A supplement to *Garden Railways* magazine

Ideas for the novice, intermediate and advanced garden railroader!

TOOLS & TECHNIQUES

Garden RAILWAYS® MAGAZINE

for the garden railroader

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Setting the stage

Properly scaled figures and structures bring a scene together, giving the trains running through the garden an air of believability.

In theater, it's not enough to just have a stage and actors. For the illusion to be a success, there needs to be a set and props as well. Our backyard railroads are really no different. Trains running through the flowers is fine, but to complete the illusion, we need accessories. It's these structures, figures, and other scene setters that give our fantasy world a foundation of believability.

The set

Let's begin by filling our empty stage with a set. Structures are the easiest way to bring the stage to life. They give your trains destinations—a point "A" and point "B." Choosing structures carefully will go a long way toward creating the illusion.

As with anything on the railroad, scale is the primary concern. You'll want to find structures that match the scale of your trains. Unfortunately, that's not always as easy as just looking on the box. Even in commercial kits where a scale is designated, certain key architectural details, such as doors, may be too big or too small for the specified scale. (Rule of thumb: Doors should be between 6' and 7' tall.) For instance, a kit specified for 1:24, but with tall doors, may work very well on a 1:20.3-scale railroad.

Plastic buildings are perhaps the easiest structures to build and maintain on a garden railroad. While a drawback may be that similar buildings will exist on other people's railroads, use of paint and setting can give them a sense of individuality, like these plastic structures on Jim Strong's Woodland Railway.

Which materials work best? A lot depends on your needs. If you want low maintenance, then you might look at the commercially available lines of plastic kits. By and large, these are sturdily constructed and will stand up to UV (ultra-violet) sun damage. Of course, a coat of paint will further aid the UV resistance of the plastic. Most of the kits currently available fall in the 1:24–1:20-scale range, though some roughly scaled buildings for 1:29 are hitting the shelves as well. Most of these kits go together easily and can be customized and kitbashed, at least to a limited extent.

If you want a medium that will give you more flexibility in building design and construction, then you may want to look at some of the wood kits currently available. The problem with wood is that it is much more susceptible to natural forces. Wood must be treated with a preservative of some sort or it will fall apart in short order. Even the most resilient woods need a little help from modern chemistry if they're to survive outdoors.

Then there's the option of concrete as a construction material, but that leads into the world of scratchbuilding, as there are no commercially available concrete buildings that I'm aware of (although JigStones products, *www.jigstones.com*, might be construed as a kit of sorts). The trade-off is that when you scratchbuild something, you have complete creative control over the outcome.

The props

Once the set is constructed, you need to fill it with props. These come in the form of figures and other accessories, like vehicles, signs, and furniture. Some of these items show up frequently at local hobby shops. Many more show up in stores and at flea markets and garage sales. The trick is to know how to shop.

Scale is the primary consideration when looking for accessories. Figures are perhaps the most commonly sought after

Common items can be used to measure figures to see if they're properly scaled. On the left, a dollar bill shows this figure's height at 6' in 1:24 scale. His counterpart on the right is 5'8" in 1:20.3, the same size as a credit card. The action figure in the center scales out at just over 6' tall in 1:20.3, still acceptable.

accessory. Miniature people make a railroad come alive. Properly scaled figures show up in the most obscure locations. I usually carry a Leatherman tool with me, which has a ruler engraved on its side. I use this to measure anything I come across that may be the right size.

If you don't have a ruler handy, there are some common items we all carry when we go shopping that can help. The first is an ordinary dollar bill. It is 2½" tall, which is about 6' in 1:29 scale. If the figure you're looking at is as tall as your dollar bill, then it's the right size for that scale. That same dollar bill, when folded in half widthwise, measures 3", or 6' in 1:24. If you're modeling in that scale, then a proper figure needs to fall around that height. If you're modeling in 1:20.3, then pull out your credit card. The width of a credit card measures 5'8" in 1:20.3. The Scale Card, Inc. makes credit-card-sized scale rules for all the popular scales, with drawings of an average-size male, female, and child on the card to make sizing figures and accessories even easier.

Proper-size figures for various scales are everywhere. I find a lot of children's action figures to be acceptable. Around Christmas, you can find a variety of Department 56-style figures that will also work well. These are especially useful for figures of children, which are hard to come by in any scale. You can also occasionally find properly scaled accessories, such as lamps, benches, vending machines, and the like, in these collections.

Hobby shops often carry plastic military figures in various scales, most commonly 1:32, though I have seen them in 1:20.3. You can find plastic mechanic figures in similar scales. The Brittains line of figures may work for 1:32 or 1:29, depending on the figure's size. Remember, people come in different shapes and sizes, so a little variation one way or the other is acceptable.

Dollhouse stores are good places to look for various accessories. These are typically limited to 1:24 scale, but some items, like lamps, hinges, door knobs, and other things, can be used in other various scales without looking at all bad.

Flea markets often turn up the most unique items. I've found birdhouses and mailboxes that would make suitable structures for the garden railroad. More often, though, I find properly scaled farm or construction equipment. I've also found refrigerator magnets and pencil sharpeners that scale very nicely.

