

# How to Select and Buck Logs for Railroad Ties

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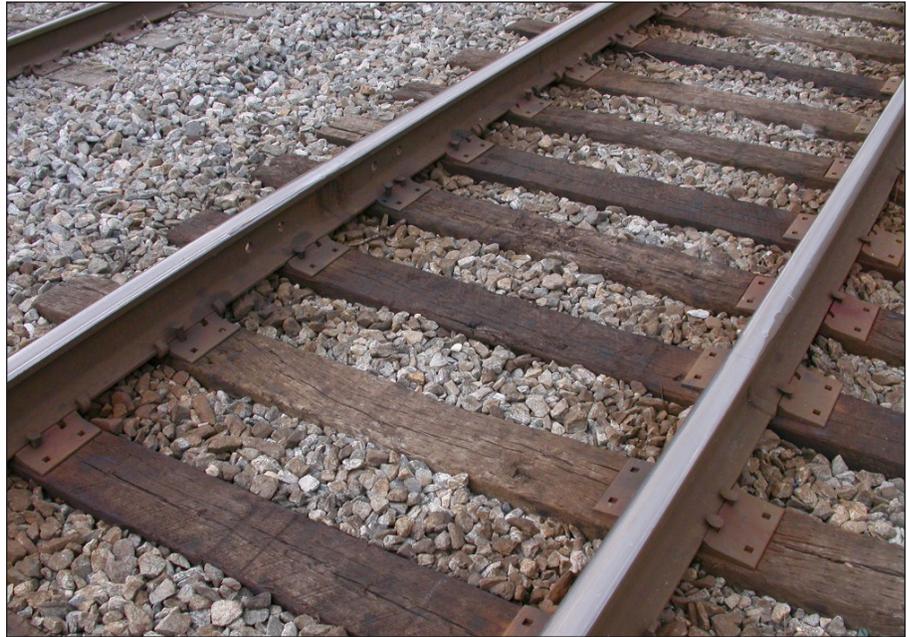
## Introduction

Railroad ties are rectangular pieces of wood with specified dimensions that are used to hold steel rails apart by a fixed distance in track. They're dried, treated with a wood preservative and installed in track with various types of hardware to support the load and to keep the wood from being crushed and worn away during service. Specifications for ties vary slightly from one customer to another.

As of 2014, railroads were purchasing in the neighborhood of 25 million wooden ties each year, so the railroad tie industry can be a reliable market for loggers and sawmillers. Prices for green ties are viewed as good compared to lower-grade lumber, though actual market prices depend on immediate demand, competing lumber prices, distance from the seller to the treating plant, and tie quality and species. If you're a logger reading this article, you'll learn to make better decisions about how to select trees and logs for crossties and switch ties, and you'll be able to buck them so that they're worth more money overall.

## Overview of Railroad Ties and their Specifications

The pieces of wood that hold the two steel rails at a fixed distance (*gauge*) are called *crossties*, and the longer pieces that support two or more sections of track as they cross or diverge from one another are called *switch ties*. Both crossties and switch ties are needed for railroad track, though switch ties are more difficult to obtain because they are longer pieces of wood. Ties have to be strong enough to hold spikes and maintain gauge, and they also have to transmit the weight of the railcars through the rock ballast to the ground (see Figure 1). Wood is the most common material used for both crossties and switch ties in North



**Figure 1.** Section of railroad track used to move freight through Lexington, Kentucky. This track uses wooden crossties.

America; it's used for about 93% of the crossties in track, though there are also some concrete ties and a few ties made from materials such as steel and plastic used on occasion.

Customers for wooden ties know the kind of traffic across their system and write their specifications for both tie dimensions and species accordingly. The dimensions of tie cross-sections are stipulated according to the anticipated load on the track, and tie lengths vary according to need as well. Acceptable species for railroad ties vary according to the railroad customer and the historical success they've had with various species in their region – some railroads buy hackberry ties, for example, while others won't touch them. Many railroads purchase oak and mixed hardwood ties and some buy ties made of softwoods such as southern pine, red pine or Douglas-fir as well. There are only a few species that aren't able to be used in track; some are too soft

to be durable or exhibit other properties that through experience railroads have learned make them unsuitable for track applications.

