APPENDIX B: GUIDELINES FOR EVALUATING NEW FIRE RETARDANTS FOR CONSIDERATION BY THE AWPA

Maintained by Subcommittee P-1

This Appendix to AWPA's Technical Committee Regulations is not an AWPA Standard. It is a non-mandatory guidelines document presented to enable the user to understand the basic testing requirements for wood protection systems and to assist the AWPA Technical Committees in the development of AWPA Standards. The testing of products in accordance with this Appendix does not constitute conformance with any AWPA Standard. No product can be considered to conform with an AWPA Standard until it has been subjected to complete technical review and voting by AWPA's Technical Committees, and procedural review and final action by the AWPA Executive Committee pursuant to the AWPA Technical Committee Regulations.

INTRODUCTION

This document is to serves as a guideline to sponsors for the data requirements needed for evaluation of new fire retardants submitted to the AWPA Technical Committees for standardization. For more specific guidance, the sponsors are encouraged to interact with the appropriate Technical Committees early in the fire retardant evaluation process.

Standard test methods may not be available for evaluating all of the criteria outlined in this document. Whenever this is the case, nonstandard methods are suggested and can be used to provide the necessary data. Use of methods other than those suggested is also acceptable provided they are based on sound experimental principles. A decision on the acceptability of data generated by new or modified test methods will be made by the particular Committee that has jurisdiction over the Standard in question. It is recommended that test reports be prepared or witnessed by independent, third-party agencies.

Development of a fire retardant Standard involves a variety of different factors and data is needed on each in order to make an evaluation. Also, various species respond differently to fire retardant chemicals so it is suggested that a range of species be considered for the testing. An outline of the important criteria is provided below which also details specific requirements for different fire retardant systems.

Recommended minimum criteria for the various performance factors are listed at the end of each section. In general, fire retardant formulations under consideration should adequately protect wood from fire and not impart significant harmful side effects.

1.0 Chemical and Physical Properties

1.1 Pertinent information on the chemical and physical properties of the fire retardant system should be provided. Particular emphasis should be placed on chemical and thermal stabilities since these factors may have an effect on long term performance. Data should also be presented on any interactions or sludging that occurs when the fire retardant formulation is mixed with common preservative systems. Chemical properties might include: vapor pressure, boiling point, density and viscosity.

1.2 Recommended Minimum Performance Criteria: Chemical and physical properties should be such that a treating plant can treat wood with commonly used processing techniques. As well, there should not be substantial unusual hazards associated with the chemicals such as high flammability, etc. The treater should be adequately forewarned if there are known hazards or unusual treating or storage procedures are needed.

2.0 Environmental

2.1 A Material Safety Data Sheet should be submitted along with any pertinent environmental information.

2.2 Recommended Minimum Performance Criteria: Substantial environmental hazards should be detailed.

3.0 Analytical Methods

3.1 Summarize analytical methods that can be used to determine concentrations in solutions and the retentions in treated wood as well as a visual method for determining fire retardant penetration. Standard AWPA methods are preferred and should be used when possible. Alternatively, drafts of the proposed methods should be submitted to the P-5 Subcommittee for consideration. One method should be proposed that can be used on a routine basis for quality control and for settling disputes over treatment quality.

3.2 Recommended Minimum Performance Criteria: Analytical methods should be complete enough that an average laboratory can routinely and accurately assay both wood and solutions.

4.0 Efficacy

4.1 Flame spread. A test report for lumber and plywood tested in accordance with ASTM E84, Surface Burning Characteristics of Building Materials, should be submitted and the retention levels used for the fire retardant should be at minimum levels. The test should be extended to 30 minutes duration. The report should also provide information regarding retentions, penetrations and treating/drying details.

4.1.1 Recommended Minimum Performance criteria: The efficacy of the formulation shall be documented with fire test reports. As a minimum, one would expect that tests in accordance with ASTM E84 would have flame spread ratings of less than 100. Preferably the flame spread will be 25 or less when subjected to ASTM E84 tests of 30-minute duration without evidence of significant progressive combustion for species in normal commerce. Any exterior formulations should have no increase in the flame spread classification

when subjected to accelerated weathering per ASTM D298, Method A.