Strangely, vehicles, be they horse-drawn or automobiles, are some of the harder items to find in the proper scale. If you model in 1:24, you're in luck. Many plastic kits are built to this scale. The old Hubley line of metal car kits is available in 1:20 scale. "Collector's" series of cars come in a variety of scales. Many die-cast metal cars found at hobby shops are labeled as 1:18. Occasionally, car manufacturers are a bit off on scale. If you know the rough size of the car you want, then it pays to check the model over. It may in fact be the right size.

Horse-drawn wagons and stage coaches are a little harder to come by, but check your local toy store. Many "old west" play sets have stage coaches that will work well in the garden. They'll need a coat of paint before going outdoors, but that's it. These play sets are also great for horses and other farm animals you may want.

Yard sales and flea markets offer many suitable finds. This model of a vintage tractor fits in nicely with the rest of the structures on the railroad.

The workshop

An ample workspace is essential to being able to build models for your garden railroad. Good lighting and a wide variety of available tools will make your indoor tasks as enjoyable as being outside with the trains.

Workshops come in all shapes and sizes. What is important about the workshop is that the work surface be large enough to accommodate whatever it is you want to work on without knocking into your stash of tools, paint and glue bottles, or anything else. You're not going to be able to build an 8' bridge on an office desk without a lot of trouble. Make sure your workbench is sturdy. You're going to be doing a fair amount of banging and shaking, so an old card table probably isn't a wise choice.

The height of the work surface is also an important consideration. Do you prefer to work standing or sitting? Some tasks, like cutting, drilling, and sanding are better done standing, while painting and building are best done sitting. Benchtop tools may have to sit on sturdy boxes or risers to elevate them to a comfortable working position if the work surface is at regular desk height.

Storage is an important part of design and organization. Every tool needs a place and that place should be easily accessible from wherever it is that tool will be used most often. Storing commonly used tools on a wall away from the workbench will not work well, as the effort required to get out of the chair and walk over to the wall to return the tool, once finished, will be far greater than that required to simply sit the tool on the workbench. The tool will then get buried, lost, or will otherwise disappear into a parallel universe. Having the tool's "official" place within arm's reach of your seat will minimize its tendency to play hide-and-seek. All of my commonly used hand tools are either stored in a drawer right next to my chair or along the backboard of my workbench. Once I'm done using a tool, it easily goes back where it belongs. Building materials and less commonly used tools can be stored further away from the workbench.

Commonly used hand tools are hung within arm's reach of the author's chair, allowing him to immediately place the tools back where they belong, instead of setting them down on the work surface to get lost.

A good workbench needs to be well lit. Overhead florescent lights are great for general lighting, but they're not always enough. My preference is old, swing arm, incandescent lamps. Each task area should have its own adjustable light. It's so much easier to work when you can see what you're working on. I also use full-spectrum bulbs in my lamps. They're a bit more expensive, but it's nice to have a light source that approaches the "color" of full sunlight, especially when painting.

Basic tools

A good collection of small hand tools, such as **pliers, diagonal cutters,** and **screwdrivers,** are essential items to have on hand. Other small hand tools should round out your basic toolbox. These include a couple of **X-acto knives,** either because one is always missing or because you can then use more than one type of blade without the need for changing them. A **razor saw** is another useful tool. When all else fails, you can cut through almost anything with one. A set of both **large and small files** will come in handy for shaping building materials. A good supply of **clamps,** large and small, is great to have on hand as well. Duct tape is a marginal substitute for clamps.

Aside from those hand tools, there are some other power tools that are almost must-haves, and will allow you to build almost anything you would need for your garden railroad.

A Dremel or other **rotary hand**

ABOVE: A drill press, disk/belt sander, bench vice, and bench grinder.

Some of the more common hand tools found around the workbench. Top row (left to right): Needlenose pliers, standard pliers, tweezers, X-acto knife, and square. Middle row: Diagonal cutters, hemostats, scissors, and scribe. Bottom row: 18" metal ruler.

tool is probably the most commonly used tool on my workbench. The reinforced cutting wheels are great for cutting a variety of materials. I use Minicraft hand tools, as they're lighter than the Dremel tools. You can also buy other tools from Minicraft, including a miniature table saw, drill press, disk sanders, etc., that all plug into the same variable-speed power supply. Whatever you use, find one with an adjustable chuck. Without that, it's worthless as a drill.

Disk/belt sanders are great for cleaning up the ends of cut lumber, sanding a bunch of lumber to the same length, or any other instance where you need to sand things.

Drill press. The ability to drill holes 100% square to the work isn't something to be taken lightly. No matter how good you think you are with a hand-held tool, you will be off. A drill press is great for setting up jigs for repetitious drilling tasks, or even for embossing rivets into brass or styrene sheets.

Bandsaw. There's almost nothing you can't cut with a bandsaw. A good, variable-speed bandsaw will provide great service. You can cut your own stripwood, cut complex curves, or pretty much anything else you can think of. They can handle light metal, as well as wood and plastic, with relative ease. The key measurement in a bandsaw is the throat clearance, or the distance between the cutting blade and the housing at the left that protects the blade (or you from it) as it continues around. Most benchtop models have either a 9" or 10" clearance. Larger is better, as it allows you to cut larger materials. These saws are great for cutting curves and other special shapes.