## Crosstie Specifications and Dimensions

**Specifications.** If you're going to cut logs for railroad ties, you should know where the specifications you are targeting come from. Of course, logs are manufactured into railroad ties through a chain of different companies, but at the top of the pyramid is a railroad customer who writes the master specifications for the ties that the company intends to put in track. In turn, the railroad's specifications get communicated downward through the other layers of manufacture: treating plants, then tie yards, sawmills and loggers. Railroads purchase treated ties from treating plants, and sometimes these plants service just a single railroad

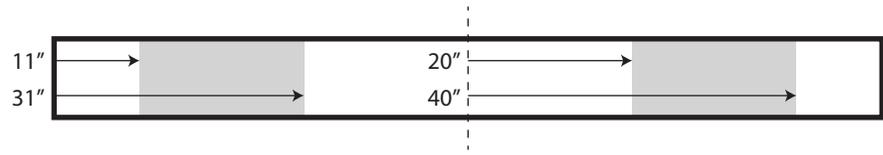
company, but not always. Treating plants often run their own tie yards to which local sawmills can sell their untreated ties, though sometimes they will purchase ties from independent tie yards or small sawmills directly as well. The tie buyers tell the sawmills which species and tie sizes they will buy, and this information gets passed along to the loggers. There's usually a little leeway on what loggers can bring to tie mills, but not much. Species and tie lengths are very important to tie buyers.

Requirements for ties are generally similar for different rail companies, but each railroad's specifications for its crossties will still vary somewhat depending on the weight of its railcars, the lateral forces created by the straightness, curvature or banking of the section of track where they are to be installed, and safety requirements. Some high-capacity freight railcars have a gross tonnage in the neighborhood of 300,000 pounds, so it's very important that the ties placed in mainline freight track are structurally sound; for obvious reasons the same reasoning applies to passenger rail. High-tonnage freight railcars need more attention to the materials used to construct the track than lighter freight on less-used track sections (a siding, for example). Larger and longer crossties develop lower stresses because the bearing area on the underlying ballast is increased.

**Crosstie dimensions and grades.** All ties are rectangular, and this applies to both crossties and switch ties; the dimensions of their faces (the wide dimension) and sides (the narrow dimension) are specified by the customer. The cross-section sizes required in North America are: 7" x 9", 7" x 8" and 6" x 8", with 7" x 9" ties being the most common. Crossties are purchased by railroads in three standard lengths: 8', 8' 6", and 9'; 8' 6" ties are by far the most common, but some 8' and 9' ties are purchased for use in light-duty or heavy-duty track, respectively.

Once a tie is sawn, the size of each tie is determined wherever there is the least wood (the most wane) on the faces within the *rail-bearing areas* (RBA) (Figure 2).

Sometimes tie dimensions are des-



**Figure 2.** Diagram showing the rail-bearing areas (shaded) in an 8' 6" crosstie.

ignated according to an AREMA grade category – but this isn't a quality designation, it's only a size designation. Don't get confused – Grade 5 ties (sometimes called Number 5) are 7" x 9", Grade 4 ties are 7" x 8", and Grade 3 ties are 6" x 8". There are two quality categories for ties, and these are quite simply called *grade ties* and *industrial grade (IG) ties*. Grade ties are worth significantly more than IG ties.

### Switch Tie Dimensions

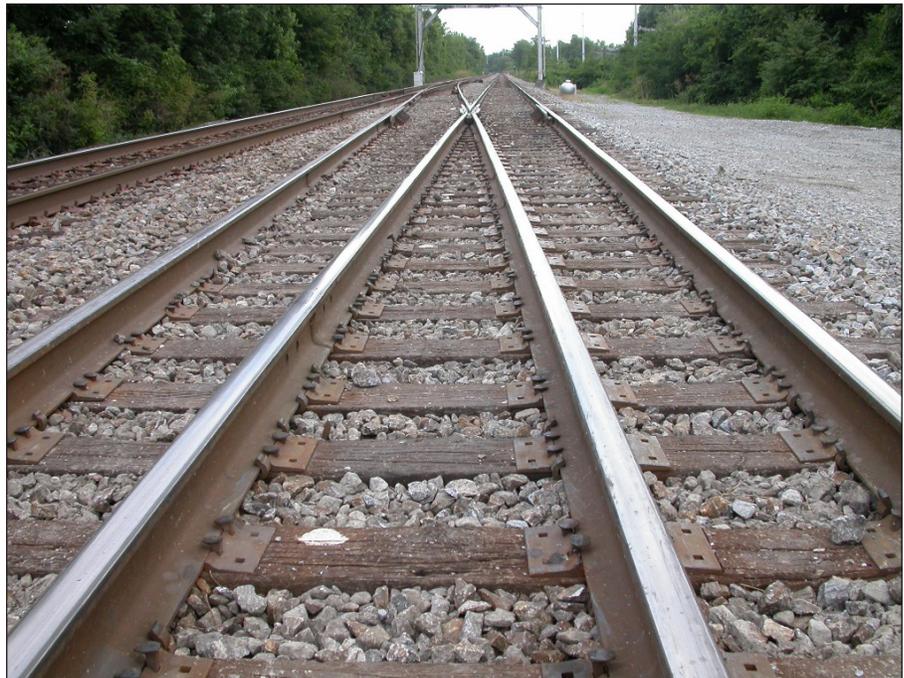
Switch ties are purchased by railroads for use where sections of track intersect, as in a location where a train has to cross from one track to another (see Figure 3). Switch ties are most commonly 10' to 16' long, although they can be as short as 9' or as long as 27'. The minimum cross-

