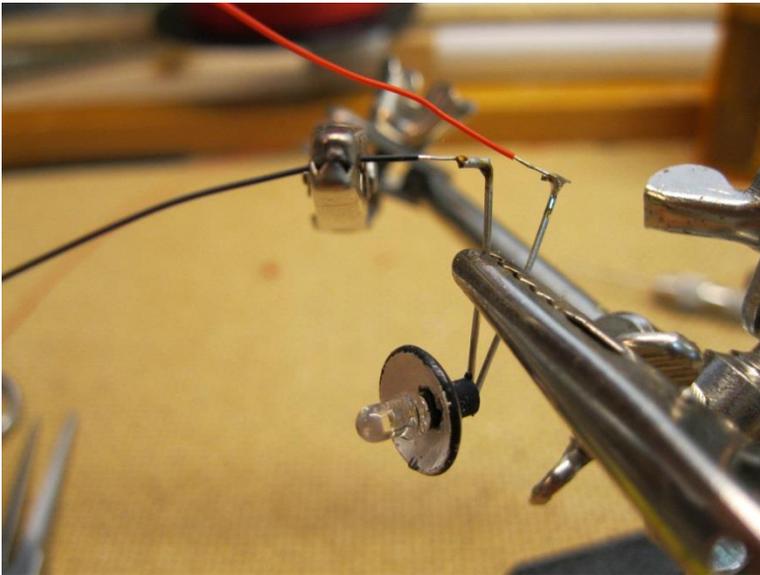
I slipped the short (3/16") piece of stir stick over the leads of the LED to act as an insulating bushing. Then, the LED leads and the bushing were inserted into the hole in the shade. The bushing provided insulation between the leads and the metal shade but allowed light to escape upward.

Using a toothpick, apply liquid tape around both leads of the LED, mostly filling the space inside the bushing. You can also use an adhesive such as a five-minute epoxy to hold the shade in place but I found that it pretty much stayed where I wanted it.



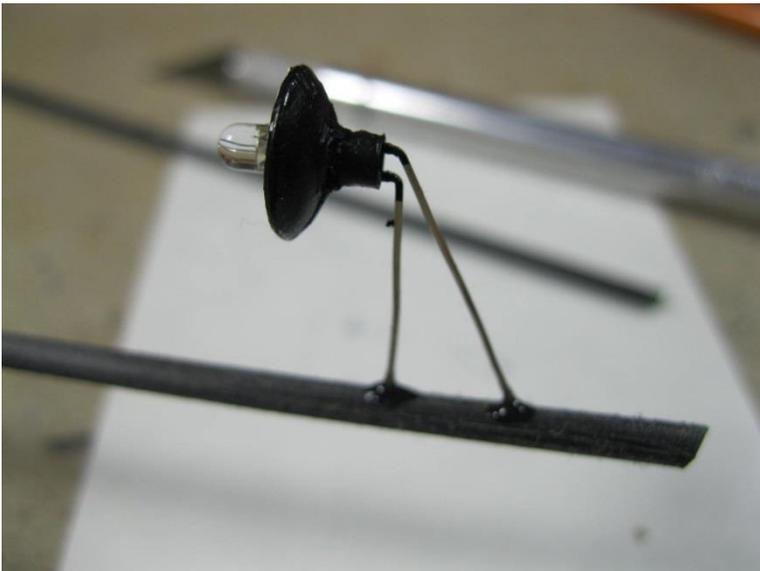
Because I intend to make several similar lights I made up a quick guide (template) to help me get close to the same bends and angles. I used needle nose pliers to bend the LED leads. The shorter (cathode) is on the bottom and the longer (anode) is on the top. The angle between them is about 30 degrees.

Once the angles were made to my satisfaction, I used the needle nose plier to bend the tips downward. I will be soldering the light post leads to the LED leads so using the template helps to visualize where the bends need to be. Also, from looking at the diagram, you can see that the bends will help to hold the light arms at the proper angles once the leads are positioned on the post.

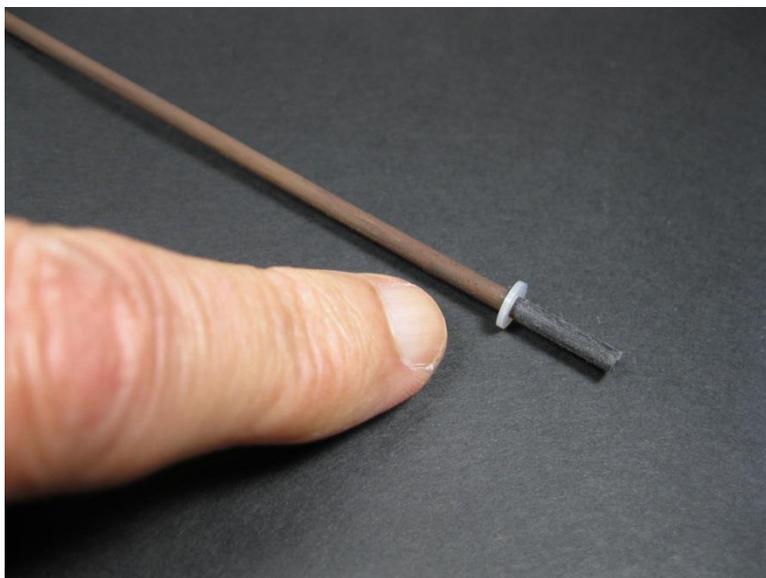


Next, I soldered 30 AWG wire leads to the LED leads. The positive (anode) is red and the negative (cathode) is black following customary color coding.

Two small holes were then drilled into the stir stick and small cuts were made above and below the holes to allow easy insertion of the lighting leads. The wires were fed through the holes and guided out the bottom of the stir stick. The LED leads were then pushed into the holes and small cuts.



Once inserted into the stir stick, the light pretty much stayed in place but it did rock back and forth a bit. So, I put a drop of CA gel on each hole to help hold the leads where I wanted them.



I glued a small fiber washer on the base of the pole. The placement of the washer will determine the height of the pole from the ground and provide for a spot to glue the post in place. If the pole is to be planted on a slope you can make a small disk out of cardboard (like from the backing of a tablet) and make an hole in the center using your X-Acto knife. Simply push the wires and base of the post through the hole and glue it in place. You can test fit and adjust the angle of the pole and cardboard before the glue sets up.

The pole, guides and shade were painted and allowed to dry.



I used a 1/8 inch drill to punch through the scenery base where I wanted to place the light. I then fed the wire leads down through the hole followed by the base of the stir stick. A little bit of adhesive keeps it in place.

Under the layout I added a resistor and hooked the light into my 9-volt accessory circuit.

A little bit of scenery touch-up and the job was done.