Cutting devices. Top to bottom: A box knife, small razor saw, large razor saw, and hacksaw.

the world of table saws, having just acquired one second hand. If I had to choose between buying one of these vs. a bandsaw, I'd opt for the bandsaw first.

Benchtop grinder. While this tool probably sees the least amount of use of any on my workbench, it's nice to have around when I do need it.

This is a rough survey of tools that occupy my workshop that I've found useful over the years. While it's always best to have the "right" tool for the job, many jobs are just as effectively done with a bit of improvisation. Also, it isn't necessary to buy everything on the list right away. The best way of acquiring tools is to get what you need when you need it.

Of all the tools in the workshop, two are by far the most important and haven't been mentioned yet. They are your eyes and hands. Everything else in a workshop can be replaced if it breaks. Eyes and hands don't come with warranties, so take the necessary precautions to protect them.

A small, rotary hand tool is the first power tool that should be on any workbench. An adjustable chuck (shown) is more desirable than a standard collet, as this allows bits of any size to be used with the tool.

Selecting raw materials

A multitude of materials is available for building structures and equipment for our garden railroads. Choosing the right one for the job will ensure the project will provide years of service.

The first lesson we learn when we take our trains outdoors is that nature doesn't play favorites. Our sensible action is to choose materials for our projects that will stand up to the forces of nature.

Plastic

Let's start with plastic, since that's what a vast majority of our trains are made of. "Plastic" is a generic term, for which there exist many variants. Most of our trains are made of ABS, or Acrylonitrile Butadiene Styrene. ABS is very durable, with excellent working characteristics. It can be cut, drilled, and machined with relative ease. It's also good for injection-molding, making it perfect for our trains.

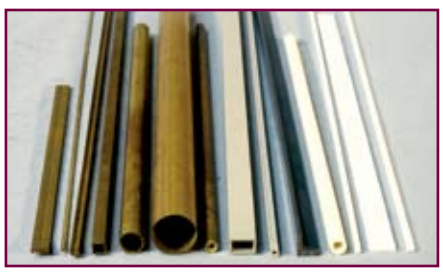
ABS has a close cousin, commonly referred to simply as styrene, which has similar working characteristics, but is a bit softer and more flexible than ABS. Both are excellent choices for the modeler and readily available at most hobby shops.

If you're looking for clear plastic, acrylic sheet is the most common option. Lucite is a common trade name, as is Plexiglas. Another common clear plastic is Lexan, one of several polycarbonates.

There's nothing wrong with mixing materials. The base of this hopper car is a commercial plastic hopper. The timbers are wood and the braces and details are metal, with the exception of the square, plastic nuts at the ends of the steel rods.

There are some thicker plastic products available, best suited for structures. These include a product called Gatorboard, which consists of a core of expanded styrene foam sandwiched between two layers of thin styrene. Another option can be found alongside the road fairly easily—corrugated plastic sheets, commonly used for political yard signs and similar applications. Both these products are available from plastic-supply houses or possibly from a local sign shop.

Plastic is great for model building. It is one of the easiest materials to work with and can be made to represent virtually any other material. If you want it to look like metal, leave it smooth. If you want it to represent wood, run some 60-grit sandpaper over it to add "grain." Cutting it is a "snap," literally. Just score a line along the plastic, then bend it until it snaps apart. No saws are necessary, unless you're doing complex shapes. If you must cut plastic with a power saw, use a sharp blade and a slow speed. That's one downside to plastics—they melt. Molten plastic will stick to a saw blade or drill bit, rendering it ineffective in a hurry. Keeping tool speeds slow will reduce heat build-up.



Brass and plastic come in a variety of shapes, many similar or identical to each other. Generally, what you can build in brass, you can build in plastic.

Plastic is a suitable material for almost any project, but is susceptible to damage from high heat and sun. If you're using it for rolling stock that you take indoors, you should have no worries. Plastic structures that are constantly exposed to the high heat of the sun have a tendency to warp.

Sunlight by itself is an enemy of plastic. The sun's ultraviolet (UV) rays deteriorate plastic. Unless the plastic has a UV stabilizer in its formulation, it will discolor and get brittle within a season. A coat of paint will slow this process, but may not eliminate it completely.

Redwood is more rot-resistant than other woods, making it a prime candidate for ties used in handlaid track. It's still is a good idea to periodically treat it with a preservative.

Wood

The second most popular material for equipment and structures alike is wood. The hardest part, when dealing with this material, is deciding which wood to use for what project. For kitbashing or scratchbuilding rolling stock or locomotives, any wood will work well (though I'd shy away from balsa, just because it's weak). As long as the models don't spend a significant amount of time in the elements, the common "hobby" woods (bass, spruce, and mahogany) will work nicely. If the model is going to spend most of its life in the elements, use a wood that will last, such as redwood, cedar, cyprus, or even pressure-treated lumber. Just as you wouldn't build a deck out of untreated pine, you shouldn't build a station out of wood that will quickly rot.

The biggest enemy of wood is water. While there are preservatives that will prolong the life of the material, wood will not last indefinitely. Preservatives must be reapplied from time to time, just like a protective coat of paint. Glues used to bond wood must also be moisture resistant. If the wood is in contact with the ground, extra care must be taken to keep the moisture away. Wood structures last much longer in dry climates.

