

# Maryland Licensed Tree Expert Exam Study Guide

## For Exam Domain:

### Tree Support and Lightning Protection

#### Version 5.1

Prior to installation of any support system, objectives shall be clearly defined (i.e., provide supplemental support to co-dominant limbs; provide supplemental support to overextended branch; etc.). All necessary pruning should be performed prior to installing a tree supplemental support system. Pruning shall be done in accordance with ANSI A300 Part 1-*Pruning*. Once a cabling system is properly installed, it needs to be periodically inspected. Prior to installation, the owner of the tree or other responsible party should be notified that such inspections will be needed, and that they shall be the responsibility of the tree owner. Items requiring inspection include the system condition, position, and cable tension, as well as the tree's structural integrity. As the tree grows and changes over time, the system may need to be replaced, relocated, or maintained in order to stay functional. If existing cables need to be replaced, they shall not be removed until the new system is installed. They may be holding parts of the tree together and whole or partial tree failure could result if the existing support is removed before the new one is installed.

When drilling holes for hardware installation, the hole for lag-thread (wood screw type threads) hardware shall be slightly smaller (1/16 inch to 1/8 inch) than the diameter of the lag as you want the threads to bite into the wood for attachment. When using threaded steel rods or eye bolts (machine screw type threads), the drill hole should be slightly larger (no more than 1/8 inch) than the hardware as this type of hardware should pass through the hole unobstructed and be attached by nuts and washers at the ends.

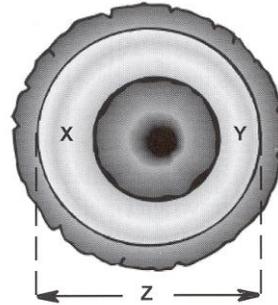
A system is only as strong as the weakest component. Cabling systems should be designed so that system components (anchors, cables, etc.) have compatible working loads.

There are two types of brace rod installations, through braces and dead-end braces. Through rods go entirely through the tree and are fastened at both ends with washers and nuts. Rods used for through bracing are machine-threaded or lag-threaded rod steel. Heavy-duty washers and nuts are used to fasten each end of the rod.



Through-braces shall be used when bracing through decayed wood, weak wood, or in trees that are poor compartmentalizers. Anchors and braces shall not be installed in decayed areas where sound wood is less than 30% of the trunk or branch diameter.

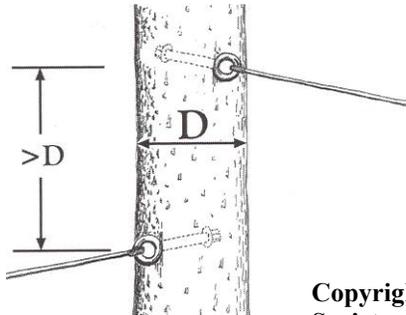
Dead-end braces go entirely through the smaller of the two leaders and at least halfway into the larger leader. The rod used for dead-end braces is lag threaded to hold the wood without nuts. Dead-end braces cannot be used if decay is present in the path of the rod, or if the tree is a poor compartmentalizer or has weak wood. Lag hooks are also not considered safe in soft wood and decayed wood.



Symbol key for equation  
 X = sound wood depth, working side  
 Y = sound wood depth, opposite side  
 Z = total trunk (or branch) diameter;  
 bark diameter not included

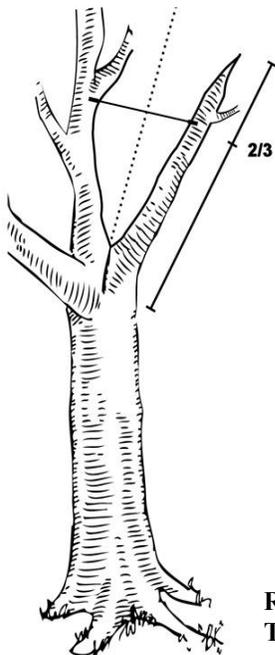
Equation for percentage of sound wood  
 for through-bolt applications:  
 $[(X + Y) \div Z] \times 100 = \% \text{ of sound wood}$   
 for through-bolt applications

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Longitudinal alignment of anchors and/or braces should be avoided. Holes should not be drilled closer together than the diameter of the branch or trunk being drilled or 12 inches, whichever is less. The diameter of the hole shall not be greater than one-sixth (1/6) the diameter of the limb, trunk, or branch at the point of installation.

