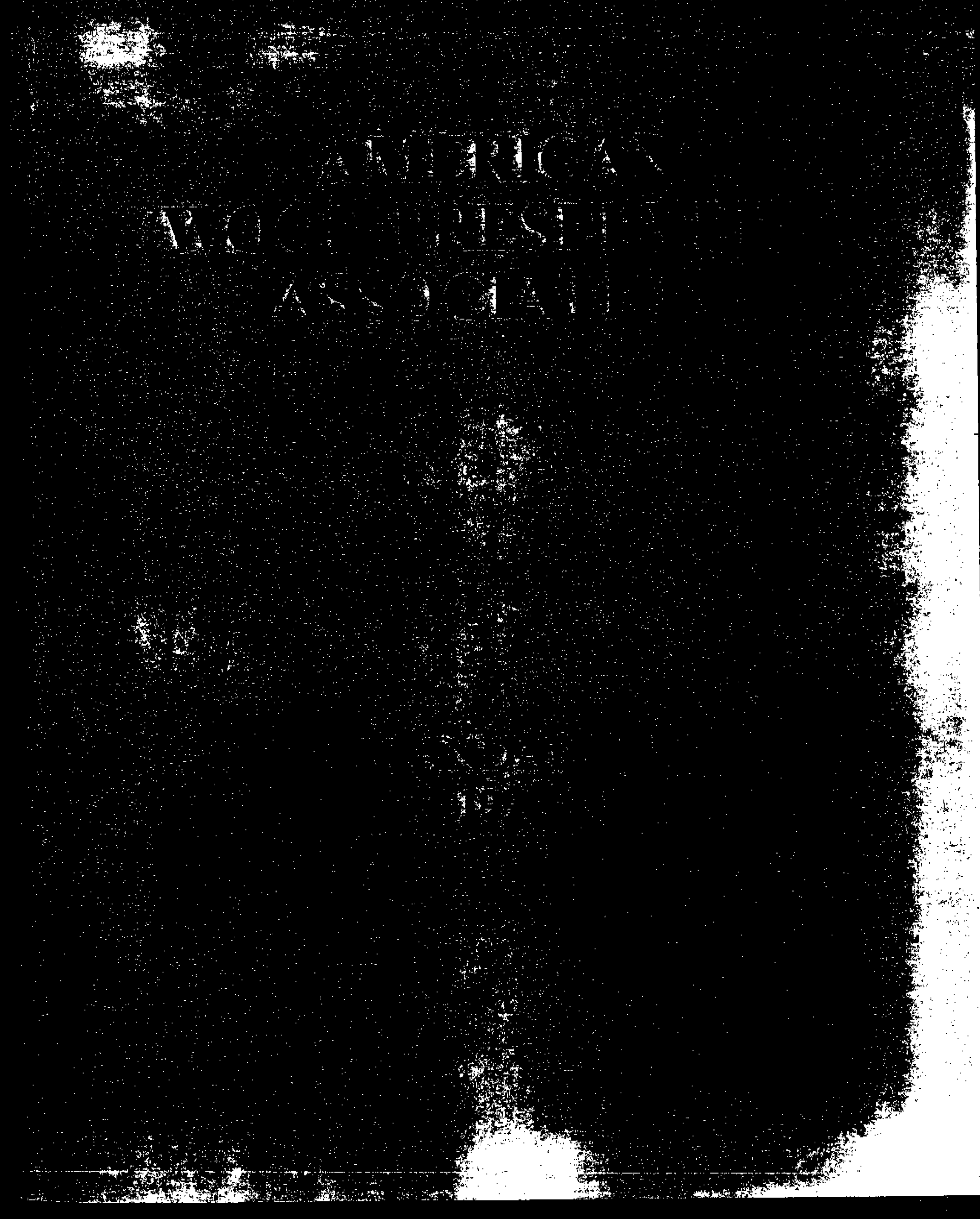
AP-42 Section 10.8
Reference 4
Report Sect. 2
Reference 4



AMERICAN WOOD PRESERVERS' ASSOCIATION

AMERICAN WOOD-PRESERVERS' ASSOCIATION

BOOK OF STANDARDS

INTRODUCTION

This Book of Standards is intended for use by the wood preserving industry as well as for guidance of the purchaser in specifying and obtaining adequately treated wood products. Generally, all wood products may at some time in their life history be subjected to wood-destroying organisms such as decay fungi, insects and marine borers. The purpose of these Standards is to ensure that wood products are treated with suitable preservatives for reasons of safety, service and savings resulting from unnecessary expensive replacements.

When buying under these Standards, purchase orders, to be complete, should state the specific Standard number or numbers that are pertinent and also cover the following: species, quality of wood products before treatment, requirements for manufacturing, surface preparation, limitations if any, special conditioning, preservative and methods of retention determination. Only those species and preservatives are listed in a commodity standard that have previously been found suitable for use in this particular application, or sufficient test information has been submitted to warrant their inclusion. When choosing a treated wood product to serve in a specific situation, the purchaser can obtain appropriate recommendations for the preservative-commodity combination from either the treating company or from qualified authorities if the use conditions are carefully described.

In the AWPA Book of Standards, pertinent phases of adequate treatment requirements for preservatives, quality control and inspection are described in the following sections.

Purchase Guide, Quality Control and Inspection Standards (M1 to M5): The M Standards offer a guide for the purchaser of wood products on the conditioning of the wood, the quality control routines for wood preserving plants, and the inspection procedures used by producer and consumer to determine product compliance with the applicable specification requirements. Also included are Standards for proper handling of treated wood products and identification of the product.

Preservative Standards (P): The P Standards contain specifications for several AWPA approved wood preservatives.

Commodity Standards (C): The C Standards contain treatment specification requirements for different commodities. C1 is the master Standard for all timber products and ensuing commodity Standards. Included are requirements for pretreatment conditioning needed for maximum preservative retention and penetration; for temperature and pressure to ensure maximum effective impregnation with minimal damage during the processing; and for such conditions as are necessary to obtain consumer acceptable products after treatment. The recommended minima for preservative retentions are also included.

Assay Standards—Chemical Analyses (A): The A Standards specify the acceptable procedures for testing preservatives. These tests encompass physical properties, chemical composition, purity of preservatives, and the results of treatment; i.e., preservative retention and penetration in the treated product.

Supplementary Standards (M6 to M15): These Standards include guidelines for physical inspection of poles in line, research and development methods encompassing laboratory and field tests for evaluation of the biological permanence and corrosive properties of preservatives prior to their acceptance as Standards. A list of these test methods and corresponding ASTM Standards is also given.

Conversion Factors and Correction Tables (F): These factors are primarily for the producers' use in everyday plant operations. A few may be of interest to the purchaser.

To aid purchasers in the use of the Book of Standards, the following information on specific sections is also included:

1. *Purchaser Guide, Quality Control and Inspection Standards:* M1 is intended to offer information to the purchaser of wood products. Included are several methods of preparing and conditioning the wood prior to the treatments described in the specific commodity—C Standards. Recommendations for specifying treatment results, i.e., penetration and retention, preservative to be used, inspection, retreatment and care of treated wood products are described.

The responsibilities of the treating plant management or the designated quality control supervisor, to ensure that quality control procedures are followed to yield a quality product are described in M3, Standard for Quality Control Procedures for Wood Preserving Plants. In addition to procedures for quality control of material in all phases of pretreatment, preservative treatment and results of treatment, certification and maintenance of plant equipment and facilities are also defined. In M2, Standard for Inspection of Treated Products, the responsibilities of the inspector are detailed.

Standard M4 outlines the steps to be taken for the care of treated wood products to ensure physical life expectancy and integrity of the product.

For record and inspection purposes, M6, Brands Used on Forest Products, lists and describes the information on the brands used on treated forest products, as well as detailed instructions for marking lumber, piles, posts and poles, in order to establish species, preservative, and treating plant identity.

2. Preservatives

2.1 Creosote and Creosote Solutions

2.1.1 *Creosote:* Creosote, as defined in the wood preserving industry, is a distillate of coal tar produced by high temperature carbonization of coal. It has proven highly effective in protecting wood against wood-destroying organisms when treated to the recommended retentions. The AWPA Standard for creosote is listed in the Preservative (P) Section of this as Standard P1/P13.

2.1.2 *Creosote Solutions:* These solutions are defined in Standard P2. They have had a long successful history for railroad ties, posts and various other structural uses where the surface condition of the treated wood is of minor importance.

2.1.3 *Creosote-Petroleum Solutions:* Standard P3 covers general-purpose solutions consisting of creosote and selected petroleums. Especially in arid parts of the country, ties, posts, and some structural items treated with these solutions have given excellent service. Their use is restricted to products where surface condition is not a governing factor.

2.2 Oil-Borne Preservatives

2.2.1 *Pentachlorophenol (Penta):* Standard P8 defines the chemical and physical properties of the technical (commercial) grade. As labeled, the technical grade of the chemical consists of approximately 90 percent penta and 10 percent related chlorinated chemical compounds. Methods of analyses to determine compliance are shown in Standard A5.

