Standard FLP-18

QUALITY CONTROL MANUAL

For the Treatment and Re-Drying of

FlamePRO®
FIRE RETARDANT TREATED WOOD

Interior Fire Retardant Treated Lumber and Plywood

May 2020

Koppers Performance Chemicals
P.O. Box O
Griffin, GA 30224-0249

Koppers Performance Chemicals Standard FLP-18

CUSTOMER
CITY, STATE
QUALITY CONTROL PROCEDURES

For Treatment and Re-Drying of

FlamePRO®
FIRE RETARDANT TREATED WOOD

Interior Fire Retardant Treated
Lumber and Plywood

_____Date:_____
Treatment Plant Management
Title
Licensed/Listed Treatment Plant

_____Date:_____
Keith Howell
Manager, Quality Control
Koppers Performance Chemicals, Inc.

_____Date:_____
UL, TPI, or SPIB

FlamePRO® Quality Control Manual

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1.0 INTRODUCTION

1.1 PURPOSE

1.1.1 The purpose of this Quality Control Manual is to ensure that material bearing the FlamePRO fire retardant trademark meets or exceeds the treating and re-drying specifications contained herein on a continuous basis.

1.2 GENERAL

1.2.1 FlamePRO fire retardant treated lumber and plywood shall be produced only at plants under a quality assurance program overviewed by UL, Timber Products Inspection, Inc. (TP), or Southern Pine Inspection Bureau (SPIB) an IAS accredited independent third-party inspection agency. UL, TP or SPIB shall monitor the treatment and re-drying of production according to the procedures contained herein.

1.2.2 FlamePRO fire retardant treated lumber and plywood is classified by UL as FR-S and standardized in the AWPA as FR-2 in standard P50 waterborne fire retardant formulation. FR-2 is an interior Type A high temperature (HT) system.

1.2.3 FlamePRO fire retardant chemicals will be manufactured under the UL Recognized Component Program (in process as of 09-2018). Raw material samples are sent to the KPC-Griffin lab for analysis and results reported to KPC-Millington. UL conducts audits and allows mark on product label. Under this program, U L LLC. waives the fire tube test requirements at the treating plant.

1.2.4 Each plant shall be qualified based on evaluation of their equipment, in-house quality control program and evaluation of the qualification charge(s) for lumber and plywood.

1.2.5 This program includes information on quality **control** testing and key processing parameters concerning treatment and re-drying. Processes to be monitored include: moisture content prior to treatment, solution concentration, method of treatment, treatment cycle parameters, chemical retention by gauge, solution temperature, kiln drying after treatment, and final moisture content. Checklists used by the quality control agency for monthly inspections are also included in this quality control manual.

1.2.6 This document delineates in-house quality control procedures as well as the Quality Assurance Monitoring Program performed by UL, TP or SPIB and is to be used in accordance with the ICC-ES report ESR-4244.

1.3 GLOSSARY

1.3.1 **Boring, Core –** The cylinder of wood removed by means of an increment borer that may be used to determine fire retardant penetration or analyzed for retention.

1.3.2 **Charge –** All the wood treated together as a batch in one cylinder or treating tank at one time.

1.3.3 **Cylinder, Treating –** A steel horizontal tank, one or both ends of which may be opened or closed, in which wood is placed for fire retardant treatment.

1.3.4 **Fire Retardant –** A chemical or mixture of chemicals whose proper application to wood substantially increases its resistance to flaming or burning.

1.3.5 **Fire Tube Test –** A method of testing fire resistance of treated wood in which a specimen is placed over a controlled flame in a specially designed vertical tube. Loss in weight and temperature are recorded during the test.

1.3.6 **KDAT (Kiln Dried After Treatment) -** The process of removing absorbed water from fire retardant treatment by stickering lumber and plywood and drying it in a heated or dehumidification kiln.

1.3.7 **Moisture Content –** The relative amount of water contained in wood, usually expressed as a percentage of the oven dry weight of wood.

1.3.8 **Moisture Meter –** An electrical instrument used to indicate the moisture content of wood.

1.3.9 **Penetration –** The depth to which fire retardant chemicals enter the wood.

1.3.10 **Pressure Treatment –** The impregnation of wood with liquid by application of vacuum and pressure processes.

1.3.11 **Quality Control Agency –** Organization providing independent quality monitoring and certification of treated wood products.

1.3.12 **Quality Mark –** Evidence applied to treated material indicating conformance to all specified requirements.

1.3.13 **Retention by Gauge –** The amount of fire retardant, in pounds per cubic foot (pcf) of the total charge, remaining in the wood immediately after treatment.

1.3.14 **Treatment, Fire Retardant –** The treatment of wood products with fire retardant chemicals to reduce flame spread, fuel contribution, and smoke development.

2.0 PRODUCT SPECIFICATIONS

FlamePRO fire retardant treated wood is lumber and plywood pressure impregnated with FlamePRO Interior Type A High Temperature (HT) fire retardant chemicals. FlamePRO is classified by UL as FR-S and standardized in AWPA as FR-2 and holds ICC-ES report ESR-4244.

2.1 WOOD SPECIES

Only the lumber and plywood species listed below are approved for treatment with FlamePRO fire retardant.

FlamePRO fire retardant treated lumber of the following species is recognized as having a flame spread rating of 25 or less when subjected to ASTM E-84 (UL 723; NFPA 255) tests of 30 minutes duration without evidence of significant progressive combustion:

Southern Pine	Red Pine
Douglas Fir	Ponderosa Pine
Western Hemlock	White Fir
Alpine Fir	Hem Fir
Lodgepole Pine	Balsam Fir
White Spruce	Jack Pine
Spruce-Pine-Fir	Engelmann Spruce
Red Spruce	Black Spruce

Plywood fabricated with face and back veneers of the following species and treated with FlamePRO fire retardant chemicals is recognized as having a flame spread rating of 25 or less when subjected to ASTM E-84 (UL 723; NFPA 255) tests of 30 minutes duration without evidence of significant progressive combustion:

Douglas Fir plywood Southern Yellow Pine plywood

2.2 TREATMENT SPECIFICATIONS

All FlamePRO treatment procedures shall be in accordance with the American Wood Protection Association standards (AWPA) and ICC-ES report ESR-4244.

