Preservative Treatment of Glued Laminated Timber

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INTRODUCTION

Structural glued laminated timbers (glulam) bearing the *APA EWS* trademark are produced by members of *APA – The Engineered Wood Association*. These glulam timbers are manufactured to conform with ANSI Standard A190.1, American National Standard for Structural Glued Laminated Timber.[1]

Although glulam does not require preservative treatment for most uses, certain applications may present environmental conditions conducive to decay, insect or marine borer attack, such as the long-term or frequent presence of moisture (generally 20 percent or greater moisture content of the wood) accompanied by temperatures ranging from 50°F to 90°F. Decay slows at temperatures outside this range and virtually ceases at temperatures below 35°F or above 100°F.

Conditions conducive to decay or insect attack are typically controlled through recognized design principles and construction techniques, such as use of overhangs, flashings, ventilation and proper joint connection details. When these conditions cannot be avoided, glulam must be pressure-preservative-treated or a naturally durable wood species must be used. Examples of construction where such hazards may exist include direct exposure to weather, ground contact (including direct contact with concrete foundations and footings), contact with fresh water or sea water and exposure to excessive condensation.

Outdoor uses of preservative-treated glulam include bridges, utility structures, marine applications, highway noise barriers and decks. Indoor uses that may require pressure treatment include environments subject to high humidity or condensation such as indoor swimming pools or greenhouses, where moisture content of the wood may exceed 20 percent. Indoor applications, such as post-frame construction in some agricultural buildings, may also involve ground contact, and thus require preservative treatment for those members in contact with the ground.

APPLICABLE STANDARDS

Applicable standards for preservative treatment of glulam include American Wood Protection Association (AWPA) Standards U1[2] (and all other standards referenced therein) and M4.[3] Related specifications include National Design Specification for Wood Construction (NDS)[4]; ANSI A190.1[1]; and Standard Specification for Transportation Materials and Methods of Sampling and Testing.[5]

APA

INTENDED END-USE SERVICE CONDITIONS

The American Wood Protection Association (AWPA) has replaced the Commodity (C) Standards with the Use Category System (UCS). Service conditions are now designated into five basic use categories in AWPA Standard U1.[2] The use categories designations and service conditions that apply to glulam are summarized in Table 1.

TABLE 1

SUMMARY OF USE CATEGORIES FOR TREATED WOOD

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[a] Above Ground Protected	Exterior construction, above ground, coated and rapid water run-off	Exposed to all weather cycles, not exposed to prolonged wetting	Decay fungi and insects	Coated millwork, siding and trim
UC3B Above Ground Exposed	Exterior construction, above ground, uncoated or poor water run-off	Exposed to all weather cycles, including prolonged wetting	Decay fungi and insects	Decking, deck joist, railings, fence pickets, uncoated millwork
UC4A Ground Contact General Use	Ground contact or freshwater, non-critical components	Exposed to all weather cycles, normal exposure conditions	Decay fungi and insects	Fence, deck and guardrail posts, cross-ties and utility poles (low decay areas)
UC4B Ground Contact Heavy Duty	Ground contact or freshwater, critical components or difficult replacement	Exposed to all weather cycles, high decay potential includes saltwater splash	Decay fungi and insects with increased potential for biodeterioration	Permanent wood foundations, building poles, horticultural posts, cross-ties and utility poles (high decay areas)
UC4C Ground Contact Extreme Duty	Ground contact or freshwater, critical structural components	Exposed to all weather cycles, severe environments, extreme decay potential	Decay fungi and insects with extreme potential for biodeterioration	Land and freshwater piling, foundation piling, cross-ties and utility poles (severe decay areas)
UC5A Marine Use Northern Waters	Salt or brackish water and adjacent mud zone Northern waters	Continuous marine exposure (saltwater)	Saltwater organisms	Piling, bulkheads, bracing
UC5B Marine Use Central Waters	Salt or brackish water and adjacent mud zone New Jersey to Georgia, south of San Francisco	Continuous marine exposure (saltwater)	Saltwater organisms, including creosote tolerant *Limnoria tripunctata*	Piling, bulkheads, bracing
UC5C Marine Use Southern Waters	Salt or brackish water and adjacent mud zone South of Georgia, Gulf Coast, Hawaii and Puerto Rico	Continuous marine exposure (saltwater)	Saltwater organisms, including creosote tolerant *Martesia and Sphaeroma*	Piling, bulkheads, bracing

(a) UC3A is not covered in AWPA Standard U1 for glulam.