2.3 *Solvents for Oil-Borne Preservatives:* The properties of the four solvent types used in conjunction with the preservatives listed in Standard P8 are described in Standard P9. The one major difference in the physical properties of these solvents is their distillation range. As a result, some of the solvents may be partially or completely recovered during treatment. Therefore, the preservative properties of the penta are the chief consideration. The selection of any penta solvent system is based on the end use requirements for appearance, cleanliness and paintability.

2.4 *Waterborne Preservatives:* Standard P5 includes acidic and basic formulations of the arsenates of copper, for soil contact and other severe types of exposure. Copper formulations have given excellent service and the product is clean and paintable. Another group of waterborne preservatives which are used above ground where decay and insect hazard is less severe is included in Standard P5. Tests for compliance are given in Standard A2.

2.5 *Other Preservative Standards:* The P Standards include other preservatives such as those for:

A. Limited Use

B. Special Application

C. Conditions of Less Severe Above Ground Exposure; Lumber for example

D. Newly Adopted Standards

3. Commodities—Treatment

3.1 *Standard Processes:* AWPA Standard C1, "All Timber Products—Standard for Preservative Treatment by Pressure Processes", describes basic standard processes and limits that apply in general to all commodities.

3.2 *Specific Commodity Standards:* These Standards give information on species, preservatives, conditioning prior to treatment, treatments and the results of treatment, including retention and penetration specific to the treatment of the particular wood product.

3.2.1 *Preservative Retention:* Retentions of preservatives are expressed as pounds per cubic foot of wood (pcf) either by assay of the wood—the method generally required for round material and for lumber —or by gauge. Assay samples of the wood after treatment are taken in accordance with the appropriate commodity, C Standard, and the amount of preservative in the sample is determined by prescribed analytical techniques given in the A Standards. Checking the retention at any time after treatment can only be accomplished by assay of wood samples.

Gauge retentions, where used, are a measure of the difference in the total amount of preservative in the working tank prior to and after treatment.

3.2.2 *Preservative Penetration:* Penetration is usually measured in inches or percent of sapwood, on an appropriate sample of the treated wood. Standard A3, Standard Methods for Determining Penetration of Preservatives, describing approved staining techniques, is used for determination of specific preservatives when penetration is not visible.

4. *Supplementary Standards:* These Standards describe laboratory and field tests for research and development of preservatives, guides to physical inspection of poles in line, reference Standards, Trade Names and a Glossary.

4.1 *Laboratory Tests:* Standards M10 and M12 are used for evaluating preservative effectiveness under conditions favorable for organisms such as decay, fungi, and termites.

4.1.1 *Properties of the Preservative:* Standard M11 is used to determine relative resistance of preservative to leaching, and M14 determines preservative corrosiveness to selected metals.

4.2 *Field and Marine Tests:* These Standards describe the treatments of wood specimens such as stakes (M7) and posts (M8) when exposed in land plots.

4.3 *Reference Standards:* Standard M15 is a guide to the available Standards for testing plant effluents, and references the evaluation tests to other nationally accepted standards.

4.4 *Pole Line Inspection:* Standard M13 is a guide to the inspection of poles in service.

4.5 *Glossary of Terms Used in Wood Preservation:* The terms in Standard M5 are approved for use throughout the industry.

AMERICAN WOOD PRESERVERS' ASSOCIATION STANDARD

11–91

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This BOOK OF STANDARDS
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American Wood-Preservers' Association
P.O. Box 286
Woodstock, MD 21163-0286

Note—In the judgment of the membership of the American Wood-Preservers' Association, these standards represent the preferred wood preservation specifications, processes, penetration, and retention in the present state of research and technical knowledge. Because of possible variations in materials, applications, and manner of use, however, AWPA cannot be responsible for results of use or performance of products treated in accordance with these standards.

AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is under the jurisdiction of AWPA Subcommittee P-2)

P1/P13–91

STANDARD FOR COAL TAR CREOSOTE FOR LAND AND, FRESH WATER AND MARINE (COASTAL WATER USE)

1. The creosote shall be a distillate derived entirely from tar produced by the carbonization of bituminous coal.
2. The new material and the material in use in treating solutions shall conform to the following detailed requirements.

	New Material		Material In Use	
	Not Less Than	Not More Than	Not Less Than	Not More Than
2.1 Water, % by Volume	—	1.5	—	3.0
2.2 Matter Insoluble in Xylene, % by wt.	—	0.5	—	1.5
2.3 Specific Gravity at 38°C Compared to water at 15.5°C:				
2.31 Whole Creosote	1.070	—	1.070	—
2.32 Fraction 235–315 C	1.028	—	1.028	—
2.33 Fraction 315–355 C	1.100	—	1.100	—
2.4 Distillation: The distillate, % by wt. on a water free basis, shall be within the following limits:				
Up to 210 C	—	2.0	—	2.0
Up to 235 C	—	12.0	—	12.0
Up to 270 C	10	40	10	40
Up to 315 C	40	65	40	65
Up to 355 C	65	77	65	77

3.0 Tests to establish conformance with the foregoing requirements shall be made in accordance with the standard methods of the American Wood Preservers Association. (See Standard A1)

AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is under the jurisdiction of AWPA Committee P-2)

P2–90

STANDARD FOR CREOSOTE SOLUTIONS

1. The material shall be a pure coal tar product derived entirely from tar produced by the carbonization of bituminous coal. It may either be a coal tar distillate or a solution of coal tar in coal tar distillate.
2. The new material and the material in use in treating operations shall conform to the following detailed requirements.

	New Material		Material In Use	
	Not Less Than	Not More Than	Not Less Than	Not More Than
2.1 Water, % by Volume	—	1.5	—	3.0
2.2 Matter Insoluble in Xylene, % by wt.	—	3.5	—	4.5
2.3 Coke Residue, % by wt.	—	9.0	—	10.0
2.4 Specific Gravity at 38 °C Compared to water at 15.5 °C:				
2.41 Whole Creosote	1.08	1.13	1.08	1.13
2.42 Fraction 235–315°C	1.025	—	1.025	—
2.43 Fraction 315–355°	1.085	—	1.085	—
2.5 Distillation: The distillate, % by wt. on a water free basis, shall be within the following limits:				
2.51 Up to 210°C	—	5	—	5
2.52 Up to 235°C	—	25	—	25
2.53 Up to 315°C	32	—	32	—
2.54 Up to 355°C	52	—	52	—

3.0 Tests to establish conformance with the foregoing requirements shall be made in accordance with the standard methods of the American Wood Preservers Association. (See Standard A1)

Proceedings: 1917, 1918, 1921, 1923, 1933, 1935, 1936, 1941, 1942, 1947, 1953, 1954, 1957, 1958, 1968, 1985, 1989.

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1985, 1989.

P3–67

STANDARD FOR CREOSOTE-PETROLEUM OIL SOLUTION

Creosote-petroleum oil solution shall consist solely of specified proportions of coal tar creosote which meets A.W.P.A. Standard P1 and of petroleum oil which meets A.W.P.A. Standard P4. No creosote-petroleum oil solution shall contain less than 50 percent by volume of such creosote or more than 50 percent by volume of such petroleum oil.*

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* Owing to the lack of suitable methods of analysis, it is not possible to determine the relative amounts of either component once these materials have been blended. The purchaser may, therefore, wish to consider obtaining the materials separately and having them blended under his supervision.

≥ 50% creosote
≤ 50% petroleum oil

AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is under the jurisdiction of AWPA Committee P-2)

P4–86

STANDARD FOR PETROLEUM OIL FOR BLENDING WITH CREOSOTE

Petroleum oil for blending with creosote (Standard P1) shall conform to the following requirements:

1. Specific gravity.*—Specific gravity at 60° F./60° F. not less than 0.96† (not greater than 15.9°, A.P.I.) A.S.T.M. Standard D 287.

2. Water and Sediment.—Water and sediment (B.S. & W.) not more than 1 percent. A.S.T.M. Standard D 96.

3. Flash Point.—Flash point not less than 175 deg., F., as determined by the Pensky–Martens closed tester. A.S.T.M. Standard D 93.

4. Viscosity.—The viscosity shall be expressed as Kinematic vis. cSt at 210° F. by ASTM D 445. It shall not be less than 4.2; nor more than 10.2. Oils of higher viscosity may be used, provided the penetration requirements are met. The purchaser may specify the viscosity best suited to his requirements, allowing the supplier a tolerance of plus or minus 10 percent of the value specified (Equivalent vis. SUS at 210° F. shall be 40 min. to 60 max. by ASTM D 88).

5. Each of the foregoing determinations shall be made in accordance with the A.S.T.M. method currently in effect. The A.S.T.M. Standards referred to herein may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 19103.

Proceedings: 1939, 1941, 1942, 1943, 1947, 1948, 1955, 1956, 1967, 1970, 1986

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* To convert the specific gravity of Group 0 petroleum oils at 60° F./60° F. to specific gravity at 38° C./15.5° C. subtract 0.0140. For Group 1 oils subtract 0.0162. Group 0 oils are those whose specific gravities at 60° F./60° F. are not less than 0.9665. Group 1 oils are those whose specific gravities at 60° F./60° F. are not less than 0.8504 and not over 0.9664.