It seems logical that plywood would be well suited for use in the garden, but you need to be careful as to which kind you purchase. Use only plywood designed specifically for exterior or marine use. The glues used to laminate the sheets together are much more waterproof than interior-grade plywood's. However, the label "marine grade" does not mean it's able to be exposed constantly to water. Wood is still wood, and will absorb water and rot. Like any other wood product, it needs to be treated or painted to protect it from the elements.

Because plastic and metal have similar qualities, plastic is often used to simulate steel cars. Here, the beams of the flat car were built from styrene strips. Rivets were embossed in a thin sheet of styrene, which was laminated to the outside of the beam.

Metal

Metal is commonly used in model construction, more for rolling stock and bridges than buildings. The most common metal used in modeling is brass, though aluminum, copper, and steel also figure prominently. The biggest advantage to using metal for construction is its strength. Metal and plastic are similar in terms of how they can be worked. Techniques for cutting, punching, and shaping these materials are almost interchangeable. Metals, however, are more tolerant and capable of being bent to shape.

The most common fear people have in regard to working with metal is soldering. This is the most effective way to join two pieces of metal. It is a skill, and can sometimes require a torch to heat the metal to the point where it will melt the solder. It is a bit daunting at first, but well worth the time to learn. A brass locomotive or freight car will last almost forever.

Concrete

The "big three" mentioned above comprise only the most common materials used for outdoor structures and rolling stock in the garden. Other materials are well suited for use in the garden, but are far more specific as to their applications. Concrete, perhaps, is the best example of this. As in the real world, concrete is best used for structures. Bridge abutments, piers, roads, and subroadbed frequent the list of concrete structures in the garden. Typically, these are cast in wood forms. Concrete has also been used effectively as a veneer over a substructure of styrofoam or other suitable material.

Materials not to use

There are a few materials that stand out as things not to use. Any paper-based product, such as cardboard, Homasote, or foamcore, top the list. Wood-chip products are also no-nos. Particle or chip board and masonite are the most common, and will absorb water and quickly fall apart. Styrofoam can be used, but don't build anything out of unprotected foam with the expectation that it will be around in two years. The material doesn't deteriorate, but it's rather weak, not able to stand up to the constant barrage of the elements without something over it.

This list of materials is far from comprehensive. New products are constantly being brought to market, each designed to be stronger and more resistant to deterioration. Ask around and find out what other modelers in your area are using. With care and proper construction, your railroad will be able to withstand whatever weather conditions come your way.

Glue

When it comes to gluing materials together, there are a variety of products that will get the job done. The trick is to choose the one that will work best for that application. Left to right: Polyvinyl acetate (PVA or "white") glue; aliphatic resin (yellow carpenter's glue); polyurethane glue in liquid and caulk forms; two-part epoxy resin, five-minute liquid and high-temperature paste; silicone all-purpose adhesive; "Goop" brand contact cement; plastic solvent cement; cyanoacrylate (CA cement or super glue) with accelerator.

The first thing you need when building a model is something to hold it together. Most often, this comes in the form of glue, and all glues are not created equal.

General-purpose adhesives

We'll start with perhaps the most basic (and familiar) adhesive, white glue. This is known as a PVA (polyvinyl acetate) glue. When it dries, it is nearly transparent. Its best uses are for gluing porous surfaces together, such as wood or paper. PVAs are not waterproof. Bonds made with PVA glues will come apart after exposure to moisture. White glue is possibly the most common form of adhesive used on indoor model railroads, as it dries fairly quickly and cleans up with soap and water. Another advantage is that it can be diluted with water for various applications, such as gluing a load of coal in a tender. You'll want to be careful when running in the rain, though, as the moisture will soften the glue. It does dry again, however, once removed from the wet, with no strength lost.

Aliphatic-resin glues are commonly referred to as "yellow" or "carpenter's" glues. They stand up well to moisture, as long as it's not a constant condition. You can build a wood structure using this glue and not worry about it falling apart in the rain or when the sprinkler comes on. I wouldn't use it to secure a structure to a foundation, though, as that has the potential for retaining moisture and breaking the bond. There are better adhesives for that. Aliphatic resins set up relatively quickly, requiring minimal clamping time. The resulting joint will be quite strong and will not deteriorate or weaken over time due to moisture or other environmental concerns.

Two-part epoxies must be mixed together prior to use. Most mix resin and hardener in equal parts.

If you want a good, waterproof joint for your outdoor structures, you can use any of the newer polyurethane glues. "Gorilla Glue" is one popular brand; Elmer's and Titebond offer similar products. Polyurethane glues are waterproof, so the joint can get saturated and not fail. They also bond a variety of materials together, such as plastic, metal, brick, stone, and glass. The most common form of this glue is a liquid, but it is also available in a caulk-style tube, ideal for gluing irregular shapes together, such as stone retaining walls, or stone blocks to a wood-framed building. The cure time for polyurethane glues is longer, from one to four hours, and it cannot be thinned with water. (Water is actually the catalyst for setting this glue. Directions indicate that one surface should be moistened slightly.) Cleanup is messier, requiring mineral spirits. Polyurethane glues are not recommended for submersed applications, such as in ponds.

