Protocols for assessment of wood preservatives

A production of the
Australasian Wood Preservation Committee

September 2015 Revision

Foreword

The *Protocols for Assessment of Wood Preservatives* was first issued by the Australasian Wood Preservation Committee (AWPC) in September 1997. The edition incorporated recognised methods for testing procedures as a basis for approval of new preservative formulations. These methods were compiled by the AWPC from the laboratory and field test procedures for all hazard class exposures (H1-H6), as used by the major government-sponsored research providers in Australasia at that time. Today, the Australian-based providers have been restructured into private fee-for-service businesses. In New Zealand, Scion remains government supported as a Crown Research Institute.

Notwithstanding the changed scenario, the AWPC continues to maintain and facilitate the Protocols.

In 2007 the Protocols were amended to include test procedures to evaluate preservative systems for New Zealand Hazard Class H1.2 and Australian Hazard Class H2F. It also included details of Accelerated Field Simulator (AFS) testing, and an alternative test procedure for Hazard Class H2.

Recent research results and the revision of standards both in Australia and New Zealand has led to the necessity of revising the 2007 Protocols. This new edition incorporates new methods and makes amendments to or clarifies some of the existing methods. The Lunch Box technique for termite field testing has been removed without prejudice.

The AWPC believes that the various test procedures included in this edition reflect current best practice for assessing candidate wood preservatives, providing a greater choice of assessment procedures than the two earlier editions.

The research on new methods supporting this edition was led by the late Dr Mick Hedley, so long an icon of the Australasian preservation research community, and Dr Laurie Cookson, formerly Wood Protection programme leader at the erstwhile CSIRO Materials Science & Engineering. Their work, ably supported by Scion scientists, compared various above-ground (H3) accelerated test methods to determine their respective suitabilities to give fast, reliable comparative results for biological durability.

The AWPC would like to acknowledge all of the constructive comments received from around the world during the various public review drafts.

Dr Harry Greaves
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September 2015

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Scope

These *Protocols* have been prepared for the benefit of suppliers of wood preservative formulations. The purpose of the *Protocols* is to provide procedures for determining the biocidal efficacy of wood preservatives intended for use in Australia and New Zealand. They have been prepared by the Australasian Wood Preservation Committee (AWPC) with input from experts in the wood preservation industry and testing laboratories.

The AWPC *Protocols* are not meant to stifle innovation by being too prescriptive. However, deviation from the procedures described in these *Protocols* should be endorsed by the various approval bodies and/or assessors before the start of experimentation.

The *Protocols* are the minimum procedures needed to provide biocidal efficacy data for obtaining preservative approval by the appropriate regulatory authorities. The AWPC does not guarantee that a candidate preservative which is assessed using these *Protocols* will be approved for commercial use by the regulatory authorities.

The AWPC recommends that prospective suppliers of wood preservative formulations should discuss their proposed needs with any of the AWPC members listed on the previous page, so that the most relevant tests may be established.

The *Protocols* are provided on the basis of the disclaimer set out in the footnote.

Disclaimer: The *Protocols* are provided on the basis that the AWPC and its members disclaim, to the extent permitted by law, all warranties whether expressed or implied. The *Protocols* are of an advisory nature only, are provided in good faith, and are not claimed to be an exhaustive treatment of the subject. Further professional advice may be required before taking any action based on the *Protocols* and the AWPC recommends that such advice be obtained. Neither the AWPC nor its members shall be liable, whether under contract, tort, equity, breach of statutory duty or otherwise for any direct, indirect, incidental, consequential loss of business profits or special damage arising out of any use of or reliance on the *Protocols*.

Preface

- These *Protocols* generally assume that test specimens are fully and continuously penetrated. If this is not the case, e.g. unpenetrated heartwood-containing specimens, separate testing is required.
- The Hazard Classes referred to in these *Protocols* are those set down in AS 1604.1 "Specification for preservative treatment, Part 1: Sawn and round timber" and NZS 3640 "Chemical preservation of sawn and round wood" (see Table 1, which is based on the Hazard Class Selection Guide of AS 1604).
- The *Protocols* cover a combination of laboratory, AFS (accelerated field simulator) and/or field testing as summarised in Table 2. In most cases laboratory and AFS data shall not form a minimum requirement on their own, but are included in assessment procedures as they can support field data, particularly where field site variability is extensive. The laboratory data for Hazard Class H1 and H1.2 end-use may be used as sole performance criteria.