2.2.1 Treatment Solutions

Solution concentrations shall conform to the range of active ingredients defined in Table 2.2.3 below.

2.2.2 Treatment Process

Only vacuum-pressure processes described in AWPA Standard T1 shall be used to produce FlamePRO fire retardant treated lumber and plywood.

2.2.3 Results of Treatment

The required retention ranges and minimum depths of penetration for each of the species are listed below in Table 2.2.3.

FlamePRO® Retention and Penetration Requirements						
Lumber Species	**UL classification**	**Soln. Conc. Range (%)**	**Retention[1] Range**	**Concentration Range as P_2O_5 (%)**	**Gauge Retention Range (PCF) as P_2O_5 (%)**	**Min. Penetration**
Southern Pine Red Pine Ponderosa Pine	FR-S	3.0 – 20.0	0.9-1.4 PCF 14-22 kg/m3	1.4 – 9.5	0.43 – 0.66	0.25" (6mm)
Douglas Fir	FR-S	3.0 – 20.0	0.7-1.2 PCF 11-19 kg/m^3	1.4 – 9.5	0.33 – 0.57	0.1875" (5mm)
Western Hemlock White Fir Hem-Fir	FR-S	3.0 – 20.0	0.9-1.4 PCF 14-22 kg/m^3	1.4 – 9.5	0.43 – 0.66	0.25" (6mm)
Alpine Fir White Spruce	FR-S	3.0 – 20.0	0.7-1.2 PCF 11-19 kg/m^3	1.4 – 9.5	0.33 – 0.57	0.1875" (5mm) 0.25" (6mm)
Lodgepole Pine Jack Pine	FR-S	3.0 – 20.0	1.2-1.8 PCF 19-29 kg/m^3	1.4 – 9.5	0.57 – 0.85	0.125" (3mm)
Engelmann Spruce Red Spruce Black Spruce	FR-S	3.0 – 20.0	1.2-1.8 PCF 19-29 kg/m^3	1.4 – 9.5	0.57 – 0.85	0.125" (3mm)
Spruce-Pine-Fir Balsam Fir	FR-S	3.0 – 20.0	1.2-1.8 PCF 19-29 kg/m^3	1.4 – 9.5	0.57 – 0.85	0.125" (3mm)
Plywood Species	**UL**	**Soln. Conc. Range (%)**	**Retention Range**	**Concentration Range as P_2O_5 (%)**	**Gauge Retention Range (PCF) as P_2O_5 (%)**	**Min. Penetration**
Douglas Fir	FR-S	4.0 – 18.0	1.6-2.0 PCF 26–32 kg/m^3	1.9 – 8.5	0.76 – 0.95	NA[2]
Southern Yellow Pine	FR-S	8.0 – 25.0	2.9-3.4 PCF 46–54 kg/m^3	3.8 – 11.9	1.37 – 1.61	NA[2]

1. Specified retention is by gauge
2. Not applicable

2.3 DRYING SPECIFICATIONS

To carry the KDAT designation, all FlamePRO fire retardant treated lumber shall be kiln dried after treatment to a moisture content of 19% or less and 15% or less for plywood. The following restrictions shall apply:

2.3.1 Lumber

Lumber			
	Southern Pine	**Douglas fir**	**SPF**
Max MC (oven dry)	19.0%	19.0%	19.0%
Max. Kiln Temp.	160°F	160°F	160°F
Max Wet Bulb Depression	40°F	40°F	40°F
Max Time at > 100°F	96 hours[2]	96 hours[2]	96 hours[2]

[2] In kiln charges where the maximum temperature does not exceed 135°F, a maximum time of 120 hours is allowed

2.3.2 Plywood

Plywood		
	Southern Pine	**Douglas fir**
Max MC (oven dry)	15.0%	15.0%
Max Kiln Temp	160°F	160°F
Max Wet Bulb Depression	40°F	40°F
Max Time at > 100°F	120 hours[1]	120 hours[1]

[1] In kiln charges where the maximum temperature does not exceed 135°F, a maximum time of 156 hours is allowed

2.3.3 Maximum Oven Dry Moisture Content After Drying Cycle

Lumber: 19%
Plywood: 15%

2.3.4

Qualitycontrol procedures must be followed and records maintained for all material treated and dried after treatment.
Each piece of material shall be marked with the applicable mark as illustrated in Appendix F. Only products in compliance with the evaluation report and quality program shall be marked with the UL, TP or SPIB designation, and the ICC-ES report number. The licensed/listed treater may not mix marked material with unmarked material in one package. See section 6.0 for specific label requirements.

***** Temperature spikes of up to 10% over listed maximum temperatures for no more than 5 hours are acceptable.

3.0 QUALIFICATION OF PLANT FACILITIES AND PERSONNEL

Each plant shall be qualified based on evaluation of their equipment, personnel, in-house quality control program, and evaluation of the qualification charge(s) for lumber and plywood.

3.1 PLANT EQUIPMENT

3.1.1 At the initial plant qualification, UL, TP, SPIB and/or ICC-ES shall make a thorough inspection of the treating plant facilities to verify that the plant has the following required equipment:

3.1.1.1 Pressure treating cylinder system and pumps capable of producing and maintaining a 20-inch vacuum and 120 PSI pressure.

3.1.1.2 Gauges, recorders, reports and other appropriate means capable of indicating and recording treating information and the conditions within the treating cylinder during all phases of the treatment process.

3.1.1.3 Dry kiln with a recorder capable of continuously maintaining and recording dry kiln conditions (including time, wet bulb thermometer, dry bulb thermometer), and controls capable of maintaining target temperatures within $\pm$ 5° F. Dry kiln recorders and controls shall be re-calibrated annually and records maintained.

3.1.1.4 All laboratory equipment necessary to perform in-plant quality conformance tests. This includes a hydrometer, thermometer, moisture meter and two-part phosphorous penetration indicator. Details are in the FlamePRO product manual.