There are times when some flexibility and gap filling are desirable. There are two glues that serve this purpose. The first is silicone adhesive, which comes in a variety of colors, though clear is probably the most useful. Silicone is waterproof, and can be used in underwater situations, such as in ponds. There's not much that silicone adhesive won't stick to.

Goop brand adhesive has similar properties, but works more like a contact cement. The glue has to be spread on each surface and allowed to dry for 2-10 minutes before joining. Once joined, the bond is almost immediate. Full curing occurs anywhere from 24 to 72 hours, depending on the materials being joined. Goop remains somewhat flexible and is waterproof. It should not be used around ponds, though, as it may harm aquatic life.

Another common glue is epoxy, a general-purpose adhesive that sticks to a wide variety of surfaces. Epoxies are two-part glues—you have to mix the resin with the hardener, usually in a 1:1 ratio. Epoxies

When using CA cements, you can speed up the curing time by applying an accelerator. This usually comes in a pump spray bottle. By putting the accelerant in a small, needle-tipped squeeze bottle, you can pinpoint exactly where you need it to go.

are rigid once set up, and form a good bond between most common materials. Epoxies are usually rated by their cure time, the most common ones being two-minute, five-minute, and 30-minute. The longer-cure-time epoxies are reputed to be stronger, though I have yet to encounter an epoxy joint that failed as a result of normal use. For high-temperature applications, such as details on a live-steam locomotive, you can use JB Weld, an epoxy product infused with iron and steel particles. This has very high strength and withstands heat up to 600°F.

Plastic cements

All the above glues work for a wide variety of materials. However, there is a family of glues designed specifically for working with plastics of various kinds, referred to as solvent cements. They work by dissolving a thin layer of the plastic on the surfaces being glued and welding them into one piece once the solvent evaporates. The end result is a joint as strong as the materials being glued, since they are now literally one piece. The caveat with solvent cements is that they don't necessarily work on all the different plastics common to model railroading. Not all plastics are created equal; each has its own chemical composition. Some cements work well for a variety of different plastics, some are specific to a particular kind of plastic. MEK (methyl ethyl keytone) is a common solvent cement that works well with most plastics. Its major drawback is that its vapors are not user friendly, so work in a well-ventilated area. Other solvent cements found in hobby shops are a little nicer to use, but are more selective as to what they work with.

Super glues

While "super glues" (cyanoacrylate or CA cements) should be on every workbench for quick repairs or light construction, they aren't necessarily the best glues for everything. CA cements were originally developed as replacements for surgical sutures. Because of this, CA glue is designed to dissolve over time when exposed to moisture. As such, it's not the best choice for building outdoor structures. I use it primarily for building rolling stock. It works well with wood and for gluing dissimilar materials, such as metal detail castings to the wood. It's not the best adhesive, but, as it dries almost instantly, it allows me to work faster and get more done in a short amount of time. Where I need a stronger glue joint, I switch to a more suitable glue, or use a mechanical joint, such as a small nail.

Cyanoacrylate glues come in various viscosities or thicknesses. The thin variety has the consistency of water and, as such runs everywhere. This is actually the strongest variety, though, as the glue penetrates best into the surfaces being joined. The thicker varieties are easier to work with, but don't dry quite as fast. They do have "gap filling" capabilities, though. CA cement has a limited shelf life, so don't get the two-ounce size unless you're doing a lot of construction.

An accelerator spray is available to instantly set CA cement. It's good stuff and makes CA cement infinitely easier to work with. It's not without drawbacks, though. The spray can be hard to control. The way around that is to put the accelerator into a small needle-tipped applicator bottle. This allows you to apply it only to the particular joint you're working on. The accelerator is photoreactive; that is, light will deteriorate its ability to do its job. I wrapped my small applicator in duct tape to keep the light out and I only put in small amounts at a time.

There is no single, do-everything adhesive. Regardless of which kind of glue you use, follow the instructions on the bottle. Surfaces need to be clean, free from dust and oil. When in doubt, clamp your work to ensure that nothing moves.

White glue is usually limited to scenic or detail applications, due to the fact that it's not water resistant. Here, diluted white glue is mixed with crushed coal to become a coal load on a tender. Since the locomotive is usually not exposed to water, the glue can be used safely.

Paint

With all the paints available to the garden railroader today, it's easy to get confused as to which is which. Some paints work well with others, while some do not. You don't want to ruin your prize model finding out which ones don't.

Anyone who's painted a room in a house knows how confusing it can be to choose the "right" paint. Besides the obvious questions concerning color, there are many things to be addressed. The same issues hold true when it comes to adding color to our miniature world. There are a large number of similarities, but also some important differences, in painting a bathroom and a boxcar.

There are three basic ingredients to any paint: the pigment, the binder, and the solvent. The pigment is what gives the paint its color. These are either synthetic or organic, depending on the desired color. For instance, iron particles have historically been used in producing the familiar "barn red" color.

The binder does just as the name suggests. Its job is to hold everything together once the paint dries. It is a glue, of sorts, that holds the pigment elements to each other and to the surface being painted.

