

## **Feature Article: Wiring with Copper By Carla Marasco, Cathy Edgar and Mark Edgar**

Wiring is a basic bonsai skill that is essential in developing raw bonsai stock into a mature bonsai. Wiring can be used to train all types of bonsai specimens, but is critical for developing conifers. This article will focus on junipers, but the wiring concepts discussed here are applicable to other types of trees. Also, this article focuses on copper wire, but the methods of application for copper are applicable for aluminum as well. It is often hard to use copper after learning to wire with aluminum, but the reverse is not true. This article was written to focus on basic wiring principles which will help to provide a good foundation so that future articles can build on this foundation. Learning wiring takes time and study.

### **Carla's Wiring Tips**

Carla is participating in the Takanashi grant program offered at the San Diego Bonsai Club. As part of the grant program, Carla is studying wiring at the Safari Park Bonsai Pavilion. Carla has demonstrated excellent wiring skills which she has applied to two bonsai at the Pavilion. Here is a list of tips from Carla to remember when you begin to wire your trees:

#### **Before You Start Wiring**

- Decide on the style of your finished tree, which side will be the front and where do you want the branches to end up when the tree is completed
- Remove branches that will not be used in your final design (remember once they're cut off, you can't put them back so choose carefully)
- It is much quicker and easier to wire a clean branch, so remember to clean any growth in the crotches, on the underside of branches, etc. before wiring
- Wire size and type will change with the size of branches and the type of trees (Copper holds more rigidly, aluminum is more pliable and less expensive making it ideal for trees that grow quickly that will require more frequent wire changes or for trees that have a thin, soft bark like deciduous trees.)

#### **Tips for Wire Application**

- Start from the base of the tree and work upwards and outwards towards tips (large to small)
- Wire should be applied at a 45° angle for aluminum and about 55 – 60° for copper
- Wire should lay snugly (not too tightly) on the branch without gaps between the wire and branch
- Use care when placing wire to avoid causing damage or additional stress to the tree
- Wire should either be connected to a sturdy anchor point opposite of the location of the branch being wired or be anchored to an opposing branch (one wire for two branches) (1 ½- 2 turns are needed for a secure anchor)
- When applying large wire, use the diamond application technique (Up, over and away, down, under and back, repeat)
- Wire direction is determined by where the branch needs to be moved (move branch up-wire underside (bottom) of branch; to go down-wire over top; move branch left the wire winds counterclockwise; move branch right the wire winds clockwise)
- Crotch and weak areas of branch (knots, etc.) should be carefully supported when wiring to avoid splitting

### Tips for Wire Monitoring and Removal

- Check wire regularly for placement (sometimes branches get bumped), broken branches, wire that is biting in

### Wiring Details - Expanded

#### Cleaning the Tree

The first task is to prepare the tree to be wired. This involves weak or unneeded foliage and branches. For each branch on the tree, remove foliage that is:

- hanging from the bottom of the branch (note that wiring can be used to change the orientation of a branch so the “bottom” of a branch may change,
- growing from the top of the branch, but not all of it because this foliage can be used to fill in empty spots on the top of the branch,
- growing from the crotches of intersecting branches, but some of this foliage can be kept on the part of the branch that is near the trunk because this foliage can be used in the future if the branch needs to be shorten,
- within about ¼” of branch intersections (with exception of some interior crotch foliage) – this facilitate wiring, and
- weak, yellow or leggy foliage.

Also, remove dead twigs/branches and knobs on branches that would hinder how wire lays on a branch. Lastly, remove branches to form an alternating branch pattern (**Figure 1**).



Figure 1.

Once the tree is cleaned it is easier to see the structure of the trunk and branches which in turns allows a design for the tree to be defined. Defining a design for the tree is essential for wiring the tree since position and shape of the branches should conform to the proposed design. Branches that are not

necessary in the proposed design can be removed, but extra branches can also be maintained to serve as backup.

### Wire Types

Two types of wire are readily available for bonsai: aluminum and copper. Aluminum wire is often black or bronze-colored to disguise the bright silver color of aluminum. Aluminum is softer (easier to bend) than copper and is easier to apply to a tree. Because aluminum is softer its power to hold a branch in position requires a larger size than copper which in turn make aluminum wire more visible than copper.

Copper wire is purchased annealed which means that the wire is heated (very hot) then cooled to make it soft. Copper “work hardens” as the wire is applied to the bonsai. Work hardening means that the orderly crystal structure of the annealed wire is disrupted causing irregularities in the crystal structure which makes the wire harder and less easy to bend. Because of this characteristic, copper wire is soft and easy to bend as it is applied to the tree. It hardens during the application and branch-bending process which makes the wire hold a bend in the branch more effectively. Since copper wire has better holding power than aluminum, a smaller size wire can be used to hold a branch in position. New copper has a bright finish, but oxidizes to a darker dull finish over time which makes it harder to see on a conifer.