4.2 Rate of Heat Release. A test report measuring the rate of heat release for lumber and plywood should be submitted using a standard methodology such as ASTM E1354, Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter. A typical heat flux for E1354 is 50 KW/m2 which represents flashover conditions but lower heat fluxes can also be used. The retention of fire retardant should be near minimum levels. Details of material preparation should be included.

4.2.1 Recommended Minimum Performance Criteria: ASTM E1354 or other calorimeter testing is useful to document performance compared to untreated wood of the same species. One would expect significant differences between the treated and untreated wood.

4.3 Bioefficacy. A test report in accordance with ASTM D1413, Method of Testing Wood Preservatives by Laboratory Soil-Block Cultures, should be submitted if the fire retardant will also claim efficacy against decay fungi. Other bioefficacy tests can be used to augment the information, depending on the intended use category for which the system is designed.

4.3.1 If appropriate, soil block (ASTM D1413) or other bioefficacy testing can be done and the candidate formulation should meet the criteria normally associated with preservative formulations and show that the formulation protects the wood from attack. (For further information on standardization of wood preservatives, see the AWPA "Guidelines for Evaluating New Wood Preservatives for Consideration by the AWPA," which appear as Appendix A to these Technical Committee Regulations.)

5.0 Fire Retardant Permanence

5.1 A test report for lumber and plywood tested in accordance with ASTM D2898, Accelerated Weathering of Fire Retardant Wood and Wood Based Products, should be submitted for exterior type formulations.

5.2 Recommended Minimum Performance Criteria: The permanence of an exterior formulation is determined by flame spread testing after accelerated weathering and comparing those results to the unweathered tests. In general, no increase in fire hazard classification is allowed following weathering.

6.0 Effects on Wood Properties

Any substantial effects on wood properties of the candidate formulation shall be documented.

6.1 Hygroscopicity. ASTM D3201, Hygroscopic Properties of Fire Retardant Wood and Wood Based Products, should be used for lumber and for plywood. The test should be extended to 10 days to allow the blocks to fully equilibrate and the fire retardant retention should be near maximum levels.

6.1.1 Recommended Minimum Performance Criteria: The equilibrium moisture content shall be determined for classification as Type A as defined in AWPA Standard U1, Commodity Specification H.

6.2 Corrosivity (AWPA Standard E12). Test reports on corrosion potential of fire retardant lumber and plywood should be based on the AWPA Standard E12 test. Other tests can be used to augment the basic information and the retention of fire retardant should be near maximum levels.

6.2.1 Recommended Minimum Performance Criteria: Corrosion rates for commonly used metals should be comparable to those of untreated wood when both are tested by AWPA Standard E12. Alternatively, higher corrosion rates can be accommodated by recommending corrosion resistant metals.

6.3 Strength. Strength tests should be submitted that document near maximum retention levels of fire retardant on:

a. initial treatment effects

b. long-term effects at ambient and elevated temperatures

6.3.1 Initial Treatment Effects. The initial treatment effects on lumber and plywood strength, as appropriate, should be documented with tests in accordance with:

a. ASTM D4761, Method of Testing Lumber.

b. ASTM D143, Method of Testing Small Clear Specimens of Timber.

c. ASTM D3043, Method of Testing Plywood in Flexure.

d. ASTM D3501, Method of Testing Plywood in Compression.

e. ASTM D2718, Method of Testing Plywood in Rolling Shear (Shear in Plane of Plies).