3.2 PERSONNEL

At qualification, the treating plant, dry kiln, and quality control personnel shall demonstrate to the UL, TP or SPIB inspector a thorough understanding of the treating and re-drying process.

3.3 QUALIFICATION CHARGES

FlamePRO fire retardant treated lumber and plywood shall be qualified on the basis of review and testing conducted by UL, TP or SPIB at their testing laboratory in accordance with the applicable standards. Requirements for the quality control of production material shall be based upon the production and testing of the qualification material. These quality control requirements shall include moisture content prior to treatment, solution concentration, method of treatment, treatment cycle parameters,

chemical retention by gauge, solution temperature, kiln drying after treatment, and post treatment and drying moisture content.

Qualified treating plants participating in this program shall label conforming fire retardant treated lumber and plywood with the registered agency's quality mark (see Section 6.0). Labeling privileges may be temporarily or permanently suspended based on the treating plant's performance.

4.0 PLANT QUALITY CONTROL PROCEDURES

Quality control at the treating plant is required to ensure that material bearing the FlamePRO fire retardant trademark meets or exceeds the treating and re-drying specifications contained herein on a continuous basis. The specifications in this standard describe and follow the treating and re-drying procedures that were used in the development of FlamePRO treated plywood span tables and lumber design values.

4.1 RESPONSIBILITY

The responsibility for the production of FlamePRO fire retardant treated wood to the minimum standards of Koppers Performance Chemicals' ICC-ES report, UL, AWPA and other specified standards writing or auditing agencies lies with the listed treating plant.

4.2 GENERAL QUALITY CONTROL

4.2.1 The management of the plant must appoint a quality control supervisor who will be responsible for the in-house quality control program and have the authority to take action as required to assure compliance of all material produced by the plant. The plant quality control supervisor will serve as the primary contact for the approved quality control inspection agency. (see this manual signature page).

4.2.2 The plant shall be equipped with the process equipment, measuring instruments, records and laboratory equipment necessary to accurately monitor the treating, drying and testing procedures conducted at the plant. The equipment shall be properly calibrated as required in section 4.4.3 and maintained in good working order and personnel shall be properly trained in its use.

4.2.3 Quality Control procedures require surveillance from purchase of the untreated lumber and plywood through all phases of manufacture and processing until delivered to the customer.

4.2.4 A central file shall be maintained in which records and reports shall be kept including treatment records, dry kiln records, and kiln recorder charts. This documentation shall be retained for at least two years.

4.2.5 Records for each lot of material processed (charge) shall carry an identification number (charge number), date of treatment, and purchaser of material.

4.2.6 Final acceptance of the material, records and reports by the Quality Control Supervisor shall be withheld until all specifications have been met. The Quality Control Supervisor shall not release any lot of material for shipment until he is satisfied that the material complies with FlamePRO specifications and the purchase order.

4.2.7 Following the treatment and re-drying processes, all FlamePRO fire retardant treated wood shall be stored off the ground in weather protected locations or protected by waterproof wrapping.

4.2.8 Should it become evident that part of the production does not comply with FlamePRO specifications and purchase order requirements, the Quality Control Supervisor shall notify the operation's management and corrective measures shall be instituted. A report of non-compliance and corrective actions must be made and filed with quality control records.

4.2.9 The listed producer shall notify the quality assurance agency when production is halted for 30 days or more and advise when production will resume. Start-ups will be governed by the conditions set forth in Section 3.0.

4.3 INCOMING MATERIALS

4.3.1 FP treatment chemical – see section 1.2.3. Verify UL mark in place

4.3.2 Verify that all incoming lumber and plywood shall be agency grade marked and meet all requirements of the marked grade.

4.3.3 All incoming materials shall be documented as to when received. Wood volumes, dimensions, species and suppliers shall be verified and recorded.

4.3.4 The Quality Control Supervisor shall determine that all material has been stored properly in accordance with recommended practices of the American Wood Protection Association (AWPA) while under plant control and prior to treatment.

4.4 PLANT GAUGES

4.4.1 Pressure plants shall be equipped with recording instruments to register time, pressure, and vacuum during each treatment cycle.

4.4.2 The mix tank and work tanks may be equipped with a temperature thermometer.

4.4.3 All recorders, thermometers and gauges shall be tested and certified for accuracy at the time of installation by an instrument company and annually thereafter. Hydrometers are to have a Certificate of Compliance and Traceability from the manufacturer confirming it has been calibrated in accordance with the A.S.T.M. standard E 126 and N.I.S.T. circular No. 555. These are typically replaced on an as needed basis.

- Gauge Certification for AWPA Compliance – an Ashcroft Model Q-149 test gauge that has been inspected and calibrated to National Institute of Standards and Technology requirements in accordance with ASME B40.1 to accuracy grade 3A and has a stated accuracy of 0.25% is used to certify that the pressure/vacuum gauges complies with AWPA Standard M3 Section 3 Item 3.5(b) and (c) and Standard M25 Section 2.1. This gauge certification is done annually.

4.4.4 When there is evidence of malfunction not corrected by simple adjustment, the defective item shall be promptly repaired or replaced and re-certified for accuracy.

4.4.5 When it is necessary for corrective action, the instrument manufacturer or qualified gauge tester shall provide written documentation of when the instrument was tested and the results therein.

4.4.6 All devices used to record the treating process shall be within the tolerances as stated in AWPA Standard M-3.

4.4.7 All results and test reports of instrument calibration and/or replacement shall be maintained in the central file. These records shall be retained for a minimum of 2 years.

4.5 TREATING SOLUTIONS

4.5.1 Solution Composition and Concentration

4.5.1.1 The FlamePRO fire retardant treatment solution shall be controlled so that the solution used for treatment operations is of the same composition, within qualified tolerances, as the solution used for the treatment of qualification test specimens.

4.5.1.2 The treating solution concentration shall be maintained within the specified range shown in Section 2.2.3 for the specific product and species being treated.

4.5.2 Solution Sampling

4.5.2.1 A representative sample of the treating solution must be drawn from the working solution for verification testing by the in-plant quality control inspector whenever any adjustments are made to the solution or before every charge.