section size for switch ties is 7" x 9".

Logs for switch ties have to be good quality with no major defects because switch ties can be spiked almost anywhere.

### Road Crossing Timbers and Bridge Timbers

Long timbers with large cross-sections may be in demand for road crossings or bridges, but not as consistently as crossties. Road crossing timbers might be desired in sizes such as 8" x 10" 8" x 12", 10" x 10", or even 8" x 24", and the lengths wanted might be as long as 25'. Check with the sawmill you sell to and find out what is needed. Softwood timbers might be in particular demand for bridge timbers (Figure 4).



**Figure 3.** Switch ties are long ties used where two sections of track meet or diverge.

## Species

You will need to ask for a list of acceptable and unacceptable species for ties at the sawmill where you anticipate selling your logs. Some species are too soft to stand up to the rough impact loading that trains will subject ties to, for example, and some species won't take up enough preservative to have a reasonable rot-free lifetime. The Railway Tie Association (RTA) publishes a list of species that are generally acceptable (Table 1).

This list is not intended to be a list of species that every railroad will accept; it is up to each railroad to specify the species that they will purchase.

In this case, the word “poplars” doesn't mean aspen or cottonwood. “Poplar” refers exclusively to yellow-poplar (also known as tulip poplar or tulip tree). Even though it's on the list, some railroads won't accept yellow-poplar because it's too soft and wears quickly. “Pine” customarily refers to hard pines, but soft pines such as white pines are not excluded. You'll need to check with your local buyer to determine which species are accepted.

## Log Length

The required log lengths are affected by the sawmill's tie length specifications, naturally, and bucking decisions for a tie log are going to be different from those for a saw log. Most sawlogs get bucked



**Figure 4.** Wooden trestle bridge across the Pennyrite Parkway near Madisonville, Kentucky.

to the nominal length plus about 4” or so of trim allowance, but tie lengths are different from standard lumber lengths and you need to make sure that logs are bucked to the length that the sawmill specifies. Nine-foot logs, if properly cut, will give the sawmill an 8' 6” tie plus a trim allowance, but check to find out the length the sawmill wants. One company I contacted prefers square-cut 8' 8” logs, and that's the length they pay for.

Bringing either short or long logs to the sawmill will cost you money. Short logs result in short ties. The sawmill might still accept and saw them, but an 8' 4” log can't make an 8' 6” crosstie. If the railroad customer is only buying 8' 6” crossties, shorter crossties might only get sold as less-valuable IG ties—or they could be rejected entirely.

As for those long logs, consider what happens when longer logs are brought to

**Table 1.** Species generally acceptable for crossties.<sup>1</sup>

Ashes	Gums	Oaks
Beech	Hackberries	Pines <sup>2</sup>
Birches	Hemlocks	Poplars <sup>2</sup>
Catalpas	Hickories	Redwoods
Cherries	Larches	Sassafras
Douglas-fir	Locusts	Spruces
Elms	Maples	Sycamores
Firs (true)	Mulberries	Walnuts

<sup>1</sup> This list is not intended to be a list of species that every railroad will accept; it is up to each railroad to specify the species that they will purchase.

<sup>2</sup> Note that the word “poplars” refers exclusively to yellow-poplar (although some railroads feel that yellow-poplar is too soft for their use); “pines” customarily refers to hard pines, but soft pines such as white pines are not excluded. Suppliers need to check with the local buyer to determine which species are accepted.



