Building a Layout: Wiring– Sometimes the Simple Way Is Better

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I've always believed that nothing beats solder connections when it comes to the wiring on train layouts. As many of you who have followed my articles over the years already know, I'm quick to point out how much better a solder connection is compared to any other type of wire-joining method. But I've also learned over the years that you don't always need *perfect* electrical wire connections.

Solder connections are the perfect method for transmitting power from wires to rails. There is also no substitute for solder joints between wires and rails when it comes to good digital signal transmissions used by command control devices such as DCS and DCC as well. Digital signal strength can be easily weakened with almost any other kind of connection except a good solder joint, and I still very much prefer only that method of attaching wiring to track.

There's nothing more important to a smoothly operating layout than cleanly getting power to the track. That was true 50 years ago, but is even more true today. This era of both digital and radio signals moving from the rails to the engines requires nothing but the most efficient method of getting both the electricity and the digital signal from the source to the train. Our trains run on relatively low voltage (0 to 24 volts), which means that any wire connection must be nearly perfect to prevent a loss of voltage or digital control signal to the track.

Back in the day when we controlled train speeds by varying the voltage in the track, if you were running the train at a very slow speed (a voltage of, say, 6 to 8 volts, as an example) the loss of as much as 1 or 2 volts due to track joints would result in a very noticeable speed change in the locomotive. Once the locomotive went a few track joints away from where the wire was attached to the center rail, you would see a noticeable drop in speed. For that reason, we added another connection from the AC+ wire to the center rail every few track joints to prevent the voltage loss from showing up in the speed of the trains.

Nowadays, with DCS, TMCC, and DCC controls, you only need a single attachment of the AC+ wire to the center rail, and we apply full voltage to the center rail from the transformer. Through DCS, DCC, or TMCC we instruct the engine to go down to the center rail to get only the voltage it needs to go a nice, slow scale speed—such as 5, 10, or 15 mph, or any other speed we specifically instruct it to go. Sure, we may have a 2-, 3-, or 4-volt drop in the center rail over a distance of 75 or 100 feet, but who cares. We only want or need some relatively small voltage amount (maybe even up to 15 or 16 volts) to go the speed we want; but since we put the full voltage into the track to begin with, we can now afford a 3- or 4-volt drop in the center rail with no affect on the train at all.

The other thing besides voltage that rides that center rail is the digital signal, the means by which we talk to the engine. For that reason I still promote nothing but soldering the wire to the rail whenever possible. It is very easy to lose digital signal strength through simple pressure connections.

But hooking up accessories is a different matter. Accessories perform a simple function at a specific voltage, with no digital electronic tricks being involved. And each accessory needs at least an AC or DC+ and an AC or DC- wire hook up. In many or most cases, it needs more than one set of such wires depending on all the things the accessory does. For instance, if you are controlling a Ross or GarGraves switch, you need one AC+ wire and two different AC- wires to determine which direction the switch is thrown. If you add a lighted switch stand, you will need another A+ and another AC- wire for the light bulb in the switch beacon. If you want the switch to be nonderailing like the old Lionel switches were, you need still two more wires—one each from an insulated outside rail to the switch machine's control wires. Lastly, you need at least two more AC- wires from the switch controller (or AIU control box) to the switch machine, and one AC+ wire to the switch machine.

I don't know if you've been counting, but that's at least 10 wire connections thus far for only one switch. By the time you add in connections for extending wires to other locations, you can easily average 16 to 20 wire connections per switch. My layout has 35 switches, so I can easily foresee 500 or more connections for wires just for the switches. When it comes to soldering wires, that's simply too much time required for making wire connections just to make switches work.

For wiring-up accessories, there is an easier way than soldering. Introducing. . . Ta-Da-a-a. . . the wire nut (Photo 1)!

Wire nuts come in a long list of colors, each one representing relative size from one to the next. For our purposes in the train layout world, we're primarily concerned with only the five colors shown in Photo 2, with gray being the smallest one and red being the largest.

This little plastic device is color coded for both the number of wires that can be joined within the wire nut, as well as the number of different sizes of wires that can be joined within the same wire nut. I bought the ones seen in Photo 3 at a local Lowe's store in packages of about 25 or 30 (depending on size) for around $2.98 per package. The package wrapping shows what size wires should be used with a particular color, as well as how many different-size wires can be joined within one wire nut.

The actual anatomy of the device is noteworthy. While they are plastic on the outside, the better ones have a metal spiral insert on the inside, as seen in Photo 4, which acts like the threads of a screw turned outside in. Check to see that the wire nuts you purchase are made with this metal spiral insert built into the plastic shell. Cheap ones are made without the metal lock included.

If you look closely at the photo, you will see that the metal spiral decreases to a smaller and smaller cone as you go deeper into the wire nut. This forms the all-important lock on the strands of the stripped wire ends as they are screwed into the wire nut.