The solvent is the liquid carrier for the binder and the pigment. It evaporates away during the drying process, leaving a dry coat of paint behind. Most modern paints also have a fourth component, that of a myriad of additives that affect things such as drying time, viscosity and flow, finish, UV resistance, weather/temperature resistance, and shelf life.

Enamels have long been the backbone of the modeler's paint arsenal. Most spray paints fall into this category. Floquil's enamels still line many workbenches. For special situations where you want more control than a brush allows, you can find paint markers, such as this one made by Testor's.

The principal division in paints is in the solvent that carries the pigments and binders. There are two basic categories here—oil or solvent-base (alkyd) paints and water-base (acrylic and latex) paints. It used to be that the "best" paints were always oil-base paints. They tended to be much more durable, flowed easier, and covered better than their water-base counterparts. Twenty years ago, you would never have used a water-base paint on the exterior of your house. That has now changed. Advances in solvents and additives have improved the qualities of latex and acrylic paints to where they rival the alkyd paints in terms of ease of use and durability. This change has made its way down to the hobby-paint market as well, but we'll start by looking at the historical favorites, the alkyds.

Alkyd paints and lacquers

In the alkyd family, there are two players—lacquers and enamels. Lacquers aren't very common in hobby paints, but do show up in some specialty finishes like metalizers. They're more common in the wood finishing arena. Lacquers differ from enamels in the solvent used and the thinners needed to clean up afterwards. Without going into the chemistry, we'll leave it with the fact that laquers and enamels are basically incompatible with each other.

Enamels are far more common in the realm of hobby paints. Two of the most common brands found on hobby-store shelves are Floquil and Testors (both owned by the same company). These enamels, and those by other manufacturers, have been around for years and are tried-and-true paints. If you're planning on airbrushing your model, they're still the some of the best paints for that application. Most popular commercial spray paints are enamel paints (Krylon, Floquil, Testors), though some brands are lacquers. If you're using sprays, read the label to find out what kind of paint it is, as one kind will attack the other if sprayed on top of it.

The biggest drawback to these paints is the cleanup. Both lacquers and enamels require solvent-based thinners to clean the brushes. These solvents aren't very user friendly. The vapors are flammable and can be harmful to breathe. Disposing of used thinner requires the same diligence as discarding oily rags.

Water-base paints are easier to clean up and don't require the thinners that solvent-base paints do. Many craft stores sell craft paint, such as the Folk Art line, that comes in a wide variety of colors. Even old companies like Floquil are expanding their line of water-base paints.

Different paints have different viscosities, but all can be thinned. Heavier paints cover better on the first coat, but may have a tendency to fill in small details. Thin paints require more coats to get an even covering, but tend to smooth out better.

Water-base paints

It's these concerns that led paint manufacturers to expand and improve their line of water-base paints. As with alkyd paints, there are two members of the water-base family: latex and acrylic. Latex paints are less common in the model world, but almost the industry standard for house paints. Acrylics make up the lion's share of hobby paints. Unlike lacquers and enamels, though, latex and acrylic paints are much more compatible with one another. The reason is the simple solvent used—water. With these paints, there is no worry about harmful or flammable vapors. Cleanup is as simple as turning on a faucet. Hobby acrylics have really come into their own in the past 20 years, and the finishes are now every bit as smooth and durable as their solvent-based counterparts. They can be had much cheaper, too. Most of my paints are $1 bottles of paint found at craft stores. I've also used artists' inks, which mix well with acrylic paints.

Acrylic paints tend not to spray as well as enamels, though Badger makes a line of acrylics specially formulated for use in an airbrush. If you intend to use an acrylic or latex paint in an airbrush, make sure it's got finely ground pigments. Otherwise, you'll find it has a tendency to clog up.

How do all these paints stand up to time and frequent handling? Of particular importance to garden railroaders is the UV stability of the paint. Few hobby or craft paints have UV stabilizers. This means they will tend to fade, crack, and otherwise deteriorate more quickly outdoors than indoors. They're great for rolling stock, figures, and details that move indoors, but they're not so well suited for buildings that spend most of the time outdoors. For this, I'd use an exterior-grade latex paint from the home-improvement store. These are thicker than most hobby paints, so they may have a tendency to hide fine details in a structure, but the paint is much better suited to the elements. A good exterior-grade latex will last 10+ years, depending on the environment. Many commercial spray paints, such as Krylon or Rust-o-leum, are also UV stable. Sprays by the hobby manufacturers tend not to be. However, you can buy a UV-stable clearcoat.