4.5.2.2 The verification test of the working solution at the plant shall include a determination of the specific gravity by hydrometer and temperature. The hydrometer reading, temperature, and solution concentration shall be recorded on the treatment record.

4.5.2.3 Solution samples shall be provided to authorized UL, TP or SPIB representatives upon request during plant inspections.

4.5.2.4 Plants in full time production should submit a minimum of one (1) solution sample per week for analysis to UL, TP or SPIB's analytical laboratory.

4.5.2.5 Upon request, a 4-ounce solution sample shall be forwarded to the address below for composition and concentration verification by laboratory analysis.

Koppers Lab Services
1641 Sigman Road – Suite B
Conyers, GA 30012

* or send to the laboratory designated for your facility

4.6 TREATMENT PROCESS

4.6.1 Only the vacuum-pressure process described in AWPA Standard T1 shall be used to produce FlamePRO fire retardant treated lumber and plywood.

4.6.2 Careful observation during treatment shall be made of cycle parameters to ensure that maximum limits are not exceeded. These parameters include, but are not limited to, pressure, vacuum, temperature, and time.

4.6.3 Each charge or lot of material shall have its own charge number and be subsequently traceable to that number. Each bundle of lumber or plywood per charge shall be labeled with the charge number. The use of a sequential numbering system is required.

4.6.4 Before treatment, all wood products shall be dried to a moisture content that allows proper treatment of FlamePRO fire retardant chemicals.

4.7 RESULTS OF TREATMENT

4.7.1 All FlamePRO treatment results shall be in accordance with ICC-ES ESR-4244.

4.7.2 Following treatment, the charge of materials shall be examined for any mechanical or treatment damage. If damage is indicated, the material shall be rejected unless the customer desires to accept the material on a conditional basis.

4.7.3 Penetration

4.7.3.1 Each charge of lumber shall be bored after treatment to determine the adequacy of fire retardant penetration. The core borings shall be taken randomly from the center of the edge or face of 20 pieces of lumber. Care shall be taken to avoid knots, pitch pockets, shakes or splits. Penetration shall be determined on a phosphorus basis and according to AWPA Standard A73-12. The charge is acceptable if 18 of the 20 borings meet the minimum penetration requirements shown in Table 2.2.3 for the specific species of lumber.

4.7.3.2 Penetration test results shall be recorded on the charge report.

4.7.3.3 There are no penetration requirements for plywood treated with FlamePRO fire retardant chemicals.

4.7.4 Chemical Retention

4.7.4.1 The acceptable gauge retention of FlamePRO fire retardant chemicals shall be within the range specified in Table 2.2.3 for the specific product and species treated.

4.8 KILN DRYING AFTER TREATMENT

4.8.1 Importance of Proper Re-Drying

4.8.1.1 The drying after treatment of FlamePRO fire retardant treated wood is equally as important as the proper treatment of the material. Proper pressure treatment ensures that the wood products contain the appropriate amount of fire retardant chemicals at the required depth of penetration. However, the superior properties of FlamePRO fire retardant treated wood, such as low hygroscopicity, low corrosion, non-blooming, and resistance to thermal degradation, depend upon the proper drying after treatment of the material.

4.8.1.2 The importance of properly re-drying fire retardant treated wood is supported by the model building codes and the American Wood Protection Association standards, which require all fire retardant treated lumber and plywood to be dried after treatment.

4.8.2 Moisture Content

4.8.2.1 All lumber treated with FlamePRO fire retardant chemicals shall be kiln dried after treatment to a moisture content of 19% or less, and all plywood shall be kiln dried after treatment to a moisture content of 15% or less.

4.8.2.2 The dry kiln operator shall be responsible for checking each kiln charge of FlamePRO fire retardant treated lumber and plywood for moisture content with a calibrated, resistance-type moisture meter as follows:

Twenty (20) pieces of lumber shall be checked for maximum moisture content. If the average moisture content exceeds the limit specified in 4.8.2.1, then an additional 20 pieces shall be evaluated. If the average of the 40 pieces exceeds the limit specified in 4.8.2.1, then the charge shall be dried further.

A minimum of 10 plywood panels per kiln charge shall be checked at no closer than 12” from any edge. If the maximum moisture content exceeds the limit specified in 4.8.2.1, then an additional 10 panels shall be evaluated. If the maximum moisture content of the 20 panels exceeds the limit specified in 4.8.2.1, then the charge shall be dried further.

4.8.2.3 Since measurements with resistance-type moisture meters are affected by FlamePRO, correction factors shall be applied to all readings. Appropriate moisture content correction factors are provided in plant’s FlamePRO Treatment and Processing Manual.

4.8.3 Kiln Drying Parameters

4.8.3.1 During the re-drying process of FlamePRO fire retardant treated lumber and plywood, the dry bulb temperature of the kiln shall not exceed 160° F (see Section 2.3.1). Temperature spikes of up to 10% over listed maximum temperatures for no more than 5 hours shall be acceptable.

4.8.3.2 During the re-drying process, the wet bulb depression shall not exceed 40° F (see Section 2.3.2). Temperature spikes of up to 10% over listed maximum temperatures for no more than 5 hours shall be acceptable.

4.8.4 Kiln Drying Non-Conformances

4.8.4.1 If at any time the requirements of 4.8.2 and 4.8.3 are not met, the kiln load shall be impounded by the Quality Control Supervisor. An Impound Report (see Appendix C) shall be completed, and the Plant Manager shall be notified. A copy of the report shall be immediately forwarded to the Third - Party Inspection Agency and Koppers Performance Chemicals.

4.8.4.2 Impounded kiln loads shall be so labeled and stored in a shed and not stamped pending disposition.

4.9 CHEMICAL VERIFICATION

4.9.1 Plants that need to meet Military specifications, ICC-ES Acceptance Criteria, and/or AWPA Standards shall verify the appropriate chemical content by means of fire tube tests. Otherwise, fire tube tests are not required as noted in Section 1.2.3.

4.9.2 When verification is required, fire tube tests shall be conducted according to ASTM Standard E69-15 (see the FlamePRO Treatment and Processing Manual).