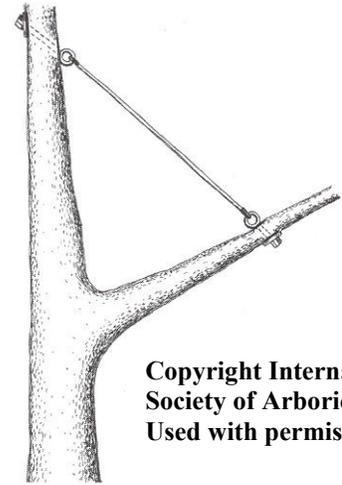
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The proper ratio of cables to anchors is 1:1. Do not attach more than one cable to an anchor. Anchors for cables should be installed at approximately 2/3rds of the length/height of the limb to be supported (starting at the crotch or trunk, go 2/3rds of the distance to the branch tip).

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Anchor(s) shall be installed in alignment with the cable and termination hardware because as the angle of pull varies from 0 degrees (the cable moves away from a direct alignment with the hardware), the strength of the anchor decreases. A turnbuckle (a drop-forged, closed-eye device) can also be used for adjusting tension. These are important as the cables should be taut following installation. When installing support system hardware, washers shall not be countersunk into the wood.



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Thimbles are used to attach cables to the anchoring hardware. A thimble is used to protect the cable from excessive wear. Dead-end grip terminations shall incorporate extra heavy-duty wire rope thimbles – Type III, that meet the performance specifications of federal standard FF-T276b. Heavy-duty thimbles must be used with extra-high-strength cable.

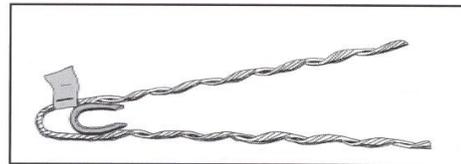


Figure 16. A thimble must be installed when using a dead-end grip.

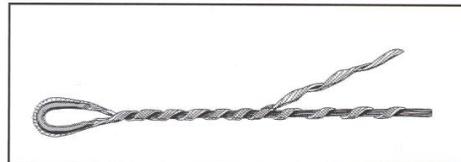
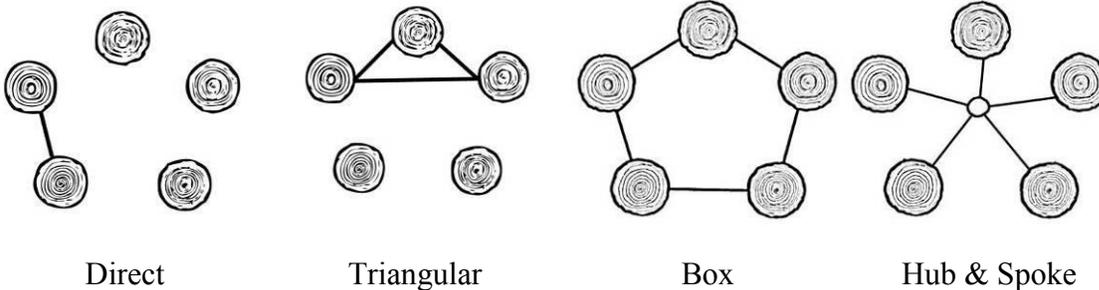


Figure 17. Dead-end grips are installed on the cable by wrapping the short leg of the grip around the cable, then wrapping the long leg. Both legs must be wrapped completely.

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There are four primary types of cabling systems. A cable system involving a single cable between two branches of approximately equal size is referred to as direct cabling. When maximum support is required, the preferred system of cabling is triangular, which consists of connecting three tree parts in combinations of threes. Box cabling connects four or more tree parts in a closed system, and should only be used when minimal support is needed. Hub and Spoke cabling systems (all cables are connected to a central hub rather than to other trunks or branches) should only be used when other installation techniques cannot be installed.



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Bracing is normally used in conjunction with, rather than instead of, cabling. The preferred location for a single rod for a non-split crotch should be one to two times the branch diameter above the crotch. A large split or weak crotch normally requires two or more rods to hold the two sections together and minimize twisting.

When tree-to-tree guying, anchor trees shall be inspected for structural integrity, have the ability to meet the objective, and be attached in their lower half to the upper half of the tree needing support. Ground anchor(s) should be placed no closer to the trunk than  $\frac{2}{3}$  the distance from the ground to the height of the lowest point of attachment in the tree.

Prior to installation of a lightning protection system, the owner or owner's agent should be notified of the need for periodic inspection of the system. Inspections are the responsibility of the tree owner, and should include the system's condition, position, and grounding integrity.