Note that special attention should be paid when specifying preservative treatments for use in areas subject to Formosan subterranean termite activities. For a list of suitable preservatives, please refer to AWPA Standard U1.[2] When specifying the use of preservative-treated glulam in the state of Hawaii, confirm with city and county building codes that the specified preservative treatments meet the requirements for structural lumber.

PRESERVATIVES

Pressure-preservative treatments listed in AWPA Standard U1[2] for glulam include creosote, pentachlorophenol, copper naphthenate, oxine copper and waterborne inorganics. Proprietary preservative treatments that meet AWPA requirements and local building department approvals are permitted for use.

Organic Preservatives

Organic preservatives listed in AWPA Standard U1 include creosote, pentachlorophenol, copper naphthenate and oxine copper. The first two are "restricted use" chemicals and not available for residential construction.

Creosote is a coal tar product which is dissolved in a distilled solution or petroleum oil. It is an effective preservative in commercial, industrial or marine applications when there is severe exposure to decay or insect attack, or marine borers in saltwater environments. Creosote-treated glulam has an odor and a dark, "oiled" surface appearance and, therefore, is not recommended where painting is required.

Pentachlorophenol (penta) is commonly dissolved in light petroleum oil or solvent, liquid petroleum gas (LPG), or in a petroleum solvent/water solution. It is suitable as a preservative for ground contact or above-ground uses. Glulam treated with penta has an odor, and oil-borne penta has an "oiled" surface appearance and, thus, is not recommended for painting. Glulam treated with solvent- or water-borne penta (including penta in LPG), however, has an oil-free surface and natural wood appearance, and should be specified where staining or painting is desired.

Copper naphthenate (CuN) is suitable for above-ground uses and ground contact when treated to a proper retention level. CuN is often dissolved in heavy oil solvents or light hydrocarbon solvents for use as preservative carriers. CuN-treated wood may have a light green coloration that diminishes during weathering. After thorough drying, it can be stained or painted, but a stain-blocking primer is recommended for finishing to minimize discoloration of the finish by the CuN treatment.

Oxine copper (Cu8) is suitable for above-ground use. The preservative is dissolved in liquid petroleum gas or light hydrocarbon solvents so that the treated glulam has a clear surface and is free of solvent odor. Oxine copper solutions may leave a greenish-brown coloration that could weather to gray. Glulam treated with oxine copper solutions may be stained or painted with an oil base finish after thorough drying.

Inorganic Preservatives

Waterborne treatments such as acid copper chromate (ACC), ammoniacal copper zinc arsenate (ACZA), alkaline copper quat-type-C (ACQ-C) and chromated copper arsenate (CCA) are not recommended by APA for glulam timbers that are to be treated after gluing, but may be applied to southern pine laminations prior to gluing. Check with the glulam manufacturer and treater to verify the availability of these treatments. CCA may only be used in applications where frequent human contact will not occur. Consult with local and state building codes prior to specifying the use of CCA-treated wood. When waterborne treatments are specified for glulam after gluing, the members must be redried after treating. This process may cause dimensional changes, such as warping and twisting, or may lead to excessive checking, splitting or raised grain, resulting in a finished product with an unacceptable appearance.

Other treatments and processes specified should be agreed to by purchaser, seller and the governing code body. Required retention and penetration levels depend on end use and exposure according to AWPA U1 or other applicable specifications. Table 2 provides a summary of these treatment characteristics and limitations.