† Petroleum oil of lower specific gravity may be used provided experience or test shows that it may be blended with creosote without the formation of excessive sludge.

AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is under the jurisdiction of AWPA Subcommittee P-4)

P5–91

STANDARDS FOR WATERBORNE PRESERVATIVES

Note: Standard P5–90 consists of four pages dated as follows: Pgs. 1–4, 1990

Scope

These standards cover waterborne preservative formulations expressed on the oxide basis and prescribe maximum and minimum values of acceptability in either solid, paste, or solution formulations for use in the preservative treatment of wood.

1. ACID COPPER CHROMATE (ACC)

1.1 Acid copper chromate shall have the following composition:

Copper, as CuO	31.8%
Hexavalent chromium, as CrO_3	68.2%

subject to the following tolerances:

1.2 The analytical composition of the solid, paste, liquid concentrate or treating solution forms of the preservative may vary within the following limits:

	Min.[b]
Copper, as CuO	28.0%
Hexavalent chromium, as CrO_3	63.3%

1.3 The solid, paste, liquid concentrate or treating solution shall be made up of water soluble compounds selected from the following groups each in excess of 95 percent purity on an anhydrous basis:

Bivalent copper—e.g., copper sulfate
Hexavalent chromium—e.g., sodium or potassium dichromate, chromium trioxide

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

1.4 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association.[c] (See Standard A2.)

2. AMMONIACAL COPPER ARSENATE (ACA)

2.1 Ammoniacal copper arsenate shall have the following composition:

Copper, as CuO	49.8%
Arsenic, as As_2O_5	50.2%

subject to the tolerances listed in paragraph 2.2.

The above shall be dissolved in a solution of ammonia (NH_3) in water. The weight of ammonia contained in a treating solution shall be a minimum of 1.5 times the weight of copper expressed on the oxide basis. To aid in solution, not over 1.7 percent of glacial acetic acid may be added.

2.2 The analytical composition of the solid, paste, liquid concentrate or treating solution forms of the preservative may vary within the following limits:

	Min.[b]
Copper, as CuO	47.7%
Arsenic, as As_2O_5	47.6%

2.3 The treating solution shall contain bivalent copper and pentavalent arsenic derived from compounds in excess of 95 percent purity on an anhydrous basis.

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

2.4 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A2.)

2.5 The valency state of the arsenic component of ACA treating solutions shall be determined in accordance with Section 13 of AWPA Standard A2, to ensure that the arsenic is in the pentavalent form.

3. AMMONIACAL COPPER ZINC ARSENATE (ACZA) .

3.1 Ammoniacal Copper Zinc Arsenate shall have the following composition:

Copper as CuO	50.0%
Zinc as ZnO	25.0%
Arsenic as As_2O_5	25.0%

Subject to the tolerances listed in Paragraph 3.2.

The above shall be dissolved in a solution of ammonia (NH_3) in water. The weight of ammonia

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[b] The composition of treating solutions in use may deviate outside the limits specified in paragraphs 1.2, 2.2, 3.2, 4.2, 5.2, 6.2 and 7.2 provided: a. The preservative retention in treated material is determined by assay and the retention so determined conforms to the requirements specified in the Table of para. 3.1 in Standard C1. b. Immediate action is taken to adjust the composition of the treating solution.

[c] Acetic acid may be used if desired to adjust pH of treating solution to conform to paragraph 1.4.

contained in a treating solution and obtained from ammonium hydroxide, shall be at least 1.38 times the weight of copper oxide. To aid in solution, it is also necessary that the treating solution contain ammonium bicarbonate (NH_4HCO_3) at least equal to 0.92 times the weight of copper oxide.

3.2 The composition of the preservative present in a treating solution may vary within the following limits:

	Min. %[b]	Max. %[b]
Copper as CuO	45.0	55.0
Zinc as ZnO	22.5	27.5
Arsenic as As_2O_5	22.5	27.5

3.3 The treating solution shall contain bivalent copper, bivalent zinc and pentavalent arsenic derived from compounds in excess of 95 percent purity on an anhydrous basis.

The commercial preservative shall be labeled as to its total content of active ingredients listed in Paragraph 3.1.

3.4 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

3.5 The valency state of the arsenic component of ACZA treating solutions shall be determined in accordance with Section 13 of AWPA Standard A2, to ensure that the arsenic is in the pentavalent form.

CHROMATED COPPER ARSENATE

4. TYPE A

4.1 Chromated copper arsenate, Type A, shall have the following composition:

Hexavalent chromium, as CrO_3	65.5%
Copper, as CuO	18.1%
Arsenic, as As_2O_5	16.4%

subject to the following tolerances:

4.2 The analytical composition of the solid, paste, liquid concentrate or treating solution forms of the preservative may vary within the following limits:

	Min., %	Max., %[b]
Hexavalent chromium, as CrO_3	59.4	69.3
Copper, as CuO	16.0	20.9
Arsenic, as As_2O_5	14.7	19.7

4.3 The solid, paste, liquid concentrate or treating solution shall be made up of water soluble compounds selected from the following groups each in excess of 95 percent purity on an anhydrous basis:

Hexavalent chromium—e.g., potassium or sodium dichromate, chromium trioxide
Bivalent copper—e.g., copper sulfate, basic copper carbonate, cupric oxide or hydroxide
Pentavalent arsenic—e.g., arsenic pentoxide, arsenic acid. sodium arsenate or pyroarsenate

Certain impurities, such as iron, lead, chloride, organic matter and insolubles, may result in the formation of sludge in CCA concentrates and/or treating solutions. Caution is advised in selecting raw materials and evaluating treating solutions. For details of these effects reference Proceedings AWPA 82:28.

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

4.4 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A2.)

5. TYPE B

5.1 Chromated copper arsenate, Type B, shall have the following composition:

Hexavalent chromium, as CrO_3	35.3%
Copper, as CuO	19.6%
Arsenic, as As_2O_5	45.1%

subject to the following tolerances:

5.2 The analytical composition of the solid, paste, liquid concentrate or treating solution forms of the preservative may vary within the following limits:

	Min., %	Max., %[b]
Hexavalent chromium, as CrO_3	33.0	38.0
Copper, as CuO	18.0	22.0
Arsenic, as As_2O_5	42.0	48.0

5.3 The solid, paste, liquid concentrate or treating solution shall be made up of water soluble compounds selected from the following groups each in excess of 95 percent purity on an anhydrous basis:

Hexavalent chromium—e.g., potassium or sodium dichromate, chromium trioxide
Bivalent copper—e.g., copper sulfate, basic copper carbonate, cupric oxide or hydroxide
Pentavalent arsenic—e.g., arsenic pentoxide, arsenic acid, sodium arsenate or pyroarsenate

Certain impurities, such as iron, lead, chloride, organic matter and insolubles, may result in the formation of sludge in CCA concentrates and/or treating solutions. Caution is advised in selecting raw materials and evaluating treating solutions. For details of these effects reference Proceedings AWPA 82:28.

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

5.4 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A2.)

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[b] The composition of treating solutions in use may deviate outside the limits specified in paragraphs 1.2, 2.2, 3.2, 4.2, 5.2, 6.2 and 7.2 provided: a. The preservative retention in treated material is determined by assay and the retention so determined conforms to the requirements specified in the Table of para. 3.1 in Standard C1. b. Immediate action is taken to adjust the composition of the treating solution.

6. TYPE C

6.1 The active ingredients in chromated copper arsenate shall have the following composition:

Hexavalent chromium, as CrO_3	47.5%
Copper, as CuO	18.5%
Arsenic, as As_2O_5	34.0%

6.2 The analytical composition of the solid, paste, liquid concentrate or treating solution forms of the preservative may vary within the following limits:

	Min., %	Max., %[b]
Hexavalent chromium, as CrO_3	44.5	50.5
Copper, as CuO	17.0	21.0
Arsenic, as As_2O_5	30.0	38.0

6.3 The solid, paste, liquid concentrate or treating solution shall be made up of water soluble compounds selected from the following groups each in excess of 95 percent purity on an anhydrous basis:

Hexavalent chromium—e.g., potassium or sodium dichromate, chromium trioxide
Bivalent copper—e.g., copper sulfate, basic copper carbonate, cupric oxide or hydroxide
Pentavalent arsenic—e.g., arsenic pentoxide, arsenic acid, sodium arsenate or pyroarsenate

Certain impurities, such as iron, lead, chloride, organic matter and insolubles, may result in the formation of sludge in CCA concentrates and/or treating solutions. Caution is advised in selecting raw materials and evaluating treating solutions. For details of these effects reference Proceedings AWPA 82:28.

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

6.4 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A2.)

7. CHROMATED ZINC CHLORIDE (CZC)

7.1 Chromated zinc chloride shall have the following composition:

Hexavalent chromium, as CrO_3	20%
Zinc, as ZnO	80%

subject to the following tolerances:

7.2 The analytical composition of the solid, paste, liquid concentrate or treating solution forms of the preservative may vary within the following limits:

	Min., %[b]
Hexavalent chromium, as CrO_3	19
Zinc, as ZnO	76

7.3 Samples of chromated zinc chloride treating solution taken from a working tank or treating cylinder may show changes in composition as a result of treating operations. Such changes shall not serve to cause rejection of the preservative if they do not raise the ratio of zinc oxide to chromium trioxide to more than 7 to 1, and if it can be shown that the original fresh preservative was of the specified composition.