**Figure 5.** This is an example of crossties with gang nail plates. In this photograph, the plates have been tacked on and they are awaiting hydraulic pressure to seat them to their full depth. If these ends weren't all squarely cut, the nail plates wouldn't seat properly.

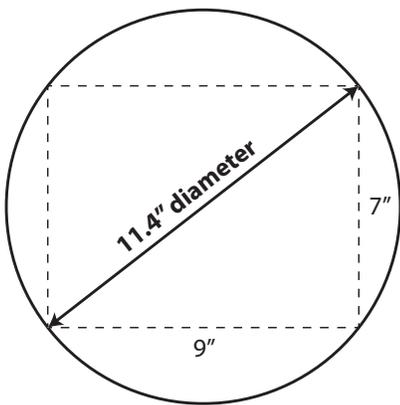
a sawmill. Sawmills don't want to get 10' tie logs because these will be too long for the most-purchased 8' 6" long crosstie. Either the sawmill or the tie plant will have to dispose of more wood in the cutoff pile, and loggers won't get paid for that extra length unless the mill is looking for switch ties.

**Pay attention to the saw during bucking: Tie lengths are measured after both ends have been double end trimmed (squared) with cut-off saws at the tie plant.** Ties need to have square ends, for two reasons: 1) they help to firmly seat ties in the rock ballast, and 2) many ties are going to be machine-plated with gang nail plates to help prevent splitting from occurring as the wood dries and shrinks, and this is more difficult or impossible without square ends (see Figure 5). Miscut or short logs can cause problems. For example, a 9' log might not make an 8' 6" tie if there's stump pull or a felling notch that isn't accounted for before bucking. If you're bucking a butt log, take a look at the bottom of the log before deciding where to cut the upper end, because you might need some extra length to meet specifications (Figure 6).

### Log Diameter

Logs have to be large enough to make square-shouldered ties, otherwise the ties will have wane (lack of wood) or bark on the corners. From geometry, it can

**Figure 7.** Diagram showing a 7" x 9" tie inside a circle representing an 11.4" diameter log (at the small end). This log would be too small to make a tie in the real world.



**Figure 6.** This is a bundle of culled crossties at a tie plant. There's more than one kind of problem shown here, but several ties were apparently culled because they were bucked too short for felling cuts to be removed by the plant's cut-off saws.

be calculated that a sawmill needs a log with a minimum diameter of at least 11.4" inside the bark at the small end to make a 7" x 9" crosstie (Figure 7). The minimum log diameter for a 6" x 8" tie is 10 inches, and the minimum diameter for a 7" x 8" crosstie is 10.7 inches. There's a big problem with these numbers, though – they won't work in the real world. Logs aren't perfectly round, and logs are seldom perfectly straight.

Even if the log is perfectly round, a sawyer needs a minimum of a 12" diameter log (inside the bark at the small end) to make a square-edged 7" x 9" crosstie. Logs aren't perfectly straight, though, and because you have to allow for saw kerf a 14" or larger diameter log would be much better. If you're looking at a standing tree, you can usually estimate that the butt log will meet the minimum size if the DBH is 13½" or larger. Larger-diameter logs might get sawn into a boxed-heart crosstie plus some lumber, or maybe even a couple of ties if the sawyer thinks he can get more value from the log that way. (Those ties might only count as IG ties, though, because the pith would probably end up on a face or corner and causes deep checks—but that's the sawyer's concern.) Check with the sawmill to see what log sizes they'll accept.

### Bucking Logs for Ties

Bucking decisions can either make you money or lose you money. If you have a log that you think would make a good tie log (based on species and size), pay attention to the location and types of defects as well. The placement of major defects will make the difference between a Grade crosstie and an IG or culled tie. If you have a log that you think might make a switch tie, you have to examine the log for major defects all along the length.

Few logs are perfect, and most have some natural defects such as knots, insect damage, etc. Butt logs will often make a terrific tie because they're larger and typically have fewer knots, but it's fairly common for these to be sent to a sawmill for lumber. The second log is often a candidate for a good tie log.

As I mentioned before, the first thing you have to make sure of is that any felling defects are accounted for when you decide where to buck the first log—cutting logs too short can cost you! Next, try to see how you can place any large defects outside of the rail-bearing area. Large defects in an area that might be spiked can cause an otherwise decent-looking tie to be downgraded to an IG tie.