TABLE 2

TREATMENT TYPE CHARACTERISTICS

	Creosote	Penta in Oils	Penta in Light Solvents	Copper Naphthenate (CuN)	Oxine Copper (Cu8)	Waterborne Preservatives
Suitable Applications	Saltwater or freshwater applications, wood block floor, bridges, towers and ground contact.	Freshwater, ground contact, above-ground uses, including docks, bridges, towers and beams.		Ground contact and above-ground uses, should not be used in direct contact with water.	Above-ground use only.	Fresh water applications and ground contact. May be used indoors provided sawdust and construction debris are cleaned up and disposed by ordinary trash collection.
Appearance	Dark, oily odor.	Oily, may be blotchy, may have odor.	Varies from natural appearance of wood to some darkening of wood.	Light green coloration that may diminish during weathering.	Varies from natural appearance of wood to some darkening of wood.	Green to brown depending on chemicals used and exposure to light.
Paintability	Not paintable.	Not practical.	Can be finished with water repellent or oil-based semi-transparent stain.	Can be stained or painted after thorough drying.	Can be finished with an oil-based stain or paint.	Can be stained or painted when surface is dry and prepared in accordance with coating manufacturer's recommendations.
Comments	Should not be used in residential interiors. May be used in industrial interiors when two coats of effective sealer are applied.	May be used in residential, industrial or commercial interiors as laminated beams or building components that are in ground contact and where two coats of effective sealer are applied.		May develop greenish discoloration, of light-colored finishes. Stain-blocking primer or second topcoat is recommended for finishing to minimize potential discoloration by the treatment. Check with supplier for use in high decay hazard applications.	Stain-blocking primer will help to minimize discoloration. May be used in residential interiors where frequent human contact will not occur.	May develop greenish discoloration of finish. Stain-blocking primer will help to minimize discoloration. Surfaces may have raised grain and extensive checking may occur.

TREATMENT RECOMMENDATIONS

Glulam timbers are available in custom and stock sizes. Stock sizes are typically cut to length at a distribution center or on the job site. Most glulam to be pressure-treated will be in custom sizes and should be ordered to exact dimensions when possible to avoid field cuts, which must be retreated. In addition, all fabrication, cutting and predrilling of holes for fasteners is recommended prior to pressure treating.

Glulam may be treated after gluing or the individual laminations may be treated prior to gluing, depending on the wood species and treatment specified. Treatments such as creosote or pentachlorophenol (penta) in oil are typically only specified for treatment of the finished member. Penta in light hydrocarbon solvents may be specified for the laminations prior to gluing or for the finished member. Copper naphthenate and oxine copper may also be specified for softwood glulam prior to gluing and for the finished glulam, depending on the species and the use category. Waterborne inorganic treatments may be specified for southern pine laminations prior to gluing, using ACC, ACZA, ACQ-C and CCA. Glulam manufactured using pre-treated laminations is not available from all manufacturers, however, so availability should be verified prior to specifying.

The use of waterborne preservatives for the treatment of finished glulam members is generally not recommended. One waterborne preservative, ACZA, is listed in AWPA Standard U1 for use with coastal region Douglas-fir after gluing. Waterborne types of treatments, however, can lead to potential discoloration of the wood, possible raised grain and excessive checking or warping of the member, and their use will void the manufacturer's warranty for western species. Although not recommended by APA nor specifically listed in AWPA Standard U1, specifiers have sometimes chosen to treat glulam with CCA after gluing. This treatment process also requires special attention to re-drying to minimize raised grain, checking and warping.

Glulam that is to be preservative-treated should be trademarked with the *APA EWS* stamp and must be bonded with wet-use adhesives conforming to ANSI A190.1.

Table 3 provides a summary of treatment recommendations.

TABLE 3

RECOMMENDED PRESERVATIVE TREATMENTS FOR GLULAM

	Western Species		Southern Pine		Hardwoods	
Treatment Type	**Glulam Treated Prior to Gluing**	**Glulam Treated After to Gluing**	**Glulam Treated Prior to Gluing**	**Glulam Treated After to Gluing**	**Glulam Treated Prior to Gluing**	**Glulam Treated After to Gluing**
Creosote	No[b]	Yes	No[b]	Yes	No	Yes
Oil-borne Penta	No[c]	Yes	No[c]	Yes	No	No
Copper Naphthenate	No[b]	Yes	No[b]	Yes	No	No
Cu8[a]	No[b]	No[d]	Yes	Yes	No	No
CCA	No[b]	No	Yes	No	No	No
ACZA	No[b]	No[b]	Yes	No	No	No
ACC	No[b]	No	Yes	No	No	No
ACQ-C	No[b]	No	Yes	No	No	No

(a) For above ground use only, AWPA Use Category UC1, UC2 and UC3B.
(b) Although not recommended, AWPA Standard U1 permits this treatment.
(c) Except when penta with hydrocarbon solvents is used.
(d) Except when treating western hemlock and hem-fir.

