



***SPECIFICATION FOR OAK AND MIXED  
HARDWOOD CROSSTIES TREATED  
WITH EITHER CREOSOTE OR  
CREOSOTE-BORATE***

**SPECIFICATION No. NS RT 003**

**Revised November, 2014**

**NORFOLK SOUTHERN SPECIFICATIONS FOR SOLID WOODEN CROSSTIES**  
**TREATED WITH EITHER CREOSOTE OR CREOSOTE-BORATE**  
**SPECIFICATION No. NS RT 003**  
**REVISED November 2014**

**SCOPE**

This specification cancels and supercedes all previous solid wooden crosstie specifications of Norfolk Southern Corporation.

**SECTION 1 – Species of acceptable woods**

Acceptable species are mixed oak and mixed hardwood with the exception of poplar, cottonwood, willow, and basswood. Mixed oak and hickory must make up a minimum of 60% of the total ties shipped from each supplying location. These species are further referenced by:

- Category 1 - red oak, white oak and hickory
- Category 2 – all mixed hardwoods

**SECTION 2 – Physical Requirements and Manufacture**

All ties shall be cut from live, sound timber, free from any defects that may impair their strength and durability. Limiting definitions that express causes for rejection are contained in **Sections 3 and 4**. Ties shall be separated into oak – hickory or mixed hardwood specie groups according to size classifications as noted in **Section 3** by the tie vendors before shipment to the treating plants. Hickories shall be included with oaks for all types of handling and treating operations. All ties will be shipped to the treating plant within 30 days after cutting. Green ties containing nails or any other metal will be rejected. No quarter-sawn ties shall be accepted.

**SECTION 3 – Classification and Design**

- |               |         |                |
|---------------|---------|----------------|
| • 6” Standard | Grade 3 | 6” x 8” x 8’6” |
| • 7” Standard | Grade 4 | 7” x 8” x 8’6” |
|               | Grade 5 | 7” x 9” x 8’6” |

Thickness and width specified are minimum cross sectional dimensions for green ties. Seasoned or treated ties may be 1/4” thinner than the specified sizes. Ties exceeding these cross sectional dimensions by more than 1” will be rejected. Not more than 20% of the 7” standard ties can be 7” x 8”. Green ties shall be of adequate length to produce a square-ended tie, not to exceed 9’. Finished ties shall be double end-trimmed to 8’ 6” +0” to -1”.

The grade of each tie shall be determined at the point of most wane, on the top or bottom, within the rail-bearing areas (those areas 20” to 40” from the tie center). The top is defined as the 8” or 9” horizontal face farthest from the heartwood or pith center. A maximum of 1” wane on Grade 3 and Grade 5 ties will be allowed in the rail bearing areas. Wane on Grade 4 ties

will be limited to “pencil wane” of ¼” in the rail-bearing areas and no more than ½” outside of the rail-bearing areas. The majority of sawn Grade 4 ties must have square-edge 8” faces. For Grade 5 crossties, outside of the rail-bearing areas, minimum 4” face widths are required on the top with no wane on the bottom. A minimum of 75% of all grade ties must have sound, square edges.

#### **SECTION 4 – Defect Descriptions**

**Wane:** Wane is the lack of wood on an edge (see **SECTION 3** for allowance). It shall not have the bark still in place in an amount that will inhibit preservative penetration.

**Bark Seam:** Bark seam is the ingrown bark left in a fork of the tree. It will not be accepted within the rail-bearing area. Bark seam will not be acceptable outside the rail-bearing areas if more than 2” deep or more than 10” long. Bark seams showing on the ends and showing down the face no more than 2” will be acceptable.

**Decay:** Ties having decay will be rejected, if it inhibits the strength and utility of the tie.

**Splits and Checks:** A split is a separation of the wood extending from one surface to an opposite or adjacent surface -- not counting the end as a surface. In unseasoned ties, a split greater than 1/8" wide or 4" long will be end-plated on both ends. Seasoned or treated ties with splits from 3" to 10" long or 3/8" to 3/4" wide shall be properly end-plated on both ends before acceptance. Ties with splits exceeding 3/4" width will be rejected as grade ties and are not to be end-plated. End-plates shall measure 6" x 7" for use on 7" ties and 5" x 6" for use on 6" ties. End-plates shall be made of structural steel, ASTM A653, grade 40, 18 gauge minimum and hot-dipped galvanized, ASTM A525, coating designation G60. End-plates will be embossed with plant ID and year. No 100% hand-driven end-plates are allowed. Treated ties, with end-plates, shall be rejected at the plant before shipment for splits wider than 3/8" or longer than 9".