6.3.2. Elevated Temperature Effects. If structural uses will expose the fire retardant lumber or plywood to elevated temperatures, the effects of elevated temperature (> 65°C / 150° F) and relative humidity on lumber and plywood strength should be documented with test reports in accordance with:

a. ASTM 5516, Standard Test Method for Evaluating the Flexural Properties of Fire-Retardant Treated Softwood Plywood Exposed to Elevated Temperatures
b. ASTM 5664, Standard Test Method for Evaluating the Effects of Fire-Retardant Treatments and Elevated Temperatures on Strength Properties of Fire-Retardant Treated Lumber

It is recommended that ASTM Draft Standard D 6305, Standard Practice for Calculating Bending Strength Adjustment Factors for FRT Plywood Roof Sheathing, be consulted to allow structural calculations evaluating elevated temperature test data to produce plywood roof span tables. Similarly, structural calculations evaluating elevated temperature test data to produce lumber modification factors can be submitted. Such reports should also provide structural calculations evaluating the initial effects of the fire retardant treatment on plywood and lumber mechanical properties at room temperature.

Strength: The effects of fire retardant treatments on mechanical properties vary for any fire retardant formulation. No universal criteria for acceptability exists, but it shall be recognized that the magnitude and variability of any strength effect is a complex function of the formulation and treating parameters used. Therefore, strength effects shall be

documented at near maximum treating parameters. Enough information shall be supplied from which to establish the estimated effect of the proposed fire retardant treatment and the variability of that estimate. If exposure to elevated in-service temperatures is expected, then additional information is required to document the expected rate of strength degradation over time under elevated temperature exposure. Several ASTM test methods are listed to define these estimates and it is strongly recommended that design value reductions be calculated or reviewed by a knowledgeable professional.

The following ratios of treated-to-untreated properties are the minimums recommended at this time and are in line with those of commercially available FR formulations. Deviations from these could be acceptable if substantial evidence is presented to justify such a change.

Minimum recommended ratios of treated-to-untreated strength properties of FR Plywood as determined using ASTM Standard D-5516:

Mechanical Property	Initial Effect (t/u) per ASTM D5516, Sec. 8.1.5	Total Reduction per ASTM D5516, Section X1.2.3
Flexural Stiffness E1	0.85	0.75
Maximum Moment MM	0.80	0.69

Ratios of treated-to-untreated of FR Lumber tested by ASTM D-5664

Mechanical Property	Initial Effect (t/u) per ASTM D5664, Sec. 7.1.2.2	Total Reduction per ASTM D5664, Section 7.1.3.3[1]
Modulus of Elasticity MOE	0.85	0.75
Bending Strength MOR	0.80	0.65
Tension Parallel to Grain T-par	0.75	0.60
Horizontal Shear Hv	0.80	–

[1] Values not shown are not evaluated in ASTM D5664.

7.0 Treatment

7.1 Appropriate treating reports and data shall be supplied to justify listing the species desired.

7.2 Recommended Minimum Performance Criteria: Treatment reports and data should document general procedures to the degree necessary to provide adequate knowledge of the process so that a treater could use the process without substantial detrimental effects to the treater, plant or wood. A minimum of 10 charges per species or species group is recommended. The results should include wood species, dimensions, pretreatment MC and treatment conditions (pressure/vacuum levels and times).

8.0 Proposed Fire Retardant Documentation

8.1 Proposed fire retardant formulation documentation should be prepared and submitted with the supporting data. This should include:

- Chemical Composition of the Fire Retardant
- Physical and Chemical Properties
- Special Handling and Storage Requirements
- Reference to Analytical Methods
- Method for Measuring Fire Retardant Penetration
- Recommended Quality Control/Inspection Procedures

Modifications of existing Standards should be suggested as well.

8.2 Recommended Minimum Performance Criteria: The proposed fire retardant documentation shall be complete enough to identify the formulation with a reasonable degree of certainty that will assure there can be no substitution and that will allow routine quality control testing to be performed. Changes in chemical composition of the formulation can impair the performance of the system and the sources of certain elements such as nitrogen and/or phosphorus are critical and should be included.

9.0 Proposed Fire-Retardant Standard

The proposal for an FR formulation should include a draft Standard that lists minimums and maximums for each component as well as minimum retention/penetration recommendations for each species or species group for which the proponent intends standardization.