4.10 TREATMENT AND RE-DRYING RECORDS

4.10.1 The treating plant shall maintain a record of treatment and re-drying for each charge or lot to document that all FlamePRO fire retardant treated lumber and plywood meets the specifications outlined in Section 2.0 of this Quality Control Manual. Each charge or lot shall be documented as follows:

4.10.1.1 A treating report that describes the species, volume of material treated, date, charge number and treating cycle parameters. A typical treating report is provided in Appendix A.

4.10.1.2 A kiln record that describes the species, sizes and volume of material dried, the kiln controller settings (wet bulb and dry bulb temperatures), time and final moisture content readings. A kiln recorder chart showing actual environmental conditions during the entire drying period shall be kept with the kiln record. A typical kiln report is provided in Appendix B.

4.10.2 Records must be kept to document that all materials, incoming and treated, meet the quality control agency requirements and that in-house quality control procedures have been properly conducted. (see 4.2.4)

4.11 EVALUATION SERVICE NOTIFICATION STATEMENTS

4.11.1 This manual will be reviewed at least annually and any revisions, including those related to product changes, will be forwarded to the manufacturing plants, inspection agencies and ICC-ES. Note that ICC-ES may require evaluation by an independent third-party of any product manual changes. See section 8.0 Record of Revision Table.

4.11.2 The ICC-ES or corresponding evaluation report numbers will only be used on FlamePRO fire retardant treated wood which complies with the published evaluation report.

4.11.3 The listed producer will notify the ICC-ES before cancellation of the inspection agreement with the quality assurance agency.

4.11.4 The listed producer and quality assurance agency will notify the ICC-ES in writing within ten (10) days of major deviation discovered by the quality assurance agency, including disposition thereof.

4.11.5 Copies of inspection reports conducted by the quality assurance agency indicating quality control variation(s) or label withdrawal are to be forwarded to the ICC-ES by the quality assurance agency within 10 days of the noted major deviation.

4.11.6 The listed producer will notify the ICC-ES in writing if unannounced follow-up inspections have not been conducted according to this manual.

4.11.7 The listed producer will promptly investigate and respond to the ICC-ES and report holder when apprised of field complaints concerning performance of FlamePRO fire retardant treated wood. The listed producer will keep a record of all significant complaints, the actions taken and the outcome. See Appendix C and the listees' plant-specific complaint form.

4.11.8 The ICC-ES is allowed to examine at manufacturing and/or distribution points any product labeled in conformance with a corresponding evaluation report. Such examination is to be conducted by individuals employed by or retained by the ICC-ES.

5.0 QUALITY CONTROL INSPECTION AGENCY

5.1 FlamePRO fire retardant treated lumber and plywood shall only be produced at plants with a quality assurance program monitored by UL, LLC, Timber Products Inspection, Inc. (TP) or Southern Pine Inspection Bureau (SPIB).

5.2 UL, TP or SPIB shall inspect every plant producing fire retardant treated wood at least once a month. More frequent inspections may be necessary for plants with high production or quality problems. The visits shall not be made on a regular schedule.

5.3 The UL, TP or SPIB inspector shall review plant records since the last inspection to make sure that the required records are being maintained in a complete and accurate fashion and that all materials treated have been properly tested and have complied with the established quality control requirements.

5.4 While at the plant, the UL, TP or SPIB inspector shall verify compliance with the plant quality control procedures specified in Section 4.0 of this quality control manual. The inspector shall check the moisture content of material that has been kiln dried and check the solution concentration by hydrometer. The inspector shall keep a report of his findings and copies of records for all witnessed tests.

5.6 During active production, the UL, TP or SPIB inspector shall sample the fire retardant solution from each plant monthly. The sample shall be obtained from the treating cylinder or storage tank at the time of the inspection. The sample shall be labeled and sent to UL, TP, SPIB or another designated laboratory to confirm proper chemical composition and concentration. The sample label shall include plant name and location, date sampled, hydrometer reading/PCS solution concentration and target solution concentration. Additionally, the agency must verify plant records on testing of the treating solution.

5.7 The UL, TP or SPIB inspector must examine production records to ensure proper accounting of production. In this regard, the agency must have total control of the identification methods. A system of traceability of finished product to treatment, drying and quality control records must be provided.

5.8 A checklist for use by the quality control inspection agency during monthly inspections is provided in Appendix E.

6.0 IDENTIFICATION AND MARKING

6.1 All FlamePRO fire retardant treated wood shall be identified by legible marking with an ink stamp issued by an IAS accredited quality control agency. At least one mark shall be applied to every piece of properly processed lumber and plywood except for sawn material less than 1 by 2 inches where one mark may be applied to a bundle of not more than 20 (twenty) board feet. The quality stamp shall consist of the following:

a. UL Classification FR-S Designation of Lumber or Plywood or TP Monitored AA-696, or SPIB monitored per AA-680 per QC manual Standard FLP-18
b. FlamePRO Trade Name and ICC-ES ESR Number
c. Classification as Interior Type A High Temperature (HT) Fire Retardant
d. Name and Location of Licensed Treater
e. The KDAT Designation
f. Year of Treatment
g. ASTM E84 Flame Spread and Smoke Developed Index
h. Species of Wood Treated

Typical quality stamp designs for FlamePRO fire retardant treated lumber and plywood are shown in Appendix F.

7.0 RESOLUTION OF NON-COMPLIANCE

7.1 GENERAL

7.1.1 In the event UL, TP or SPIB discovers a significant non-conformance with requirements outlined in this quality control manual or the plant-specific SOP's were not followed, they shall, at their discretion, initiate double frequency inspections until two consecutive audits show full conformance. If three consecutive or four inspections in a six-month period show non-conformance, the plant's marking privileges shall be suspended and all stamps and labels removed from the plant until all requirements are met to the satisfaction of the inspection agency.

7.1.2 If a plant fails to maintain all required records in a complete and accurate manner, UL, TP or SPIB shall give the plant a written warning with details of the deficiencies. Three consecutive monthly warnings or four warnings in a six month period shall result in suspension of the plant's marking privileges and removal of all stamps and labels from the plant until the requirements are met to the satisfaction of the inspection agency.