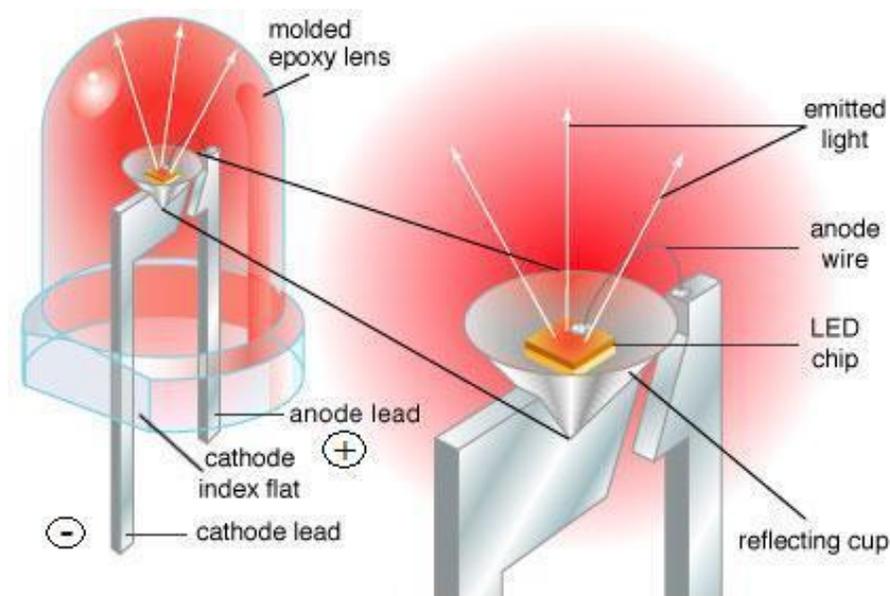
CLINIC: LED 101

Contributed by Alan Ashton (Spokane)



Before you set out to install lighting on your layout you should consider LEDs. LED is shorthand for *light emitting diode*. A diode, as most of you know, is a two-terminal semiconductor electronic component with *asymmetric conductance*; it has low (ideally zero) resistance to current in one direction, and high (ideally infinite) resistance in the other. In simpler terms, it is an electronic device with two wire leads that allows current to flow in only one direction. An LED works like a diode with respect to the one-directional current but it also has the ability to release some of the energy flowing through it in the form of photons (light).

For model railroaders, the importance of LEDs can be summarized as follows: 1) they are relative inexpensive to buy, 2) they use very little energy, 3) they can last a really long time, and 4) they come in a variety of sizes and colors. Their size, energy consumption and longevity most often make LEDs a better choice than incandescent bulbs.



At this moment we don't need to go any further into the science of LEDs but we do need to understand a little bit about the physical architecture of the commonly available types of this device.

For those of us who model in HO scale or larger, the two-lead LED with a molded lens that protects the LED itself is a good place to start experimenting. An example of this type of LED is shown at left.

When we wire an LED into our layout we first need to know what kind of power is needed. Generally, a low voltage direct current (DC) supply is needed for LEDs. Consider having voltage sources between six and 12 volts available. If you want to

keep everything as simple as possible you can go with the 12-14 volt "accessory" outputs common to power packs but there are a few drawbacks to that plan. But I will reserve commenting until later.

Second, we need to understand the physical elements of the LED itself. Because an LED will conduct current in only one direction, you need to know how to identify the anode (+) and cathode (-) leads. Most LEDs with a molded lens have a flat "index" side that identifies the "negative" lead or the *cathode*. In addition, most will also have one longer lead which usually identifies the "positive" side or the *anode*.

Choosing an LED

The first thing to consider is *size*. What is your application? Are you installing lighting inside a building or are you designing exterior lighting? If the LED can't be seen, as inside of a structure, then it can be larger. If the LED is to be seen, as in a shaded lamp outside of a building, it should be smaller. LEDs with the epoxy lens come in several sizes. The two sizes that you might want to consider while gaining experience are 5mm (sometimes referred to as T-1 3/4) and 3mm (sometimes referred to as T-1). For the time being I won't be discussing *surface mount* or "micro- or nano-LEDs" but these are still important for modelers as they can be fit into locomotives and can also provide a suitable light source for special situations such as street lights, warning lights and vehicle lighting. You will also be interested in these really small LEDs if you model in N- or Z-scale. One more word about these

smaller LEDs: the terms *micro* and *nano* are not necessarily industry terms but are sometimes used to describe products on websites that specialize in related products.

The next thing that you need to decide is what *color* you need for your application. Your first response for common lighting is probably *white* and that is a good place to start. But *white* can range between white with a yellowish tint, sometime called *warm white*, or white with a bluish tint sometimes called *cool white*. Then, there are also distinctions such as *ultra-bright* and *diffused*. It is easy to become confused by the choices. If you are just starting out, be willing to experiment and buy a variety.

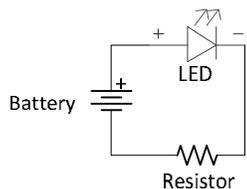
Get Ready, Get Set, Test!

Once you have your LEDs in hand you can experiment to determine which sizes and colors will work best for your applications. Before you can actually install the LEDs on your layout you will need a source of DC power and my recommendation would be to purchase a couple of wall-plug transformers. These should be *switched* or *regulated* to keep the voltage constant regardless of how many LEDs you may have on your circuit. You should also be mindful of the amperage rating; one ampere should be sufficient for small layouts since each LED will draw only about 20 milliamps. Look for more amps if you are planning a lot of layout lighting or simply purchase additional plug-in transformers for different zones.

You aren't quite ready to rock and roll yet, however. You will likely need some resistors. Why do LEDs typically need a resistor? The answer is that the resistor will determine the current flowing through each LED and the current determines the brightness and, often, color. Too little current and the LED will not light; too much current and the LED will turn into a single-use flashbulb. But what value should your resistors be?

Sorry, But It's the Law

At this point we need to resume our science lesson. There are two *laws* that need to be considered when choosing a resistor value. *Kirchoff's Voltage Law* states that in any complete circuit the voltages must balance. That is, the amount generated (at the source) = the amount used (by whatever elements are in the circuit).



Let's assume that we create a simple series circuit using a 9-volt battery, an LED and a resistor. Let's also assume that we know the optimal *forward* voltage (sometime written as V_F) used by the LED. This voltage value should be found on the specification sheet or packaging for your LED. If it is not available, assume a value of 2 which is usually safe. If your source is 9-volts and the LED is using say, 2 forward volts, then you still need to account for 7 volts. The 7 volts will be *used* by the resistor and converted to heat (measured in watts). The higher your source voltage, the more you

will need to *burn off* with resistance so why use a 12-14 volt accessory circuit on a power pack if you can supply 9-volts of regulated power at a relatively low cost?

Next, we turn to *Ohm's Law* that states the relationships between current (amperage or *I*), voltage (volts or *E*) and resistance (ohms or *R*) in a circuit. The relevant formula is $R=E/I$ where *R* is the resistor value that you will need to *burn off* the seven volts. We then need to know the optimal milliamp rating for our LED. Turn to the specifications but if you cannot locate that value use 20 milliamps (or 15 mA if you really want to play it safe).

In the example above, *E* will be the voltage across the resistor minus the voltage used by the LED; seven (7) volts. That will be divided by the current (*I*) in the circuit which we want to be 20 milliamps (0.02 amps). So, our formula is: $7 / 0.02 = 350\Omega$. We will need at least a 350 ohm resistor to maintain a maximum safe current of 20 milliamps. If we increase the resistance we will reduce the amperage (current) and thus reduce the amount of light generated by the LED.

Is that simple enough? If not, you can find several on-line tools that should be very helpful. See the links below. I'm getting older and find it easier to make mistakes that to be corrected in my calculations so I prefer to use an on-line calculator or an *Excel* worksheet that I created for my own use.