The better holding power and less visible nature of copper wire makes it a great choice for wiring conifers. The drawback of copper wire is that it is more difficult to apply to a tree than aluminum, but with practice and some helpful hints wiring with copper can become a useful bonsai tool.

For this article copper wire will be the focus, but the overall goals for all wiring are to:

- have function (ability to bend the branch wherever you want),
- be aesthetically pleasing,
- have the same angle for every turn,
- have the same space between every turn, and
- have no gaps between the wire and the branch.

Copper wire uses a larger angle (55 to 60°) in comparison to aluminum (45°). See **Figure 2**.

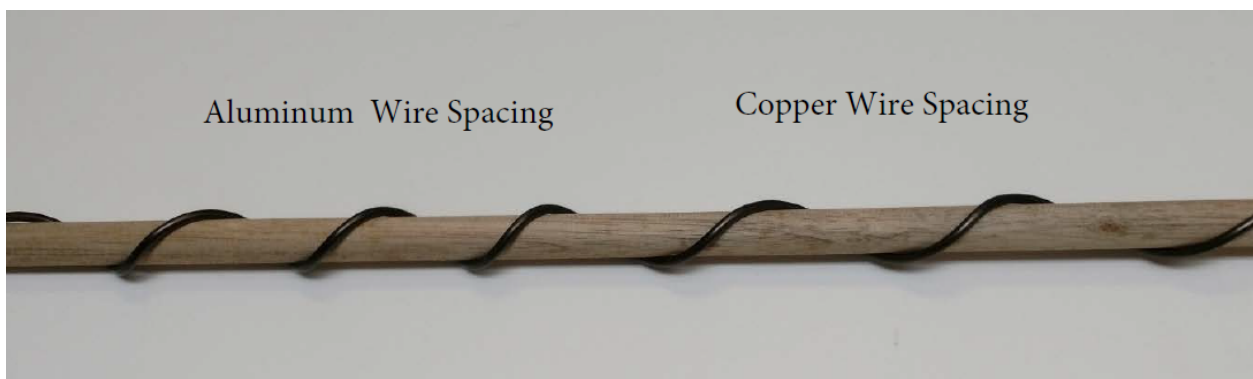


Figure 2.

## Selection of Wire

The right size of copper wire is the size that will move the branch as desired, but not damage the branch by being too big. Obvious, perhaps, but wiring beginners often select wire that is too small. Picking the right size wire takes practice. As wiring skill improves, the size of wire that can be smoothly applied to a branch increases. As a rough guideline, smaller size wire is around 1/3 the size of the branch to be wired. The wire for large branches tends to be a bit less than 1/3 the size of the branch. The size of wire needed for copper wire is a bit deceiving because the holding power of the wire increases during the wiring and bending processes (work hardening).

## Wire Gauge

Aluminum wire sizes are given in millimeters usually 1.5 mm through 6 mm, the bigger the number the larger the wire size. Copper wire is given in gauge sizes, usually 20 through 4, the smaller the number the larger the wire. Copper wire for bonsai is available in even number gauges (20, 18, 16, etc.). Gauges 20 – 16 are mainly used on the ends of the branches (secondary and tertiary branches). Gauges 14 – 10 are often used on the thicker parts of the secondary branches and the thinner parts of the primary branches. Gauges 8 – 4 are most often used for setting structural branches (trunk and primary branches).

## Wiring Process

Wiring is divided into three parts (**Figure 3**):

- structural (includes the trunk, if wired, and primary branches - those connected to the trunk),
- secondary branches (connected to primary branches), and tertiary branches (connected to secondary branches).

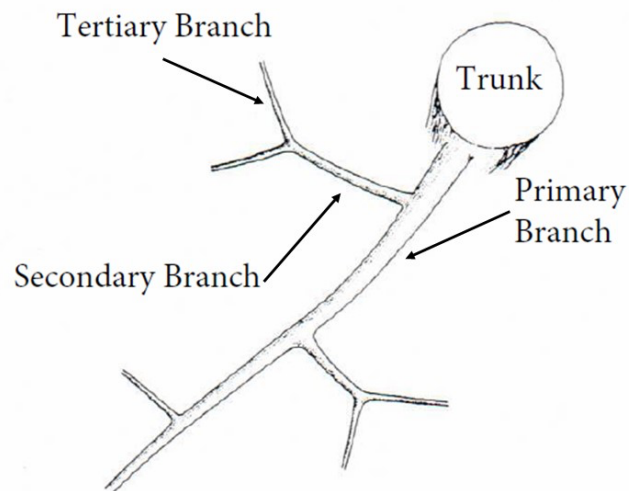


Figure 3.