HAZARD CLASS	EXPOSURE	SPECIFIC SERVICE CONDITIONS	BIOLOGICAL HAZARD	TYPICAL USES
H1	Inside, above ground	Completely protected from the weather and well ventilated and protected from termites	Insects other than termites (lyctines in Australia, and lyctines and anobiids in New Zealand)	Framing, flooring, furniture, interior joinery
H1.2 New Zealand only	Inside, above ground	Inadequately protected from the weather, and risk of moisture entrapment/non-drying	Decay	House framing
H2 and H2F Australia only	Inside, above ground	Protected from wetting. Nil leaching	Borers and termites	Framing, flooring, etc. used in dry situations
H3 Australia **H3.1 and H3.2** New Zealand	Outside, above ground	Subject to periodic wetting and leaching	Moderate decay, borers and termites	Weatherboard, fascia, window joinery and decking
H4	Outside, in ground	Subject to severe wetting and leaching	Severe decay, borers and termites	Fence posts, greenhouses, pergolas and landscaping timbers
H5	Outside, in ground contact, with or in fresh water	Subject to extreme wetting and leaching and/or where the critical use requires a higher degree of protection	Very severe decay, borers and termites	Retaining walls, piling, house stumps, building poles, cooling tower fill
H6	Marine waters exposure	Subject to prolonged immersion in sea water	Marine wood borers and decay	Marine piles, jetty cross-bracing, landing steps, etc.

Table 1. *Hazard class selection guide.*

- Field tests shall be conducted on the preservative formulation that is intended for registration and commercial use. If the preservative formulation, upon which the original approval is obtained, is to undergo substantial change, then some level of new efficacy testing is required. Substantial changes would include changing the solvent system (e.g. from oil to water-borne), significant alteration to the proportion of water repellents or other additives, or new combinations of actives. Long term field testing of the previously approved actives is not required if laboratory testing (H1 to H3, and H6) shows that there has been no reduction in efficacy relative to the original formulation. Modification to existing H4 and H5 actives would also require a fungal AFS trial.
- Field data should include at least one test site from Australia or New Zealand, while additional field data may be generated at overseas sites if the biodeteriogens and timber species are appropriate to the countries of end use. If in doubt, advice from a member of the AWPC should be sought.

- The function of untreated control specimens, particularly in field tests, is to monitor the level of the hazard to ensure that the test is relevant to a preservative's performance. Should untreated controls fail to be attacked, another test site should be selected. Biometric expertise in experimental design and layout is considered advantageous.
- Reference preservatives must be selected from those currently approved in the relevant Australia and New Zealand standards and included in any test procedure at threshold and sub-threshold levels. Usually, CCA is the recommended reference preservative for H3 to H6.
- The determination of chemical distribution, spot test development, preservative behaviour in the wood, safety, environmental, and engineering aspects are not covered by these *Protocols*.
- The majority of the test procedures described should be conducted by independent laboratories. If test timbers are treated by the preservative company, then the treatment work shall be witnessed by an independent party, and/or a representative sample of test specimens shall be chemically analysed by an independent laboratory.
- Termite laboratory tests are useful but not essential, as the same termite species are tested during H2 and H3 field tests.
- Engineered wood products may be tested using similar *Protocols* to those described here for solid wood. Accepted differences and points to note in test methods are:

1. Test specimen size shall accommodate composite profiles or board thicknesses.
2. Glueline additives shall be tested in the same glue type as will be used commercially. Results in UF resin do not apply in PF resin.
3. Field test specimens from engineered wood products should comprise all components of the product. For example, I-beams should be tested intact rather than with web and flanges separated.

HAZARD CLASS	INSECT	DECAY	MARINE BORERS
H1 Laboratory	★	★ (H1.2 only)	
Field			
H2 Laboratory	★ (Optional)		
Field	★		
H3 Laboratory	★ (Optional)	★	
Field	★	★	
H4 Laboratory	★ (Optional)	★	
AFS		★ (Optional)	
Field	★	★	
H5 Laboratory	★ (Optional)	★	
AFS		★ (Optional)	
Field	★	★	
H6 Laboratory			★ (Optional)
Field			★

Table 2. *Assessment procedures for each hazard class included in these* Protocols.