One More Calculation

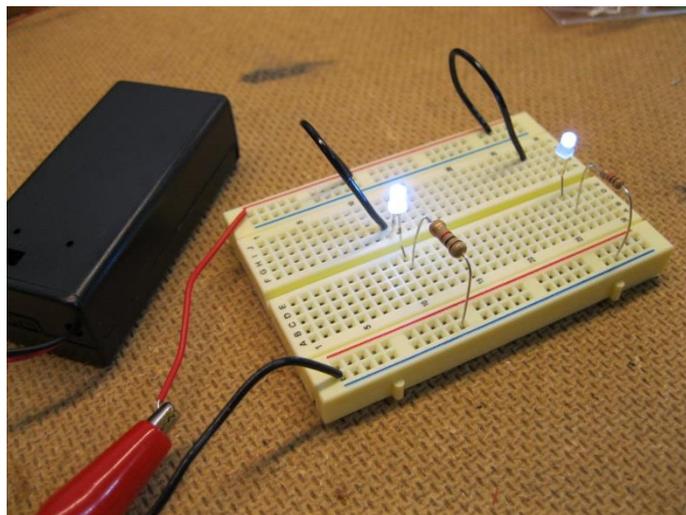
Before you rush out to buy some resistors you should have an idea of what kind of heat that you will be generating. Heat (power) is measured in watts and the formula is $P = E * I$ (voltage times current). In our example: $7 * 0.02 = 0.14$ watts. That value is important because resistors are rated for *maximum* power consumption. Our calculations indicate that a ¼ watt resistor will be needed (0.14 watts is less than 0.25 watts). If, however, you chose to use an unregulated accessory output from a power pack, the calculations for the same LED would be $12 / 0.02 = 600\Omega$ resistor and $12 * 0.02 = 0.24$ watts of power (heat). In this calculation I am using 14 volts from the power pack since it may be an unregulated source. You would be well advised to go to a resistor rated for ½ watt because you are marginally below the ¼ watt shown in the calculation.

Time to Experiment

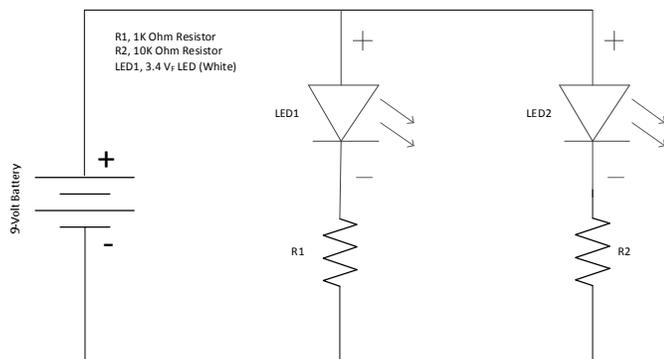
Before you actually install LEDs I recommend that you play with them for a while. Get two or three different LEDs and a few resistors. A 9-volt battery is a good source of power for your test bench. I have hooked up a little breadboard to make changes easily but you don't have to do that if you have a supply of alligator clips attached to a collection of wire leads. This exercise will build confidence quickly.

Remember a few rules:

- Make a habit of placing the resistor on the negative or cathode side of the LED.
- If you don't have a resistor at the value that you calculated you can use a resistor of the *next higher value* or you can wire two or more resistors *in series*. When wired in series you simply add together the values of the individual resistors.
- Generally, if you accidentally wire an LED backward nothing will happen (although some LEDs will light with a red color). However, if too much power is applied you could exceed the *backward voltage* and damage the LED.
- If you wire LEDs in *series*, total the forward voltages for your resistor calculation. For example, if you have three LEDs *wired in series* and they each have V_F of 2 volts, use a total V_F of 6 volts for your circuit calculations.
- If you wire LEDs in *parallel* and use a single resistor, the required value (ohms) of the resistor can be divided by the number of LEDs in the circuit. Because more power must be dissipated by the resistor, the wattage rating will likely need to increase.
- LEDs are pretty inexpensive so if you fry one, don't fret. Just learn from the experience.



This simple circuit demonstrates a few of the points that I have tried to communicate in this clinic. My breadboard is connected to a 9-volt battery. The black lead is the negative side and the red is the positive. The two LEDs are identical and each has a V_F of 3.4. They are wired in *parallel*. There are two resistors in the circuit; the one on the left has a value of 1,000 Ω (1K) and the one on the right has a value of 10,000 Ω (10K). Notice the difference in brightness. This could be useful if you wanted to have one circuit driving two building lights. Perhaps you would like the outside light to be brighter than the inside light.



Here is a schematic of the circuit. I wanted to illustrate that two identical LEDs in the same circuit can have different intensities when they are wired in parallel using resistors with different values. In addition, this illustration should show that the value of the resistor is relatively unimportant provided that it is greater than the minimum needed to protect the LED. The LEDs that I selected for this illustration would each require a minimum of 280Ω yet both are still lighted with up to $10K\Omega$.

Some final comments:

- LEDs generally don't generate much heat or nor should the resistors in this type of usage. If you feel the LED and then the resistor and one or the other feels warm, recheck your calculations. An LED may run hot for a while but heat can drastically reduce the life of the component so don't take chances.
- An LED rated at 20 mA will usually have a peak load of around 30 mA (check your specs). For this reason, you can "overdrive" the LED if the time period is brief. Think about this when you want an LED flasher. You won't build up much heat if the LED is on for just a fraction of a second.
- For more complicated applications it is a good idea to test for brightness and color before you actually install the circuit on your layout. Ideally, you should check out how the LEDs will look on the layout but that is not always practical.

In a coming issue of *The Goat* we will look into more characteristics of LEDs including brightness and color. We will also take a look at surface mount LEDs that come in a surprising variety of sizes and have many useful applications. Watch for it!

Sources

Here, in no particular order of preference, are some sources for LEDs and related supplies:

All Electronics	http://www.allelectronics.com/
DigiKey	www.digikey.com/
Evan Designs	www.modeltrainsoftware.com/
Jameco Electronics	www.jameco.com/
Mouser Electronics	http://www.mouser.com/
nGineering	http://www.ngineering.com/
Radio Shack	http://www.radioshack.com (also, check to see if you have a nearby store)
Richmond Controls	http://www.richmondcontrols.com/

You should be able to click on any of the above addresses if you are reading this on-line. Otherwise, type the address into your browser when you want to check out their product lines.

Resources

If you would like to use a calculator on-line here is a good one: <http://ledcalc.com/>. This tool will calculate the size of the resistor that you need and graphically show you the circuit along with the power consumption. It will also do the calculations for both parallel and series circuits with multiple LEDs (assuming that each of the LEDs has the same V_F).

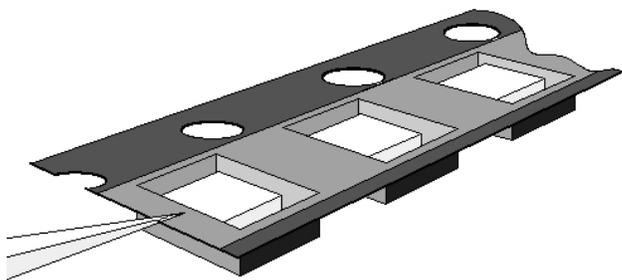
TIPS & TECHNIQUES

If you have tried soldering 38 AWG wire to very small *surface mount* LEDs you may have muttered a few words that are not used in polite company. I recently purchased some streetlights from Ngeengineering.com (www.Ngeengineering.com) and talked briefly to **Tim Anderson** of that company while at the train show in Calgary last spring. Besides words of encouragement, Tim has provided some really great tips for soldering these very small components. What appears in our *Tips and Techniques* column is adapted from Tim's website; with his permission, of course. If you have never worked with magnet wire you may want to read *A Word About Wire* that follows the soldering article first. [Ed.]