7.1.3 UL, TP or SPIB shall notify the Plant Quality Control Supervisor, the Plant Manager and Koppers Performance Chemicals of all non-conformances.

7.2 SOLUTION CONCENTRATION

7.2.1 Working solution concentration must be within the specified range shown in Table 2.2.3 of this quality control manual. If the solution concentration is found to be low, the charge must be dried and then retreated with solution sufficient to attain the minimum retention level.

7.3 SOLUTION ANALYSIS

7.3.1 The analysis of solution sampled by the quality control agency must confirm proper composition and balance of components. Out of balance or low solution requires appropriate action by the plant to adjust the solution. Additional samples must then be analyzed on a weekly basis until conformance has been demonstrated by two consecutive samples.

7.3.2 All material found to have been treated with a non-conforming solution shall be segregated and labeled as non-conforming. If, after review of the treating process records and test results, the charge is confirmed to be non-conforming, then the material is ineligible to bear a FlamePRO quality mark unless retreated.

7.4 GAUGE RETENTION

7.4.1 The charge must be within the specified range of gauge retention of fire retardant chemical as determined during qualification testing for the applicable material and species (see Table 2.2.3).

7.4.2 If retention is below the minimum, the charge must be retreated so that the total retention is within the minimum and maximum qualified values. If retention is above the allowed maximum, the lumber or plywood in the charge is ineligible to bear a quality mark.

8.0 Record of Revision Table

Revision Number	Date	Summary of Changes
1	6-27-2018	Added Southern Pine Inspection Bureau as 3rd party agency
2	9-6-2018	Revise Table 2.2.3, sections 2.3.1 and 2.3.2. Add section 8.0 Various edits sections 1.2.3, 3.1.1.4, 4.2.2, 4.2.4, 4.2.6, 4.3.1, 4.4.7, 4.11.1, 4.11.7, and App. F
3	7-2-2019	Revisions to sections 4.2.2, 4.4.3, 4.4.7, 4.10.2, 4.11.7, 7.1.1 and APP. C.
4	7-9-2019	Rev. Min. Penetrations Table 2.2.3
5	8-2-2019	Revise section 4.4.3 – calibration details
6	9-27-2019	Revised Table 2.2.3 to add P_2O_5 values
7	5-26-2020	Revised Appendix D Moisture Meter Correction Factors

APPENDICES

Appendix A: **FlamePRO® Treating Report**

Appendix B: **FlamePRO® Kiln Drying Report**

Appendix C: **FlamePRO® Impound Report**

Appendix D: **Moisture Meter Correction Factors**

Appendix E: **QC Agency Monthly Inspection Checklist**

Appendix F: **Typical Quality Marks**

Appendix A

FlamePRO® TREATING REPORT

Plant _____ Charge Number _____ Date _____

CALCULATED RETENTION

Cu. Ft. of Wood _____

Required retention _____ lbs. oxides per cu. ft.

Metal oxides to be absorbed _____ lbs.

Gals. Soln. per lb. of oxides @ _____ % _____ gals.

Total gals. of Solution to be absorbed _____

RETENTION

BEFORE TREATMENT

Hydrometer reading _____ Temp. _____ °F

Percent solution _____

Cylinder capacity empty _____ gals.

Less lumber displacement (Cu. Ft. x 7.48) _____ =

Gals. required to fill retort _____

Gals. in work tank _____

Less Gals. required to fill retort _____ =

Gals. in work tank after filling retort _____

Less gals. to be absorbed _____ =

Gals. in work tank after pressure _____

TREATMENT	VALUE	ON TIME	OFF TIME	DURATION
Initial Vacuum, Inches				
Fill Retort				
Solution Pressure				
Empty Retort				
Final Vacuum, Inches				
Total Treating Time				

RETENTION

AFTER TREATMENT

Total Gals. in storage _____ (Before Treatment)

Total Gals. in storage _____ (After Treatment)

Gallons absorbed _____

Lbs. oxides per gal. @ _____ °F _____ % _____ lbs.

+ _____ lbs. oxides absorbed / cubic foot of wood = _____ Retention-lbs. per cubic foot

+ _____ Gallons absorbed / cubic foot of wood = _____ Gals. Soln. absorbed per cubic foot of wood

RCRA DRIP PAD RESIDENCE TIME

Time on pad _____ Date on pad _____

Time off pad _____ Date off pad _____

MATERIAL TREATED

No. Pieces	Size	Board Feet	Cubic Feet	Species	Remarks

BORINGS PENETRATION

Boring No.	Sap Wood Depth	Penetration	Boring No.	Sap Wood Depth	Penetration	Boring No.	Sap Wood Depth	Penetration	Boring No.	Sap Wood Depth	Penetration
1			6			11			16		
2			7			12			17		
3			8			13			18		
4			9			14			19		
5			10			15			20		

* Circle Borings That Fail
* Borings Fail If Does Not Meet AWPA Standard C-2

TREATING ENGINEER _____

☐ **Recorder Chart Attached**

Appendix B

FlamePRO® KILN DRYING REPORT

Plant_____ **Date** _____

Location_____ **Kiln No.** _____

Operator_____ **Charge No.** _____

Material_____ **Species**_____ **MBF** _____

Start Time_____ **End Time**_____ **Total Hrs.** _____

DRY KILN OPERATING CONDITIONS						
Date						
Time						
Total Drying Hours						
Dry Bulb Temp. (° F)						
Wet Bulb Temp. (° F)						
Moisture Content %						

MATERIALS LIST					
Customer	**Material**	**Species**	**Treatment**	**Pieces**	**MBF**

Signed_____ **Total Volume**_____**MBF**

☐ **Recorder Chart Attached**

Appendix C

FlamePRO® IMPOUND REPORT

Plant:_____ **Date:** _____

Treatment Charge No.: _____

Kiln Charge No.: _____

Incoming Material type: _____

Non-Conforming: ☐ **Treatment** ☐ **KDAT** ☐ **Incoming Materials**	
Reason for Non-Conformance:	
Notification: ☐ **Plant Manager** _____ ☐ **Inspection agency** _____ ☐ **Koppers P. C.** _____	
Disposition of Non-Conforming Material:	
Quality Control Supervisor: _____ **Date:** _____ **Plant Manager:** _____ **Date:** _____	

