PETITION FOR DECLARATORY STATEMENT BEFORE THE FLORIDA BUILDING COMMISSION

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DS 2021-015

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Statute(s), Agency Rule(s), Agency Order(s) and/or Code Sections on which Declaratory Statement is sought:

FBC 2020, RESIDENTIAL, R317
FBC 2020, RESIDENTIAL, R318.1
FBC 2020, RESIDENTIAL, CHAPTER 46, REFERENCED STANDARDS, PART IX, AWPA
IBC 2018, RESIDENTIAL, R318.1 (unchanged in 2021 edition)

Background:

GFA International, Inc. is a full-service engineering firm providing engineering services including private provider plan review and inspection services pursuant to FS 553.791. GFA's private provider services include plan review and inspections of the installation of on-frame modular homes ("modular homes") pursuant to FBC Section 458 and Chapter 1 of the FBC as it relates to Section 458. Additionally, since the manufactured home is being used as a residential occupancy, it is classified as a one-two family dwelling. Therefore, the installation of the manufactured buildings and construction activities conducted at the site of the installation shall by conducted pursuant to the Florida Building Code, Residential.

More specifically, GFA regularly reviews plans for modular homes throughout Florida. These modular homes are fabricated off-site at the manufacture's facility under the requirements of FBC 458. The modular homes are transported to a site and supported by various foundation systems consisting of concrete, masonry, and wood. The frames are typically specified to be a minimum of 18" above the ground surface.

GFA believes the Code requirements are ambiguous and is seeking clarifications on certain sections of the FBC-R concerning treatment of building components and surroundings which are intended to prevent decay and termite infestation/damage. GFA seeks clarification concerning the intended application of different methods of wood and soil treatment required by the FBC-R. Specifically, the wood treatment protection requirements set forth in Section R317 and termite protection requirements set forth in Section R318 **as they relate to the installation of manufactured homes.**

GFA seeks these clarifications to insure GFA is performing private provider plan review and inspection services in compliance with the intent of the FBC. GFA also seeks clarification of the applicability of the codes to insure the applicable codes are uniformly interpreted and enforced for purposes of consumer protection. GFA seeks these clarifications as a "substantially affected person" under the procedures set forth in Section 553.775, Florida Statutes.[1]

GFA understands the extensive work of the Commission in developing codes for greater safety and improvements for the benefit of the consumer and public generally. GFA's Petition for Declaratory Statement furthers the Commission's work by insuring consistent and uniform application of the codes.

Section Cites

Section R317 - PROTECTION OF WOOD AND WOOD-BASED PRODUCTS AGAINST DECAY

R317.1 Location required.
Protection of wood and wood-based products from decay shall be provided in the following locations by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 for the species, product, preservative, and end use. Preservatives shall be listed in Section 4 of AWPA U1.

[1] It is the intent of the Legislature that the Florida Building Code and the Florida Accessibility Code for Building Construction be interpreted by building officials, local enforcement agencies, and the commission in a manner that protects the public safety, health, and welfare at the most reasonable cost to the consumer by ensuring uniform interpretations throughout the state and by providing processes for resolving disputes regarding interpretations of the Florida Building Code and the Florida Accessibility Code for Building Construction which are just and expeditious. §553.775 (1), Fla. Stat. 2020.

1. Wood joists or the bottom of a wood structural floor when closer than 18 inches (457 mm) or wood girders when closer than 12 inches (305 mm) to the exposed ground in crawl spaces or unexcavated area located within the periphery of the building foundation.
2. Wood framing members that rest on concrete or masonry exterior foundation walls and are less than 8 inches (203 mm) from the exposed ground.
3. Sills and sleepers on a concrete or masonry slab that is in direct contact with the ground unless separated from such slab by an impervious moisture barrier.
4. The ends of wood girders entering exterior masonry or concrete walls having clearances of less than $^1/_2$ inch (12.7 mm) on tops, sides and ends.
5. Wood siding, sheathing and wall framing on the exterior of a building having a clearance of less than 6 inches (152 mm) from the ground or less than 2 inches (51 mm) measured vertically from concrete steps, porch slabs, patio slabs and similar horizontal surfaces exposed to the weather.
6. Wood structural members supporting moisture-permeable floors or roofs that are exposed to the weather, such as concrete or masonry slabs, unless separated from such floors or roofs by an impervious moisture barrier.
7. Wood furring strips or other wood framing members attached directly to the interior of exterior masonry walls or concrete walls below *grade* except where an *approved* vapor retarder is applied between the wall and the furring strips or framing members.

R317.2 Quality mark.
Lumber and plywood required to be pressure-preservative treated in accordance with Section R317.1 shall bear the quality *mark* of an *approved* inspection agency that maintains continuing supervision, testing and inspection over the quality of the product and that has been *approved* by an accreditation body that complies with the requirements of the American Lumber Standard Committee treated wood program.

R317.2.1 Required information.
The required quality *mark* on each piece of pressure-preservative-treated lumber or plywood shall contain the following information:
1. Identification of the treating plant.
2. Type of preservative.
3. The minimum preservative retention.
4. End use for which the product was treated.
5. Standard to which the product was treated.
6. Identity of the *approved* inspection agency.
7. The designation "Dry," if applicable.

<u>SECTION 318 Termite Protection</u>

R318.1 Termite protection.
Termite protection shall be provided by registered termiticides, including soil applied pesticides, baiting systems, and pesticides applied to wood, or other approved methods of termite protection labeled for use as a preventative treatment to new construction. See Section 202, "Registered termiticide." Upon completion of the application of the termite protective treatment, a Certificate of Compliance shall be issued to the building department by the licensed pest control company that contains the following statement: "The building has

received a complete treatment for the prevention of subterranean termites. Treatment is in accordance with rules and laws established by the Florida Department of Agriculture and Consumer Services."

R318.1.1
If soil treatment is used for subterranean termite prevention, the initial chemical soil treatment inside the foundation perimeter shall be done after all excavation, backfilling and compaction is complete.

R318.1.2
If soil treatment is used for subterranean termite prevention, soil area disturbed after initial chemical soil treatment shall be retreated with a chemical soil treatment, including spaces boxed or formed.

R318.1.3
If soil treatment is used for subterranean termite prevention, space in concrete floors boxed out or formed for the subsequent installation of plumbing traps, drains or any other purpose shall be created by using plastic or metal permanently placed forms of sufficient depth to eliminate any planned soil disturbance after initial chemical soil treatment.

R318.1.4
If soil treatment is used for subterranean termite prevention, chemically treated soil shall be protected with a minimum 6 mil vapor retarder to protect against rainfall dilution. If rainfall occurs before vapor retarder placement, retreatment is required. Any work, including placement of reinforcing steel, done after chemical treatment until the concrete floor is poured, shall be done in such manner as to avoid penetrating or disturbing treated soil.

R318.1.5
If soil treatment is used for subterranean termite prevention, concrete overpour or mortar accumulated along the exterior foundation perimeter shall be removed prior to exterior chemical soil treatment, to enhance vertical penetration of the chemicals.

R318.1.6
If soil treatment is used for subterranean termite prevention, chemical soil treatments shall also be applied under all exterior concrete or grade within 1 foot (305 mm) of the primary structure sidewalls. Also, a vertical chemical barrier shall be applied promptly after construction is completed, including initial landscaping and irrigation/sprinkler installation. Any soil disturbed after the chemical vertical barrier is applied shall be promptly retreated.

R318.1.7
If a registered termiticide formulated and registered as a bait system is used for subterranean termite prevention, Sections R318.1.1 through R318.1.6 do not apply; however, a signed contract assuring the installation, maintenance and monitoring of the baiting system that is in compliance with the requirements of Chapter 482, Florida Statutes shall be provided to the building official prior to the pouring of the slab, and the system must be installed prior to final building approval.
If the baiting system directions for use require a monitoring phase prior to installation of the pesticide active ingredient, the installation of the monitoring phase components shall be deemed to constitute installation of the system.

R318.1.8
If a registered termiticide formulated and registered as a wood treatment is used for subterranean termite prevention, Sections R318.1.1 through R318.1.6 do not apply.

Application of the wood treatment termiticide shall be as required by label directions for use and must be completed prior to final building approval.

FBC 2020, RESIDENTIAL, CHAPTER 46, REFERENCED STANDARDs, PART IX

AWPA

American Wood Protection Association, P.O. Box 361784BirminghamAL35236-1784

C1—03 - All Timber Products—Preservative Treatment by Pressure Processes, R902.2
M4—16 - Standard for the Care of Preservative-treated Wood Products, R317.1.1
U1—16* - USE CATEGORY SYSTEM: User Specification for Treated Wood Except Commodity Specification H, R317.1, R402.1.2, R504.3, R703.6.3, Table R905.8.5

IBC 2018, RESIDENTIAL, R318.1 (unchanged in 2021 edition)
SECTION R318
PROTECTION AGAINST
SUBTERRANEAN TERMITES

R318.1 Subterranean termite control methods.
In areas subject to damage from termites as indicated by Table R301.2(1), protection shall be by one, or a combination, of the following methods:

1. Chemical termiticide treatment in accordance with Section R318.2.
2. Termite-baiting system installed and maintained in accordance with the *label.*
3. **Pressure-preservative-treated wood in accordance with the provisions of Section R317 .1.**
4. Naturally durable termite-resistant wood.
5. Physical barriers in accordance with Section R318.3 and used in locations as specified in Section R317.1.
6. Cold-formed steel framing in accordance with Sections R505.2.1 and R603.2.1.

<u>Projects</u>

As noted above, GFA International, Inc. provides engineering services including private provider plan review and inspection services pursuant to FS 553.791. Project #1, detailed below, is a manufactured home project that GFA International, Inc. is expected to review for compliance with the 2020 Florida Building Code – Residential.

GFA's scope of services will encompass review of the wood components to be used/installed in Project # 1 for compliance with the aforementioned code provisions concerning protection against subterranean termites. More specifically, GFA is expected to review wood components in the locations required by Section R317.1.1 through R317.1.7 (collectively, "***Required Locations***"). GFA's review is intended to verify that the wood components in Required

Locations comply with termite treatment requirements set forth in the aforementioned code provisions.

Project #1: A 26' by 48' modular home will be transported to a prepared site and supported on CMU Blocks which will be supported on ABS Pads. The frame of the modular home is specified to be a minimum of 18" above the ground surface. A 10"x16" perimeter footing is specified around the perimeter of the modular homes to act as the ground anchor for the unit tie-downs. A perimeter wall skirt is specified to be attached to the perimeter footing and the underside of the modular home frame. All wood shims, skirt wall framing, and sheathing in the ***Required Locations*** are naturally durable or preservative treated (P.T.) wood. **(SEE FIGURE 1)**

Question 1: As it pertains to the modular home described in Project #1, do the locations set forth in R317.1.1 through R317.1.7 ("Required Locations") encompass all locations requiring wood treatment as contemplated by Section 318.1.8?

Question 2: As it pertains to the modular home described in Project #1, if the wood in locations set forth in R317.1.1 through R317.1.7 ("Required Locations") is treated in accordance with Section R318.1.8, is soil applied pesticides OR baiting systems in accordance with R318.1.1 through R318.1.7 required?

Question 3: R317 requires protection of wood and wood-based products from decay in the locations specified in R317.1.1 to R317.1.7 by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 for the species, product, preservative, and end use. Wood which is preservative-treated in accordance with AWPA U1 provides termite protection labeled for use as a preventative treatment. Is the use of preservative treated wood in accordance with the provisions of Section R317.1 an approved method of subterranean termite control?

Summary Position

Position as to Question 1:

It is GFA's position that the code is vague and ambiguous regarding **the locations to which** the wood treatment is to be applied. It is GFA's position that if a registered termiticide formulated and registered as a wood treatment is selected as the method for subterranean termite prevention in accordance with R318.1.8, then **only** the wood located in areas required by Sections R317.1.1 through R317.1.7 must be treated ("***Required Locations***").

Position as to Question 2:

It is GFA's position that R318.1.8 is very clear in that if a registered termiticide formulated and registered as a wood treatment is used for subterranean termite prevention, the

Sections R318.1.1 through R318.1.6 DO NOT APPLY. In other words, soil applied pesticides OR baiting systems in accordance with R318.1.1 through R318.1.7 ARE NOT required.

In other words, wood treatment is an approved **stand-alone** method of subterranean termite prevention. This is further supported by the Florida Department of Agriculture and Consumer Services FAQ's web link at https://www.fdacs.gov/content/download/21893/file/AREA%202%20--%20Termite%20Protection%20in%20Buildings.pdf **(ATTACHMENT 2),** which states:

> ***24. Are wood treatments such as borates allowable as stand-alone treatments for new construction?***
> *Currently there is one product registered as a preventive treatment for new construction as a direct treatment to wood. This product is a borate containing insecticide. As a registered pesticide, this material may legally be used as a stand-alone preventive treatment.*

Position as to Question 3:

R317 requires protection of wood and wood-based products from decay in the locations specified in R317.1.1 to R317.1.7 by the use of naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 for the species, product, preservative, and end use. It is GFA's position that wood that is preservative-treated in accordance with AWPA U1 not only provides protection against decay but also provides protection against subterranean termite protection (**ATTACHMENT 3**).

This is clearly illustrated in Section R318.1 of the *International Residential Code* which allows the use of pressure-preservative treated wood in accordance with the requirements of R317.1 as a single means of termite protection:

> R318.1 Subterranean termite control methods.
> In areas subject to damage from termites as indicated by Table R301.2(1), protection shall be by **one**, or a combination, of the following methods:
>
> 1. Chemical termiticide treatment in accordance with Section R318.2.
> 2. Termite-baiting system installed and maintained in accordance with the *label.*
> 3. **Pressure-preservative-treated wood in accordance with the provisions of Section R317.1.**
> 4. Naturally durable termite-resistant wood.
> 5. Physical barriers in accordance with Section R318.3 and used in locations as specified in Section R317.1.
> 6. Cold-formed steel framing in accordance with Sections R505.2.1 and R603.2.1 .

It is also GFA's position that naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 is better than wood treated with a registered termiticide. As noted in the University of Florida's publication #P1276, "Wood Preservatives" **(ATTACHMENT 4)**. *Borate wood preservatives have been used to treat wood for interior construction including* *joists, sheathing, sill plates, and other uses for over 70 years.* ***Borates leach readily from treated wood; therefore, the treated wood is suited for use only above ground and where it can be protected from wetting.*** The only registered termiticide approved for wood treatment in Florida is a borate. Therefore, it is GFA's position that providing naturally durable wood or wood that is preservative-treated in accordance with AWPA U1 **provides greater protection** against subterranean termites than wood treated with a registered termiticide and should be allowed as a stand-alone method of protection against subterranean termites in accordance with R318.1.8.

In addition, R202 defines **[RB]TERMITE-RESISTANT MATERIAL** as **"*Pressure-preservative-treated wood in accordance with the AWPA standards in Section R317.1*,** *naturally durable termite-resistant wood, steel, concrete, masonry or other approved material"*.

The US Department of Agriculture's publication "Guidelines for Selection and Use of Pressure Treated Wood" **(ATTACHMENT 5)** further emphasizes the use of pressure-preservative treated wood for termite protection.:

> *"Wood is a versatile and sustainable building material but may be vulnerable to fungal decay and insect damage when used outdoors or otherwise subjected to moisture. Pressure treatment with wood preservatives is the most common method of protecting wood from biological deterioration".*
>
> *"Structural infestations of drywood termites occur in Hawaii and across the most southern states of the United States from coastal regions of southern California through Texas and Florida. In regions with a particularly severe termite hazard, using pressure-treated lumber for interior construction is at least advisable and in some cases may be required by building codes".*
>
> *"In structures complying with building codes, use of a preservative-treated or naturally durable wood is required for some members. Examples include joists within 18 in. of the soil beneath a structure, sill plates, and posts or columns resting on concrete".*

DATE: March 24, 2021

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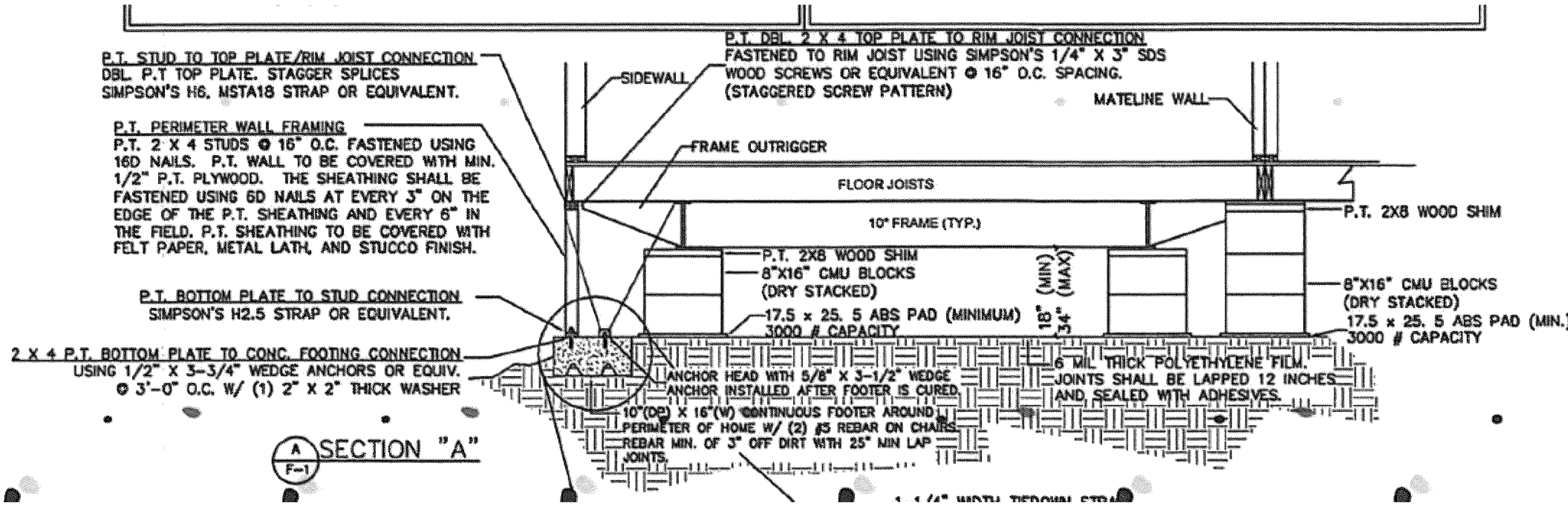
ATTACHMENT 1



ATTACHMENT 2

TERMITE PROTECTION IN BUILDINGS

Protection of homes and businesses from termites in Florida requires the combined efforts of builders, pest management professionals, and building inspectors. The Florida Building Code contains provisions that prevent certain building practices that make buildings more vulnerable to termite invasion, other practices that protect the measures applied by pest control companies, and other practices that ensure that the building owners get the information they need to continue to protect their structures from termites.

Building Inspectors have a critical role in protecting structures from termites. Unless the provisions of the code are complied with, building owners will face expensive termite control and damage repair costs over the life of the structure.

Termite Protection Provisions of the Code are found in the following code sections:

104.2.6 Certificate of Protective Treatment for Prevention of Termites requires posting of applications - No "final approval" if all the applications not made, including vertical barriers

104.2.7 Notice of Termite Protection requires posting of consumer notice inside the house - will inform owner of the need to renew his contract and inspect annually

1403.1.6 **Veneered Walls.** Require at least a 6 inch space between the grade and siding for termite inspection.

1503.4.4 **Roof Assemblies**. Protection against decay and termites requires discharge lines and gutter downspouts to terminate at least one foot from the foundation.

1816.1- 1816.2 **Foundations and Retaining Walls** - Termite protection requires foundations to have some form of protection from termites ("labeled for use as a preventative treatment to new construction"). If soil treatment is used, it must be done after compaction. Disturbed areas must be re-treated. Forms and traps must be plastic or metal. A vapor barrier must be installed. Concrete overpour must be removed. Applications must also be made within one foot of the foundation under adjoining slabs. Protective sleeves around slab penetrations must not be cellulose. Protective sleeves around slab penetrations must not be cellulose.

2116. **Masonry** - Termite Inspection (Cleaning) Cells in blocks must not contain cellulosic debris. Concrete Bearing Ledge Brick veneers must be on an integral ledge or a soil treatment must be made

2301.4.6 Preservative treated wood must meet a standard.

2303.1 **Wood Construction** Practices. Sites must be graded to provide drainage. Cellulose debris must be removed from the foundation. Wooden grade stakes, form boards, etc. must be removed. No cellulose material can be buried within 15 feet of the foundation.

2304 **Wood Construction** - Protection against decay and termites requires preservative or naturally decaying resistant wood in certain areas. Clearance between wood siding and the ground must be 6 inches. Decks fences and patios must have an inspection clearance or be built to allow inspection for termites.

2603.3 **Foam Plastic Insulation**. Plastic foam insulation cannot be installed below grade. A 6 inch clearance is required between foam plastic insulation on the exterior of buildings and earth grade.

ATTACHMENT 2

Frequently asked questions:

1. Can I use the baiting system for termite prevention?

Section 1816.1 of the Code states that termite preventive treatments can be provided by soil applied insecticides, termite bait systems, and wood treatments. DCA 03 - DEC-222, also addresses baiting systems.

2. With regard to termite bait systems, when does the clock start for the five years for the contract/monitoring?

Chapter 482, Florida Statutes, requires that pest control licensees provide a contract to property owners for which preventive treatment for termites is provided. This contract must include a warranty for retreatment only or for retreatment and damage repair for one year with the option for automatic renewal for up to four additional years upon the payment of an annual renewal fee, with no increase in the renewal fee for the first four renewals per the contract. An increase in renewal fee is allowed if the contract specifies that the fee may be increased. The time period begins with the effective date of the contract, typically the date the treatment is performed.

3. What happens if a contract for maintenance and monitoring is terminated after the CO is issued, but prior to the conclusion of the required five years?

If the property owner does not choose to pay for the renewal of the termite protection contract, the pest control licensee is not obligated to renew the contract. The pest control licensee must renew the contract if the annual renewal fee is paid. This applies to all types of preventive treatment.

4. Is a termite baiting system which consists of monitoring stations containing wooden stakes an acceptable product for use in new construction for the purpose of protecting new homes from termites?

Preventive treatment must be provided by a registered termiticide or alternative means approved by building officials (Section 1816.1) A termite bait system registered as a pesticide for the preventive treatment for new construction will consist of more than wooden stakes, but will also include a pesticide active ingredient. The system will also have to meet the performance standards established in Chapter 5E-2.0311, FAC to be eligible for registration. Some registered termite bait systems include a component for monitoring that consist of wooden stakes or equivalent. Provided that these are used in a manner that is consistent with the directions for use of the registered termite baiting system, they are part of the protection system for the structure.

5. When a baiting system is used, at what time would application of a pesticide be required?

Some baiting systems registered as preventive treatments for new construction contain the pesticide active ingredient as part of the initial installation, others require installation of the active ingredient after termite activity is detected. The time of installation of the active ingredient is specified in the directions for use on the label of the pesticide.

6. What type of termite protection products/systems are required by the code?

The Code requires that termite protection be provided by a registered termiticide, including soil applied termiticides, bait systems, or pesticides labeled for direct application to wood, or an alternative method approved by the building official. All three kinds of products are registered in Florida.

7. Does the code require treatment of ground for structures which will not have wood products in it; e.g. preengineered metal buildings, or aluminum buildings?

The code requires preventive treatment for any structure with a foundation. Termite infestations occur in any structure that contains cellulose, and even metal buildings will contain cellulose in the form of wood finishing and furnishings, stored paper or other cellulose articles, etc.

8. What is the minimum clearance between exterior wall coverings and final earth grade on the exterior of a building in order to provide for inspection for termite infestation?

Section 1403.1.6 requires a minimum of six inches clearance to allow for detection of termite foraging and mud tubes entering a structure. If this gap is not provided, termite infestation may occur undetected.

9. How far should condensate lines and roof downspouts discharge from a structure's sidewall, to prevent decay and termites?

Section - 1503.4.4 of the Code requires a discharge at least 12 inches from the foundation. This will aid in minimizing moisture at the foundation which is conducive to termite infestation.

10. Is termite treatment required when Foam plastic insulation is installed below grade on foundation walls?

Section - 2603.3.1 of the Code prohibits installation of foam plastic below grade on foundation walls with certain exceptions. Installation of foam plastic insulation below grade creates an avenue for termite infestation and can defeat termite preventive measures.

11. At what stage of construction should soil treatment for subterranean termite prevention, be applied?

The application of soil applied insecticides for preventive treatment of new construction depends on the creation of a treated zone under and around the foundation of a structure. This is accomplished by three stages of application - to the compacted soil of a foundation prior to the pouring of a slab, along both sides of stem walls, under adjoining slabs, and along the exterior of the foundation when construction is completed. This final application has to be accomplished prior to the issuance of the certificate of occupancy.

12. If the soil is disturbed after initial chemical soil treatment, is there a requirement to re-treat?

Section 1816 of the Code, requires this to be done.

13. Who is responsible to retreat when soil is disturbed, the contractor or the pest control company?

In order to be in compliance with the Code, the contractor should contact the pest control company to conduct a retreatment.

14. Is a vapor retarder required to protect the treated soil against rainfall dilution?

Installation of a vapor barrier is a requirement of the label directions of soil applied insecticides when applied prior to the pouring of concrete slabs. The vapor barrier also protects flooring from sub-slab moisture penetration.

15. The code requires a protective sleeve around metallic piping penetrating concrete slab-on-grade floors when soil treatment is used for subterranean termite protection. Is the annular space between protective sleeve and pipe required to be treated?

Treatment of the annular space is a requirement by Section 1816.2 of the code. It is necessary to prevent termites from breaching the treated soil zone under a slab when the soil treatment is the preventive method used.

16. What is the minimum required clearance between the ground and insulated concrete forms.

Section - 1916.7.5.1 requires clearance between earth and insulated concrete forms (ICF) to be not less than 6 inches.

17. What is the role of the Department of Agriculture relative to termite protection?

ATTACHMENT 2

The Department of Agriculture and Consumer Services licenses and inspects pest control companies and registers the pesticides used for preventive treatment for new construction.

18. Are products for termite protection required to be approved? If so, who is responsible for the approval?

The products used for this purpose are pesticides, and are not "approved" as such, but are either eligible for registration or not eligible. Pesticides that include directions for use as preventive treatments for new construction can be registered if they meet the requirements of Chapter 5E-2.0311, Florida Administrative Code. This rule is administered by the Florida Department of Agriculture and Consumer Services. A list of pesticides registered as preventive treatment for new construction can be accessed at www.flaes.org.

19. What are the Statutes and Rule (FAC) that governs termite protection?

Chapter 482, Florida Statutes and Chapter 5E-14, Florida Administrative Code, govern structural pest control in Florida. The Bureau of Entomology and Pest Control of the Department of Agriculture and Consumer Services is the regulatory body responsible for administering this statute and rule.

20. When is a vertical treatment required and what are the specifications relative to the distance from the perimeter of the building?

Vertical treatment is the application of a soil applied termiticide to the soil around the exterior of a foundation. The specifications for this application are included in the directions for application on the label of the pesticide. Typically the directions are for an application of four gallons of insecticide mixture per ten linear feet of foundation, immediately adjacent to the foundation.

21. What is the responsibility of local building departments relative to the inspection of the termite system and what specific things should they inspect?

Termite bait systems are registered pesticides and contain label directions that include inspection intervals. It is the responsibility of the licensed pest control operator to follow label directions in the use of these pesticides. Section 105.11 of the Code requires that building components and surroundings required by the Code to be protected from termite damage must not be covered or concealed until approved by the building official. Questions regarding compliance with label directions for use by the pest control operator should be directed to the Florida Department of Agriculture and Consumer Services Bureau of Entomology and Pest Control at 850-617-7997.

22. Should inspections be made per manufacturer's requirements or as required based on the approval of the system?

Termite bait systems are registered pesticides and contain label directions that include inspection intervals. It is the responsibility of the licensed pest control operator to follow label directions in the use of these pesticides. Where the Code does not provided specific installation instructions for the termite protection system, inspection by the building official must be in accordance with system approval. For all bait systems currently registered, a single inspection by the building official when construction is completed should be sufficient to verify that the system has been installed.

23. Is a license required to apply pesticides, and if so, would that include a contractors license?

The application of pesticides (including use of termite bait systems) as preventive treatment of new construction is considered pest control. In Florida, a license from the Florida Department of Agriculture and Consumer Services is required to perform pest control on property other than your own. Performing pest control without a valid license is illegal.

24. Are wood treatments such as borates allowable as stand alone treatments for new construction?

Currently there is one product registered as a preventive treatment for new construction as a direct treatment to wood. This product is a borate containing insecticide. As a registered pesticide, this material may legally be used as a stand alone preventive treatment.

25. What should the building official do if the Certificate of Protective Treatment for Prevention of Termites has not been provided by the pest control operator but the final inspection has been completed and passed?

The Certificate of Protective Treatment for Prevention of Termites must be provided prior to the issuance of the Certificate of Occupancy as per Section 104.2.6 of the code.

More information on the Termite Provisions of the Building Code is available from the following sources:

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Planning Manager, CBO
2555 Shumard Oak Boulevard
Tallahassee, Florida 32399-2100
850-487-1824
www.floridabuilding.org

Steven Dwinell
Assistant Director
Division of Agricultural Environmental Services
Florida Department of Agriculture and Consumer Services
3125 Conner Boulevard
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Tel: (352) 392-2484

ATTACHMENT 3

U1-20 AMERICAN WOOD PROTECTION ASSOCIATION **STANDARD**

USE CATEGORY SYSTEM: USER SPECIFICATION FOR TREATED WOOD

Adopted: 1999

Revised: 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020

SECTION 1: INTRODUCTION TO THE USE CATEGORY SYSTEM (INFORMATIVE)

Jurisdiction: AWPA Technical Committee T-1

The Use Category System (UCS) of the American Wood Protection Association (AWPA) designates what preservative systems and retentions have been determined to be effective in protecting wood products under specified exposure conditions. The strength of the UCS and its focus is that all wood uses can be placed into one of five major Use Categories that clearly describe the exposure conditions that specific wood products can be subjected to in service. The major Use Categories are further broken down into sub-categories to define the associated degree of biodegradation hazard and product service life expectations for specific products and exposure conditions. In addition to the five Use Categories for biodeterioration, there is a sixth and separate Use Category for fire retardant applications. The Use Category designations are described in detail in Section 2 below. The Use Category system is designed to help specifiers and product users locate the appropriate AWPA Standards that specifies preservatives deemed acceptable for specific products and end-use environments. The user of the AWPA Standard U1 should first become familiar with the major differences between the Use Categories and the expected service conditions as described in Section 2. This information is then used in conjunction with Section 3: Guide to Treated Wood End Uses to determine the specific commodity specification of the standard that lists the appropriate preservative requirements for that use. When purchasing under the Use Category System, material orders should include the specific commodity, Use Category designation, Standard U1 Commodity Specification, wood species, preservative and any special requirements such as pre- or post-treatment preparations (including conditioning and drying). Wherever practicable, material should be manufactured in its final form prior to treatment to eliminate the necessity for subsequent cutting or boring of the treated wood. Risk assessment documents and models (e.g., Best Management Practices) have been developed by the Western Wood Preservers Institute (www.wwpinstitute.org) for the use of CCA, ACZA, Creosote, Pentachlorophenol and ACQ treated wood in aquatic environments. Projects calling for large volumes of treated wood immersed in (i.e., below the splash zone) poorly circulating bodies of water should be evaluated on an individual basis using risk assessment procedures. There are a number of other AWPA Standards that complement Standard U1 for wood treated with preservative systems. These include:

Standard T1: Use Category System: Processing and Treatment Standard, that governs the preservative retention and penetration requirements, processing limitations, quality control and inspection requirements for treated wood.