A check is a separation of wood due to seasoning which appears on one surface only – not counting the end as a surface. Season checks greater than 1” deep **and** 3/8” wide **and** 36” long, or checks greater than 1/2” wide will be rejected. Any dry or treated tie showing a check on the end 3/8” wide shall be plated.

**Shakes:** Ties with shakes (ring separations) having a width on the cross-section greater than 3” or extending nearer than 1” to any surface will be rejected. Ties with shakes on both ends will be rejected.

**Holes:** Ties having solid holes on any surface within the rail-bearing areas greater than 1/2” diameter or greater than 3” deep will be rejected. Ties with holes outside the rail-bearing areas with a hole greater than 2” diameter or greater than 3” deep will be rejected. Ties having numerous small holes that equal a large hole in damaging effect will also be rejected.

**Knots:** Within the rail-bearing areas, a knot with an average diameter of 3” or more will be rejected. Such a knot will be allowed if located outside the rail-bearing area. Within the rail-bearing areas, numerous knots equaling a large knot in damaging effect will be rejected.

Cross or Spiral Grain: Except in wood having characteristic interlocking grain, ties having cross, slant, or spiral grain greater than 1” in 12” of length will be rejected.

Manufacturing Defects: All ties must be straight, square-sawn, cut square at the ends, have top and bottom parallel, and have bark entirely removed. Ties will be rejected for the following conditions:

- Lack of Straightness—A straight line from a point on one end to a corresponding point on the other end is no more than 1-1/2” from the surface at any point.
- Not Well-Sawn—Surfaces are cut with score marks more than 1/2” deep, or surfaces are not even.
- The top and bottom of a tie are parallel if any difference at the sides or ends does not exceed 1/2”.
- Unacceptable Nail Plate Seating Area—Tie ends are not flat and are out-of-square with a sloped end of more than 1/2" (more than 1 in 20 cant).

## **SECTION 5 – Seasoning and Conditioning**

**Air Seasoning** - Prior to air seasoning, ties shall be incised, separated by size and species groups, and stacked promptly upon receipt at the treating plant. Hickory shall be air-stacked with the oaks.

Each completed run of green ties will be dated on the front of the run, conforming to the fiscal or status month in which completed. No longer than 30 days will be allowed for the construction, completion and dating of any given run of ties. Each completed run of ties will be scheduled for treatment when moisture contents fall to specified levels. The month stacked shall not count as a drying month; i.e., January – November equals a 10-month period.

For air-dried runs, 7 of the 20 borings required for moisture assessment shall be taken from the hacks on the ends of the runs. Sufficient runs must be sampled to yield a representative moisture content that will allow proper creosote penetration in all of the ties that have satisfied drying requirements for that month. A solid 3” boring shall be taken midway between the ends and midway from the top and bottom of each tie sampled. All species within a run should be included in the moisture content determination.

The whole 3” boring shall be dried, and the finished moisture content percentage shall not exceed the following limits:

- Oak-Hickory 50% maximum moisture content
- Mixed Hardwoods 40% maximum moisture content

The stacking method that normally produces the best results for a particular locality shall be used. However, regardless of stacking method, all stacks must be supported on treated sills. The first layer of ties shall be off the ground by 12” or more. Space between the stacks or runs shall be dictated by site and climate. Horizontal and vertical alignment of ties within a stack or run must be equal to provide for adequate air circulation within and between stacks or runs of ties. When stickers are used for air-drying, they must be preservative treated and at least 1-1/2” thick.

All seasoning yards shall be so located and constructed to provide for free, unobstructed flow of prevailing air currents, and complete water drainage away from the stacks of seasoning ties. Seasoning yards will be kept free and clear of grass, weeds, decayed wood and other objects that inhibit good seasoning.

