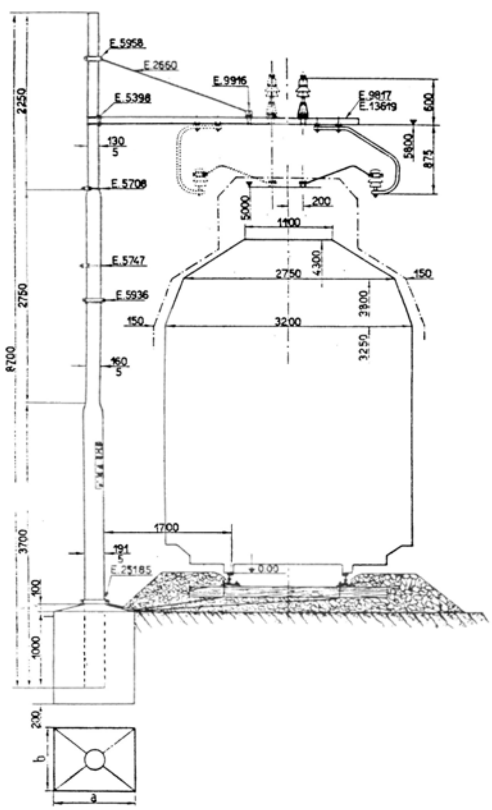
# Italian Railway Catenary Poles in N Scale

**By Blaine Bachman**



Notwithstanding improvements made over the years, the catenary system used on the Italian Peninsula is fairly uniform throughout. Excluding the distinctive overhead supports of the *Direttisima* and the latticework poles found on some of the northern lines, the remainder follows precisely defined, familiar design standards. The Italian clearance gauge is somewhat lower than that used in Germany, but in recent years clearances have increased on international lines, in most cases necessitating raising of the catenary. For the purposes of this article, I will ignore this development.




**The Prototype:**

This hallmark of the FS catenary system is the 'Type M' pole[1]. While these come in ten basic varieties, they are immediately recognizable by their circular cross-section and three-tiered construction. Each pole is composed of three sections of progressively smaller diameter tube. The heaviest poles have a base diameter of 229mm (~9") while the lightest ones have a top section diameter of just 80mm (~3").

The adjacent figure shows the typical construction of a 'standard' Type M25a pole on single-track line. All dimensions are in full (1:1) scale and given in millimeters. It is worth noting that prototype height of the contact wire above the railhead is 5 meters. This is significantly lower than the minimum established by the NEM 201 Standard[2]. which equals 5440 scale millimeters in N. The exacting modeler may use the diagram's dimensions, reduced by a factor of 160, to create an precise scale replica of Italian catenary poles. However, I suggest adopting the modified dimensions described in this article to build N scale catenary conforming to NEM Standards thereby ensuring good operation.[3]

Furthermore, since the dynamic forces present in a model environment are often disproportionate to the scale

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[1] This design is named 'Type M' after Mannesmann, the company that manufactures the poles.

[2] NEM 201 Standards call for minimum height of 34mm in N scale; the 5 meter prototype height scales out to only 31.25mm.

[3] A similar discrepancy exists in HO scale. Sommerfeldt makes FS Type M catenary poles in HO scale that are suitably enlarged to meet the NEM Standards.

reduction, I recommend a slightly heftier construction. For example, the largest diameter of the heaviest Type M pole scales down to just under 1/16 inch in N. A very accurate Type M27a pole can be built using 1/16" and 3/64" thin-wall brass tube and 1/32" brass rod, but it would be quite fragile. Also, the extremely small cross-section at the top of the pole would make securely attaching the cross arm difficult. My construction process uses components one size larger than scale to address these shortcomings.

The prototype and model dimensions of the Type M27a pole are:

| | **Length** Note 1 | | | **Outside Diameter** Note 2 | | |
|---|---|---|---|---|---|---|
| **Segment** | **Proto (mm)** | **1:160 (mm)** | **1:160 (in.)** | **Proto (mm)** | **1:160 (mm)** | **Tube (in.)** |
| Top | 2250 | 15.3 | 0.6 | 130 | 0.81 | 3/64" |
| Middle | 2750 | 18.7 | 0.74 | 190 | 1.19 | 1/16" |
| Bottom | 3700 | 25.16 | 0.991 | 219 | 1.37 | 5/64" |
| Total | 8700 | 59.16 | 2.331 | | | |
| Notes: | 1. Scale length dimensions increased by 8.8% in order to bring the overhead wire placement into compliance with NEM 201. | | | 2. Brass tube diameter increased by 1/64" for strength. | | |

In the typical installation, up to 1 meter of the pole is buried in the concrete footing that anchors the pole in the ground. This extra length also serves on bridge installations where the pole is strapped to the side of the structure by two or more heavy steel bands.