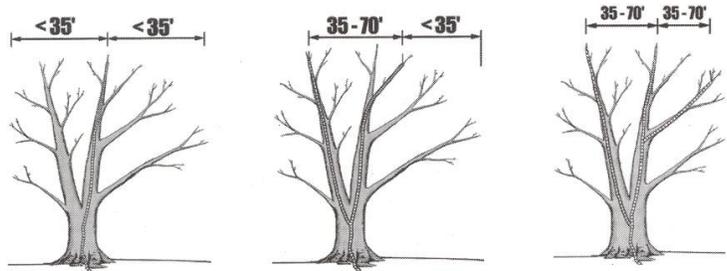
The uppermost point of a lightning protection system, intended to intercept lightning strikes, is the air terminal. Tree lightning protection systems may be terminated with or without manufactured air terminals or "points." If manufactured air terminals are used, blunt terminals are better receptors than sharp terminals.

Only one primary conductor is required, even on large-diameter trees. However, if the tree is wide spreading, additional branch conductors should be installed. Branch conductors connect all other air terminals to the primary conductor. Branch conductors should be installed on large branches so that no

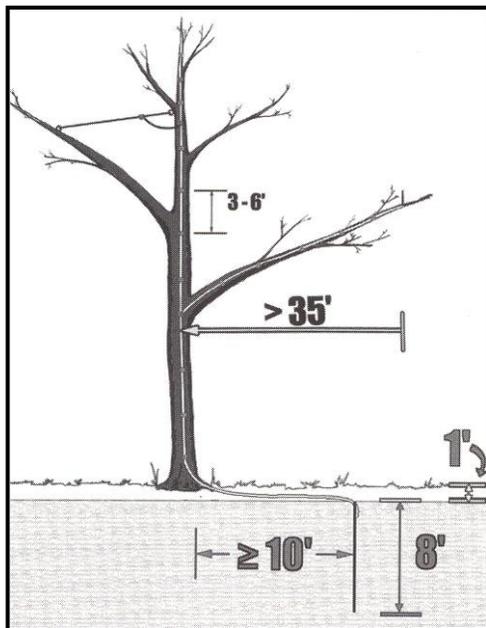
aerial portion of the tree is farther than 35 feet from a conductor. Cable splicers or clamp-type (multi-use)

connectors shall be used to form end-to-end, side-by-side, or

Y splices in conductors. The conductors shall be at least 14 strands of 17 AWG copper wire.



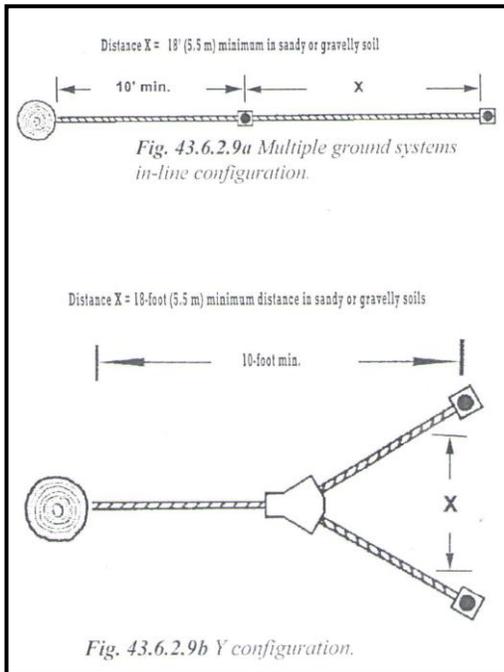
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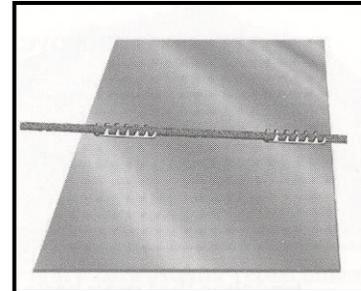
When installing lightning protection systems, conductors shall be fastened to the trees with drive fasteners, installed at intervals of no more than six feet. If a tree with a lightning protection has also been cabled, the cables should be connected to the lightning protection system by a bronze or bimetallic clamp-type lamp that form an electrolytic couple.

Ground terminal installation should not damage roots greater than two inches in diameter. When using a single ground rod system, the ground conductor shall be installed in the soil at a minimum depth of eight inches and at least ten feet away from the trunk. The ground terminal rod (at least 8 feet long) shall extend into the earth to a minimum depth of nine feet.



Multiple grounding systems shall be used when the full length of the ground rod cannot be driven into the soil. When using ground rods as in-line or Y configurations in sandy or gravelly soils, the rods shall be located a minimum distance of 18 feet from each other and 10 feet from the tree.

Horizontal ground systems should be preferred when ground rods cannot be driven at least two feet into the soil. Horizontal systems should terminate with a ground plate installed eight inches or deeper below the soil surface if conditions allow. Conductors shall be installed in trenches extending away from the tree at least 24 feet in sandy or gravelly soil and 12 feet in other soils.



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