SPECIES

Softwood species listed in AWPA Standard U1 for preservative treatment include coastal Douglas-fir, western hemlock, hem-fir and southern pine. Listed hardwood species include red oak, red maple and yellow poplar when treated after gluing. The most commonly available west coast species are Douglas-fir and hem-fir. Other species of glulam may also be available for pressure treatment, subject to agreement by the seller and purchaser and to approval by the governing code body.

Incising is required for Douglas-fir, western hemlock, hem-fir, red maple and yellow poplar. Such incising is normally performed after gluing of the finished glulam. If laminating lumber is to be treated prior to gluing, the mating faces to be glued should not be incised. Incising is not considered to have a detrimental effect on the strength of glulam. The effects of incising on appearance, however, should be considered when ordering glulam where aesthetics are important. If incising is not specified, difficulties in meeting the specified treatment retention and penetration levels may result. This option should only be considered with caution. If the specifier waives the incising requirement, penetration and retention requirements may still apply.

RETENTION AND PENETRATION LEVELS

Retention and penetration levels are specified in AWPA Standards in pounds of retained preservative per cubic foot (pcf) of wood and depth of penetration in inches. Specified retention and penetration levels vary according to the type of preservative, species of wood and the level of exposure. AWPA Standard U1 lists specified retention levels according to the intended end use, and is summarized in Tables 4, 5, 6 and 7.

TABLE 4

PRESERVATIVE RETENTIONS (pcf): GLUE-LAMINATED MEMBERS (Laminations treated prior to gluing)

USE CATEGORY	Preservative System									
	Creosote			PCP-A						
Species	CR	CR-S	CR-PS	PCP-C	Cu8	CuN	ACQ-C	ACC	ACZA	CCA
UC1, UC2, UC3B										
Southern Pine	8.0[b]	8.0[b]	—[a,b]	0.30[b]	0.020	0.040	0.25	0.25	0.25	0.25
Coastal Douglas-fir	8.0[b]	—[a,b]	8.0[b]	0.30[b]	0.020[b]	0.040[b]	0.25[b]	0.25[b]	0.25[b]	0.25[b]
Western Hemlock	8.0[b]	—[a,b]	8.0[b]	0.30[b]	0.020[b]	0.040[b]	0.25[b]	0.25[b]	0.25[b]	0.25[b]
Hem-fir	8.0[b]	—[a,b]	8.0[b]	0.30[b]	0.020[b]	0.040[b]	0.25[b]	0.25[b]	0.25[b]	0.25[b]
UC4A										
Southern Pine	10.0[b]	10.0[b]	—[a,b]	0.60[b]	—[a]	0.060	0.40	0.50	0.40	0.40
Coastal Douglas-fir	10.0[b]	—[a,b]	10.0[b]	0.60[b]	—[a,b]	0.060[b]	0.40[b]	0.50[b]	0.40[b]	0.40[b]
Western Hemlock	10.0[b]	—[a,b]	10.0[b]	0.60[b]	—[a,b]	0.060[b]	0.40[b]	0.50[b]	0.40[b]	0.40[b]
Hem-fir	10.0[b]	—[a,b]	10.0[b]	0.60[b]	—[a,b]	0.060[b]	0.40[b]	0.50[b]	0.40[b]	0.40[b]

(a) Not recommended by AWPA.
(b) Not recommended by the glulam industry, see Table 3.

