How to model electric, phone, and cable lines

By Jeff Wilson/Photos by the author

A variety of electric, telephone, and other utility lines surround us in real life, although we often overlook them on our model railroads. Adding poles, wires, cables, and other related details is relatively easy, and doing so adds a great deal of interest to many scenes.

Electric wires are the most common above-ground utility lines. Beginning in the 1880s, small municipal electric plants began generating power for local users. The system of wires connecting these utilities to customers expanded greatly by the early 1900s, first in cities, then in rural areas. As power plants grew in number and size, the power lines serving their customers also grew in size and scope. By the 1930s the country was linked by a nationwide power grid.

Electricity is distributed by a system of power lines, from steel-tower-mounted cables carrying extremely high-voltage circuits to distribution lines that feed low-voltage power to individual homes and businesses. The national power grid is interconnected, allowing local utilities to buy electricity from multiple sources and enabling power to be routed around problem areas such as downed lines or areas under repair.

Power distribution

Alternating current (AC) is the standard for household and industrial use in the United States. This AC is produced as three-phase power, which – to greatly simplify the science of it – increases efficiency by using three conductors to even out the 60-hertz (60 cycles per second) property of the alternating current. What this means to modelers is that each electric circuit carried on poles has three...
conductors, or wires, each of which carries one phase of the AC power.

Large transformers at the power plant increase the voltage to allow it to be transmitted long distances (sometimes hundreds of miles). Called high-tension lines, tall steel towers carry circuits ranging from 110 to 500 kilovolts or more (each kilovolt, or kv, is 1,000 volts).

High-tension towers are 70 feet or more tall and carry single circuits (three main wires) or two circuits (six main wires). Two additional smaller wires, called shield wires, are carried at the top of the towers. The shield wires are grounded to the towers and protect the power conductors from lightning strikes.

Smaller transmission lines (138 to 230 kv) often use wood poles of various designs, especially in rural areas. These lines generally carry a single circuit of three wires plus one shield wire (single-pole installations) or two shield wires (H-frame twin-pole structures), although some may carry two circuits.

Transmission lines carry electricity to substations like the one in fig. 1. Here transformers step the voltage down, then a power bus and large banks of switches route power to various smaller lines. Large circuit breakers and switches allow circuits to be turned off, and circuit breakers and lightning arrestors protect against power surges. Outgoing power lines can include transmission or subtransmission (66 to 138 kv) lines destined for other substations, as well as smaller distribution lines (typically 2.2 to 36 kv) that deliver electricity to end users as shown in fig. 2.

What that means for modelers is that unless you’re modeling a substation, any large transmission or subtransmission lines should merely pass through scenes, and not include feeder lines to structures. An exception would be a large industry, which might receive power directly from a subtransmission line.

For the most part, modelers can concentrate on the distribution lines that typically follow city streets and rural roads. Through the early 1900s, most of the distribution lines were above ground, especially in large metropolitan areas, and could involve some extremely complex mazes of wires. Underground distribution lines became common by the mid-1900s, and by the late 1900s many city neighborhoods and downtown areas had no above-ground utility poles except for streetlights.

The advantage to modelers is that we can be selective about modeling utility lines. We can add them to selected areas, while other scenes can rely on underground lines.

**Telephone and other lines**

Along with electric lines, other utilities run their wires on poles, including telephone, cable television, and fiber-optic systems. These systems often share space with electric lines on joint poles, as shown in fig. 3 on page 58, but sometimes have their own. See fig. 4. You’ll also find some single electric lines carrying circuits for streetlights or traffic signals.

Through the mid-1900s, telephone lines consisted of bare wires carried on multi-pin crossarms that closely resembled those of railway telegraph and communication lines. Telephone lines could be found in several configurations, including six-, eight-, ten-, and even 16-pin crossarms, often with multiple arms on each pole. Like railroad pole lines, many telephone lines didn’t use all the pins on each crossarm. Some rural lines consisted of just a pair of wires carried on a short two-pin crossarm, or on insulators mounted on either side of a pole.

Telephone lines were transposed every few hundred feet – meaning the
wires changed positions relative to each other. This was done to limit interference from induction, which could occur if lines kept their same relative positions for long distances.

From the 1960s through today, telephone lines – especially in densely populated areas – are commonly bundled together into a single cable. This heavy cable is supported by a steel suspension cable, as seen in fig 4.

Cable television lines also use a heavy cable supported by a steel wire.