Laboratory. Lyctine Borers

Hazard Class H1

Timber species. Timber species shall be known lyctine-susceptible species which have sufficient starch concentration to ensure attack of untreated controls. The timber species shall be appropriate to the country or region of proposed end-use.

Test Specimens. Test specimens shall be sapwood with a minimum dimension of 18 (radial) x 25 (tangential) x 75 (longitudinal) mm, and have a moisture content of between 10-15%. Specimens shall be cut to size prior to treatment using a sharp blade that does not cause burrs that can occlude vessels. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a basis on which to assess the candidate.

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks.

Retention levels shall be segregated during these procedures.

Pre-test conditioning of specimens. After air-drying, test specimens shall be vacuum oven-dried at 40°C and -95 kPa for five days. Test specimens shall then be brought to equilibrium moisture content in a conditioned insectary (26°C, 70% relative humidity (RH)) prior to inoculation with test insects.

Bioassay. Each test specimen shall be exposed to not less than 20 unsexed *Lyctus brunneus* adults for a period of not less than three months.

Performance criteria. The test specimens shall be split longitudinally and visually examined for evidence of larval channelling. Toxic values for the preservative under test are between the highest retention which allows larval channelling and the lowest retention which prevents larval channelling. Results shall be valid if a minimum of 80% of untreated and, where applicable, solvent controls show evidence of larval channelling.

Approval criterion. The recommended minimum retention for H1 shall be 1.5x the higher toxic value.

Laboratory. Anobiid Borers

Hazard Class H1

Anobium punctatum egg-laying test

Timber species. The timber species shall be a known anobiid-susceptible species appropriate to the country or region of proposed end-use.

Test Specimens. Test specimens shall be sapwood cut from the outer growth rings of freshly-felled trees. Test specimens shall have a minimum dimension of 20 (radial) x 30 (tangential) x 50 (longitudinal) mm. Annual rings shall be parallel to the tangential faces. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a broad guide on which to assess the candidate. Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks. Retention levels shall be segregated during these procedures.

Pre-test conditioning of specimens. After air-drying, test specimens shall be vacuum oven-dried at 40°C and -95 kPa for five days. Test specimens shall then be brought to equilibrium moisture content in a conditioned insectary (26°C, 70% RH) prior to inoculation with test insects.

Exposure to oviposition. The two 50 x 30 mm tangential surfaces of each specimen shall be lightly punched with a sharp point to provide suitable oviposition sites. The depth and number of indentations is not critical, but fifty, 1-2 mm deep on each surface is recommended. Specimens shall then be randomly enclosed in glass containers, one formulation per container. A minimum of 50 adult *Anobium punctatum* (50:50 male to female mix) shall be placed in each container. Each specimen shall be examined each day for presence of oviposited eggs. Individual specimens shall be removed when they have accumulated a minimum of 25 eggs. Fresh adults shall be supplied to containers if needed.

Storage of test assemblies for egg-hatching. Specimens shall be stored in open-topped containers at ambient temperature. Containers shall be stood in trays of paraffin oil as a means of avoiding mite infestation. After six months storage, specimens shall be examined by X-ray, or, less desirably, by dissection, to determine whether eggs have hatched and whether larval development has occurred. Any specimen in which there is no evidence of egg hatching shall be rejected from the test at this stage.

Specimens shall then be returned to storage for a further six months, after which further examination by X-ray or dissection shall occur.

Performance criterion. Toxic values for the preservative under test are between the highest retention which allows egg-hatching and larval development and the lowest retention which allows egg-hatching, but prevents larval development in all test specimens. Results shall be valid if a minimum of 80% of untreated controls and, where applicable, solvent controls show evidence of egg-hatching and larval development.

Approval criteria. The recommended minimum retention for H1 shall be 1.5x the higher toxic value.

Hazard Class H1 *continued*

Anobium punctatum larval transfer test

Timber species. The timber species shall be a known anobiid-susceptible species appropriate to the country or region of proposed end-use.