Miscellaneous (M) Standards for quality control and inspection items

Analytical (A) Standards to determine conformance of preservative systems, penetration, and retention. Refer to the Introduction to this *Book of Standards* at the front of this edition for additional information.

SECTION 2: SERVICE CONDITIONS FOR USE CATEGORY DESIGNATIONS (NORMATIVE/MANDATORY)

Jurisdiction: AWPA Technical Committees T-2, T-3, T-4, and T-8

The following is a breakdown of the Use Categories used by AWPA to describe the exposure conditions that wood may be subject to in service. This is also given in table form to summarize the major differences between Use Category groupings.

UC1 INTERIOR/DRY

Wood and wood based materials used in interior construction not in contact with the ground or foundations. Such products are protected from weather and interior sources of water such as leaking plumbing, condensate, pools and spas. Examples are interior furniture, construction furnishings, and millwork.

UC2 INTERIOR/DAMP

Wood and wood based materials used for interior construction that are not in contact with ground, but may be subject to dampness. These products are continuously protected from the weather but may be exposed to occasional sources of moisture. Examples are interior beams, timbers, flooring, framing, millwork and sill plates.

UC3 ABOVE GROUND (Exterior)

UC3A ABOVE GROUND Protected -- Wood and wood-based materials used in above ground exterior construction that are either (a) exposed to the full effects of weather, but protected by a coating and constructed such that water will quickly drain from the surface or (b) fully and continuously protected by design, construction and maintenance from precipitation, including wind-driven rain and splash-back from horizontal surfaces. Examples of (a) are coated millwork, siding & and trim. Examples of (b) are framing and sheathing, not covered by a weather-resistive barrier, but protected from exposure to liquid water.

UC3B ABOVE GROUND Exposed -- Wood and wood based materials used in exterior construction and not in contact with the ground. Materials do not require an exterior coating, but may be finished to achieve a desired aesthetic appearance. Materials are used for a variety of applications in either horizontal or vertical positions such as decking, sills, walkways, railings and fence pickets. **Note:** Retentions above the minimum specified for materials in this use category may be required for products such as crossarms where the individual components are difficult to maintain, repair or replace and are critical to the performance and safety of the entire system.

For Commodity Specification A only: See Note 1 under UC4A GROUND CONTACT for sawn components that may be physically above ground but that are required to be treated for ground contact. This includes sawn components that are difficult to replace and critical to the structure, or that may be exposed to ground contact type hazards due to climate, artificial or natural processes or construction.

UC4 GROUND CONTACT

UC4A GROUND CONTACT General Use (for Commodity Specification A only) -- Wood and wood-based materials (1) used in contact with the ground, fresh water, or other situations favorable to deterioration; (2) used above ground but are difficult to maintain, repair or replace and are critical to the performance and safety of the entire system /construction; or (3) used above ground but may end up in ground contact or are subject to hazards comparable to ground contact due to climate, artificial or natural processes or construction. Examples are sawn fence posts, sawn deck posts, sawn guardrail posts, structural lumber, joists and beams for decks and freshwater docks, and timbers located in regions of low natural potential for wood decay and insect attack.

Note 1 (for Commodity Specification A only): The following sawn components for exterior above ground use shall be treated to Ground Contact UC4A or higher requirements:

a) When there is a reasonable expectation that soil, vegetation, leaf litter or other debris may build up and remain in contact with the component.

b) When the construction itself, other structures or anticipated vegetation growth will not allow air to circulate underneath the construction and between decking boards.

c) When components are installed less than six inches above ground (final grade after landscaping) and supported on permeable building materials (e.g. treated wood or concrete) without a moisture break/barrier separation.

d) When components are in direct contact with non-durable untreated wood, or any older construction with any evidence of decay.

e) When components are wetted on a frequent or recurrent basis (e.g., on a freshwater floating dock or by a watering system that is fixed and not adjustable).

f) When components are used in tropical climates

UC4A GROUND CONTACT General Use (for all other Commodity Specifications) -- Wood and wood-based materials used in contact with the ground, fresh water, or other situations favorable to deterioration. Examples are round, half-round, and quarter-round fence posts, round deck posts, round guardrail posts, and utility poles located in regions of low natural potential for wood decay and insect attack.

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 semi-tropical or tropical environments.

UC5 MARINE USE

UC5A MARINE USE Northern Waters -- Wood and wood based materials exposed to salt and brackish water which includes Long Island, NY and northward on the east coast and north of San Francisco on the west coast to the extent that the marine borers can attack them. This includes areas where *Limnoria quadripunctata* is present, but lacks those borers listed under UC5B and UC5C. This includes piling and bracing, bulk-heading or other construction that is actually exposed at some time during the year to salt water.

UC5B MARINE USE Central Waters -- Wood and wood based materials exposed to salt and brackish water south of Long Island, NY to the southern border of Georgia on the east coast and south of San Francisco on the west coast to the extent that the marine borers can attack them. This includes areas where creosote tolerant *Limnoria tripunctata* is present, but lacks those borers listed under UC5C. This includes piling and bracing, bulk-heading or other construction that is actually exposed at some time during the year to salt water.

UC5C MARINE USE Southern Waters -- Wood and wood based materials exposed to salt and brackish water south of Georgia and along the gulf coasts in the eastern U.S., as well as Hawaii and Puerto Rico, to the extent that the marine borers can attack them. This includes areas where *Martesia* and *Sphaeroma* are present. This includes piling and bracing, bulk-heading or other construction that is actually exposed at some time during the year to salt water.

UCF FIRE RETARDANT

UCFA FIRE RETARDANT Interior -- Wood and wood based materials intended for fire protection and used in interior construction where wood material is not in contact with the ground and is protected from exterior weather.

UCFB FIRE RETARDANT Exterior -- Wood and wood based materials intended for fire protection and used in exterior construction that is not in contact with the ground or with foundations, but may be exposed to full effects of weather such as intermittent rain, dew, sunlight and wind. Materials are applied to vertical, exterior walls, inclined roof surfaces or other types of construction that allow water to quickly drain from the surface.

TABLE 2-1 SERVICE CONDITIONS FOR USE CATEGORY DESIGNATIONS

USE CATEGORY	SERVICE CONDITIONS	USE ENVIRONMENT	COMMON AGENTS OF DETERIORATION	TYPICAL APPLICATIONS
UC1 INTERIOR/ DRY	**Interior construction Above Ground Dry**	Continuously protected from weather or other sources of moisture	Insects only	Interior construction and furnishings
UC2 INTERIOR/ DAMP	**Interior construction Above Ground Damp**	Protected from weather, but may be subject to sources of moisture	Decay fungi and insects	Interior construction
UC3A ABOVE GROUND Protected (Commodity Specification A only)	**Exterior construction Above Ground Coated & rapid water runoff**	Exposed to all weather cycles, including intermittent wetting	Decay fungi and insects	Coated millwork, siding and trim
UC3A ABOVE GROUND Protected (all other Commodity Specifications)	**Exterior construction Above Ground Coated & rapid water runoff; Protected by design from liquid water**	Exposed to all weather cycles, but either coated and installed in a manner that prevents prolonged wetting or fully protected from liquid water by building design & construction	Decay fungi and insects	Coated millwork, siding and trim. Exterior framing & sheathing fully protected from exposure to liquid water
UC3B ABOVE GROUND Exposed (Commodity Specification A only)	**Exterior construction Above Ground Uncoated or poor water run-off Excludes above ground applications with ground contact type hazards (see Section 2 UC4 Note1)**	Exposed to all weather cycles including intermittent wetting but with sufficient air circulation so wood can readily dry	Decay fungi and insects	Decking, railings, joists and beams for decks and freshwater docks[1], fence pickets, uncoated millwork
UC3B ABOVE GROUND Exposed (all other Commodity Specifications)	**Exterior construction Above Ground Uncoated or poor water run-off**	Exposed to all weather cycles including prolonged wetting	Decay fungi and insects	Uncoated nonpressure treated millwork
UC4A GROUND CONTACT General Use (Commodity Specification A only)	**Ground Contact or Fresh Water Non-critical components (Includes above ground applications with ground contact type hazards or that are critical or hard to replace)**	Exposed to all weather cycles, including continuous or prolonged wetting	Decay fungi and insects	Sawn fence, deck, and guardrail posts, cantilevered members extending beyond the building envelope, joists and beams for decks and freshwater docks[1]
UC4A GROUND CONTACT General Use (all other Commodity Specifications)	**Ground Contact or Fresh Water Non-critical components**	Exposed to all weather cycles, normal exposure conditions	Decay fungi and insects	Round, half-round, and quarter-round fence posts, round deck posts, and round guardrail posts, crossties & utility poles (low decay areas)
UC4B GROUND CONTACT Heavy Duty (Commodity Specification A only)	**Ground Contact or Fresh Water Critical components or difficult replacement**	Exposed to all weather cycles, including continuous or prolonged wetting, high decay potential includes salt water splash	Decay fungi and insects with increased potential for biodeterioration	Permanent wood foundations, sawn building structural support posts and poles, sawn agricultural posts and poles
UC4B GROUND CONTACT Heavy Duty (all other Commodity Specifications)	**Ground Contact or Fresh Water Critical components or difficult replacement**	Exposed to all weather cycles, high decay potential includes salt water splash	Decay fungi and insects with increased potential for biodeterioration	Building poles, round, half-round, and quarter-round agricultural posts, crossties & utility poles (high decay areas)

USE CATEGORY	SERVICE CONDITIONS	USE ENVIRONMENT	COMMON AGENTS OF DETERIORATION	TYPICAL APPLICATIONS
UC4C GROUND CONTACT Extreme Duty (Commodity Specification A only)	**Ground Contact or Fresh Water Critical structural components**	Exposed to all weather cycles, including continuous or prolonged wetting, severe environments extreme decay potential	Decay fungi and insects with extreme potential for biodeterioration	Sawn foundation piling
UC4C GROUND CONTACT Extreme Duty (all other Commodity Specifications)	**Ground Contact or Fresh Water Critical structural components**	Exposed to all weather cycles, severe environments extreme decay potential	Decay fungi and insects with extreme potential for biodeterioration	Land & Freshwater piling, foundation piling, crossties & utility poles (severe decay areas)
UC5A MARINE USE Northern Waters	**Salt or brackish water and adjacent mud zone which includes Long Island, NY and northward, north of San Francisco**	Continuous marine exposure (salt water)	Salt water organisms	Piling, bulkheads, bracing
UC5B MARINE USE Central Waters	**Salt or brackish water and adjacent mud zone south of Long Island, NY to the southern border of GA, south of San Francisco**	Continuous marine exposure (salt water)	Salt water organisms Including creosote tolerant *Limnoria tripunctata*	Piling, bulkheads, bracing
UC5C MARINE USE Southern Waters	**Salt or brackish water and adjacent mud zone South of GA, Gulf Coast, Hawaii, and Puerto Rico**	Continuous marine exposure (salt water)	Salt water organisms Including *Martesia, Sphaeroma*	Piling, bulkheads, bracing
UCFA FIRE RETARDANT Interior	**Fire protection as required by codes Above Ground Interior construction**	Continuously protected from weather or other sources of moisture	Fire	Roof sheathing, roof trusses, studs, joists, paneling
UCFB FIRE RETARDANT Exterior	**Fire protection as required by codes Above Ground Exterior construction**	Subject to wetting	Fire	Vertical exterior walls, inclined roof surfaces or other construction which allows water to quickly drain

[1] Joists and beams shall be treated to requirements for UC4A when they are difficult to maintain, repair or replace and are critical to the performance and safety of the entire system/construction.

SECTION 3: GUIDE TO COMMODITY SPECIFICATIONS FOR TREATED WOOD END USES (INFORMATIVE)

Jurisdiction: AWPA Technical Committee T-1

The Commodity Specifications identify all AWPA standardized preservative systems and required retentions for specific commodities and end-uses. This section is designed to help direct users and specifiers to the governing commodity specification for the treated wood application, and to help identify the appropriate Use Category for the intended use. Some commodities may require a retention for a specific application beyond that suggested by Section 2 of this Standard due to the critical nature of their use. Note that this section is only intended to be a guide. The designer should use their best judgment to determine the appropriate specifications for a particular use.

Table 3-1 Guide to commodity specifications for treated wood end uses, arranged by use

Commodity	Use	Exposure	Use Category	Commodity Specification	
				Section	Special Reqs.
Balconies, Cantilevered	Decking	Above Ground, Exterior	3B	A	
	Joists and beams extending beyond the building envelope	Above Ground, Exterior	4A	A	
Bender Board	General	Ground Contact or Fresh Water	4A	A	
Bulkhead Sheathing	Non-Marine	Ground Contact or Fresh Water	4A	A	
	Marine	Brackish or Salt Water	5A-5B-5C	G	6.1-6.4
Cant Strips	Building Construction	Above Ground	3B	A	4.1
Composite Lumber (PSL & LVL)	Structural	Above Ground, Exterior	3B	F	
	Highway Structural, General	Ground Contact or Fresh Water	4A	F	
	Highway Structural, Important or High Decay	Ground Contact or Fresh Water	4B	F	
	Highway Structural, Critical or Severe Decay	Ground Contact or Fresh Water	4C	F	
Cribbing	Highway	Ground Contact or Fresh Water	4C	A	
Crossarms, Sawn	General Use	Above Ground, Exterior	3B	A	4.5
	Critical or Hard to Replace	Above Ground, Exterior	4A		
Crossties, Switchties	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	
Decking	Painted/Unpainted	Above Ground, Exterior	3B	A	
	Building Construction, General	Ground Contact or Fresh Water	4A	A	
	Highway Bridge Structural, Critical/Severe Decay	Above Ground	4B, 4C	A	4.3
Decks, Residential	Decking (Painted/Unpainted) Joists and Beams[1] Railing Components	Above Ground, Exterior	3B	A	
	Joists and Beams[1] Joists and Beams Support Posts (Sawn)	Above Ground, Exterior Ground Contact or Fresh Water	4A	A	
Expansion Boards	General	Ground Contact or Fresh Water	4A	A	
Fascia Boards	Painted/Coated	Above Ground, Exterior	3A	A	
	Unpainted	Above Ground, Exterior	3B	A	
Fence Pickets	Painted/Coated	Above Ground, Exterior	3A	A	
	Unpainted	Above Ground, Exterior	3B	A	
Fence Rail	Painted/Coated	Above Ground, Exterior	3A	A	
	Unpainted	Above Ground, Exterior	3B	A	
	Stockyard, Agricultural	Above Ground, Exterior	4A	A	
Floor Plate	Building Construction	Above Ground, Potentially Wet	3B	A	
Flooring	Above Ground, Interior	Protected, Insect Only	1	A	4.1
	Above Ground, Interior	Protected, Damp	2	A	4.1
	Residential/Commercial, Veranda	Above Ground, Exterior	3B	A	4.1
Flooring, block	Above Ground	Low Humidity	2	A	
	Above Ground	High Humidity	3A	A	

Table 3-1 Guide to commodity specifications for treated wood end uses, arranged by use (cont.)

Commodity	Use	Exposure	Use Category	Commodity Specification Section	Special Reqs.
Furniture	Indoor	Protected, Insect Only	1	A	
	Outdoor	Above Ground, Exterior	3B	A	
	Outdoor	Ground Contact	4A	A	
Furring Strips	Indoor	Above Ground, Damp	2	A	
	Outdoor	Above Ground	3B	A	
Gazebo Material	Painted/Coated	Above Ground, Exterior	3A	A	
	Unpainted	Above Ground, Exterior	3B	A	
Glued Laminated and Mechanically Fastened Timber	Above Ground, Interior	Protected, Insect Only	1	F	
	Above Ground, Interior	Protected, Damp	2	F	
	Above Ground Structural (Painted/Unpainted)	Exterior	3B	F	
	General Structural, Highway Structural Non-Critical	Ground Contact or Fresh Water, Low Decay	4A	F	
	Important Structural, Highway Important Structural or Saltwater Splash	Ground Contact or Fresh Water, High Decay	4B	F	
	Critical Structural or Highway Critical Structural	Ground Contact or Fresh Water, Severe Decay	4C	F	
Handrails/Guardrails	Highway Construction	Above Ground, Exterior	3B	A	4.3
Joists	Above Ground, Interior	Insect Only	1	A	4.1
	Above Ground, Interior	Above Ground, Damp	2	A	4.1
	Building Construction[1]	Above Ground, Exterior	3B, 4A	A	
	Building Construction Joists and beams extending beyond the building envelope	Ground Contact/Fresh Water Above Ground, Exterior	4A	A	
Laminated Veneer Lumber (LVL)	See Composite Lumber				
Landscape Ties	General	Ground Contact or Fresh Water	4A	A	
Lattice	Painted/Unpainted	Above Ground, Exterior	3B	A	
Lumber/Timbers	Above Ground, Interior	Insect Only	1	A	4.1
	Above Ground, Interior	Wood Exposed to Dampness	2	A	4.1
	Above Ground, Exterior, Coated/Painted	All Applications	3A		
	Above Ground, Exterior Joists and Beams[1]	Above Ground, Exterior	3B, 4A	A	
	General, Including Agriculture/Farms	Above Ground, Exterior, Uncoated	3B	A	
	Docks, freshwater, joists and beams[1]	Above Ground, Exterior		A	
	Food Harvest and Storage	Above Ground, Exterior		A	
	Roof Decking, Flooring/Subflooring	Above Ground, Exterior		A	4.1
	Food Contact	Above Ground, Exterior		A	
	General, Including Retaining Walls, Edging, Agri-/Mariculture, Boats, Furniture, Gazebos, Compost/ Plant/Mushroom Boxes, Flumes	Ground Contact or Fresh Water	4A	A	
	Fire Escapes, Exterior Exposed	Above Ground and Ground Contact		A	
	Wet Industrial Processing Areas	Above Ground and Ground Contact		A	
	Docks, freshwater, joists and beams[1]	Above Ground or Fresh Water		A	
	Cooling Towers	Fresh Water Contact		A	4.4
	Joists and beams extending beyond the building envelope	Above Ground, Exterior		A	
	Brine Storage, Highway Construction Materials	Ground Contact or Fresh Water		B	4.1
	Playground Equipment	Ground Contact or Fresh Water		B	4.3

Table 3-1 Guide to commodity specifications for treated wood end uses, arranged by use (cont.)

Commodity	Use	Exposure	Use Category	Commodity Specification Section	Commodity Specification Special Reqs.
Lumber/Timbers, cont.	Permanent Wood Foundation	Ground Contact and Above Ground	4B	A	4.2
	Highway Construction, Building Structural Support	Ground Contact or Fresh Water		A	4.3
	Crib Walls, Retaining Walls, Important Structural, Greenhouse	Ground Contact or Fresh Water		A	
	Marine Out of Water and Above Ground	Salt Water Splash		A	G-2.9
	Marine Out of Water and Ground Contact	Salt Water Splash	4C	A	G-2.9
	Aquaculture	Fresh Water		A	
	Marine, Aqua/Mariculture, Highway, Boats	Brackish or Salt Water	5A-5B-5C	G	6.1-6.4
	Fire Retardant, Fire Protection	Interior	FA	H	
	Fire Retardant, Fire Protection	Exterior	FB	H	
Millwork, Trim	Above Ground, Interior	Insect Only	1	A	4.1
	Above Ground, Interior	Above Ground, Damp	2	A	4.1
	Painted/Coated	Above Ground, Exterior	3A	A	4.1
	Unpainted	Above Ground, Exterior	3B	A	
Oriented Strand Board (OSB)	Sheathing, Above Ground, Interior	Insect Only	1	J	
	Sheathing, Above Ground, Interior	Damp	2	J	
	Sheathing, Above Ground, Protected Exterior	Protected	3A	J	
Parallel Strand Lumber (PSL)	See Composite Lumber				
Pergola	Pergola	Ground Contact or Fresh Water	4A	A	
Piles, Foundation	Building Construction, Completely Embedded in Soil	Ground Contact	4C	E	
Piles, Round	Highway Construction	Ground Contact or Fresh Water	4C	E	
	Marine/Highway Construction	Brackish or Salt Water	5A-5B-5C	G	6.1-6.4
Piles, Sawn	Residential/Business Structural Support	Ground Contact or Fresh Water	4B	A	
	Residential/Business Structural Support, Critical	Ground Contact or Fresh Water	4C	A	
Plywood	Above Ground, Interior, Subfloor	Above Ground, Damp	2	F	
	General, Including Agriculture/Farms	Above Ground, Exterior	3B	F	
	Food Harvest-Storage-Contact	Above Ground, Exterior		F	
	Roof Decking, Flooring/Subflooring	Above Ground, Exterior		F	2.6
	General: Including Edging, Agriculture, Mariculture, Boats, Furniture, Gazebos, Compost/Plant/Mushroom Boxes, Flumes	Ground Contact or Fresh Water	4A	F	
	Brine Storage, Highway Construction Materials	Ground Contact or Fresh Water		F	B-4.1
	Wet Industrial Processing Areas	Ground Contact or Fresh Water		F	
	Fire Escapes, Exterior Exposed	Above Ground and Ground Contact		F	
	Marine	Salt Water Splash	4B	F	
	Permanent Wood Foundation	Ground Contact and Above Ground		A	4.2
	Marine/Highway Construction, Boat Building	Brackish or Salt Water	5A-5B-5C	G	
	Fire Retardant, Fire Protection	Interior	FA	H	
	Fire Retardant, Fire Protection	Exterior	FB	H	

Table 3-1 Guide to commodity specifications for treated wood end uses, arranged by use (cont.)

Commodity	Use	Exposure	Use Category	Commodity Specification Section	Special Reqs.
Poles (Round)	Agricultural Use, Utility	Ground Contact or Fresh Water, Low Decay	4A	D	
	Agriculture, Utility, Highway Construction, Lighting	Ground Contact or Fresh Water, Moderate Decay	4B	D	
	Building Structural	Ground Contact or Fresh Water		B	4.4
	Utility, Lighting	Ground Contact or Fresh Water, High Decay	4C	D	
Poles (Sawn)	Agricultural/Farm	Ground Contact or Fresh Water	4B	A	
	Building Structural Support	Ground Contact or Fresh Water			
Poles (Glued Laminated)	Utility Poles	Ground Contact or Fresh Water, Low or Moderate Decay	4A/4B	D	6
	Utility Poles	Ground Contact or Fresh Water, High Decay	4C	D	6
Posts Round, ½ & ¼ Round	General, Fence, Highway Construction Including Guide, Sign, Sight and Guardrail Posts, Spacer Blocks	Ground Contact or Fresh Water	4A	B	
	Playground Equipment	Ground Contact or Fresh Water		B	
			4B		
	Building Construction	Ground Contact or Fresh Water		B	4.4
	Agricultural Used as Round Structural Members	Ground Contact or Fresh Water,		B	4.2.1
	Brine Storage, Highway	Ground Contact or Fresh Water,		B	4.1.2
Posts (Sawn 4 Sides)	General, Fence, Deck Support Highway Construction, General Including Guardrail Posts, Spacer Blocks	Ground Contact or Fresh Water	4A	A	
	Playground Equipment	Ground Contact or Fresh Water		B	4.3
	Agricultural Uses	Ground Contact or Fresh Water	4B	A	
	Building Structural Support	Ground Contact or Fresh Water		A	
Purlins	Above Ground, Interior	Insect Only	1	A	
	Above Ground, Interior	Above Ground, Damp	2	A	
	Painted/Coated	Above Ground, Exterior	3A	A	
	Unpainted	Above Ground, Exterior	3B	A	
Shakes and Shingles	Painted or Unpainted	Above Ground, Exterior	3B	A	4.6
Siding (Beveled or Not)	Painted/Coated	Above Ground, Exterior	3A	A	4.1
	Unpainted	Above Ground, Exterior	3B	A	
Siding, Engineered Wood (EWS)	Wall Paneling, Interior	Insect Only	1	J	
	Wall Paneling, Interior	Damp	2	J	
	Siding & Trim, Exterior	Above Ground, Protected	3A	J	
Sill Plates	Interior	Above Ground, Damp	2	A	4.1
Skirtboard	Post Frame Construction	Ground Contact	4A	A	
Stakes (Sawn 4 Sides)	Grape, Agriculture	Ground Contact/Fresh Water	4A	A	
Structural Composite Lumber	See Composite Lumber				
Studs	Building Construction, Interior	Insect Only	1	A	4.1
	Building Construction, Interior	Wood Exposed to Dampness	2	A	4.1
Ties	Mine and Bridge	Ground Contact or Fresh Water	4A	B	
	Mine and Bridge	Brackish or Salt Water	5A-5B-5C	G	6.1-6.4
Trusses	Roof	Insect Only	1	A	4.1
	Roof	Wood Exposed to Dampness	2	A	4.1
	Floor	Above Ground	3B	A	4.1

Table 3-1 Guide to commodity specifications for treated wood end uses, arranged by use (cont.)

Commodity	Use	Exposure	Use Category	Commodity Specification Section	Commodity Specification Special Reqs.
Utility Poles	Distribution, Transmission, Laminated, General	Ground Contact or Fresh Water	4A	D	
	Distribution, Transmission, Laminated, Important	Ground Contact or Fresh Water, High Decay	4B	D	
	Distribution, Transmission, Laminated, Critical	Ground Contact or Fresh Water, Severe Decay	4C	D	
Veranda supports	Veranda Supports	Ground Contact or Fresh Water	4A	A	

[1] Joists and beam shall be treated to requirements for UC4A when they are difficult to maintain, repair or replace and are critical to the performance and safety of the entire system/construction. Refer to the Section 2 description of UC4 Ground Contact for any provisions that may also be applicable to joists and beams.

SECTION 4: STANDARDIZED PRESERVATIVES (INFORMATIVE)

Jurisdiction: AWPA Technical Committee T-1

Table 1. Preservatives for Pressure Treatment Processes

Preservatives listed in this table are limited to those referenced in U1 Commodity Specifications A-G and the corresponding T1 sections.

Preservative Abbreviation	P Standard Reference	Preservative	Retention Basis, as	Preservative Carrier
Oilborne and Creosote-Based				
CR	P1/P13	Creosote	Creosote	Not applicable
CR-S	P2	Creosote Solution	Creosote Solution	Not applicable
CR-PS	P3	Creosote-Petroleum Solution	Creosote plus Petroleum	Petroleum Oil
Cu8	P37	Oxine Copper	Oxine Copper	Hydrocarbon Solvent Type A or C
CuN	P36	Copper Naphthenate	Copper	Hydrocarbon Solvent Type A
DCOI-A	P39	DCOI Solvent A	DCOI	Hydrocarbon Solvent Type A
IPBC/PER	P58	IPBC/Permethrin	IPBC + PER	Hydrocarbon Solvent Type C
PCP-A	P35	Pentachlorophenol (Penta) Solvent A	PCP	Hydrocarbon Solvent Type A
PCP-C	P35	Pentachlorophenol (Penta) Solvent C	PCP	Hydrocarbon Solvent Type C
PCP-G	P35	Pentachlorophenol (Penta) Solvent G	PCP	Hydrocarbon Solvent Type G
SBX-O	P60	Inorganic Boron, Oilborne	B_2O_3	Creosote, Creosote Solution
Waterborne, Acid-based				
CCA	P23	Chromated Copper Arsenate Type C	Metal Oxides	Water
Waterborne, Alkali-based (amine/ammonia)				
ACQ-A	P26	Alkaline Copper Quat Type A	CuO + Quat	Water
ACQ-B	P27	Alkaline Copper Quat Type B	CuO + Quat	Water
ACQ-C	P28	Alkaline Copper Quat Type C	CuO + Quat	Water
ACQ-D	P29	Alkaline Copper Quat Type D	CuO + Quat	Water
ACZA	P22	Ammoniacal Copper Zinc Arsenate	Metal Oxides	Water
CA-B	P32	Copper Azole Type B	Cu + azole	Water
CA-C	P48	Copper Azole Type C	Cu + azoles	Water
CX-A	P33	Copper HDO Type A	$CuO + H_3BO_3$ + HDO	Water
KDS	P55	Alkaline Copper Betaine	CuO + DPAB + H_3BO_3	Water
KDS-B	P56	Alkaline Copper Betaine Type B	CuO + DPAB	Water
Waterborne, Other				
CuN-W	P34	Waterborne Copper Naphthenate	Copper	Water
EL2	P47	4,5-dichloro-2-n-octyl-4-isothiazolin-3-one (DCOI) and 2-Imidazolidinimine, 1-((6-chloro-3-pyridinyl)methyl)-nitro (Imidacloprid)	DCOI + Imidacloprid	Water
MCA	P61	Micronized Copper Azole	Cu + Tebuconazole	Water
MCA-C	P62	Micronized Copper Azole Type C	Cu + azoles	Water
PTI	P45	Propiconazole Tebuconazole Imidacloprid	Propiconazole Tebuconazole Imidacloprid	Water
SBX	P25	Inorganic Boron (SBX)	B_2O_3	Water

Table 2. Protectants for Fire-Retardant Treatment Processes
Applies to Commodity Specification H.

Protectant Abbreviation	P Standard Reference	Protectant	Retention Basis	Preservative Carrier
FR-1	P49	FR-1	Not Available	Water
FR-2	P50	FR-2	Not Available	Water

Table 3. Preservatives for Non-Pressure Treatment Processes
Applies to Commodity Specifications I through J.