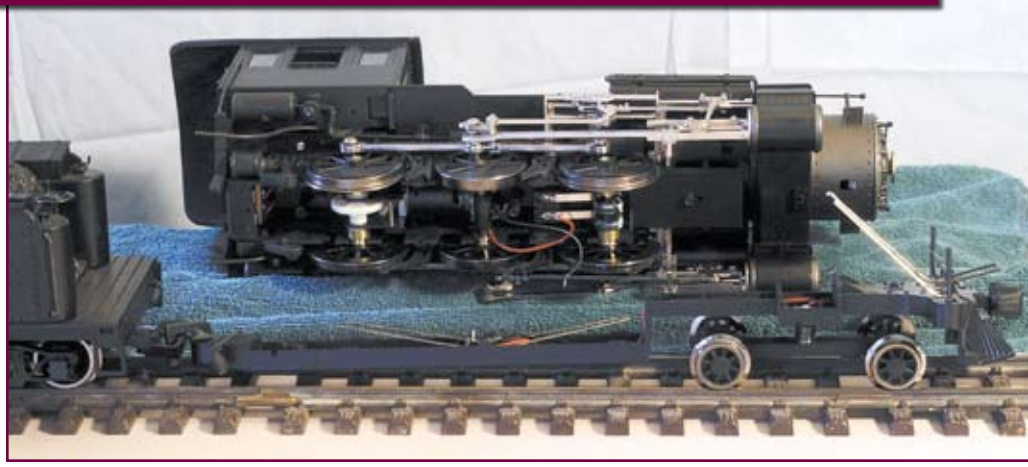
The last consideration is the finish of a paint has once it's dry. There are three basic finishes a paint can take. A gloss finish is highly reflective. If you're planning to apply decals to a model, a gloss finish will give you the best results. At the other end of the spectrum is a flat finish. This surface has almost no reflectivity to it. A semi-gloss or satin finish lies in the middle. It's got some reflectivity, but not so much that you can see yourself in the reflection. If the paint you're using has one kind of finish, but you want another, there are clear paints that will give you the desired finish. These can be either sprayed or brushed on. It's entirely possible to paint a model with flat paint, overspray it with a gloss coat so you can apply decals, then spray it again with a flat finish.

Brushes

I have a small arsenal of brushes, ranging from ¾" wide down to 10/0 (ten-ought), which is a very fine brush used for painting details. Thin paints work well with soft brushes, but thicker paints need a stiff brush to move them around. You don't have to buy top-of-the-line brushes for our purposes, but you will want to stay away from the bargain-basement brushes.

There are a number of products that will allow you to alter the look of the finish. Krylon makes a variety of different finishes, and Testor's Dull-Cote has long been a modeler's favorite. Future floor wax is a clear acrylic that will give your model a glossy look.

Maintain your equipment



Routine maintenance of locomotives and rolling stock is the key to reliable operation.

A few minutes spent maintaining your engines and rolling stock will go a long way toward avoiding problems that will cost far more time and aggravation later. There's nothing more frustrating than putting a locomotive on the track only to have it stop moving 10 feet down the line because its gears have stripped. Basic maintenance is the key to reliable operation. There are several simple things you can do to keep your trains running through the garden.

Locomotives

Let's start with basic engine maintenance. Proper lubrication is so important to reliable operation that Bachmann includes a video with many of its locomotives that demonstrates how to keep things moving smoothly. This is no less important with other manufacturers' locomotives. Many include exploded drawings or written instructions on how to lubricate the gears properly.

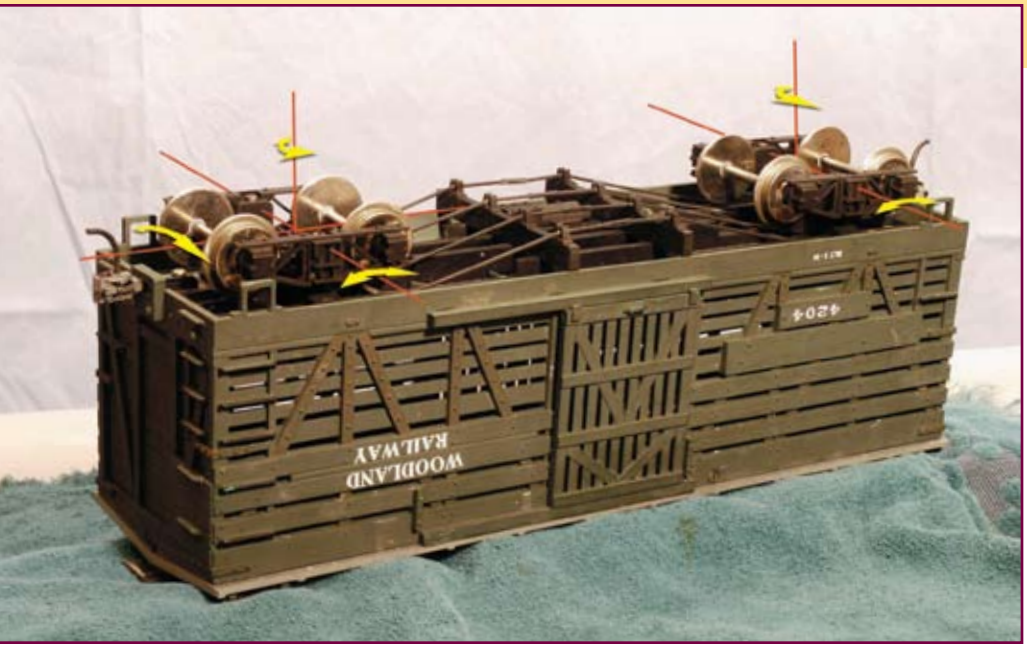
Generally speaking, all moving parts should be kept lubricated. The most important point is the gearing. Gears should be coated with a plastic-compatible grease. If the main gears are allowed to run dry, they will be prone to stripping, accelerated wear, and even breakage.