****NOTE – Record and related reports are to be retained for a minimum of 2 years.**

Appendix D

FlamePRO Moisture Content Meter Correction Factors

LUMBER		
Temperature Corrected Meter Reading	Adjusted %MC	
	Douglas fir lumber	Southern pine lumber
12.0	9.6	8.1
12.5	9.9	8.5
13.0	10.3	8.8
13.5	10.7	9.1
14.0	11.0	9.4
14.5	11.3	9.8
15.0	11.6	10.1
15.5	11.9	10.4
16.0	12.2	10.7
16.5	12.6	11.0
17.0	12.9	11.3
17.5	13.3	11.7
18.0	13.6	12.0
18.5	13.9	12.3
19.0	14.2	12.6
19.5	14.5	12.9
20.0	14.8	13.2
20.5	15.2	13.6
21.0	15.5	13.9
21.5	15.8	14.2
22.0	16.2	14.6
22.5	16.5	14.9
23.0	16.8	15.2
23.5	17.1	15.5
24.0	17.4	15.8
24.5	17.7	16.1
25.0	18.1	16.5
25.5	18.4	16.8
26.0	18.7	17.1
26.5	19.1	17.4
27.0	19.4	17.7
27.5	19.7	18.1
28.0	20.0	18.4
28.5	20.3	18.7
29.0	20.7	19.0
29.5	21.0	19.3
30.0	21.3	19.7
30.5	21.6	20.0
31.0	22.0	20.3
31.5	22.3	20.6
32.0	22.6	20.9
32.5	23.0	21.2
33.0	23.3	21.6
33.5	23.6	21.9
34.0	23.9	22.2
34.5	24.2	22.6
35.0	24.5	22.9

PLYWOOD		
Temperature Corrected Meter Reading	Adjusted %MC	
	Douglas fir plywood	Southern pine plywood
12.0	9.6	8.1
12.5	9.9	8.5
13.0	10.3	8.8
13.5	10.7	9.1
14.0	11.0	9.4
14.5	11.3	9.8
15.0	11.6	10.1
15.5	11.9	10.4
16.0	12.2	10.7
16.5	12.6	11.0
17.0	12.9	11.3
17.5	13.3	11.7
18.0	13.6	12.0
18.5	13.9	12.3
19.0	14.2	12.6
19.5	14.5	12.9
20.0	14.8	13.2
20.5	15.2	13.6
21.0	15.5	13.9
21.5	15.8	14.2
22.0	16.2	14.6
22.5	16.5	14.9
23.0	16.8	15.2
23.5	17.1	15.5
24.0	17.4	15.8
24.5	17.7	16.1
25.0	18.1	16.5
25.5	18.4	16.8
26.0	18.7	17.1
26.5	19.1	17.4
27.0	19.4	17.7
27.5	19.7	18.1
28.0	20.0	18.4

FlamePRO CORRECTION FACTORS										
FOR TEMPERATURE OF WOOD										
	Moisture content reading of wood									
Temp 'F	10	11	12	13	14	15	16	17	18	19
0°	+5	+5	+6	+6	+7	+7	+8	+9	+10	+11
20°	+4	+4	+4	+5	+5	+5	+6	+6	+7	+8
40°	+2	+2	+2	+3	+3	+3	+3	+4	+4	+4
60°	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
80°	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
100°	-2	-2	-2	-3	-3	-3	-3	-3	-3	-3
120°	-3	-3	-3	-4	-4	-4	-4	-5	-5	-5
140°	-3	-3	-4	-4	-5	-5	-5	-6	-6	-6
160°	-4	-4	-5	-5	-6	-6	-7	-7	-8	-8

Appendix E

QC AGENCY MONTHLY INSPECTION CHECKLIST

During the unannounced plant inspection each month, the inspector shall perform the following:

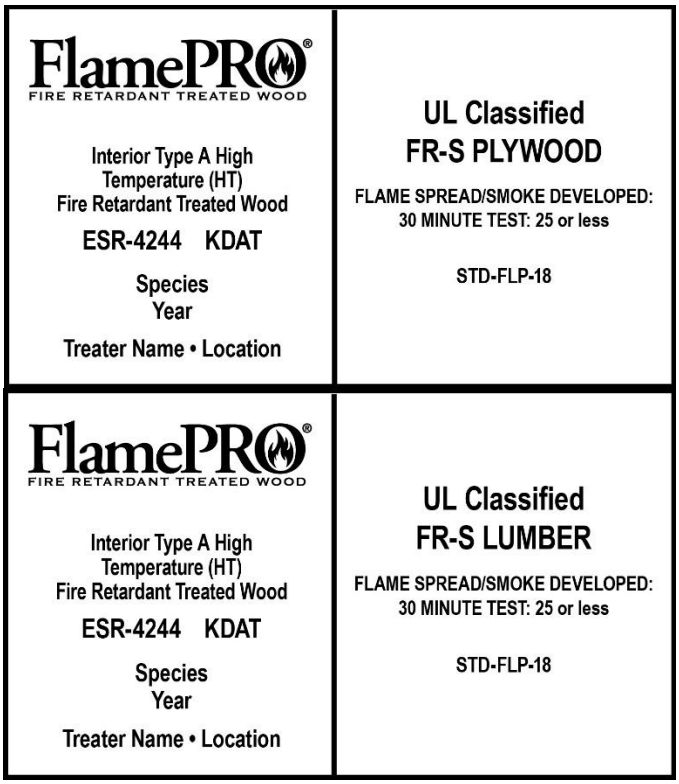
- ☐ **Review the central QC files to ensure that required records are being maintained.**
- ☐ **Check moisture content of material that has been kiln dried.**
- ☐ **Check the solution concentration(s) by PCS/hydrometer.**
- ☐ **Audit treating reports for gauge retention and penetration.**
- ☐ **Audit treating reports to ensure that maximum vacuum, pressure and time limits were not exceeded.**
- ☐ **Audit kiln reports and recorder charts.**
- ☐ **Collect a representative solution sample from each work tank for laboratory analysis to confirm proper chemical composition and concentration.**
- ☐ **Examine production records to ensure proper accounting of production.**
- ☐ **Examine production to ensure that treated materials are properly marked.**
- ☐ **Audit impoundment reports.**
- ☐ **Notify the Plant Quality Control Supervisor, the Plant Manager and Koppers P.C. of any non-conformances.**