## Defects

Here's a list of some of the defects to look for before you decide where to buck that log:

### Decay

Decayed wood/"doty" wood is not permissible in a Grade tie. The specifications are slightly relaxed for IG ties. Ties can have small decay pockets (up to 1½" in diameter) within the rail-bearing areas, and larger decay pockets are allowed outside the RBA. If you see decay, plan your bucking to minimize it in the RBA and the sawmill might get an IG tie out of the log instead of a cull.

The presence of rotten knots (Figure 8) will often mean that the rot has spread into the surrounding wood, though some species such as white oaks are known to compartmentalize decay better than others.

Fire scars are sometimes associated with rot as well (figures 9 and 10). Several species that are particularly prone to decay include red oak, elm, hackberry, soft maple, sycamore, sweet gum, and black gum.

If you see decay that's more than 2" across on both ends of a log, it's unacceptable even for an IG tie.

### Holes

Large holes are frequently found in lower-quality logs due to insect damage or other causes. Just as for decay, the specifications are most stringent within the rail-bearing area. Holes are a particular problem there because there isn't enough sound wood to reliably hold a rail spike. It's impossible to tell what you're actually going to find once a log is opened up, but if you detect evidence of significant damage by grubs or other insects on the sides of a log, (especially if it looks like there might be deep holes), try to place the damaged area outside the RBA for the best chance to sell the log as Grade tie material.

Sometimes there's a hole on the end of the log, and you often have to probe it to know just how far it goes. If you have a log with a deep hole, don't bother sending it to a tie mill because it will be culled. See how far one hole went, and what its effect was, in Figure 11. (I've run a tape measure as far as 5½' through an 8' log, so holes can go quite a ways.)



**Figure 8.** A large rotten knot caused this tie to be culled.



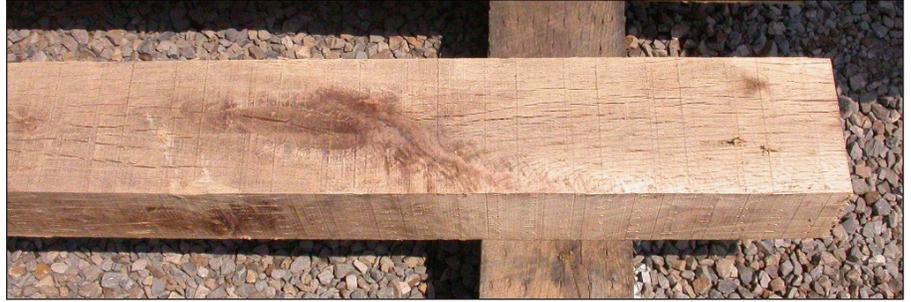
**Figure 9.** Fire scar in hickory, apparently sound. (Arrow points to the tip of the fire scar).



**Figure 10.** An oak tie showing fire scar with decay. (Arrow points to the tip of the fire scar).



**Figure 11.** Large holes caused this tie to be culled. Notice how the hole extends from the end of the tie into the RBA.



**Figure 12.** A large knot in the RBA was sufficient to reject this tie.

### **Knots**

Large knots, or groups of smaller knots that have the same damaging effect, are not allowed in the rail-bearing areas. Specifications for knots are written with the tie surface in mind, and up to 3" knots are allowed on 9" crosstie faces within the RBA of both Grade and IG ties (Figure 12). Large knots are allowed outside the rail-bearing areas, in either the middle or the ends of the ties, so this should affect log bucking decisions. It's impossible to know where the RBAs might be in switch ties, so large knots are only allowed within 12" of the ends.

### **Slope of Grain (Cross Grain)**

Logs or ties that have a significant slope of grain should not be cut for ties, because heavy loads placed on the tie will cause the tie to break very quickly. If you see signs that a log has significant slope of grain (the bark might indicate this), it's probably not worth merchandising for a tie log. Grade ties and switch ties have a restriction of a 1 in 15 slope of grain, and IG ties specifications are only slightly more relaxed (2 in 15). See figures 13 and 14.



**Figure 13.** This tie was culled for slope of grain.



**Figure 14.** This tie broke when I picked it up. There was a combination of slope of grain and decay here.

### **Bark Seams/Bark Pockets, Twin Hearts**

Bark seams can be a problem in sawn ties regardless of where they're located, particularly if they go deep into the tie. Avoid selecting deeply seamed logs for ties. A bark seam might end up in part of a tie cut near a large branch as well (Figure 15).