The cross arm is attached to the upper segment of the pole at a point 5800mm above the railhead. The length of the cross arm varies depending on the number of tracks being served by the pole. This measurement is also affected by the distance from the pole to the near rail; The minimum distance is 1700mm, but other factors can require that the pole be placed further away.

The usual maximum number of tracks is six (up to three on either side of the pole) and any combination is possible. Diagonal guy wires stretch from the top of the pole to the cross arm, one for each track; hence, a pole serving six yard tracks would have six guy wires, each one extending from the top of the pole to an attachment point near the messenger wire insulator on the cross arm.

Note that the F.S. uses multi-track catenary poles most often in yards and stations and in other locations where more than two tracks run side-by-side. Double-track main lines are typically served by single arm poles placed along the outside of the right-of-way. Most likely this is to keep maintenance people from having to work between main line tracks and to prevent total disruption of the electrical service in the event of damage due to derailment or other catastrophe.

**Before Beginning:**

This article assumes that you are already familiar with the technical principles of catenary installation and understand the need for standard dimensions, zig-zag, and the like. If not, please purchase a copy of Sommerfeldt's instruction book, Mit Oberleitungen fahren wie beim Vorbild before you start. The book contains English text and is Sommerfeldt catalog #002.

As with all how-to articles, read this one through a couple of times, gather materials and tools, and plan your work. Note the options suggested and consider how you may need to modify the process further to meet your particular needs. One option is to use silver solder for more robust joints than you can get with lead-tin alloy solder. This requires higher heat necessitating the use of a small soldering torch or a resistance soldering outfit.

This article also assumes that you have the basic ability to use the techniques, methods, and tools in safely and successfully executing the procedures described. You can find a good set of workshop safety guidelines in the front of any recent Walthers Catalog.

I recommend that you build one or two poles and evaluate your work. When you are satisfied that the poles you construct will meet your needs, change your approach to an assembly line operation; cut a bunch of materials, construct subassemblies, and put the pieces together. In this way, you can spread a big project over several work sessions without having to get every tool out each time.

**Materials:**

- Thin wall brass tubing in 3/64", 1/16", and 5/64" diameter. One source is K&S Metals, available through Walther's Catalog.
- 1/32" brass rod.
- 0.010" to 0.015" brass or phosphor bronze wire.
- 0.020" phosphor bronze wire.
- Scale insulators (available from Sommerfeldt, or scratchbuild your own).
- 0.125" x 0.250" styrene strip (Evergreen #189)

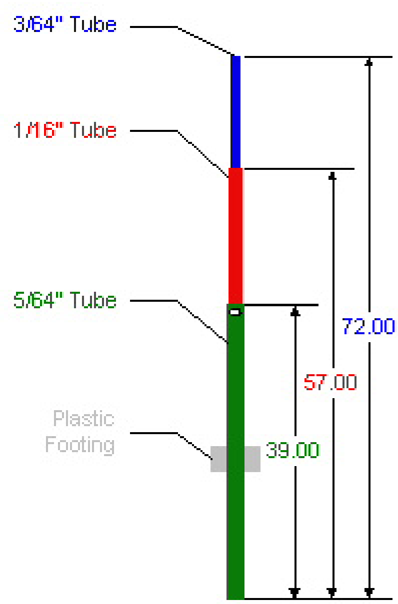
**Tools and supplies:**

- Tubing cutter (K&S) or razor saw.
- Small pliers and wire cutters.
- Jeweler's file set.
- Self-closing tweezers, alligator clips, and/or heat sink clips.
- 5/64" drill and drill motor.
- Soldering iron, solder, and flux.
- Solvent to clean poles before painting.
- Paint (SP Lark Light Grey, Concrete, & White).
- Cyanoacrilate Adhesive (CA).

**Optional:** Soldering torch or resistance soldering outfit, and silver solder with paste.

**Constructing the Basic Pole:**

The measurements given below allow for a pole whose base will be inserted 3/8" into the plywood subroadbed.




1. Slip the 3/64" tube into the 1/16" tube so that 15mm of the smaller tube projects from the end of the larger tube.
2. Solder the two tubes together where the smaller tube exits the larger one.
3. Slip this assembly into the 5/64" tube and align it so that a total of 33mm protrudes from the larger tube.
4. Solder the assembly to the larger tube in the same manner as before.
5. Cut this assembly from the remainder of the tube at a point 72mm from the small end (by assembling first and then cutting, it is possible to use the tubing cutter which will normally not cut tubing smaller than 1/16" in diameter).

**Customizing the Basic Pole:**

At this point, you now have a basic Type M27a pole. This is the starting point for all other pole configurations.

