Wood RR Ties: Understanding Species & Defect Specifications

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Overview of RR Tie Production
Ties Are Received, Graded & Sorted

Usually ties are graded twice: Green and Seasoned

Ties Are Often Incised
To Control Drying Checks

Two sets of rollers (horizontal and vertical) incise all four sides
Incised Oak Ties
(Pre- and Post-seasoning)

Air-Drying Ties:
German Stacking
Air-Drying Ties:  
*Stick Stacking*

Creosote Impregnation
Creosote Impregnation

Creosote Impregnation
Specifications Maximize Tie Life

~35 years average tie life in SE U.S., a high-decay region.

Why Species Matters

Species differ by:

- Hardness, strength
- Natural durability (rot resistance)
- Amount of creosote absorbed, heartwood treatability
Generally Acceptable Species
(* RR’s specifications differ *)

- Ash
- Beech
- Birch
- Elm
- Gums
- Hackberries
- Hemlock
- Hickories
- Locusts
- Maples
- Mulberry
- Oaks
- Sassafras
- Sycamore
- Southern pines
- Cherry, walnut, yellow-poplar**

Multiple Elements in Track

*Ties.* preservative, rail, tie plate assemblies, fasteners, clips, ballast, …
Some ties outlast others in track – WHY?

Some species resist plate cutting better than others.
Some species hold spikes better than others.

Some ties are more rot-resistant than others.
Some ties are more rot-resistant than others.

Preservative penetration affects decay resistance.

Creosote use has been widespread only since ~ 1921. (First used in L&N RR, 1876 bridge timbers)
Heartwood - Sapwood

Both color and permeability differences

If preservative only gets into the sapwood, there’s a problem.

Heartwood isn’t always rot-resistant – depends on the species
Heartwood and sapwood both treat well. The large earlywood pores contain most of the creosote in each ring, giving these cores a striped appearance.

Only the sapwood will treat, so only ¾"-1" penetration is possible. 7 to 40 year life depending on location.
Hickory sapwood is often wide & treats very well. Some species have treatable heartwood, but others do not.

**Dual Treatment Option**

Dip or Pressure-Treat with Borate Solution

Water-soluble borate followed by creosote overcoat
Grade Ties, Industrial Grade (IG) Ties or Cull

1) Size & species acceptable (Grader sorts by both)
2) Amount/number of defects
3) No decay!

*(See RTA “Cheat Sheet”)*
Comparison of Specifications for Grade vs. Industrial Grade Ties

Tie Dimensions

Atlantic, Mississippi and Ohio RR, from Norfolk and Western Historical Photograph Collection
**Dimensions**

- **Length**
  - Mostly 8’6”
    - Maybe some 8’ or 9’ ties
    - Switch ties may go 12’ to ~16’ (+)

- **Cross-section**
  - Mostly 7” x 9” ties
    - Some 6”x8”, 7”x8” ties

**Rail-Bearing Area (RBA)**

- 8’ 6” Crosstie
- 10’-12’(+) length that could be spiked
- Switch or Bridge
Ties Must Be Properly Sized

Exclusive of wane, all dimensions are the minimum for green Grade ties.

Defects to Avoid
Color as well as texture reveals decay. Look for decay around broken limbs, large knots.

Grade ties cannot have any decay.

“Stack Burn” = Incipient Decay

Slight incipient decay is allowed in IG ties if the tie looks good otherwise.
Rot
(Seen Here In Drying Stacks)

Wane decreases the bearing surface under the tie plate.

Wane often shows up when the log is too small and a sawyer tries to make two ties.

1” of wane is allowed in the top RBA (Grade ties). There isn’t a rule for wane outside the top RBA, but 2” is generally allowed.

Up to 1” wane allowed on bottom.
Bark prevents creosote penetration.

Bark Seams

Bark seams cannot be deeper than 2” or longer than 10” (both Grade and IG ties).
Bark Seam - Cull
Twin Hearts = Usually OK

Don’t use the end surface when measuring a bark seam.

Cross Grain

When the grain isn’t straight, the spikes can cause edge-to-edge splitting.

That’s effectively a broken tie - it can’t hold gage.
Grade ties: Up to 1 in 15 slope of grain acceptable
IG ties: Up to 2 in 15 slope of grain acceptable

A little crossgrain, a little rot – look what happens!
Sound Knots (Grade Ties)

Max 1/3 of surface width in RBA (on average)

The arrows are 3” long, and the face is 9” wide here. No limits on knot size outside the RBA for Grade ties.

Sound Knots (IG Ties)

Knots are allowed up to 3” across in the RBA (compared to 1/3 the face dimension in Grade ties). No limits on knot size outside the RBA for IG ties.
Rotten Knot in RBA

Cull for rot, cull for knot size.

Wind, snow & ice loads bend tree trunks and cause growth rings to separate. These breaks don’t heal. Spikes driven into these separations create splits.
Shake (Grade ties)

3” Maximum Width

Not closer than 1” to any surface

9” Face

Shake width is always measured perpendicularly down from the wide face.

Shake

4” wide

Too wide for a 7” x 9” Grade tie, but up to 5” wide is allowed for an IG tie.
Shake Must Not Run the Entire Tie Length

Shake can affect both RBAs, a very serious defect.

Shake with any degree of decay is the worst combination.
Shake Frequency & Species

- Some species are more prone to shake than others.

- **Sycamore** is especially notorious for being prone to shake. Some railroads won’t accept it at all for this reason.

- Elm and maple are prone to shake also.

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**Fire Scar**

A fire scar must conform to the same rules as a bark seam.

Cannot be deeper than 2” or longer than 10”
Fire scars always exhibit a little point where the initial scar healed and enclosed the healing bark.

Fire Scars Often Contain Decay
Fire Scar

Fire Scar/Shake
**Holes**

**Grade ties:**
Within the RBA, holes can’t be larger than ½” diameter AND 3” deep.

Outside RBA, no knots > ¼ any surface width AND 3” deep.

*Numerous holes = Large hole*

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**Cull For Holes in RBA**

(Ant damage shown)

IG ties: Allowed up to 1-1/2” wide holes on any surface or 3” deep in RBA on any surface. Allowed up to 3” diameter or 4” deep on any surface outside RBA.
Cull For Holes

A tape extended 6 feet into this hole!

White oak

Cull For Holes
Without dual treatment, knots or holes can lead to premature failure in species where creosote won’t penetrate the heartwood (white oak, maple, sweet gum).

**Splits: From one surface to another**

Unseasoned Grade ties: the maximum split allowed is 1/8” wide and/or 4” long

Seasoned Grade ties: ¼” by face width splits allowed. Often plated & accepted if larger.

Up to 1/2” wide x 11” long allowed for seasoned IG ties

Don’t count the end as a surface when measuring length!
Don’t Try to Make This Into a Tie!

End plates cannot fix large splits.
How Ties Are Cut Affects Life and Grade
(and what you get paid!)

**BOXED-HEART TIE**
Heartwood Centered Well Treated Sapwood Protects Heartwood

**SPLIT-HEART TIE**
Heart Face Turned Up - Checks Catch Rain Heart Face Has Least Creosote

**SPLIT-HEART TIE**
Heart Face Turned Down - Fewer Checks To Catch Rain Sap Face Has Most Creosote

A split or quartered heart turned up is the worst condition in track.
Heart checks allows moisture to enter freely.
Any Questions?