7.4 The solid, paste, liquid concentrate or treating solution shall be made up of water soluble compounds selected from the following groups each in excess of 95 percent purity on an anhydrous basis:

Hexavalent chromium—e.g., sodium dichromate, chromium trioxide
Zinc—e.g., zinc chloride

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

7.5 Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A2.)

8. ALKYL AMMONIUM COMPOUND (AAC)

8.1 Aklyl ammonium compound shall have the following composition:

Didecyldimethylammonium chloride	90% min.
Dialkyldimethylammonium chlorides (containing C8 or C12)	10% max.

8.2 The liquid concentrate shall be made up in lower (<C4) alcohols and/or water such that the active ingredient is freely soluble in water.

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

9. INORGANIC BORON

9.1 Borate oxide (SBX)

9.2 Boron as B_2O_3

9.3 The solid or treating solutions shall be made up of sufficient water soluble compounds, each in excess of 98% purity on an anhydrous basis. Acceptable borate salts are sodium octaborate, sodium tetraborate, and sodium pentaborate.

9.4 The commercial preservative shall be labeled as to its total content of active ingredients listed in the second paragraph.

Tests to establish conformity with the foregoing requirements shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A2.)

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[b] The composition of treating solutions in use may deviate outside the limits specified in paragraphs 1.2, 2.2, 3.2, 4.2, 5.2, 6.2 and 7.2 provided: a. The preservative retention in treated material is determined by assay and the retention so determined conforms to the requirements specified in the Table of para. 3.1 in Standard C1. b. Immediate action is taken to adjust the composition of the treating solution.

10. pH OF TREATING SOLUTIONS

10.1 The pH of waterborne preservative solutions shall be within the following limits:

Preservative	*pH Limits*
ACC	3.0–7.0
ACA	Not Applicable
ACC	2.0–3.9
ACZA	Not applicable
CCA-Type A	1.6–2.7
CCA-Type B	1.6–2.5
CCA-Type C	1.6–2.5
CZC	2.8–4.0
SBX	7.9–9.0

10.2 These pH values are preferably measured at an oxide concentration in the treating solution of 15–22 g./l. and at a temperature of 20–30°C. If a CCA treating solution has a pH outside the stated limits and can be shown that it can be made conforming by the addition of CCA concentrate or chromic acid while remaining within the recommended limits stated in Standard P-5, Sections 4.2, 5.2 and 6.2, the solution shall be considered conforming to the standard.

11. STANDARD ADDITIVES.

The CCA/oil emulsion formulation is recognized as a standard additive system for CCA, per the 1991 Report of Subcommittee P-4.

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AMERICAN WOOD-PRESERVERS' ASSOCIATION
STANDARD

(This Standard is under the jurisdiction of AWPA Committee P-3)

P8–91

STANDARDS FOR OIL-BORNE PRESERVATIVES

1. PENTACHLOROPHENOL

1.1 Pentachlorophenol shall contain not less than 95 percent of chlorinated phenols as determined by titration of hydroxyl and calculated as pentachlorophenol.

1.2 It shall contain not more than 1 percent of matter insoluble in N/1 aqueous sodium hydroxide solution.

1.3 It shall have a freezing point of not less than 174°C.

1.4 The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association. (See Standard A5).

1.5 Solvents used to prepare solutions of pentachlorophenol shall comply with the standards of the American Wood-Preservers' Association (See Standard P9)

2. COPPER NAPHTHENATE

2.1 The naphthenic acid used in the manufacture of copper naphthenate shall be of the group of alicyclic carboxylic acids occurring in petroleum and shall have an acid number of not less than 180 and not more than 250, on an oil-free basis.

2.2 The copper naphthenate concentrate used to prepare wood-preserving solutions shall contain not less than 6 percent nor more than 8 percent copper in the form of copper naphthenate.

2.3 All of the copper present in the concentrate shall be combined as copper naphthenate.

2.4 The copper naphthenate concentrate shall not contain more than 0.5 percent water.

2.5 The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.[1] (See Standard A5)

2.6 Solvents used to prepare solutions of copper naphthenate shall comply with the standards of the American Wood-Preservers' Association. (See Standard P9)

2.7 The copper naphthenate concentrate shall not contain more than 2% (relative) of the total copper in the concentrate as being water extractable as determined by the Analytical Method designated A-14-xx on page 248 of the 1987 AWPA Proceedings.

3. SOLUBILIZED COPPER-8-QUINOLINOLATE

3.1 Solubilized Copper-8-Quinolinolate shall have the following composition:

Copper-8-quinolinolate, wt., min.	10.0%
Nickel-2-ethylhexoate, wt., min.	10.0%
Inert ingredients (hydrocarbon solvents), wt., min.	80.0%
	100.0%
Physical Properties	
Copper as metal, wt., min.	1.80%
Nickel as metal, wt., min.	1.80%
pH	5.5–6.5
Specific gravity at 77°F.	0.935–0.975

Solubility—Completely soluble in aliphatic and aromatic solvents which comply with the standards of the American Wood-Preservers' Association.

3.2 Solubilized copper-8-quinolinolate should be free of amines, phosphoric acid, or naphthenic acid and its derivatives.

4. BIS(TRI-N-BUTYLTIN) OXIDE

4. Bis(tri-n-butyltin) oxide, commonly called TBTO[2], shall have the following composition:

4.1 TBTO shall have the following composition: Bis (tri-n-butyltin) oxide, wt. min.—95%; Tin as metal, wt. min.—38.2%; wt. max.—40.1%.

4.2 TBTO shall be a colorless to slightly yellow liquid.

4.3 The solvent employed in formulating the preservation solution shall meet the requirements of Hydrocarbon Solvent Type C, Standard P9, Par. 3.1.

5. ALKYL AMMONIUM COMPOUND (AAC)

5.1. Alkyl ammonium compound shall have the following composition:

Didecyldimethylammonium chloride	90% min.
Dialkyldimethylammonium chlorides (containing C8 or C12)	10% max.

5.2. The liquid concentrate shall be made up in lower (<C4) alcohols and/or water such that the active ingredient is freely soluble in water.

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[1] Methods are being prepared for determining conformity with pars. 2.1 and 2.3.

[2] Trademark M&T Chemical Co.

The commercial preservative shall be labeled as to its total content of active ingredients listed in the first paragraph.

6. 4,5-DICHLOR-2-N-OCTYL-4-ISOTHIAZOLIN-3-ONE

6.1 Composition of:

4,5-dichlor-2-n-octyl-4-isothiazolin-3-one	98%
related non-volatile impurities	<2%

6.2 Appearance crystalline, brown solid

6.3 Physical Properties

Vapor Pressure (25 C)	7.35 x 10-6 torr
Solubility in:	
Acetone	Approximately 40%
Ethanol	Approximately 35%
Cellosolve	Approximately 40%
Water	<14 ppm
Octanol Water partition coefficient	6.4

6.4 The solvent used in formulating the preservative solution shall meet the requirements of Standard P9, Type C.

7. 3-IODO-2-PROPYNYL BUTYL CARBAMATE (IPBC) for non-structural, above ground use only, shall have a composition of:

7.1 IPBC shall be composed of: 3-iodo-2-propynyl butyl carbamate, wt. min. 97%, Iodine as element, wt. min. 43.4%.

7.2 IPBC shall be a white to slightly yellow crystaline solid.

7.3 Chemical purity shall be determined using Standard A5-88.

AMERICAN WOOD-PRESERVERS' ASSOCIATION STANDARD

(This Standard is under the jurisdiction of AWPA Committee P–3)

P9–91

STANDARDS FOR SOLVENTS AND FORMULATIONS FOR ORGANIC PRESERVATIVE SYSTEMS

Note: Standard P9–87 consists of three pages dated as follows: Pgs. 1–3, 1987.

Note: The ASTM Standards referred to herein may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pa. 19103.

1. **Hydrocarbon Solvent,** Type A for preparing solutions of oil-borne preservatives such as pentachlorophenol and copper naphthenate shall be composed of petroleum distillates, or a blend of petroleum distillates and co-solvents provided that the blended solvent meets the following requirements:

1.1 Distillation, ASTM Standard D-86, total volume of fractions:

1.1.1 50% volume distilling point—490° F. minimum.

1.1.2 90% volume distilling point—585° F. minimum.

1.2 Viscosity of the oil fraction undistilled above 500° F. from a 100 ml ASTM Standard D-86 distillation—Kinematic viscosity, cSt @ 100° F., ASTM Standard D-445—3.46 min. (equivalent SSU viscosity @ 100° F.—37.5 min., ASTM Standard D-88).

1.3 Flash Point, PMCC, ASTM Standard D-93—150° F. minimum.

1.4 Solvency, grams of pentachlorophenol soluble at 75 degrees F. (see Standard A5, Sect. 4)

1.4.1 In 90 grams of whole oil—10 grams minimum.

1.4.2 In the oil fraction undistilled above 500°F from a 100 ml ASTM Standard D-86 distillation—6 grams minimum.

1.5 Water and Sediment, percent, B.S.&W., ASTM Standard D-96—0.5 maximum.

Note 1: If any co-solvents used are chlorinated solvents, they should not be distilled in a copper distillation apparatus, and the Lime Ignition method should not be used for boring assay.