Preservative Abbreviation	P Standard Reference	Preservative	Retention Basis	Preservative Carrier
Oilborne and Creosote-based				
Cu8	P37	Oxine Copper	Oxine Copper	Hydrocarbon Solvent Type C or F
CuN	P36	Copper Naphthenate	Copper	Hydrocarbon Solvent Type C or F
Waterborne, Other				
AAC-W	P24	Alkyl Ammonium Compound, Waterborne	Not Available	Water
SBX	P25	Inorganic Boron	Boron as B_2O_3	Water
Light Organic Solvent Systems				
AAC	P38	Alkyl Ammonium Compound, Oilborne	Not Available	Hydrocarbon Solvent Type C
DCOI	P39	4.5-dichlor-2-N-octyl-4-Isothiazolin-3-one (Isothiazolin) (Note b)	Not Available	Hydrocarbon Solvent Type C
IPBC	P40	3-iodo-2 propynyl butyl carbamate (Note b)	Not Available	Hydrocarbon Solvent Type C
PPZ	P42	1-[2-(4-dichlorophenyl)-4-propyl-1,3-dioxolan-2-1`L-methyl]-1H-1,2,4-triazole (Propiconazole) (Note b)	Not Available	Hydrocarbon Solvent Type C
TEB	P41	1`-(2(4(chlorophenyl)ethyl-y-(1,1-dimethylethyl)-1H-1,2,4-Triazole-1 Ethanol (Tebuconazole) (Note b)	Not Available	Hydrocarbon Solvent Type C
Preservative Added During Manufacture				
KDS	P57	Alkaline Copper Betaine	CuO + DPAB + H_3BO_3	Water
ZB	P51	Zinc Borate	$2ZnO \cdot 3B_2O_3 \cdot 3.5H_2O$	Not Applicable

Table 4. Preservatives for Thermal Treatment Processes
Applies to Commodity Specification D.

Preservative Abbreviation	P Standard Reference	Preservative	Retention Basis	Preservative Carrier
CuN	P36	Copper Naphthenate	Copper	Hydrocarbon Solvent Type A
PCP-A	P35	Pentachlorophenol (Penta) Solvent A	PCP	Hydrocarbon Solvent Type A

Table 5. Protectants for Nonbiocidal Treatment Processes

Protectant Abbreviation	P Standard Reference	Protectant	Retention Basis	Protectant Carrier
CM-A	P59	Chemical Modification by Acetylation	% Bound Acetyl	Not Applicable

SECTION 5: SPECIES AND SPECIES GROUPINGS REFERENCED IN AWPA STANDARDS (INFORMATIVE)

Jurisdiction: AWPA Technical Committee T-1

The individual species and species groupings herein have been included in AWPA Standards because experience has shown that it is possible to treat them successfully, with at least some preservative systems. The specification of a species in these tables does not imply that they are suitable for all preservative systems, or that a preservative system appropriate to specific applications is listed or available.

Most species are treated either as sawn or round commodities. Other species groupings, such as those listed in the grade books of various ALSC-accredited grading agencies may contain a mix of species which cannot be readily separated, or properly treated as a whole. Grade marks are an acceptable means of species identification, but only sawn material is grade-marked. To predict treatability, species should be positively identified. The following list includes species groupings that are commonly treated under AWPA Standards, which are described under Notes 1-9 below. Treating of other species groupings should be avoided unless individual species identification can be made by a means acceptable to both buyer and seller. However, acceptance under AWPA Standards is ultimately governed by preservative penetration and retention. The specification of a preservative with a species or species group does not necessarily imply the species or the species group is treated regularly with any specific preservative. Prior to specifying a species for a given application, it should be cross-referenced with the specific commodity specification, and information should be obtained on the availability of a species preservative combination.

Species Treatability and Variability. Some species are difficult to treat to the requirements of the AWPA Standards even when incised. Individual pieces or lots within a species or species grouping may vary, sometimes significantly in their treatability. Prior to specifying a species or species group for any commodity and preservative, accurate information should be obtained about the treatability and the variability of the species or species group. The recognized common and scientific names of wood species used in AWPA Standards are as follows.

<u>Notes and Footnotes for Species Names and Listings in Section 5 Tables</u>
<u>UCS-U1 – Use Category System: User Specification for Treated Wood Products</u>

[1] Coastal = West of Summit of Cascade Mountains; Intermountain = East of Cascade Summit.
[2] Usually, but not always.
[3] For sawn products treated with CCA, Western larch was removed from AWPA Standards with prejudice. For ammoniacal copper preservatives and pentachlorophenol, Western larch was removed from AWPA Standards without prejudice.

Note 1: Southern Pine includes *Pinus echinata* (shortleaf), *P. elliottii* (slash), *P. palustris* (longleaf), *P. taeda* (loblolly)
Note 2: Mixed Southern pine includes all Southern Pine species plus *Pinus serotina* (pond) and *P. virginiana* (Virginia)
Note 3: Hem-fir includes *Tsuga heterophylla, Abies amabilis* (pacific silver), *A. concolor* (white), *A. grandis* (grand), *A. magnifica* (Cal. red), *A. procera* (nobel)
Note 4: Hem-fir North includes *Tsuga heterophylla, Abies amabilis*
Note 5: Spruce-Pine-Fir includes *Abies balsamea, A. lasiocarpa, Picea engelmannii, P. glauca, P. mariana, P. rubrens, Pinus banksiana, P. contorta*
Note 6: Spruce-Pine-Fir West (NLGA Grade Rules) is a Western Canadian subset of Spruce-Pine-Fir that is graded Northern Lumber Grading Association (NLGA) rules, but only by the following Western Canadian agencies: Alberta Forest Products Association (AFPA), Caribou Lumber Manufacturers Association (CLMA), Canadian Mill Services Association (COFI), Interior Lumber Manufacturers Association (ILMA), Northern Forest Products Association (NFPA). It includes *Abies lasiocarpa, Picea engelmannii, P. mariana, P. plauca, Pinus contorta*
Note 7: Red Oak includes *Quercus coccinea, Q. elllipsoidalis, Q falcata, Q. kelloggii, Q. laevis, Q. laurifolia, Q. marilandica, Q. nigra, Q. nuttallii, Q. palustris, Q. phellos, Q. rubra, Q. shumardii and Q. velutina*
Note 8: White Oak includes *Quercus alba, Q. prinus, Q stellata , Q. lyrata, Q. michauxii, Q. macrocarpa, Q. muehlenbergii, Q. bicolor, and Q. virginiana.*
Note 9: Scots Pine-Ger is *Pinus sylvestris* from Germany as certified by a qualified third-party agency.
Note 10: Scots pine-Swe is *Pinus sylvestris* from Sweden as certified by a qualified third-party agency.
Note 11: Patula Pine is *Pinus patula* from South Africa and a component of African Montane Pine as certified by a qualified third-party agency.

Species Names and Listings in U1 – Use Category System: User Specification for Treated Wood Products

Common Name(s)	Scientific Name(s)	Sawn Products												
		UCS Listings												
		UC1&2	UC3	UC4A	UC4B	UC4C	UC5A	UC5B	UC5C	PWF	Shakes Shingles	Cooling Towers	Sawn X-arms	Bridges highway
Douglas-fir														
Coastal (Oregon Pine/Red Fir)[1]	*Pseudotsuga menziesii var. menziesii*[2]	X	X	X	X	X	X	X	X	X		X	X	X
Interior (Mountain or Intermountain)[1]	*Pseudotsuga menziesii var. glauca*[2]													
Pines														
Southern	*Note 1*	X	X	X	X	X	X	X	X	X	X	X	X	X
Mixed Southern	*Note 2*	X	X	X	X	X	X	X	X					
Ponderosa	*P. ponderosa*	X	X	X	X	X	X	X	X	X		X		
Jack	*P. banksiana*	X	X	X	X	X								
Lodgepole	*P. contorta*	X	X	X	X	X								
Eastern White (Northern White)	*P. strobus*	X	X	X	X	X								
Radiata	*P. radata*	X	X	X	X	X								
Caribbean (Ocote, Honduras)	*P. caribaea, P.oocarpa*	X	X	X	X	X								
Red (Norway)	*P. resinosa*	X	X	X	X	X	X	X	X	X				
Spruce	*Pinus glabra*	X	X	X	X	X								
Scots Pine – Ger	*Note 9*	X	X	X	X					X				
Scots Pine – Swe	*Note 10*	X	X	X	X					X				
Patula	*Note 11*	X	X	X	X					X				
Redwood	*Sequoia sempervirens*	X	X	X	X	X						X		
Hemlocks, Spruces, True Firs														
Hem-fir	*Note 3*	X	X	X	X	X	X	X	X	X		X	X	X
Hem-fir North	*Note 4*	X	X	X	X	X	X	X	X			X	X	X
Western Hemlock	*Tsuga heterophylla*						X	X	X	X		X	X	X
Eastern Hemlock	*Tsuga canadensis*	X	X	X										
Subalpine (alpine) Fir	*Abies lasiocarpa*	X	X	X	X	X				X				
Spruce-Pine-Fir	*Note 5*	X												
Spruce-Pine-Fir West	*Note 6*	X	X	X	X	X								
Sitka Spruce	*Picea sitchensis*	X	X	X	X	X								
Western White Spruce	*Picea glauca*	X	X	X	X	X								
Englemann Spruce	*Picea engelmannii*	X	X	X	X	X								
Western Larch[3]	*Larix occidentalis*												X	
Cedars														
Western Red Cedar	*Thuja plicata*	X	X								X			
Alaska Yellow Cedar	*Chemaecyparis nootkatensis*	X	X											
Northern White Cedar	*Thuja occidentalis*													
Incense Cedar	*Libocedrus decurrens*	X	X											
Baldcypress (cypress)	*Taxodium distichum*													
Hardwoods														
Oak	*all Quercus sp.*						X	X	X					
Red Oak	*Note 7*	X	X	X										
White Oak	*Note 8*	X	X	X										
Maple	*Acer sp.*	X	X	X										
Red Maple	*Acer rubrum*													
Black Gum	*Nyssa spp.*	X	X	X			X	X	X					
Red (sweet) Gum	*Liquidambar spp.*	X	X	X			X	X	X					
Hickory	*Carya spp.*													
Yellow Poplar	*Liriodendron tulipifera*													
Mixed Hardwoods	All other N.A. hardwood species													

Species Names and Listings in U1 – Use Category System: User Specification for Treated Wood Products

Common Name(s)	Scientific Name(s)	Posts General UC4A	Posts General UC4B	Structural Poles/Posts Farm UC4Bmod	Structural Poles/Posts Building UC4B	Crossties Switchties UC4	Utility Poles General UC4A	Utility Poles General UC4B	Utility Poles General UC4C	Utility Poles Glue-lam UC4A-C	Utility Poles Thermal UC4A&B	Utility Poles Thermal UC4C
Douglas-fir												
Coastal (Oregon Pine/Red Fir)[1]	*Pseudotsuga menziesii var. menziesii*[2]	X	X	X	X	X	X	X	X	X		
Interior (Mountain or Intermountain)[1]	*Pseudotsuga menziesii var. glauca*[2]			X		X						
Pines												
Southern	*Note 1*	X	X	X	X	X	X	X	X	X		
Mixed Southern	*Note 2*											
Ponderosa	*P. ponderosa*	X	X	X	X	X	X	X	X			
Jack	*P. banksiana*	X	X	X		X	X	X	X			
Lodgepole	*P. contorta*	X	X	X		X	X	X	X			
Eastern White (Northern White)	*P. strobus*											
Radiata	*P. radata*	X	X	X	X		X	X	X			
Caribbean (Ocote, Honduras)	*P. caribaea, P.oocarpa*											
Red (Norway)	*P. resinosa*	X	X	X	X	X	X	X	X			
Spruce	*Pinus glabra*											
Redwood	*Sequoia sempervirens*											
Hemlocks, Spruces, True Firs												
Hem-fir	*Note 3*											
Hem-fir North	*Note 4*											
Western Hemlock	*Tsuga heterophylla*	X	X			X						
Eastern Hemlock	*Tsuga canadensis*											
Subalpine (alpine) Fir	*Abies lasiocarpa*											
Spruce-Pine-Fir	*Note 5*											
Spruce-Pine-Fir West	*Note 6*											
Sitka Spruce	*Picea sitchensis*											
Western White Spruce	*Picea glauca*											
Englemann Spruce	*Picea engelmannii*											
Western Larch[3]	*Larix occidentalis*	X	X	X		X	X	X	X		X	X
Cedars												
Western Red Cedar	*Thuja plicata*			X			X	X	X		X	X
Alaska Yellow Cedar	*Chemaecyparis nootkatensis*						X	X	X		X	X
Northern White Cedar	*Thuja occidentalis*										X	X
Incense Cedar	*Libocedrus decurrens*											
Baldcypress (cypress)	*Taxodium distichum*											
Hardwoods												
Oak	*all Quercus sp.*					X						
Red Oak	*Note 7*											
Maple	*Acer sp.*											
Red Maple	*Acer rubrum*											
Black Gum	*Nyssa spp.*											
Red (sweet) Gum	*Liquidambar spp.*											
Hickory	*Carya spp.*					X						
Yellow Poplar	*Liriodendron tulipifera*											
Mixed Hardwoods	All other N.A. hardwood species					X						

Species Names and Listings in U1 – Use Category System: User Specification for Treated Wood Products

Common	Scientific	Round Piling	Glue-Lam					
			Treated After Gluing				Before Gluing	
Name(s)	Name(s)	UC4C	UC1-3B	UC4A	UC4B	UC4C	UC1-3B	UC4A
Douglas-fir								
Coastal (Oregon Pine/Red Fir)[1]	*Pseudotsuga menziesii var. menziesii*[2]	X	X	X	X	X	X	X
Interior (Mountain or Intermountain)[1]	*Pseudotsuga menziesii var. glauca*[2]	X						
Pines								
Southern	*Note 1*	X	X	X	X	X	X	X
Mixed Southern	*Note 2*							
Ponderosa	*P. ponderosa*	X						
Jack	*P. banksiana*	X						
Lodgepole	*P. contorta*	X						
Eastern White (Northern White)	*P. strobus*							
Radiata	*P. radata*							
Caribbean (Ocote, Honduras)	*P. caribaea, P. oocarpa*							
Red (Norway)	*P. resinosa*	X						
Spruce	*Pinus glabra*							
Redwood	*Sequoia sempervirens*							
Hemlocks, Spruces, True Firs								
Hem-fir	*Note 3*		X	X			X	X
Hem-fir North	*Note 4*							
Western Hemlock	*Tsuga heterophylla*		X	X			X	X
Eastern Hemlock	*Tsuga canadensis*							
Subalpine (alpine) Fir	*Abies lasiocarpa*							
Spruce-Pine-Fir	*Note 5*							
Spruce-Pine-Fir West	*Note 6*							
Sitka Spruce	*Picea sitchensis*							
Western White Spruce	*Picea glauca*							
Englemann Spruce	*Picea engelmannii*							
Western Larch[3]	*Larix occidentalis*	X						
Cedars								
Western Red Cedar	*Thuja plicata*							
Alaska Yellow Cedar	*Chemaecyparis nootkatensis*							
Northern White Cedar	*Thuja occidentalis*							
Incense Cedar	*Libocedrus decurrens*							
Baldcypress (cypress)	*Taxodium distichum*							
Hardwoods								
Oak	*all Quercus sp.*	X						
Red Oak	*Note 7*		X	X				
Maple	*Acer sp.*							
Red Maple	*Acer rubrum*		X	X				
Black Gum	*Nyssa spp.*							
Red (sweet) Gum	*Liquidambar spp.*							
Hickory	*Carya spp.*							
Yellow Poplar	*Liriodendron tulipifera*		X	X				
Mixed Hardwoods	All other N.A. hardwood species							

Species Names and Listings in U1 – Use Category System: User Specification for Treated Wood Products

Common Name(s)	Scientific Name(s)	Structural Composite Lumber						Marine Piling		
		PSL			LVL					
		UC1-3B	UC4A	UC4B	UC1-3B	UC4A	UC4B	UC5A	UC5B	UC5C
Douglas-fir										
Coastal (Oregon Pine/Red Fir)[1]	*Pseudotsuga menziesii var. menziesii*[2]	X	X	X				X	X	X
Interior (Mountain or Intermountain)[1]	*Pseudotsuga menziesii var. glauca*[2]									
Pines										
Southern	*Note 1*	X	X	X	X	X	X	X	X	X
Mixed Southern	*Note 2*									
Ponderosa	*P. ponderosa*									
Jack	*P. banksiana*									
Lodgepole	*P. contorta*									
Eastern White (Northern White)	*P. strobus*									
Radiata	*P. radiata*									
Caribbean (Ocote, Honduras)	*P. caribaea, P.oocarpa*									
Red (Norway)	*P. resinosa*							X	X	X
Spruce	*Pinus glabra*									
Redwood	*Sequoia sempervirens*									
Hemlocks, Spruces, True Firs										
Hem-fir	*Note 3*									
Hem-fir North	*Note 4*									
Western Hemlock	*Tsuga heterophylla*									
Eastern Hemlock	*Tsuga canadensis*									
Subalpine (alpine) Fir	*Abies lasiocarpa*									
Spruce-Pine-Fir	*Note 5*									
Spruce-Pine-Fir West	*Note 6*									
Sitka Spruce	*Picea sitchensis*									
Western White Spruce	*Picea glauca*									
Engelmann Spruce	*Picea engelmannii*									
Western Larch[3]	*Larix occidentalis*									
Cedars										
Western Red Cedar	*Thuja plicata*									
Alaska Yellow Cedar	*Chemaecyparis nootkatensis*									
Northern White Cedar	*Thuja occidentalis*									
Incense Cedar	*Libocedrus decurrens*									
Baldcypress (cypress)	*Taxodium distichum*									
Hardwoods										
Oak	*all Quercus sp.*									
Red Oak	*Note 7*									
Maple	*Acer sp.*									
Red Maple	*Acer rubrum*				X	X	X			
Black Gum	*Nyssa spp.*									
Red (sweet) Gum	*Liquidambar spp.*									
Hickory	*Carya spp.*									
Yellow Poplar	*Liriodendron tulipifera*	X	X		X	X	X			
Mixed Hardwoods	All other N.A. hardwood species									

Species Names and Listings in U1 – Use Category System: User Specification for Treated Wood Products

Common Name(s)	Scientific Name(s)	Non-pressure Treated Wood Composites (*Note: wood composites may be manufactured from a single species or a blend of species. Detailed species descriptions for the commodities standardized are found in Standard T1, Section J.*)		
		Laminated Strand Lumber (LSL)	**Oriented Strand Board (OSB)**	**Engineered Wood Siding (EWS)**
		UC1-3A	**UC1-3A**	**UC1-3A**
Softwoods				
Pine	*Pinus spp.*		X	
Spruce	*Picea spp.*		X	
Fir	*Abies spp.*		X	X
Mixed Softwoods	Other softwood species (see note)			
Hardwoods				
Aspen	*Populus spp.*	X	X	X
Yellow-poplar	*Liriodendron tulipifera*	X		
Mixed Hardwoods	Other hardwood species (see notes)	X	X	X

COMMODITY SPECIFICATIONS

The Commodity Specifications identify all AWPA specifications for treated wood products. It is organized into a series of major commodity classifications and provides information on the preservative systems and species/species groupings that can be treated under AWPA Standards for each Use Category (use exposure condition). Use category descriptions are given in Section 2. If a user/specifier is unsure where to look up a specific commodity and end-use within these tables, they should consult Section 3 of this standard for specific commodity references. In all cases, treated material should be clean of preservative deposits and suitable for its intended end use. Material treated with creosote, creosote solutions, or oil-borne preservatives in Use Categories UC1 through UC5 shall be supplied reasonably free of exudate and surface deposits. Material treated with waterborne preservatives shall be supplied free of visible surface deposits. Drying after treatment of material treated with waterborne preservatives is sometimes required or desirable for dimensional stability and should be specified. When drying after treatment is required, the moisture content in each piece of lumber shall not exceed 19% or that allowed by National Grading Rules for the species and size specified to be dried. The moisture content in each piece of plywood shall not exceed 18%.

COMMODITY SPECIFICATIONS

- **A. Sawn Products**
- **B. Posts**
- **C. Crossties and Switchties**
- **D. Poles**
- **E. Round Timber Piling**
- **F. Pressure-Treated Wood Composites**
- **G. Marine (Salt Water) Applications**
- **H. Fire Retardants**
- **I. Nonpressure Applications**
- **J. Non-Pressure Treated Wood Composites**
- **K. Barrier Protection Systems**

Location of Some Specialized Commodities, not otherwise obvious:

Permanent Wood Foundation (PWF)
Both Lumber and Plywood: Commodity Specification A, Section 4.2

Playground Material
Lumber, rounds (Posts/poles): Commodity Specification B, Section 4.3

Round Building Poles and Posts
Both poles and posts: Commodity Specification B, Section 4.4

ATTACHMENT 4

USDA United States Department of Agriculture

Guidelines for Selection and Use of Pressure-Treated Wood

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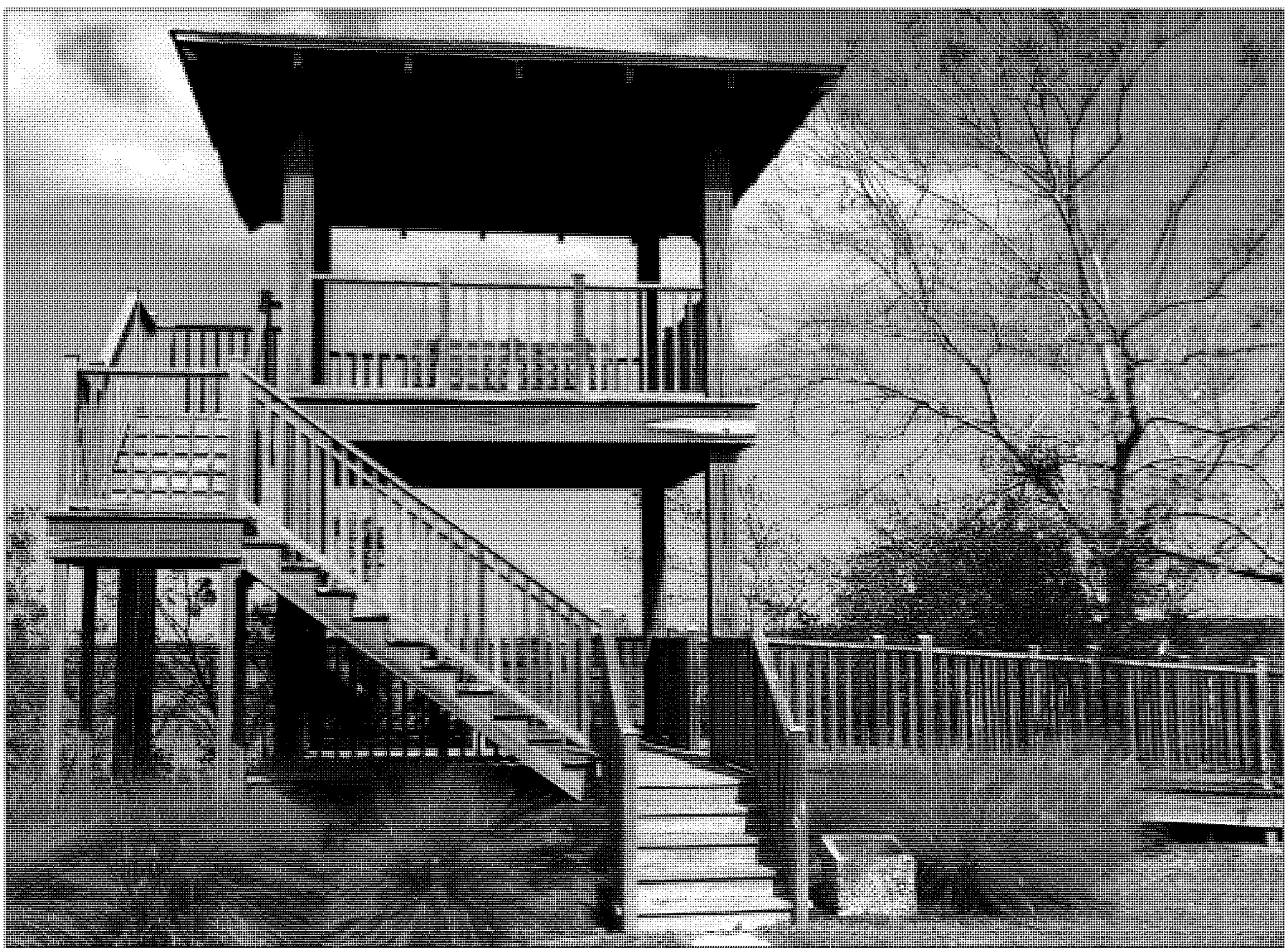

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ATTACHMENT 4

Abstract

Wood is a versatile and sustainable building material but may be vulnerable to fungal decay and insect damage when used outdoors or otherwise subjected to moisture. Pressure treatment with wood preservatives is the most common method of protecting wood from biological deterioration. This publication summarizes characteristics of pressure-treating preservatives and provides guidance for selection of pressure-treated wood for specific applications. It also discusses construction practices, service life expectations, and environmental considerations. The intended audience for this publication is users of pressure-treated wood such as homeowners, builders, contractors, engineers, and architects.

Keywords: Pressure treatment; wood preservatives; selection; specification; standards

Contents

Conversion table

English unit	Conversion factor	SI unit
inch (in.)	2.54×10^1	millimeter (mm)
$T_{°F}$	$T_{°C} = (T_{°F} - 32)/1.8$	$T_{°C}$
Nominal lumber size (in.)		Standard lumber size (mm)
2 by 4 (actual 1.5 by 3.5)		38 by 89
2 by 8 (actual 1.5 by 7.5)		38 by 184
4 by 4 (actual 3.5 by 3.5)		89 by 89
6 by 6 (actual 5.5 by 5.5)		140 by 140

December 2019

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The Forest Products Laboratory is maintained in cooperation with the University of Wisconsin.

ATTACHMENT 4

Guidelines for Selection and Use of Pressure-Treated Wood

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Introduction

Wood is one of the oldest and most versatile building materials. Today, wood is widely used for construction because of its unique combination of availability, high strength-to-weight ratio, and ease of machining. Wood is also being recognized for its value as a sustainable building material; the harvesting and production of structural wood products requires much less energy, and thus emits substantially less carbon dioxide, than does the harvesting and production of alternative building materials. It is estimated that the amount of carbon dioxide emitted to produce a ton of concrete or steel is 8 to 21 times greater than that to produce a ton of framing lumber (Falk 2010). Wood is also a renewable resource, and for more than 50 years, the volume of timber growing stock in U.S. forest lands has continued to increase. As of 2012, the volume of annual net growth was two times greater than the volume of annual removals (Oswalt 2014).

Wood is also a biodegradable material, and this plays an important and positive role in natural ecosystems. However, biodegradability can present challenges when a material is expected to provide many decades of service as a structural product. Fortunately, damage from most wood deterioration organisms is minimal, as long as wood is kept dry, and this continues to be the basis for use of wood in most structures. Although, protecting structural wood products from moisture is not always practical, and there are some situations in which even wood that is relatively dry may be attacked by fungi, termites, or wood-boring insects. In these situations, durable wood products must be used to ensure a satisfactory service life. Typically, this durability is imparted by pressure treatment with preservatives that protect the wood from a wide range of wood-degrading organisms. Both hardwoods (such as red oak) and softwoods (such as pine) are pressure-treated with preservatives for a range of applications. Pressure-treated softwood lumber is widely available at lumber yards, and softwoods are also commonly used for poles and pilings. Pressure-treated hardwoods are used extensively in railroad construction, as well as other applications in which the qualities of hardness and abrasion resistance are particularly useful.

Pressure-treating preservatives are often broadly grouped as either waterborne or oilborne. Although creosote is not actually oilborne, it has properties similar to oilborne preservatives and is often grouped with oilborne preservatives. The use of waterborne versus oilborne preservatives depends on the type of exposure and end-use requirements. Waterborne preservatives typically have little odor and leave the wood with a dry, paintable surface. They are used for a wide range of applications including treated lumber sold by lumber yards for construction of residential decks and fences. Oilborne treatments have the advantage of imparting some water repellency to the wood and can help protect metal fasteners from corrosion. They may have an odor and are most commonly used for heavy-duty industrial applications.

Selection of a type of pressure-treated wood depends on the species of wood being treated, the type of wood product, and the requirements of the specific application. To guide the selection process, the American Wood Protection Association (AWPA) publishes the Use Category System (UCS), which categorizes treated wood applications by the severity of the exposure, as well as the structural significance of the application. Ancillary properties of wood preservatives such as odor or compatibility with a wood species, should also be considered when selecting preservatives. Construction and design practices can extend durability by minimizing traps for moisture, minimizing field cuts, and applying supplemental preservatives to saw cuts and bolt holes that expose untreated wood during construction. The expected service life of pressure-treated structures depends on a number of factors, including type of structure and location. With proper selection of preservatives and construction detailing, wood structures often outperform durability estimates and outlast usefulness before succumbing to biological deterioration. Similar to many other construction materials, preservative-treated wood contains chemicals that could potentially harm the environment if released in sufficient quantities. However, research indicates that for most applications, the amount of chemical released from preservative-treated wood is too low to be a concern. An online screening assessment tool is available to evaluate the potential of environmental effect for projects that use large volumes of treated wood in sensitive aquatic habitats. The risk of environmental impacts can be further decreased by specifying treatment in accordance with best management practices for wood used in aquatic environments.

When is Pressure-Treated Wood Needed?

In general, some type of biological deterioration may occur in any untreated portion of a structure in which wood moisture content above 20% to 25% and oxygen are present for sustained periods. Moist wood is required or preferred for most degrading organisms. Decay fungi require a moisture content of at least 20% to sustain any growth, and higher moisture contents (greater than 29%) are required for initial spore germination (Clausen 2010, Zabel and Morrell 1992). Because decay fungi also require oxygen, wood that is continually immersed in water does not suffer damage from decay fungi, although this wood can very slowly degrade because of anaerobic bacteria. This accounts for the longevity of submerged wood in some types of nonseawater structures and the subsequent onset of decay when water levels decline. However, ample oxygen and moisture for decay are almost always present in wooden members placed in contact with the ground or above the waterline area of members placed in freshwater. Even in very dry climates, wood in contact with the ground has sufficient moisture for decay. In moist climates, there is also sufficient moisture for decay in members that are not in contact with soil or water if they are not protected from precipitation. Liquid water is rapidly absorbed in end-grain during rain events, and subsequent drying can be slowed if air movement is limited in that area. Wood that rests on concrete or masonry near the ground may absorb sufficient moisture for biodeterioration even if protected from other sources of wetting.

Although moisture is the most important risk factor for biodeterioration, in some situations, dry wood can be vulnerable to attack by termites and other insects. Native subterranean termites require moisture but can attack wood with moisture content well below the fiber saturation point (about 30% moisture content) by building shelter tubes from the soil and periodically returning to the soil to replenish water lost from their bodies. Native subterranean termites are widely distributed in the United States with heaviest populations in the Southeast. The introduced Formosan termite is an invasive species that has become established in Hawaii and along coastal regions of the southeastern United States, where it continues to slowly expand its range northward. Formosan subterranean termites also require a source of moisture to attack wood above ground but are less reliant on proximity to soil for survival. Formosan termites may establish colonies on upper floors of buildings if a consistent source of moisture is present. Drywood termites are so-named because they can survive in wood structures above ground, deriving moisture solely from the wood. Structural infestations of drywood termites occur in Hawaii and across the most southern states of the United States from coastal regions of southern California through Texas and Florida. In regions with a particularly severe termite hazard, using pressure-treated lumber for interior construction is at least advisable and in some cases may be required by building codes.