TABLE 5

PRESERVATIVE RETENTIONS (pcf): GLULAM MEMBERS (Treated after gluing)

USE CATEGORY	Preservative System						
	Creosote			PCP-A PCP-C			
Species	CR	CR-S	CR-PS		Cu8	CuN	ACZA
UC1, UC2, UC3B							
Southern Pine	8.0	8.0	8.0	0.30	0.020	0.040	—[a,b]
Coastal Douglas-fir	8.0	8.0	8.0	0.30	—[a,b]	0.040	0.30[b]
Western Hemlock, Hem-fir	8.0	8.0	8.0	0.30	0.020	0.040	—[a,b]
Red Oak	7.0	7.0	7.0	—[a,b]	—[a,b]	—[a,b]	—[a,b]
Red Maple, Yellow Poplar	8.0	8.0	8.0	—[a,b]	—[a,b]	—[a,b]	—[a,b]
UC4A							
Southern Pine	10.0	10.0	10.0	0.60	—[a]	0.060	—[a,b]
Coastal Douglas-fir	10.0	10.0	10.0	0.60	—[a,b]	0.060	0.60[b]
Western Hemlock, Hem-fir	10.0	10.0	10.0	0.60	—[a]	0.060	—[a,b]
Red Oak	8.5	8.5	8.5	—[a,b]	—[a,b]	—[a,b]	—[a,b]
Red Maple, Yellow Poplar	10.0	10.0	10.0	—[a,b]	—[a,b]	—[a,b]	—[a,b]
UC4B, UC4C: See Table 7 (Glulam Poles).							

(a) Not recommended by AWPA.

(b) Not recommended by the glulam industry, see Table 3.

TABLE 6

PRESERVATIVE RETENTIONS (pcf): GLULAM MEMBERS (Treated after gluing)[a]

USE CATEGORY	Preservative System
	Creosote
Species	CR/CR-S
UC5A	
Southern Pine	20.0
Coastal Douglas-fir	20.0
Western Hemlock, Hem-fir	25.0
UC5B, UC5C	
Southern Pine	25.0
Coastal Douglas-fir	25.0
Western Hemlock, Hem-fir	25.0

(a) Retentions levels are based on published values for sawn products.

TABLE 7

PRESERVATIVE RETENTIONS (pcf): GLULAM POLES (Treated after gluing)

USE CATEGORY	Preservative System		
Species	CR as solution	PCP-A PCP-C as a.i.	CuN Cu as metal
UC4A, UC4B			
Southern Pine			
Outer Zone	9.0	0.45	0.095
Inner Zone[a]	4.5	0.23	0.048
Coastal Douglas-fir			
Outer Zone	9.0	0.45	0.095
Inner Zone[a]	4.5	0.23	0.048
UC4C			
Southern Pine			
Outer Zone	12.0	0.60	0.15
Inner Zone[a]	6.0	0.30	0.075
Coastal Douglas-fir			
Outer Zone	12.0	0.60	0.15
Inner Zone[a]	6.0	0.30	0.075

a.i. = active ingredient

(a) Inner assay zone to be taken in the radial drilled zone.

FIELD CUTS

It is strongly recommended that all fabrication, trimming and boring of glulam be performed prior to pressure treating. If there is any field fabrication or surface damage to the glulam, all cuts, holes or damaged areas must be field treated to protect the exposed wood material. Copper naphthenate may be used to reseal exposed areas of glulam treated with creosote or pentachlorophenol. It may leave a greenish coloration. Field treatments should be applied to saturation by dipping, brushing, spraying, soaking or coating in accordance with AWPA Standard M4.[3]

FASTENERS

AWPA recommends using fasteners that meet the requirements of the major model building codes, which specify that fasteners (including nuts and washers) in contact with preservative-treated wood shall be hot-dipped zinc-coated galvanized steel, stainless steel, silicon bronze or copper. Connectors that are used in exterior applications and in contact with preservative-treated wood shall have coating types and weights in accordance with the treated wood or connector manufacturer's recommendations. In the absence of manufacturer's recommendations, a minimum of ASTM A653 type G185 zinc-coated galvanized steel, or equivalent, shall be used.

STRUCTURAL PROPERTIES

The International Building Code (IBC) and International Residential Code (IRC) recognize glulam design values as specified in the latest edition of the *National Design Specification for Wood Design* (NDS).[4] Although the NDS does not specify reductions in the dry design values for preservative-treated glulam according to AWPA Standards, it does specify that moisture content design capacity adjustment factors be used whenever the moisture content in service is 16 percent or more. It is important to note that the application of a moisture content adjustment factor is based on the judgment of the designer of record considering the end-use environment to which the member is subjected and is not related to any preservative treatment that may be specified.