- **Single Arm Pole:** Temporarily install the pole alongside the track and locate a point on the pole exactly 39mm above the railhead. This marks the location for the cross arm and its correct placement ensures that the contact wire will be positioned at the proper height according to NEM 201. Lay the pole on its side and drill a hole into the tube using a #66 drill. Drill a second smaller hole within 2mm of the top of the pole and in line with the larger hole.

Measure the horizontal distance from the baseboard pole mounting hole to the outside of the far rail. Cut a piece of 1/32" brass rod to that length. Insert the rod into the hole you drilled in the tube, square it up, and solder it in place.

Make the guy line and the support for the messenger wire insulator out of a single piece of 0.010" to 0.015" brass wire. Place a $90^{o}$ bend in the wire approximately 5-10 millimeters from the end. At a point 2-3 millimeters further on, make an approximate $30^{o}$ bend.

Mark the cross arm at a point exactly above the centerline of the track. Position the guy wire assembly atop the pole with the $90^{o}$ bend on the mark and solder it to the arm. Thread the other end of the wire through the small hole at the top of the pole, bend it out the top, solder it in place, and trim away the excess.

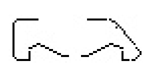
Fill the top of the pole in with solder and file it slightly round.

Slip an insulator over the messenger wire support and bend the remaining wire into a small loop. Clip off the excess wire.

- **Double Arm Pole:** This is a simple variation on the single arm pole, just drill both holes completely through the pole. To determine the length of the cross arm, measure the distance from the outside of the far rail on one side of the pole to the outside of the far rail on the other side. When positioning the cross arm, be sure to account for any off-center condition that may require one arm to be longer than the other.
- **Extended Arm Pole:** As mentioned earlier, the Type M pole is often used with a long arm or arms to serve several tracks in a yard or station. Again, due to the disproportionate dynamic forces in the model environment, it is probably not wise to attempt to serve more than two tracks on each arm. When building a multi-track arm, install a guy wire for each track.
- **Tensioning Pole:** This is the simplest elaboration as it is just a Type M pole without a cross arm. Three varieties exist, one with self-regulating tensioning mechanisms on both the contact wire and the messenger wire, one with a single mechanism for the contact wire, and one without any mechanism. Cross arm poles often perform double duty as tensioning poles. In any case, do not forget to install insulators on the contact wire and messenger wire. Tensioning poles often have a guy wire from the top of the pole to a ground anchor.

**The Wire Hanger:**

Two basic versions of the wire hanger bracket exist, one for inside hangars and one for outside hangars. On the prototype the entire assembly consists of a bracket, an insulator, and a hanger arm. This is convincingly modeled in N scale with a single piece of phosphor-bronze wire and a slip-on insulator. The following figure shows the shape of these pieces in scale. The assembly on the left is the inside hangar and the one on the right is the outside hanger. Refer to the figure on page 1 to see where these are mounted on the arm and the relationship to the track centerline. For reference, the height of this assembly should be 5 millimeters.



1. Bend the hanger starting at the top.
2. After completing the third bend (at this point the wire is pointing straight up), thread the insulator on.
3. Complete the bending of the hanger arm.
4. Clip the remaining wire off.

5. Carefully solder the completed bracket to the underside of the cross arm; use heat sinks to prevent loosening of the other solder joints. Position the hanger so that the tip of the hanger arm (lower end) stops just short of an imaginary line drawn down through the messenger wire insulator. This ensures that a minimal zig-zag can be placed in the catenary.

**Finishing:**

1. Clean the completed pole in a suitable solvent to remove all traces of soldering flux and other contamination.
2. You may want to soak the assembly in a vinegar bath for a few hours to slightly etch the brass thereby giving the paint a better surface upon which to adhere.
3. Wash and rinse the assembly and allow it to air dry.
4. Paint the pole, cross arm, guy wires, and hanger bracket a light grey (SP Lark Light Grey).
5. Paint the footing Concrete.
6. Paint the insulators white.
7. After the pole is installed and the catenary soldered in place, paint the messenger wire hangar and the contact wire hanger arm silver-grey to represent bare galvanized metal.

**Installation:**

My original design called for a threaded base for the pole so that it could be installed in much the same way as the Swiss and German poles made by Sommerfeldt. After some experimentation, I found that this was unnecessary and added additional complication to the fabrication process. I decided to make the bottom segment of the pole long enough so that it could be press fit into a 5/64" hole drilled in the 3/8" subroadbed (be sure to put the plastic footing on the pole before installing it in the hole). For added 'security' and to keep the poles perfectly square with the track, a modest application of CA adhesive around the pole will fix it in place.

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**BIBLIOGRAPHY:**

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Sommerfeldt Eisenbahn-Modelle GmbH. Mit Oberleitungen fahren wie beim Vorbild.