AREMA
American Railway Engineering and Maintenance-of-Way Association

Part 3

Solid Sawn Timber Ties

— 2016 —

FOREWORD

Section 3.1 through 3.5, Section 3.8 and Section 3.9 formulate specific and detailed rules for the design, handling, and inspection of wood cross ties and wood switch ties, and give data pertaining to their service life and economics. Section 3.6 through Section 3.7 formulate specific detailed rules for the preservative treatment of wood cross ties, switch ties and other forest products, including specifications for preservatives.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT)

LIST OF FIGURES

LIST OF TABLES

SECTION 3.1 TIMBER CROSS TIES[1]

3.1.1 SPECIFICATIONS FOR TIMBER CROSS TIES (2014)

NOTE: It is recommended for West Coast Species that West Coast Lumber Inspection Bureau (WCLIB) Grading Rules apply and for Southern Yellow Pine species that Southern Pine Inspection Bureau (SPIB) Grading Rules apply.

3.1.1.1 Material

3.1.1.1.1 Kinds of Wood[2]

Before manufacturing ties, producers shall ascertain which of the following kinds of wood suitable for Cross ties will be accepted:

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

[1] References, Vol. 75, 1974, p. 379; Vol. 85, 1984, p. 7; Vol. 88, 1987, p. 55; Vol. 94, p. 61.
[2] Each railway will specify only the kind of wood it desires to use.

Others will not be accepted unless specially ordered.

3.1.1.1.2 Timber Ties of Non-Indigenous Species

a. Non-indigenous tie species must possess similar design characteristics to domestic species with regard to adequate rail bearing area, sufficient bearing surface on the ballast, maximum strength to prevent failure of the tie or the tie fastenings while providing against undue deflection in the rail. Tie size, along with the inclusion of all other indigenous wood tie specifications, mechanical properties, and quality must apply.

b. Regardless of the materials used and the quality of the construction, track will not remain permanently to gage, surface, and line under the loads imposed upon it in typical revenue service applications. Restorative and maintenance operations will, therefore, always be necessary. Some alternative tie species may provide additional resistance to any change in gage or line as may be caused by wheel loads and may allow for easy adjustment to correct any changes in track geometry that do occur. Density of the alternative species is the primary driver for this and thus evaluation of this property as well as specie workability is necessary.

c. All ties produced from non-indigenous species shall be manufactured in accordance with AREMA Chapter 30, Part 3, Solid Sawn Timber Ties, and shall be free of any defects that may impair their strength or durability for use as crossties, such as: decay, large splits, large shakes, slanting grain, or large or numerous holes or knots.

d. The decay resistance properties of heartwood and sapwood of non-indigenous wood species vary greatly. Both, the heartwood and sapwood, shall be tested in accordance with AWPA standards to determine the degree of natural decay resistance, which, in turn, determines if preservative treatment is necessary.

e. All alternative tie species must be tested to determine classification for resistance to termite infestation and fungal decay. Certain species may exhibit high resistance to decay and insect attack and determination of these properties by AWPA standard methodologies is recommended. "Highly Resistant" indicates the maximum resistance in this classification. If the species meets this classification, then preservative treatment is not necessary. Otherwise, treatment in accordance to AWPA Standards is recommended.

f. All alternative tie species must conform dimensionally in length, width, and thickness in a green and seasoned state, holding to the same standards for indigenous wood ties as outlined in Article 3.1.1.3.1.

g. Insulation – Ties produced from non-indigenous species must be tested to insure that they perform satisfactorily in regard to track circuitry, signaling and communication requirements.

h. Alternative tie species shall be tested to determine the suitability and application requirements of all plate and rail fastening hardware.

3.1.1.2 Physical Requirements

3.1.1.2.1 General Quality

Except as hereinafter provided, all ties shall be free from any defects that may impair their strength or durability as cross ties, such as decay, large splits, large shakes, slanting grain, or large or numerous holes or knots.

3.1.1.2.2 Resistance to Wear

When so ordered, ties from needled-leaved trees shall be of compact wood throughout the top fourth of the tie, where any inch of any radius from the pith shall have six or more rings of annual growth. Southern Yellow Pine ties shall conform to the most current SPIB Standard Grading Rules for Southern Pine Lumber; Section 400 - Timbers 5x5 or Larger - No. 1 Dense or better. West Coast Softwood species shall conform to the most current WCLIB Specifications - Standard No. 17 Grading Rules; Section 6: Special Use Grades - Railroad Ties; Item 192-b - No. 1 Railroad Ties or Better.

3.1.1.3 Design

3.1.1.3.1 Dimensions

Ties shall be 8'-0", 8'-6", or 9'-0" long as specified by the customer. Thickness, width, and length specified are minimum dimensions for green ties. Dry or treated ties may be 1/4 inch thinner or narrower than the specified sizes. Ties exceeding these dimensions by more than l inch shall be rejected. The grade of each tie shall be determined at the point of most wane on the top face of the tie within the rail-bearing areas. The rail-bearing areas are those sections between 20 inches and 40 inches from the center of the tie. The top of the tie shall be the narrowest face and/or the horizontal face farthest from the heart or pith center.

All rail-bearing areas shall measure as follows: 7-inch grade cross ties shall be 7" x 9" in cross section with a maximum of 1 inch of wane in the top rail-bearing areas. A maximum of 20% of the ties in any given quantity may be square-sawn 7" x 8" in cross section with no wane in the rail-bearing areas. A 6-inch grade tie shall be 6" x 8" in cross section with a maximum of 1 inch of wane permitted in the top rail-bearing areas. For both 6-inch and 7-inch grade ties, wane shall be permitted on the bottom face so long as it does not exceed 1 inch at any given point (Figure 30-3-1).

3.1.1.4 Inspection

3.1.1.4.1 Place

Ties shall be inspected at suitable points as specified in the purchase agreement of the railway.

3.1.1.4.2 Manner

Ties must be presented for inspection in an organized manner with all surfaces clean for ready observation. Inspectors will make a reasonably close examination of the top, bottom, sides and ends of each tie. Each tie will be judged independently, without regard to the decisions on others in the same lot.

3.1.1.4.3 Decay

Decay is the disintegration of the wood substance due to the action of wood destroying fungi. "Blue stain" is not decay and is permissible in any wood.

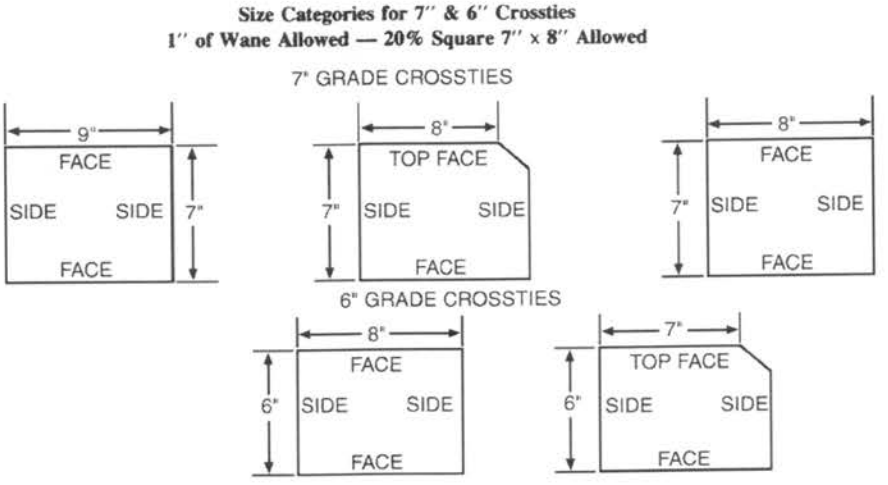

Figure 30-3-1. Dimensions of 7-inch and 6-inch Cross Ties

3.1.1.4.4 Holes

A large hole is one more than 1/2 inch in diameter and 3 inches deep within, or more than one-fourth the width of the surface on which it appears and 3 inches deep outside, the sections of the tie between 20 inches and 40 inches from its middle. Numerous holes are any number equalling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.

3.1.1.4.5 Knots

Within the rail bearing areas, a large knot is one having an average diameter more than 1/3 the width of the surface on which it appears; but such a knot will be allowed if it is located outside the rail bearing areas. Numerous knots are any number equalling a large knot in damaging effect.

3.1.1.4.6 Shake

a. A shake is a separation along the grain, most of which occurs between the rings of annual growth.

b. The procedure shown in Figure 30-3-2 shall be used to determine the length of a shake. One which is not more than one-third the width of the tie will be allowed, provided it does not extend nearer than 1 inch to any surface.

3.1.1.4.7 Split

A split is a separation of the wood extending from one surface to an opposite or adjacent surface. Do not count the end as a surface when measuring the length of a split. In unseasoned cross ties, a split no more than 1/8 inch wide and/or 4 inches long is acceptable. In a seasoned cross tie, a split no more than 1/4 inch wide and/or longer than the width of the face across which it occurs is acceptable. In seasoned cross ties, a split exceeding the limit is acceptable, provided split limitations and anti-splitting devices are approved by the buyer and properly applied.

3.1.1.4.8 Checks

A check is a separation of the wood due to seasoning which appears on one surface only. Do not count the end as a surface. Ties with continuous checks whose depth in a fully seasoned and/or treated tie is greater than 1/4 the thickness and longer than 1/2 the length of the tie will be rejected.

3.1.1.4.9 Slope of Grain

Except in woods with interlocking grain a slope in grain in excess of 1 in 15 will not be permitted.

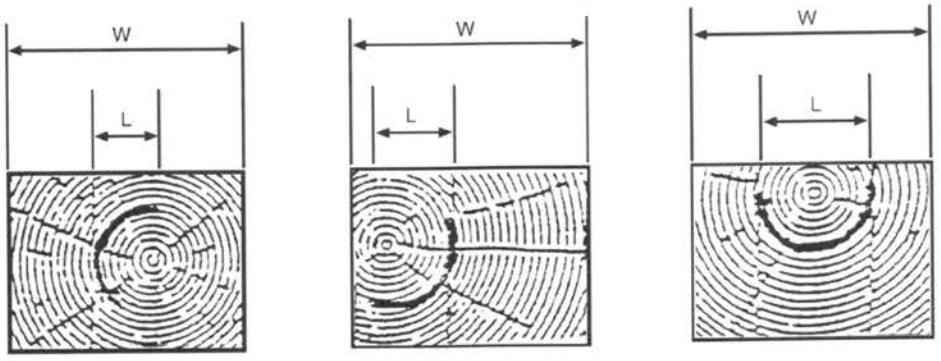

Figure 30-3-2. Shake Allowances

3.1.1.4.10 Bark Seams

A bark seam or pocket is a patch of bark partially or wholly enclosed in the wood. Bark seams will be allowed provided they are not more than 2 inches below the surface and/or 10 inches long.

3.1.1.4.11 Manufacturing Defects

All ties must be straight, square-sawn, cut square at the ends, have top and bottom parallel, and have bark entirely removed. Any ties which do not meet the following characteristics of good manufacture will be rejected:

a. A tie will be considered straight when a straight line from a point on one end to a corresponding point on the other end is no more than 1-1/2 inches from the surface at all points.

b. A tie is not well-sawn when its surfaces are cut into with scoremarks more than 1/2 inch deep, or when its surfaces are not even.

c. The top and bottom of a tie will be considered parallel if any difference at the sides or ends does not exceed 1/2, inch.

d. For proper seating of nail plates, tie ends must be flat, and will be considered square with a sloped end of up to 1/2 inch, which equals a 1 in 20 cant.

3.1.1.5 Delivery

3.1.1.5.1 On Railway Premises

Ties shall be delivered and stacked as specified in the purchase agreement of the railway. If ties are to be inspected, they must be placed so that all ties are accessible to the inspector.

3.1.1.5.2 Risk, Rejection

All ties are at the owner's risk until accepted. All rejected ties shall be removed within one month after inspection.

3.1.1.6 Shipment

Ties forwarded in cars or vessels shall be separated therein according to the above groups, and also according to the above sizes if inspected before loading, or as may be stipulated in the contract or order for them.

3.1.2 MARKING TIES TO INDICATE SIZE ACCEPTANCE[1] (2002)

3.1.2.1 General

Each tie shall be marked in accordance with the Railroad's Specifications in such a manner that the marks will not be obliterated by treatment.

[1] References, Vol. 31, 1930, pp. 1091, 1744; Vol. 53, 1952, pp. 336, 1120; Vol. 54, 1953, pp. 626, 1394; Vol. 61, 1960, pp. 407, 1167; Vol. 94, p. 62.

3.1.3 EXPLANATIONS OF CROSS TIE DESIGN[1] (2013)

3.1.3.1 General

a. The size of ties most widely used under heavy mainline traffic has increased since 1905 from 6" x 8" x 8' to 7" x 9" x 8'-6".

b. Owing to the many variables involved, including strength of timber in its average condition in track, condition of roadbed, etc., it is not possible to calculate a design for a tie in the sense that a bridge member is designed.

c. For heavy mainline traffic lines, ties meeting the standard specification for 7-inch grade ties should be used.

d. A space of 10 inches between tops of ties allows sufficient room for tamping; the maximum of bearing area on the ballast may be secured by the use of the wider and longer ties laid with this spacing.

e. Where ties shorter than 8'-6" are in use, in heavy mainline traffic lines, it is recommended that longer ties be used in the interest of promoting economy in track maintenance:

3.1.4 SPECIFICATIONS FOR MACHINING CROSS TIES[2] (2014)

3.1.4.1 General

When ties are adzed, bored, branded, incised or trimmed, the operations required by any or all machining ordered shall be carried out before air-seasoning, or immediately prior to preserving, in accordance with the following specifications:

3.1.4.2 Adzing

Sawn ties provide a flat surface for tie plate seating which precludes the need for adzing.