Wheel bearings should be oiled occasionally with a touch of sewing machine (or similar) oil. WD-40 is **not** an acceptable lubricant. It's great for freeing up rusted bolts but it has no long-term lubricative properties. Occasionally put a drop of oil on the valve-gear joints of steam locomotives. This routine oiling around isn't something that has to be done before every run. Depending on how often you run, once or twice a year is adequate. The grease on the main gears tends to stay put for longer periods of time because, in most cases, the gear boxes are sealed. Oil on the bearings and valve gear tends to evaporate or dry out more quickly and may need to be replenished more often. You don't need to bathe the parts in oil. A little drop will do quite well. There's a reason that most oil applicators we buy for the hobby have narrow, needle-like applicators. Oil is a viscous liquid and will, over time, pick up abrasive matter (dirt and grit). The more excess oil, the more of this matter is picked up and distributed into the joints the oil is supposed to be protecting.

Proper gauge is essential for good tracking. The accepted standard for back-to-back spacing of gauge-1 wheels is 1.575". Here, an inexpensive dial caliper is used to check spacing. Don't trust a ready-made wheel gauge until you have checked its accuracy with a caliper.

Of course, it doesn't matter how smoothly the running gear turns if there are no electrons getting to the motor. Proper electrical conductivity is essential for good operation. Cleaning needs to be done a little more often than lubricating, depending on your operating environment (assuming you rely on track power to run your trains). The key areas that need to be kept clean are the wheel treads and the point at which power is transferred from the wheels to the brushes or wipers that carry electricity to the motor.

There is no magic bullet for keeping wheel treads clean. Some manufacturers suggest coating the wheels with a conductive lubricant to aid in this endeavor. I'm not a big fan of putting any kind of liquid on the wheels, as this invites trouble. Dust from the ballast can be picked up as the locomotive runs down the track. This dust



Trucks need to be able to move freely against the car, but not so freely that the car wobbles when it rolls down the track. In this diagram, the left-hand truck is set loosely so it can rotate around all three axes. The right truck can swivel and rotate front to back, but it cannot rock side-to-side. This eliminates any wobbling the car may otherwise want to do with loose trucks.

not only gets in the way of electrical conductivity, but also slowly grinds away the surface of the wheel and the rail as it's run over by the train. (You can use these products on other electrical contact points, just not the wheel treads.) My favorite tool for cleaning wheels is a fine Scotch-brite pad. It's also possible to use a pencil eraser to clean wheel treads and other electrical contact points. Avoid sandpaper, as this creates microscopic grooves that actually collect dirt and grime, after which you'll have to clean the wheels more often. The best recipe for keeping wheels clean is to keep the track clean. Equipping your rolling stock with metal wheels goes a long way toward facilitating this, as it eliminates the plastic buildup that can cause a lot of conductivity problems.

Rolling stock

While electrical conductivity and proper lubrication make up the majority of routine maintenance tasks, there are other basic things that should be done to every piece of rolling stock on your railroad to ensure proper operation. These are largely mechanical issues and, once resolved, should not have to be revisited. The most common problem lies in the wheels. They need to be properly gauged to provide smooth operation. The standard back-to-back spacing for wheels running on Nº 1-gauge track is 1.575". Wheels that are too far apart or too close together will have a tendency to derail on switches or on curves, where they will want to climb the rails or fall between. It's more common for wheels to be too close together. This can be fixed by resting the wheel on the jaws of a vise and tapping the axle lightly until the wheels are the proper distance apart. Wheels that are too far apart may be more difficult to correct, as you may need to remove some material from the plastic axle to allow them to come into gauge.

Another malady is a wheel that doesn't sit squarely on its axle, giving it a wobble as it rolls. For metal wheels, light tapping with a hammer may correct this problem. If it's a plastic wheel, replacement is commonly the only solution.

Once the wheels are in gauge, make sure the trucks they're mounted in are in good shape. A drop of plastic-compatible oil on the ends of the axle will lubricate the journals (the boxes on the truck in which the axles rotates) so the wheels turn freely. Make sure there is a slight amount of lateral play in the axles. If there isn't, that means the journals are pressing in on the axle ends and the axle won't rotate freely. This can be fixed by drilling out the ends of the journals ever so slightly. Be careful to use a drill that is the same size as the existing hole. Don't enlarge the diameter, just make it a little deeper. Too much lateral movement, however, can also lead to trouble. The axles could pop out of the journals, causing a derailment. Thin washers placed on the axles between the wheels and the journals can help here by limiting the amount of play between the journal and the hub of the wheel.

The attachment of the trucks to the car should also be checked. Trucks need to be loose enough that they can turn freely, but not so loose that the car wobbles when it rolls down the track. I try to keep one truck tight enough that the car has some movement back and forth longitudinally, but not side to side, while the other truck has a little side-to-side play. This allows the car to roll better over uneven track without danger of derailing.

Routine maintenance is just that—routine. Yet there is a reason why we do such tasks. I would much rather spend an evening giving my entire collection a quick once over than have to spend the same evening in a frustrated stew because the gears on my favorite locomotive need to be replaced. The less time we spend fixing problems, the more time we can spend on more constructive projects or the never-ending task of weeding. II

Resting one wheel on the vise while gently tapping the end of the axle will widen the gauge of narrowly spaced wheels.