## Structural Wiring (trunk and/or primary branches)

Wiring begins with setting the structure of the tree by wiring the primary branches and trunk (if needed). To begin structural wiring, stand at the side of the primary branch as opposed to standing in front of the branch. You should be looking at the side of the branch.

Most of the time two branches are wired with one piece of wire. Branches to be wired with the same wire should be roughly the same diameter and relatively close to each other. The wiring process is started by selecting a length of wire that is about 1/3 longer than the length of the two branches to be wired added together. The wire is positioned on the trunk behind the branches to be wired so that about one half of the wire is available for each branch. One half of the wire is held to the trunk at the mid-point of the wire while the other half of the wire is wound around one of the branches to be wire. Initially, the wire should touch the point where the primary branch joins the trunk (shoulder) on top of the branch if the branch is to be lowered (or on the bottom if the branch is to be raised). From this point, the wire is wound around the branch with the following considerations:

- One hand is used to hold the wire and the branch together at the point where the wire is being turned onto the branch – the other hand holds the wire about 4 to 6” from the part of the wire that last touches the branch. The reason for this is to provide leverage to help turn the wire onto the branch. It makes using large copper wire much easier.
- The wire is applied in quarter turns around the branch (in a diamond shape, **Figure 4**). Since the person doing the wiring is standing on the side of the branch, the motion (with respect to the



Figure 4a. Wire Up



Figure 4b. Wire Back

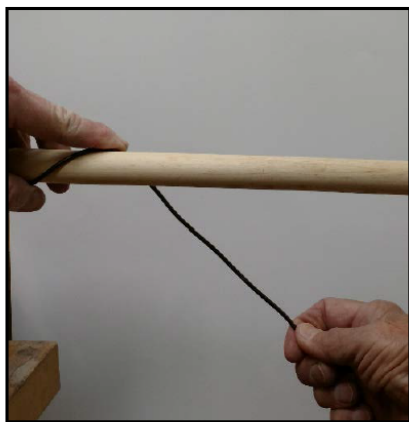


Figure 4c. Wire Down

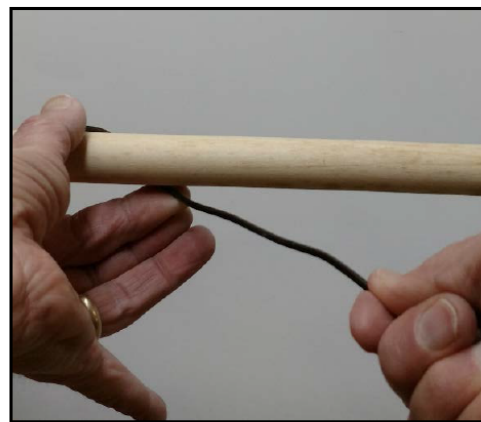


Figure 4d. Wire Toward

person) is away, down, toward and up. After each quarter turn, the hand holding the wire moves to the new point on the wire where the branch last touches the wire. To prevent gaps, it

is also helpful to hold the branch and wire together at two places. This is usually done using the thumb and forefinger placed at different parts of the wire/branch at the same time. If the wire has gaps between the branch and wire it means that hand holding the wire and branch is not working correctly.

- As a primary branch is wired, try to make sure that when the wire comes to a branch (secondary branch) it turns before the branch (**Figure 5**). If this is done in every case then wiring the secondary branches is easier. This applies to secondary/tertiary wiring as well.

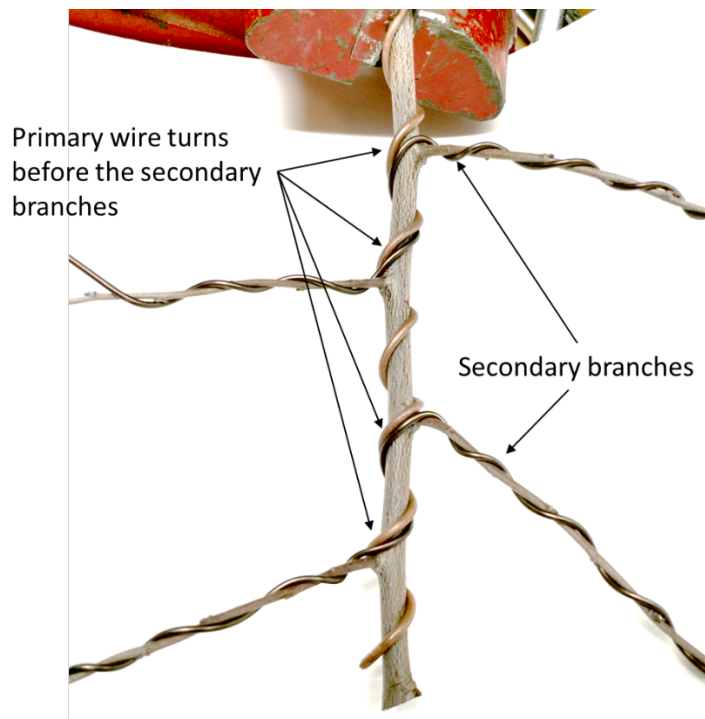


Figure 5.