Test specimens. Test specimens shall be outer sapwood cut from the outer growth rings of freshly-felled trees. Test specimens shall have a minimum dimension of 20 (radial) x 30 (tangential) x 50 (longitudinal) mm. Annual rings shall be parallel to the tangential faces. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a broad guide on which to assess the candidate.

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks. Retentions shall be segregated during these procedures.

Pre-test conditioning of specimens. After air-drying, test specimens shall be vacuum oven-dried at 40°C and -95 kPa for five days. Test specimens shall then be brought to equilibrium moisture content in a conditioned insectary (26°C, 70% RH) prior to inoculation with test insects.

Larval transfer. Following treatment and when dry, ten tapered holes 3-4 mm deep and with 3 mm maximum diameter shall be drilled into one face of each test specimen. A weighed *Anobium* larva of between 3 and 6 mg shall be placed head down into each hole. Larvae shall be examined microscopically before transfer to ensure they are undamaged and free of *Pyemotes* mites.

Storage of test assemblies for larval development. Assemblies shall be placed in a container with a sheet of glass placed over the specimens and larvae contained therein. The container shall be placed in a tray of paraffin oil to prevent infestation with mites.

Each specimen shall be examined daily for the first week and larval activity recorded (i.e. larval activity penetrating the specimen, chew- ings and/or frass being produced). These observations shall provide insight into the type of preservative toxicity involved (i.e. acutely or chronically poisonous). Further inspections shall be made weekly. At the end of three months specimens shall be examined by X-ray, or less desirably, by dissection, to assess larval activity. Specimens shall then be returned to containers for a further three months after which further examination by dissection shall occur. Larvae shall be further checked visually and weighed.

Performance criteria. Toxic values for the preservative under test are between the highest retention which allows larval development as evidenced by larval weight gain and the lowest retention which prevents larval development, as evidenced by mortality or lack of active feeding or weight gain, in all test specimens. Results shall be valid if a minimum of 80% of untreated and, where applicable, solvent controls show evidence of larval development.

Approval criterion. The recommended minimum retention for H1 shall be 1.5x the higher toxic value.

Laboratory. Decay

Hazard Class H1.2

H1.2 is an indoor decay hazard applicable to New Zealand. The development of *Protocols* to assess preservative systems for temporary (up to 5 years) protection of framing timbers is an on-going activity. Two such procedures are described below. However, Scion, Wood Protection, Rotorua staff should be consulted when deciding appropriate procedures for particular products.

Timber species. The timber species shall be representative of the proposed end-use; it may be necessary to utilise both softwood and hardwood substrates.

Wall frame cavity test

Test specimens. Test specimens shall be standard framing timber (90 to 95 x 45 mm). For each test unit (with all timbers in the one unit of the same treatment), two studs shall be 500 mm long, top and bottom plates 500 mm long, and the central dwang or noggin about 450 mm long to fit the test unit (Fig. 1).

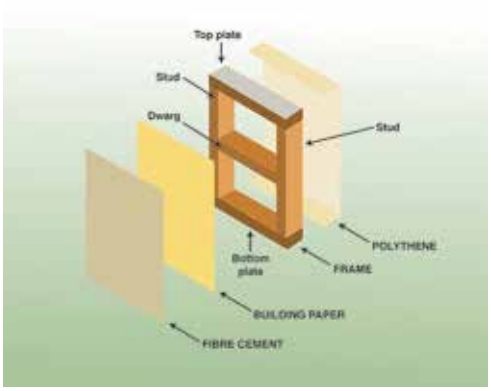


Figure 1. *Components of the wall frame cavity test.*

Components are cut after the treatment of end sealed specimens at least 1000 mm long and with moisture content of between 10-15%. Sufficient specimens of each retention of reference and candidate preservative shall be treated to permit selection of a minimum of six exposure test units per treatment. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will give an indication of the decay hazard for the test and serve as a basis on which to assess the candidate.

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Pre-test conditioning of specimens. After assembly of the timber components, frames from each treatment group shall be stacked in a large tank, weighted and the tank filled with water. They are soaked for two hours, drained and placed in a large covered stack. This period of soaking results in an average sample moisture content of around 40%, but most of the moisture is in the outer 5 - 10 mm of the sample. Framing units shall be weighed before and after wetting to allow calculation of moisture content. The water repellent properties of LOSP treatments may necessitate one or more further wetting cycles before the wood reaches at least 30% moisture content.