These cable systems began serving city customers in the late 1950s, and later expanded into rural areas. The black or gray TV cables have junction boxes every pole or two, and also have strain loops periodically that allow for cable expansion and contraction.

Utility poles

The basic utility pole arrangement is simple: Electric lines are at the top, with cable, telephone, and other users at the bottom. Figure 3 shows how multiple utilities often share the same pole, with the highest voltage on top.

Height requirements vary by the voltage carried, and many have changed over the years. As a general rule, keep electric primary (distribution) lines at least 27 feet above a railroad and 22 feet above a road or highway. As the drawing shows, there must be at least 40° of clearance between the lowest electric wire and the top communication wire (30° is allowed underneath a transformer). Subtransmission lines should be at least 31 feet off the ground, and transmission lines 48 feet.

Depending upon the type of circuit used, there may be three or four wires making up a circuit. Delta-connected circuits have three wires (one for each phase). Wye-connected (also called “star”) circuits have a fourth wire, the MGN (multi-grounded neutral), which usually runs below the conductors.

Rural distribution lines branching off of three-phase primary circuits often have just a pair of wires, one phase and an MGN. See fig. 2 on page 57. Pole-mounted step-down transformers convert this electricity into the 240-volt, single-phase power that’s delivered to most end users. See the drawing. Delta circuits will have a wire from each of two conductors connecting to the transformer input; wye circuits will have a wire from one conductor and the MGN. Many business and industrial users require three-phase power to operate production machinery, so their lines usually include three transformers at the distribution point.

At most modern installations, the three output wires from the transformer are bundled together (two of them insulated) as a single line. Older installations used open-wire connections, with three or four separate lines running parallel to each other from the pole to a building.

Some poles feed power to underground lines. These have connections from the conductors running down through heavy conduits the length of the pole.

You’ll find lots of other hardware on utility poles, including lightning arrestors, fused cutouts, and circuit breakers. It’s impossible to cover all of the possible wiring combinations – study photos and prototype examples, and follow these in building models.
Modeling pole lines

Modelers in HO have a selection of components available to them, as shown in fig. 5. Walthers offers a plastic kit for utility poles (No. 933-3101) that includes multiple poles, several styles of crossarms, separate insulators, and two types of pole-mounted step-down transformers. Rapido Trains has announced its line of Totally Wired telephone poles for release this spring. Other products include crossarms (no. 2393) and early telephone or telegraph insulators and brackets (no. 2540) from Scale Structures Limited, utility poles (no. 628-30) and separate crossarms (no. 628-31) from Rix, and utility poles with molded-on crossarms from Atlas (no. 775) and others.

Modelers in N scale have fewer choices, including utility poles with crossarms from Atlas (no. 2801) and Bachmann (no. 42506) and metal castings of six-pin crossarms from Depots By John (no. 6006).

You can also make your own poles and crossarms from wood dowel and stripwood, but I recommend using the available commercial models because they have the hardware and insulators molded in place. See fig. 6. These Walthers and Rix plastic poles feature wood grain and also capture the gentle taper found in real utility poles.

Prototype poles are generally rough, so start by scraping the poles with the edge of a razor saw, as shown in fig. 7. This goes a long way toward eliminating the plastic sheen and improves the realism of these models.

Determine the insulator and crossarm arrangement needed. You can combine parts from different sources and modify crossarms by cutting off insulators. Figure 8 shows several model poles as examples.

Although several styles of insulators are available, you can make your own using beads, see figs. 9 and 10,
or by turning them from plastic rod. Beads come in several sizes and colors. I used black seed beads (found in bead and craft stores) placed on eyebolts or .022" wire for the MGN insulator on several poles.

Dead-end and suspension insulators have a distinctive profile that’s fairly easy to re-create with plastic rod. To turn an insulator, place a short length of plastic rod in the chuck of a drill press (you can also use a portable drill held in a bench vise). I used a piece of sprue .077” in diameter for my primary-line insulators. With the drill turning at slow speed, use a needle file to gently shape the rod as in Fig. 10. Be patient and work slowly to avoid overheating and melting the plastic. Once it’s the proper shape, drill the insulator lengthwise through its center with a no. 80 bit, then insert a wire eyebolt.

**Painting utility poles**

Prototype poles vary greatly in color. New poles range from gray (or nearly white) to dark brown. Black and light to dark brown creosote stains are common, especially at the bottoms of poles. Old poles weather to a more uniform medium or light gray.