SOME TIPS ON SOLDERING THOSE VERY TINY LEDs

Contributed by Tim Anderson, Ngeengineering.com

Many of our products are packaged in a protective carrier strip. Some items are sensitive to static electricity and the carrier is a black plastic material designed to help protect against static discharge. Other carrier strips can be clear plastic or a pressed paper strip. The sketch below is an example of a typical anti-static carrier strip.

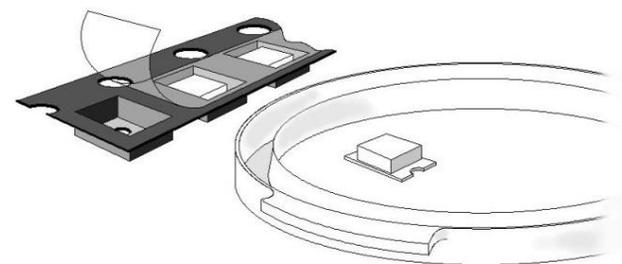


The actual parts are housed in small 'pockets' in the strip and are held in place by a thin clear plastic film strip which covers the pockets.

To remove the parts from the protective carrier, simply slide a sharp tweezers under the clear film at one end and peel it back as shown at right.

We recommend **only** exposing as many pockets as are needed for the parts currently to be worked with. Simply tip the carrier and the part(s) will fall out.

Some parts are extremely small and can be easily misplaced. For example, our nano-LED can easily hide under the end of your fingernail! Be sure to use good lighting and a clear working area when opening the protective carriers.



We have found it best to tip the opened carrier strip over a small receptacle to catch the parts, rather than placing them directly on the workbench surface. An ideal receptacle is a white plastic pill bottle cover turned upside down. It is soft plastic so it cannot damage parts, it has a raised edge or lip to retain parts, and it is bright white so parts are very easy to see. Also, they're readily available... and cheap!

VERY IMPORTANT: Our micro-, nano- and subminiature-LEDs are available in different colors. These different colors are produced electronically, not by the color of the epoxy capsule on the part and each color has a **different** device voltage. Once these parts and carriers are removed from their labeled bag, it is impossible to tell one color from another. Applying the wrong (excessive) device voltage to an LED will weaken, if not destroy it.

It is **strongly** recommended to work with one color LED at a time and always return the unused portion to their labeled bag or an appropriately marked container. Nothing can spoil a project like unnecessarily zapping a few LEDs.

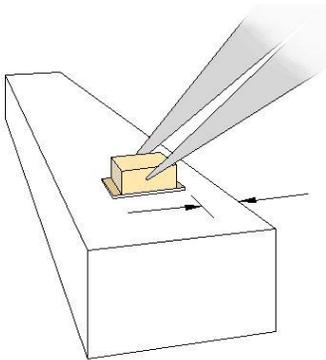
Our surface-mount resistors are housed in a similar carrier strip. We carry three sizes (1/8-watt, 1/4-watt & 1/2-watt), and many different resistance values of each physical size. Unlike our LEDs, each resistor is stamped with a number on its surface that corresponds to the resistance value (and our part number) so mix-up won't be a potential problem.

Wiring our Micro-LEDs

If you've wired up some of our 2x3 LEDs, you've gained the general techniques required to wire up our micro- (or nano-) LEDs. The solder pads are much smaller (as are the LEDs), but with good magnification (here we go again), all of the same steps apply. (If you need to review wiring procedures for our 2x3's you may visit our website at www.Ngineering.com.)

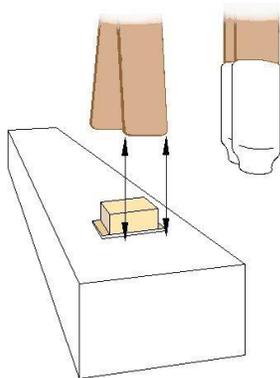
Following is a graphic step-by-step wiring of a micro-LED using our **NT301 Holding Tool**. The wire routing method shown, we refer to as "back wiring" (for lack of a better term). The wires are routed directly away from the back of the LED. This is a useful wiring method, for example, if we were going to build a streetlight or building light and want the LED facing down from the inside of a lampshade, or to face down from the ceiling of a building interior.

Our LEDs are packaged in a black conductive plastic carrier strip. This strip contains pockets, or cavities that contain the individual LEDs and are held in place by a clear plastic cover-strip that can be peeled back to remove the LEDs. The reason that the carrier strip is conductive is that the LEDs are **static electrically sensitive devices**. Therefore, before removal or handling of the LEDs, precautions to prevent static discharge should be taken (good grounding, anti-static mat or wrist strap, etc.).



Once an LED has been removed from its protective carrier and placed in some temporary receptacle, orient the LED so it is "face up" (solder pads and circuit board side facing down) in the receptacle. We are now ready to carefully grasp the part with tweezers and position it for wiring. Since we will be using our *holding tool*, we will transfer the LED from its temporary receptacle to a riser block as shown in the figure.

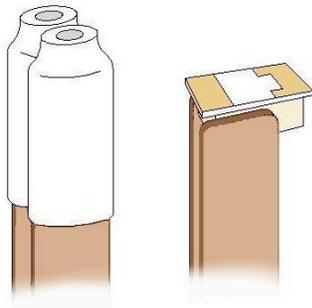
This riser block is used to space the LED above the workbench so our holding tool can properly grasp the sides of the part. This "riser block" can be any small smooth block that is at least 1/4" in height. We use a piece of 1/4" thick white styrene and it seems to work very well. As you will see in Figure 2, this block is necessary to provide clearance for the side of the tool that has the longer padded clip. Position the LED "long ways" from left to right and closer to the right side of the riser as shown by the arrows in above figure.



Now, grasp the Holding Tool by the un-padded clip and invert the Tool upside down with the unpadded clip held in the open position. Note the figure at left.

A WORD OF CAUTION!

Our RED micro-, nano- and subminiature-LEDs are wired differently than all of our other LEDs. The polarity mark on the LED is for the ANODE (+) connection, not the CATHODE (-) connection.



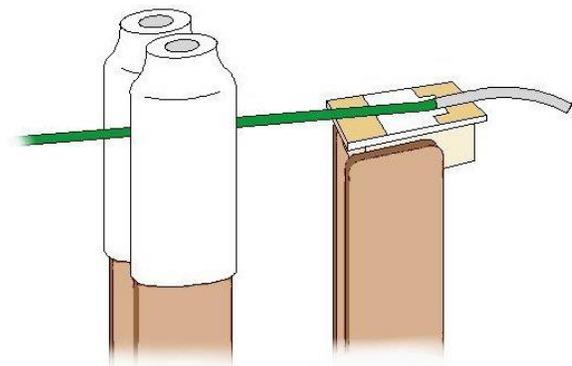
Lower the open clip over the LED and gently release the clip so it grasps the LED by the "sides". **Very important:** Grasp the LED slightly right-of-center as shown above so that the left side of the LED will be exposed past the left side of the clip as shown by the arrow positions above. This is to ensure the solder pad on the left side of the LED will be exposed for easy soldering when the Tool is turned over. See Figure 3 below.

Turn the holding tool over and clamp its brass sheet base in your bench vise or whatever you will be using to secure it while it is on your workbench surface. If you use a bench vise, note that the bottom of the brass sheet is square and straight for easy alignment in a small vise. Note that the LED is offset slightly in the clip allowing the solder pad on the right to be totally exposed. This will make soldering to the pad much easier.