Wood immersed in seawater requires pressure treatment with preservative for protection against various types of marine borers. The three most destructive groups in the United States are shipworms, boring clams, and gribbles. Shipworms and the less commonly found boring clams are both bivalve mollusks, related to oysters and mussels, whereas gribbles are isopod crustaceans. Unlike the boring clams and gribbles, which attack wood near exterior surfaces producing visible damage that can be monitored, the damage from shipworms can go undetected until it becomes catastrophic. The reason for this is that shipworms eat away at the interior of wood members creating tunnels as they grow, but because they enter the wood as small larvae, the exterior appears undamaged. Unlike decay fungi and termites, marine borers can attack wood with low oxygen levels, and thus, constant immersion does not provide protection. The number of species of destructive borers increases in warmer waters, but at least one species of destructive borer is present in all U.S. coastal waters (Clausen 2010).

In structures complying with building codes, use of a preservative-treated or naturally durable wood is required for some members. Examples include joists within 18 in. of the soil beneath a structure, sill plates, and posts or columns resting on concrete. More specific information on code requirements for use of pressure-treated wood can be found in the International Building Code and International Residential Code (ICC 2018). This is a model code; therefore, states or local governments may have modifications. Depending on the use and custodianship of the structure, other standards such as those of the American Association of State Highway and Transportation Officials (AASHTO 2016) or federal or state agencies may govern specifications for pressure-treated wood.

What are Pressure-Treating Preservatives?

Because the term "wood preservative" is applied to a broad range of products, there is often confusion or misunderstanding about the types of products being described. The term preservative is sometimes applied to water-repellents, hardeners, or finishes whose purpose is to maintain the appearance or stability of a wood product. For additional information on surface-applied water-repellents and finishes, see Williams (2010). In this guide, we consider wood preservatives to be substances that extend the useful service life and structural integrity of wood products by protecting them from fungal and insect attack. Such wood preservatives are generally chemicals that are either toxic to wood-degrading organisms and/or cause some change

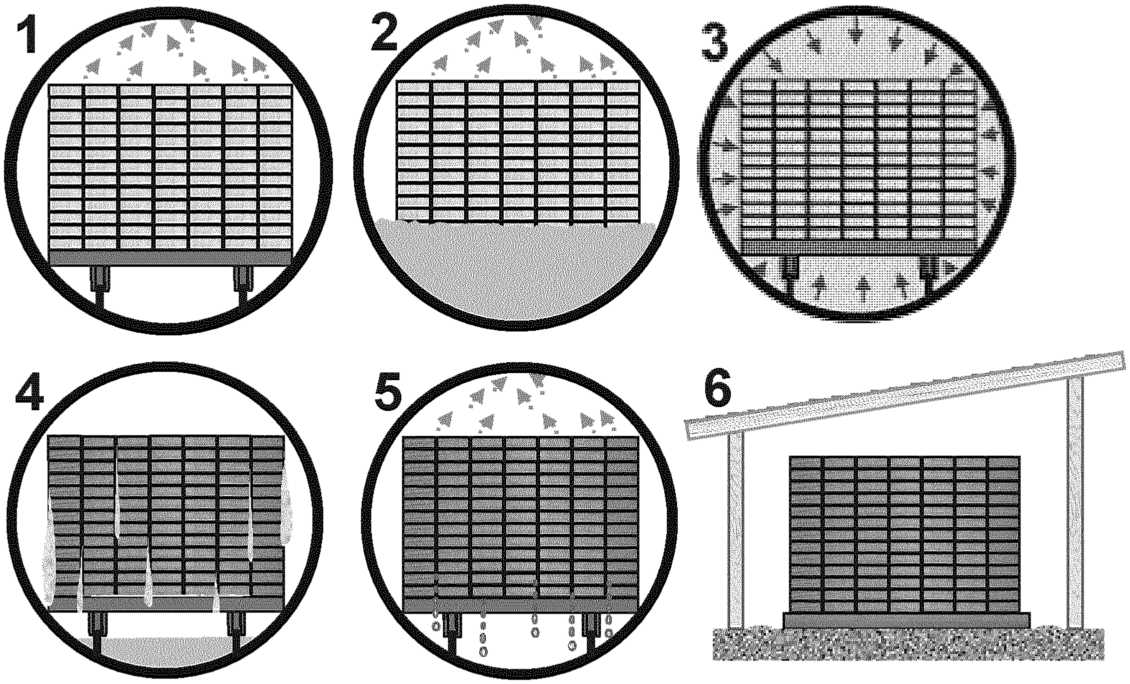

Figure 1. A typical pressure-treatment process with waterborne preservatives includes (1) pulling an initial vacuum to remove air from the wood cells, (2) filling the cylinder with preservative while maintaining the vacuum, (3) releasing the vacuum and applying pressure to force preservative into the wood, (4) releasing the pressure and emptying the cylinder, (5) pulling a final vacuum to remove excess preservative, and (6) storing on a covered drip pad.

in wood properties that renders the wood less vulnerable to biodegradation. Most contain biocide ingredients and meet the definition of a pesticide under federal law, and as such, must have registration with the U.S. Environmental Protection Agency (EPA) as well as state or territory lead agencies.

The greatest volume of wood preservatives is used in the pressure treatment of wood at specialized treatment facilities. In these treatment plants, bundles of wood products are placed into large pressure cylinders and combinations of vacuum, pressure, and sometimes heat are used to force the preservative deeply into the wood (Fig. 1). Pressure-treated wood typically has much deeper and more uniform preservative penetration than wood treated by other methods. Pressure-treating preservatives and pressure-treated wood also undergo review by standard-setting organizations to ensure that the resulting product will be sufficiently durable in the intended end-use. Standards also apply to treatment processes and require specific quality control and quality assurance procedures for the treated wood product (AWPA 2018). This level of oversight is needed because pressure-treated wood is often used in structural applications in which it is expected to provide service for decades and premature failure could result in injury or death.

Preservatives are not always applied by pressure treatment. In some cases, preservatives may be brushed on the surface of the wood or applied to holes drilled into large wooden members. A major limitation of these nonpressure treatments is that the preservative is not forced deeply into the wood under pressure, and thus, a much lower proportion of the wood volume is protected with preservative. This is not to suggest that nonpressure preservatives do not have a role in wood protection. They can be of great value when used as in-place treatments to supplement wood that was initially pressure-treated. Nonpressure treatments are beyond the scope of this guide, but a detailed discussion on their use can be found in Lebow and others (2012).

Characteristics of Pressure-Treating Preservatives

Pressure-treating preservatives are often broadly divided into two groups depending on whether they are waterborne or oilborne. Although creosote is not an oilborne preservative, it is often grouped with oilborne preservatives because of the similarity in properties. Typically, a concentrated formulation of active ingredient(s) is provided to the pressure-treatment facility, and that concentrate is then diluted with water or oil before treatment. An exception is creosote, which is often used without dilution. The distinction between waterborne and oilborne preservatives is sometimes blurred, however, because some can be formulated for use with either type of carrier.

Figure 2. Lumber pressure-treated with waterborne preservatives is an important component of residential construction.

Waterborne Preservatives

Waterborne preservatives typically have little odor and leave the wood with a dry, paintable surface. They are used for a wide range of applications, including the treated lumber sold by lumber yards for construction of residential decks (Fig. 2) and fences. Some waterborne preservatives are also used for more industrial-type applications, such as poles, piling, and bridge timbers. Most waterborne preservatives have some type of chemical mechanism, which makes the active ingredients resistant to leaching in rainfall or standing water.

Waterborne preservatives typically contain at least two active ingredients, which makes them effective against a range of decay fungi and insects. The ratio of these active ingredients in any particular preservative depends on efficacy determined in testing, formulation stability, cost, and other factors. Years of laboratory and field tests were conducted during the development of preservative formulations. Many waterborne preservatives contain copper as an active ingredient. Copper is effective against most types of decay fungi as well as major insect pests and has low toxicity for mammals. However, certain types of copper-tolerant decay fungi can sporadically cause severe and rapid damage in wood treated with copper. Thus, commercial copper-based preservatives typically include a co-biocide (e.g., quaternary ammonium compounds, triazoles, or naphthenic acids) to provide additional protection. In some situations, waterborne preservatives containing copper are less effective in protecting hardwoods than softwoods, leading to less common use in hardwoods. The color of wood treated with copper-based preservatives varies from light green to greenish brown, although in some cases, stains or colorants are used to create an appearance more similar to cedar or redwood. More recently, some waterborne preservatives have also been formulated without copper for use in above-ground applications in which the decay hazard is typically less severe. These treatments impart little color change to the wood.

Alkaline Copper Betaine (KDS and KDS-B)

Alkaline copper betaine is an example of a preservative formulation that utilizes copper solubilized with ethanolamine along with polymeric betaine and borate (KDS) or polymeric betaine (KDS-B). The active ingredient composition for KDS is 47% copper oxide, 23% polymeric betaine, and 30% borate as boric acid, whereas KDS-B has 68% copper oxide and 32% polymeric betaine. Both are standardized by AWPA for treatment of commodities used above ground and for posts in contact with soil. AWPA standards do not currently list KDS for critical structural components in ground contact.

Alkaline Copper Quat (ACQ-A, ACQ-B, ACQ-C, ACQ-D)

Alkaline copper quat (ACQ) contains copper and a quaternary ammonium compound (quat). Multiple variations of ACQ are standardized. ACQ-A differs in that it has 50% copper oxide and 50% quat, whereas the other formulations have 67% copper oxide and 33% quat. ACQ-B is an ammoniacal copper formulation, whereas ACQ-D is an ethanolamine and/or ammoniacal-copper formulation. ACQ-C is a combined ammoniacal-ethanolamine formulation with a slightly different quat compound. The multiple formulations of ACQ allow some flexibility in achieving intended treating results for specific wood species and applications. When ammonia is used as the carrier, ACQ has improved ability to penetrate difficult to treat wood species. However, if the wood species is readily treatable, such as pine sapwood, an amine carrier is typically used.

Ammoniacal Copper Zinc Arsenate (ACZA)

ACZA is a waterborne preservative that contains copper oxide (50%), zinc oxide (25%), and arsenic pentoxide (25%). It is a refinement of an earlier formulation, ammoniacal copper arsenate (ACA), which is no longer in use. The color of the treated wood varies from brown to bluish green. The wood may have a slight ammonia odor until it is thoroughly dried after treatment. The ammonia in the treating solution, in combination with processing techniques such as steaming and extended pressure periods, allows ACZA to obtain better penetration of difficult-to-treat wood species than many other waterborne wood preservatives. ACZA has been commonly used for treatment of Douglas-fir poles, piles, and large timbers. It can also be used for treated wood placed in seawater.

Chromated Copper Arsenate (CCA)

CCA composition in terms of active ingredients is 47.5% chromium oxide, 18.5% copper oxide, and 34% arsenic pentoxide. Wood treated with CCA (commonly called "green treated") dominated the treated wood market from the late 1970s until 2004. However, as the result of voluntary label changes submitted by the CCA registrants, the EPA labeling of CCA currently permits the product to be used for industrial and certain agricultural applications only, and CCA-treated lumber is not available at retail lumber yards for residential use. It is important to note that existing structures are not affected by this labeling change, and that the EPA has not recommended removing structures built with CCA-treated lumber. Examples of common uses for new installations include sawn crossarms, round poles, piles, agricultural fencing and posts, plywood, and wood used in seawater or in highway construction. Use for permanent wood foundations is also allowed. The chromium in CCA helps to mitigate metal fastener corrosion sometimes associated with the use of solubilized copper.

Copper Azole (CA-B, CA-C, MCA, and MCA-C)

Copper azole is a formulation composed of copper (96%) and 4% triazole compounds. The triazole is either tebuconazole or a 50:50 mixture of propiconazole and tebuconazole (C designation). Copper azole may be prepared with copper solubilized in ammonia and/or ethanolamine (CA-B and CA-C) or with the copper ground to very fine particles (micronized), which are then dispersed in the treatment solution with surfactants (MCA and MCA-C). Wood treated with the particulate formulations tends to have a lighter color than that treated with soluble copper formulations. Both types of copper azole formulations are commonly used to pressure-treat decking and dimension lumber commonly found at lumber yards but are also standardized for treatment of posts, poles, and timbers. Copper azole formulations using particulate copper may be less corrosive to metal fasteners than the soluble copper formulations.

Copper HDO (CX-A)

Copper HDO or CX-A is an ethanolamine copper waterborne preservative that has been used in Europe and is standardized in the United States. It is also referred to as copper xyligen. The active ingredients are copper oxide (61.5%), boric acid (24.5%), and HDO (N-cyclohexyldiazeniumdioxide) (14.0%). The appearance and handling characteristics of wood treated with CX-A are similar to the other amine copper-based treatments. Currently, CX-A is standardized by AWPA only for applications that are not in direct contact with soil or water. It has seen little commercial use in North America but is used to some extent in Europe.

EL2

EL2 is an emulsion form of waterborne preservative composed of the fungicide 4, 5-dichloro-2-N-octyl-4-isothiazolin-3-one (DCOI), the insecticide imidacloprid, and a moisture control stabilizer (MCS). The percentage active ingredient composition is 98% DCOI and 2% imidacloprid, but the MCS is also considered to be a necessary component to ensure preservative efficacy. EL2 is currently listed in AWPA standards for above-ground applications only and is most commonly used to treat decking and dimension lumber for residential applications. Moisture control stabilizers are incorporated into the treatment solution to lessen checking and splitting. The treatment is essentially colorless.

Inorganic Boron (Borate) (SBX)

Borates are unusual among waterborne preservatives because they remain water soluble in the wood after pressure treatment. They include formulations prepared from sodium tetraborate, sodium pentaborate, and boric acid, but the most common form is disodium octaborate tetrahydrate (DOT). DOT has greater water solubility than many other forms of borate, allowing the use of higher

Figure 3. Creosote is often used for pressure treatment of railroad ties.

solution concentrations and increasing the mobility of the borate through the wood. Borates are used for pressure treatment of framing lumber that will be used in areas with high termite hazard, such as Hawaii. With the use of heated solutions, extended pressure periods, and diffusion periods after treatment, DOT is able to penetrate relatively refractory species, such as spruce. Although boron has many potential applications in framing lumber, it is not suitable for applications in which it is exposed to frequent wetting unless the boron can be somehow protected from liquid water. An exception is recent developments in the use of boron formulations as a pretreatment for railroad crossties and switch ties prior to pressure treatment with creosote or copper naphthenate. In this case, the boron is intended to diffuse deeply in the wood and protect the interior of the tie while the subsequent creosote or oil treatment protects the exterior of the tie and helps to lessen boron depletion in service. Wood treated with borates is colorless. However, some borate treaters use a dye to color the wood for easier field identification.

Propiconazole-Tebuconazole-Imidacloprid (PTI)

PTI is a waterborne preservative solution composed of two fungicides (propiconazole and tebuconazole) and the insecticide imidacloprid. PTI is currently listed in AWPA standards for above-ground applications only. The efficacy of PTI is enhanced by the incorporation of a water-repellent stabilizer in the treatment solutions, and lower retentions are allowed if the stabilizer is used. The treatment is essentially colorless.

Oilborne Preservatives, Including Creosote

Oilborne preservatives are dissolved in either heavy or light oils. Heavy oil is similar to diesel, whereas light oil is similar to mineral spirits. The properties and applications of oilborne preservatives depend on the type of oil used. Heavy oil treatments are typically used for heavy-duty applications, such as utility poles, bridge timbers, and railroad ties (Fig. 3). Heavy oil treatments have the advantage of imparting some water-repellency to the wood and can help protect metal fasteners from corrosion. However, wood that has been pressure-treated with heavy oils may have a noticeable odor and should not be used in the interior of inhabited structures. Light oil treatments are sometimes used when it is desirable that the wood have a drier surface and less residual odor. Oilborne treatments are typically used to treat glue-laminated timbers (when treated after lamination) because they do not swell the wood as do waterborne preservatives. Oilborne preservatives are effective in protecting hardwoods at retentions similar to those used in softwoods. Creosote is grouped with the oilborne preservatives in this guide, although it is not always diluted with oil. Currently, there are fewer oilborne preservatives than waterborne preservatives.

Creosote (CR, CR-S, CR-PS)

Coal-tar creosote is the oldest wood preservative still in commercial use and remains the primary preservative used to protect wood used in railroad construction. It is made by distilling the coal tar that is obtained after high-temperature carbonization of coal. Unlike the other oil-type preservatives, creosote is not always dissolved in oil, but it does have properties that make it look and feel oily. In AWPA standards, creosote is further differentiated as either coal tar distillate (CR), a solution of coal tar in coal tar distillate (CR-S), or a 50:50 creosote–petroleum solution combination (CR-PS). Creosote-treated wood has a dark brown to black color and a noticeable odor and is often not the first choice for applications in which there is a high probability of human contact. Creosote is effective in protecting both hardwoods and softwoods and is thought to improve the dimensional stability of the treated wood. It is used in the pressure treatment of utility poles, bridge timbers, railroad ties, agricultural fences, guardrails for highway construction, and glue-laminated timbers. Creosote is also effective in protecting wood used in seawater environments (in northern latitudes) and is often used to treat marine piles. With the use of heated solutions and lengthy pressure periods, creosote can be fairly effective at penetrating even difficult-to-treat wood species. Creosote treatment does not accelerate, and may even inhibit, the rate of metal fastener corrosion compared with untreated wood.

Oxine Copper (Cu8)

Copper-8-quinolinolate or oxine copper is an organometallic compound that has been used for pressure treatment of wood exposed above ground or above water but not in contact with the ground or immersed in water. Copper-8-quinolinolate has a relatively low toxicity to mammals, and the light oil formulation has sometimes been used for parts of a structure in which human contact is expected, such as hand rails of pedestrian bridges. The treated wood has a greenish-brown color.

Pentachlorophenol (PCP-A, PCP-C)

Pentachlorophenol has been widely used as a pressure treatment since the 1940s. The active ingredients, chlorinated phenols, are crystalline solids that can be dissolved in different types of organic solvents. The performance of pentachlorophenol, and the properties of the treated wood, are influenced by the properties of the solvent. The heavy oil solvent (PCP-A) may be preferable when the treated wood is to be used in ground contact because wood treated with lighter solvents (PCP-C) may not be as durable in such exposures. Wood treated with pentachlorophenol in heavy oil typically has a brown color and may have a slightly oily surface that is difficult to paint. It also has some odor, which is associated with the solvent. As with creosote, pentachlorophenol in heavy oil is not the first choice for applications in which frequent contact with skin is likely (e.g., hand rails). Pentachlorophenol in heavy oil has long been a common choice for treatment of utility poles, bridge timbers, glue-laminated timbers, and foundation piling. As with creosote, pentachlorophenol is effective in protecting both hardwoods and softwoods and is often thought to improve the dimensional stability of the treated wood. Unlike creosote, pentachlorophenol is not used in marine–saltwater environments. With the use of heated solutions and extended pressure periods, pentachlorophenol is fairly effective at penetrating difficult-to-treat species. It does not accelerate corrosion of metal fasteners compared with untreated wood, and the heavy oil solvent helps to impart some water-repellency to the treated wood.

Copper Naphthenate (CuN, CuN-W)

The preservative efficacy of copper naphthenate has been known since the early 1900s, and various formulations have been used commercially since the 1940s. It is an organometallic compound formed as a reaction product of copper salts and petroleum-derived naphthenic acids or a blend of naphthenic acid and other carboxylic acids. It is also often recommended for field treatment of cut ends and holes drilled during construction with pressure-treated wood. Copper-naphthenate-treated wood initially has a green color that weathers to light brown. The treated wood also has an odor that dissipates somewhat with time. Depending on the solvent used and treatment procedures, it may be possible to paint copper-naphthenate-treated wood after it has been allowed to weather for a few weeks. As with pentachlorophenol, copper naphthenate can be dissolved in a variety of solvents but has greater efficacy when dissolved in heavy oil. Copper naphthenate is used in the pressure treatment of utility poles, bridge timbers, glue-laminated timbers, and railroad ties. It is not used for treatment of wood used in seawater. A waterborne formulation of copper naphthenate (CuN-W) is also standardized for some applications, but wood pressure-treated with waterborne copper naphthenate is currently less available than wood with the oilborne formulation.

DCOI

The oilborne formulation of DCOI uses the same active ingredient (4, 5-dichloro-2-N-octyl-4-isothiazolin-3-one) as the waterborne emulsion formulation EL2. DCOI is soluble in the types of oils used for wood preservation and is standardized for treatment of posts and pole cross-arms with heavy oil. In contrast to other oilborne preservatives, diluted DCOI is nearly colorless and the treated wood has little color change other than that imparted by the oil.

IPBC/PER

IPBC/PER has an active ingredient composition of 64% of the fungicide 3-iodo-2-propynyl butyl carbamate (IPBC) with 36% permethrin (PER) included to prevent insect attack. It has been standardized for light solvent for treatment of glue-laminated timbers that extend outside a structure but are partially protected by a roof overhang. The treatment is clear, allowing the wood to maintain its natural appearance. It is not currently standardized to treat wood that is fully exposed to the weather.

Figure 4. Ground-contact stake testing is conducted for years as part of evaluating a wood preservative.

Inorganic Boron (SBX-O)

A fairly recent development in use of boron for pressure treatment is the formulation of boric acid in a manner that allows it to be mixed directly into creosote and creosote solutions for one-step pressure treatment of cross-ties and switch-ties. The creosote acts as the primary preservative to protect the exterior of the tie, while the boron gradually diffuses more deeply into the tie to provide interior protection. Although currently this approach is primarily used for treatment of hardwoods in railroad construction, it may have potential for protection of large timbers used in other types of applications.

Quality Assurance for Pressure-Treated Wood

Before a wood preservative can be approved for pressure treatment of structural members, it must be evaluated to ensure that it provides the necessary durability without adversely compromising the strength properties of the wood. The EPA typically does not evaluate how well a wood preservative protects the wood. Traditionally, this evaluation has been conducted through the standardization process of AWPA, an ANSI-accredited standard setting body (AWPA 2018). The *AWPA Book of Standards* lists a series of laboratory and field exposure tests (Fig. 4) that must be conducted when evaluating new wood preservatives. The durability of test products are compared with those of established durable products and nondurable controls. The results of those tests are then presented to the appropriate AWPA committees for review. AWPA committees are composed of representatives from industry, academia, and government agencies who have familiarity with conducting and interpreting durability evaluations. Preservative standardization by AWPA is a two-step process. If the performance of a new preservative is considered appropriate, it is first listed as a potential preservative. Secondary committee action is needed to have the new preservative listed for specific commodities and to set the required treatment levels for each use category.

More recently, the International Code Council Evaluation Service (ICC-ES) has evolved as an additional route for gaining building code acceptance of new types of pressure-treated wood. In contrast to AWPA, the ICC-ES does not standardize preservatives. Instead, it issues evaluation reports that provide evidence that a building product complies with building codes (ICC-ES 2018). The data and other information needed to obtain an evaluation report are first established as acceptance criteria (AC). AC326, which sets the performance criteria used by ICC-ES to evaluate proprietary wood preservatives, requires submittal of documentation from accredited third-party agencies in accordance with AWPA, ASTM, and EN standard test methods. The results of those tests are then reviewed by ICC-ES to determine if the preservative has met the appropriate AC.

The American Association of State Highway and Transportation Officials (AASHTO) also has a standard specification for Preservatives and Pressure Treatment Processes for Timber, called M 133 (AASHTO 2016). This specification is under the oversight of AASHTO Technical Section 4c - Coatings, Paints, Preservatives,

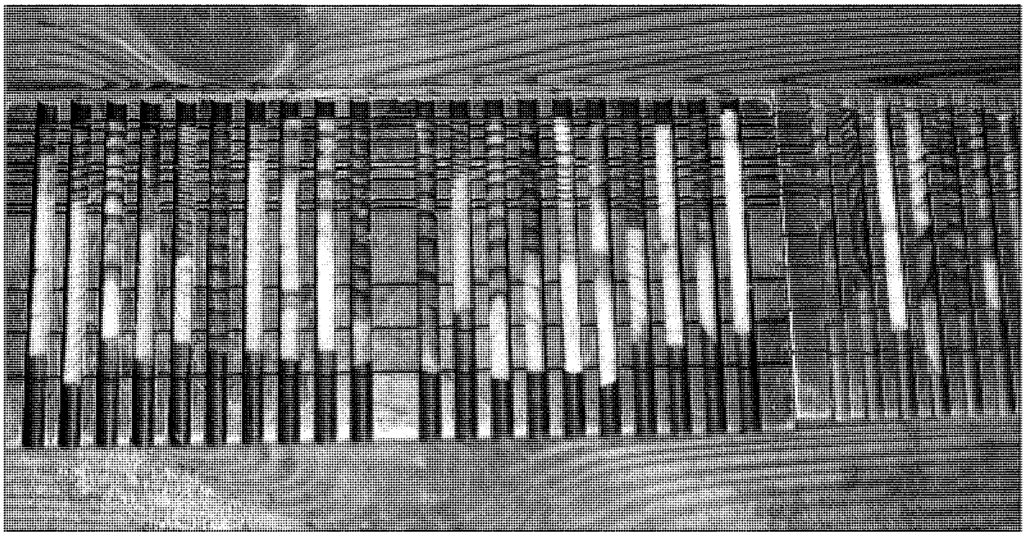

Figure 5. Each pressure-treated charge (cylinder load) of wood is inspected by removing increment cores from 20 or more pieces. Preservative penetration is measured on the cores, and then the portion corresponding to the assay zone is removed for chemical analysis of preservative retention.

Bonding Agents, and Traffic Markings. Unlike AWPA and ICC-ES, AASHTO does not evaluate new preservatives for inclusion in AASHTO M 133. Instead, AASHTO lists some (but not necessarily all) preservatives that have been either standardized by AWPA or have an ICC-ES evaluation report. AASHTO M 133 also refers to AWPA standards or ICC-ES evaluation reports for specifications on treatment processes and limitations.

Specifications on the treatment of various wood products by pressure processes have been developed by AWPA. These specifications limit pressures, temperatures, and time of conditioning and treatment to avoid conditions that will cause damage to the wood. The specifications also contain minimum requirements for preservative penetration and retention levels and recommendations for handling wood after treatment to provide a quality product. However, specifications are broad in some respects, allowing the purchaser some latitude in specifying the details of their individual requirements. Regardless, the purchaser should recognize that their individual requirements cannot stray outside the tolerances that balance treating conditions with quality of the treatment and strength properties of the final product.

Penetration and retention requirements are equally important in determining the quality of preservative treatment. Penetration levels vary, even in pressure-treated material. Generally the outer portion of the tree stem adjacent to the bark (sapwood) is more readily treated with preservatives because sapwood cells function to move sap up and down the tree. In contrast, the darker inner heartwood portion of the stem is difficult to treat for many species. Complete penetration of the sapwood should be the goal in all pressure treatments. It can often be accomplished in small-size timbers of various commercial woods and is sometimes obtained in piles, ties, and structural timbers. Practically, however, the operator cannot always ensure complete penetration of sapwood in every piece when treating large pieces with thick sapwood (such as poles and piles). Accordingly, treatment requirements vary, depending on the preservative, wood species, size, class, and use category.

Preservative retentions are expressed on the basis of the mass of preservative per unit volume of wood within a prescribed assay zone, typically pounds per cubic foot or kilograms per cubic meter. The retention calculation is not based on the volume of the entire piece of wood. Retention is determined by assaying the amount of active ingredients retained in a predetermined assay zone predicated by wood species, size, and AWPA processing standards for the use category. For example, the assay zone for Southern Pine lumber (<2 in. thick) is 0 to 0.6 in. from the wood surface. To determine the retention, a boring is removed from the narrow face (edge) of at least 20 pieces in each charge and these borings are then combined and analyzed for preservative concentration (Fig. 5). Because the borings are combined for analysis, the retention value is similar to an average retention for the pieces in a charge. Individual pieces may have higher or lower retentions.

The preservatives and minimum charge retention levels are listed in the AWPA commodity standards and ICC-ES evaluation reports. The current issues of these specifications should be referenced for up-to-date recommendations and other details (AWPA 2018, ICC-ES 2018). Higher preservative retention levels are specified for products to be installed under severe climatic or exposure conditions. Heavy-duty transmission poles and items with a high replacement cost, such as structural timbers and house

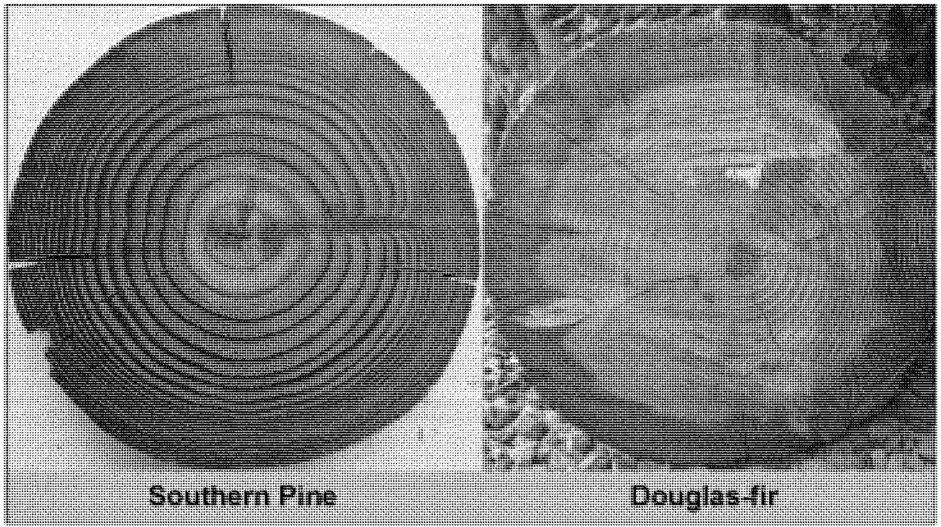

Figure 6. Example of the cross sections of pressure-treated poles showing the greater proportion of treatable sapwood in Southern Pine compared with Douglas-fir.

foundations, are also required to be treated to higher retention levels.

Fortunately, the end-user does not need to become an expert in treated wood specifications. The UCS standards developed by AWPA simplify the process of finding appropriate preservatives and preservative retentions for specific end-uses. To use the UCS standards, one needs only to know the intended end-use of the treated wood. An end-user would first refer to AWPA Standard U1, table 3-1, where most types of applications for treated wood are listed. They will then be shown the use category and directed to the appropriate commodity specification. The AWPA commodity specification lists all the preservatives that are standardized for each use category, as well as the appropriate preservative retention and penetration requirements. However, the user needs only to specify that the product be treated according to the appropriate use category.