3.1.4.3 Boring

a. Boring for spike holes is optional. If boring is done then boring for spike holes shall conform in size and location to plans provided, with ±1/16 inch permitted in each distance between holes. The spike holes shall be centered across the width of the tie in such a way that the tie plates will center on the tie when the spikes are driven into the prebored holes. A tolerance of 1/8 inch in the centering of the holes across the width of the tie is permissible.

b. The depth of the hole shall be bored in accordance to the individual customer specifications.

c. When the head diameter of the bits has been reduced 1/16 inch by wear, bits shall be replaced. Cutting heads of bits shall be sharpened at regular intervals to insure clean boring.

d. It is recommended:

(1) That 1/2 inch holes be bored in hardwood ties for 9/16 inch cut spikes.

(2) That 9/16 inch holes be bored in hardwood ties for 5/8 inch cut spikes.

(3) That 7/16 inch holes be bored in softwood ties for 9/16 inch cut spikes.

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[1] References, Vol. 25, 1924, pp. 128, 1221; Vol. 43, 1942, pp. 401, 696; Vol. 54, 1953, pp. 626, 1394; Vol. 63, 1962, pp. 316, 741; Vol. 85, 1984, p. 9; Vol. 94, p. 62.

[2] References, Vol. 37, 1936, pp. 419, 989; Vol. 54, 1953, pp. 626, 1394; Vol. 62, 1961, pp. 409, 919; Vol. 67, 1966, pp. 176, 718; Vol. 85, 1984, p. 9; Vol. 94, p. 62.

(4) That 1/2 inch holes be bored in softwood ties for 5/8 inch cut spikes.

3.1.4.4 Trimming

a. Trimmed ties shall be cleanly sawed at both ends to the specified length prior to treatment.

b. Machines shall be preferably equipped with devices for centering the ties lengthwise and where machines are so equipped equalizers and guides shall be so set that an equal amount is cut from each end of the tie. When machines are not equipped with equalizers, guides shall be set to trim 1/2 inch from one (line) end of tie and sufficient from the opposite end to result in the specified length.

3.1.4.5 Branding

a. Branding of ends or the top or bottom surfaces of the ties shall be done with letters, figures or symbols to indicate one or more of the following:

- Wood.
- Treatment(s).
- Weight of rail for which bored.
- Year manufactured or treated.
- Size.
- Identity of plant.
- Identity of railroad.

b. The height of letters and figures comprising the marking along with the specific location shall be determined by individual customer specifications.

(1) If ties are hydraulically machined or hammer branded on the ends, dies used shall have cutting edges 1/8 inch wide and shall indent the wood at least 1/4 inch deep.

(2) Burn branding is also allowed and must produce burn identification marks that penetrate at least 1/8" wide and at least 1/8" deep.

(3) If ties are to be end-plated, it is preferred to have end-plates embossed with the marking in the webbing in at least one location on the plate.

(4) Date-nailing is also an acceptable method of identification. Nails must be ring shank type galvanized steel or aluminum with embossed head. Nails must be driven flush to the surface or end of the tie.

3.1.5 SPECIFICATIONS FOR TIE PLUGS AND SYNTHETIC TIE PLUGGING MATERIALS[1] (2006)

3.1.5.1 General Background

Wood tie plugs and synthetic tie plugging materials are used to fill holes left in ties after plate and rail fasteners, such as cut spikes and screw spikes, are removed.

3.1.5.2 Purpose

Tie plug and synthetic tie plugging materials serve two primary purposes.

a. To protect the tie from environmental contamination.

b. To provide new material into which fasteners may be re-installed.

3.1.5.3 General Quality

a. For maximum effectiveness, wooden plugs must fit tightly in the vacated holes. The dimensions and preservative treatment of wooden plugs may be recommended by the tie plug manufacturer or specified by the end user.

b. For maximum effectiveness, synthetic plugging materials must completely fill the vacated holes. Cure time and material hardness may be recommended by the manufacturer of the plugging material or specified by the end user.

3.1.6 SPECIFICATIONS FOR DEVICES TO CONTROL THE SPLITTING OF WOOD TIES[2] (2012)

3.1.6.1 Anti-Splitting Devices

Anti-splitting devices may be of (a) the type made from a strip of steel and applied by driving into the end (cross section) of the tie; or (b) of the steel dowel type, applied parallel to the wide face of the tie, transverse to its length; or (c) the steel multi-nail plate type to be pressed or driven flush into the end (cross section) of the tie.

3.1.6.2 Materials

3.1.6.2.1 Dowels

If the steel dowel type is used, it shall be of the dimensions and thread design specified by the purchaser, and shall be of C-1020 steel, ASTM Specifications, designation A 575-96 (2002), with a minimum of 0.2 of 1% copper.

3.1.6.2.2 Irons

a. The finished strip shall conform to the following minimum tensile properties:

Strength, psi	75,000
Yield point, psi	40,000
Elongation in 2 in., percent	20

b. *Design.* Anti-splitting irons shall be of the shape and size stipulated by the purchaser.

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[1] References, Vol. 26, 1925, pp. 1079, 1433; Vol. 54, 1953, pp. 627, 1394; Vol. 61, 1960, pp. 407, 1167.

[2] References, Vol. 32, 1931, pp. 236, 736; Vol. 45, 1944, pp. 270, 598, Vol. 63, 1962, pp. 316, 741; Vol. 85, 1984, p. 9.

c. *Manufacture.* Anti-splitting irons shall have smooth surfaces and be free of distortion, scale, jagged ends, and blunt beveled edge.

The dimensions of the steel strip in anti-splitting irons shall be not less than:

Thickness . . . . . 0.083 in.
Width . . . . . 3/4 in.
Length . . . . . as required by the design

d. *Variations.* Variations (over or under) from dimensions specified shall not exceed:

Thickness . . . . . 0.005 in.
Width of strip . . . . . 1/32 in.
Width of bevel . . . . . 1/32 in.
Length . . . . . 1/8 in.

3.1.6.2.3 Nail Plates

If a steel nail plate is used it shall be made of 18 gage galvanized sheet steel ASTM A653/A653M Structural Steel (SS) Grade 40 or better with a minimum coating designation of G60. ASTM A653/A653M SS Grade 40 G60 mechanical properties are as follows:

Yield Strength - 40,000 psi minimum

Ultimate Tensile Strength - 55,000 psi minimum

Elongation in 2 inches - 16% minimum

3.1.6.3 Inspection

Inspectors representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works which concern the manufacture of the material ordered. The manufacturer shall afford the inspectors, without charge, all reasonable facilities to satisfy them that the material is being supplied in accordance with these specifications. Unless otherwise agreed all inspection and tests shall be made at the place of manufacture prior to shipment, and shall be so conducted as to not interfere unnecessarily with the operation of the works.

3.1.6.4 Delivery

Accepted devices shall be shipped by the seller in accordance with instructions in the order covering them, securely packed in containers marked with the name, type, grade, and quantity of the material therein, and with the name of the seller and the number of the buyer's contract or order.

3.1.7 APPLICATION OF ANTI-SPLITTING DEVICES[1] (2005)

3.1.7.1 General

a. All hardwood ties (those from broadleaved trees) are subject to splitting and when so designated by the purchaser shall have anti-splitting devices applied. Either nail plates, strip irons or dowels may be used for this purpose.

[1] References, Vol. 32, 1931, pp. 236, 736; Vol. 45, 1944, pp. 270, 598; Vol. 63, 1962, pp. 318, 741; Vol. 85, 1984, p. 9.

b. Anti-splitting devices designed to control the splitting of ties should be applied prior to or at the time the ties are delivered to the treating plant.

3.1.7.2 Nail Plates

a. One multi-nail plate should be positioned onto the end (cross section) of the tie, with the plate being placed to cover the greatest area of splitting. This should enable the plate to hold both vertical and horizontal splits together.

b. Nail plates should be applied by a mechanical device capable of squeezing the splits together, bringing the tie back to its original dimensions, prior to application.

3.1.7.3 Irons

Anti-splitting strip irons driven into the ends of ties should be so placed as to cross at right angles the greatest possible manner of radial lines of the wood. Irons should be placed far enough from the wide faces to prevent splitting.

SECTION 3.2 TIMBER SWITCH TIES[1]

3.2.1 SPECIFICATIONS FOR TIMBER SWITCH TIES (2015)

NOTE: It is recommended for West Coast species that West Coast Lumber Inspection Bureau (WCLB) Grading Rules apply.

3.2.1.1 Material

3.2.1.1.1 Kinds of Wood

a. Before manufacturing ties, producers shall ascertain which of the following kinds of wood suitable for switch ties will be accepted:

Ashes	Elms	Larches	Redwood
Beech	Firs (true)	Locusts	Spruces
Birches	Gums	Maples	Walnuts
Cherries	Hemlocks	Oaks	
Douglas fir	Hickories	Pines	

b. Others will not be accepted unless specially ordered.

3.2.1.2 Physical Requirements

3.2.1.2.1 General Quality

Except as hereinafter provided, all ties shall be free from any defects that may impair their strength or durability as switch ties, such as decay, large splits, large shakes, slanting grain, or large or numerous holes or knots.

[1] References, Vol. 17, 1916, pp. 245, 840; Vol. 22, 1921, pp. 332, 1005; Vol. 27, 1926, pp. 695, 1388; Vol. 35, 1934, pp. 780. 1160; Vol. 53, 1952, pp. 336, 1120; Vol. 54, 1953, pp. 626, 1394; Vol. 55, 1954, pp. 470, 1074; Vol. 63, 1962, pp. 318, 741; Vol. 75, 1974, p. 379; Vol. 88, 1987, p. 55; Vol. 94, p. 63.

3.2.1.2.2 Resistance to Wear

When so ordered, ties from needle-leaved trees shall be of compact wood throughout the top fourth of the tie where any inch of any radius from the pith shall have 6 or more rings of annual growth. Southern Yellow Pine ties shall conform to the most current SPIB Standard Grading Rules for Southern Pine Lumber; Section 400 – Timbers 5x5 or Larger – No. 1 Dense or Better. West Coast Softwood species shall conform to the most current WCLIB Specifications – Standard No. 17 Grading Rules; Section 6: Special Use Grades – Railroad Ties; Item No. 192-b – No. 1 Railroad Ties or Better.

3.2.1.3 Design

3.2.1.3.1 Dimensions

a. All unseasoned or green switch ties shall measure in cross section a minimum of 7 inches in side thickness and 9 inches in face width. A maximum of 1 inch of wane is allowed on the top or bottom faces within the rail-bearing area, which is defined as the section between 12 inches from each end of the tie. Seasoned or treated switch ties may be 1/4 inch under the specified dimensions for thickness and width, or not more than 1 inch over the specified dimensions. Lengths and length tolerances shall be specified by the customer.

b. All thickness and face width dimensions apply to the rail-bearing area. All determinations of face width shall be made on the top of the switch tie, which is the narrowest horizontal face. If both horizontal faces are of equal width, the top shall be that face with the narrowest or no heartwood.

3.2.1.4 Inspection

3.2.1.4.1 Place

Ties shall be inspected at suitable points as specified in the purchase agreement of the railway.

3.2.1.4.2 Manner

Ties must be presented for inspection in an organized manner with all surfaces clean for ready observation. Inspectors will make a reasonably close examination of the top, bottom, sides and ends of each tie. Each tie will be judged independently without regard to the decisions on others in the same lot.

3.2.1.4.3 Decay

Decay is the disintegration of the wood substance due to the action of wood destroying fungi. "Blue stain" is not decay and is permissible in any wood.

3.2.1.4.4 Holes

A large hole is one more than 1/2 inch in diameter and 3 inches deep within, or more than one-fourth the width of the surface on which it appears and 3 inches deep outside, the section of the tie between 12 inches from each end of the tie. Numerous holes are any number equaling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.

3.2.1.4.5 Knots

Within the rail bearing area of switch ties, which is that area between 12 inches from each end of the tie, a large knot is one having an average diameter more than 1/3 the width of the surface on which it appears, but such a knot may be allowed if it is located outside the rail bearing area. Numerous knots are any number equaling a large knot in damaging effect.

3.2.1.4.6 Shake

a. A shake is a separation along the grain most of which occurs between the rings of annual growth.

b. The procedure shown in Article 3.1.1.4.6 and Figure 30-3-2 for crossties shall also apply to switch ties for measuring the length of a shake. One which is not more than one-third the width of the tie will be allowed provided it does not extend nearer than 1 inch to any surface.

3.2.1.4.7 Splits

a. A split is a separation of the wood extending from one surface to an opposite or adjacent surface. Do not count the end as a surface when measuring the length of a split.

b. In unseasoned or green switch ties, a split no more than 1/8 inch wide and/or 5 inches long is acceptable. In a seasoned or treated switch tie, a split no more than 1/4 inch wide and/or longer than the width of the face across which it occurs is acceptable. A split exceeding the limit is acceptable, provided split limitations and anti-splitting devices are approved by the buyer and properly applied.

3.2.1.4.8 Checks

A check is a separation of the wood due to seasoning which appears on one surface only. Do not count the end as a surface when measuring the length of a check. Ties with continuous checks whose depth in a fully seasoned and/or treated tie is greater than 1/4 the thickness and longer than 1/2 the length of the tie will be rejected.

3.2.1.4.9 Slope of Grain

Except in woods with interlocking grain, a slope of grain in excess of 1 in 15 will not be permitted.

3.2.1.4.10 Bark Seams

A bark seam or pocket is a patch of bark partially or wholly enclosed in the wood. Bark seams will be allowed provided they are not more than 2 inches below the surface and/or 10 inches long.

