No Fail Tortoise Installation Instructions

The Tortoise switch motor is popular among modelers because it is sturdy, reliable, and operates in a slow, prototypical fashion. You can watch your turnout point rails move slowly, just like the real thing. And the motor may be used in any application where an electrically operated movement is required -raising and lowering crossing gates, operating semaphores -you name it! Aside from its own legendary reliability, the motor also makes your turnouts more reliable. Tortoise uses an electrical "stall" motor, which simply means that it is always trying to keep moving in whatever direction it has been thrown, and simply "stalls out" when it can't move any further. That's what keeps pressure on the point rails, so they stay firmly applied to the stock rails of the turnout.

But mounting the motor can be intimidating at first glance. Especially for existing layouts, how in the world do you drill holes in the table that will perfectly align the Tortoise throw wire (the "spring wire") with the tiny hole in your turnout's throw arm? Worse yet, how do make all this work when you're UNDER the table, but need to see what's happening on TOP of the table?!

The Tortoise instruction sheet is exactly correct in terms of what it tells you to do, but the instructions do not, and really cannot, address all the practical problems of actual layouts - especially the ones with track already permanently installed. Experienced modelers everywhere have developed all kinds of clever approaches, and if you are a member of a railroad group you have no doubt heard many of them, or you soon will.

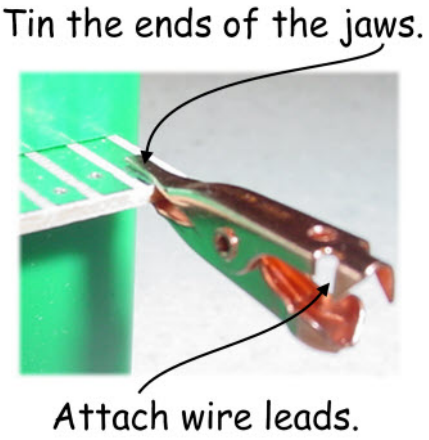
These instructions are aimed at people who have rarely or never installed a Tortoise motor. Accordingly, we are interested in fast and effective and easy methods. As was the case when you learned to drive a car, after a few times doing it, the actual work is accomplished much more quickly than explaining how to do it. While many people rely on measurements, templates and the like, we prefer instead to use easily understood visual references and methods which are forgiving of errors.

Before we deal with physical mounting of the Tortoise, let's look at the electrical connection. One of the most vexing challenges of the Tortoise is those thin metal foil connectors. Apply too much heat for too long and they just melt away. And attempting to solder wire to them AFTER they've been mounted can be almost impossible.

A better way is to attach short wires to the tab foils before mounting the Tortoise under the table. Those connections can either run to a terminal strip, or simply left hanging for attachment of longer wires to them later on; it is much easier and much safer to solder or attach a wire to a wire, then to the foil on the Tortoise after it has been mounted.

A handy method we've developed to make this entire process speedy and effective is to solder tiny alligator type "test" clips to the Tortoise foils. These clips have jaws like alligator clips, but no teeth. Instead, the clamping surfaces are perfectly flat. Furthermore, they are easily shaped to conform to the thickness of the tab on the Tortoise.

Start by soldering wires to the clips. Then, with the clip jaws open, tin the clamping surfaces of the jaws. Next, open the jaws and engage the foil surface on the Tortoise tab (the ones on each end are for powering the Tortoise -see the Tortoise instructions). Feel free to gently squeeze the clip jaws with a needle nose type pliars so they are making good, flat contact with the foil. Finally, touch the jaws with the soldering iron to flow the previously applied solder onto the foil. Done! Those little copper clips are sold at Radio Shack and similar places. They're cheap. Do all this on the work bench or other convenient area.



There is also a device known as an "edge connector" which pushes onto the Tortoise tab to make a friction connection. At first blush, this seems like a good idea, but in our experience it simply moves the problem from the Tortoise foils to the connector itself. The connector has very tiny metal points for soldering on a wire, and they are easily ruined by the soldering iron.

Of course, you could use any kind of connector that is most convenient for you -the idea is simply to have the tedious part of the electrical hookup essentially complete before you're under the table so you need not worry about spoiling the foil on the Tortoise.

Returning now to physical installation of the Tortoise, the object, of course, is to get the Tortoise spring wire matched up as closely as possible to a tiny hole in the turnout throw bar, so that when the spring wire is at the center position on the Tortoise, the throw bar of the turnout is likewise centered between the rails of the turnout. You must also make sure that the swing direction of the spring wire matches the confined direction of back and forth travel of the throw bar.

The ideal solution is to mount the Tortoise under the layout so that it will stick to the underside of the table, yet can be adjusted to achieve BOTH the centering and the correct travel direction. Given that you will often be completely under the table yourself, it is awkward and seemingly impossible to know when the Tortoise position is correct with respect to the throw arm of the turnout which of course is on top of the table where you can't see it.