Start by painting each pole a gray base color. I prefer Polly Scale acrylic paints, but any flat paint will work. Start with Grimy Black or MOW Gray (or a mix of the two). Don’t worry if you don’t cover each pole thoroughly—it’s OK if some of the original gray or brown shows through. Add highlights by giving the poles washes (nine parts water or Polly Scale Airbrush Thinner; one part paint) of Engine Black, Railroad Tie Brown, Reefer White, and various grays.

Insulators on electric lines are made of porcelain or composite material, and can be black, brown, gray, or white. Telephone and telegraph insulators were usually either clear or green glass. Use gloss paints to paint insulators the appropriate colors. Testor’s Jade Green enamel works well for simulating green glass insulators, as seen in Fig. 11. Apply it over a silver base coat for a brighter look. Silver paint, with an overcoat of clear gloss, does a reasonable job of simulating the glass insulators.

Crossarm brackets on telephone lines are usually metal. These can be painted gray to represent galvanized metal or various shades of brown to represent older brackets that are rusting from the weather. Brackets on electric lines are usually wood, with metal only for the connectors.

**Pole installation and wiring**

Pole spacing varies depending upon the voltage being carried and the height of the poles. I find 75- to 80-foot spacing looks about right for primary lines in model scenes. In general, keeping the pole spacing slightly tighter on models than in real life looks good (and it’s a form of selective compression).

You’ll need guy wires on any poles where wires terminate, or where pole lines make a sharp curve. These can be modeled as shown in the drawing on page 59 by using nylon thread or monofilament attached to an eyebolt on the pole. Install any guy lines before stringing the line wires.

Whether or not to string wires is a matter of personal preference. A well-executed scene with wires on poles can be an effective attention grabber. However, if the lines are heavy, or if...
they twist or sag unrealistically, they’ll detract from the realism.

I’d suggest that if you model the lines, keep them fairly simple. The overall appearance will still be effective, but require less work, and they’re less likely to get snagged by a stray hand or tool.

There are several materials available for stringing wire. My favorite is EZ Line, made by Berkshire Junction (www.berkshirejunction.com). This fine, elastic thread comes in two sizes and several colors, with black the most useful for electric and telephone wires. The elasticity of EZ Line allows it to stretch and hold its shape, even if it’s bumped. The material’s disadvantage is that it cannot capture the between-poles sag of real power lines and cables.

Some modelers have had success using monofilament, especially for lighter-weight wires such as phone lines. However, it’s non-elastic. Unless you string each strand with the same tension, multiple wires can curl or sag unrealistically. Also, if a pole or the wires are bumped, the impact can damage adjacent poles.

Modeler and author Lou Sassi has had good success using thread, as described in his book How to Build & Detail Model Railroad Scenes (Kalmbach Books), which I highly recommend for those interested in detailed utility poles and lines. Lou’s trick is to prep the thread by coating it with white glue (by pulling it through glue-coated fingers), then hanging it with a weight clipped on the bottom to straighten it while it dries. The glue helps the thread hold its shape, making it easier to model the between-pole sag of real power lines as realistically as possible. This is how I modeled my line from the pole to the building.

Using EZ Line

I strung the main wires in my HO scale scene with EZ Line, using fine for the phone wires and heavy for the electric lines. Starting at the end of a line, apply a drop of medium-viscosity cyanoacrylate adhesive (CA) to the top or side of the insulator, then hold the EZ line against it until the bond sets.

Place CA on the proper insulator on the next pole. Pull the EZ Line just beyond the point it becomes taut, then set it carefully on the insulator and hold it for a few seconds until the CA takes hold. See fig. 12.

It may take a few tries to get the hang of this technique, so you may want to practice on a sample before trying it on a finished model. You’ll get the most realistic appearance by attaching the line to the top or side of the insulator. It’s easier to attach the line to the base of the insulator, but the results won’t be as realistic.

Continue stringing each line from pole to pole, starting with the bottom wires and working your way to the top. If you choose to model details such as transformer installations and lines, do as much of this work as possible in advance. I made my transformer connections using EZ Line at the workbench before planting the pole in place.

I added the lower heavy communication cable using glue-coated thread, running it through an eyebolt on each pole. The junction box in the lead photo is a piece of .020” x .060” strip styrene painted black and glued to the line after it was in place.

You can detail utility poles and lines to any level you desire. Take your time and study the prototype to create a realistic scene.

Jeff Wilson is a veteran HO modeler and prolific author of model railroad hobby books. His latest book, Detailing Diesel Locomotives, has just been published by Kalmbach Books.