As the treating industry adapts to the use of new types of wood preservatives, it is more important than ever to ensure that wood is being treated to standard specifications. In the United States, the U.S. Department of Commerce American Lumber Standard Committee (ALSC) accredits third-party inspection agencies for treated wood products. Quality control overview by ALSC-accredited agencies is preferable to simple treating plant certificates or other claims of conformance made by the producer without inspection by an independent agency. Updated lists of accredited agencies can be obtained from the ALSC website at http://www.alsc.org. The use of treated wood with such third-party certification may be mandated by applicable building code regulations. Wood that is treated in accordance with these quality assurance programs will have a stamp or end tag with the quality mark of an accredited inspection agency.

Detailed specifications on the different treatments can be found in the applicable standards of AWPA.

Selecting a Type of Treated Wood

The type of preservative that is most appropriate depends on the species of wood being treated, the type of wood product, and the requirements of the specific application. Ancillary properties of a preservative, such as odor, may also affect its suitability for an application. For example, lumber treated with creosote or oilborne preservatives is not standardized for interior residential applications. Also, not all standardized preservatives are readily available in all areas of the United States. Large retail home improvement stores typically only stock one or two types of waterborne preservatives used in residential construction, and wood treated with other types of preservatives may need to be ordered. The type of preservatives available varies geographically and in particular is influenced by the dominant tree species available in a region.

Southern Pine species are most commonly used for pressure treatment because these trees have a high proportion of readily treatable sapwood (Fig. 6). Southern Pine species are also the most widely used for conducting wood preservative research. In some geographic regions, other wood species such as western hemlock, true firs, Douglas-fir, red pine, or ponderosa pine are used. Some of these species are less readily treated with preservatives and may have incising requirements in order to meet penetration specifications. Incising is a process of cutting small slits into the wood before treatment to improve preservative penetration (Fig. 7). Incising can cause reductions in mechanical properties, and adjustments are provided in design specifications (NDS 2018). Douglas-fir, an important structural wood species in the western United States, is less treatable than pine and thus has been standardized with

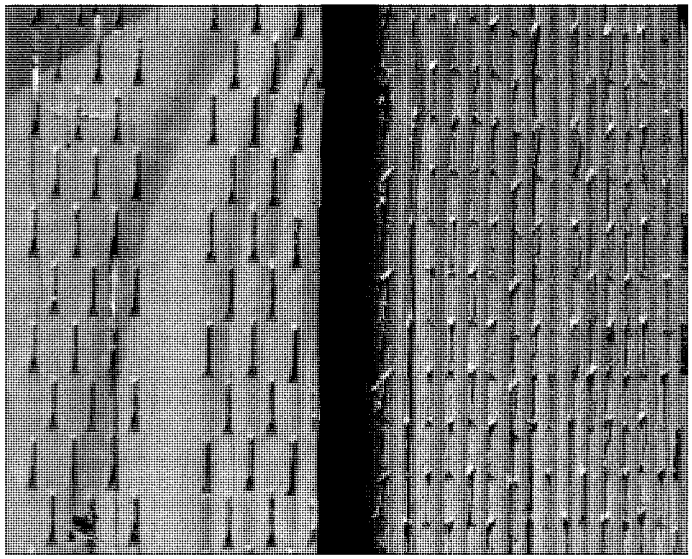

Figure 7. Examples of the appearance of lumber that has been incised prior to pressure treatment to increase the depth and uniformity of preservative penetration.

slightly fewer preservatives. The treatability of Douglas-fir harvested from coastal regions (defined as west of the crest of the Cascade mountain range) tends to be greater than that from the interior west, and in some cases, the standards limit the source of Douglas-fir to coastal areas (AWPA 2018). There are also some traditional differences in preservatives used to treat hardwoods and softwoods. Hardwoods have generally been treated with oilborne preservatives, in part because of concerns that copper-containing waterborne preservatives may be less effective for hardwoods placed in contact with the ground. There are exceptions, however, such as the standardized use of ACZA to treat railroad ties.

Standardized preservatives may also vary by the type of wood product. Sawn lumber is commonly used for many applications and has the greatest number of standardized pressure-treating preservatives. Preservative compatibility may not have been evaluated for some types of wood products, whereas in other cases, there are known concerns with some types of preservatives. For example, waterborne preservatives are generally not standardized for pressure treatment of glue-laminated timbers after gluing (with the exception of ACZA treatment of Douglas-fir) because of concerns that the forces created by water swelling and shrinking the timber could impact its subsequent mechanical properties.

The severity of the deterioration exposure hazard and criticality of the member have the greatest impact on the choices of standardized preservatives and the retention required. For example, direct contact with soil or water is considered a severe deterioration hazard, and preservatives used in these applications must have a high degree of leach resistance and efficacy against a broad spectrum of organisms. These same preservatives may also be used at lower retentions to protect wood exposed in lower deterioration hazards, such as above the ground. The exposure is less severe for wood that is partially protected from the weather, and preservatives that lack the permanence or toxicity to withstand continued exposure to precipitation may be effective in such protected applications. Other formulations, such as borates when used alone, may be so readily leachable that they can only be used where protected from precipitation. The importance of the member also factors into the retention and, in some cases, the types of preservatives that are standardized. For example, because bridge timbers are structurally critical, they warrant a higher retention with fewer standardized preservatives than for more general applications.

To guide selection of the types of preservatives and loadings appropriate to a specific end-use, AWPA developed the UCS standards (Table 1). The UCS standards simplify the process of finding appropriate preservatives and preservative retentions for specific end-uses. They categorize treated wood applications by the severity of the deterioration hazard, as well as the structural significance of the application. The lowest category, Use Category 1 (UC1) is for wood that is used in interior construction and kept dry, whereas UC2 is for interior wood, completely protected from the weather but occasionally damp. UC3 is for exterior wood used above ground and is further subdivided into UC3A and UC3B. UC3A is for products that will be partially protected from the weather, such as siding, whereas UC3B is for products that are fully exposed to the weather, such as deck boards. However, members used above ground for structurally critical applications are sometimes considered to fall under UC4, especially if the conditions

Table 1—Summary of AWPA use categories for pressure-treated wood

Use category	Description[a]
UC1	Interior and dry (insect attack is primary concern)
UC2	Interior but occasionally damp
UC3A	Exterior but partially protected from weather
UC3B	Fully exposed exterior, not structurally critical, moderate decay hazard
UC4A	General ground contact, or above ground for critical members or high decay hazard
UC4B	Heavy duty ground contact or critical members used in any ground contact
UC4C	Severe ground contact and structurally critical
UC5A	Seawater use, northern waters
UC5B	Seawater use, southern waters
UC5C	Seawater use, southern to tropical waters

[a]This table provides only an abbreviated summary. Refer to AWPA standards for full description.

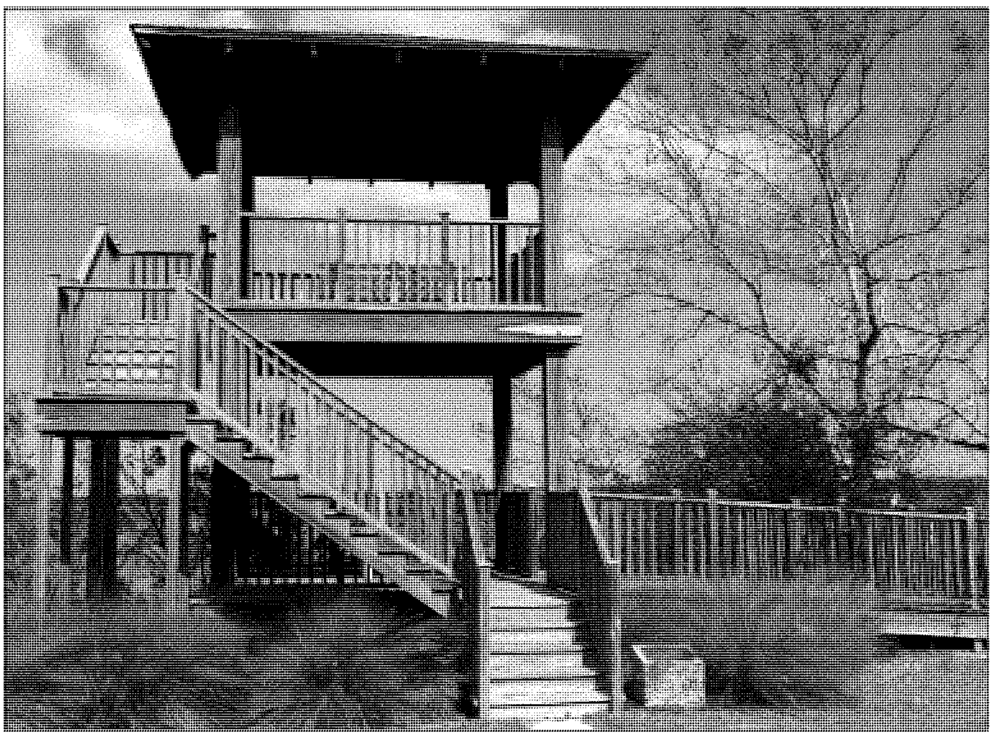

Figure 8. Pressure-treated lumber and sawn timbers are used in a wide range of structures.

at the site create a high decay hazard (e.g., less than 6 in. above ground, poor air circulation, tropical climate). UC4 is for wood used in ground contact or placed into standing water (not including seawater). UC4A is for general use, whereas UC4B and UC4C applications are more structurally critical and/or have a greater decay or termite threat. UC5 includes applications that place treated wood in contact with seawater and marine borers. UC5 is further divided into UC5A, B, and C because types of marine borers vary with water temperature. AWPA Commodity Specifications then list all the preservatives that are standardized for a specific use category and the appropriate preservative retentions.

Sawn Lumber, Sawn Timbers, and Sawn Posts

Sawn material includes a large volume and wide range of types of treated wood products. Most of the pressure-treated wood sold by retailers and used in residential construction falls within this category. Similar dimensions of sawn treated products may be used in applications ranging from decks (Fig. 8) to highway bridges. The types and retentions of wood preservatives used to treat sawn products vary somewhat with the application and, to some extent, wood species (Table 2). For example, the water-soluble borate preservatives are not standardized for exterior applications of sawn lumber, timbers, and posts, whereas some of the

Table 2—General sawn lumber, sawn timbers, and sawn posts (excluding seawater applications). Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use categories by species	Preservatives standardized by AWPA
Southern Pine	
UC1 and UC2	Waterborne: SBX
UC1 through UC3B	Oilborne: Cu8 Waterborne: CX-A, EL2, PTI
UC1 through UC4A	Waterborne: ACQ-A, CuN-W, KDS
UC3B and UC4A	Oilborne: DCOI-A
UC1 through UC4C	Oilborne: CR[a], CR-S[a], CR-PS[a], CuNa, PCP-A, C[a] Waterborne: ACQ-B,C,D, ACZA[b], CA-B,C, CCA[b], MCA, MCA-C
Eastern white, ponderosa, and red pines	Same as Southern Pine except exclude DCOI-A and MCA-C
Douglas-fir	Same as Southern Pine except exclude Cu8, MCA, and MCA-C
Hem–Fir group	Same as Southern Pine except exclude DCOI-A
Other species	There are some other species listed for specific use category/preservative combinations. Refer to AWPA standards.

[a]Not for interior residential use.
[b]ACZA and CCA allowable uses are limited to specific applications by EPA labeling. Most allowable applications fall into UC3B and above.

Table 3—Specific sawn lumber and sawn timbers for highway bridges (UC4C, excluding seawater immersion). Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use category by species	Preservatives standardized by AWPA
Southern Pine and western hemlock	Oilborne: CR, CR-S, CR-PS, CuN, PCP-A,C Waterborne: ACQ-B,C, ACZA, CA-B,C, CCA, MCA, MCA-C
Douglas-fir	Same as Southern Pine except add ACQ-D, exclude MCA and MCA-C
Hem–Fir group	Waterborne: ACQ-C, CA-B,C, MCA, MCA-C

oilborne preservatives are not standardized for interior residential use. A few applications, such as highway bridges, have specific standards within the sawn lumber category. Some of the preservatives standardized for the general sawn lumber applications are not standardized for use in highway bridges (Table 3), and the use category level is increased because of the critical nature of bridge components.

Round Posts and Building Poles

Roundwood posts are widely used for farm and highway fencing, but have a variety of other uses as well (Fig. 9). AWPA standards specify that fence posts be treated to UC4A and list a number of preservatives depending on the wood species (Table 4). Round posts to be used for more structurally critical purposes, such as guardrail posts, should be treated to UC4B. Because of their structural importance, a separate AWPA listing has been created for poles and posts used in buildings (Table 5), all of which fall under the UC4B category.

Utility Poles

Round pressure-treated poles have long been a mainstay of utilities for transmission and distribution of electricity (Fig. 10). Utilities often have their own preferences and specifications for these poles but generally still rely on the AWPA standardization process to define wood species and preservative options. AWPA standards classify utility poles under UC4A, UC4B, or UC4C depending on the deterioration hazard, difficulty of replacement, and criticality (Table 6). As with many other wood products, the largest number of preservatives have been standardized for treatment of Southern Pine poles. Glue-laminated utility poles are also used in some situations and can be designed and installed to maximize properties in a desired direction. Only oilborne preservatives are currently standardized for treatment of glue-laminated utility poles.

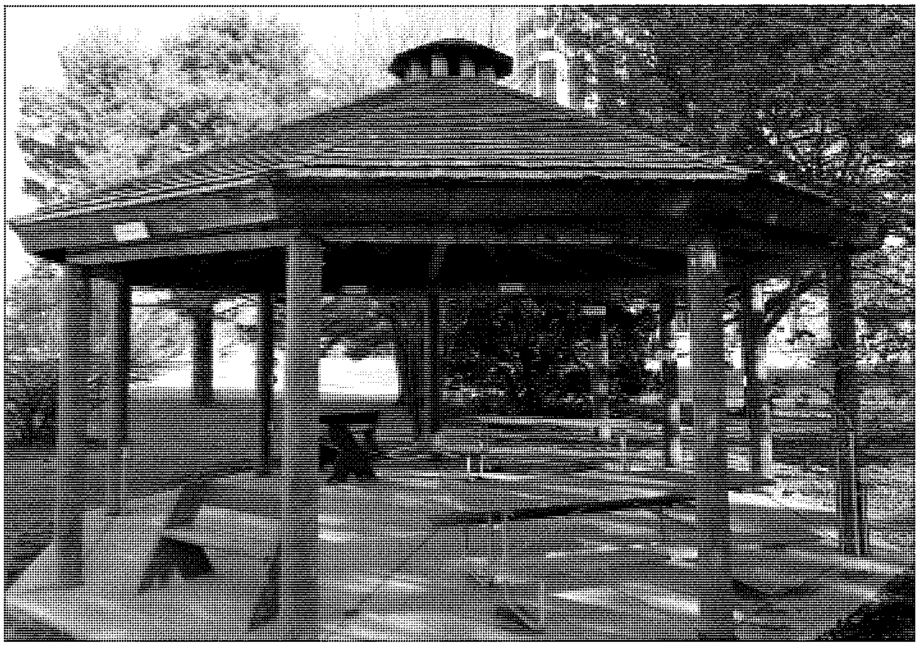

Figure 9. Round building poles and posts are structurally critical and pressure-treated to meet AWPA Use Category 4B.

Table 4—Round posts. Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use categories by species	Preservatives standardized by AWPA
Southern Pine	
UC4A	CuN-W, KDS, MCA-C
UC4A and UC4B	Oilborne: CR, CR-S, CR-PS, CuN, DCOI-A, PCP-A,C Waterborne: ACQ-B,C,D, ACZA, CA-B,C, CCA, MCA
Ponderosa pine	
UC4A and UC4B	Oilborne: CR, CR-S, CR-PS, CuN, PCP-A,C Waterborne: ACQ-B, ACZA, CCA
Lodgepole pine	
UC4A and UC4B	Oilborne: CR, CR-S, CR-PS, PCP-A,C Waterborne: ACQ-C, ACZA, CA-B,C CCA
Red pine	
UC4A and UC4B	Oilborne: CR, CR-S, CR-PS, CuN, DCOI-A, PCP-A,C Waterborne: ACQ-C, ACZA, CA-B,C, CCA
Douglas-fir	
UC4A	Oilborne: CR, CR-PS, CuN, PCP-A,C Waterborne: ACQ-B, ACZA, CCA, KDS
UC4B	Oilborne: CR, CR-S, CR-PS, CuN, DCOI-A, PCP-A,C Waterborne: ACQ-B, ACZA, CCA
Other species	There are some other species listed for specific use category/ preservative combinations. Refer to AWPA standards.

Table 5—Round building posts and poles (UC4B). Preservatives standardized by AWPA by wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Southern Pine	Oilborne: CR, DCOI-A, PCP-A,C Waterborne: ACZA, CA-B,C, CCA, MCA
Ponderosa pine	Oilborne: CR, PCP-A,C, Waterborne: ACZA, CCA
Red pine	Oilborne: CR, DCOI-A, PCP-A,C Waterborne: ACZA, CA-B,C, CCA
Douglas-fir	Oilborne: CR, PCP-A,C Waterborne: ACZA, CCA

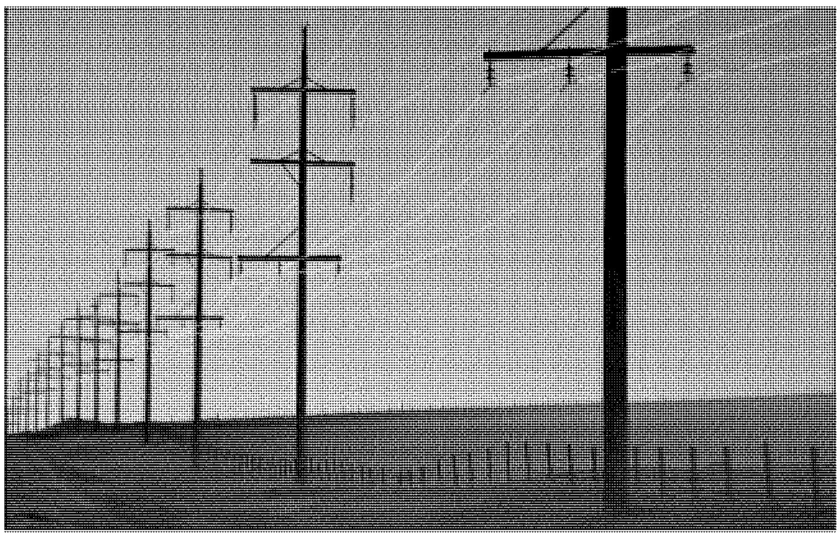

Figure 10. Pressure-treated poles are widely used to support transmission and distribution of electricity.

Table 6—Utility poles. Preservatives standardized by AWPA by wood species. In each case, the preservatives listed are standardized for UC4A, UC4B, and UC4C, although retentions may differ by use category. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Round utility poles	
Southern Pine	Oilborne: CR, CR-S, CuN, DCOI-A, PCP-A,C Waterborne: ACQ-B, ACZA, CA-B,C, CCA, MCA
Douglas-fir and red pine	Oilborne: CR, CR-S, CuN, DCOI-A, PCP-A,C Waterborne: ACQ-B, ACZA, CCA
Ponderosa, lodgepole, and jack pine	Oilborne: CR, CR-S, CuN, PCP-A,C Waterborne: ACQ-B, ACZA, CCA
Western redcedar	Oilborne: CR, CR-S, CuN, PCP-A,C Waterborne: ACQ-B, ACZA, CA-B, C, CCA
Western larch	Oilborne: CR, CR-S, PCP-A,C Waterborne: ACQ-B, ACZA, CCA
Other species	There are some other species listed for specific use category/ preservative combinations. Refer to AWPA standards.
Glue-laminated utility poles	
Southern Pine and Douglas-fir	Oilborne: CR, PCP-A,C, CuN

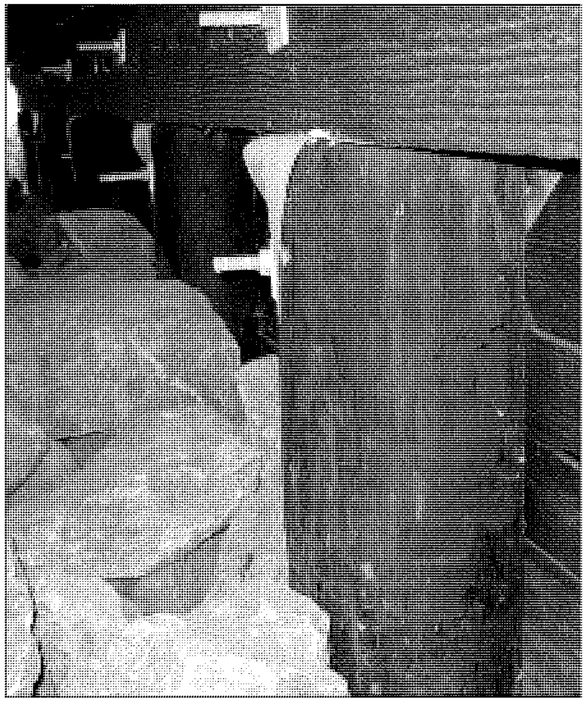

Figure 11. Pressure-treated round support piles used in applications such as this highway bridge are structurally critical and have a high decay hazard. They are treated to meet AWPA Use Category 4C.

Table 7—Round piles (UC4C). Preservatives standardized by AWPA by wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Southern Pine	Oilborne: CR, CR-S, CR-PS, CuN, PCP-A,C Waterborne: ACQ-C, ACZA, CA-B,C, CCA, MCA
Douglas-fir	Oilborne: CR, CR-S, CR-PS, CuN, PCP-A,C Waterborne: ACZA, CCA
Ponderosa, red, lodgepole, and jack pines, western larch	Oilborne: CR, CR-S, CR-PS, PCP-A,C Waterborne: ACZA, CCA

Round Piles (Foundation, Land, and Freshwater)

Round timber piles are almost always used in structurally critical applications and in many cases are difficult to replace (Fig. 11). As such, they are expected to be highly durable, and AWPA standards place them into UC4C (Table 7).

Plywood

Softwood plywood glued with exterior adhesive is routinely pressure-treated with wood preservatives and has been standardized with numerous preservatives. AWPA standards do not currently cover treatment of hardwood plywood. Although softwood species used in the plywood are not specified in AWPA standards, most softwood plywood is either Southern Pine or Douglas-fir (FPL 2010, Chapter 11). Good preservative penetration into plywood is usually possible because plywood is relatively thin and because the lathe checks formed during peeling create pathways for preservative flow. AWPA has categorized plywood applications from UC1 through UC4B (no UC4C category is listed for plywood) (Table 8).

Table 8—Plywood. Preservatives standardized by AWPA by use category. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use category	Preservatives standardized by AWPA
UC1 and UC2	SBX
UC1 through UC3B	Oilborne: Cu8[a], CuN[a] Waterborne: CX-A, EL2, KDS, KDS-B, PTI
UC1 through UC4A	Waterborne: ACQ-A, ACQ-C
UC1 through UC4B	Oilborne: CR[a], CR-S[a], CR-PS[a], PCP-A,C[a] Waterborne: ACQ-B,D, ACZA[b], CA-B,C, CCA[b], MCA, MCA-C

[a]Not for interior residential use.
[b]Applications for plywood ACZA and CCA may be limited by EPA labeling.

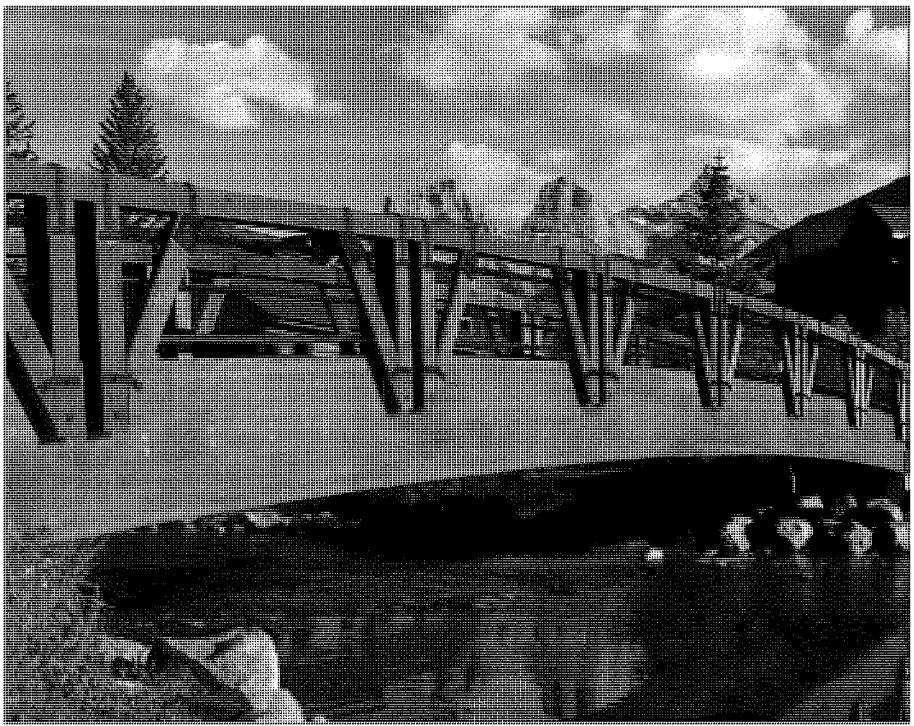

Figure 12. Pressure-treated glue-laminated timbers are frequently used to support bridges and in other applications with long spans and/or high strength requirements

Laminated Timbers and Columns

Pressure-treated laminated timbers or columns are frequently used in applications with long spans and/or high strength requirements (Fig. 12). They are commonly used to support trail or road bridges but may also be used in building construction when a portion of the timber or column is exposed to the weather. Oilborne preservatives are typically used for treatment of timbers after gluing because the swelling and subsequent shrinkage associated with a waterborne treatment can stress glue bonds. One exception is that ACZA has been standardized for treatment of Douglas-fir laminated members (Table 9). Laminated timbers and columns can also be constructed from lumber that was previously pressure-treated (Table 1). Typically lumber used to assemble glue-laminated members is treated with waterborne preservatives because oilborne treatments (and particularly creosote or heavy oil solvents) can interfere with gluing. Mechanically laminated (nail- or screw-laminated) timbers can be constructed with lumber that was pressure-treated with either oil or waterborne preservatives (Table 10). It is important to note that AWPA standardization procedures do not require submission of data to demonstrate that a type of pressure-treated lumber can successfully be glued. Instead, AWPA standards state that it is the responsibility of the laminator to comply with bonding quality standards.

Table 9—Laminated timbers and columns treated after gluing. Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use categories by species	Preservatives standardized by AWPA
Southern Pine	
UC1 through UC3A	Oilborne: IPBC/PER
UC1 through UC3B	Oilborne: Cu8[a]
UC1 through UC4A	Oilborne: CR-PS[a]
UC1 through UC4C	Oilborne: CR[a], CR-S[a], PCP-A,C[a], CuN[a]
Douglas-fir	
UC1 through UC3A	Oilborne: IPBC/PER
UC1 through UC4C	Oilborne: CR[a], CR-S[a], CR-PS[a], PCP-A,C[a], CuN[a] Waterborne: ACZA[b]
Western hemlock, Hem-Fir	
UC1 through UC3A	Oilborne: IPBC/PER
UC1 through UC3B	Oilborne: Cu8[a]
UC1 through UC4A	Oilborne: CR[a], CR-S[a], CR-PS[a], PCP-A,C[a], CuN[a]
Red oak, red maple, yellow-poplar	
UC1 through UC4A	Oilborne: CR[a], CR-S[a], CR-PS[a]

[a]Not for interior residential use.
[b]ACZA allowable uses are limited to specific applications by EPA labeling. Most allowable applications fall into UC3B and above.

Table 10—Laminated timbers and columns, treated before assembly. Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use categories by species	Preservatives standardized by AWPA
Southern Pine	
UC1 through UC3A	Waterborne: PTI, KDS-B
UC1 through UC3B	Oilborne: Cu8 Waterborne: KDS
UC1 through UC4A	Oilborne: CR[a,b], CR-S[a,b], CuN[a,b], PCP-A,C[a,b] Waterborne: ACQ-A,C, ACZA[c], CA-C, CCA[c], MCA-C
UC4B, UC4C	None
Douglas-fir, western hemlock, Hem-Fir	Same as Southern Pine except exclude CR-S and MCA-C, add CR-PS

[a]Not for interior residential use.
[b]Oilborne preservatives are typically used for mechanically fastened members rather than glue-lamination.
[c]ACZA and CCA allowable uses are limited to specific applications by EPA labeling. Most allowable applications fall into UC3B and above.

Structural Composites

Parallel strand lumber (PSL) (Fig. 13) and laminated veneer lumber (LVL) have become increasingly used in high-capacity load-bearing applications, some of which require pressure treatment. PSL and LVL have substantially different compositions, and their standardized preservative options differ as well. Numerous preservatives, including both oilborne and waterborne, have been standardized for treatment of PSL (Table 11). In contrast, the only preservatives standardized for treatment of LVL are two creosote formulations (Table 12).

Figure 13. Pressure-treated parallel strand lumber (PSL) beams were used as supports for this trail bridge.

Table 11—Parallel strand lumber. Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use categories by species	Preservatives standardized by AWPA
Southern Pine and Douglas-fir	
UC1 through UC4A	Oilborne: CR[a], CR-S[a], CR-PS[a], CuN[a], PCP-A,C[a] Waterborne: ACZA[b], CA-B,C, CCA[b], MCA
Southern Pine and Douglas-fir	
UC4B and UC4C	Same as U/C1 through UC4A except exclude CR-PS for Southern Pine
Yellow-poplar	
UC1 through UC4A	Oilborne: CR[a], CR-S[a], CR-PS[a]

[a]Not for interior residential use.
[b]ACZA and CCA allowable uses are limited to specific applications by EPA labeling. Most allowable applications fall into UC3B and above.

Table 12—Laminated veneer lumber. Preservatives standardized by AWPA by use category and wood species. Standardized preservatives or retentions may change; refer to current AWPA standards.

Use categories by species	Preservatives standardized by AWPA
Southern Pine, red maple, yellow-poplar	
UC1 through UC4C	Oilborne: CR[a], CR-S[a]

[a]Not for interior residential use.