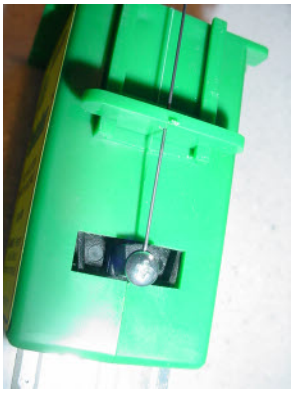
The easy answer is an adhesive which is strong enough to hold the Tortoise to the bottom of the table, yet pliable enough, until set, to let you move the Tortoise without detaching it from the table. We'll get back to this.

Bear in mind as well that it is not just the Tortoise which must be properly aligned, but also the turnout itself must be correctly positioned with respect to the connecting trackwork. The

turnout need NOT be permanently placed -in fact, its better if it can be easily moved or, better yet, taken up- but you don't want to deal with changing much of your existing trackwork simply to accommodate the position of the Tortoise.

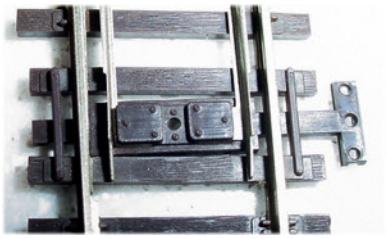
Now of course, if you are in the track laying stage of building your layout, you may not know NOW the exact, final placement of your turnouts. You can, however lay down enough track and turnouts -even without roadbed- to decide on such placement. Let any future adjustments take place somewhere ***else*** along the line, and make your turnout placement "sacred." Alternatively, you may also finalize all the trackwork, but leave the turnouts and immediately adjoining trackwork "loose" so you can pull them away.

Install a spring wire onto a Tortoise motor as per the instruction sheet. Move the black actuator to the center position, so the spring wire is vertical. That actuator (Tortoise calls it a throw arm) is tight -just keep applying pressure to get it to move to center. Look it over so you understand what's going on here: the closer the "fulcrum" is to the actuator, the greater the swing of the top of the spring wire. A movement to the left of the actuator transfers the same movement -but to the right- to the top of the spring wire. The spring wire, in turn will move the throw arm of the turnout. Get all that into your head.



With your Tortoise pre-wired and the spring wire installed, you're ready to tackle the train table. The following instructions assume a kind of "worse case" scenario, in which you have your trackwork basically finished and permanently installed, and you're going to somehow retrofit the Tortoise to what's there.

1. Move the throw bar of the turnout to its centered position. The point rails are just slightly away from the stock rails on either side. Now, with the spring wire on center, and the turnout throw arm likewise on center, you'll have the maximum travel possible to the left and right.

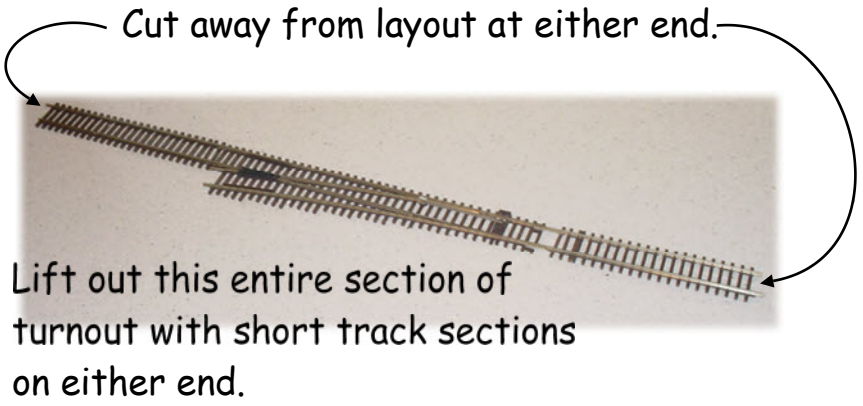
   

   You could, of course, just as well move the spring wire all the way to the right, and the turnout throw bar all the way left and get basically the same result. However, the penetration of the spring wire through the table would then be at an angle, making it difficult to fit the hole in the turnout throw bar over it. Furthermore, the center-to-center approach keeps the turnout itself centered with respect to the adjoining tracks.

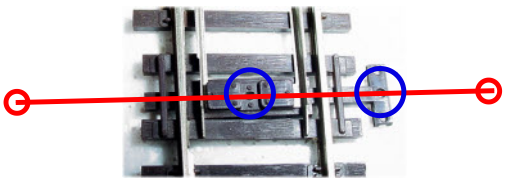
2. Determine whether you want to use the throw bar hole in the middle of the throw bar (between the rails) or at one end (outside the rails). If the portion of the throw bar outside the rails has no hole, you can make one. In general, using an outside end of the throwbar is easier because the rails and ties of the turnout don't block your view into

the hole and the outside position of the hole makes it easier to fit the throw arm hole over the spring wire.