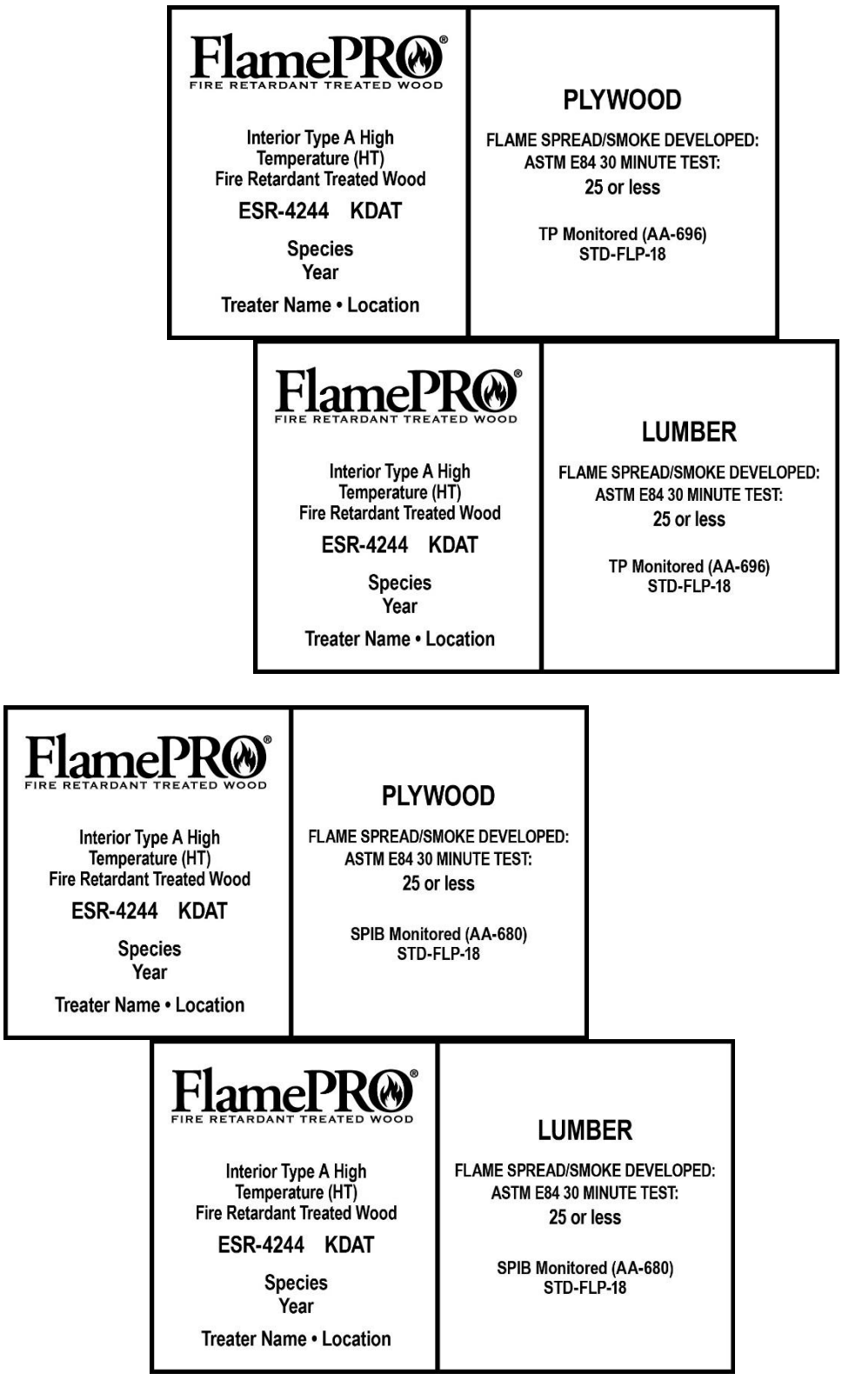
Appendix F

TYPICAL QUALITY MARKS

Typical FlamePRO® Fire Retardant Treated Lumber and Plywood Stamp Designs are shown below. Refer to Section 6.0 for additional information regarding product identification.

FlamePRO® Sample Labels




FlamePRO
FIRE RETARDANT TREATED WOOD
Interior Type A High Temperature (HT) Fire Retardant Treated Wood
ESR-4244 KDAT
Species
Year
Treater Name • Location
PLYWOOD
FLAME SPREAD/SMOKE DEVELOPED:
ASTM E84 30 MINUTE TEST:
25 or less
TP Monitored (AA-696)
STD-FLP-18
FlamePRO
FIRE RETARDANT TREATED WOOD
Interior Type A High Temperature (HT) Fire Retardant Treated Wood
ESR-4244 KDAT
Species
Year
Treater Name • Location
LUMBER
FLAME SPREAD/SMOKE DEVELOPED:
ASTM E84 30 MINUTE TEST:
25 or less
TP Monitored (AA-696)
STD-FLP-18
FlamePRO
FIRE RETARDANT TREATED WOOD
Interior Type A High Temperature (HT) Fire Retardant Treated Wood
ESR-4244 KDAT
Species
Year
Treater Name • Location
PLYWOOD
FLAME SPREAD/SMOKE DEVELOPED:
ASTM E84 30 MINUTE TEST:
25 or less
SPIB Monitored (AA-680)
STD-FLP-18
FlamePRO
FIRE RETARDANT TREATED WOOD
Interior Type A High Temperature (HT) Fire Retardant Treated Wood
ESR-4244 KDAT
Species
Year
Treater Name • Location
LUMBER
FLAME SPREAD/SMOKE DEVELOPED:
ASTM E84 30 MINUTE TEST:
25 or less
SPIB Monitored (AA-680)
STD-FLP-18