USE AND HANDLING PRECAUTIONS

The chemical formulations used for preservative treatment of glulam are registered with the U.S. Environmental Protection Agency (EPA), which has approved guidelines for the use of pressure-treated wood to ensure safe handling and avoid environmental or health hazards.

The use precautions for creosote, pentachlorophenol and inorganic arsenical preservative-treated wood are published in EPA-approved Consumer Information Sheets (CISs) for these treatments. These sheets are available from treaters and should accompany each shipment of treated wood. They can also be obtained from the Western Wood Preservers Institute (WWPI) at their website, www.wwpinstitute.org, under the headings, "EPA Approved Consumer Information and Safety Sheets" and "Consumer Safety Information Sheets."

Refer to Consumer Information Sheets and the treater's Material Safety Data Sheets (MSDS) for specific use and handling precautions.

Use and Handling Tips

- Treated wood, in some forms, is considered to be a hazardous waste and as such can only be disposed of in an approved hazardous waste disposal site. Contact your local agency for further information.
- Treated wood from commercial or industrial uses (e.g., construction sites) may be burned only in commercial or industrial incinerators or boilers in accordance with state and federal regulations.
- Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, wear a dust mask.
- Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood.
- When power sawing and machining, wear goggles to protect eyes from flying particles.
- Avoid frequent or prolonged skin contact with any form of preservative-treated wood. When handling wood treated with these chemicals, wear long-sleeved shirts and long pants, and use gloves.
- After working with treated wood, and before eating, drinking or using tobacco products, wash hands and exposed skin areas thoroughly.
- If preservatives or sawdust accumulate on clothes, launder before reuse. Wash work clothes separately from other clothing.

FINISHING

Creosote or pentachlorophenol in oil are not paintable on a practical basis. Pentachlorophenol in light solvents can be finished with natural finishes, such as a clear water repellent or an oil-based semitransparent stain. Clear film-forming finishes such as lacquers, varnishes or urethanes are not recommended for glulam used outdoors because they have a short service life and require extensive surface preparation prior to refinishing.

Glulam that has been treated with waterborne preservatives, such as CCA, can be finished with clear water repellents, oil-based semitransparent stains or film-forming finishes, such as solid-color stains or paint systems. The treatment, however, may leave a green or brown color on the glulam surface that can affect the color and appearance of the finish.

If an opaque coating is desired, the most durable finish is a top-quality paint system, such as a stain-blocking acrylic latex primer followed by two all-acrylic latex topcoats, preferably from the same manufacturer. A stain-blocking primer may also be required under light-colored acrylic latex or solid-color stains to help minimize discoloration of the finish. Always follow the coating manufacturer's recommendations.

If treated wood is to be used indoors, follow the EPA recommendations for appropriate sealing of the wood. See Table 8.

TABLE 8

EPA RECOMMENDED SEALERS FOR TREATED GLULAM

Creosote	Urethane, epoxy, shellac. Coal tar pitch or coal tar pitch emulsions suitable for wood block flooring.
Pentachlorophenol	Urethane, shellac, latex epoxy enamel, varnish.

LIST OF REFERENCES

(1) *APA – The Engineered Wood Association.* 2012. *American National Standard for Wood Products – Structural Glued Laminated Timber,* ANSI A190.1. Tacoma, WA.

(2) American Wood Protection Association. 2013. *U1 – Use Category System: User Specification for Treated Wood.* Birmingham, AL.

(3) American Wood Protection Association. 2013. *M4 – Standard for the Care of Preservative-Treated Wood Products.* Birmingham, AL.

(4) American Wood Council. 2012. *National Design Specification for Wood Construction.* Leesburg, VA.

(5) American Association of State Highway and Transportation Officials. 2012. *Standard Specifications for Transportation Materials and Methods of Sampling and Testing.* Washington, DC.

Preservative Treatment of Glued Laminated Timber

We have field representatives in many major U.S. cities and in Canada who can help answer questions involving APA trademarked products. For additional assistance in specifying engineered wood products, contact us:

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