3. Precisely mark the place where the hole in the turnout throw arm you are going to use is positioned when the point rails are centered between the stock rails. It can be helpful to actually tape the rails to hold that position. Use a small drill bit or something similar to make a hole or mark in the roadbed or table at that spot. If there is ballast there, or roadbed material, it will tend to self-seal when you pull out whatever you're using to make the hole or mark, so wiggle it around enough to make it visible after you've pulled away the turnout.
4. Select a place a few inches to a foot away from the straight-through ends of the turnout and cut clean through the track at those points. In effect, you've just created a longer turnout.
5. Now pull the turnout and the few inches of track attached at either end up and away from the diverging track. Keep your eye on that spot you've marked for the spring wire hole under the throw arm, and quickly insert a piece of wire, nail or something similar so you can find it again. This method works most easily on straight sections of track. If you're on a curve, be sure to use stick pins, small nails or something similar to maintain the radius of the tracks you've left behind after you've pulled away the portion to be removed.



6. Now drill a ¼" to ½" through the table at the place you marked for the Tortoise spring wire hole. We prefer the ½" hole because it allows for a full swing of the spring wire, and it is the pressure of the spring wire that keeps the point rails pressed into place.
7. An optional step: On top of the table, mark a line which passes through the middle of the throw bar, is perpendicular to the rails, and ends on both sides of the turnout at a short distance from the outside of the rails. Drill holes down through the table at the ends of the line you just marked. Push small wires through so you can see the penetration under the table. You should now have three holes under the table. The one near the middle marks the place



where the spring wire from the Tortoise will go, and the ones to the left and right are a reference to line up the side of the Tortoise where the spring wire is located so that the side-to-side motion of the spring wire matches the side-to-side motion of the throw bar on the turn out.

8. Apply some Loc-Tite "Power Grab" adhesive to the base of the Tortoise. From under the table, push the Tortoise toward the hole, and visually guide the spring wire up into the center of the hole. As the body of the Tortoise nears the underside of the table, it will block your view of where the spring wire is going. The spring wire side of the Tortoise should be aligned to match the direction of the throw arm movement up top (which is why optional step 7 above can be helpful). Press the Tortoise up against the underside of the table so the Loc-Tite adhesive grabs the underside of the table and holds to it. There may be other adhesives that work as well, but Loc-Tite Power Grab does do the job. Get it at home improvement places like Lowes, Home Depot, etc.

The Tortoise instructions advise you to sand and seal the underside of the table, let dry overnight, then use double faced tape to mount the Tortoise, then apply caulking, then wait overnight AGAIN before proceeding. The problem with this is not just the 48 hour delay, but also having a motor which might not be placed correctly. We think immediate feedback -to say nothing of immediate gratification- is a better approach.

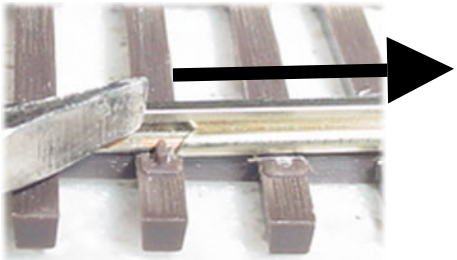
9. Back on top, inspect the position of the spring wire to be sure it appears in the center of the hole for it. If you are able to look at this while reaching under the table, so much the better -you can move the Tortoise to achieve the center-on-center relationship. Otherwise, you look, then go under the table and adjust, then look again, until you've got it right. If you can get a helper at this stage, by all means do so.
10. Likewise, now move the black actuator left or right, and inspect on top to be sure the spring wire has moved along the correct path. When you're satisfied, return the wire to center.
11. Before replacing the turnout you'll need to prepare the ends of the short sections of track attached at either end so they can be joined back to the track on the layout. Undercut the rails at the ends of the attached track to shave off the retainers that hold the ties to the rails, so that a rail joiner will slip ***completely*** underneath the rail. A fresh, sharp utility knife blade works very well for this purpose. Nip away the retainers on the outside of the rails, then starting from the end of the rails, slide the blade underneath each rail to shave off the inside portion of the retainers. You may also need to do the same to the track still on the layout, but only enough to receive its half of the rail joiner -same as when normally laying track.

You may also consider shortening the rail joiner itself to minimize the undercut of the rails. The most effective way

Rail joiner completely under the rail.

to do this -without distorting the shape of the joiner- is to grip one end of the joiner in a tool, and gently push the other end against the flat side of a cut-off or other abrasive disc mounted in a Dremel or similar tool. Let the disc grind off a portion of the joiner, then turn the joiner around and take away some material from the other end. Alternatively, use a file to manually reduce the length of the joiner.