Twin hearts on log ends (near crotches) frequently contain embedded bark, but unless the bark extends into the RBA this usually won't count as a defect (Figure 16). Buck your logs accordingly. The tie grader will decide to accept or cull these ties based on how far the bark appears to go into the tie.

### **Splits**

Splits can come about with seams in trees as two trunks grow together, or they can occur as a result of growth stress release or felling damage. Regardless of the cause, bad splits are a problem. If a split goes from one side of a tie directly across to the other, and if it isn't too long, then the treating plant will probably try to salvage that tie for use by putting a gang nail plate on the end of the tie ("end plating"). For a Grade tie, splits in a green tie (log) are limited to being no more than 1/8" wide and/or 4" long (Figures 17 and 18). (Don't measure the length of a split on the end of the tie.) Some railroads may be slightly more liberal in what they will accept, so consult the local tie buyer.



**Figure 15.** Bark seam in a tie due to a branch.



**Figure 16.** The bark seam in this twin heart hard maple doesn't look like it will extend very far, and therefore it would likely be acceptable.



**Figure 17.** Log with split. If this split doesn't widen too much when the log is cut, it would probably be plated with a gang nail plate and could make an excellent tie.

### Ring Shake/Shake

Shake is the separation of the wood between growth rings (Figure 19). It's often said to be caused by high winds, but it's actually caused by a bacterial infection. You can sometimes tell if a log has a bacterial infection by the smell, which is sometimes described as kind of "swampy."

Shake isn't just a problem with a localized part of the log—it often runs for quite a ways, sometimes to the other end of the log (Figure 20). Ties with shake don't provide a firm piece of wood to spike to, and that's why shake is such a problem.

Shake in a log doesn't necessarily mean that the log can't be sawn into a tie. What makes or breaks the tie is the amount and the location of the shake. Shake close to the surface of a tie is bad; it can't get any closer to the surface than one inch for a grade tie. Shake that extends significantly around the growth ring is bad too.

To measure the amount of shake, hold a ruler across the width of the shake (not along the curve of the growth ring) (Figure 21). Hopefully, you can imagine how the tie(s) might be cut from the log. Any shake wider than 1/3 the width of the face of the tie (at only one end) is enough to downgrade a grade tie to an IG; IG ties may contain shake up to 5" across. Shake in IG ties can be on one or both ends, but even if it's on both ends the same shake can't extend the length of the tie.

**Detecting shake.** Shake in green logs may not show up until the wood dries out a bit so there's often not a lot that a logger can do to check for this, but keep an eye out for fine separation lines anyway. Elm, soft maple and sycamore are species that are especially prone to shake. When it gets into the treating cylinder, any shake present will only get worse.



**Figure 18.** This beech bark seam is essentially a split and can't be saved with an end plate.



**Figure 19.** This is an example of really bad shake in a black locust tie.



**Figure 20.** Shake can run the entire length of a log.



**Figure 21.** The shake in this 7" x 9" oak crosstie measures 4" across, making this an IG tie. If it were 3" wide or less it would have made a grade tie, because the shake doesn't appear to come to within 1" of any surface.

## Summary

### Points to Think About When Selecting and Bucking Tie Logs

1. Be sure that the log you're planning on selling as a tie log is from an acceptable species. There's a list of generally acceptable species in this publication, but every railroad has its own preferences. Some of the species on that list may not be accepted by your customer.
2. Make sure the log is large enough in diameter at the small end. Logs that are too small to saw into a square-edged tie won't bring top dollar.
3. Be sure that the log meets the minimum length that your customer wants. If your customer is producing 8' 6" crossties, they probably want a log that's close to 9' long, not 10' long as you'd cut for a sawlog. Of course, if they're also buying longer logs for switch ties, take them the best and longest logs you can find.
4. Look the log over for obvious defects. If necessary, adjust where you buck the log so that you can place these outside what will become the rail-bearing area. To find the RBA, take a tape measure and measure 20" from the center of the log, and then extend that another 20". That's the RBA. Do this for both ends of the log and you'll have a good idea where the spikes will go and where you need to have the soundest wood with the fewest possible defects.
5. Aside from defects arising from felling the tree, there are some natural defects to watch for. Some of these (knots and holes) may not be a problem if you buck the tree to get around them, but others might mean that the best the sawmill might get out of the log would be an Industrial Grade tie instead of the more valuable Grade tie:
  - Decay
  - Large holes
  - Large knots
  - Slope of grain
  - Bark seams
  - Splits
  - Shake

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