Note 2: Any co-solvents used shall meet the following requirements on water solubility:

A. The co-solvent shall not be completely water soluble.

B. The co-solvent shall be permitted to have solubility in water to the extent that upon saturation, the solubility of pentachlorophenol in the total preservative blend shall not be affected and that emulsions do not result that would preclude its use.

C. The co-solvent shall not induce leaching of pentachlorophenol from the total preservative blend as determined by the method in Standard A5, Paragraph 8. The amount of pentachlorophenol found in the test sample shall not be less than that found in the control.

Note 3: When hydrocarbon solvent Type A is used to treat species that require steam conditioning (such as southern pine), it is recommended that the solvent have a maximum specific gravity of 0.910 at 60 degrees F. (minimum API gravity 24), ASTM Standard D-287. This will help avoid the formation of oil–water emulsions.

Note 4: When copper naphthenate is used, the penta solvency requirement in Section 1.4 may be deleted.

2. **Hydrocarbon Solvent, Type B (Volatile Petroleum Solvent—LPG)** for preparing solutions of pentachlorophenol, copper naphthenate and Copper-8-Quinolinolate, shall conform to the following requirements:

2.1 Vapor pressure @ 100 degrees F., ASTM Standard D-1287—200 psig maximum.

2.2 Distillation, ASTM Standard D-1837.

2.2.1 95 percent volume distilling point—36° F. maximum.

2.3 Auxiliary Solvent.

2.3.1 The auxiliary solvent not to exceed five percent of the total volume of the combined solvent and which will not increase the 95 percent boiling point of the liquefied petroleum gas above 36 degrees F., may be used providing its dry point shall be not more than 160 degrees F. by test method ASTM Standard D-1078.

Note: In using pentachlorophenol dissolved in the type of solvent described above, the usual requirement for solution concentration does not apply. The wood is treated using a full cell process and the retention is controlled by adjusting solution concentration. Results of treatment, with respect to retention, are determined either by assaying the treated wood or by inventorying the preservative in solution before and after a charge.

3. **Hydrocarbon Solvent, Type C (Light Hydrocarbon Solvent with Auxiliary Solvent).**

Petroleum solvent for preparing solutions of pentachlorophenol shall be composed of the following solvents conforming to the respective indicated requirements:

3.1	Light Petroleum Solvent[1]	
3.11	Gravity, °API at 60° F (D-287)	40.9 min.
3.12	Gravity, Spec. at 60° F (by conversion)	0.820 max.
3.13	Color (D-1500)	1 max.
3.14	Flash TCC, °F (D-56)	80 min.
3.15	Distillation, °F (D-86)	
	IBP	360 max.
	EP	415 max.
3.16	Doctor Test (D-484)	Negative

3.2 Auxiliary Solvent

3.21 An auxiliary or co-solvent shall be used with the Light Petroleum Solvent and pentachlorophenol but shall not exceed 10% of the total volume of the combined solvents. The combination of the auxiliary solvent and Light Petroleum Solvent shall have the following properties:

(a) Viscosity: Kin. vis. cSt. at 100° F. (D 445) ... 5.8 max. (Equiv. SUS vis. at 100° F. = 45 max. by ASTM D-88.)

(b) Flash, TCC °F (D-56) ... 80 min.

3.22 Anti-Blooming. The auxiliary solvent shall have such properties and shall be used at such concentrations to prevent "blooming". Blooming is defined as formation of visible penta crystals on any surface of the treated wood within a period of two days after completion of treatment.

3.23 Water Solubility of Auxiliary Solvent. (Standard A5, Par. 9)—Interface not less than 49.5 ml; not more than 50.5 ml.

3.3 For Solubilized Copper-8-Quinolinolate and Copper Naphthenate solutions the auxiliary solvent need not be used.

4. Hydrocarbon Solvent, Type D (Chlorinated Hydrocarbon Solvent-Inhibited Grade of Methylene Chloride) for preparing solutions of pentachlorophenol, shall conform to the following requirements:

4.1	Distillation Range, °C @ 760 mm Hg ASTM D 1078-49T	39 min. 40 max.
4.2	Specific Gravity, 25/25°C ASTM D 2111B-71	1.314 min. 1.319 max.
4.3	Color, APHA ASTM D 2108–64	15 max.
4.4	Water Content, ppm ASTM D 1364–64	100 max.
4.5	Nonvolatile Matter, ppm ASTM D 2109–71	10 max.
4.6	Acidity as HCl, percent ASTM D 1613–66	0.001 max.
4.7	Acid Acceptance, percent ASTM D 2107–68	0.03 min.

5. System Type E for Preparation of Solutions of Pentachlorophenol and Dispersions of these in Water.

5.1 Definitions

5.1.1 The "organic solvent" is defined as the solvent for the pentachlorophenol as defined in paragraph 5.3.

5.1.2 "Penta concentrate" is defined as a solution of pentachlorophenol in the "organic solvent".

5.1.3 The "dispersing agent" is defined as the substance that, when mixed with the "penta concentrate" causes that "penta concentrate" to disperse easily when mixed into water.

5.1.4 The "dispersible concentrate" is the "penta concentrate" mixed with the "dispersing agent" in the proper proportions for use.

5.1.5 The "treating mixture" is the resulting liquid after the "dispersible concentrate" has been mixed with water and the system is ready for use.

5.2 Specifications of Pentachlorophenol

Pentachlorophenol used in the water dispersible system shall meet the requirements of AWPA Standard P8.

5.3 Specifications of the "Organic Solvent"

5.3.1 The solvent for preparing the solutions of pentachlorophenol shall be composed of petroleum distillates, or a blend of petroleum distillates and co-solvents provided that the blended solvent meets the following requirements:

5.3.1.1 Distillation, ASTM Standard D-86, total volume of fractions:

5.3.1.1.1 50% volume distilling point — 490°F minimum.

5.3.1.1.2 90% volume distilling point — 585°F minimum.

5.3.1.2 Viscosity of the solvent fraction undistilled above 500°F from a 100 ml ASTM Standard D-86 distillation—Kinematic viscosity, cSt @ 100°F, ASTM Standard D-445—3.46 min. (equivalent SSU viscosity @ 100°F—37.5 min., ASTM Standard D-88).

5.3.1.3 Flash Point, PMCC, ASTM Standard D-93—150°F minimum.

5.3.1.4 Solvency, grams of pentachlorophenol soluble at 75°F. (See Standard A5, Sect. 4) In the solvent fraction undistilled above 500°F from 100 ml ASTM Standard D-86 distillation—6 grams minimum.

5.3.1.5 Water and Sediment, percent, B.S. & W., ASTM Standard D-96—0.5 maximum.

Note 1: If any co-solvents used are chlorinated solvents, they should not be distilled in a copper distillation apparatus, and the Lime Ignition method should not be used for boring assay.

Note 2: Any co-solvents used shall meet the following requirements on water solubility:

A. The co-solvent shall not be completely water soluble.

B. The co-solvent shall not include leaching of pentachlorophenol from the total preservative blend as determined by the method in Standard A5, Paragraph 8. The amount of pentachlorophenol found in the test sample shall not be less than that found in the control.

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[1] For treatment of lumber, the distillation E.P. shall be 375° F. max.

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5.4 Specifications of the "Dispersing Agent" The "dispersing agent" shall be composed on alkyl aryl sulfonates containing C-8 to C-16 alkyl chains with at least 90% in the C-10 to C-14 range. Co-surfactants shall not exceed 30% by weight of the total active sulfonates.

5.5 Requirements of the "Dispersible Concentrate"

5.5.1 The "dispersible concentrate" shall show no signs of penta crystallization while standing at 40°F (test method shown in Appendix A).

5.5.2 The "dispersible concentrate" shall blend easily with water. (Mixing test method shown in Appendix B).

5.6 Requirements of the "Treating Mixture"

5.6.1 The "treating mixture" shall show no signs of penta crystallization at 40°F (test method shown in Appendix A).

5.6.2 The "treating mixture" shall be stable when tested by the method in Appendix C (Mixing test in Appendix B can be used to form mixture for stability test).

5.6.3 The pH of the treating mixture shall not exceed 7.5.

5.6.4 The treating mixture shall not produce blooming on treated wood.

6. **Hydrocarbon Solvent Type F** for non-pressure treatment. Petroleum solvent for preparing solutions of preservatives shall be composed of the following solvents conforming to the respective indicated requirements.