3.2.1.4.11 Manufacturing Defects

All ties must be straight, square-sawn, cut square at the ends, have top and bottom parallel, and have bark entirely removed. Any ties which do not meet the following characteristics of good manufacture will be rejected:

a. A tie will be considered straight when a straight line from a point on one end to a corresponding point on the other end is no more than 2 inches from the surface at all points.

b. A tie is not well-sawn when its surfaces are cut into with scoremarks more than 1/2 inch deep, or when its surfaces are not even.

c. The top and bottom of a switch tie will be considered parallel if any difference at the sides or ends does not exceed 1/2 inch.

d. For proper seating of nail plates, tie ends must be flat, and will be considered square with a sloped end of up to 1/2 inch, which equals a 1 in 20 cant.

3.2.1.5 Delivery

3.2.1.5.1 On Railway Premises

Ties shall be delivered and stacked as specified in the purchase agreement of the railway. If ties are to be inspected, they must be placed so that all ties are accessible to the inspector.

3.2.1.5.2 Risk, Rejection

All ties are at the owner's risk until accepted. All rejected ties shall be removed within one month after inspection.

3.2.1.6 Shipment

Ties forwarded in cars or vessels shall be separated therein according to the above groups, and also according to the above sets or lengths if inspected before loading, or as may be stipulated in the contract or order for them.

SECTION 3.3 TIE TESTS AND THE ECONOMICS OF SERVICE LIFE[1]

3.3.1 PURPOSE OF TIE TESTS (2014)

a. Tie tests may be installed to demonstrate average years of service life under various conditions, sizes, designs, materials, spacing, wood species, preservatives, retentions, tonnage, anti-splitting devices, coatings, grade, curvature, speed, rail size, etc.

b. For the purpose of evaluating new railroad tie products, consider published references such as the Railway Tie Association's document "Gateway Document for Candidate Railroad Tie Products".

3.3.2 DESIGN[2] (1975)

a. Test sections shall be so devised that all of the variables affecting life, except the one to be determined, will, as far as possible, neutralize or cancel out.

b. Thus, if the effect of size is to be determined, the test should be designed as follows:

(1) Select a location where the various sizes to be tested are inserted under one tangent track with constant grade, drainage, and ballast.

(2) Use ties of the same species of wood, treated with one preservative to the same retention.

(3) Use identical fastenings, plates and anti-splitting devices.

c. If the effect of traffic is to be determined, a location should be chosen where adjacent tangent tracks are similar in all respects except for tonnage.

3.3.3 MARKING TEST TIES[3] (2014)

a. Test ties must be physically identified for the life of the test. Some of the acceptable means include:

(1) dating nails,

(2) surface and/or end markings,

(3) tags of metal or other materials suitable to withstand weathering and tie tests,

(4) shallow bore holes,

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[1] References, Vol. 75, 1974, p.379

[2] References, Vol. 24, 1923, pp. 256, 1148; Vol. 28, 1927, pp. 189, 1288; Vol. 54, 1953, pp. 627, 1394; Vol. 63, 1962, pp. 319, 741.

[3] References, Vol. 27, 1926, pp. 702, 1388; Vol. 48, 1947, pp. 377, 875; Vol. 54, 1953, pp. 627, 1394; Vol. 63, 1962, pp. 319, 741; Vol. 67, 1966, pp. 176, 718.

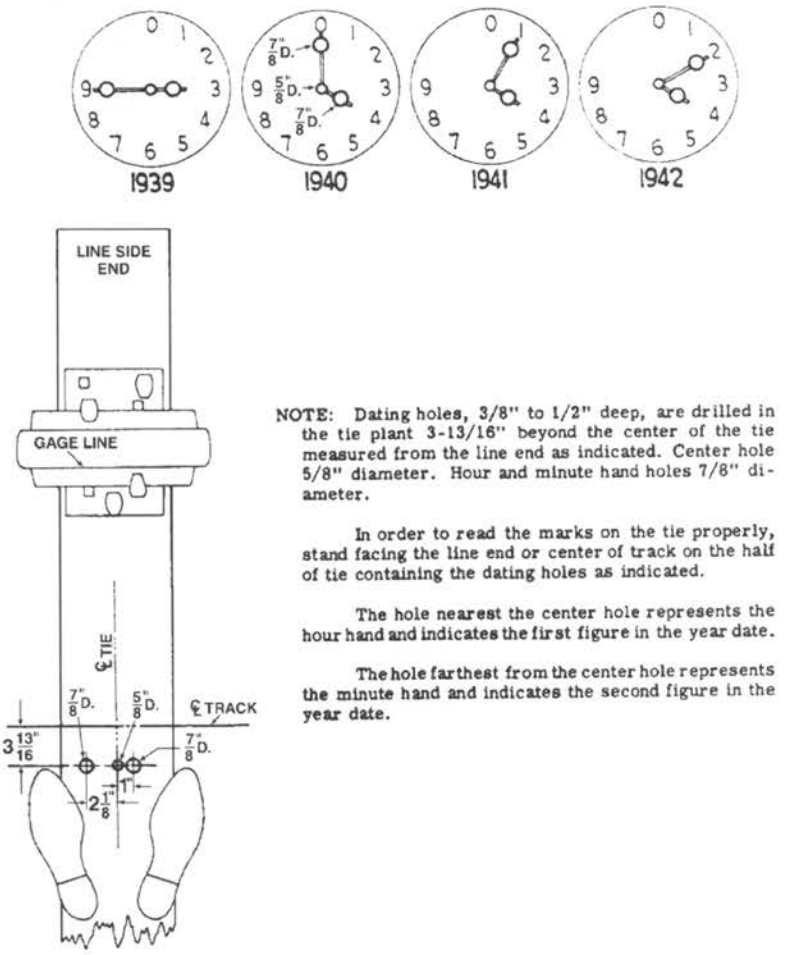

Figure 30-3-3. Clock Dating Tie Method

(5) paint

(6) embossed nail plates.

(7) branding

(8) electronic identification

Methods (1), (3) and (4) are usually located 10 inches toward the tie center from the inside edge of the tie plate on the line side.

b. It is recommended that all ties be physically identfied to indicate one or more of the following: the year of purchase or treatment, wood species group, kind of treatment, and treating plant identification.

c. One former method of dating ties is called Clock Dating. For reference, this method is described and illustrated in Figure 30-3-3.

3.3.4 ECONOMIC COMPARISON OF SERVICE LIFE[1] (2014)

a. Except in isolated cases, ultimate economy in labor and material results from the use of properly treated ties, as compared with untreated ties.

b. The economy of any tie of known price and life may be determined by the following formulas:

- Required – Total capitalization of tie:

$$C + C^1 = \frac{C(1+R)^n}{(1+R)^n - 1}$$

where:

C = First cost of tie

C^1 = Amount of money at compound interest which will produce interest equaling first cost of tie, during life of tie

R = Rate of interest

n = Life of tie in years

- Required – Total annual cost:

$$I = CR$$

$$A = \frac{CR}{(1+R)^n - 1}$$

- Total annual cost =

$$I + A = \frac{CR(1+R)^n}{(1+R)^n - 1}$$

where:

C = First cost of tie

R = Rate of interest

I = Interest on first cost

A = Amount of money at compound interest which will provide for renewal at end of life of tie

n = Life of tie in years

- Tie costs are equivalent when the capitalization or annual costs are equal, or:

$$C^2 = \frac{C(1+R)^n}{(1+R)^n - 1} \times \frac{(1+R)^{n1} - 1}{(1+R)^{n1}}$$

[1] References, Vol. 16, 1915, pp. 524, 1091; Vol. 40, 1939, pp. 635, 786; Vol. 53, 1952, pp. 337, 1120; Vol. 54, 1953, pp. 626, 1394; Vol. 55, 1954, pp. 470, 1074; Vol. 63, 1962, pp. 319, 741.

where:

R = Rate of interest

C = Cost of tie of n years life

C^2 = Cost of tie of n^1 years life

c. Other tie life cycle costing models are available from sources such as:

(1) Railway Tie Association

(2) Treated Wood Council

3.3.5 TRAFFIC UNIT FOR USE IN COMPARING TIE LIFE[1] (1975)

For comparing cross tie service, the density of traffic units shall be the "Equivalent gross ton-miles per mile of track," determined according to the formula given below:

Let:

D = Equivalent gross ton-miles per mile of maintained track

N = Net ton-miles, freight

T = Ton-miles, freight cars (tare)

L = Ton-miles, freight locomotives

P = Passenger car miles

M = Miles of maintained track

$$D = \frac{N + T + 2L + 144P}{M}$$

NOTE: The term 144 P embraces passenger locomotives.

SECTION 3.4 SUBSTITUTE TIMBER TIES[2]

3.4.1 FUNDAMENTALS TO BE CONSIDERED IN DESIGNS OF SUBSTITUTE TIES (2013)

3.4.1.1 General

a. The substitute must be designed to have sufficient strength to prevent failure of the tie or its fastenings, and sufficient bearing surface on the ballast and with the rail to properly support the loads imposed, and provide against undue deflection in the rail.

b. Track will not remain permanently to gage, surface and line under the loads imposed upon it, and restorative or maintenance operations, more or less frequent, will always be necessary. Therefore, the tie design should provide a maximum resistance to any change in gage or line as may be caused by wheel loads and should allow easy adjustment to correct for any change in track gage.

[1] References, Vol. 31, 1930, pp. 1144, 1747; Vol. 49, 1948, pp. 238, 601; Vol. 54, 1953, pp. 627, 1394; Vol. 63, 1962, pp. 319, 741.

[2] References, Vol. 24, 1923, pp. 249, 1147; Vol. 54, 1953, pp. 627, 1394; Vol. 63, 1962, pp. 319, 741; Vol. 75, 1974, p. 379.

c. The life cycle per unit of length of track for renewals and track maintenance should compare favorably with wood ties. Economy in renewals depends upon first cost, ease of installation and durability. Economy in maintenance will depend upon how closely the requirements heretofore specified are met.

3.4.1.2 Fastenings and Gage

a. The fastenings must be of sufficient strength to maintain gage and resist rail creepage, being so designed that without taking the tie from the track and without change to the holes, or fixed bolts or projections in the tie, a reasonable change of width or thickness of the base of rail, or variation of gage, may be made. The fastenings should be such as to offer as little obstruction to derailed wheels as possible. They should permit shimming where necessary, the change of defective rail, or the renewal of rails with ease, and should be replaceable if broken or defective, without disturbing the tie.

b. The combination of rail bearing area and lateral fastening restraint must be sufficient to withstand expected lateral loads without excessive gage widening due to canting of rail.

c. If the design provides one support under each rail, united by a transverse member to hold gage, the transverse member must be of sufficient strength to maintain gage and plane, and of such design as to withstand a reasonable amount of the damage incident to derailment.

3.4.1.3 Line

The tie should be of such shape that it will not only resist the tendency of track to get out of line, but also permit the track to be thrown back to line when necessary. Projections of the base of the tie that project into the ballast make it necessary to lift the track out of surface before relining, and are therefore objectionable. Ties clamped in pairs which enclose a considerable amount of ballast between their several parts, to such extent that the ballast must be removed before the track is lined, add a material burden to the labor necessary to line track.

3.4.1.4 Surface

a. The tie should have sufficient length and breadth to provide a bearing surface per rail length of track at least equal to that obtained with wood ties, for the same class of track, without reducing the space between the ties to such an extent as to make tamping difficult. It should have sufficient stiffness as a beam to develop the full bearing area on the roadbed.

b. The base of the tie must be so shaped that the ballast can be readily and effectively tamped under the tie and also not cut into or disturb the tamped bed.

3.4.1.5 Insulation

Ties to be used in track circuit territory should be insulated if their native impedance or resistance is insufficient to ensure proper operation of electrical devices. The fastenings of such ties should be so designed that the insulation material will not be subjected to abrasion or to great stress other than compression.

3.4.1.6 Causes of Failure

Past experience indicates that some of the features that produce failure in substitute ties are as follows:

a. Lack of efficient protection against corrosion.

b. Failure of rail fastenings.

c. Failure of insulation.

d. Loss of beam strength due to weakening tie in vicinity of rail or tie center, resulting in flexure cracking.

e. Use of sharp interior angles, square holes, or other stress risers from which cracks develop.

f. Lack of resistance to derailed wheels.

g. Design of base of tie such as to render tamping difficult or impossible and such as to make maintenance of proper surface of track impracticable.

h. Design of tie such that track will not hold line, or such as to make lining of track impracticable.

i. Lack of beam strength causing breakage on yielding roadbed.

j. Lack of protection from abrasion by ballast.

k. Lack of provision for expansion and contraction, where materials with varying coefficients of expansion are used in combination.

l. Lack of compressive strength or ability to resist crushing action of tie plate or rail.

m. Lack of lateral strength, causing loss of retentive power of spikes, bolts, or other similar devices and insufficient resistance to their lateral thrust.

SECTION 3.5 THE HANDLING OF TIES FROM THE TREE INTO THE TRACK[1]

Long, satisfactory tie life stems from adherence to proven production practices beginning in the woods.

3.5.1 SEASONAL MANUFACTURE (1975)

Investigations of the moisture content of standing trees prove that during winter they contain as much sap as during other seasons. Consequently, felling timber during spring or summer does not result in ties having more moisture than would otherwise be the case. However, winter cutting is advantageous to the extent that then the cut surfaces of logs and ties are exposed first during cold weather, when fungi and insects are least active. By the time warm weather comes, winter-cut forest products are usually out of the woods (where destructive agents are the most prevalent) and become partly seasoned, decreasing the tendency for fungi to develop and reducing the liability to insect attack. It is also true that ties dry more slowly during the winter and early spring than they do in the summer, thereby reducing the tendency to excessively split and check. Because winter cutting is not everywhere practicable, owing to climatic or other conditions, it is necessary in most sections of the country that ties be manufactured throughout the year. Entirely satisfactory ties can be produced during any season if proper precautions are observed.