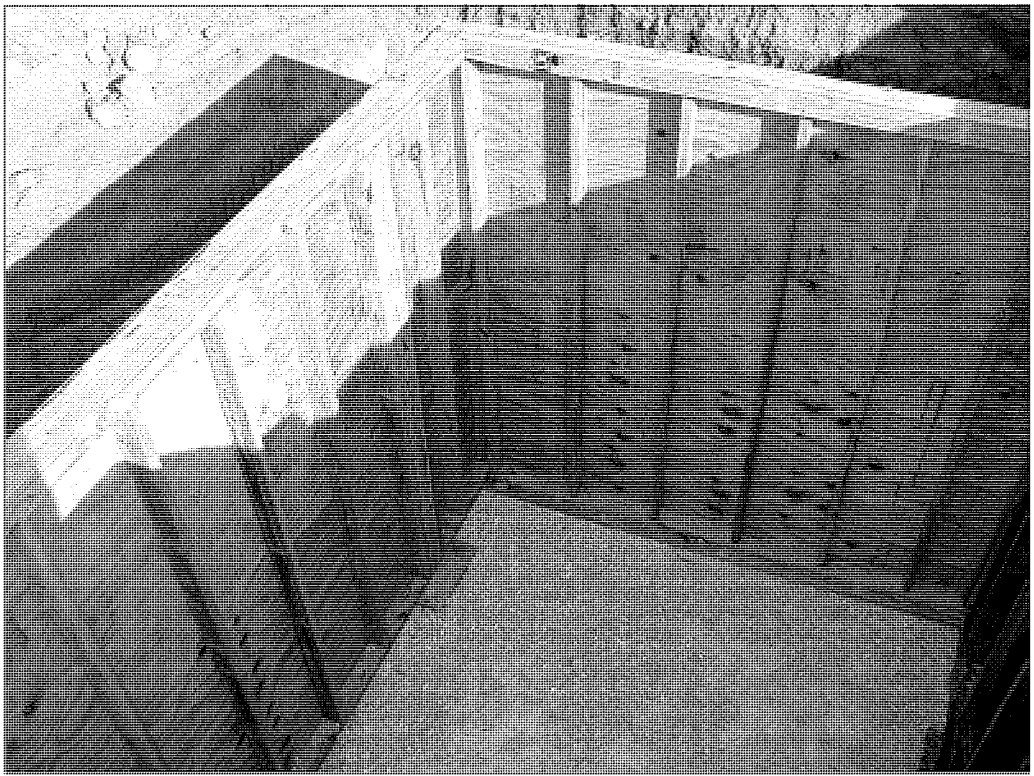

Figure 14. Lumber and plywood used for permanent wood foundations is structurally critical and is treated to meet AWPA Use Category 4B.

Table 13—Permanent wood foundations (UC4B). Preservatives standardized by AWPA for plywood or by wood species for lumber. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Softwood plywood	Waterborne: ACQ-B, ACQ-C, ACQ-D, ACZA, CA-B,C, CCA, MCA, MCA-C
Southern Pine, western hemlock, Hem-Fir	Waterborne: ACQ-B, ACQ-C, ACQ-D, ACZA, CA-B,C, CCA, MCA, MCA-C
Douglas-fir	Waterborne: ACQ-B, ACQ-C, ACQ-D, ACZA, CA-B,C
Ponderosa and red pine	Waterborne: ACQ-B, ACQ-C, ACQ-D, ACZA, CA-B,C, CCA, MCA, MCA-C
Other species	There are other lesser-used species listed for this application. Refer to AWPA standards.

Permanent Wood Foundations

Permanent wood foundations are engineered systems used to support primarily residential and other light-frame structures. They are constructed from pressure-treated plywood and lumber (Fig. 14), but an exterior membrane and gravel drainage system are also considered to be integral parts of the foundation (AWC 2015a) and stainless steel fasteners are recommended. Because of their structural criticality and difficulty of replacement, permanent wood foundations are considered UC4B applications. Currently, only waterborne preservatives are standardized for use in permanent wood foundations (Table 13). EPA labeling currently allows treatment with ACZA and CCA preservatives for this application.

Shakes and Shingles

Wood shakes and shingles are widely used as roofing and siding materials. Often, they are obtained from naturally durable species such as western redcedar, Alaska yellow-cedar, or redwood (Bonura and others 2011) and may be installed without preservative treatment. However, western redcedar shakes and shingles may also be pressure-treated before installation to enhance their durability. In addition, pressure treatment allows use of nondurable Southern Pine species for shakes and shingles. AWPA standards contain a section specific to pressure treatment of shakes and shingles and designate this application as falling within UC3B (Table 14). Currently, only waterborne preservatives are standardized for treatment of shakes and shingles (AWPA 2018).

Table 14—Shakes and shingles (UC3B). Preservatives standardized by AWPA for treatment of shakes and shingles. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Wester redcedar	ACQ-A, ACQ-C, ACQ-D, CA-B, CA-C, CCA, CuN-W, CX-A
Southern Pine	ACQ-A, ACQ-C, ACQ-D, CA-B, CA-C, CCA, CuN-W, CX-A, MCA, MCA-C

Figure 15. Wood immersed or partially immersed in seawater, such as these marine piles, is pressure-treated with increased retentions of chromated copper arsenate, ammoniacal copper zinc arsenate, or creosote to prevent attack by marine borers.

Marine (Seawater) Applications

Seawater presents a unique challenge because of several types of marine borers that either consume wood or attempt to tunnel into it for shelter. These marine borers tend to be more tolerant of wood preservatives than decay fungi or termites, and currently only ACZA, CCA, and creosote are standardized for use in seawater (Fig. 15). Even for those preservatives, higher retentions are needed than for terrestrial or freshwater applications. Because of the unusual hazard, treated wood placed into seawater is placed into a separate use category, UC5. UC5 is further divided into UC5A, B, or C depending on latitude, and the retentions required vary accordingly. Warmer southern waters have a wider variety of marine borers, some of which are more preservative-tolerant. UC5A is for waters approximately north of San Francisco Bay on the west coast and from Long Island northward on the east coast (Fig. 16). UC5B extends south through the remainder of California on the west coast and down to the northern border of Florida on the east coast. Waters off Florida and further south (including Hawaii and Puerto Rico) fall into UC5C. Under severe UC5C conditions, dual treatment (treatment first with CCA or ACZA and then with creosote) may be needed to provide long-term protection. It is important to note that these boundaries are approximate and that marine borer distribution can vary with time. Persons knowledgeable about local marine borer populations should be consulted prior to selecting pressure-treated wood for a project. Preservative retentions for wood used in seawater also vary slightly depending on whether the product is round piles, sawn lumber, or plywood (Tables 15 and 16). Also, members of a structure that are above the typical high tide and subjected to only occasional seawater splash do not require UC5 preservatives or retentions. These elements of the structure can be treated with UC4B if above water or UC4C if in ground contact.

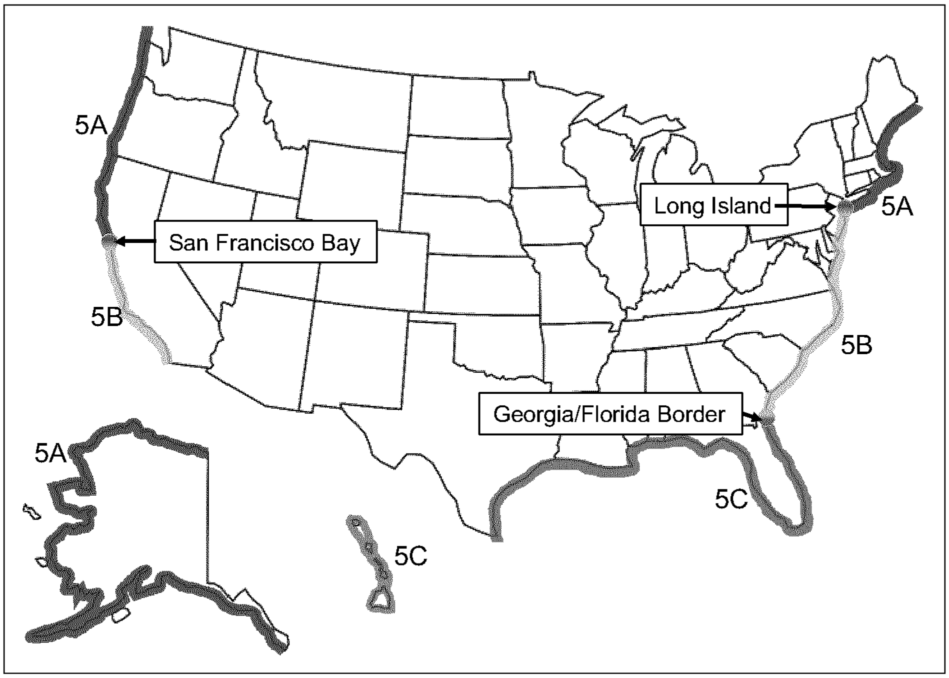

Figure 16. AWPA-designated locations of Use Categories 5A, 5B, and 5C for pressure-treated wood placed into seawater. The designations are based on the type of marine borers present and should be considered approximate because of potential changes in marine borer populations.

Table 15—Sawn lumber, sawn timbers, or plywood used in seawater. Preservatives standardized by AWPA for plywood or by wood species for lumber. Listings are for UC5A, B, and C, but retentions vary by product and use category. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Plywood	Oilborne: CR, CR-S Waterborne: ACZA, CCA
Southern Pine, red pine, ponderosa pine, Douglas-fir	Oilborne: CR, CR-S Waterborne: ACZA, CCA
Western hemlock, Hem-Fir	Oilborne: CR, CR-S Waterborne: ACZA
Oak, black and red gum	Oilborne: CR, CR-S
Dual treatment (lumber or timbers)	
Southern Pine, Douglas-fir, Hem-Fir	ACZA or CCA then CR or CR-S

Table 16—Round piles in seawater. Preservatives standardized by AWPA by wood species. Listings are for UC5A, B, and C, but retentions vary by species and use category. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Southern Pine, red pine, Douglas-fir	Oilborne: CR, CR-S Waterborne: ACZA, CCA
Dual treatment	
Southern Pine, Douglas-fir	ACZA or CCA then CR or CR-S

Table 17—Railway ties. Preservatives standardized by AWPA by wood species grouping. In each case, the preservatives listed are standardized for UC4A, UC4B, and UC4C. Standardized preservatives or retentions may change; refer to current AWPA standards.

Wood species	Preservatives standardized by AWPA
Oak, hickory, and mixed hardwood, Southern Pine, ponderosa pine	Oilborne: CR, CR-S, CR-PS, CuN, PCP-A,C,G, SBX-O Waterborne: ACZA, SBX pretreatment[a]
Douglas-fir (coastal), western hemlock, western larch	Oilborne: CR, CR-S, CR-PS, CuN, PCP-A,C,G Waterborne: ACZA
Douglas-fir (interior)	Oilborne: CR, CR-S, CR-PS, PCP-A,C,G
Jack, red, and lodgepole pine	Oilborne: CR, CR-S, CR-PS Waterborne: ACZA

[a]Must be subsequently pressure-treated with CR, CR-S, CR-PS, or CuN.

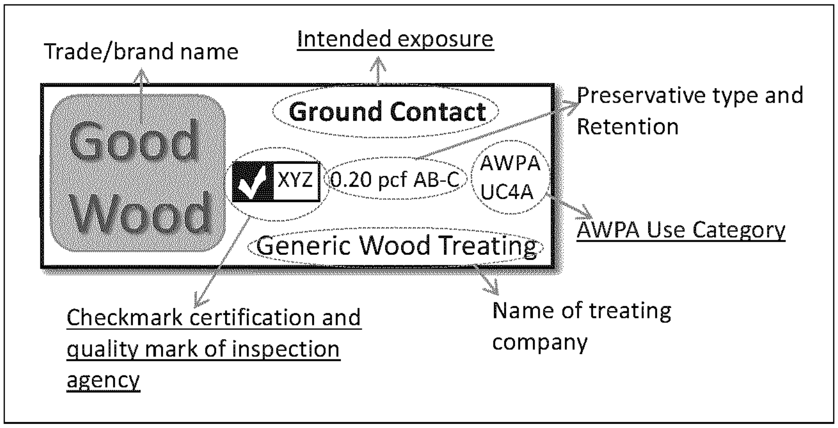

Figure 17. The end tags on pieces of treated wood provide valuable information about the intended end-use, preservative type and retention, and conformance to treatment standards.

Railway Ties

Railway ties were among the earliest wood components to be pressure-treated with wood preservatives. They are different from other pressure-treated commodities because hardwoods are more commonly used than softwoods. Creosote formulations have been the primary preservatives used to treat railway ties for more than a century (Webb and Webb 2016), but other preservatives have been standardized and are now used for these applications (Table 17). Recent developments have been the pretreatment of ties with borate solution prior to pressure treatment with creosote or copper naphthenate or incorporation of boric acid into the creosote formulation. Ties are considered UC4A, B, or C applications, but although retentions vary slightly by species grouping, they do not currently vary by use category.

Interpreting the End Tag

Most pressure-treated wood products sold at retail outlets have an end tag stapled to one end of each piece. The end tag provides valuable information about the intended end-use, type of preservative, and if the wood was treated in accordance with an ALSC-accredited quality assurance program (Fig. 17). The tag will indicate the exposure conditions in which the wood is intended to be used. "Above-ground" or "ground contact" are the most common examples. The checkmark and third-party inspection agency logo is also of great importance because it indicates that the wood was treated in accordance with AWPA standards and an ALSC-accredited third-party inspection program. If the end tag does not include these marks, it is likely that the wood was not produced in full accordance with AWPA standards. The end tag also indicates the type of preservative, use category, and retention of the preservative in the wood. The use category designation is of further value in determining if the wood will be sufficiently durable for the intended end-use. For example, wood treated to both UC4A and UC4B is intended to provide protection for wood placed in contact with the ground, but UC4B provides additional protection for critical ground contact members in locations with a high decay hazard. In many cases, the type of preservative and retention are of lesser importance to the user than the use category, but they are necessary to confirm that the treatment complies with a specification. Although the content on the tag that is required to claim treatment to AWPA standards is standardized, the arrangement of that information on the tag is not (Fig. 17). The layout of the tag varies by producer, and in some cases, content is on the back of the tag.

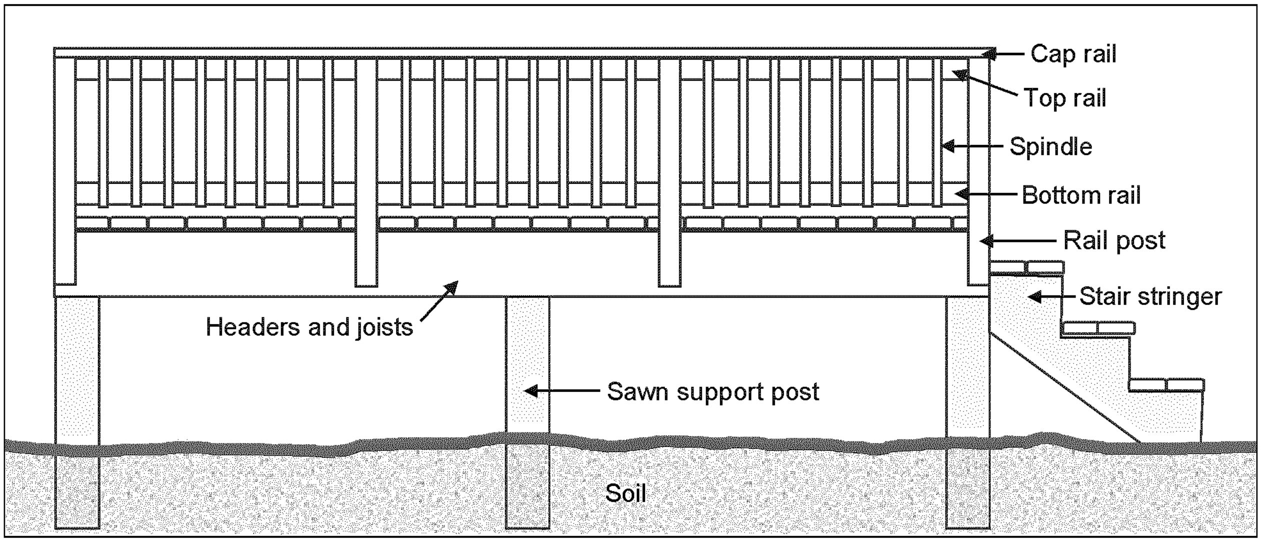

Figure 18. Residential decks are one of the most common applications for pressure-treated sawn lumber and posts. Decking and rail components are often treated to Use Category 3B, whereas headers, joists, and stair stringers may be treated to Use Category 3B or 4A, depending on the situation. Sawn support posts are treated to either Use Category 4A or 4B.

Examples of Selecting Types of Pressure-Treated Wood

This publication provides guidance on selection and use of pressure-treated wood in relation to resistance to biological degradation. It is not intended as a guide for engineering or design of structures. Diagrams are illustrative only.

Residential Decks

One of the most common uses of pressure-treated wood is for construction of residential decks. Although decks vary greatly in construction, typical deck members include support posts, headers, joists, deck boards, rail posts, rails, balusters or spindles, and stairs (Fig. 18). Because low odor and a dry wood surface are important for residential decks, the members are typically treated with waterborne preservatives rather than oilborne preservatives. EPA labeling does not allow use of ACZA- or CCA-treated wood in construction of new residential decks.

Support posts: Deck support posts are structurally critical and typically in direct contact with either the ground or some type of footing. Soil contact creates a high deterioration hazard, and many post footing configurations create conditions that trap moisture, promoting fungal decay and termite attack. Because of these factors, deck support posts fall into UC4A or UC4B, depending on the climate and type of structure. In warm humid climates and for elevated decks, UC4B should be considered. Deck support posts typically are either the 4 by 4 or 6 by 6 dimension with the larger dimension now recommended by the American Wood Council (AWC 2015b). Because these dimensions are primarily used for posts rather than for above-ground supports, they are usually treated for ground-contact use. One possible area of confusion is the 4 by 4 deck railing posts sold at many lumber yards. Deck railing posts are intended for above-ground use and are often only treated to UC3B. However, railing posts are sold in shorter lengths than support posts and typically have some type of notching or decorative detailing. In either case, the end tag will indicate if the post is intended for above-ground or ground-contact applications. Depending on the wood species, standardized preservatives for residential deck support posts are the waterborne preservatives ACQ-B,C,D; CA-B,C; MCA; and MCA-C for UC4A or UC4B applications and ACQ-A, CuN-W, and KDS for UC4A applications (Table 2).

Joists and headers: Deck joists and headers are important structural elements that are typically not in contact with the ground. AWPA standards call for them to be treated to either UC3B or UC4A depending on the situation. The UC4A designation applies when the members are difficult to replace and critical to the performance of the structure. One example is cantilevered joists that extend out from inside the building envelope. UC4A also applies if the specific application involves decay hazard conditions more similar to ground contact. This may occur if the joists or headers are within 6 in. of the ground, airflow is limited, or if accumulation of leaf litter or other organic debris is likely. The UC4A treatment should also be used for all joists and headers for construction in tropical climates. Availability of UC3B versus UC4A joists and headers vary by retailer. Some retailers have transitioned to stocking primarily UC4A treatments for all dimension lumber 1.5 in. thick or larger, whereas others carry both UC3B and UC4A material. It is important with products of these dimensions to check the end tag to confirm that the members are treated to the desired use category. Depending on the wood species, standardized preservatives for residential deck joists and headers are the waterborne preservatives CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3b or UC4A applications (Table 2).

Deck boards: Because deck boards are easily replaced and failure of a single member does not compromise the overall structure, they are considered UC3B for most applications, although UC4A may be warranted. Many retailers stock decking products that are uniquely dimensioned (for example, the 5/4 radius edge deck boards) and not easily confused with dimension lumber for structural applications. These specialized decking products are often available as UC3B, although some retailers also stock UC4A deck boards. Conventional "2 by" dimension lumber is also used for decking, and these members may be available as either UC3B, UC4A, or both, depending on the vendor. Use of UC4A deck boards is necessary in tropical climates and is a consideration for any deck built close to the ground (<6 in.) or in situations where accumulation and contact with organic debris is likely. Deck boards are often marketed with colorants and/or an incorporated water-repellent. The colorant does not affect the durability or use category designation, but in some cases, the water-repellent may increase durability and lessen cracking. The benefit of the water-repellent, if any, has been considered in standardization of preservative and the use category designation; therefore, no further increase in decay resistance should be expected when a retailer advertises a product as having an incorporated water-repellent. However, the water-repellent may provide benefit in maintaining the appearance of the deck boards. Depending on the wood species, standardized preservatives for residential deck boards are the waterborne preservatives CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3B or UC4A applications (Table 2).

Deck rail posts: Deck rail posts can be purchased from retailers or cut from longer 4 by 4 or 6 by 6 support posts. Deck rail posts sold are often designated as UC3B although some vendors carry rail posts treated to UC4A. In contrast, sawn support posts are UC4A or higher. AWPA standards allow the UC3B designation for deck railing posts, but UC4A rail posts may be warranted for elevated decks or for conditions of high decay hazard, such as tropical climates or applications with limited airflow and where accumulation of leaf litter or other organic material is likely. Depending on the wood species, standardized preservatives for residential deck railing posts are the waterborne preservatives CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3B or UC4A applications (Table 2).

Deck rails: Deck rails are considered an above-ground UC3B application, and the machined hand rails that can be purchased from some retailers are typically treated to UC3B. Use of UC4A material may be warranted for elevated decks and for construction in tropical climates. In addition, some retailers only carry UC4A treatments in sawn dimension lumber, and thus UC4A may be the only choice for rails constructed from stock dimension lumber. Depending on the wood species, standardized preservatives for residential deck railing posts are the waterborne preservatives CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3B or UC4A applications (Table 2).

Balusters and spindles: Deck railing balusters and spindles are of unique dimensions that serve a specialized purpose. They are easily replaced, their small dimensions lessen moisture retention, and failure of single member is unlikely to affect the integrity of the structure. Because of these factors and the low risk of confusion with other members, they are typically designated UC3B and may not be readily available as UC4A. If a UC4A treatment is warranted (such as in tropical climates), it may be necessary to special order or use 2 by 4 material for the spindles or balusters. Depending on the wood species, standardized preservatives for balusters and spindles are the waterborne preservatives ACQ-A,B,C,D; CA-B,C; CuN-W; CX-A; EL2; KDS; MCA; MCA-C; and PTI. (Table 2).

Residential Fences

Backyard fences, such as those built for privacy or pet containment, are another very common use for pressure-treated wood. Unlike many other uses of treated wood, residential fences are not structurally critical and are also not especially difficult to replace. Still, they are important to the homeowner, who expects some level of durability.

Fence posts: Residential fences typically use sawn posts of the 4 by 4 dimension, although the 6 by 6 dimension is also sometimes used, especially for gate or corner posts. Because fence posts are in contact with the ground but not structurally critical, it is considered acceptable to use posts meeting UC4A in most situations (Fig. 19). This is true regardless of whether they are set in concrete, soil, or gravel. However, UC4B should be considered for tropical climates or in other locations with a high deterioration hazard. Retailers commonly stock sawn posts treated to either UC4A or UC4B, which will be shown on the end tag. Depending on the wood species, standardized preservatives for sawn residential fence posts are the waterborne preservatives ACQ-B,C,D; CA-B,C; CuN-W; MCA; and MCA-C for UC4A or UC4B applications and ACQ-A and KDS for UC4A applications (Table 2). Preservatives standardized for treatment of round fence posts can be found in Table 4.

Fence rails: The selection of the use category for fence rails depends on how the fence is constructed. Durability of the fence will be greater if space is left between the

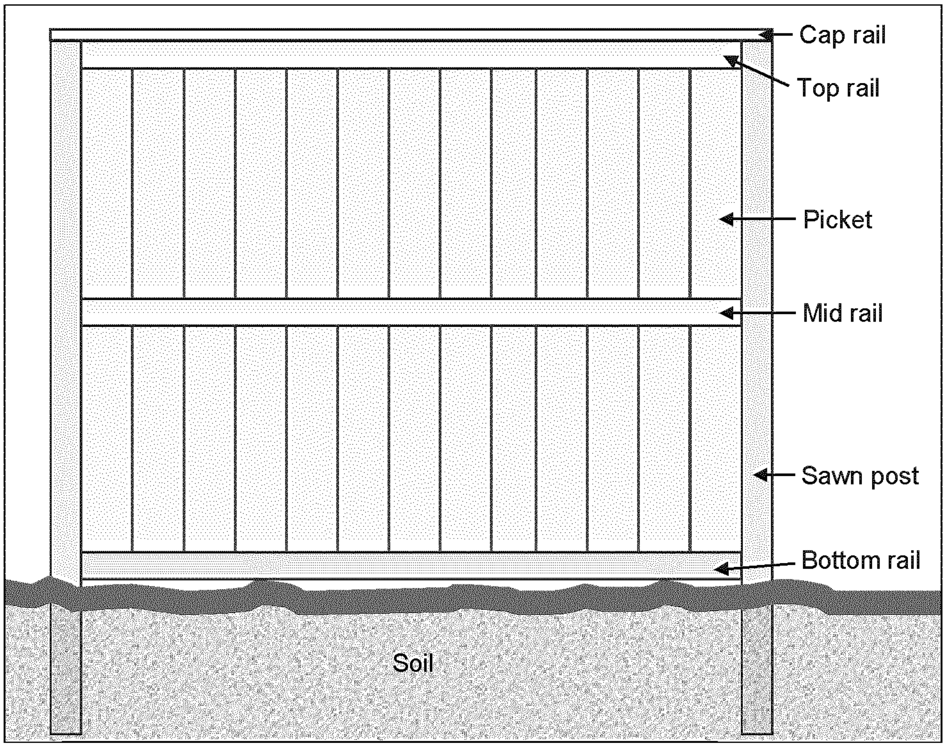

Figure 19. Posts used to construct a privacy fence should be treated to AWPA Use Category 4A or 4B, whereas other components can be treated to Use Category 3B or 4A.

bottom rail and the ground. If the bottom rail is in contact with the ground or very close to the ground, it is likely that soil or build-up of organic debris will create a decay hazard similar to soil contact. In this case, the bottom rail should be treated to UC4A, whereas UC3B is sufficient for the other rails. The exception is tropical climates where UC4A may be necessary for all of the rails. If pre-assembled rail and picket panels are purchased, it may be difficult to determine the use category of the bottom rail. In this case, it is especially important to leave clearance between the bottom rail and the ground. Depending on the wood species, standardized preservatives for residential deck railing posts are the waterborne preservatives CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3B or UC4A applications (Table 2).

Fence pickets: The fence picket boards are the least structurally important and most easily replaced members of the fence and are typically not exposed to ground contact. As such, they are considered a UC3B application and may only be available as UC3B from many retailers. UC3A may also be considered acceptable if sold with a durable protective coating. In some cases, retailers stock pickets that are not treated to AWPA standards because they are so readily replaced. The above-ground treatment typically used for pickets can create an area of vulnerability if the bottom rail is placed close to the ground or if the bottoms of the pickets are extended below the bottom rail to near the ground level. In addition to the increased risk of decay, moisture wicking up into the bottom of the pickets can shorten the longevity of finishes applied to the wood. Depending on the wood species, standardized preservatives for pickets are the waterborne preservatives ACQ-A,B,C,D; CA-B,C; CuN-W; CX-A; EL2; KDS; MCA; MCA-C; and PTI (Table 2).

Highway Bridges

A wide range of pressure-treated wood products are used in highway construction, but perhaps one of the most important applications is timber bridges. It is estimated that more than 50,000 timber highway bridges are currently in use across the United States (Wacker and Brashaw 2017). Because highway bridges are structurally critical, most components are treated to UC4C. This includes both round and sawn support piles, stringers, abutment materials, and deck components. An exception is the rail posts and rails, which are typically treated to UC4A or even UC3B. Unless constructed with separate walkways or fishing areas, most timber bridges are expected to have relatively little pedestrian use, and preservatives carried in heavy oil can be used. EPA labeling also allows CCA and ACZA to be used for round timber piles and for other highway bridge components. If frequent pedestrian use or fishing activities are anticipated, waterborne preservatives should be considered for bridge rail components. Figure 20 provides an example of a timber highway bridge with a

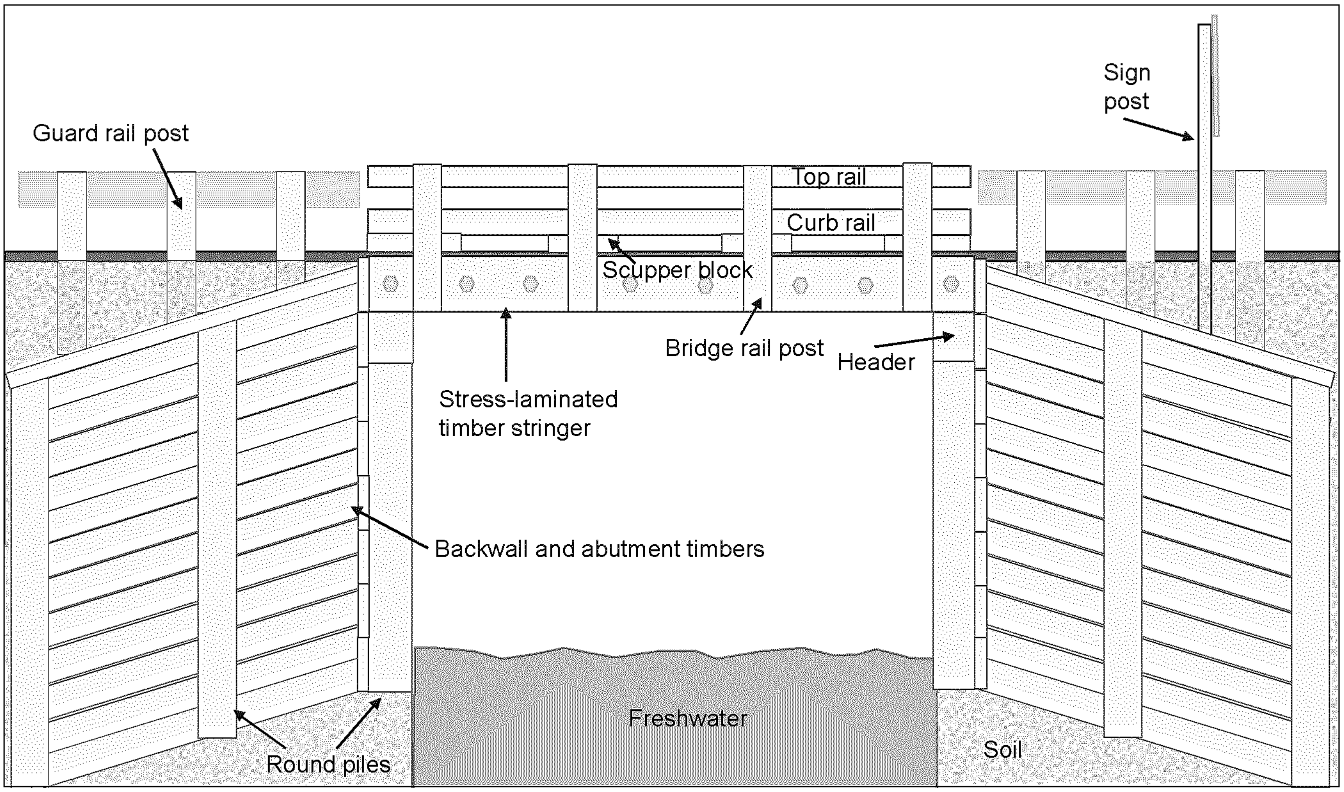

Figure 20. Pressure-treated wood components supporting a highway bridge are considered to be structurally critical and most are pressure-treated to meet AWPA Use Category 4C.

stress-laminated timber deck supported by round piles. Depending on the wood species, the standardized UC4C preservative options for round timber piles are the oilborne preservatives CR, CR-S, CR-PS, CuN, and PCP-A,C and the waterborne preservatives ACQ-C, ACZA, CCA, MCA, and CA-B,C (Table 7). The headers, abutment timbers, and bulkhead timbers are also specified as UC4C and the standardized preservatives (depending on the wood species) are the oilborne preservatives CR, CR-S, CR-PS, CuN, and PCP-A,C and the waterborne preservatives ACQ-B,C; ACZA; CA-B,C; CCA; MCA; and MCA-C (Table 3). If an engineer or specifier does not have a preservative preference, it is sufficient to specify that the piles be treated in accordance with AWPA Standard U1 Commodity Specification E and that lumber and timbers be treated to AWPA Standard U1 Commodity Specification A Section 4.3 (AWPA 2018).