6.1 Light Petroleum Solvent

6.11	Gravity, API @ 60 F (D-287)	57 min.
6.12	Gravity Spec. @ 60 F (D-891)	0.7275 min.
6.13	Color (D-158)	30 min.
6.14	Flash point (F), T.C.C. (D-56)	<20 min.
6.15	Distillation (F) (D-86)	
	IBP	360 max.
	EP	415 max.
6.16	Sulfur H_2S/Doctor (D-484)	Negative

APPENDIX A
TEST METHOD FOR CRYSTALLIZATION

A 100 ml sample to be tested is poured into a stopper-type 100 ml graduated cylinder. A seed crystal of pentachlorophenol is added to the sample. The stopper is then placed on the graduate and the graduate is placed in a conventional refrigerator compartment (normally maintained at 40°F). The sample is allowed to rest undisturbed for four hours. After the four hour chilling cycle is complete, the test sample is removed from the refrigerator and allowed to warm up to room temperature (75°F to 78°F) for at least two hours. After the sample has set undisturbed for this warmup period, it is visually examined to see if any additional crystals are present. If any additional penta crystals are present, the sample fails. If not, the chill warm cycles are repeated four more times. No signs of additional penta crystals after five complete cycles indicates satisfactory results.

APPENDIX B
MIXING TEST

1. Put 85 ml of water to be used in preparing the treating mixture into a stopper-type 100 ml graduated cylinder.
2. Adjust the temperature of the water in the graduate and the sample of dispersible concentrate to be tested to between 65°F and 95°F.
3. Slowly pour 15 ml of dispersible concentrate into the water without allowing the dispersible concentrate to contact the sides of the graduate. Dispersion formation should occur immediately as the dispersible concentrate contacts the water.
4. Place the stopper on the graduate and invert the cylinder 3 times shaking slightly with each inversion.
5. The treating mixture in the cylinder should now be homogeneous in appearance and ready for use.

Note: This procedure can be used to form the treating mixture for the stability test.

APPENDIX C
STABILITY TEST FOR TREATING MIXTURES

1. To test a treating mixture freshly prepared from the dispersible concentrate, prepare a treating mixture as in the Mixing Test (Appendix B). Allow the sample to sit undisturbed for 12 hrs. Maintain the temperature between 65 and 95°F.
2. For used treating mixtures, obtain a 100 ml sample in a stoppered 100 ml graduate cylinder. Shake the cylinder 10 times to obtain a homogeneous liquid. Allow the sample to sit undisturbed for twice the length of time required for the pressure period of the treating cycle.
3. After the settling period, obtain a sample from the top 5 ml of the undisturbed dispersion.
4. Shake the cylinder vigorously for 60 sec., and immediately obtain a sample of the shaken dispersion.
5. Analyze both samples for pentachlorophenol. The penta concentration of the settled sample should be within 10 percent of the penta concentration of the shaken sample.

NOTE:

After 1991, Solvent Types B and D, as used with pentachlorophenol will be removed, without prejudice, for lack of use.

AMERICAN WOOD PRESERVERS' ASSOCIATION
STANDARD

(This Standard is under the jurisdiction of AWPA Subcommittee P–2)

P15–91

STANDARD FOR LIGNITE CREOSOTE FOR BLENDING WITH P1/P13 CREOSOTE FOR LAND AND FRESH WATER USE

1. The creosote shall be a distillate derived entirely from tar produced by pyrolysis processing of lignite for use in a blend of 50% lignite creosote and 50% P1/P13 creosote.
2. The new material and the material in use in treating operations shall conform to the following detailed requirements:

	New Material		In Use*	
	Not Less Than	Not More Than	Not Less Than	Not More Than
2.1 Water, percent by volume	—	1.5	—	3.0
2.2 Matter Insoluble in Xylene, percent by Wt.	—	0.5	—	1.5
2.3 Specific Gravity at 38°C compared with water at 15.5°C				
2.31 Whole Creosote	1.035	—		
2.32 Fraction 235–315°C	0.983	—		
2.33 Fraction 315–355°C	1.002	—		
2.4 Distillation: The distillate, percent by Wt. on a water-free basis, shall be within the following limits:				
Up to 210°C	—	2.0		
235°C	—	4.0		
270°C	—	6.0		
315°C	20.0	35.0		
355°C	35.0	60.0		

3. Tests to establish conformance with the foregoing requirements shall be made in accordance with the standard methods of the American Wood Preservers' Association. (See Standard A1.)

* Owing to the lack of suitable methods of analysis, it is not possible to determine the relative amounts of either component once these materials have been blended. The purchaser may, therefore, wish to consider obtaining the materials separately and having them blended under his supervision.

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AMERICAN WOOD-PRESERVERS' ASSOCIATION STANDARD

(This Standard is under the jurisdiction of AWPA Subcommittee T-1)

C1-91

ALL TIMBER PRODUCTS—PRESERVATIVE TREATMENT BY PRESSURE PROCESSES

Note: Standard C1-90 consists of six pages. Revised in 1990.

1. GENERAL REQUIREMENTS

1.1 The following requirements, as modified or supplemented by other AWPA Standards, apply to each of the treating processes and to all species and types of material. If these requirements are to be otherwise modified to meet special conditions, complete detailed instructions shall be given.

Maximum time duration (total elapsed time of a treating phase), maximum temperature, and maximum pressure limits shall not be exceeded. Only those species and preservatives listed in a commodity standard that have previously been found suitable for use in this particular application, or sufficient test information has been submitted to warrant their inclusion. A phase shall begin when a change in conditions within the cylinder is initiated and shall end when either new conditions are imposed or the cylinder is emptied of preservative.

For example, the period of steaming shall begin when the temperature reaches 200°F and end when the steam is shut off in the cylinder and the cylinder vented.

The minimum time duration, when stipulated for a phase, shall be the period of time after the minimum condition has been attained and until the end of that phase.

All dimensions referred to are nominal dimensions for sawn four sides material.

1.2 **Plant Equipment.**—Treating plants shall be equipped with the thermometers, gauges, and recorders necessary to indicate and record accurately the conditions within the treating cylinder during all stages of treatment. These instruments as well as all other necessary equipment shall be maintained in proper working condition. Laboratory facilities and all apparatus and chemicals for making analyses and tests required by the purchaser shall be provided and maintained in proper condition by the plant operator for use by the customer or his representative. These facilities preferably shall be provided on the plant site but may be located at a central laboratory removed from the plant site when more convenient.

1.3 **Conditioning.**—Material shall be conditioned by air-seasoning, by kiln drying, by steaming, by heating in the preservative at atmospheric pressure, by Boulton drying, or by vapor drying, or by a combination of them as agreed upon in such manner as will not cause damage for the intended use. Ice-coated or frozen material may be steamed prior to conditioning or treatment for a total period not to exceed 2 hours; the temperature shall not exceed 240°F, or those conditions permitted in the appropriate commodity standard for ice coated or frozen material.

1.31 When air-seasoning is used, it shall be done as far as practicable, according to Standard M1.

1.32 When steam conditioning is used, material shall be steamed in the cylinder at the temperature specified for the individual type of material or species but, in any case, the maximum temperature specified shall not be reached in less than one hour. The cylinder shall be provided with vents to relieve it of air and insure proper distribution of steam. Two types of steam sources are allowable; steam directly from the boiler (live steam) and steam generated within the cylinder by the use of water over the heating coils (closed steam). With live steam, the cylinder shall be drained continuously or frequently enough during the steaming to prevent condensate from accumulating in sufficient quantity to reach the wood. With closed steam, the water level will be limited to covering the heating coils and no venting is needed after maximum temperature levels are reached. After steaming is completed, a vacuum as specified for the individual type of material or species may be created in the cylinder. Before the preservative is introduced, the cylinder shall be drained of condensate.

When material to be treated with either chromated copper arsenate preservative or acid cupric chromate preservative is presteamed prior to treatment, the material must be removed from the cylinder following the conditioning phase of the cycle and cooled to 120°F or below. Following the cooling, the material shall be returned to the cylinder and treated by appropriate standard procedure.

1.33 When conditioning by heating in the preservative is used the preservative shall cover the material in the cylinder. The temperature of the preservative during the conditioning period shall not exceed the maximum specified for the individual type of material or species. Conditioning by heating in water-borne preservatives is not permitted.

When Boulton drying is used, the vacuum drawn during the conditioning period shall be of sufficient intensity to evaporate water from the material at the temperature of the preservative. The intensity of the vacuum, or the temperature of the preservative, or both, shall be adjusted so as to regulate the evaporation of the water satisfactorily. The conditioning shall continue until the material is sufficiently heated and enough water removed to permit proper penetration. The preservative shall be removed from the cylinder and air admitted before an empty-cell process is applied.

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

1.5 **Machining.**—All cutting, such as adzing, boring, chamfering, framing, gaining, surfacing, trimming, etc., should be done prior to treatment. In the event that cutting becomes absolutely necessary after treatment, treatment of cut surfaces should be made in accordance with Standard M4.

1.6 **Incising.**—Species which are difficult to penetrate should be incised prior to treatment.

1.61 **Ground Line Preparation.**—By agreement between the purchaser and the treater, all Douglas Fir poles 50 feet long and longer, commonly called transmission poles, should be ground line prepared by deep incising, radial drilling or through boring prior to treatment. Deep incising or radial drilling will be made by a minimum 3 inches by 6 inches diamond pattern and a maximum of a 4-inch by 9-inch diamond pattern to a depth of 2½ inches. Radial drilling will use a drill bit of not less than ¼ inch nor greater than $^{5}/_{16}$-inch diameter. Through boring will be done using a pattern and drill bit size approved by the purchaser. The purchaser may specify deep incising or radial drilling to depths greater than 2½ inches at his discretion to provide a deeper zone of treated wood when deemed necessary.