3.5.2 LOG STORAGE (1975)

Soil generally contains many species of fungi and is usually moist enough to dampen any wood in contact with it, thus providing the source of infection and conditions conducive to its propagation. Consequently, tie-logs should be moved as promptly as possible from woods to mill. Where prime seasons must be used for log hauling, pre-cut logs should be carefully stacked above the ground.

[1] References, Vol. 24, 1923, pp. 251, 1148; Vol. 32, 1931, pp. 260, 740: Vol. 37, 1936, pp. 417, 989; Vol. 46, 1945, pp. 470, 812; Vol. 54, 1953, pp. 626, 1394; Vol. 63, 1962, pp. 319, 741; Vol. 67, 1966, pp. 177, 718; Vol. 68, 1967, p. 182; Vol. 75, 1974, p. 379; Vol. 86, 1985, p. 9.

3.5.3 SPECIFICATIONS (1975)

Ties manufactured and purchased in accordance with AREMA specifications will meet requirements as to quality and size which assure the greatest economy in wood utilization and maximum service in track.

3.5.4 INSPECTION (2011)

a. If ties are to be inspected from solid stacks at mills or concentration yards prior to shipment, the inspection should take place as promptly as possible after being sawn to prevent stain and fungi build-up. If, for some reason, ties must be held for more than four winter months or one summer month, they should be air stacked in accordance with Article 3.5.6.2.

b. To reduce the high cost of mill or concentration yard inspection due to unavoidable delays, ties may be inspected at unloading stations located at destination treating plants or other tie inspection facilities. The area designated for inspection should be equipped with a kicker for turning, a mirror for observing the ends of ties opposite the inspection station, proper lighting and equipment for mechanical handling and separating.

c. Accepted ties should be marked to show ownership, year produced, and other information as specified.

3.5.5 TRANSPORTATION TO THE TREATING PLANTS (2011)

It may be advantageous to make provisions for the assignment of a sufficient number of cars or trucks to promptly handle the movement of green ties from concentration and/or mill yards to the tie inspection facility for seasoning prior to treatment. Delays in loading and hauling "dead" stacked ties may result in wood fiber infection.

3.5.6 SEASONING (2005)

3.5.6.1 Methods

Methods of seasoning should include air drying, Boultonizing, Steam Conditioning or other approved process.

3.5.6.2 Air Seasoning

a. Ties should be yarded in accordance with provisions set down under AREMA Plant Practice, Article 3.6.3.

b. Because the various species and sizes of ties dry at different rates, it is necessary to stack like kinds together-thus, No. 4 and No. 5 oaks would be stacked by themselves as would No. 3 beech, birch and maple. Hickory, pine and red gum are often stacked as separate species due to peculiar seasoning characteristics.

c. Tie stacks should contain only those ties received during the same month or 30 day period and be so labeled. This practice will bring ties out of air seasoning prior to treatment at the approximately same moisture content, preventing over- or under-drying.

d. Ties should be stacked for air seasoning in a manner which will allow free circulation of air, minimum contact of surfaces, maximum rain run off and maximum economy of space consistent with economical handling. It is recommended that stacks be built not over 20 layers high and the ties arranged 1 × 7 to 9. (Figure 30-3-4, Figure 30-3-5, Figure 30-3-6 and Figure 30-3-7.)

e. Ground contact sills should be of sound treated wood or of inorganic materials.

f. In areas where ties are subject to excessive splitting and checking during air seasoning, semi-solid square stacks (7 to 9 × 7 to 9) with end ties turned on their edges may be employed.

g. Other methods of reducing air seasoning defects which have been successfully demonstrated are stacking ties under the roof of a pole shed, covering open stacks with portable pile covers, tie end-coating and incising.

3.5.6.2.1 Species Groups for Seasoning and Treating

Crossties shall be grouped as shown in Table 30-3-1 for air-seasoning or artificial seasoning and subsequent preservative treatment. Only the kinds of wood named in a group may be processed together.

Table 30-3-1. Species Groups for Seasoning and Treating

Group Ta	Group Tb	Group Tc	Group Td
Black Locust	Douglas Fir	Gums	Ashes
Honey Locust	Firs (True)		Beech
Red Oaks	Hemlocks		Birches
White Oaks	Larches		Cherries
Black Walnut	Pines		Elms
	Redwood		Hard Maples
	Spruces		Hickory
			Soft Maples
			White Walnut

3.5.7 CONTROL OF SPLITTING IN AIR SEASONING (1985)

a. Wooden ties, in particular the hardwood species, check and split under fast or prolonged drying due to differential shrinkage.

b. Hardwood ties may be protected prior to or during seasoning by the application of one or more of the anti-splitting devices, at or near both ends, as outlined in Article 3.1.6.1.

c. Splitting and/or excessive checking can be retarded in air seasoning by sheltering, arranging tie stacks so that tie ends do not face prevailing winds, turning the heart faces of top ties down, incising and end coating.

d. Ties can be originally incised, and then only those ties developing a definite split at the close of the air seasoning period are selected for application of split control devices.

Figure 30-3-4. Ties Stacked 20 Layers High, German Style, for Seasoning

Figure 30-3-5. End View of Stacks of Ties being Air-seasoned

Figure 30-3-6. Stickered Air-Dried Ties with Two Space Stickers Per Layer

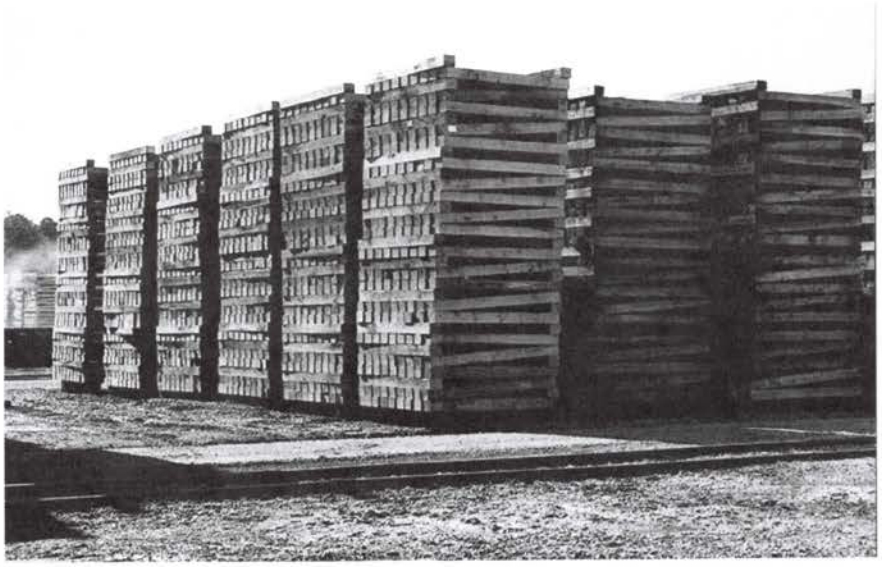

Figure 30-3-7. Broad View of a Clean, Well Drained Air-dry Yard Seasoning Ties

3.5.8 MACHINING (1985)

a. Ties may be bored prior to treatment to minimize splitting when driving spikes and provide preservative penetration around the spike holes.

b. Incising is recommended prior to seasoning to hasten seasoning, retard splitting and serious checking and permit deeper preservative penetration of recalcitrant woods.

c. Poorly sawn ties should be adzed prior to seasoning or treatment for the purpose of insuring even support for tie plates in the same plane.

3.5.9 PRESERVATION (1985)

a. When long service life is desired, ties should be subjected to preservative treatment to insure against early failure from both fungi and insects.

b. To determine the most economical treatment requires careful and complete study of the species of woods available, preservatives available, conditions of use and results of previous tie tests.

c. The preservative treatment of ties should be in accordance with Section 3.6, Wood Preserving.

3.5.10 CARE AFTER PRESERVATIVE TREATMENT (2013)

a. Ties treated in excess of those needed at the time on line should be stored at the treating plant until required in order to provide better care and a more flexible supply than is practicable when surplus ties are stored along the right-of-way.

b. It is recommended that treated ties be stored as steel-strapped or wired tram bundles. Stacks of bundles should be stored on treated sills and should be separated with treated strips for efficient lift truck or crane rehandling.

c. It is important that treated ties be handled carefully and in such a manner that the protective sheath of preservative-treated fibers will not be broken, thereby exposing untreated heartwood to infection and insect attack. An incision made by a pick or fibers broken by the mis-blow of a maul may provide an opening through which decay may enter.

3.5.11 DISTRIBUTION (2005)

a. Conditions affecting the distribution of ties in various localities differ so greatly that it is impractical to single out any procedure as universally superior. Careful study by all departments concerned is required to determine the best method of moving ties from each point of storage.

b. As a rule, it is more economical to load ties to cars directly from treatment, thereby saving one handling. Although direct loading is highly desirable, seasoning schedules may often require the storage of treated ties and rehandling will be necessary.

c. Tram bundles of treated ties are usually crane loaded, crosswise, into a gondola car. Each tie is then unloaded to a point along the right-of-way opposite the tie to be replaced.

d. Ties will be shipped from treating plants for usage under three general conditions:

(1) A large number of ties for renewal in connection with mechanized maintenance work over a several consecutive mile work location. These ties are best handled in special tie cars designed for this purpose, facilitating rapid unloading with minimum maintenance labor and greater safety. Ties should be unloaded at the point of usage to avoid labor expense in stacking or rehandling. Time between unloading and insertion should be the minimum practical to avoid damage to ties due to exposure to elements.

(2) A small number of ties to separate locations for use as on-line emergency stock or spot renewals. Handling can be in special tie cars or in such other cars as the railroad has available.

(3) A large number of ties shipped for use in construction work. The loading and handling method should mesh with the construction situation. Banded bundles can be used if ties are to be transferred from railway cars to trucks. Special tie cars are practical for adjoining track construction.

e. Ties should be carefully handled in a manner which will prevent breaking or bruising. Ties should not be discharged from cars onto rails or rocks. If a tie pick is used, it should be inserted in the end only.

f. Treated ties not needed for immediate use should be solidly stacked and may be covered with cinders or earth for protection against weather.

3.5.12 CARE DURING AND AFTER INSTALLATION (2005)

a. Ties should be carefully handled from the right-of-way to the point of insertion, guarding the vulnerable treated exterior.

b. Ties should be protected from excessive abrasion under the rail by the application of tie plates of sufficient area and thickness to distribute the traffic loads adequately. The least damage to ties as well as the smoothest track result from the use of plates having bottoms which do not necessitate the impact of traffic to seat the plate.

c. In order to economically enjoy the longest and most satisfactory service life from treated wooden ties, highest standards of surface and sub-surface maintenance must be practiced.

d. Ties should be adzed only in cases of necessity, as when rail is relaid, plate size changed or when the damage from a derailment involves the removal of splinters and crushed wood fibers. Whenever deep adzing of the treated surface takes place, steps should be taken to protect the adzed surfaces with a penetrating preservative paste or a preservative treated pad. Some states may require the applicator supervisor to have a permit for handling of pesticides.

e. Used spike holes should be filled with treated plugs or by chemical means.

f. Damage to ties from slewing as a result of rail creeping or running should be prevented by adequate anchoring of the rail.

g. Ties of the species and size best suited for each location should be selected. Ties made from the denser hardwoods should be used in sharp curves, steep grades, at ends of open-deck bridges and where tonnage is excessively heavy.

h. Treated ties should be placed in track with the wide surface nearest the pith, down.

i. Ties should be laid square across the track; i.e. at right angles to the rail.

j. Care should be taken to set and drive spikes at right angles to the tie surface, straight down.

3.5.13 RENEWALS (2013)

a. Although differences in operational organizations and physical conditions on the various railroads make it impractical to formulate a procedure that is applicable everywhere, no phase of track maintenance is more important than the selection of the ties to be renewed in a given year. Improper tie renewals over a period of years are sure to be costly, and may prove to be disastrous, whether the replacements are too few or too many.

b. The total number of ties required to maintain satisfactory track in one year is rarely the same as the number renewed during the previous year or the average renewals over any period. Therefore, careful inspection of the ties in track will provide more dependable information than any assumptions based on statistics.

c. Whatever method is used in the inspection and selection of the ties to be renewed, the procedure should be so planned as to provide a record of the system requirements as distinguished from those of a section or division. Training and experience for those making inspections of ties in track are necessary to assure uniformity in their procedure and consistency in their conclusions.

d. Each tie to be removed is generally identified by a mark on the tie or on the rail above it. Absolute adherence to this marking is required in some instances. More often the foreman is allowed to leave some marked ties and to remove some unmarked ties. Ordinarily, only ties which are useless where they are should be removed; but when track is given a general out-of-face overhauling, all ties which appear to be nearing the end of their service life may be removed.

e. Records of inspections of ties in track, detailed as to location by subdivision, track, milepost, and/or GPS coordinates aid in the unloading of ties where needed and thus avoid expensive extra handling.