Since the LEDs are polarity sensitive devices, we use color-coded wiring to differentiate between the positive (+), and negative (-) electrical connections. In keeping with standard electrical conventions, we will connect the RED wire to the positive (+), or Anode solder pad of the LED (the electrically "hot" connection), and the GREEN wire to the negative (-), or Cathode solder pad (electrical "ground" connection). Remember that in the case of Red LEDs, the polarity mark points to the **Anode** (+) connection. For all other LEDs, the polarity mark points to the Cathode (-) connection. For all LEDs, the RED wire should be connected to the **Anode** solder pad.

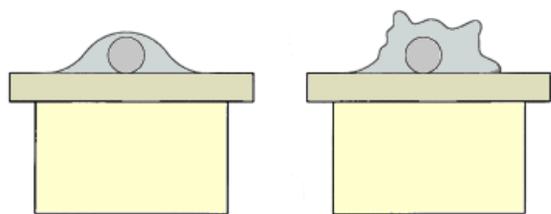
Which side is which?

The previous figure shows the back view of a typical micro-LED. Note the fat "C" shaped opening between the solder pads on each end of the LED. The base of the "C" points at the polarity mark. In this example, it points to the solder pad that is the Cathode, or negative (-) electrical connection. Another reminder is that (except for Red LEDs) the Cathode solder pad is shaped like a "C" (for cathode). Since the cathode solder pad is on the right, we will solder the GREEN wire first.

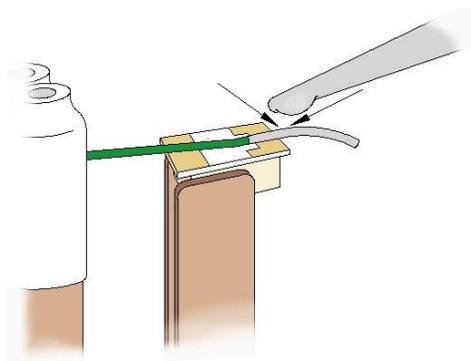


This figure shows a tinned segment of green #38 magnet wire positioned over the cathode (-) solder pad of the LED. This is performed by gently holding open the padded clip while sliding the green wire into position over the solder pad, then releasing the padded clip to grip the wire. Center the wire over the pad and align the wire so that the insulated portion begins at the inside edge of the solder pad, as shown. This is easily done by opening and closing the padded clip with the right hand while adjusting the wire with the left hand. Position the wire so it lays flat against the pad. If necessary, a sharpened toothpick can be used to gently move the tinned portion front to back for best position.

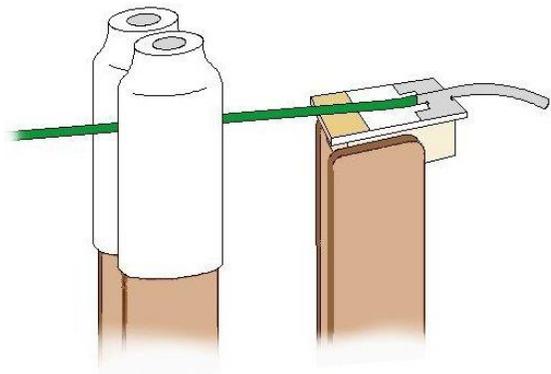
In the next step, the wire will be soldered to the solder pad of the LED. Remember, these LEDs are very sensitive to thermal shock and excessive heat. Manufacturer's recommendations for soldering of these devices limits solder temperature to a maximum of 260°C (500°F), and a maximum contact time (soldering iron contact) of 2 seconds. In reality, since the wire has been pre-tinned and the solder pad is gold plated, actual contact time for acceptable solder flow should be much less than ½ second. A quick "touch" with a properly tinned iron having a tiny amount of low-temperature solder is all that will be required to complete the solder joint. As mentioned in the 2x3 LED wiring procedure, as an aid to the quick and even flow of the solder joint, we recommend placing a tiny (very tiny) amount of liquid flux at the point where the tinned wire and solder pad touch each other. Too much liquid flux will require cleanup.



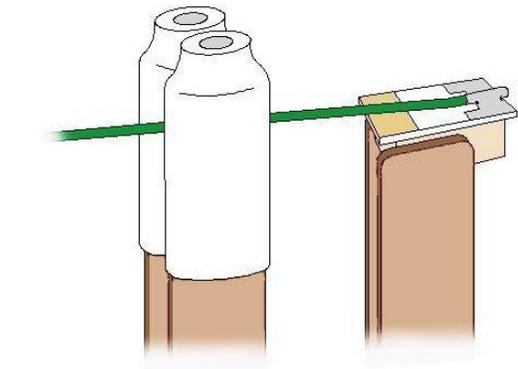
The figure at left is an end view of two LEDs. The left view shows a good solder joint which has a low, smooth profile. The LED on the right has a solder joint with too much solder, which also contains peaks and a general irregular surface. Again a tiny bit of liquid flux will assist the quick and even flow of solder.



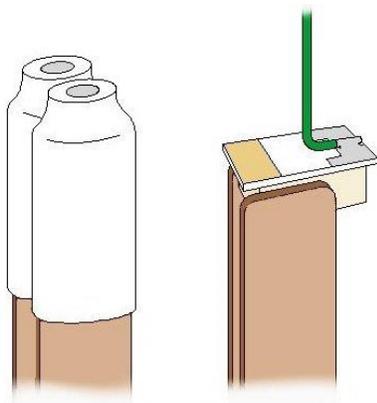
When positioning you iron tip over the part a technique that will help minimize the size of the solder "blob" that occurs at the solder pad & wire junction, is to contact the tinned portion of the wire with the molten solder just off the pad and allow it to "wick" onto the pad. The tinned wire will readily accept the molten solder and act like a wick drawing it up the wire. This method will give you much better control of the amount of solder that actually flows onto the solder pad. See the figure at left.



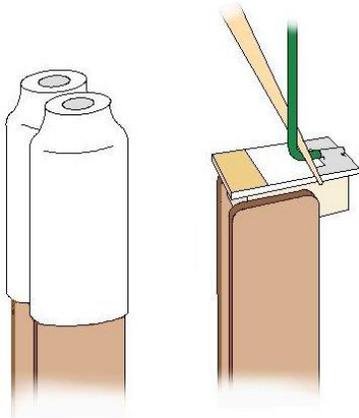
This figure shows the green wire properly soldered to the cathode (-) solder pad of the LED.



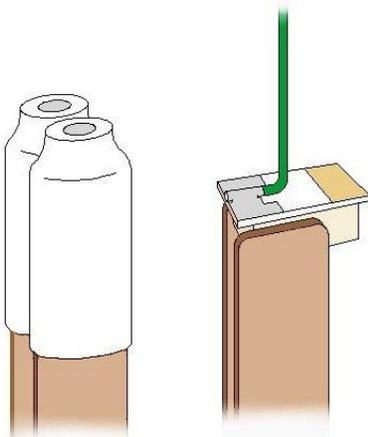
The next step is to trim off the excess tinned wire that hangs off the edge of the LED. Using micro-scissors or a sharp scalpel, carefully trim off the excess wire even with the edge of the LED circuit board as shown in the illustration.



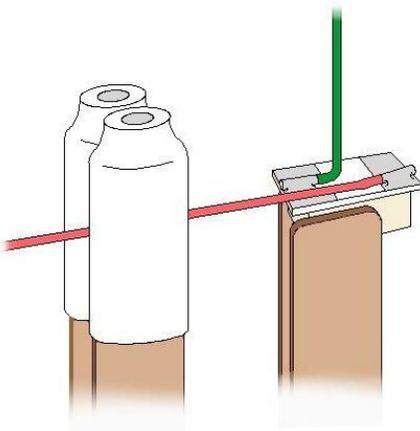
Open the **padded** clip and carefully route the green wire up, away from the Cathode solder pad as shown.