**Artificial Seasoning (Boultonizing)** – Crossties scheduled for Boultonizing shall be separated by size and species, incised, and forwarded to the tramming station for handling as outlined in **SECTION 6** prior to initiation of the drying process. Hickory ties must be Boultonized with oaks. Each layer of ties on the tram shall be separated with one 3/4” steel spacer placed on alternate ends as the layers are built.

Moisture contents will be determined in accordance with AWPAs procedures using twenty 3” borings from each charge prior to drying. Water removal is acceptable when target moisture contents of 50% for oak-hickory charges and 40% for mixed hardwoods are obtained. A preheating period of 3 hours without any vacuum applied will be initiated after filling the cylinder and heating the oil to a minimum of 190°F. This period must be shown on charge reports as “Heated in oil at 190-210°F”. After this heating period, the Boulton cycle is initiated as described below with temperatures of 170-210°F and vacuums sufficient to boil the water at the desired rate. The Boulton cycle will continue until the required amount of water is removed, or the minimum water flow rate is achieved. If a plant elects to control the Boulton vacuum times based on flow rates alone, then the above initial moisture content borings and water removal calculations are not required. If flow rates are used alone, then the target amount of gallons to be removed will be an amount equal to the cubic foot volume of ties in the cylinder, i.e. 3500 cubic feet would require a target amount of 3500 gallons of water to be removed.

The Boulton cycle may be terminated before the calculated amount of water is removed if the following conditions have **all** been met during the previous 2 out of 3 consecutive hours:

- Temperature of the oil bath was 190°F or more.
- A vacuum of 20” or more of mercury existed in the cylinder.
- Not more than 0.30 lb. water / cubic foot of wood in the cylinder was recovered per hour.

Moisture content after treatment shall be taken on one charge per week and shall not exceed the following averages from 20 - 3” cores:

- Oak-Hickory 50% maximum moisture content
- Mixed Hardwood 40% maximum moisture content.

## **SECTION 6 – Processing and Handling**

Just prior to being loaded on trams for preservative treatment and/or Boultonizing, all ties shall be double end-trimmed square to 8' 6" length, inspected, graded and end-branded with the letters 'NS', plant location, and year treated. Letters shall be a minimum of 1" high, 1/2" wide, and 1/8" deep. Letter designations for plant locations are as follows:

A - Koppers, Glenvar, VA	S - Koppers, Susquehanna, PA
K - Cahaba, Brierfield, AL	V - Stella-Jones, Goshen, VA
M - Mellott, Needmore, PA	W - Stella-Jones, Winslow, IN
R - Stella-Jones, McAlisterville, PA	X - Stella-Jones, Montevallo, AL.

Inspection and grading shall consist of the examination of all four surfaces and both ends of the tie. Acceptance is based on the requirements of this specification being met.

Incisor heads must be well-maintained to assure an average penetration depth of 1/2" minimum for each tooth for the full length of the tie. New teeth must measure 1" in length and be a minimum 7/32" thick. Any 9" face must have 8 incisions per row with a minimum of 7 rows for every 12" of length. An incisor blade or bar shall be replaced when any two adjacent teeth are missing or damaged or more than three teeth are missing from the entire length of the blade or bar. Blade teeth are considered worn out when thickness on the outer half inch averages 1/16" or less.

## **SECTION 7 – Treatment and Preservatives**

The methods, requirements, and specifications to insure proper handling, conditioning and treatment of ties shall be governed first by NS Specifications and supplemented secondly with the current AWPA Standards U1 (UC4A-UC5C), T1 – T 8C, M1, M2, M3 and M4, with the following exceptions:

- Treatment shall be by the empty cell method with a creosote/coal tar solution in accordance with AWPA Standard P-2. The P2 solution may be supplemented upon permission of NS. The preservative solution shall be tested monthly according to AWPA Standard A-1 with a copy of the results kept for review by NS representatives.
- Net retention for **creosote only** shall not be less than 8 pounds per cubic foot (pcf) in oak-hickory and 8 pcf in mixed hardwoods by gauge or until refusal.