3.5.14 SALVAGE (2016)

a. Ties still serviceable enough for economical reuse become available when lines are abandoned and tracks are taken up; when the renewal of all ties in tunnels, in road crossings, or at station platforms releases them; and when ties under heavy traffic have to be removed because their service in such track is no longer satisfactory.

b. While the reclamation or salvage of ties is sound in principle and highly desirable, it can easily be overdone. To guard against any tendency toward false economy resulting from loyalty to reclamation as such, all costs must be considered. Complete records of all expenses connected with picking up, stacking, preparing, and shipping ties for reuse should be kept for comparison with the prices of other materials for a given purpose, together with the respective costs of installation. Expenditures for handling and hauling may confine their reuse to locations close to where they are removed from track.

c. The most economical use of ties is to leave them in their original locations until they are so decayed or mechanically worn that they cannot serve their purposes any longer. However, in connection with general track reconditioning, it is usually economical to replace ties near the end of their serviceability, in order that the track need not be disturbed again for several years. This procedure is desirable in heavy-traffic, high-speed lines where spot tie renewals are expensive and the disturbance of refined track surface is especially inadvisable.

d. Ties removed from track should be carefully inspected and sorted into those fit for reuse in mainline track, other than mainline track, those suitable for other non-track uses, and "culls."

e. Ties reusable in track should be re-inserted with the same surface up as in original location. Only when light adzing of that surface will not provide satisfactory seats for the tie plates should ties be turned over.

f. Ties suitable for reuse in mainline track should meet the specifications for timber crossties as listed in Article 3.1.1 with the following additional requirements:

(1) Anchor wear should not exceed 1/2 inch in depth.

(2) Plate cut or adzing depth should not exceed 1/2 inch and should be uniform and not adversely affect tie plate bearing or rail cant.

(3) Spike holes must be sound with no evidence of internal decay.

(4) Prior to installation all spike holes should be completely filled with tight fitting treated tie plugs or synthetic plugging material.

g. Ties suitable for other than mainline track such as branch lines, sidings and yards should meet the specifications for timber industrial grade crossties as listed in Section 3.9 with the following additional requirements:

(1) Anchor wear should not exceed 1 inch in depth.

(2) Plate cut or adzing depth should not exceed 3/4 inch and should be uniform and not adversely affect tie plate bearing or rail cant.

(3) Spike holes must be sound with no evidence of internal decay.

(4) Prior to installation all spike holes should be completely filled with tight fitting treated tie plugs or synthetic plugging material.

h. Salvaged ties must be reinstalled or re-treated as soon as possible after being removed from ballast. If a used tie is allowed to dry out it tends to be subject to excessive checking and/or splitting.

i. Ties unfit for reuse in track should be disposed of in accordance with U.S. Environmental Protection Agency and individual state guidelines. EPA guidelines under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) may be found for each preservative on their fact sheet at http://www.epa.gov/pesticides/factsheets/index.htm.

SECTION 3.6 WOOD PRESERVING[1]

3.6.1 FUNDAMENTALS (1985)

Preservative treatment of wood to retard or prevent the effectiveness of wood-destroying agencies such as fungi, bacteria, insects, marine borers, and fire has succeeded in making wood an economical material for use in many fields. The magnitude of annual savings produced by preservative treatment is proportional to the degree of careful attention assigned to the quality of preservatives, the detail of the treating procedures, the proper handling of the treated material and the competent inspection of all of these essentials. Heartwood of most naturally durable woods resists penetration by preservative. Yet its life is generally extended by treatment, even though the depth of penetration is slight, providing that the wood is properly seasoned prior to treatment. Preservative treatment will not restore any loss of strength resulting from defects of any kind; consequently, only wood free of significant defects which will render it unfit for use can be treated to advantage.

[1] References, Vol. 10, 1909, pp. 629, 669; Vol. 11, 1910, part 2, pp. 737, 860; Vol. 15, 1914, pp. 632, 1094; Vol. 27, 1926, pp. 921, 1414; Vol. 28, 1927, pp. 1117, 1427; Vol. 43, 1942, pp. 407, 413, 698; Vol. 47, 1946, pp. 137, 139, 621; Vol. 54, 1953, pp. 702, 704, 1361; Vol. 55, 1954, pp. 545, 1048; Vol. 57, 1956, pp. 444, 1019; Vol. 61, 1960, pp. 417, 1165; Vol. 75, 1974, p. 379; Vol. 86, 1985, p. 9; Vol. 92, 1991, p. 42; Vol. 96, p. 26.

3.6.2 PREPARATION OF MATERIAL PRIOR TO TREATMENT (2013)

a. If pressure treated wood materials are to give the proper service life, care must be taken to insure that the material has been prepared properly before it is processed. For example, preservatives do not penetrate through any inner bark left on the surface of wood. Inner bark also retards the seasoning of wood. For these reasons, round stock such as poles, piling, and posts should be inspected carefully before it is put out into a seasoning yard or trammed for processing in a cylinder to make sure that the surfaces are free of large patches of inner bark. Standard specifications permit inner bark provided that the strips are not more than 3/4 inch wide and 8 inches long and are separated by at least 1 inch of clear surface between any two strips. Cross ties and other sawn material do not present any problem in this respect.

b. If anti-checking irons such as "S" irons, dowels and nail plates are used to reduce splitting, they should be applied prior to or on arrival of the material at the treating plant or as soon as possible after stacking in the seasoning yard.

c. With the exception of switch ties and other more costly timbers, it is a more common practice to permit splits to occur in the ties during the seasoning process and then selective doweling or end plating only those ties which will be benefited. Hydraulic pressure is used to close the opening created by the split. Then while the split is held closed, (1) two dowels are driven into prebored holes through the tie in a direction parallel to the face, and close to each end, or (2) toothed nail plates are driven into the ends of the tie.

d. Adzing, boring, trimming, branding and/or incising of cross ties, if specified, should be performed prior to treatment, and in accordance with Article 3.1.4 and Article 3.6.2.g. Adzing provides a smooth and true bearing for tie plates and was necessary when it was common to use hewn, rather than sawn, cross ties. When boring for spikes is required, the boring pattern should fit the hole pattern in the tie plates.

e. When it is not to be expected that a pattern bored for spikes will fit the tie plate, then many railroads substitute a specific pattern to be bored into the tie plate area disregarding the pattern in the plates. The purpose of this is to obtain deeper, more general penetration of the preservative in this vulnerable area during subsequent pressure treatment.

f. There are two reasons why some sawn material is incised prior to treatment. First, the cell structure of wood is such that preservatives penetrate the wood farther in a longitudinal direction than in either a radial or tangential direction. This is particularly true of the heartwood in Douglas fir. Incising of this species prior to treatment opens up access ways for the preservative to move longitudinally through the cells of the wood. Incising of this species prior to treatment results in a better treated commodity. Secondly, incising of some species of hardwoods, such as the gums, before seasoning has taken place, reduces the build up of tension stresses in the surface area of material during seasoning. This reduces the width and the depth of the checks that do develop during seasoning. In addition, the checks tend to grow only from one incision to the next along the grain. Therefore, the lengths of the checks are also controlled.

g. If incising is specified for material over 2 inches in thickness, the pattern used shall be that shown in Figure 30-3-8. (Patterns slightly different are not objectionable if machines constructed prior to 1940 are used). The incising teeth shall be not more than 7/32 inch thick. If the material being incised is less than 5 inches thick but more than 2 inches thick, the incision shall be made to a depth of 3/4 inch in the edges but to a depth of only 1/2 inch in the sides. In pieces 5 inches or more thick, the incisions shall be made to a depth of 3/4 inch on all four sides.

h. While some western species 2 inches and less in thickness are incised for purposes of obtaining penetration, the patterns used generally vary greatly from that shown in Figure 30-3-8. Such material is generally incised to a depth not exceeding 3/8 inch.

i. Any opening that develops in treated wood that penetrates through the treated zone opens up untreated wood to attack by decay. If such occurs, the service life of the piece is shortened. It is, therefore, desirable to reduce the potential for this to occur by performing every milling or framing operation prior to treatment rather than after treatment. For example, bridge ties should be completely framed prior to treatment. Construction timbers should be cut to length and

bored for bolt holes prior to treatment. Poles should be gained and bored for crossarms and braces, cut to length and roofed.

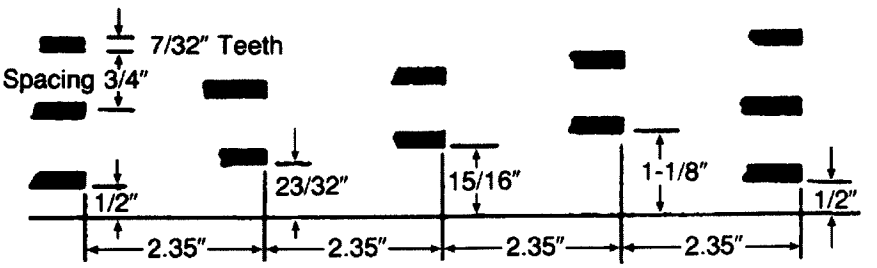

Figure 30-3-8. Incising Pattern for Material Over Two Inches Thick

3.6.3 CONDITIONING PRIOR TO TREATMENT (2013)

a. Wood needs to be conditioned for preservative treatment by a procedure which will render it receptive to penetration by preservative without reducing its strength. In addition, the conditioning process should be such that the moisture content of oaks is reduced to a level of 50% or less and of the gums and mixed hardwoods to a level of 45% or less. The moisture content of the western softwoods should be reduced to below 30%. The moisture levels shall be determined with a moisture meter, by the toluene extraction method, or by the oven-drying method as specified by the purchaser. Details for the moisture tests can be found in Standard M2, Section 2, of the Standards of the American Wood Protection Association. The objective of such conditioning is to create seasoning checks before treatment if possible rather than have them develop after treatment and possibly expose untreated wood.

b. The southern pines are a special situation. Round stock of this species has deep sapwood which can be penetrated to a depth of 3 inches to 3.5 inches with a simple steam conditioning cycle. Thus, it is not necessary to season round southern pine commodities before treatment to the level that checks are developed. It is generally sound, however, to season sawn southern pine to low moisture content because this type product has heartwood surfaces which can not be penetrated to a depth of more than 1/4 inch.

c. There are three methods commonly used to condition wood prior to treatment. These are air-drying, Boulton drying and live steaming. The first two reduce the moisture content in the outer 1-1/2 inches of the cross section to a level well below the fiber saturation point (25-30%). When this happens, the wood shrinks from the surface inward and a good, desirable checking pattern occurs.

d. Steam conditioning of unseasoned material is generally restricted to the southern pines. It does not reduce the moisture content below the fiber saturation level and thus its use does not develop a checking pattern in the lumber.

3.6.3.1 Air Seasoning

a. Historically, the oaks, gums and hardwood species most often have been air seasoned prior to treatment. While it is time consuming, the long service life of treated cross ties is a testament to the successful use of the technique. Air seasoning yards should be located where there is maximum exposure to the sun and to freely circulating air. Low humid areas should be avoided. Good drainage must be maintained and the seasoning yard must be kept free of vegetation, debris and decaying wood.

b. All stacks of seasoning material must be supported on treated or other non-decaying sills. The bottom layer of material shall be supported at least 12 inches off the ground. In warm, humid localities, more space should be provided.

c. Air circulation should be promoted by providing alleys at least 3 feet wide between stacks of material. The yard should be designed such that these alleys are continuous across the seasoning yard. In laying out the design, consideration should be given to the prevailing wind so that the air will flow through the layers of material stacked in the seasoning yard.

d. Open stacking furthers the drying of wood, but satisfactory spacing of the pieces depends on their size, the mean relative humidity and the mean temperature of the locality. In most sections satisfactory seasoning is accomplished by stacking cross ties in layers of 8 to 10 with one tie as a stringer at every other end. This is commonly referred to as the German style. Timbers 5 inches or more thick should be stacked with at least 2 inches of air space between layer. Lumber less than 5 inches thick should be stacked with at least 1 inch between layers. Within each layer, all pieces should be at least 2 inches apart. Stickers of preserved wood or areas of contact brushed with preservatives will reduce the likelihood of a type of decay called "stackburn".

e. The length of time required to adequately air-dry wood in preparation for its preservative treatment varies with the kind, dimensions, and moisture content when stacked and climatic and site conditions. Consequently, a specific seasoning period must be determined for each particular locality and care taken to assure the treatment of all material before it starts to deteriorate in seasoning stacks.

3.6.3.2 Boulton Drying

a. Boulton drying is increasingly important as the cost of the money tied up in air seasoning cross tie inventories becomes an operating cost factor.

b. Historically, Boulton drying has been used with good success to dry the western softwoods prior to treatment. The seasoning conditions in the cool damp Pacific Northwest often makes air seasoning impractical.

c. The Boulton process can be used just as successfully to condition and dry the oaks, hickories, gums, and mixed hardwoods prior to treatment. It is not desirable to use this process, however, if the lumber or timber item has been partially air seasoned in excess of sixty days as this will result in the product having excessive splits or checks. Care must be taken to determine the moisture content of the material prior to drying. This value should then be used to calculate the amount of water that must be removed during the Boulton drying process.

d. During the Boulton drying process ties shall be trammed with each layer separated by 3/8 inch minimum sticker placed at each end of the ties. To condition by this process, the ties are heated in oil under vacuum in the treating cylinder. The water obtained during the period shall pass through a condenser and be collected in a receiver so that it can be weighed or measured. The light oils that evaporate from the preservative and collect on top of the water are drawn off and returned to the preservative tank. Such boiling is continued until the moisture content of the wood is low enough to allow proper treatment and meet the requirements of A.W.P.A. Standard C6 paragraph 3.1.4.

e. This method results in material having a steeper moisture gradient from the surface to a depth of 2 inches below the surface than is found in an air seasoned tie. It is not known whether this is a plus factor or a minus factor. The gradient does change to that of air seasoned material within a few months after treatment.

f. One benefit of Boulton Drying is that the material is heated to a temperature of 200 degrees F or more throughout the cross section before treatment. Thus, the preservative stays thin during the subsequent treatment and it is possible to obtain deeper penetration in less time than it is possible to obtain in air seasoned ties. This deeper penetration is not obtained however without using more preservative in the processing operation. Another benefit is that the 200 degrees F temperature sterilizes the wood. Any spore of a fungi that might be present is killed.