Where a diffusible or leachable preservative is used, an alternative method may be

Hazard Class H1.2 *continued*

required. An additional test specimen will be used to check the preservative retention after wetting. Test specimens of engineered wood products such as LVL and plywood may require a longer wetting procedure to achieve 30% moisture content.

Exposure. A sheet of 250 micron thick black polythene 900 x 500 mm shall be placed on the back of the frame. The ends shall be wrapped over the top and bottom plates and held in place with stainless steel staples in the front edge of the plates. The edges of the polythene sheet are fixed to the back of the studs with 35 x 10 mm CCA treated battens and 30 mm galvanised flathead nails.

Test specimens shall be exposed to at least two different species of brown-rot fungi for softwood framing, or one brown-rot and one white-rot fungus for hardwood framing. The brown-rots shall be typical of those found in decaying framing. In New Zealand these include *Oligoporus placenta, Antrodia sinuosa, Paxillus panuoides* and *Serpula lacrymans*. The white-rots shall be *Perenniporia tephropora* or *Trametes versicolor.* Feeder strips about 7 x 35 x 35 mm of a susceptible timber shall be first inoculated by placing them on plastic mesh placed over actively growing cultures of each fungus maintained on 2% malt agar for four weeks until feeder strips are overgrown with fungus.

The upper horizontal surfaces of timber pieces near the corners shall be surface sterilised by swabbing with 100% ethanol, and then allowed to dry for ten minutes. Decaying feeder strips shall be tacked with galvanised nails into the swabbed corners. The two test fungi may be placed in the same test unit, with one fungus placed in the right hand corners, and the other in the left hand corners.

Fibreglass insulating batts (R1.8, 75 mm thick) cut to wall cavity size shall be thoroughly wet by immersing them three times in water, allowed to drain for 30 seconds, and placed in the wall unit cavity. Sheets 600 x 500 mm of standard black bituminous building paper and 6 mm thick fibre-cement sheets shall be placed on the front of the unit and fixed to the studs with two 20 mm long stainless steel screws on each side.

Units shall be stored in a controlled environment room maintained at 27°C and 85-90% RH. All units shall be periodically sprayed with water to maintain the wood moisture content at a level suitable for decay to progress. Incubation shall be for a minimum of 12 weeks.

Performance criteria. Each timber specimen shall be inspected for extent of decay, and rated using any internationally recognised system. The spread of fungal growth shall also be determined.

Approval criterion. The candidate preservative may be approved when it has a mean rating equal to or above the H1.2 reference preservative after a minimum of 12 months testing.

"I" Frame sample test

Test specimens. Test specimens shall be standard framing timber (90 to 95 x 45 mm) at least 600 mm long, end-sealed before preservative treatment. After preservative treatment an 80-100 mm long block is cut from each end of the specimen. These blocks are then attached to the end of the sample that they were removed from, at right angles to the main sample (Figure 2), using 12 mm long, stainless-steel staples.

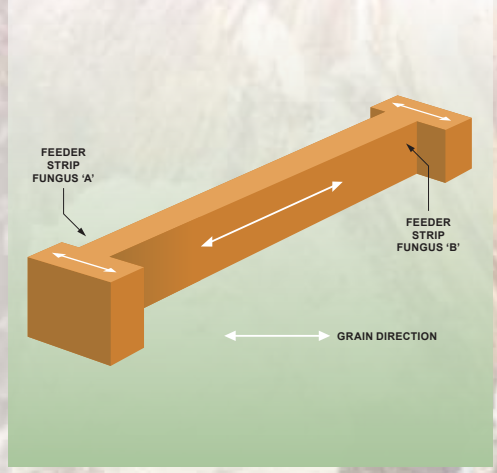


Figure 2. Assembly of test samples

Components are cut after the treatment of end-sealed specimens and with a moisture content of between 10-15%. Sufficient specimens of each retention of reference and

Laboratory. Decay

Hazard Class H1.2 *continued*

candidate preservative shall be treated to permit selection of a minimum of ten exposure test specimens per treatment. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The preservative treatment process used shall be similar to the Wall Frame Cavity Test as described above.