**Air-Dry Treatment with Creosote Only** – All air-dried charges of ties shall be held in 190-210°F oil for a minimum of 6 hours. This time will be a combination of pressure and preheating in oil to achieve sterilization and deeper distribution of creosote in air-dried material. Preheating time will begin only after 190°F is attained. These preheats will have only the “initial air” pressure applied and will be 3 hours minimum for both oak-hickory and mixed hardwood. Pressure periods will include only the time at 175 psi or more, and will be sufficient to meet desired retentions. Each layer of ties on the tram shall be separated with one ¾” steel spacer placed on alternate ends as the layers are built.

**Boulton Treatment with Creosote Only** - Pressure periods will include only the time at 175 psi or more, and will be sufficient to meet desired retentions. Each individual charge or “lot” of treated ties must have process records retained for review by Norfolk Southern Corp. representatives. These records shall be maintained for a minimum of 7 years.

All tie treatment facilities shall certify on invoices that treated ties meet the appropriate Norfolk Southern specifications and AWWA standard treating requirements.

**Dual-Treatment** – The specification / procedure used for dual-treated crossties is considered plant specific. The individual plants will submit their specification to Norfolk Southern for approval. The specification must cover the processing and dual treatment of ties with disodium octaborate tetrahydrate (DOT), or its NS approved equivalent, followed by overtreatment with creosote.

#### **General Dual-Treatment Requirements –**

- The DOT must meet the AWWA Standard P25-10, be an EPA registered pesticide, and have a product label specifying its use in railroad crossties.
- Creosote shall meet the requirements specified above for P-2.
- Applicable sections of this Specification NS RT 003 should be incorporated.
- Finished crossties must be treated to a minimum retention of 0.28 pcf DOT or 0.18 pcf Boric Oxide Equivalent (B2 O3).
- DOT retention by assay shall be determined before overtreatment and after sufficient diffusion period (no sooner than 90 days after DOT treatment). Retention shall be determined using current edition AWWA Method A40 with 20 borings taken from an assay zone from the surface to a depth of 1.5”. All borings shall be taken from the 6” or 7” side of the tie. Four charges per month shall be assayed in this manner.
- Creosote overtreatment retention shall be 6 pcf (or refusal) for all species groups.
- Sterilization pretreatment is required for dual-treated crossties unless the plant can demonstrate that their borate procedure effectively sterilizes fungi/incipient decay in air-dried crossties.
- Specification must include QA/QC procedures for both creosote and borate solutions and retentions.
- Minimum penetration requirements for DOT will be per AWWA T-1 – Section 8C. Spray all dual-treated borings with 2-part curcumin solution to visually check for borate penetration. These should be the same borings used for the visual determination of creosote penetration.

- Dual-treated crossties shall bear a 1/8” wide by 1/8” deep kerf mark across the top and bottom face of one end positioned approximately 9” from the end.
- NS dual-treated ties shall be processed in the following specie categories:
  - Category 1 – red oak, white oak and hickory
  - Category 2 – all mixed hardwoods
- Assay and gauge retentions shall be maintained and available for review by NS representatives.

**SECTION 8 – Inspection After Treatment**

All tie treatment facilities shall certify on invoices and charge reports that treated ties meet the appropriate Norfolk Southern specifications and/or AWPAs Standard treating requirements.

Except as hereinafter provided, all post-treatment inspection tests shall be made in accordance with requirements stipulated in AWPA Standard T-1 – Section 8C. Each treated charge of ties will be tested for penetration of preservative after removal from the treating cylinder or retort. This visual test shall consist of at least 20 borer cores taken at random throughout the entire charge of material and shall be representative of the charge as a whole. All penetration test borings shall be made on the 6” or 7” side of the tie midway between the ends and midway between the top and bottom to a minimum depth of 3-1/2”. All holes made during boring shall be plugged with tight-fitting, treated plugs. If 80% of the test cores in any charge meet the annual ring penetration requirements, that charge shall be accepted.

Minimum **creosote** penetration requirements for oak-hickory charges are as follows:

- White Oak                    95% of sapwood annual rings
- Red Oak                      65% of annual rings in a 3-1/2” test core
- Hickory                        90% of sapwood annual rings

Only the red oak and hickory ties are to be bored to assess the charge penetration results. If the average red oak and hickory penetration of the 20 test cores meets the requirements, the charge shall be accepted.