3.6.3.3 Steam Conditioning

As a conditioning process used prior to treatment, steam conditioning is limited to southern pine to be treated with creosote or the oil-borne preservatives, to conditioning western softwood species which are to be treated with one of the water-borne salt preservatives or for thawing ice coated or frozen material prior to treatment. The process does not reduce the moisture content

of material to a level below the fiber saturation point; thus checking of unseasoned but treated material will occur after processing rather than before.

3.6.4 PRESERVATIVES (2014)

3.6.4.1 Preservative Specifications

Specific requirements for the preservative treatment of cross ties and switch ties by pressure processes can be found in the American Wood Protection Association (AWPA) latest edition, Section A (Analysis Methods), U (Use Category), F (Conversion Factor and Correction Tables), M (Miscellaneous) and P (Preservatives) Standards.

The following AWPA Standards are incorporated by reference:

Use Category System Standards

U1: User Specification for Treated Wood, Commodity Specification C: Crossties and Switchties

T1: Processing and Treatment Standard, Section C: Crossties and Switchties

Preservative Standards

P1/P13: Standard for Creosote Preservative

P2: Standard for Creosote Solution

P3: Standard for Creosote-Petroleum Solution

P4: Standard for Petroleum Oil for Blending with Creosote

P5: Standard for Waterborne Preservatives

P8: Standard for Oil-Borne Preservatives

P9: Standards for Solvents and Formulations for Organic Preservative Systems

P18: Nonpressure Preservatives

P22: Standard for Ammoniacal Copper Zinc Arsenate (ACZA)

P23: Standard for Chromated Copper Arsenate Type C (CCA-C)

P25: Standard for Inorganic Boron (SBX)

P35: Standard for Pentachlorophenol (PCP)

P36: Standard for Copper Naphthenate (CuN)

Hydrocarbon Solvent Standards

HSA: Standard for Hydrocarbon Solvent, Type A

HSC: Standard for Hydrocarbon Solvent, Type C

HSF: Standard for Hydrocarbon Solvent, Type F

HSG: Standard for Hydrocarbon Solvent, Type G

Analysis Method Standards

A1: Standard Methods for Analysis of Creosote and Oil-Type Preservatives

A2: Standard Methods for Analysis of Waterborne Preservatives and Fire-Retardant Formulations

A3: Standard Methods for Determining the Penetration of Preservatives and Fire Retardants

A4: Standard Methods for Sampling Wood Preservatives

A5: Standard Methods for Analysis of Oil-Borne Preservatives

A6: Standard Method for the Determination of Retention of Oil-Type Preservatives from Small Samples

A7: Standard for Wet Ashing Procedures for Preparing Wood for Chemical Analysis

A9: Standard Method for Analysis of Treated Wood and Treating Solutions by X-Ray Spectroscopy

A12: Wood Densities for Preservative Retention Calculations

A13: Standard Method of Analysis for Acid Number of Naphthenic Acids in Copper Naphthenate

A14: Standard Method for Determination of Water-Extractable Copper in Copper Naphthenate

A15: Referee Methods

A19: Standard Method for Sample Preparation for Determining Penetration of Preservatives in Wood

A22: Standard Method for the Quantitative Determination of Creosote in AWPA P3 Creosote-Petroleum Oil Solutions

A35: The Determination of the Propensity of a Ready-To-Use Oilborne/Oil-Type Wood Preservative Treating Solution to Form Stable Emulsions

A40: Standard Methods for Determination of Boron Trioxide in Treating Solutions and Treated Wood by Potentiometric Titration with Sodium Hydroxide

A41: Standard Method for Determination of Naphthenic Acid in Copper Naphthenate in Wood and Treating Solutions by Gas Chromatography

A49: Standard for Determination of Heartwood in Pines and Douglas-fir

Miscellaneous Standards

M1: Standard for the Purchase of Treated Wood Products

M2: Standard for Inspection of Wood Products Treated with Preservatives

M3: Standard Quality Control Procedures for Wood Preserving Plants

M4: Standard for the Care of Preservative-Treated Wood Products

M6: Brands Used on Forest Products

M19: Standard for Destination Inspections

M22: Standard for Third-Party Agency Evaluation of Inspection Data

Volume and Specific Gravity Conversion Tables for Creosote and Creosote Solution

Abridged Volume and Specific Gravity Correction Tables for Petroleum Oils and Pentachlorophenol and Copper Naphthenate Solutions

Volumes of Round Forest Products

Volume Correction Table for Creosote-Petroleum Solutions

Miscellaneous Conversion Factors and Correction Tables

Crossties, Switchties in the AWPA Use category system are as follows:

USE	Exposure	Use Category	Commodity Section
General	Ground Contact or Fresh Water	4A	C
Important and/or High Decay	Ground Contact or Fresh Water	4B	C
Critical and/or Severe Decay	Ground Contact or Fresh Water	4C	C

UC4 GROUND CONTACT as defined in the AWPA Book of Standards

UC4A GROUND CONTACT General Use -- Wood and wood-based materials used in contact with the ground, freshwater, or other situations favorable to deterioration. Examples are fence posts, deck posts, guardrail posts, structural lumber, timbers and utility poles located in regions of low natural potential for wood decay and insect attack.

USE	Exposure	Use Category	Commodity Section
General	Ground Contact or Fresh Water	4A	C
Important and/or High Decay	Ground Contact or Fresh Water	4B	C
Critical and/or Severe Decay	Ground Contact or Fresh Water	4C	C

UC4B GROUND CONTACT Heavy Duty -- Wood and wood-based material used in contact with the ground, either in severe environments, such as horticultural sites, in climates with a high potential for deterioration, in critically important components such as utility poles, building poles and permanent wood foundations, and wood used in salt water splash zones. This category includes utility poles used in moist temperate climates.

UC4C GROUND CONTACT Extreme Duty -- Wood and wood-based materials used in contact with the ground, either in very severe environments or climates demonstrated to have extremely high potential for deterioration, in critical structural components such as land and fresh water piling and foundation piling, and utility poles located in semitropical or tropical environments.

3.6.4.2 Creosote

Creosote and creosote solutions are EPA-registered, restricted use pesticides used for the protection of wood ties as a primary protective treatment against the attack of the wood by decay organisms or termites. Creosote must meet the requirements of AWPA P1/P13 and the formulated creosote solutions must meet AWPA Standard P2 or P3.

3.6.4.3 Oil-Borne Preservatives

Copper naphthenate (CuN) is an EPA-registered, non-restricted use pesticide used for protection of wood ties as a primary protective treatment against the attack of the wood by decay organisms or termites. The solvent used with CuN is No. 2 fuel oil but other carriers meeting American Wood Protection Association (AWPA) Standard HSA can be used. Pentachlorophenol is an EPA-registered, restricted use oil soluble preservative. The solvent used with pentachlorophenol is a No. 2 fuel oil but other penta carriers meeting AWPA Standard HSA or HSG can be used. Copper naphthenate and Penta are not suitable preservatives for wood that may come in contact with marine waters.

3.6.4.4 Water-Borne Preservatives

a. Water-borne preservatives are used for protection of wood ties as either primary or ancillary protective treatment against the attack of the wood by decay organisms or termites.

b. Primary water-borne preservatives, CCA-C and ACZA are EPA-registered, restricted use pesticides generally used if a low odor, paintable, leach resistant product is desirable.

c. Ancillary waterborne preservatives such as Boron compounds (SBX) are EPA-registered, non-restricted use pesticides that do not provide long term protection in exterior applications. Water-borne ancillary wood preservatives shall be used in conjunction with primary wood preservatives, which may include a follow-up application of a primary preservative or added to a primary preservative to enhance protection of wood ties. Refer to AWPA Standard U1 specifications for dual treatment in conjunction with boron compounds.

3.6.4.5 Dual Treatments

Wood ties treated with certain boron compounds, in conjunction with other preservatives, are being used to prevent biological degradation from decay causing fungi and insect attack. There are various delivery methods, boron compounds and retention levels currently in use, and users should satisfy themselves that the product of their choice will meet their needs. The American Wood Protection Association (AWPA) standard covering dual treatment is in AWPA standard U1, Commodity Specification C: Crossties and Switchties.

3.6.5 TREATING PLANT EQUIPMENT (1985)

a. The combination of temperature and pressure used in treatment can result in damage to wood commodities. The lack of adequate vacuum can result in material having less than specified retention or penetration. Thus, thermometers, pressure gages, and vacuum gages must be tested at least annually and more often if there is any evidence of a malfunctioning instrument. Whenever a malfunction can not be corrected by simple adjustment, the instrument must be replaced promptly.

b. Similarly, the accuracy of working tank gages or track scales are important in maintaining the quality of treatment at a location. These, too, must be tested at least annually against a certified tank tape reading.

c. AWPA Standard M-3 "Standard Quality Control Procedures for Wood Preserving Plants" states the accuracy that should be expected from these instruments and gages. Purchasers are entitled to review the results of the periodic testing and/or retesting of instrument and gages to insure they have an accuracy in accordance with this standard.

3.6.6 INSPECTION OF TREATED TIMBER PRODUCTS (2002)

AWPA Standard M2, "Inspection of Treated Timber Products" has been written specifically to outline the authority and responsibility of the inspector employed by the railroad for the purpose of determining that material purchased by the railroad has been processed properly and that the resulting product will provide long service life.

3.6.7 CARE OF MATERIAL AFTER TREATMENT (2013)

Careless handling of wood after treatment is apt to expose areas not reached by the preservative. Thus, the use of pointed tools other than end hooks is objectionable.

a. If it is necessary to cut into treated wood the freshly cut surfaces should be further protected by a thorough application of preservative to the freshly cut surface. Further details on this can be found in AWPA Standard M4 - Care of Pressure Treated Wood Products of the Standard of the American Wood Protection Association.

b. Special attention is directed to Section 5 and 6 of this standard which deals with the precautions that should be taken after piles have been cut off to the design elevation and ties which are adzed and bored during the upgrading of a track construction.

3.6.8 USE OF TREATED WOOD (2014)

a. Chemically treated wood used by railroads has been preserved with EPA registered pesticides to protect it from insect attack and decay. Wood treated with these chemicals (creosote, pentachlorophenol, or inorganic arsenicals) should be used only where such protection is important and necessary.

b. These chemicals penetrate deeply into and remain in the treated wood for a long time. Exposure to these chemical compounds may present certain hazards. Therefore, the following precautions should be taken both when handling treated wood and in determining where to use treated wood.

c. Wood treated with CCA-C, ACZA or SBX may be used in interior places, such as residential wood foundations, industrial or commercial settings and farm buildings. Refer to the Preservative Treated Wood MSDS and Product label for additional limits on use site precautions.

3.6.8.1 Use Site Precautions

a. Wood treated with creosote or creosote solutions may only be used in interior places, such as industrial and commercial settings and farm buildings, if the interiors are well ventilated or an effective sealer is used. Refer to the Preservative Treated Wood MSDS and Product label for additional limits on use site precautions.

b. Wood treated with copper naphthenate or pentachlorophenol may only be used in interior places, such as industrial and commercial settings and farm buildings, if the interiors are well ventilated or an effective sealer is used. Refer to the Preservative Treated Wood MSDS and Product label for additional limits on use site precautions.

c. Wood treated with CCA-C, ACZA or SBX may be used in interior places, such as residential wood foundations, industrial or commercial settings and farm buildings. Refer to the Preservative Treated Wood MSDS and Product label for addtional limits on use site precautions.

3.6.8.2 Handling Precautions

a. Dispose of treated wood by ordinary trash collection or burial. Treated wood should not be burned in open fires or fireplaces. Treated wood may be burned for commercial or industrial applications in accordance with State and Federal regulations.

b. Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, wear a dust mask. Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood.

c. Avoid frequent or prolonged skin contact with pentachlorophenol or creosote-treated wood; when handling the treated wood, wear tightly woven coveralls and use gloves impervious to the chemicals (for example, gloves that are vinyl coated or made of rubber). When power-sawing and machining, wear goggles to protect eyes from flying particles. Wash thoroughly after skin contact, especially before eating, drinking or use of tobacco products. If oily pre-preservatives or sawdust accumulates on clothes, launder before reuse. Wash work clothes separately.

3.6.9 SPECIFIED REQUIREMENTS FOR PRESERVATIVE TREATMENT (2016)

Specified requirements for the preservative treatment of cross ties and switch ties by pressure processes can be found in the American Wood Preservers' Association (AWPA) Standard U1 Commodity Specification C: Cross Ties and Switch Ties.

SECTION 3.7 SPECIFICATIONS FOR TREATMENT[1]

3.7.1 GENERAL REQUIREMENTS (2013)

The following requirements apply to each of the treatment processes. If these requirements are to be modified to meet special conditions, complete detailed instructions shall be given.

3.7.1.1 Plant Equipment

Treating plants shall be equipped with the thermometers and gages necessary to indicate and record accurately the conditions at all stages of treatment, and all equipment shall be maintained in acceptable, proper working condition and meet the requirements of AWPA Standard M-3. The apparatus and chemicals necessary for making the analyses and tests required by the purchaser shall also be provided by plant operators, and kept in condition for use at all times.

3.7.1.2 Incising

When incising is specified, the material shall be incised prior to yarding and seasoning to reduce checking, or if dry prior to treatment on four sides, with incisor not more than 7/32 inch thick to the pattern shown in Figure 30-3-9. In pieces 5 inches or more thick, the incisions shall be 3/4 inch deep. In pieces less than 5 inches but more than 2 inches thick, they shall be 3/4 inch

[1] References, Vol. 21, 1920, pp. 328, 1385; Vol. 27, 1926, pp. 919, 965, 1414, 1415; Vol. 43, 1942, pp. 408, 463, 698; Vol. 54, 1953, pp. 708, 1361; Vol. 55, 1954, pp. 543, 1048; Vol. 57, 1956, pp. 445, 1020; Vol. 59, 1958, pp. 605, 1227; Vol. 62, 1961, pp. 503, 916; Vol. 63, 1962, pp. 322, 743; Vol. 67, 1966, pp. 179, 717; Vol. 69, 1968, p. 338; Vol. 75, 1974, p. 379; Vol. 92, 1991, p. 46; Vol. 96, p. 26.

deep in the edges but only 1/2 inch deep in the sides. Incising of pieces 2 inches and thinner is not recommended. Patterns slightly different are not objectionable if machines constructed prior to 1940 are used.