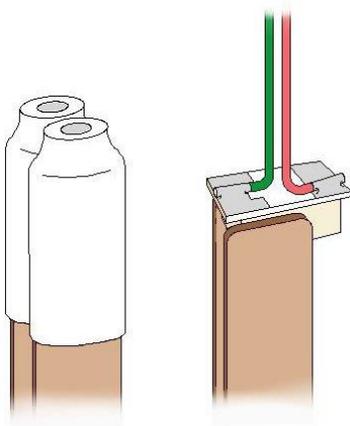
This process can be assisted by using a sharpened toothpick to help support the wire near the solder pad while pulling it up away from the back of the LED.



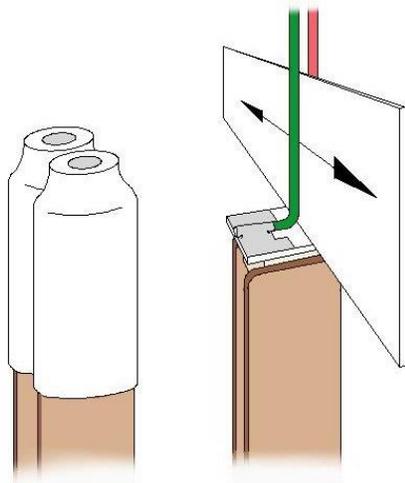
Next, we will release the unpadded clip while holding the green wire and using the wire as a "handle" rotate the LED so the other (anode) solder pad is facing left. Open the unpadded clip with your left hand and position the LED into the clip just like it was (slightly offset) before with the anode solder pad exposed past the right side of the clip, and release the clip. You may need to make tiny adjustments by holding the wire while reopening and closing the clip for best positioning.



Now, perform the same procedures as above for the anode solder pad using a tinned segment of RED #38 magnet wire.



Finally, route red wire up away from the back of the LED as shown in Figure 15 below. The wires should exit the back of the LED parallel to each other with a close 90° bend in each wire so they lay flat on the LED back and then exit up and away as shown.



Should there be any residual liquid flux from soldering in the area between the solder pads, an easy way to soak up and remove the flux is by gently sliding a small cut piece of paper edgewise between the 2 wires so that it slides along the back of the LED. The paper is quite absorbent and very slightly abrasive, so it cleans that portion of the rear of the LED very nicely.

This completes the wiring process for micro-LEDs. In addition to "back wiring" as we've shown here, there are other wiring schemes that can be useful for various applications. They are covered in detail in our Advanced Lighting section for our nano-LEDs. A link to that topic is [here](#).

Remember to thoroughly re-inspect the solder joints and be sure to test the wired LED **prior** to installation.

A WORD ABOUT WIRE

Contributed by Tim Anderson, Ngeineering.com

The magnet wire supplied by nGineering.com is manufactured by *Superior Essex, Inc.* and has a single-build (single layer coating) of Superior's Soderon[®] heat removable insulation. This is vastly superior (no pun intended) to chemical removable insulations or the kind that require scraping. While Superior has many different types of heat removable insulations, we chose *Soderon 155* for its low-temperature removal characteristics compared to their other insulations. Following is a quote from their Engineering Department:

The minimum requirements for our Soderon/155 are specified by the NEMA Standard. NEMA MW-80C requires sizes 30-36 awg to solder a maximum of 4 seconds at 390 deg. C. The requirement for 37-44 is 3 seconds maximum at 390 deg. C. Our Soderon/155 product typically will solder at least 1 second faster than what NEMA requires.

What this means for our #38 wire is that without pre-tinning, the wire can be soldered to a typical solder pad by simply applying an iron (with solder and flux) that is at least 390 deg. C (734 deg. F) for about 2 seconds and the insulation will burn back and the solder joint will be made. What could be simpler?

HOWEVER: If we did that to the solder pads on our LEDs, they'd be **cooked!**

The maximum temperature/duration guidelines for soldering our LEDs varies slightly between our 2x3 LEDs, our micro- and nano-LEDs, and our Subminiature LEDs, but is essentially 260 deg. C (500 deg. F) for 2-3 seconds maximum. For this reason, the soldering procedure we recommend is to pre-tin (thereby stripping) the wire. This does three things:

1. We control the quality and amount of insulation removal without worrying about damaging a component with excessive heat.
2. We are tinning the bare copper wire in preparation for step 3 and this pre-tinning ensures the attachment of the wire to the heat-sensitive LEDs will be as easy and as quick, as is possible. Practice makes this process easy and allows for a clean, low-profile solder joint which is very desirable when trying to get our micro- and nano-LEDs to "snuggle up" close to objects (like lampshades for instance).
3. By having the wire pre-tinned with solder, and having solder pads on the LEDs that are either gold plated or pre-tinned themselves, the wires nearly instantaneously bond to the LEDs when touching the wire/solder

pad junction with the iron. In nearly all cases a clean iron with a very slight amount of fresh solder on the tip will make this "perfect" low-profile wet looking solder joint. Hardly any cleanup will be necessary (possibly none). You may find it helpful to add a tiny (very, very tiny) amount of liquid soldering flux to the solder pad prior to this "touching" operation with the iron. This will guarantee the instantaneous flow of solder and a wet shiny joint. There are many brands of liquid soldering flux on the market. One that we've found to work very well is made by GC Electronics (their part #10-200). If used very sparingly, there should be almost no residue for cleanup. If flux remains after soldering, blot away any excess and cleanup with a Q-tip lightly saturated with isopropyl alcohol. However, do not saturate the LEDs with liquid. You may find there is sufficient flux in your wire solder that you don't need the additional fluxing agent. If so, that makes cleanup a little easier. A little practice of the above and this becomes a very easy and repeatable process.

We recommend using our 12 watt miniature soldering iron for soldering wires to our LEDs because it is closer in temperature to the guidelines of our LEDs than most small irons (it reaches 600- 650 deg. F when up to temperature) and its ultra-small size, flexible cord and short "fingers-to-tip" distance gives the best control. When you're working with tiny components like our LEDs or N-Scale locomotive decoder wiring in tight places, these features make the difference.

To properly tin the magnet wire a larger, hotter iron is necessary. We recommend a 30-40 watt iron which will give about 750-850° F. Radio Shack as well as most hardware stores carry such irons and they're relatively inexpensive. Check the iron package. It should say what the tip temperature range will be. Most hobbyists probably already have one. Using this hotter iron will ensure a brightly tinned wire with uniform burn-back of the insulation. Too cold of an iron requires a longer period of wire -to-solder contact. This discolors the insulation further up the wire and makes a ragged tinning job with poor definition between clean insulation and shiny tinned wire. With very little practice, it becomes a quick, simple, one-step motion to tin & strip our magnet wire.

To master the stripping and tinning of our wire is quite simple, but like most things, requires a bit of practice. We recommend cutting 5 to 10, 6" pieces of both the red and the green wire to use as "practice wires". This wire is very inexpensive (200 feet on our spool for just under \$5), so sacrificing a few feet is just a few pennies. The important part of this process is to develop a "tempo" that works well for **you**, with **your iron**. That builds confidence.