Pre-test conditioning of specimens. After assembly, the test samples shall be conditioned as described in the Wall Frame Cavity Test method above.

Exposure. Test specimens shall be exposed to at least two different species of brown-rot fungi for softwood framing, or one brown-rot and one white-rot fungus for hardwood framing. The brown-rots shall be typical of those found in decaying framing. In New Zealand these include *Oligoporus placenta, Antrodia sinuosa, Paxillus panuoides* and *Serpula lacrymans*. The white-rots shall be *Perenniporia tephropora* or *Trametes versicolor*. Feeder strips about 7 x 35 x 35 mm of a susceptible timber shall be first inoculated by placing them on plastic mesh placed over actively growing cultures of each fungus maintained on 2% malt agar for four weeks until feeder strips are overgrown with fungus.

The 90 mm wide surface of the main sample piece, adjacent to the end block, shall be surface sterilised by swabbing with 100% ethanol, and then allowed to dry for ten minutes. Decaying feeder strips shall be tacked with galvanised nails into the swabbed corners. The two test fungi may be placed on the same sample, with one fungus placed at one end on one face of the sample and the other placed at the other end on the opposite face (Figure 2).

Samples should be placed on edge in a stack with 15-20 mm thick untreated wood or plastic fillets between each layer. The stack may be in a lidded plastic tank or totally enclosed in polyethylene film. This should be stored in a controlled environment room maintained at 27°C and 85-90% RH. All samples shall be periodically sprayed with water to maintain the wood moisture content at a level suitable for decay to progress. Incubation shall be for a minimum of 12 weeks.

Performance and approval criteria. The performance and approval criteria shall be similar to those described in the Wall Frame Cavity Test method above.

Hazard Class H2, H3, H4 and H5

Timber species. The timber species shall be softwood or hardwood and representative of the country or region of proposed end-use.

Test specimens. Test specimens shall be sapwood with a minimum dimension of 15 (radial) x 25 (tangential) x 50 (longitudinal) mm (18.75 cm^3). For bioassays in 1 L jars, the maximum test specimen volume is 56.25 cm^3, and a similar ratio will apply for other jar volumes. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention for each termite species or vacuum oven control. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a broad guide on which to assess the candidate.

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks. Retentions shall be segregated during these procedures.

Pre-test conditioning of specimens. All test specimens (including H2) shall undergo the vacuum oven drying procedure. The leaching procedure is only required for termiticides to be used in Hazard Classes H3, H4 and H5.

Test specimens shall be vacuum-impregnated with water for 30 minutes and allowed to remain for a further 30 minutes in a jar containing at least three times the volume of water as of specimens. Water shall be drained from the jars and replaced with an equal amount of clean water. The jars shall be placed in a shaking water bath maintained at 35°C for 5-7 days with the water in the jars changed daily during five of the days. Specimens shall then be placed on drying racks for two days to surface dry.

Specimens shall be dried in vacuum ovens at 40°C and -95 kPa for five days and then weighed to obtain initial masses.

Bioassay. Test specimens shall be exposed to at least one species of subterranean termite. If only one species is to be used then the preferred species is *Coptotermes acinaciformis*. However, if the preservative is intended for use north of the Tropic of Capricorn then *Mastotermes darwiniensis* also shall be used. Termites of a given species should be sourced from a minimum of two, and preferably three, different colonies. However, for preliminary laboratory screening trials, termites sourced from one colony are sufficient. Termites shall be fresh, field collected stocks and shall be used within two weeks of collection.

Laboratory. Termites

Hazard Class H2, H3, H4 and H5 *continued*

Preferred method.

1. ***Coptotermes acinaciformis.*** The bioassay shall occur within a glass jar (ca.1L) filled with a moist matrix of mound material. One test specimen shall be embedded in the matrix, unless the candidate preservative is of a freely diffusible formulation; in this case the specimen shall not be in direct contact with the matrix, but separated from it by an impervious material. A minimum of 10 grams of termites shall be added to each jar and a ventilated lid shall close the jar. The jars shall be maintained in an insectary at 27°C and 75% RH for eight weeks. In order to minimise potential environmental effects in the insectary, all jars shall be rotated 90° on a weekly basis.