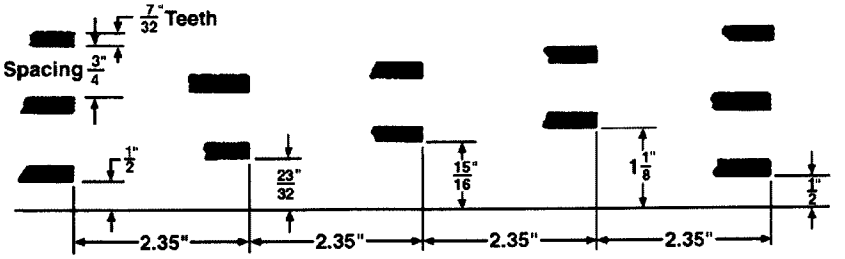

Figure 30-3-9. Incising Pattern

3.7.1.3 Conditioning

a. Material shall be conditioned by air-seasoning, by kiln drying, by steaming, or by heating in the preservative either under vacuum or at atmospheric pressure, or by a combination of them as agreed upon, in such a manner as will not cause damage for the use intended.

b. When air-seasoning is used, the material shall be treated before it begins to deteriorate.

c. When steam conditioning is used, the maximum temperature and the overall maximum duration of steaming shall be as prescribed for the species and type of material in the appropriate AWPA Commodity Standard. The maximum temperatures specified shall not be reached in less than 1 hour. Lower temperatures and shorter steaming periods may be used when agreed to by the purchaser.

d. The cylinder shall be provided with vents to relieve it of air and to insure proper distribution of steam. After steaming is completed, a vacuum of at least 22 inches at sea level shall be drawn.

e. The cylinder shall be relieved continuously or frequently enough to prevent condensate from accumulating in sufficient quantity to reach the wood. Before preservative is introduced the cylinder shall be drained of condensate.

f. When steaming is used solely to preheat the material prior to treatment, the vacuum period may be waived. Ice-coated or frozen material may be steamed prior to conditioning or treatment for a total period not to exceed 2 hours. The temperature shall not exceed 240 degrees F.

g. When conditioning by heating in oil is used, the oil shall cover the material in the cylinder. If a vacuum is drawn during the conditioning period, it shall be of sufficient intensity to evaporate water from the material at the temperature of the oil. The intensity of the vacuum, or the temperature of the oil, or both, shall be adjusted so as to regulate the evaporation of water satisfactorily. The conditioning shall continue until the material is sufficiently heated and enough water removed to permit proper penetration. The oil shall be removed from the cylinder before an empty-cell process is applied.

3.7.1.4 Machining

It is preferred that all adzing, boring, chamfering, framing, gaining, incising, surfacing and trimming be done prior to treatment.

3.7.1.5 Sorting and Spacing

Whenever it is practicable, the material in any charge shall consist of pieces similar in size, species, moisture content, and receptivity to treatment and so separated as to insure contact of treating medium with all surfaces.

3.7.2 TREATMENT (2013)

3.7.2.1 Creosote-Type Preservatives

3.7.2.1.1 Manner of Treatment

Following the conditioning period, the material shall be treated by an empty-cell process whenever practicable, to obtain as deep and uniform penetration as possible with the retention of preservative stipulated. Material shall be treated by the full-cell process only when the maximum net retention is desired and when pressure is held to refusal, or when the stipulated retention is greater than can be obtained by the use of an empty-cell process. The ranges of pressure, temperature and time duration shall be controlled so as to obtain maximum penetration with the quantity of preservative injected.

3.7.2.1.2 Empty-Cell–Lowry and Rueping[1]

a. Material shall be subjected to atmospheric air pressure or to a higher initial air pressure of the necessary intensity and duration. The preservative shall be introduced until the cylinder is filled, the air pressure being maintained constant during the filling operation. The pressure shall be raised to not more than that specified in the appropriate AWPA Commodity Standard. Material shall be held under pressure until there is obtained the largest practicable volumetric injection that can be reduced to the stipulated retention by ejection of surplus preservative from expansion of the air initially introduced and by a quick high vacuum.

b. The temperature of the preservative during the entire pressure period shall be not more than 210 degrees F, but shall average at least 180 degrees F.

c. After the pressure period is completed the cylinder shall be emptied speedily of preservative, and a vacuum of not less than 22 inches at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

d. An expansion bath may be applied after pressure of an oil treatment is completed and before removal of preservative from the cylinder, by quickly reheating the oil surrounding the material to the maximum temperature permitted by the individual species specification, either at atmospheric pressure or under vacuum, the steam to be turned off the heating coils immediately after the maximum temperature is reached. The cylinder shall then be emptied speedily of preservative and a vacuum of not less than 22 inches at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

e. At the completion of the treatment, material may be cleaned by final steaming as specified in the appropriate AWPA Commodity Standard for the individual type of material or species.

3.7.2.1.3 Full Cell–Bethel

a. Material shall be subjected to a vacuum of not less than 22 inches at sea level for not less than 30 minutes either before the cylinder is filled or during the period of heating in the preservative. If not already full, the cylinder shall then be filled without first breaking the vacuum. The pressure shall be raised to not more than that specified in the appropriate AWPA Commodity Standard. Material shall be held under pressure until there is obtained the volumetric injection that will insure the stipulated retention, or until the wood is treated to refusal.

b. The temperature of the preservative during the entire pressure period shall be not more than 210 degrees F, but shall average at least 180 degrees F.

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[1] If the cylinder is filled at atmospheric air pressure, the process is known as Lowry. If initial air pressure higher than atmospheric is used, the process is known as Rueping.

c. After pressure is completed, the cylinder shall be emptied speedily of preservative and a vacuum of not less than 22 inches at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

3.7.2.2 Water-Borne Preservatives

3.7.2.2.1 Manner of Treatment

a. Following the conditioning period[1], the material shall be treated by the full-cell process as described in Article 3.7.2.1.3. The treating solution shall be of uniform concentration and no stronger than necessary to obtain the required retention of dry salt preservative with the largest volumetric absorption practicable. The ranges of pressure, temperature and time duration shall be controlled so as to obtain the maximum penetration by the quantity of preservative injected.

b. The temperature of the preservative during the entire pressure period shall not be more than 160 degrees F in the case of chromated zinc chloride, or 120 degrees F for acid copper chromate.

3.7.2.3 Oil-Borne Preservatives

3.7.2.3.1 Manner of Treatment

a. Following the conditioning period[2], the material shall be treated by an empty-cell process as described in Article 3.7.2.1.2. whenever practicable, to obtain as deep and uniform a penetration as possible with the retention of preservative stipulated. Material shall be treated by the full-cell process as described in Article 3.7.2.1.3, only when the maximum net retention is desired and where pressure is held to refusal, or when the stipulated retention is greater than can be obtained by the use of an empty-cell process. The ranges of temperature, pressure and time duration shall be controlled so as to obtain maximum penetration with the quantity of preservative injected.

b. The temperature of the preservative during the entire pressure period shall not exceed the maximum temperatures but shall average at least the minimum temperature as shown in the appropriate AWPA Standards.

c. After pressure is completed, the cylinder shall be emptied of preservative solution and a vacuum of not less than 22 inches at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping solution.

d. An expansion bath may be applied after pressure of an oil treatment is completed and before removal of preservative from the cylinder, by quickly reheating the oil surrounding the material to the maximum temperature permitted by the individual species specification, either at atmospheric pressure or under vacuum, the steam to be turned off the heating coils immediately after the maximum temperature is reached. The cylinder shall then be emptied of preservative and a vacuum of not less than 22 inches at sea level created promptly and maintained until the wood can be removed from the cylinder free of dripping preservative.

e. At the completion of treatment by an empty-cell process material may be cleaned by final steaming as specified in the appropriate AWPA Standards for the individual type of material or species.

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[1] If the cylinder is filled at atmospheric air pressure, the process is known as Lowry. If initial air pressure higher than atmospheric is used, the process is known as Rueping.

[2] Heating in preservative is not practicable.

3.7.3 RESULTS OF TREATMENT (2013)

3.7.3.1 Retention of Preservative

a. The net retention in any charge shall be not less than 90% of the quantity of preservative that may be specified; but the average retention by the material treated under any contract or order and the average retention of any 5 consecutive charges shall be at least 100% of the quantity required, unless specified, and treated to refusal. The amount of preservative retained shall be calculated from reading of working-tank gages, or scales, or from weights before and after treatment of loaded trams on suitable track scales, with the necessary corrections for changes in moisture content, or by the assay method. Recommended minimum retentions for various materials for various uses are contained in the appropriate AWPA Commodity Standard.

b. The retention of oil-borne and water-borne preservatives shall be expressed in pounds of dry preservative per cubic foot. The volume and specific gravity correction tables of the AWPA F Standards shall be used in calculating retention.

c. The volume of oil-borne preservatives shall be calculated on the basis of 100 degrees F. Calculations of volume or weight shall be made by the use of temperature or specific gravity factors contained in the volume and specific gravity correction tables of the AWPA F Standards.

d. The amount of preservative retained shall be in accordance with the appropriate AWPA Standards, unless modified by the purchaser.

e. The penetration of preservative shall be as specified in the appropriate AWPA Standards.

3.7.3.2 Plugging Penetration Test Holes

All holes made for determining penetration of preservative shall be filled with tight-fitting treated plugs.

3.7.4 PRESERVATIVES (2014)

The preservative used shall be whichever of the following specifications is stipulated. See Article 3.6.4 of this Chapter for specific considerations.

3.7.4.1 Creosote-Type Preservatives

a. Creosote.

b. Creosote-Coal Tar Solutions[1].

c. Creosote-Petroleum Solutions[1].

3.7.4.2 Water-Borne Preservatives

a. Ammoniacal Copper Zinc Arsenate (ACZA).

b. Chromated Copper Arsenate (CCA-C).

c. Boron based preservatives (SBX).

d. Ammoniacal Copper Arsenate (ACA) removed due to reformulation to ACZA and no longer available.

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[1] Retention for creosote-coal tar and creosote-petroleum solutions are based on a 50 percent creosote solution.

3.7.4.3 Oil-Borne Preservatives

a. Copper Naphthenate.

b. Pentachlorophenol.

3.7.5 INSPECTION (2013)

Inspection for conformity to the requirements of this specification shall be as specified for the individual type of material or species as shown in the appropriate AWPA Standards and as specified in Article 3.7.5.1, Article 3.7.5.2 and Article 3.7.5.3.

3.7.5.1 Retention of Preservative

When maximum retention by full-cell process or treatment to refusal is specified, the pressure and temperature shall be maintained constant or increased within a range consistent with good practice for the material being treated until the quantity of preservative absorbed is not more than the following percentages of the amount already injected: All species except Douglas fir and oak–1/2% in any half hour; Douglas fir and oak–2% in each of any 2 consecutive half hours.

3.7.5.2 Penetration

After treatment, the inspector shall examine the charge and select representative material to be bored for determining penetration by the preservative. A boring shall be made by the inspector approximately midway between the ends of each selected piece, avoiding checks, knots, pitch pockets, shakes and splits, except in red oak longer than 9 feet, when the boring shall be approximately 4 feet from either end of the piece.

3.7.5.3 Measurement of Penetration

a. Except in the case of red oak, cores shall be split smoothly, lengthwise across the grain, and depth of penetration and thickness of sapwood measured to the nearest 1/10 inch. The depth of penetration shall be the distance from the outer end of the core to and including the summerwood of the innermost ring showing penetration in its summerwood, provided there are no untreated bands of one or more annual growth rings within the measured distance.

b. In the case of red oak, the number of annual growth rings in the core and the number of rings containing preservative shall be counted. The latter divided by the former will give the percentage of rings penetrated. When any ring appears on the core more than once, each appearance shall be counted. Preservative in any pore or vessel of any annual ring of the core shall class that ring as penetrated. In case of doubt, the questionable ring shall be cut crosswise through the springwood, and if any pore on the cut surface shows preservative for its length the ring shall be considered penetrated. The percentage of rings penetrated in any charge shall be determined by totaling the individual percentage and dividing their sum by the number of cores.

3.7.6 METHODS OF DETERMINING PENETRATION IN WOOD TREATED WITH PRESERVATIVES (2002)

3.7.6.1 General

a. Penetration in material treated with water-borne preservatives shall be determined in accordance with AWPA Standard A3, Standard Method for Determining Penetration of Preservatives.

b. The depth of penetration in gum lumber and ties shall be the sum of all treated sections appearing on the core.

3.7.7 RETREATMENT (1995)

3.7.7.1 General

Material not conforming to the stipulated minimum requirements may be reoffered for acceptance under the following conditions:

a. Material shall not be retreated more than twice.

b. When material is retreated in a charge with untreated material, the volume of the retreatable material shall not exceed 10% of the total volume of the charge, and in the computation of the required minimum net retention of preservative, all material in the charge shall be considered as untreated.

c. When a charge as a whole is retreated, the total retention as a result of all treatments shall be sufficient to satisfy the specified requirements for both net retention and penetration.

d. When a charge made up for pieces of insufficient penetration only is retreated, the amount of preservative injected during retreatment shall be sufficient to produce the required penetration.