- Structural wire on a primary branch rarely goes to the end of the primary branch (See **Figure 6**). A primary branch becomes progressively less thick as the wiring proceeds to the end of the branch. At or before the point where the wire becomes too big for the primary branch, the primary wire is continued a turn and one half beyond the nearest secondary branch junction. Continuing a turn and one half provides an anchor point for the finer wire that is used to complete wiring the remaining portion of the primary and the secondary branch that will ultimately be wired.

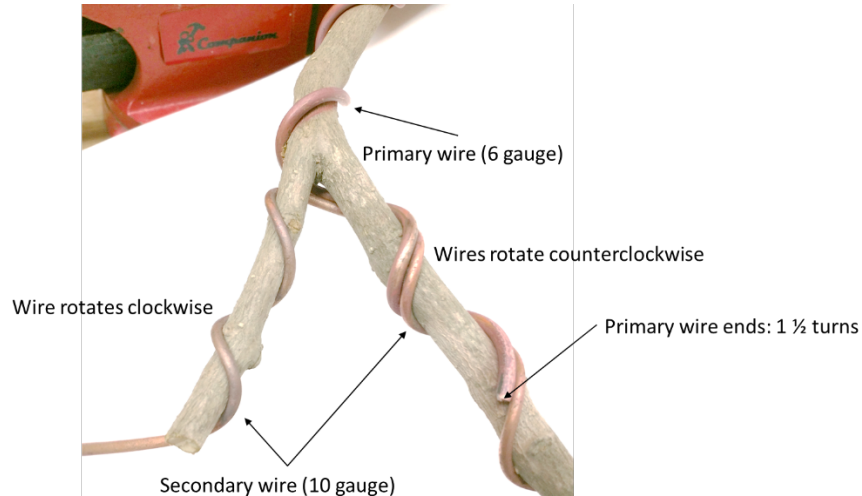


Figure 6.

- To lower a primary branch, the wire must touch the shoulder (junction of branch and trunk) on top of the branch. To raise a primary branch, the wire must touch the shoulder on the bottom part of the branch.
- If a branch is to be moved to the left then the wire should wind counterclockwise on the branch. The opposite is true for a branch to be moved to the right.
- All primary branches (and trunk if needed) should be wired and moved into place before secondary and tertiary wiring is completed.
- The key to applying copper wire is to not over manipulate the wire during application. If the wire becomes too difficult to apply, start over with a new wire.

### **Secondary / Tertiary Wiring**

To complete secondary and tertiary wiring, the end of the branch should point directly at the person doing the wiring. As with structural wiring a single wire is used to wire two similar sized branches. Secondary/tertiary wiring begins with the bottom branches of the tree then proceeds to the top as lower branches are completed. The wire is applied to interior branches first and progresses to the branch tip. The first branch to wire is the main branch which is usually the lowest branch on the tree. This branch sets the style for the entire tree. Style means, for example, the angle of the branch (up/down/level), and the size of the foliage pad (broad/narrow). The characteristics of the first branch are reflected in the other branches on the tree. Wire application considerations include:

- As for primary wire, two similar sized secondary/tertiary branches are wired as a pair with one wire with one end of the wire turning clockwise while the other turns counterclockwise. Whichever way the wire is turning it must continue turning the same way through completion of applying the wire.
- As with primary wiring, try to make sure that when the wire comes to a branch (tertiary branch) it turns before the branch (Figure 5). If this is done in every case then wiring the tertiary branches is easier.

- For secondary branches the wire follows the structural wire on the primary branch for some distance to get from one secondary branch to the other secondary branch. See Figure 6 for an example.
- Note that wires should not cross (overlap) each other. This looks bad and causes the wire to lose function.

### **Other Wiring Considerations**

Wiring takes practice, lots of practice. Practicing on branches of any size taken from your trees and plant trimmings from your yard, or cheap nursery stock is very helpful and will save you time and money in the long run. As with any technique, there are nuances and variations that one will learn with time and practice.

For excellent videos on wiring see Bonsai Mirai Live Library: <https://live.bonsaimirai.com/library>