12. Slide the rail joiner completely onto the rails, so none of it sticks out. Now you can slide your turnout and attached track back into place. First engage the diverging section, then lay down the rest of the turnout, guiding it to let the spring wire pass through the throw bar hole. Match up the ends of the rails on the attached track to the rails on the layout. Use a small straight blade screw driver or similar tool to push buried rail joiners back to their normal position and engage the rails of the adjoining tracks. You may then solder the joints for a solid mechanical and electrical bond.



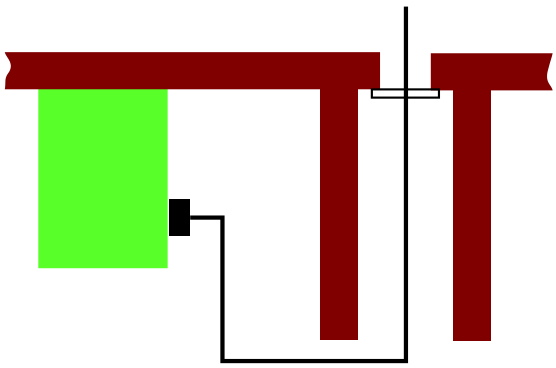
Push rail joiner back out to engage connecting track section.

This procedure is surgical in nature, but it is far less disruptive to an installed railway then lifting and twisting sections of track to accommodate the space taken up by a rail joiner. Furthermore, the connection between track and turnout is completely undisturbed.

13. With the Tortoise spring wire now passing through the hole in the turnout throw arm, you may manually move the actuator on the Tortoise to test the action. If its not quite right, you can nudge the Tortoise into a proper adjustment. If the spring wire extends too far above the throw arm, nip it off.

How to Handle Obstructions Under the Train Table

Inevitably, you'll encounter road blocks under the table -part of the table structure itself, or a wall surface or something that gets in the way of the ideal placement of the Tortoise. In general, the instructions above still apply to the actual physical installation, but you'll need to apply some geometric thinking to the size, shape and length of the spring wire.



Identify a nearby place you can put the Tortoise, then consider what shape the wire must have to reach horizontally across the underside of the train table before making an upward turn into the hole to the turnout throw arm. You can use an ordinary piece of wire which is easily bent to try out various shapes and angles. You might also consider placing a fulcrum across the bottom of the hole -a popsicle stick with a small hole in it for the spring wire to pass through, glued to the underside of the train table, will help reduce distortion in the spring wire when its moved by the Tortoise, and also keep it centered at the bottom of the hole.

You'll need to use a heavier gauge of wire than the one that comes packed with the Tortoise, get the next size larger at your hobby shop. The wire is sometimes called "piano wire," and it is often used as a push rod to control steering mechanisms on remote control planes and automobiles. Take the supplied Tortoise wire with you so you make certain that the wire you buy is just one size bigger.

Be aware that this wire is very tough stuff and is fiendish to cut and to bend. Measure the overall length of the test wire you had previously configured to the right shape. Then, cut away a section of the piano wire that is 1/2" or more too long. Starting at the Tortoise end, and with very tightly gripping pliars, copy the bends on your test wire as closely as you can. Then widen the hole in the Tortoise actuator to allow a snug fit of the new piano wire. Do a test install of the piano wire and tighten the retaining screw to assure a proper fit that doesn't let go. When you're sure it's a good fit, de-install the wire.

Back on the layout, pass the new spring wire up through the hole in the table to the turnout throw arm, and run the wire through the throw arm hole on the turnout. Use a clamp or some other means to keep the wire in place, suspended in the hole through the table. It should be able to turn, but NOT drop through onto the floor. Now go under the table and affix the Tortoise motor to the table so that the hole in the actuator is properly aligned to the end of the spring wire. Insert the wire into the Tortoise actuator and fasten it with the retaining screw. Test the action and make your adjustments. If its all good, you may now cut off the excess length of spring wire poking above the turnout throw arm -and, in fact, using a cut off wheel is the best way to do this as the wire is incredibly resistant to the shearing action of cutters.

Here, more than anywhere, the “keep it simple” rule applies. It is better to have the Tortoise further away from the hole to the throw arm, but with a simple path for the spring wire, than to have it closer with a complex, twisting and turning path.

If at all possible, install your first few Tortoise motors near the edge of the layout and away from obstructions where you can reach them with your hands while watching what’s happening up top. This will help condition you for the ones in more difficult locations.

The best advice we can impart now is to read through these instructions again -and maybe yet again- so as the have a notion of the procedure in your mind. That way, when it comes time to do the actual installation, you’ll know where you’re headed.

Believe us when we tell you that after a few installations, you won’t need to consult these instructions anymore, and the process will come to you quite naturally.