3.7.8 SPECIFIC REQUIREMENTS FOR PRESERVATIVE TREATMENT BY PRESSURE PROCESS (2013)

Refer to the appropriate AWPA Standards for the specific requirements for preservative treatment by pressure processes. The complete list of applicable AWPA Standards is given in Article 3.6.4.1.

SECTION 3.8 RECOMMENDED PRACTICE FOR THE MANUFACTURE OF TWO-PIECE STEEL DOWELED LAMINATED CROSS TIES (TPSDLC)[1]

3.8.1 MATERIAL (1984)

3.8.1.1 Kinds of Wood

a. Before manufacturing TPSDLC's, producers shall ascertain which of the following kinds of wood suitable for cross ties will be accepted:

Ashes	Cypresses	Hemlocks	Oaks	Sycamores
Beech	Douglas Fir	Hickories	Pines	Walnuts
Birches	Elms	Larches	Poplars	
Catalpas	Firs (true)	Locusts	Redwoods	
Cedars	Gums	Maples	Sassafras	
Cherries	Hackberries	Mulberries	Spruces	

NOTE: All species listed are permitted unless the buyer specifies otherwise. Density requirements on conifers, if any, to be specified by the buyer. (In eastern production areas hardwoods are recommended and should be grouped as oak and mixed hardwoods.) Each component, half should be from the same species grouping, i.e. oak-oak and mixed hardwood-mixed hardwood.

[1] References, Vol. 85, 1984, p. 10.

b. Except as hereinafter provided, all pieces used to make up the TPSDLC's shall be free from any defects that may impair their strength or durability as TPSDLC components, such as decay, large splits, large shakes, large or numerous holes or knots, grain with slant greater than one in fifteen.

3.8.2 DESIGN (2011)

3.8.2.1 Dimensions

a. Before manufacturing TPSDLC's producers shall ascertain which of the following lengths, shapes, or sizes will be accepted.

b. Standard gage TPSDLC's shall be 8'-0", 8'-6", or 9'-0". The length to be specified by the buyer.

c. Except as hereinafter provided, TPSDLC's shall measure as follows throughout the rail bearing areas. The rail bearing areas as used here and hereafter are defined as those sections of the TPSDLC between 20 inches and 40 inches from its middle:

- Size 5 – 7" × 9", minimum 9 inch faces.

3.8.2.2 General Requirements

a. Except as hereinafter provided, all TPSDLC's shall be straight, well-manufactured, cut square at the ends, and have the bark entirely removed.

b. After doweling, all TPSDLC's shall be manufactured such that one 9 inch surface shall be flat, without offset between the two components. An offset of not more than 1/4 inch between the two components shall be permitted on the opposite surface.

3.8.2.3 Doweling

a. Dowels shall be steel, either three of four fluted, and shall be 1/2 inch in diameter with 3/8 inch root diameter. Dowel lengths used shall be 8: inches for 7" × 9" TPSDLC's.

b. Two dowels shall be required at a point 5 inches from either end and at the midpoint of every TPSDLC, regardless of its length, for a total of six dowels per tie. Dowel holes shall be 3/8 inch in diameter.

c. In a nominal 7 inch thick tie, the dowels will be inserted 4 inches apart, which will place them 1-1/2 inches ±1/8 inch from the top or bottom of the tie.

3.8.3 INSPECTION (1984)

3.8.3.1 Location

a. Each piece to be used in making up a TPSDLC shall be inspected before being doweled into place. These pieces will be inspected at suitable and convenient places, at point of shipment or at destination, as may be agreed between the supplier and the buyer.

b. Each completed TPSDLC will likewise be inspected at a suitable and convenient place, either at point of shipment or at destination, as may be agreed between the supplier and the buyer.

3.8.3.2 Tolerances

3.8.3.2.1 Decay

"Blue stain" is not decay and is permissible in any wood.

3.8.3.2.2 Holes

Within the rail bearing areas a large hole is one more than 1/2 inch in diameter and 3 inches deep, excepting one caused by "pipe or stump rot" in cedar. Outside the rail bearing areas a large hole is one having a diameter more than 1/4 inch the width of the surface on which it appears and a depth of more than 1-1/2 inches. Numerous holes are any number equaling a large hole in damaging effect. Such holes may be caused in manufacture or otherwise.

3.8.3.2.3 Knots

Within the rail bearing areas a large knot is one having an average diameter more than 1/3 inch the width of the surface of the component on which it appears; but such a knot will be allowed if it is located outside the rail bearing areas. Numerous knots are any number equaling a large knot in damaging effect.

3.8.3.2.4 Shakes

Shakes are acceptable provided largest dimension measuring length is not more than 1/3 of width and provided they do not extend nearer than 1 inch to any surface. The procedure illustrated in Figure 30-3-10 shall be used in determining the length of a shake.

3.8.3.2.5 Splits

a. A split is a separation of the wood extending from one surface to an opposite or adjacent surface. In a TPSDLC component, a split no more than 1/8 inch wide and/or 4 inches long is acceptable.

b. Anti-splitting devices will not be allowed on component pieces which have splits exceeding these limits. Such pieces are deemed unacceptable and shall not be used in manufacturing a TPSDLC.

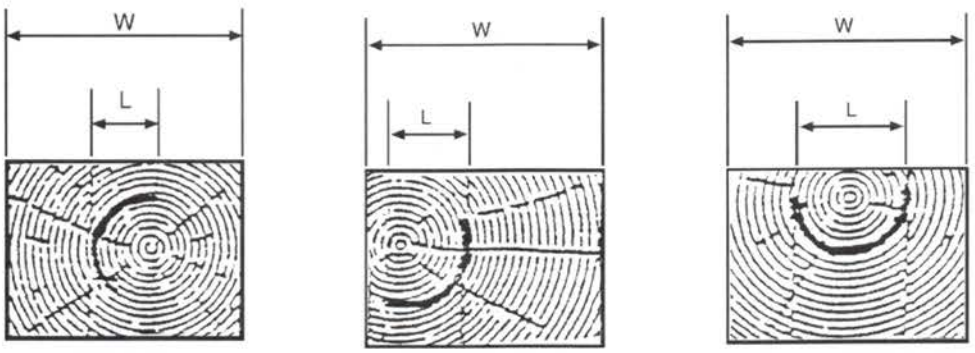

Figure 30-3-10. Determining the Length of Shake

3.8.3.3 Manufacture

3.8.3.3.1 General

a. All TPSDLC's will be manufactured from components cut from live trees. A component will be considered straight:

- when a straight line along the top from the middle of one end to the middle of the other end is everywhere at least 1 inch from the edge of the component, and
- when a straight line along a side from the middle of one end to the middle of the other end is everywhere more than 2 inches from the top and bottom of the component.

b. A TPSDLC is not well manufactured when its surfaces are cut into with score marks more than 1/2 inch deep.

c. The top and bottom of the TPSDLC will be considered parallel if any difference in the thickness at the sides or ends does not exceed 1/2 inch.

3.8.3.3.2 Dimensions

a. Specified dimensions for TPSDLC's apply to the unseasoned condition. Specified thickness and widths are considered to be met after conditioning if the TPSDLC's are not more than 1/4 inch thinner or narrower than the specified sizes. TPSDLC's over 1 inch thicker or wider than the specified sizes may be rejected. TPSDLC's over 2 inches longer or 1 inch shorter than the specified lengths may be rejected.

b. Minimum unseasoned component size shall be a full 4-1/2" × 7".

c. All thickness, width, and face dimensions, apply to the rail bearing areas of the TPSDLC. All determinations of the width will be made on top of the TPSDLC, which is the narrower of the horizontal surfaces, or the one with the narrower or no heartwood if both horizontal surfaces are of the same width.

d. Wane appearing anywhere along the joint between components is cause for reject. A maximum of 1 inch wane will be permitted on outside corners not within the rail bearing areas.

e. There must be a tight fit between components. Warp on only one component will be permitted provided it does not exceed 1/8 inch from a straight line after doweling.

3.8.4 DELIVERY (1984)

Place and manner of delivery to be as agreed between supplier and buyer.

3.8.5 SHIPMENT (1984)

Means and manner of shipment to be as agreed between supplier and buyer.

3.8.6 TIE PLATES (1984)

AREMA B punch plates are not recommended. Smooth-bottom plates only should be used with TPSDLC's.

SECTION 3.9 SPECIFICATIONS FOR TIMBER INDUSTRIAL GRADE CROSS TIES[1]

3.9.1 SPECIFICATIONS (2015)

3.9.1.1 Material

3.9.1.1.1 Kinds of Wood

Before manufacturing ties, producers shall ascertain which of the following kinds of wood suitable for cross ties will be accepted:

Ashes	Elms	Larches	Poplars
Beech	Firs (true)	Locusts	Redwoods
Birches	Gums	Maples	Sassafras
Catalpas	Hackberries	Mulberries	Spruces
Cherries	Hemlocks	Oaks	Sycamores
Douglas Fir	Hickories	Pines	Walnuts

3.9.1.2 General

All procedures regarding quality, manufacture, inspection, shipment, and delivery will comply fully with those specified for grade cross ties in Part 1, General Considerations unless excepted by information contained in this part.

3.9.1.3 Classification and Design

a. Refer to Table 30-3-2 for the allowable sizes, lengths, minimum faces and tolerances.

b. The above minimum face requirements apply to the rail-bearing areas, which are the areas between 20 inches and 40 inches from the middle of the industrial grade cross ties. Outside the rail-bearing areas, up to 5" of wane is allowed on each surface. The grade of each tie shall be determined at the point of most wane, on the top or bottom, within the rail-bearing areas. (The top is defined as the horizontal face farthest from the heartwood or pith center.)

c. Dry or treated ties may be 1 inch narrower or 1/2 inch thinner than the specified sizes. Thickness and width may not vary more than 1 inch from end to end. The tie body may be out of square by no more than 1 inch throughout the length. Tie length may vary from +6 inches to –6 inches for 9' and 8'6" ties, and +6" to -2" for 8' ties.

Table 30-3-2. Requirements for Cross Ties

Grade	Dimensions	Minimum Faces Allowed
6 inch IG	6" × 8" × 8'-0" / 8'-6"	6 inch face on top or bottom
7 inch IG	7" × 8" × 8'-0" / 8'-6"	6 inch face on top or bottom
7 inch IG	7" × 9" × 8'-0" / 8'-6"	6 inch face on top or bottom

[1] References, Vol. 94, p. 65.

3.9.1.4 Definitions of Defects

3.9.1.4.1 Wane

Wane is defined as bark or the lack of wood (see Article 3.9.1.3 for allowance).

3.9.1.4.2 Decay

Ties with decay greater than 1-1/2 inches in diameter within the rail bearing areas will be rejected. Slight incipient decay will be allowed if the tie as a whole is of good quality. Decay is allowed outside of the rail bearing areas if the decayed area does not exceed 3 inches in diameter. Ties with decay greater than 2 inches in diameter appearing in both ends of the tie will be rejected.

3.9.1.4.3 Holes

Ties having holes on any surface within the rail bearing areas greater than 1-1/2 inches in diameter or greater than 3 inches deep will be rejected. Ties with holes on any surface outside the rail bearing areas greater than 3 inches in diameter or deeper than 4 inches will be rejected. Numerous holes are any number equaling a large hole in damaging effect and will be cause for the tie to be rejected.

3.9.1.4.4 Knots

A knot greater than 3 inches in diameter within the rail-bearing area will not be permitted.

3.9.1.4.5 Shakes

Shake that is not more than 5 inches in length will be allowed. Shake may appear on one face or both ends as long as it does not run the entire length of the tie. Length measurments shall be made using Figure 30-3-10 as a guide. If end plates are used they must be mechanically applied to insure they are fully seated for maximum performance.

3.9.1.4.6 Splits

A split is a separation of wood extending from one surface to an opposite or adjacent surface-not counting the end as a surface. A seasoned or treated tie with a split greater than 1/2 inch wide or 11 inches long will be rejected unless a nail plate has been properly applied.

3.9.1.4.7 Checks

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 2 inches deep or 3/4 inch wide shall be rejected as industrial grade ties.

3.9.1.4.8 Cross or Spiral Grain

Except in species with interlocking grain, ties having cross, slant, or spiral grain greater than 2 inches in 15 inches of length will be rejected.

3.9.1.4.9 Bark Seams

Bark seams will not be acceptable if more than 2 inches deep or more than 10 inches long anywhere in the tie.

3.9.1.4.10 Manufacturing Defects

All ties must be straight and have top and bottom parallel. Any ties which do not meet the following characteristics of good manufacture will be rejected:

a. A tie will be considered straight when a straight line from a point on one end to a corresponding point on the other end is no more than 2 inches from the surface at all points.

b. The top and bottom of a tie will be considered parallel if any difference at the sides or ends does not exceed 1 inch.

c. A tie is not well-sawn when its surfaces are cut with scoremarks more than 1 inch deep.

d. For proper seating of nail plates, tie ends must be flat, and will be considered square with a sloped end of up to 1/2 inch, which equals a 1 in 20 cant. When nail plates are applied they must be fully seated and flush with the end surface. If corners of nail plates are exposed, they must be pounded flat over the corner of the tie to reduce the danger of injury to personnel handling the ties.

3.9.1.5 Delivery

3.9.1.5.1 On Railway Premises

Ties shall be delivered and stacked as specified in the purchase agreement of the railway. If ties are to be inspected, they must be placed so that all ties are accessible to the inspector.

3.9.1.5.2 Risk, Rejection

All ties are at the owners risk until accepted. All rejected ties shall be removed within one month after inspection.

3.9.1.6 SHIPMENT

Ties forwarded in cars or vessels shall be separated therein according to the above groups (Table 30-3-2), and also according to the above sets or lengths if inspected before loading, or as may be stipulated in the contract or order for them.