Unless otherwise modified by the purchaser, deep incising or radial drilling will be performed in the pole section from 2 feet above to 4 feet below the standard ground line or setting depth as defined in the latest issue of ANSI 05.1. Purchasers specifying through boring shall specify the location of the pole section to be through bored. Purchasers of through bored poles shall also specify the penetration depth desired and its method of determination.

1.7 **Painting.**—Painting of pressure-treated wood should be undertaken with caution. When painting after treatment is intended, the processor should be so advised when the order is placed. The painting should be done in accordance with the recommendations of the processor, the paint manufacturer, or the painting contractor.

1.8 **Branding.**—Lumber, timber, and plywood shall be marked to indicate the intended end use "above ground," "ground contact," or "coastal waters" identifying both the preservative and the specified retention. Each piece of material treated with a waterborne preservative or with a preservative in the Type B, C or D of Standard P9 Solvent shall be so labeled. Lumber, timber and plywood treated with other preservatives may, as an alternate, be labeled by the bundle.

1.9 **Pole Anti-Splitting Devices.**—By agreement between the purchaser and the treater, anti-checking devices such as Star Irons or Splitter Bolts may be used to control splitting of Douglas-fir pole tops.

2. TREATMENT

2.1 **Manner of Treatment.**—The material shall be impregnated with preservative by a combination of such processes and under such conditions as will produce a satisfactory product for the use intended.

2.11 **Oil Treatments.**—Following the conditioning period, the material shall be treated by an empty-cell process whenever practicable, unless otherwise specified, to obtain as deep and uniform penetration as possible with the retention of preservative stipulated. Material shall be treated by the full-cell process only when the maximum net retention is desired and where pressure is held to refusal, or when the stipulated retention is greater than can be obtained by the use of an empty-cell process.

2.12 **Waterborne Treatments.**—Following the conditioning period, the material shall be treated using full-cell or modified full-cell processes.

Lumber less than 5" in thickness, and plywood shall be treated by a Lowry, a full cell or a modified full-cell process. Piling and poles may be treated by the Modified Full-Cell process when a fixation period is used (2.25).

2.13 **Dual Treatment.**—This method consists of two successive (dual) treatments with different preservatives. After seasoning and/or conditioning, the materials shall be treated with one of the recommended water-borne preservatives. Following this treatment, the material shall be again seasoned and/or conditioned as permitted and then be treated with creosote or creosote-coal tar type preservative.

2.2 **Standard Processes**

2.21 **Initial Air Pressure or Vacuum.**—The ini-

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ɔreservative.

n.—The ini-

tial air pressure or vacuum shall be maintained while the cylinder is being filled with preservative.

2.211 **Empty-Cell.**—Material shall be subjected to atmospheric air pressure (Lowry) or to higher air pressures (Rueping) of the necessary intensity and duration.

2.212 **Modified Full-Cell.**—Using this process, the cylinder pressure shall be adjusted prior to filling, to any desired level between atmospheric pressure and maximum vacuum.

2.213 **Full-Cell.**—Material shall be subjected to a vacuum equivalent to not less than 22" of mercury at sea level for not less than 30 minutes either before the cylinder is filled with preservative or during the period of conditioning in the event that such conditioning precedes treatment by the full-cell process.

2.214 **Refusal.**—When maximum possible retention by full-cell process or treatment to refusal is specified, the pressure and temperature shall be maintained constant or be increased within a range consistent with good practice for the material being treated until the quantity of preservative absorbed in each of any two consecutive half hours is not more than 2 percent of the amount already injected. Treatment to refusal does not constitute an acceptable alternative to the minimum penetration or retention requirements specified under results of treatment except as specifically listed.

2.22 **Pressure Period.**—Pressure shall be increased to at least the minimum but not higher than the maximum specified and shall be maintained until the desired volumetric injection has been obtained. At the conclusion of the pressure period and after the cylinder has been emptied of preservative, a vacuum of no less than 22" at sea level may be created. This procedure generally results in the material having drier surfaces upon removal from the cylinder. It is not recommended to draw a vacuum after a full-cell or refusal treatment when the maximum treatment retention is desired, however, this is permitted.

2.221 **Temperature of Preservative.**—The temperature of the preservative during the entire pressure period shall not exceed the maximum temperatures specified below.

Creosote or Creosote Solutions	**Maximum**
Western red cedar	200°F
All other species	210°F
Oil-Borne Preservatives	
Southern, ponderosa, jack, red and lodgepole pines	210°F
Western red cedar	200°F
All other species	210°F
Water-Borne Preservatives	
Acid copper chromate (ACC)	120°F
Ammoniacal copper arsenate (ACA)	150°F
Ammoniacal copper zinc arsenate (ACZA)	150°F
Chromated copper arsenate (CCA)	120°F
Chromated zinc chloride (CZC)	140°F
Inorganic boron (SBX)	200°F

2.23 **Expansion Bath.**—When permitted by the applicable commodity standard, an expansion bath may be applied after completion of the pressure phase of an oil treatment for the purpose of recovering excess preservative and improving the surface cleanliness of the material. The expansion bath shall be performed before removal of the preservative from the cylinder by quickly heating the preservative surrounding the material to not more than the maximum temperature permitted by the individual species specification. The heating may be done either at atmospheric pressure or under vacuum but the source of heat must be turned off immediately upon reaching the maximum temperature. The preservative shall then be promptly removed from the cylinder, after which a vacuum equivalent to at least 22" of mercury at sea level shall be created in cylinder and maintained for sufficient duration so that the wood will be free of dripping preservative when removed from the cylinder.

2.24 **Final Steaming.**—At the completion of an oil treatment, material may be cleaned by final steaming as specified for the individual type of material or species.

2.25 **Fixation Period.**—When permitted by Commodity Standard C3 or C4, a fixation period may be utilized after the pressure phase of a treatment with CCA preservative in order to fix substantially all of the CCA components in the wood prior to removal from the cylinder. At the end of the pressure period while returning the solution from the cylinder and during the entire period of fixation, sufficient pressure shall be maintained to prevent any kickback returning to the treating tank. Hot water or steam may be used in the fixation process. Maximum temperatures and duration shall not be exceeded as specified in Commodity Standards. Final vacuum should be used to draw out the excess water upon the completion of the fixation period.

3. RESULTS OF TREATMENT

3.1 **Retention of Preservative.**—When retentions for both above ground and soil contact are shown in a commodity standard, the heavier retention should be used if there is any question as to the final use of the product. In addition, when more than one retention of a preservative is shown for a given species, the higher retention and corresponding penetration requirement should be specified for material of larger size or severe exposure condition. Unless otherwise specified, all retentions and corresponding penetrations are minimum. Retentions shall be determined by assay or by gauge as indicated in the applicable commodity standard. Borings for assay shall be taken in accordance with the requirements of Standard M2. Where reference in a given standard is made to both retentions by assay and retentions

Preservative	Retention as Specified (pcf) in Commodity Standards	Minimum Retention of Individual Components (pcf)				Minimum Sum of Retention of Individual Components Assayed (pcf)
		Copper as CuO	Chromium as CrO_3	Arsenic as As_2O_5	Zinc as ZnO	
Acid Copper Chromate (ACC)	0.25	0.64	.136			.250
	0.50	.127	.273			.500
Ammoniacal Copper Arsenate (ACA)	0.25	.100		.100		.250
	0.40	.159		.161		.400
	0.60	.239		.241		.600
	1.00	.398		.402		1.000
	1.50	0.598		0.602		1.500
	2.50	0.996		1.004		2.500
Ammoniacal Copper Zinc Arsenate (ACZA)	0.25	0.100		0.050	0.050	0.250
	0.40	0.160		0.080	0.080	0.400
	0.60	0.240		0.120	0.120	0.600
	1.00	0.400		0.200	0.200	1.000
	1.50	0.600		0.300	0.300	0.500
	2.50	1.000		0.500	0.500	2.500
Chromated Copper Arsenate (A) CCA—A	0.25	.041	.147	.037		.250
	0.40	.065	.236	.059		.400
	0.60	.098	.354	.089		.600
	1.00	.163	.590	0.148		1.000
	1.50	0.244	0.884	0.221		1.500
	2.50	0.407	1.473	0.369		2.500
Chromated Copper Arsenate (B) CCA—B	0.25	.044	.079	.101		.250
	0.40	.071	.127	.162		.400
	0.60	.106	.191	.243		.600
	1.00	.176	.318	.406		1.000
	1.50	0.265	0.477	0.609		1.500
	2.50	0.441	0.794	1.015		2.500
Chromated Copper Arsenate (C) CCA—C	0.25	.042	.107	.075		.250
	0.40	.067	.171	.122		.400
	0.60	.100	.257	.184		.600
	1.00	.167	0.428	.306		1.000
	1.50	0.250	0.641	0.459		1.500
	2.50	0.416	1.069	0.765		2.500
Chromated Zinc Chloride (CZC)	0.45		.081		.324	.450
	0.62		.099		.397	.620

by gauge, the purchaser shall advise which method of determining retention shall be used.