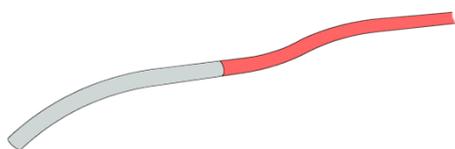
Once this is achieved, making good looking tinned and stripped wire segments becomes easy and very repeatable. This is especially important when soldering wires to our tiny nano-LEDs. The transition from the stripped and tinned portion of the wire to the point where the insulation is unstripped must be a nice clean and sharp transition, not ragged. This is because our tiny nano-LEDs have solder pads that are quite small and close together. We need to make sure the wires that exit from the solder pads are insulated so they don't short against each other.

Our "preferred method" for pre-tinning wire is to clamp our iron in a bench vise so it is held in place about 4-6" above the workbench surface and about 6" in from the front edge of the bench. This positioning gives us good comfort and hand control because we can rest our hands on the workbench for good steady support. We also want a damp sponge nearby so we can wipe the tip clean and apply fresh solder as required.

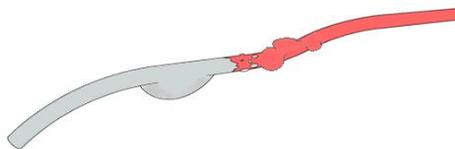


With the iron hot and the tip clean, apply solder to the tip to form a "bubble" (our N4200 solder works very well for this operation also). Depending on the type of soldering tip on your iron (flat, spade, or pointed), this bubble of solder may either be setting up on the top of the tip, or hanging down on the underside of the tip.

CAUTION: We recommend placing your dampened sponge on the workbench **directly under** the tip of your iron. If the molten solder from your iron should drip and splatter on your workbench surface, you can be severely burned and your clothing can be damaged. The damp sponge will catch any solder drip and the moisture in the sponge will instantly cool and solidify the solder.



Pick up a piece of the cut wire and poke the end of the wire into the solder bubble and immediately pull it out. If the iron is hot enough to burn away the insulation on the wire, the piece you just pulled out of the bubble should look like the figure shown at left.



If the iron is too hot or if you left the wire inside the solder bubble too long, the insulation can get bubbly and ragged looking. Too much time in the bubble can also excessively discolor and burn the insulation. See the figure at left for what you *don't* want to see.

This is the whole reason for "practice wires". To learn what works best with your iron and solder. It may take several attempts before you get the "rhythm" and resulting consistency, but it's easy once you've tried it a few times.

What we're looking for here is a definite "line" or transition where the tinned wire becomes the insulated wire. This ensures us that when we position the tinned portion over a solder pad and solder it in-place, insulated wire is leaving the other side of the pad. That way there will never be a chance of shorting to an adjacent pad or wire. When you dealing with these small components and wire, good clean soldering jobs ensure reliable connections that will work after everything's assembled and not fail later. Enough said. Try it, it's easy and you'll like the results.

Remember, it doesn't matter how long the tinned portion is (1/8" to 1/2" is fine), because you'll trim it to the length you need at hookup time.

Repeat the process for the other end of the wire. It is always good to tin both ends of every wire so that as you wire up LEDs, they can be easily tested. The wire end may need to get trimmed when running wire through tubing or a small hole, but it is easy enough to re-tin the end before retesting an assembled light or connecting the wire to a power source.

As you progress in pre-tinning wires you may find that it is very helpful to tin up a bunch of them ahead of time so when you're building various projects you don't have to stop and pre-tin wire. We keep a small section of masking tape stuck next to the workbench and tin up 10-20 of each color at a time so they're always available.

As you strip and tin the wire, you will find that the solder bubble get quickly contaminated with the wire insulation residue. It will appear somewhat rough rather than smooth and dull in color rather than shiny silver. Take your damp sponge and wipe the iron tip clean and apply a fresh solder bubble. This may be necessary every 2-6 wire tinnings, depending on how much (in length) the wire is tinned.

General handling of magnet wire

The insulation on our #38 magnet wire is quite durable considering its thickness is only about .0003" on average. It will standup nicely to most normal handling so you can work with it with confidence. If you feel you may have nicked a section or kinked it unnecessarily, cut that portion off and throw it away (or use it for N-Scale 3/4" cabling somewhere). It's not worth the risk of an electrical short or broken connection to try to fix the possible damage. Keep the wire clean and make sure your hands are oil-free when handling it so that if you wish to paint the wire you'll get good, even adherence. That's about it.

MODELING PRODUCTS AND SERVICES: ADHESIVES, PART 2

Contributed by Alan Ashton (Spokane)

Before I begin Part 2 and the last installment on adhesives, here is a brief review from Part 1

- Have a core of adhesives for the types of materials that you use.
- Use the right adhesive for your work product.
- Buy in as small quantity as possible.
- Use sparingly.
- Many adhesives have volatile components and should only be used with adequate ventilation.
- Successful application generally depends upon good preparation of the surfaces to be bonded.
- My list is not intended to be exhaustive and you should determine what works best for you.

In **Part 1** of this series I discussed products that I find most useful when working on scenery. In Part 2, I will cover adhesives that I use for building kits and doing scratch building projects.



Aleene's® Tacky Glue® can be found in most craft stores and is quite affordable. There are several varieties in addition to the original formulation. I choose the *Quick Dry* and use it for joining wood parts. It dries clear, holds well, and doesn't take as long to set up as many other white types of glue. It is available in small quantities and has a reasonably good shelf life. This product, like closely related adhesives such as *Elmer's* white glue, is somewhat water soluble so take that into consideration in some of your applications. Like many other adhesives, it won't hold many commonly used coloring agents so excess glue must be avoided. Use only on porous materials such as wood, cloth or paper. This product is one of my *core adhesives*.



Cyanoacrylate (CA or superglue) is, to me, a must have bonding agent and is on my *core adhesives* list. It is one of the most dependable products for bonding dissimilar materials. CA is available from many sources but I prefer to purchase mine at a dollar store where it is available in small quantities at a very reasonable price. Usually, there are two and sometimes three tubes in a package. I always check to see if both standard and gel varieties are on the shelf. Once opened, CA has one of the shorter shelf lives of all of the adhesives that I use. Since I don't use CA on every project, I don't much care if a tube goes bad between uses. There are some precautions and downsides to using CA: This can be a very fast acting and strong adhesive. You can easily bond your fingers together if you aren't careful. Having a CA *de-bonder* around isn't a bad idea. Also, CA can have unwanted effects on some plastics. For example, if CA is around clear styrene, it can easily etch the plastic giving it a cloudy appearance. Although I don't personally use an *accelerator*, you may find it useful in some applications.



Slo-Zap® is one of several special preparations of **Cyanoacrylate** (CA) adhesives from *Robart Manufacturing*. If I have a number of projects on my workbench that will require the use of CA I would buy this or related products. The previous comments regarding CA apply to Slo-Zap. This bottle cost about \$8.00 and, having used only a small amount on a metal kit, it is nearly solid now. I store the bottle upside down to slow the deterioration in the bottle but still expect a limited shelf-life. Slo-Zap, Zap-a-Gap, Plasti-Zap CA++, and CA accelerators and debonders are all available from Robart. Although I don't have personal experience with all of these, I trust the manufacturer and wouldn't hesitate to make a purchase. As an alternative source of CA, consider the small tubes (regular or gel) that are available at dollar stores. Generally, I find this to be a very good source because of the small quantity and low price. I do prefer the gel version.