Even with the smallest size (the gray wire nut shown in Photo 5), there is still a small, spiral locking mechanism built into the device. The coin is included in the photo to show relative size of the device.

For most train layout accessory wiring you will be using primarily the gray and the blue wire nut colors. Photo 6 shows two green 22-gauge wires stripped and ready to be joined with a gray wire nut. How much insulation you strip off depends on the wire size, the number of wires being joined in the same wire nut, and whether there is more than one wire size being joined in the same wire nut. In the example shown in Photo 6, I stripped off about 9/16" of insulation of both 22-gauge green wires shown.

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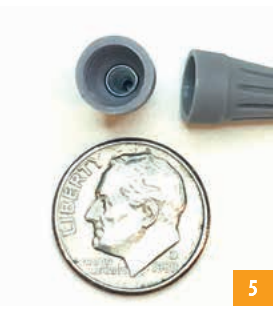

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After removing the insulation, gently twist the wire strands together so they look like what is shown in the photo. Then twist the ends of the two wires together and check to see that the resulting stripped ends of the wire are not longer than the depth of the wire nut itself. If they are, go ahead and trim them off with a wire cutter.

Note in Photo 7 that many times you may need more than two wires joined together in one wire nut. Always be sure to check the guideline specifications of the wire nut packaging to make sure you are not putting more wires into one wire nut than the guideline allows. If you do have too many wires, go up to the next size in wire nuts.

Once the wire ends have been trimmed to length, gently screw on the wire nut, turning the nut onto the bare ends of the twisted wires in the same direction as the wire ends were turned. When complete, the result should look like what is seen in Photo 8, with no bare wire extending out from the bottom of the wire nut.

Be careful not to overtighten the wire nut. Working with smaller wire sizes in particular, it is easy to overtighten the wire nut and break off the stripped ends of the wires within the nut.

Many times in accessory wiring you will have to join wires of two different gauges, especially when wiring switch beacons and other small lights. Photo 9 shows a 22-gauge green wire and a very tiny (about 34 gauge) black wire from the light bulb. When twisting these two radically different wire sizes together, it is more a case of wrapping the smaller wire around the larger wire. When this happens, you will need to have the smaller wire stripped to a longer length than the larger wire.


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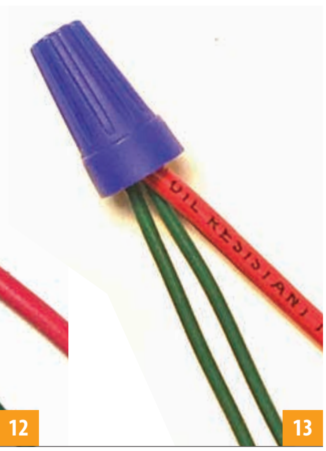

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Another factor to consider is that the result of the paired 22-gauge and tiny 36-gauge wire will probably still be too small to grip into the small gray wire nut. The solution for this is to make the twisted pair of wires twice as long as you would normally need, then double them over as shown in Photo 10 before inserting them into the wire nut. The finished result should look like what you see in Photo 11.

Photo 12 shows two 22-gauge green wires and one 18-gauge red wire. Once these three stripped wires are ready for a wire nut, it will be obvious that they will not fit nicely into the tiny, gray wire nut. Go up one size to a blue wire nut and they will all fit together and get along nicely (Photo 13).

Once you get above 20-gauge wire, wire nut sizes need to increase rapidly due to the increased amount of bulky wire housed within the wire nut. If I remove the red 18-gauge wire and replace it with a black 16-gauge wire, an even larger orange wire nut is needed to make the connection (Photo 14). Interestingly enough, that one step up in wire nut size will even let you add the red 18-gauge wire back into the mix (Photo 15) without causing any problem.

Wire nuts are not very good for wire connections where a digital signal is present. Electrically speaking, a wire nut is a pressure connector (joining two or more wires through a pressure contact inside the wire nut). Digital signal strength is easily diminished or lost through pressure connections, and is never lost through a proper solder connection. But wire nuts are good for simple power connectors for any and all accessories. They are also very forgiving. If you find later that you have to add a wire into an existing connection, simply unscrew the wire nut, add the new wire in, and reconnect with either the same wire nut or the next size up, as needed.

There are a couple of other good points for using wire nuts as well. You need only two tools—a small pair of wire cutters and a wire stripper—and you don't need any electrical tape. Give 'em a try!

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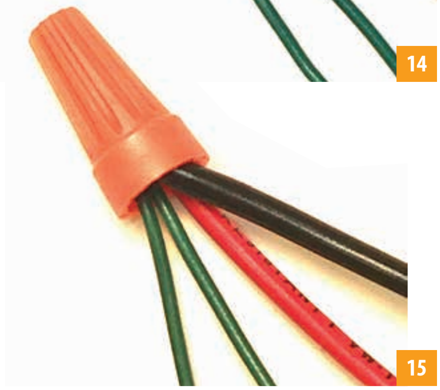

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