Standards do not require the rail components of a highway bridge to be treated to UC4C. Although treatment of highway bridge rail posts is not separately specified in AWPA standards, the application would appear to warrant treatment to at least UC4B given the structural importance. Although the rail posts are above ground, their critical nature and the tendency for gravel and soil to accumulate at the edges of the bridge increases risk. Similar logic would apply to the curb rail and blocks. The top rail would be considered a UC3B application in terms of decay hazard, but at least UC4A is warranted because of the structural importance.

Trail Bridge with Glue-Laminated Stringers

Pressure-treated wood is a commonly used construction material for trail bridges, elevated walkways, and boardwalks. Wood's relatively light weight and ease of construction make it especially well-suited for difficult-to-access trail locations. In many cases, the use categories and preservative option for trail structures are similar to those of residential structures. However, trail bridges in remote areas may be difficult to access and replace, and this may warrant consideration of higher use category levels. There are also some differences in the types of wood products used, especially for the longer stringers sometimes used in trail bridges. In the example shown in Figure 21, the bridge deck is supported by glue-laminated stringers, which in some cases can allow for longer spans than solid sawn timbers. Although a glue-laminated stringer used in a trail bridge is primarily above the ground or water, conditions that favor moisture retention often occur when the stringer rests on the sills and makes contact with the back wall planks. The stringer is also structurally critical and, because of these factors, should be considered as UC4A or 4B, depending on the climate, risks associated with failure, and difficulty of replacement.

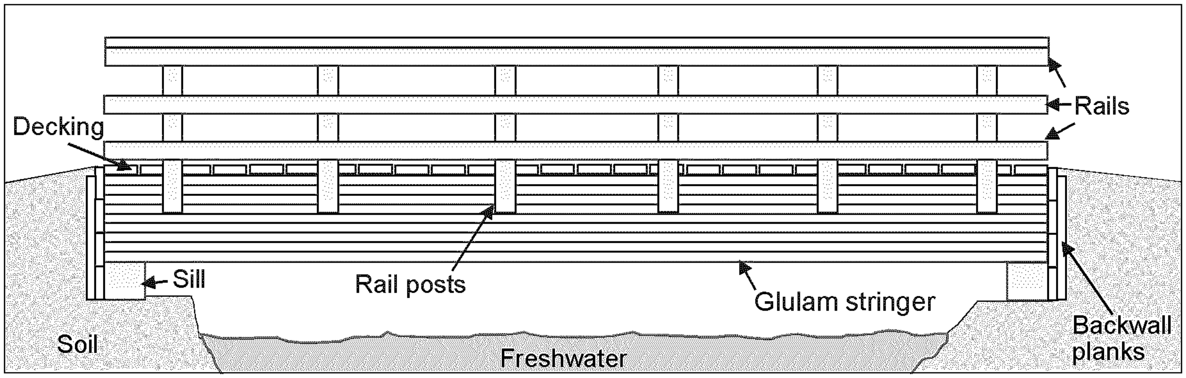

Figure 21. Pressure-treatment options for glulam beams, such as those used to support a trail bridge, differ somewhat from solid-sawn members.

Glue-laminated timbers can be constructed from lumber that was previously pressure-treated with a waterborne preservative or pressure-treated after gluing, typically with an oilborne preservative. When treated before gluing, the highest AWPA use category is currently UC4A, whereas timbers treated after gluing can also meet UC4B and UC4C. The UC4A waterborne preservatives standardized for treatment before gluing are ACQ-A,C; ACZA; CA-C; CCA; and MCA-C, depending on the wood species. Note that ACZA and CCA are allowed for the laminated timber portion of a trail bridge but not for the rail components. The glue-laminated stringer of a trail bridge is unlikely to have frequent human hand contact, and thus oilborne preservatives are an option. The oilborne preservatives standardized for UC4B treatment of glue-laminated timbers (after gluing) are CR; CR-S; PCP-A,C; and CuN, depending on the species. This list expands to CR-PS for UC4A applications (Table 9). The waterborne preservative ACZA is also standardized for UC4A and UC4B treatment after gluing but only with Douglas-fir.

The sill and back wall components of the example trail bridge shown in Figure 21 are in direct contact with the ground and therefore should be considered UC4A or UC4B, depending on the severity of the decay hazard at the location. As with the glue-laminated stringer, the sill and back wall components are not likely to have frequent hand contact and thus can be treated with either waterborne or oilborne preservatives. There is no AWPA standard specific to trail bridges. Therefore, the applicable standards are those that cover general sawn products (Table 2). Depending on the wood species, the AWPA standardized UC4B preservatives for this application are the oilborne preservatives CR, CR-S, CR-PS, CuN, and PCP-A,C and the waterborne preservatives ACQ-B,C,D; CA-B,C; MCA; and MCA-C. For UC4A applications, the standardized preservatives also include oilborne DCOI-A and waterborne ACQ-A, CuN-W, and KDS. CCA and ACZA (depending on the species) can also be used for sill treatment (both UC4A and UC4B) if that member is greater than 5 in. thick.

Decking for a trail bridge presents slightly different conditions than that used in residential decking. Trail bridge decking is susceptible to repeated wear within a confined path and often 2 by lumber or thicker is used rather than the 5/4 radius edge decking that is often used in residential decks. In addition, the approaches on each end of a trail bridge are more vulnerable to accumulation of gravel or soil from the adjacent trail, thus creating more severe decay conditions. Because of these considerations, trail bridge decking is often considered a UC4A application, although UC3B is an option in situations with low decay hazard and low safety risk associated with failure. In some cases, dimension lumber may only be available treated for UC4A or higher. Depending on the wood species, standardized preservatives for trail bridge decking are the waterborne preservatives CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3B or UC4A applications (Table 2). Oilborne preservatives can also be used. Heavy oil treatments with CuN or PCP may result in some odor and some oil visible on the surface during initial rainfall events but may also lessen checking. Light solvent treatments are also sometimes used for trail bridge decking.

The trail bridge rail components would be considered UC3B or UC4A, depending on the circumstances. For the rail posts, UC4A should be considered because of their structural importance and because dirt and organic debris often accumulate on the edges of the bridge, especially near the bridge ends. The rail components would typically be considered UC3B except in areas of high decay hazard. Hand contact is likely to occur with rail components, and treatment with preservatives in heavy oil is less common. However, light solvent treatments with CuN or PCP are sometimes used for UC3B or UC4A rail components, and light solvent Cu8 treatment is also standardized for UC3B rail members. Depending on the wood species, waterborne preservatives standardized for UC4A trail bridge rail components are CX-A, EL2, and PTI for UC3B applications and ACQ-A,B,C,D; CA-B,C; CuN-W; KDS; MCA; and MCA-C for UC3B or UC4A applications (Table 2).

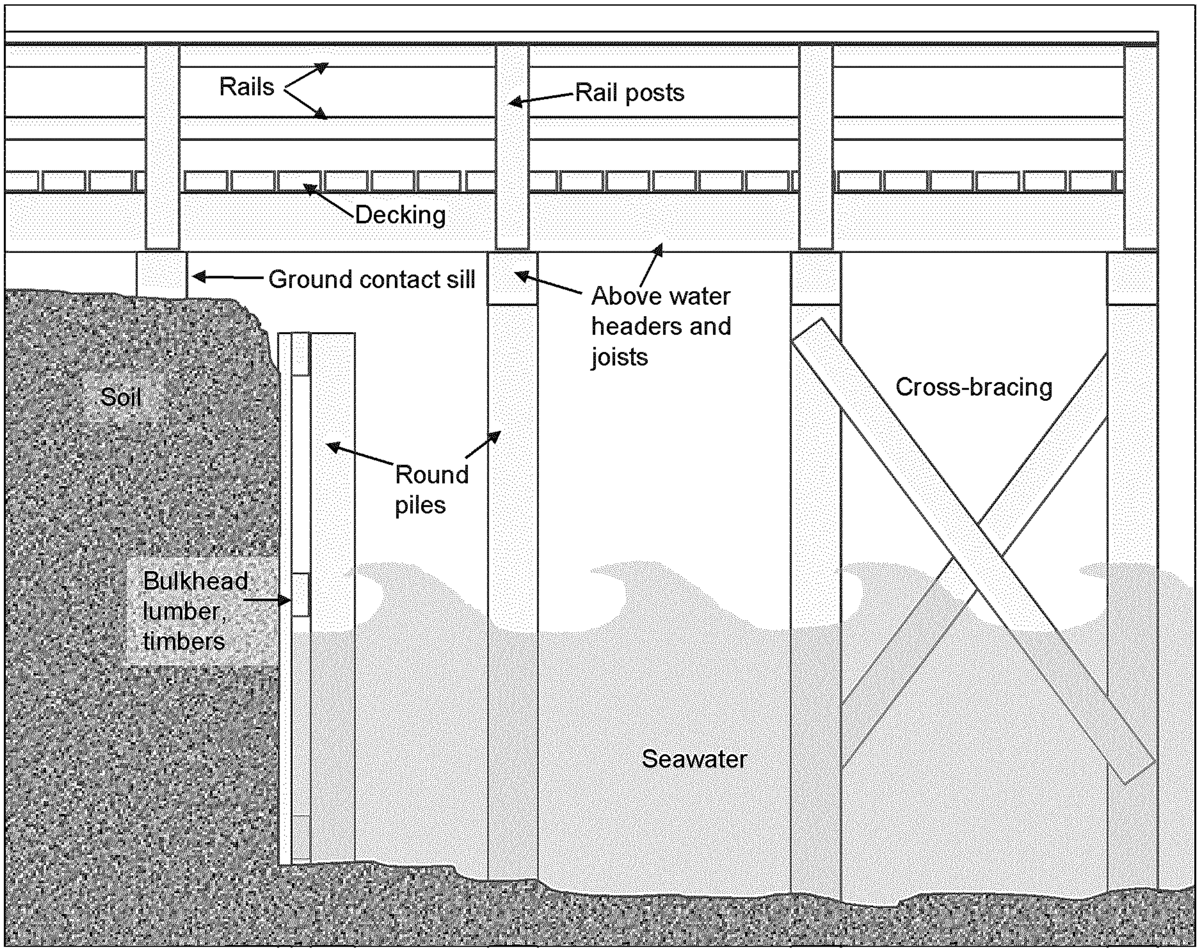

Figure 22. Pressure-treated wood partially or fully immersed in seawater requires different treatment compared with the treated wood used above the water.

Marine Dock, Pier, or Wharf

Structures placed into seawater require special consideration for treatment. Portions of the structure that are routinely immersed are susceptible to marine borer activity and thus are considered UC5. This includes not only the piles but also any lumber, timbers, or wood composites that are partially immersed. In the example shown in Figure 22, all round piles and sawn lumber or timbers used in the cross-bracing and bulkhead would be considered UC5. Currently, only creosote, CCA, and ACZA are standardized for treatment of wood immersed in seawater (Tables 14 and 15), and the required retentions of those preservatives vary depending on geographic location. Portions of the structure that are not routinely immersed but are subject to saltwater splash are considered either UC4B or UC4C. The UC4B designation applies to members above the water and not in contact with the ground, such as the joists and headers, decking, and rail components shown in Figure 22. If a member is both in contact with the ground and subject to salt water splash, as is the case for the sill shown in Figure 22, it is designated as UC4C. The preservatives standardized for lumber and timbers treated for UC4B and UC4C (depending on the wood species) are the oilborne preservatives CR, CR-S, CR-PS, CuN, and PCP-A,C and the waterborne preservatives ACQ-B,C,D; ACZA; CA-B,C; CCA; MCA; and MCA-C (Table 2). However, above-water use of CCA- and ACZA-treated lumber and timbers in marine structures is limited by EPA labeling to dimensions that are 2 by 8 and larger or greater than 3 in. thick. Use of waterborne preservatives for decking and rail components may be advisable if the structure is intended for public use, whereas both waterborne and oilborne preservatives are options for industrial-use structures.

Construction Practices that Influence Longevity

Decay and Insect Resistance

There are at least three primary areas where construction practices can influence durability of a structure constructed from pressure-treated wood. The first is ensuring that the end-use matches the use category (more specifically, avoiding use of material treated for UC3B applications

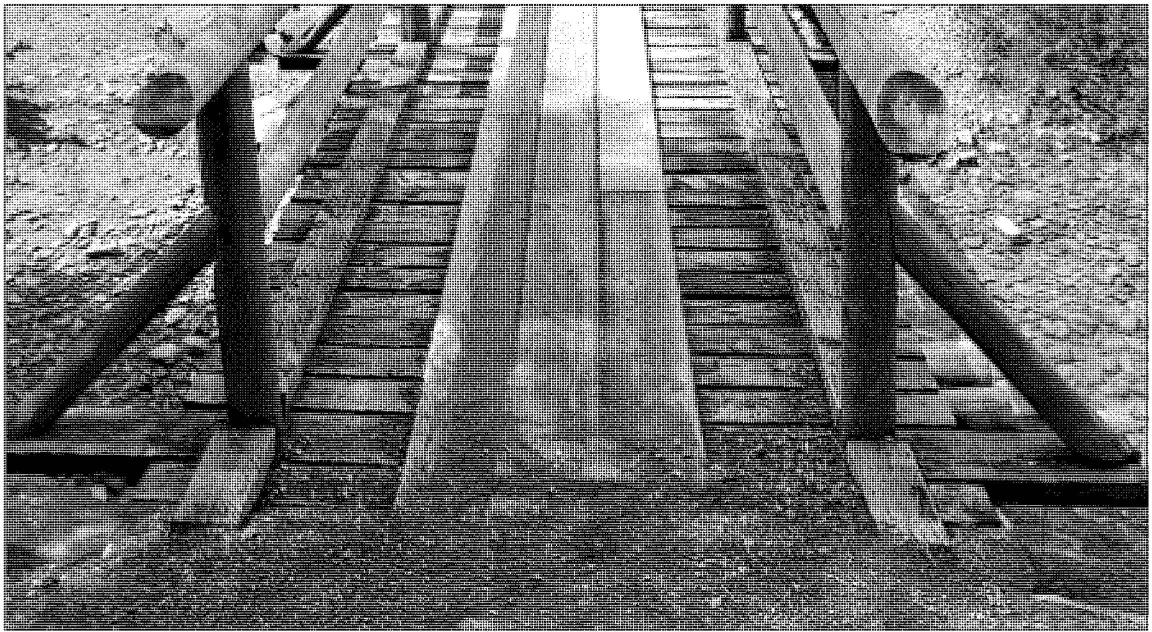

Figure 23. Gradual accumulation of dirt and other organic debris can create a ground contact decay hazard in portions of a structure that were originally above ground.

in conditions that create a decay hazard similar to ground contact). This can happen simply by mistake if material of similar dimensions but different use categories is present at a job site. But perhaps a more common occurrence is underestimation of the decay hazard or assuming that UC3B is sufficient if most of a member is used above ground. Construction that places members treated to UC3B close to the ground (less than 6 in.) or in areas where organic debris will accumulate can also expose those members to a greater deterioration hazard than anticipated (Fig. 23).

Another concern is the extent to which the structure design affects moisture trapping and organic debris accumulation, particularly in the above-ground portion of the structure. Fungal decay above ground is dependent on the presence of sufficient moisture, and the risk of decay is greater when construction details cause portions of the structure to decrease air circulation and hold moisture. Moisture trapping can occur with many types of wood on wood connections and is difficult to avoid. However, some moisture trapping scenarios occur because wood is added primarily for aesthetic purposes. One example in residential deck construction is covering the ends of deck boards with a decorative skirt or fascia board (Fig. 24). This construction method allows leaf litter to accumulate against the ends of the deck boards where moisture is readily wicked into the end-grain. The problem can be exacerbated because the outer ends of deck boards are often trimmed to uniform length after installation, potentially exposing inadequately treated wood in the center of the deck boards. Installation of an under-deck roof (or ceiling) on an elevated deck can also contribute to decay by preventing drying and allowing leaf litter to accumulate against the deck joists.

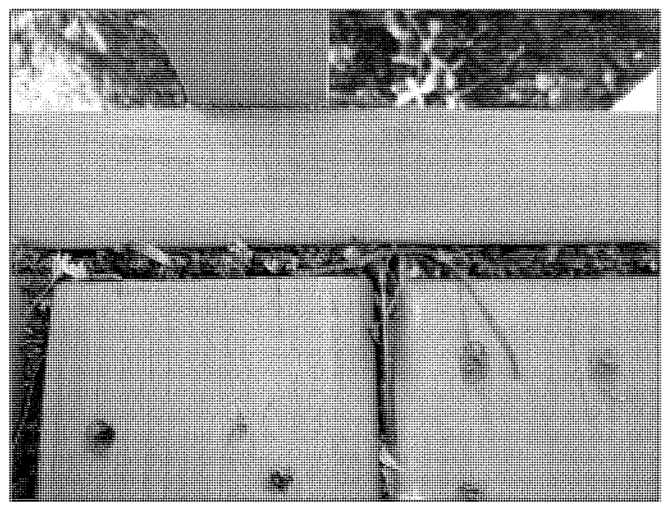

Figure 24. A deck construction design that covers the cut ends of the deck boards with a decorative skirt or fascia board. This practice allows organic debris to accumulate and trap moisture, which can increase the decay hazard and shorten the life of the structure.

A third construction consideration than can affect durability is the exposure of untreated wood during on-site fabrication. Pressure treatment forces preservative deeply into the wood, but often the center of a member has poorly treated wood. This is particularly the case for larger dimensions, for members that include heartwood, and for thin sapwood species, such as Douglas-fir. When these members are cut to length or bored, untreated wood can be exposed (Fig. 25). For designed and custom pressure-treatment orders, such as timber bridges, this potential problem should be minimized by completing as much of the necessary cutting as possible

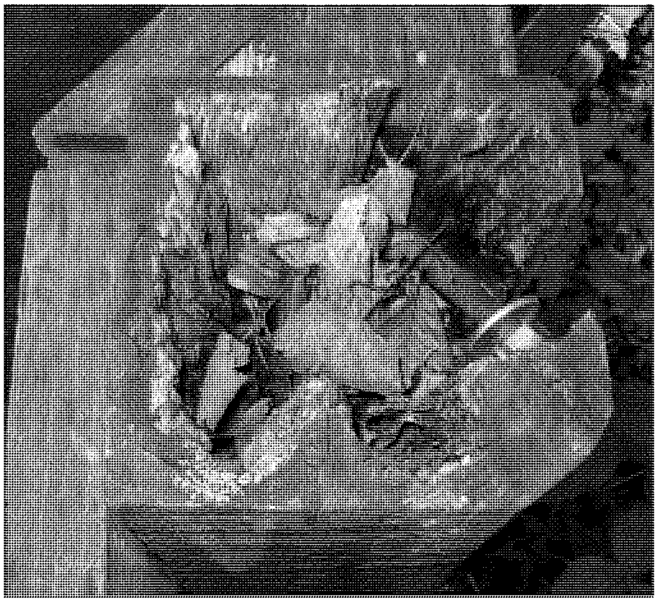

Figure 25. Sawn posts may contain poorly treated heartwood that is exposed if the post is cut to height after installation. If cutting to height is necessary, the exposed top should be coated with a field treatment preservative such as copper naphthenate.

prior to pressure treatment. However, when structures are built with stock pressure-treated material available from retail vendors, it is much more difficult to avoid cutting, which might result in exposure of untreated wood. To lessen the risk of decay development, all cuts, holes, or injuries that may have penetrated through the treated zone should be brushed or sprayed with field treatment preservative. Preservatives currently listed for this use by AWPA are copper naphthenate containing 1% or 2% elemental copper or an oilborne solution containing at least 0.675% oxine copper (copper-8-quinolinolate). Borate solutions can also be used for field treatment of wood used in indoor (UC1 or UC2) applications. Manufacturers may have recommendations on field treatments most suitable for specific pressure-treating preservatives.

Fastener Selection

Corrosion of metal fasteners is a concern for any type of structure exposed to moisture, and pressure-treated wood structures are no exception. In addition, some waterborne preservatives containing copper have the potential to increase the rate of fastener corrosion compared with that of fastener corrosion in untreated wood. In contrast, treatments with creosote or oilborne preservative have the potential to lessen fastener corrosion. However, protection is required because corrosion is always possible when moisture is present. Building codes require use of stainless steel, hot dip galvanized, bronze, or copper fasteners in most instances (ICC 2018). Preservative suppliers may have additional recommendations specific to the preservative formulation. Fastener protection is especially important for joist hangers, bolts, lag screws, and other components used in structurally critical supports. Zelinka (2013a, 2013b) provides a more detailed discussion of fastener protection in pressure-treated wood.

Environmental Considerations

All common outdoor construction materials, including concrete, steel, pressure-treated wood, and even some species of untreated wood, contain compounds that are potentially toxic to aquatic organisms (Lalonde and others 2011). However, impact is not expected unless the environmental concentrations of the compounds reach levels of concern for the organisms(s) present. In the case of pressure-treated wood, concerns sometimes arise that preservative may leach from the wood and impact sensitive organisms, particularly when used in aquatic environments. This type of concern is initially evaluated by the EPA before a wood preservative can be marketed. As part of the registration process, the EPA develops risk assessments that evaluate the potential for harm to humans, wildlife, fish, and plants, including endangered species and nontarget organisms (EPA 2018). Potential environmental impact has also been the subject of extensive research over the past two decades, including several studies conducted or funded by the U.S. Forest Service (Brooks 2000, 2011a, 2011b, 2011c, 2011d; Lebow and others 2000, 2004; Lebow and Foster 2010; Morrell and others 2003, 2011; Townsend and Solo-Gabriele 2006). These studies of the environmental impact of treated wood reveal several key points. All types of treated wood evaluated release small amounts of preservative components into the environment. These components can be detected in soil or sediment samples. Shortly after construction, elevated levels of preservative components sometimes can be detected in the water column. Detectable increases in soil and sediment concentrations of preservative components generally are limited to areas close to the structure. The leached preservative components either have low water solubility or react with components of the soil or sediment, limiting their mobility and limiting the range of environmental contamination. The levels of these components in the soil immediately adjacent to treated structures can increase gradually over the years, whereas levels in sediments tend to decline with time (Fig. 26). Research on existing structures indicates that environmental releases from treated wood rarely cause measurable impacts on the abundance or diversity of aquatic invertebrates adjacent to the structures (Brooks 2000). In most cases, levels of preservative components were below concentrations that might be expected to affect aquatic life. Samples with elevated levels of preservative components tended to be limited to fine sediments beneath stagnant or slow-moving water in which the invertebrate community is somewhat tolerant of pollutants (Brooks 2000, 2011b).

Figure 26. This wetland boardwalk in Oregon was part of a study to evaluate the leaching and aquatic impacts of treated wood used in sensitive environments.

Minimizing the potential for environmental impacts of future treated-wood structures has also been the subject of research. The expected environmental concentration of preservative associated with use of pressure-treated wood has been found to be dependent on factors such as type of preservative, volume of wood used, amount of precipitation, and volume and flow rate of the receiving water body (Brooks 2011d). Toxicity at a given environmental concentration varies depending on the form or biological availability of the pesticide component. For carbon-based preservative components, environmental concentrations are also dependent on rate of pesticide decomposition in the environment. Comprehensive reviews of preservative-treated wood impacts have indicated that environmental pesticide concentrations from most treated-wood structures are unlikely to reach levels of concern (NOAA Fisheries 2009, Stratus Consulting 2006, Brooks 2011b) but that risks may be greater with large structures constructed in stagnant water.

Environmental Assessment Modeling Tool

A large research effort was undertaken to characterize the extent of pesticide release from most types of preservative-treated wood and to develop models for assessment of potential environmental impacts (Brooks 2011c, 2011d). The model uses site-specific inputs for physical, biological, and chemical conditions, as well as project design characteristics. Potential effects are then calculated based on pesticide leaching rates, biological effects, and environmental fate, as well as water quality standards and benchmarks for the chemicals of concern. Subsequently, Oregon State University and the Western Wood Preservers Institute (WWPI) cooperated to produce a web-based version of the model that project designers and regulators can use to evaluate potential impacts of projects (WWPI 2018a). Use of this tool is suggested for proposed projects involving large volumes of preservative-treated wood placed in or above slow-moving water.

Best Management Practices for Aquatic Environments

The potential for wood preservative components to leach or move out of pressure-treated wood and into the environment can be influenced to some extent by processing conditions and construction practices. Industry associations, the AWPA, and government agencies have developed best management practices (BMPs) and/or guidance documents to minimize environmental releases (AWPA 2018, Pilon 2002, Lebow and Tippie 2001, WWPI 2011).

Best Management Practices during Production

The WWPI and other industry groups have cooperated to produce the most comprehensive BMPs for production of treated wood (WWPI 2011). These BMPs prescribe treating procedures and, in some cases, testing that can be used to minimize potential environmental releases for treated wood intended for aquatic environments. Following the BMP treatment procedures is the responsibility of the producer, and it is not necessary that the specifier understand these procedures in detail. However, it is important that the specifier request these BMP procedures when pressure-treated wood is intended for use in sensitive environments. The WWPI has produced a supplemental specifier's guide to the BMPs to assist in its implementation (WWPI 2018b). The specifier's guide stresses three main points for specification:

- That the wood be treated in accordance with AWPA standards (the BMPs do not replace AWPA standards, they are additional requirements).
- That the wood be produced in accordance with the most recent version of the BMPs.
- That BMP compliance be subject to third-party inspection.

The specifier and contractor can also have a role in the production process beyond specifying BMPs. Although treatment processes may seem to be solely the responsibility of the treater, they are also influenced by the specifications and demands of the specifier and contractor. Specifying prefabrication prior to pressure treatment may help to lessen environmental releases and does increase the long-term durability of a structure. Whenever possible, it is desirable to cut wooden members to length and perform boring and other machining processes prior to treatment. Durability is enhanced because fewer field cuts, which often break the treated shell and expose untreated wood, are required. Decreasing the amount of field fabrication also helps to prevent the discharge of treated sawdust, drill shavings, and other construction debris into the environment at the construction site. It also minimizes the need for treatment of these field cuts with a topical wood preservative at the construction site. Admittedly, the exact dimensions of members and location of connectors is not always known, but in many cases, it is possible to perform prefabrication. Decking and rail posts are examples of members that can often be cut and/or bored prior to treatment.

One pitfall to avoid is specifying excessive treatment retentions. Asking the treater to increase the retention based on the "more is better" theory needlessly increases the amount of leachable chemical in the wood without providing a durability benefit. It is rarely good practice to ask for a retention higher than those specified in wood treatment standards. Typically, increasing the retention by one use category level is sufficient to account for any uncertainty in the severity of the exposure hazard.

It is also important to allow time for the producer to implement BMPs. If the contractor demands the treated product on very short notice, the treater may be forced to rush or delete processing steps that improve the final product. This includes adequate drying or otherwise conditioning the nonseasoned wood prior to pressure treatment. These conditioning steps (air seasoning, kiln-drying, and steam conditioning) prior to treatment are important because they help maximize preservative penetration, ensure specified retention levels are achievable, and kill any resident fungi and termites that might already be present in the wood.

Best Management Practices during Construction

Construction site practices that can influence environmental releases include rejection of improperly treated material, on-site storage considerations, collection of construction debris, and application of in-place preservative treatments. Pressure-treated wood that arrives on the job site oozing preservative or with excessive surface residue should be rejected. It is not normal or typical for preservative to be dripping from the treated wood, and this is an indication that the BMPs were not properly implemented. However, moisture alone is not necessarily a concern for wood pressure-treated with waterborne preservatives because the chemical reactions that bind the preservative components in the wood do not require drying.

Treated material that is shipped to the job site should be stored in an area free from standing water or wet soil. Ideally, it should be covered but with adequate ventilation until used. Difficulties are sometimes encountered in construction of wetland boardwalks; therefore, it may be most convenient to divide the material and store smaller quantities at intervals along the intended path of construction. In this case, it is desirable to place untreated bunks into the wetland and then place the treated material on these bunks. Again, the stacks of treated wood should be covered to protect them from precipitation.

As previously discussed, the amount of field cutting and drilling of treated wood should be minimized by careful prefabrication before treatment. Unfortunately, this is not always practical for some members, and some degree of fabrication is usually necessary during construction. However, if sawdust and shavings generated during construction are allowed to enter a sensitive environment below a treated wood structure, they make a disproportionately large contribution to the overall releases from that structure. Because of their greater surface area to volume ratio, the proportional release from small wood particles such as sawdust is greater than that from the treated wood itself.

There are many approaches to ensuring the debris from field fabrication is not discharged into the environment. Tarps are commonly used to contain construction debris in a variety of ways. The large surface area of tarps makes them ideal for collecting sawdust from circular saws and chainsaws. Often, a single cutting station is set up over a large tarp, and pieces to be cut or drilled are carried to the tarp for fabrication. Ideally, this cutting station should be placed over soil, not water. If the member to be cut is already incorporated into the structure, tarps may be spread under that part of the structure before cutting. The use of tarps to contain sawdust becomes more difficult in windy or rainy conditions. Shavings from drilling holes are generally easier to contain in a small area than sawdust. Plastic tubs are useful collection devices when drilling holes on site. Regardless of the method used, it is inevitable that collection and disposal of construction debris will add some time and expense to a construction project. The importance of collection should be stressed in planning and budgeting for the project so that the construction crew is clear that debris collection is an integral part of the project.

It is important that any untreated wood that is exposed during field fabrication be treated to prevent decay. However, as with the treated wood itself, these field treatment preservatives contain ingredients that could be toxic to aquatic organisms if they are released into the environment in sufficiently high concentrations. Accordingly, field treatment preservatives should be applied sparingly and with care to avoid spillage. The use of field treatment preservatives is best limited through prefabrication of the treated wood, which decreases the need for field cutting and drilling. When field treatment preservative is needed, care in application should be stressed. Whenever possible, the field treatment should be applied to the member before it is placed in a structure over water. Excess preservative should be wiped from the wood. If the preservative must be applied to wood above water, a tray, bucket, pan, or other collection device should be used to contain spills and drips. Field treatments should not be applied in the rain to wood that is above water. Materials treated with field preservatives should not be placed directly into water unless the treated surface has dried and is free of excess preservative. AWPA Standard M4, Standard for the Care of Preservative-Treated Wood Products (AWPA 2018) gives requirements for field treatment and should be specified for construction projects in or over aquatic environments.