Testors® Clear Parts Cement & Window Maker® is used for, well, bonding clear parts (styrene window panes) and for making windows. The product has a long shelf life and comes in a wonderful applicator for placing just the smallest drop of adhesive right where it is needed. The most important aspect of this adhesive is that it does not affect clear styrene (doesn't melt, discolor or produce a haze) and I use it regularly for attaching window glazing. This product is on my *core adhesives* list.



Two-Part Epoxy can be found in most craft and hobby stores and may often be found with two setting times: 5- and 30-minute being the most common. The resin and hardener are mixed together (50/50) in the amount that is needed for a project. Obviously, once the two are mixed you have to work with the adhesive immediately and there is no storing the mixture for later. The bond created with epoxy is very strong. I started using this bonding agent when I built my first *Downtown Deco* kit as it was recommended by Randy Pepprock in the kit's instructions. I use the 5-minute variety and find that I have plenty of time to apply and adjust the pieces that I am working on. The adhesive is very tacky after five minutes but isn't firm for about 10 minutes. The bond is set completely in about 20 minutes. Unmixed, the resin and hardener have good shelf lives but the resin can begin to harden a bit after several months. This product is now on my *core adhesives list*.



Ambroid® Liquid Cement is another product that has been around for a long time. It was once the standard for model makers in a variety of hobbies but it has been eclipsed by many of the newer adhesives and bonding agents that were unavailable back in the dark ages. One nice thing about *Ambroid Liquid Cement* is that it can be sanded. It makes a strong bond on most porous materials but I have limited success on plastics and none on metals. This adhesive does not dry clear and I have noticed deterioration on some older models.



Walther's Goo®, like rubber cement, is considered by some to be "contact cement." There are uses for *Goo* but I don't consider this product to be in my *core adhesives list*. It does not dry clear and tends to produce "strings" during application. Still, there are a few places where I use *Goo* and will keep my current supply until it is gone (it has a long shelf life). There are other products that I tend to reach for when I can "blind-bind" parts (where the glue cannot be seen). Having said all that, *Goo* is not affected by moisture once it is set (being rubber based) and can be used to bind dissimilar materials. Joints are somewhat flexible so joints typically don't crack.

MEK-Like bonding agents for plastics (no photo available)

Solvent cements like MEK (Methyl Ethyl Ketone or butanone) have been used as a bonding agent for plastic structures. As butanone dissolves polystyrene, it is sold as "model cement" for use in connecting plastic parts. Though often considered an adhesive, butanone is actually functioning as a welding agent in this context. There are several potential problems with these solvents, usually related to their volatility and flammability. True MEK is not readily available in stores at this time but there are "MEK-like" products that may be substituted. There are also a variety of solvent cements available for modelers (e.g. *Plastic Weld®* from Plastruct Inc. and *Liquid Plastic Cement* from Testors). I have a bottle from Bachmann (no longer available) and it could be thirty years old but still works. When parts are dry fit and secured in place, a small amount of solvent can be applied to the joint with a brush or syringe. Capillary action moves the solvent into the joint and welds the pieces together. A little goes a long way. One note of caution: There are many different types of plastics on the market now and it is a good idea to test your solvent on scrap pieces. Some will etch and damage surfaces. Those made for modelers are *usually* safe for ABS, Styrene, Butyrate and Acrylic plastics. I don't build too much with plastics but when I do, I like to use one of these welding agents. Therefore, it is on my *core adhesives list*.

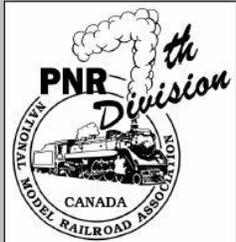


I bought a tube of Testors Cement for Metal & Wood Models when I was assembling a model with mostly metal parts. I didn't like it as much as gel CA because it didn't seem to hold the pieces in place and set up a quickly. I have used it in a few applications but it probably won't become one of my core adhesives.

There are many other products on the market and I would like to hear about what you like to use and why. If you send something to me I will put it into *The Goat* as a product to consider or a tip if you tell me why your adhesive works well in a certain situation. When I want a bonding agent (cement or adhesive) I consider the materials that I want to join. While exceptions may prove the rule, here is a list of my preferences:

Material	My Preferred Product
Wood to wood	Aleene's Tacky Glue or Elmers Carpenters Glue
Plastic to plastic	A MEK-like solvent (I have a product from Bachmann that has been around for many years and I still find it usable)
Metal to metal	CA (regular or gel depending upon the application) or 5-minute (two part) epoxy resin
Hydrocal® castings	5-minute (two-part) epoxy resin
Window glazing	Testor's Clear Parts Cement & Window Maker
Scenery (ballast, Woodland Scenics material, etc.)	For general scenery, white glue diluted to 30 percent glue, 70 percent water with a bit of dish detergent and/or 70% rubbing alcohol added to break the surface tension; also, hot glue for several applications such as planting trees.
Cork Roadbed to plywood and flex-track to roadbed	Alex Plus Latex Caulk®
Foam Board (anything that is to be attached including two pieces of foam board)	Foamboard adhesive (any brand)
Tree flocking	Hairspray (extra hold, no scent, cheap as they come)
Paper to cardboard (building images printed on paper)	Spray-on contact cement
Any two dissimilar materials	CA (regular or gel depending upon the application) OR two-part epoxy resin





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REGIONAL NEWS

The **TRI-CITY MODEL RAILROADERS** is happy to report that their application for a 501(c)(3) tax exemption was recently approved by the Internal Revenue Service. The organization is now a qualified educational entity.

A founding member of TCMR recently had his home layout featured in the August 2014 issue of "Trackside Model Railroading." Check the publisher's website on how to obtain a copy. In addition to the article's good discussion and numerous photos, it provided access to video clips and some great sounds of the layout's operations. This layout is one of several under development by individual members of the organization.

On September 27, another public showing was held for the organization's modular layout. The show included demonstrations, displays and a table of free railroading magazines. Attendees were also able to vote for their favorite locomotive lash-up on display. Attendance was good and everyone had a great time. The next show is planned for December 5-6 at the Richland Community Center, concurrent with the annual Christmas "Lighted Boat Parade" on the River.

The organization continues to seek a facility to start a new permanent layout and establish a model railroad educational center. Various sites are still under consideration.

TIME TABLE – EVENTS

October 11-12, 2014, Spokane, WA. **River City Modelers** club open house, 1130 East Sprague Avenue. Hours: Saturday 4 p.m. to 8 p.m. and Sunday 12 p.m. to 4 p.m.

October 11, 2014, Spokane Valley, WA. **Evergreen Railroad Modelers** club open house, 18213 East Appleway in the *Greenacres Shopping Center*, Saturday, 5 p.m. to 9 p.m.

October 12, 2014, Spokane, WA. **Fall 2014 Model Train Show** at the Spokane County Fair and Expo Center, 404 North Havana, Ag Buildings C and D, Spokane, WA. 9:30 a.m. to 3:30 p.m., \$6.00 admission, 12 and under free. Model railroad clinics will be offered throughout the day for all visitors!

November 8-9, 2014, Burnaby, BC. **Trains 2014: Annual Model Railway Exhibition** at Cameron Recreation Complex, 9523 Cameron Street, Burnaby, BC (across from Lougheed Town Centre). 10 a.m. to 4 p.m. Admission fees: adult, \$10, NMRA member, \$5, Senior (60+), \$8, Family, \$25, Youth (6-15), \$5, children under 6, free.

For additional event listings for the PNR jump to <http://pnr.nmra.org/>.

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