Charges of white oak with less penetration may be accepted, if the wood is conditioned properly, and treatment was continued to refusal.

Minimum **creosote** penetration requirements for mixed hardwoods are as follows:

- Black gum                    2 1/2” solid or 90% of sapwood rings
- Mixed Hardwood            90% of sapwood rings.



Assay extractions for **creosote** by zone (0-1", 1-2", 2-3") on a 3" core, as per AWPA A-6 shall be done weekly, or more often as required by any of the following: the supplier's Quality Assurance representative, treating supervisor or Norfolk Southern representative. Only red oak and hickory ties shall be assayed to determine if adequate retention levels are being obtained in the oak-hickory charges, but any of the mixed hardwoods may be assayed. Assay results should be at least 70% of gauge retentions. Assays for **DOT** shall be done regularly as dictated by the dual-treatment section of this specification and the plant's written procedure.

No charge shall be pulled from the cylinder for refusal with less than the specified amount of treating solution injected until the charge has been "bumped" twice after the injection rate of creosote has slowed to no more than 0.2 lbs./ cubic ft. of wood per hour. The bumping procedure shall consist of dropping the pressure to the initial air pressure, then raising pressure back up to 175 psi minimum. If the injection rate has not increased, then the pressure period can be terminated under refusal conditions, and the charge can be pulled. Charges designated as "refusing charges" must have had a minimum total of 5 hours at a minimum of 175 psi.

All treated borings must be stored in sealed zip-loc plastic bags with the charge no., tie size, species, date, and retention clearly marked on the bag. These bags must be kept in date order until inspected by the NS representative.

### **SECTION 9 – Retreatment**

**Creosote Only** -- Treated ties not conforming to the minimum requirements for retention and/or penetration may be retreated and re-offered for acceptance in accordance with AWPA Standards T-1-6 and the following conditions:

- Tie charges to be retreated will be heated in 190-210°F oil for 3 hours before applying pressure. A pressure period of 2 hours at a minimum of 175 psi will be required to improve penetration.
- When a charge is retreated, the total retention as a result of all treatments shall be sufficient to satisfy the requirements for both net retention and penetration.
- Ties may not be retreated more than once.

**Dual Treatment** – Ties shall be retreated to conform to AWPA Standards T-1-6.

## **SECTION 10 – Inspection, Care and Handling after Treatment**

Treated ties on trams to be shipped or stored on the yard for Norfolk Southern inventory shall be inspected with the universal NS tie gauge prior to loading or storing. This is a go/no-go gauge for inspecting all of the defects outlined in **Section 4**. Soft areas can be probed for soundness as well. Each inspector in the loading and tramming areas must have access to a universal NS tie gauge for use in the final inspection process.

Ties that are to be plated must be marked with a slash on the end. All other rejects must be marked with an “X” on the end. This is to preclude the accidental shipment of less than grade ties, and to permanently identify the industrial grade ties if they are found mixed with grade tie shipments in the field.

All treated ties not handled directly from tram to car must be carefully and neatly stored. Different size classifications must be kept separate, and all bundles or stacks must be marked with ‘NS’, grade, and treatment date. All ties must be stacked to ensure that tie straightness is not impaired during temporary storage. Treated stringers must be placed underneath all stacks of treated ties. No loose windrows of NS treated ties will be allowed. Shipments are to be made from the oldest stacks first. If any ties become excessively bleached during storage, they will be retreated or replaced by the vendor if not properly rotated. Yard drainage conditions must provide rapid drainage of water from beneath stacks of treated ties. Storage areas must be kept free of grass and weeds to aid in the free flow of air and to minimize the possibility of fire. The vendor shall be liable for all fire damage while NS crosstie inventory is located on the property of the vendor. Care must also be exercised in the handling of NS crossties for storage or shipment to prevent damage which affects the utility of the crosstie in service.

For shipments already delivered, compliance with Section 4 of this specification shall be deemed satisfactory if no more than 5% of the ties in any given shipment are considered borderline compliant. This 5% allowance is only for subjective variations in the judgment of the inspectors. NS reserves the right to refuse any obvious rejects.

NSCrosstieSpecDual #003-11/2014