Service Life Expectations

"How long will it last?" is a common question about pressure-treated wood. There is not one answer to this question because durability of treated wood depends on several factors, some of which are specific to a particular application and location. It appears that in many cases specifiers or engineers may underestimate the longevity of pressure-treated wood. In the case of utility poles, analysis of replacement rate data indicates that the average service life of poles is much greater than perceived by utility personnel. One survey found that utility personnel reported an average perceived pole service life of only 33 years, whereas the replacement rate data indicated a service life of more than 75 years (Stewart 1996). Another researcher noted that, based on reported replacement rates, pole service life would easily reach 80 years in many parts of the United States (Morrell 2008). Australian researchers conducted a statistical analysis of utility pole service life data and concluded that the expected service life of the poles would be in the range of 80 to 95 years (Mackisack and Stillman 1996). A similar tendency to underestimate the durability of treated wood structures has been reported for timber bridges, for which the perceived longevity is 25 to 35 years despite numerous examples of bridges with 60- or 70-year service records (Wacker and Brashaw 2017).

A report on the durability of pressure-treated round posts exposed for 50 years in southern Mississippi also supports the long-term durability of pressure-treated wood (Lebow and others 2015). No failures occurred in any of the 125 posts treated with CCA or in any of the 75 posts treated with pentachlorophenol. Three of 25 posts treated with ACA (a precursor to ACZA) and five of 25 creosote-treated posts failed during the 50 years. Estimated times to 50% failure in the ACA and creosote-treated posts were calculated as 96 and 78 years, respectively. The estimated years to failure for the CCA- and pentachlorophenol-treated posts could not be calculated but would be greater than that calculated for ACA and creosote because of the current lack of failures. The long-term durability of the posts is notable considering that the exposure site presents a severe biodeterioration hazard.

There is relatively little data on the service life of pressure-treated wood used in residential construction, such as back yard decks. This is due to the lack of a centralized mechanism for collecting this type of data and because residential decks are often replaced for cosmetic reasons rather than failure from decay or insect attack (Smith and others 2006, McQueen and Stevens 1998). One study reported that the average age of a deck at its removal is 9 years (McQueen and Stevens 1998). In contrast, tests conducted with 2 by 4 sections placed into the ground indicate that pressure-treated lumber can potentially last in excess of 60 years (Fig. 27).

The longevity of pressure-treated structures can be increased by

- purchasing lumber that has been treated in accordance with AWPA standards,
- selecting the appropriate use category for the application (e.g., do not use wood treated for above-ground use if it will be in contact with the ground),
- using designs that minimize water trapping, and
- treating cut ends and bolt holes that expose untreated wood with preservative.

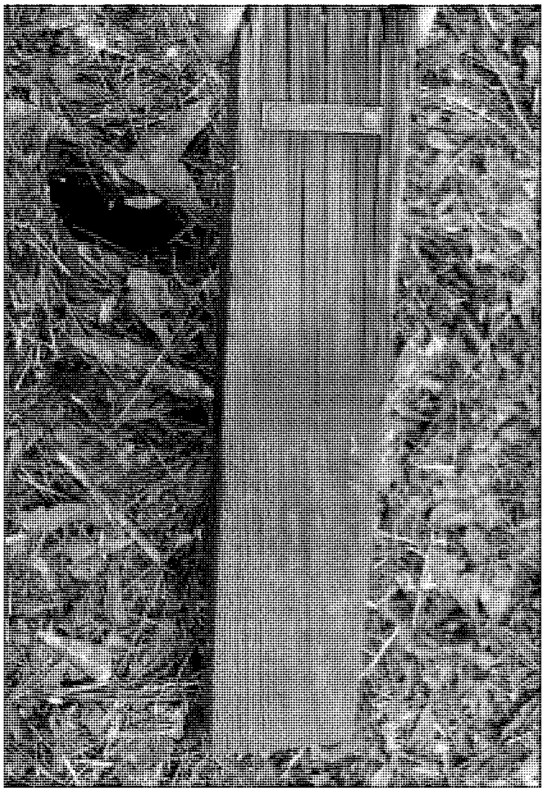

Figure 27. This pressure-treated 2 by 4 lumber specimen has remained in good condition for more than 60 years of exposure at the USDA Forest Service, Forest Products Laboratory test site in southern Mississippi.

Reuse and Disposal

Although preservative-treated wood is a durable construction material, it is eventually removed from service. The fate of treated wood removed from service varies depending on the original application and the type of preservative used. As with many materials, reuse of treated wood in a manner similar to that originally intended may be a viable alternative to disposal. In many situations, treated wood removed from its original application retains sufficient durability and structural integrity to be reused in a similar application (Clausen and Lebow 2011). Numerous other methods of recycling used treated wood have been proposed, and some have been shown to be technically feasible (Clausen and Lebow 2011, Smith and others 2006). However, most have economic or other barriers that have prevented widespread use. One alternative option to recycling is a current commercial practice that involves combustion of creosote- or copper-naphthenate-treated railroad ties for energy production.

Treated wood is not listed as hazardous waste under federal law, and it can be disposed of in any waste management facility authorized under state and local law to manage such material. The most common disposal method for treated wood waste in the United States is landfilling in a construction and demolition (C&D) facility (Clausen and Lebow 2011). However, C&D debris disposal is regulated by state agencies; therefore, requirements can and do vary from state to state. Older landfills were typically unlined, and some states, including Minnesota, have banned treated wood waste from unlined landfills, but other states currently allow disposal of CCA-treated wood waste in Class I, II, or III landfills and C&D debris disposal facilities (Clausen and Lebow 2011).

Used treated wood and treated construction scraps must not be burned in open fires because burning may release toxic gasses and/or may concentrate preservative elements in the ash. In some cases, wood treated with oilborne preservatives can be burned for production of energy but only in specialized facilities and in accordance with state and federal regulations.

State and local jurisdictions may regulate the use, reuse, and disposal of treated wood and treated wood construction waste. Users should check with state and local authorities for any special regulations relating to treated wood.

Alternatives to Pressure-Treated Wood

Naturally Durable Species

Naturally durable species produce chemicals that are toxic to wood decay fungi. These chemicals, or extractives, are produced as the wood cells transition from sapwood cells to heartwood cells. Extractives are found only in heartwood and serve to protect the tree from fungal and, in some cases, insect attack. Naturally durable tree species native to North America include old growth bald cypress, catalpa, cedars, chestnut, junipers, black locust, mesquite, redwood, red mulberry, several species of oak, osage orange, sassafras, black walnut, pacific yew, and heartwood of old growth southern yellow pine. A number of imported tropical hardwoods are also known for their natural durability. Some naturally durable wood species have other properties that are desirable in some applications. Cedar and redwood have less tendency to warp than commonly treated pine species, and the hardness of white oak makes it well suited for use as a wearing surface.

One widely recognized limitation of naturally durable species is that only the heartwood is durable. Untreated sapwood of naturally durable wood species has low resistance to decay and usually has a short service life under decay-producing conditions. Therefore, it is important to specify 100% heartwood for repair or replacement material. Although the vulnerability of sapwood is understood, it can be difficult and expensive to find sufficient material in which all pieces are completely free of sapwood. The presence of sapwood can be both an aesthetic and a structural concern for large timbers in moisture-prone areas.

A less-recognized characteristic of many naturally durable species is the high degree of variability in durability. The properties that make a wood naturally resistant to decay and insects can vary considerably from tree to tree and even within the same tree (Daniels and Russell 2007, DeBell and others 1999, Pollet and others 2008). Therefore, predicting performance based on durability can be difficult. The decay resistance of heartwood is greatly affected by differences in the preservative qualities of the wood extractives, the attacking fungus and/or insect, and the conditions of exposure. Considerable difference in service life can be obtained from pieces of wood cut from the same species, even from the same tree, and used under apparently similar conditions.

Some naturally durable species also appear to be more affected by the severity of the decay environment than wood treated with preservatives. Woods that provide adequate performance above ground may sometimes decay nearly as rapidly as nondurable species when placed into ground contact. These differences appear to be a function of wood permeability. Less permeable woods used above ground, such as cedar, absorb less moisture during wetting events and thus are less likely to be sufficiently moist long enough to sustain growth of decay. This advantage is lost for wood placed in contact with the ground because moisture from the soil eventually diffuses into wood with low permeability.

Thermal Modification

Thermal modification is a carefully controlled process in which wood is exposed to high temperatures for sufficient time to modify the wood's chemical structure. Thermal modification is sometimes confused with surface charring or with the heat treatment used to sterilize wood products for import or export. Neither of those processes imparts significant durability, but heating wood at high temperatures for extended periods can cause chemical changes that affect a range of wood properties, including decay resistance. Several thermal treatment processes are in commercial use in Europe and to a lesser extent in North America. In these processes, the wood is heated to temperatures ranging from 320 to 500 °F in specially constructed kilns under controlled conditions. The processes may use steam, nitrogen, or vacuum to minimize oxygen and chemical degradation by oxidative reactions. One process heats the wood in oil. Thermally treated wood has only moderate decay resistance and little termite resistance; therefore, most applications are confined to above-ground use. Decay resistance increases at higher processing temperatures, but losses in mechanical properties, especially impact bending, also increase. An advantage of heat treatment is that it can be used with wood species that are difficult to penetrate with preservatives. It can also lessen the tendency of wood to absorb moisture and thus decrease problems associated with shrinking and swelling. It also retains a natural appearance, and although the color is initially darkened somewhat, the wood does weather to grey when exposed to sunlight. Because of its qualities, thermally treated wood is sometimes used in noncritical above-ground applications, such as siding or decking. Thermally modified wood currently has limited availability in the United States.

Chemically Modified Wood

Chemical modification is a general term applied for treatments that attempt to modify the wood into a less attractive nutrient source for decay fungi and insects. Currently, the two most prevalent processes are acetylation and furfurylation. In the acetylation process, wood is treated with acetic anhydride, which replaces hydroscopic hydroxyl groups (OH-) with less hygroscopic acetyl groups in the wood cell walls. This process causes the wood to absorb less moisture. In the furfurylation process, the wood is treated with furfuryl alcohol, which is then catalyzed to form polymers in the wood. Furfuryl alcohol is also thought to react with chemical groups such as lignin that make up the wood cell structure. Furfurylation also causes the wood to absorb less water than untreated wood. Both processes require the use of much more chemical than is used in conventional wood preservatives to achieve significant durability. Weight gains of at least 15% to 20% are needed for acetylation, and even greater weight gains are needed in the furfurylation process. As a result, chemically modified wood tends to be more costly than wood pressure-treated with preservatives. In addition to decay resistance, the treated wood is harder, heavier, and more dimensionally stable. Protection against attack by mold fungi and termites has not been as thoroughly evaluated as decay resistance. Chemically modified wood currently has limited availability in the United States.

Summary

Most wood species need to be protected from decay fungi and insect attack when used for construction outdoors or otherwise exposed to frequent wetting. Typically, this protection is achieved by pressure treatment with preservatives that protect the wood from a wide range of wood-degrading organisms. Pressure treatment provides deeper and more uniform preservative penetration compared with wood treated by other methods. Pressure-treatment preservatives are liquids that are classed as either waterborne or oilborne. Although creosote can be used without oil dilution, it has properties similar to oilborne preservatives and is often grouped with these. Waterborne preservatives tend to have little odor and leave the wood with a dry, paintable surface. They are used for a wide range of applications, including the treated lumber sold by lumber yards for construction of residential decks and fences. Some waterborne preservatives are also used for more industrial-type applications such as round poles, piling, and bridge timbers. Oilborne preservatives are dissolved in either heavy or light oil. Heavy oil is similar to diesel, whereas light oil is similar to mineral spirits. The properties and applications of oilborne preservatives depend on the type of oil used. Heavy oil treatments are typically used for heavy-duty applications, such as utility poles, bridge timbers, and railroad ties. Heavy oil treatments have the advantage of imparting some water-repellency to the wood and can help protect metal fasteners from corrosion. However, wood pressure-treated with heavy oils may have a noticeable odor and should not be used for the interior of inhabited structures. Light oil treatments are sometimes used when it is desirable to have wood with a drier surface and less residual odor.

Before a wood preservative can be approved for pressure treatment of structural members, it must be evaluated to ensure that it provides the necessary durability. Traditionally, this evaluation has been conducted through the standardization process of the AWPA. Part of the AWPA evaluation process includes specifications for minimum preservative penetration and retention levels. To guide selection of the types of preservatives and retentions appropriate to a specific end-use, the AWPA developed UCS standards. The UCS standards categorize treated-wood applications by the severity of the deterioration hazard, as well as the structural significance of the application. There are separate UCS standards for sawn products (lumber, timbers, and posts), round poles, piles, and structural wood composites. They list the preservatives that are standardized for each type of end-use by wood species. AWPA also considers other factors such as odor and surface cleanliness when making recommendations for specific applications.

Design and construction practices also play an important role in the durability of pressure-treated wood. One potential pitfall is the use of wood treated for UC3B (above-ground) applications under conditions that immediately or over time create a decay hazard similar to ground contact. Similarly, construction designs that create moisture traps or facilitate accumulation of leaf litter can create increased decay hazards. Field cuts or bolt holes can expose untreated wood, especially in larger members. These areas should be field-treated in accordance with AWPA Standard M4 (AWPA 2018).

Most wood preservatives contain pesticides, and concerns sometimes arise that pressure-treated wood may negatively affect sensitive aquatic environments. However, potential environmental effects are evaluated by the EPA before a wood preservative can be registered, and studies by university and government researchers have indicated that environmental risks associated with pressure-treated wood are low in most situations. A web-based environmental assessment tool has been developed to assist users in evaluating potential pesticide released from proposed projects involving large volumes of preservative-treated wood placed in or above slow moving water. Best management practices for production and use of pressure-treated wood in sensitive aquatic environments have also been developed to further decrease the potential for environmental impacts.

Alternatives to preservative treatment include naturally durable species, thermally modified wood, and chemically modified wood. Resistance to warping and cracking can be an advantage of these alternatives, although this is not the case for all naturally durable woods. Naturally durable species may vary greatly in durability from piece to piece, and they may not be sufficiently durable for some applications. Chemically and thermally modified wood is typically substantially more costly than pressure-treated wood, and thermal modification can negatively impact strength properties.

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Wood Preservatives[1]

Frederick M. Fishel[2]

This document describes the purpose of applying preservatives to various wood products. A description of wood preservatives registered for use in Florida is also provided.

Wood is well-suited as a structural material because it is very strong for its weight and can be easily cut into the needed dimensions. It is available in a range of species that can suit a variety of demands, such as utility poles, fence posts, marine pilings, lumber, timbers, and plywood. These wood products are used in widely different environments, ranging from above ground, to ground contact, to both freshwater and marine settings. Wood is highly durable if properly protected from pests and excessive moisture (Figure 1).

Figure 1. Lumber treatment facility.
Credits: BB&S Treated Lumber of New England, North Kingstown, RI

Effective wood preservation treatments protect wood products from pests and extend the service life of those products. This has two important benefits: environmental and economic.

Wood is the only renewable building material. It comes from trees growing in forests, which serve environmental and recreational purposes; it is important to conserve and protect this valuable resource. By extending the service life of wood products, wood preservation reduces the frequency with which those products need to be replaced. This helps preserve forests.

Replacing wood products in service can be an involved and expensive endeavor. As an example, consider what is required to replace utility poles. To make new poles, you must harvest trees, cut them to the proper dimension, peel and dry them, and treat them with preservatives. Then you must remove the old poles, which could temporarily interrupt communications and electric service for many people. Finally, you must put the newly produced poles in place. Each of these steps, and the many others not mentioned, cost money, not including any costs resulting from the failure of the original poles (e.g., downed power lines when a pole falls). Reducing the frequency of replacement makes wood products more economical and saves money (and trouble) for people who rely on them.

Insects, fungi, and bacteria can damage wood over time. Treating wood with pesticides can prevent wood from rotting as quickly. Several wood preservatives are registered with the United States Environmental Protection Agency (EPA) and the Florida Department of Agriculture and

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Consumer Services (FDACS), each with different uses and potential risks.

Wood can be a source of food and/or shelter for many microorganisms and small animals, but those which damage the wood are considered pests. If pests gain access to susceptible wood, they can break down and/or consume its structural components and reduce its service life. Wood products that meet the ground are generally at greater risk of being attacked by different pests. Since all pests require adequate moisture, products placed in the ground or in direct contact with water are at higher risk of attack from pests.

Wood Pests

Fungi

Fungi are spore-producing organisms that derive metabolic nourishment from living or dead host tissue. There are three general classes of fungi that attack wood; these include decay, stain, and mold fungi. However, each requires adequate moisture and temperature to attack wood.

The first type, decay fungi, feed on various components of wood and can extend deep into the product. The fungi feed by using enzymes to break down the lignin and other hard fibers. This results in the long and hard wood fibers becoming spongy and weak. This structurally weaker product will often need to be replaced. Again, wood that is in contact with the ground or water is most susceptible to attack by decay fungi.

Stain and mold fungi do not reduce wood's structural integrity, but rather reduce the value of wood and the effectiveness of wood preservation. They also increase the permeability of wood; water penetrates the wood more easily, making conditions more favorable to decay fungi that can reduce the service life of the wood product. This process usually starts after insect infestation, such as wood-boring beetles (Figure 2).

Figure 2. Pine logs discolored by blue stain fungus transmitted by pine beetle.
Credits: William M. Ciesla, Forest Health Management International, bugwood.org

Insects

Insect pests include termites, wood-boring beetles, carpenter ants (Figure 3), and carpenter bees. Some of these insects eat wood while others only use it for shelter (Figure 4). All, however, destroy wood in the process and, like decay fungi, can weaken the wood and cause it to fail. Subterranean termites and carpenter ants are more likely to attack wood that is in ground contact because they prefer wet or moist wood that does not dry readily, though wood above ground level is not immune.

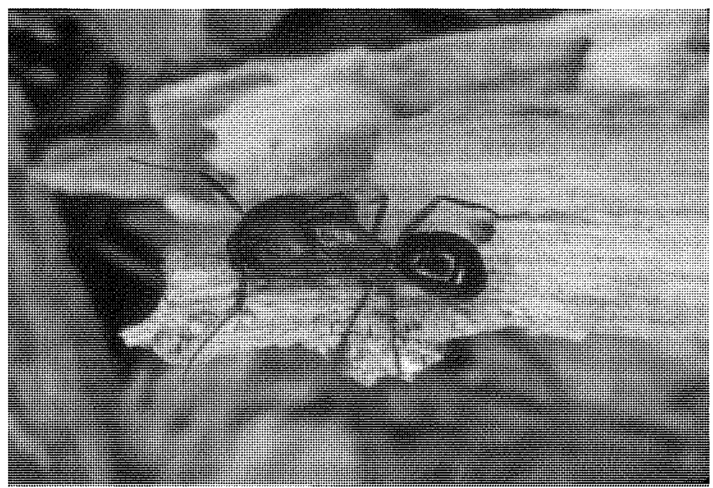
Figure 3. Carpenter ant feeding on wood.
Credits: UF/IFAS Entomology and Nematology

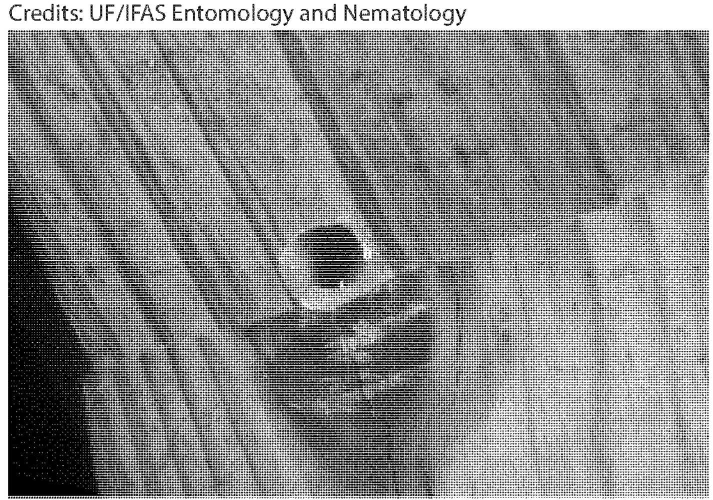
Figure 4. Carpenter bee damage to mailbox.
Credits: UF/IFAS Entomology and Nematology

As their name implies, marine borers will attack wood, such as pilings, that is submerged in salt water or brackish waters. Some bore deeply into wood and greatly reduce its structural strength. Other species make more shallow tunnels, which can make the surface of the wood susceptible to erosion from wave action.

Preservation

Wood preservation is the treatment of wood products with chemicals to protect the wood from pests; therefore, these chemicals are considered pesticides. To be effective, a treatment must be thorough enough so that no untreated wood is exposed and available for pests to attack. The EPA classifies wood products that have been treated with preservatives as "treated articles" rather than as pesticides; treated wood is therefore not regulated under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), though its uses may be restricted by state law and/or the preservative label. Also, handling freshly treated wood may pose some health risks.

The chemicals used are classified as pesticides and are referred to as wood preservatives. They are generally classified as either oilborne preservatives or waterborne preservatives based on whether the product is formulated in either oil or water. A description of those registered for use in Florida is presented in Table 1 where a summary of their properties is also provided. Wood preservatives are subject to federal and state pesticide regulations.

Oilborne Wood Preservations

Oilborne wood preservatives are formulated or mixed with solvents such as petroleum oils and mineral spirits; they are largely used where human contact with the treated wood will be rare. The solvent can affect characteristics of the treated wood such as color, cleanliness (oily to the touch), paint-ability, and odor. Preservative solutions with heavy, less-volatile oils adversely affect these traits more than solutions with more-volatile, lighter oils or solvents. However, lighter solvents might provide less protection in some situations, so all aspects of the wood's end use should be considered. Oil-based solvents are also flammable and can pose health risks. Treatment with oilborne preservatives does not make wood swell. The solvents make treated wood less susceptible to cracks and separation along the grain of the wood.

Copper Naphthenate

Copper naphthenate is a thick, dark-green liquid that can be dissolved in heavy or light oils, though formulations that are emulsifiable in water are also available. Use of lighter oils aids penetration into hard-to-treat species. Copper naphthenate protects against wood-destroying fungi and insects, though less so against termites. Treated wood can be used for above-ground, ground contact, and freshwater sites. Treated softwoods are commonly used for utility poles, greenhouse lumber, seedling trays, posts, piers, and docks. Railroad ties commonly utilize hardwoods treated with copper naphthenate.

Copper naphthenate can cause skin and eye irritation, and prolonged skin contact may cause allergic reactions. Wood treated with copper naphthenate has a strong odor and is unsuitable for contact with food or for use in food gardens. However, the preservative can be used around bedding plants after the volatile solvent evaporates.

Oxine Copper

Oxine copper (copper-8-quinolinolate or "Copper 8") is a greenish brown solution that contains the metals copper and nickel in equal amounts. It can be dissolved in a range of organic solvents, but protection is best when heavy oils are used. Treated wood is odorless and is paintable.

Oxine copper is toxic to wood-destroying fungi and insects and is effective above ground but not when in contact with the ground. Exterior, above-ground uses include playground equipment and decking. Oxine copper is permitted for use in wood that comes in direct contact with food, such as flooring in meat lockers, food pallets, and crates.

Oxine copper also comes in a water-soluble formulation. In that form, it is corrosive and can cause irreversible eye damage.

Pentachlorophenol

Pentachlorophenol, or "penta," is a crystalline, odorless solid that can be dissolved in light or heavy petroleum oil. The desired end use of the wood will influence the choice of solvent. The solvent used affects the odor and color of the solution (nearly colorless to dark brown), the appearance, cleanliness, weight, and paint-ability of the treated wood, and how the wood can be used. For example, while heavier solvents cause more problems with paint-ability, color, and cleanliness of the treated wood and make it up to 20% to 50% heavier, they allow the wood to be used in harsher environments, such as for ground contact.

Penta resists leaching because it is relatively insoluble in water. It protects against decay fungi and insects in wood used above ground, in ground contact, and in freshwater.

Penta is most commonly used to treat utility poles and crossarms. Wood treated with penta is not for residential use, nor is it suitable for use in living areas or where contact with plants, animals, or food is likely.

Penta is a restricted-use pesticide because of concerns that it can cause tumors, birth defects, and cancer. EPA considers it to be a probable human carcinogen. Because of the concern over birth defects, pregnant women should avoid all direct exposure to penta. Vapors irritate the eyes and respiratory tract. Contact with penta may cause skin disorders or irritation. Inhalation of concentrated vapors or excessive skin contact with penta may cause fever, headache, weakness, dizziness, nausea, loss of coordination, sweating, convulsions, and low body temperature; prolonged exposure could damage the liver, kidneys, and nervous system. Some formulations may be fatal if inhaled or absorbed through the skin.

Penta is also toxic to plants, fish, and wildlife. Penta is a marine pollutant and is not approved for use in wood products that would be used in marine environments.

Water Preservatives

Waterborne preservatives can be dissolved or suspended in water, though they may have other chemicals added (e.g., ammonia, surfactant) to aid in penetration. Most remain fixed in the wood (i.e., resistant to leaching) after treatment.

Examples of treated commodities include timber, posts, building foundations, poles, and piling. Waterborne preservatives are especially suited for lumber because when dry, the treated wood is clean to handle, odorless, and paintable.

Alkaline copper quaternary (ACQ) compounds

ACQ wood preservatives (types A, B, C, and D) are composed of copper oxide and a quaternary ammonia compound. The ammonia carrier improves the penetration of ACQ Type B into hard-to-treat species. Type D has an amine carrier and is used for easier-to-treat woods, such as southern yellow pine. Type C uses both carriers. The absence of chemicals like arsenic or chromium has made ACQ one of the most widely used residential wood preservatives.

ACQ can be used on many softwood species, and the range of formulations provide flexibility in treating different species for different uses, both aboveground and in-ground contact. The color of treated wood varies with the chemical type, from dark greenish-brown fading to a lighter brown, with Type B to lighter greenish-brown with Type D. The color of wood treated with Type C varies between Types B and D depending on the formulation.

ACQ concentrate is corrosive and can cause skin burns and irreversible eye damage. Prolonged or frequently repeated skin contact with the amine formulation may cause allergic reactions.

Copper azoles

Copper azoles contain copper, along with fungicides from a family of chemicals known as the triazoles; together, they protect wood from insects and decay fungi. The two types of copper azole are called dissolved and micronized, sometimes referred to as "dispersed," which refer to how the copper is present in the preservative. In the dissolved type, the copper metal is liquefied into a solution using a chemical. In micronized copper azoles, tiny particles of copper are suspended in water.

Copper azoles protect softwoods from wood-destroying fungi and insects. Cooper azoles have largely replaced chromated copper arsenate (CCA) as the preservative of choice for retail sale of lumber for residential uses.

Copper azoles are corrosive and can cause skin burns and irreversible eye damage.

Tebuconazole and propiconazole

Tebuconazole and propiconazole are triazole fungicides. In addition to being components of copper azole products, tebuconazole and propiconazole can form a stand-alone product which could be mixed with other wood-preserving chemicals such as quaternary ammonium compounds. The fungicides are also formulated with the insecticide imidacloprid for spray, dip, or pressure treatment to protect wood from wood-destroying fungi and insects; treated products include window and door trim, fascia boards, and millwork.

The exposure concerns will vary by product, with some being corrosive and able to cause irreversible eye damage.

Borates

Borate wood preservatives have been used to treat wood for interior construction including joists, sheathing, sill plates, and other uses for over 70 years. Borates leach readily from treated wood; therefore, the treated wood is suited for use only above ground and where it can be protected from wetting. The high solubility aids penetration during treatment, as borates "follow the water" into the wood's interior. Borates add no color to treated wood and so do not interfere with staining.

Borates provide excellent protection against wood-destroying fungi and insects, including termites, wood-boring beetles, and carpenter ants. Pressure treatment of various softwoods for framing lumber in areas with high termite hazard and for cabin logs is common. In the latter case, the wood must be stained to prevent the preservative from leaching out when the logs are exposed to rain.

Borates can cause mild eye irritation but have low toxicity to fish, birds, and mammals.

Is treated wood safe for raised bed gardening?

The EPA determines product safety during their wood preservative registration process. The wood preservatives used in treated wood available to consumers have been registered by the EPA for general use, which means that the EPA has determined it is relatively safe for most, if not all, consumer applications. Different people perceive safety in different ways. If you're concerned, you could always apply some type of coating or sealer to reduce the amount of soil contact with the preservative-treated wood, or perhaps even put a sheet of plastic between the treated wood and the soil if you want to minimize or eliminate contact between wood and soil. Please note that most of the treated wood that's two inches or less in thickness tends to be treated for above-ground uses, so it may not last very long in a ground-contact application. Be sure to contact the manufacturer of the treated wood product or the manufacturer of the wood preservative chemical for information on product safety. There should be contact information on the end tag of the treated wood at your lumber retailer (Figure 5).

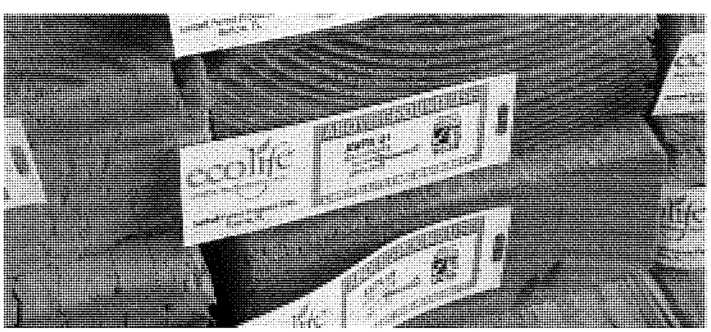

Figure 5. Treated lumber end tag on lumber for retail sale.
Credits: UF/IFAS Pesticide Information Office

ATTACHMENT 5

Table 1. USDA Forest Service summary of wood preservative properties.

Standardized use	Preservative	Solvent characteristics	Surface/handling restrictions	Color	Odor
All uses (except in seawater)	Copper naphthenate	No. 2 fuel oil	Oily, not for frequent human contact	Green, weathers to brownish gray	Strong, lasting
	Penta			Dark brown	
Above ground, fully exposed	Oxine copper	Mineral spirits	Dry, okay for human contact	Greenish brown, weathers to gray	Mild, short term
All uses (except in seawater)	ACQ	Water	Dry, okay for human contact	Greenish brown, weathers to gray	Mild, short term
	Copper azoles				
Indoors (usually for insect protection)	Borates			Colorless, blue dye often added	None