Where retention by assay is specified, the retention shall be determined by extraction or analysis of the treated wood as described by Section A—*Analysis Methods.* The retention of water-borne salt preservatives shall be not less than indicated in the table on page 4 for any individual component or for the sum total of the components.

Where retention by gauge is specified, the amount of preservative solution retained shall be determined from readings of working tank gauges or scales or from weights made before and after treatment of loaded trams on suitable track scales. If retention is determined from readings of working tank gauges, the retention of preservatives shall be calculated after correcting the volume of creosote type preservative to 100° F and of penta-petroleum type preservative to 60° F. Correction of volume or specific gravity shall be made using the factors contained in Section F—*Conversion Factors and Correction Tables.* If retention is determined by weighing material on track scales before and after treatment, a correction shall be made for the loss of moisture from the treated material that occurred during treatment with a creosote or oil type preservative providing that the plant equipment is such that such moisture can be collected and measured.

3.11 **Creosote and Creosote Solutions.**—The retention of creosote or creosote solutions shall be calculated as pounds of the preservative as defined in Standards P1/13, P2 and P3.

3.12 **Oil-Borne Preservatives.**—The retention of oil-borne preservatives shall be calculated as pounds of the preservative as defined in Standard P8. Concentration of preservative in solution shall be determined by analysis in accordance with Standard A5.

3.121 If retention by gauge only is specified then the concentration of the copper in the copper naphthenate treating solution shall be 0.5% copper minimum by weight.

3.13 **Water-Borne Preservatives.**—The retention of water-borne preservative shall be calculated as pounds of the preservative as defined in Standard P5. Concentration of preservative in solution shall be determined by analysis in accordance with Standard A2 and A4.

3.2 **Penetration.**—The penetration shall be specified by the purchaser in accordance with use

inimum Sum of Retention of Individual Components Assayed (pcf)
.250
.500
.250
.400
.600
1.000
1.500
2.500
0.250
0.400
0.600
1.000
0.500
2.500
.250
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.600
1.000
1.500
2.500
.250
.400
.600
1.000
1.500
2.500
.250
.400
.600
1.000
1.500
2.500
.450
.620

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requirements, but shall not be less than that specified for the individual type of material or species.

3.21 **Determination of Penetration.**—Penetration shall be determined by boring a representative number of pieces that are well distributed throughout each charge as specified for the individual type of material and species. (See AWPA Standard M2).

Wherever depth 'or' percent of sapwood penetration is specified, it shall be interpreted to mean whichever is less. Wherever depth 'and' percent of sapwood penetration is specified, it shall be interpreted to mean whichever is greater.

The maximum penetration required in any piece of sawn material shall be no greater than one-half the width of the piece if bored from the edge or one-half the thickness if bored on the (wide) face.

3.3 **Plugging Test Holes.**—All holes made for determining penetration and/or retention of preservatives shall be filled with tight fitting treated cylindrical plugs.

3.4 **Condition of Material.**—When minimum retentions are specified for creosote, creosote solutions, or oil-borne preservatives, material shall be supplied reasonably free of exudate and surface deposits. Such surface conditions cannot be required for heavier retentions of these preservatives. Material treated with water-borne preservatives shall be supplied free of visible surface deposits. All material shall be processed in such a manner as to prevent damage and minimize degrade.

4. PRESERVATIVES

The preservative used shall be whichever of the following standards of the American Wood-Preservers' Association is stipulated:

4.1 **Creosote and Creosote Solutions**
4.11 Creosote—Standards P1/P13.
4.12 Creosote-solutions—Standard P2
4.13 Creosote-petroleum solution—Standard P3.
4.14 Creosote-Pentachlorophenol Wood Preservative Solution—Standard P11.
4.2 **Oil-Borne Preservatives**
4.21 Pentachlorophenol—Standards P8 and P9.
4.22 Solubilized Copper-8-Quinolinolate-Standards P8 and P9.
4.23 Copper Naphthenate—Standards P8 and P9.
4.3 **Water-Borne Preservatives**
4.31 Acid copper chromate (ACC)—Standard P5.
4.32 Ammoniacal copper arsenate (ACA)—Standard P5.
4.33 Ammoniacal copper zinc arsenate (ACZA)—Standard P5.
4.34 Chromated copper arsenate (CCA)—Standard P5.
4.35 Chromated zinc chloride (CZC)—Standard P5.
4.36 Inorganic boron (SBX)-Standard P5

5. INSPECTION

Inspection of material for conformity to the requirements of this specification shall be in accordance with American Wood-Preservers' Association Standard M2, Standard for Inspection of Treated Timber Products.

6. RE-TREATMENT

6.1 When results of the original treatment do not meet the stipulated minimum requirements material may be re-treated and may be re-offered for acceptance, subject to the following conditions:

6.11 Material shall not be re-treated more than twice.

6.12 The limits on pressure and temperature for conditioning and treatment included in this standard (C1) and in the other Commodity Standards shall not be exceeded during re-treatment.

6.13 With respect to duration of steam conditioning permitted for retreatment, the following limits shall not be exceeded:

a. When either a charge as a whole or a charge made up of pieces rejected from two or more charges is retreated to obtain specified penetration and/or retention, the total steaming time for the original treatment and the retreatment combined, including any post-steaming, shall not exceed the maximum duration permitted for the original treatment.
b. When material previously rejected for penetration and/or retention is retreated in a charge with untreated material, the volume of the previously rejected material shall not exceed 10 percent of the total volume of the charge and the entire charge shall be considered as untreated both with respect to the maximum duration of the steaming time permitted and for computing the minimum required retention of preservative, if specified by gauge.

6.14 When material is re-treated in a charge with untreated material, the volume of the material to be re-treated shall not exceed 10 percent of the total volume of the charge, and all of the material in the charge shall be considered as untreated.

(a) With respect to the maximum duration of steaming time permitted, and,
(b) When computing the minimum required net retention of preservative, if specified by gauge.

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

6.16 When a charge made up of pieces rejected for insufficient penetration only is re-treated, the amount of preservative injected during re-treatment shall be sufficient to produce the required penetration.

7. SPECIES AND SPECIES GROUPINGS REFERENCED IN AWPA STANDARDS

The recognized common and scientific names of wood species used in AWPA Standards are as follows:

SOFTWOODS:	
Coastal Douglas-Fir	*Pseudotsuga menziesii var. menziesii*
a.k.a. Oregon Pine	
a.k.a. Red Fir	
Interior Douglas-Fir	*Pseudotsuga menziesii var. glauca*
a.k.a. Mountain Douglas-Fir	
a.k.a. Intermountain Douglas-Fir	
SOUTHERN PINE	*Pinus elliottii, P. echinata, P. palustris, P. taeda, P. serotina (pond), P. virginiana (virginia)*
Ponderosa Pine	*Pinus ponderosa*
Scotch Pine	*Pinus sylvestris*
a.k.a. Redwood (European)	
Jack Pine	*Pinus banksiana*
Lodgepole Pine	*Pinus contorta*
Eastern White Pine	*Pinus strobus*
a.k.a. Northern White Pine	
Radiata Pine	*Pinus radiata*
Caribbean Pine	*Pinus caribaea, P. oocarpa*
a.k.a. Ocote Pine	
a.k.a. Honduras Pine	
Sugar Pine	*Pinus lambertiana*
Western White Pine	*Pinus monticola*
Red Pine	*Pinus resinosa*
Western Hemlock	*Tsuga heterophylla*
HEM-FIR	*Tsuga heterophylla, Abies concolor* (white), *A. magnifica (Cal. red), A. grandis* (grand), *A. procera (noble), A amabilis* (Pac. silver)
Western Larch	*Larix occidentalis*
Redwood	*Sequoia sempervirens*
Western Red Cedar	*Thuja plicata*
Northern White Cedar	*Thuja occidentalis*
Atlantic White Cedar	*Chamaecyparis thyoides*
a.k.a. Southern White Cedar	
Alaska Yellow Cedar	*Chamaecyparis nootkatensis*
Spruce	*Picea spp.* (except Sitka and Engelmann)
Sitka Spruce	*Picea sitchensis*
Englemann Spruce	*Picea engelmannii, P. pungens*
HARDWOODS:	
Oak	
Red Oaks	*Quercus rubra, Q. velutina, Q. marilandica, Q. kelloggii, Q. falcata, Q. laurifolia, Q. ellipsoidalis, Q. nuttallii, Q. palustris, Q. coccinea, Q. shumardii, Q. laevis, Q. phellos, and Q. nigra.*
White Oaks	*Quercus alba, Q. bicolor, Q. macrocarpa, Q. arizonica, Q. douglasii, Q. lobata, Q. emory, Q. muehlenbergii, Q. gambelii, Q. oblongifolia, Q. garryana, Q. lyrata, Q. stellata, Q. michauxii, Q. prinus, and Q. virginiana.*
Black Gum	*Nyssa spp.*
Sweet Gum	*Liquidambar spp.*
a.k.a. Red Gum	
Hickory	*Carya spp.*
Mixed Hardwood	All North American hardwoods not otherwise specifically referenced in AWPA standards.