2. ***Mastotermes darwiniensis.*** The bioassay shall occur within a glass jar (ca.1L) filled with a mixture of vermiculite and sawdust of a susceptible timber species, e.g. *Eucalyptus regnans*. One test specimen shall be embedded in the matrix, unless the candidate preservative is of a freely diffusible formulation; in this case the specimen shall not be in direct contact with the matrix, but separated from it by an impervious material. Water shall then be added to the matrix to achieve a 275% moisture content. A minimum of 15 grams of termites shall be added to each jar and a ventilated lid shall close the jar. The jars shall be maintained in an insectary at 32°C and 75% RH for six weeks. In order to minimise environmental effects in the insectary, all jars shall be rotated 90° on a weekly basis.

Post-bioassay conditioning. At the conclusion of the bioassay exposure, specimens shall be removed from the jars and cleaned of termite mudding and faecal matter. Specimens as well as vacuum oven controls shall be vacuum oven dried at 40°C and -95 kPa for five days. Specimens shall be weighed and compared with their initial mass to obtain mass loss.

Mass losses of test specimens exposed to termites shall be adjusted to accommodate any changes recorded by the vacuum oven controls. The test will be valid for those termite species that produce a mean mass loss of more than 40% in the untreated control specimens. Attack is controlled when mean mass loss is 5% or less.

Performance criteria. The toxic threshold value for each termite species and preservative under test is the lowest retention which prevented a mean mass loss of more than 5%.

Data generated in these laboratory tests cannot be used solely to establish commercial retention levels, but may be used to support field data. In addition the laboratory data may be used as a basis for establishing retentions for field testing.

Hazard Class H2 and H3

Note: The following test procedures against *Coptotermes acinaciformis* and *Mastotermes darwiniensis* are also suitable for establishing termiticidal efficacy of insecticides which may be included in formulations for treatment to Hazard Classes H4 and H5 (following artificial leaching and drying). It will also be necessary to test the preservative in a direct ground contact field test where termites (variety of species) are active for Hazard Classes H4 and H5. A minimum of one of the two test procedures shall be required.

Drum technique

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. Test specimens shall be a minimum of 25 x 25 x 100 mm sapwood. In the case of H2F treatments, the cross section of test specimens shall be the maximum size to be produced commercially. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention for each termite species or vacuum oven control. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested. H2 and H3 treatments shall achieve full sapwood penetration, while more limited penetration is accepted for H2F envelope treatments (e.g. treated by spray or dip). Test specimens with full sapwood penetration shall be weighed before and after treatment allowing calculation of individual piece retention. For H2F treatments, the retention and penetration of the candidate preservative in the envelope treated zone of spare test specimens shall be confirmed by chemical analysis. A set of H2F test specimens shall be tested with at least one end docked after treatment. If one or more of the docked test specimens are attacked through the exposed end-grain, then a trial is needed to show that termites cannot enter test specimens when an unsealed end abuts another test specimen's treated surface. The join between the two test specimens (such as in a T-piece assembly) should not be perfect, but have a gap of at least 2 mm between test specimens. Also required is a test of exposed docked ends, as would occur in wall frame corners, where the docked ends are resealed by the process that would occur commercially (e.g. a brush or spray treatment).

A minimum of three retentions of each candidate preservative shall be tested. Retentions may be based on the threshold value or on any other values specified by the supplier. Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a basis on which to assess the candidate.

Immediately after treatment, specimens (excluding untreated controls) shall be

Field. Termites

Hazard Class H2 and H3 *continued*

wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Pre-test conditioning of test specimens. Test specimens shall be dried in vacuum ovens at 40°C and -95 kPa for five days to remove any residual solvents and volatiles. Envelope (H2F) treated test specimens shall be exposed to natural weathering outdoors for a minimum of four weeks. Test specimen orientation will not be altered during this time. The uppermost exposed face with most UV and weathering exposure shall remain identifiable during field testing to aid inspection. H2 and H3 treated test specimens do not require UV conditioning.

Test specimens being tested by this procedure for H3, shall be leached prior to vacuum oven drying. Test specimens shall be vacuum-impregnated with water for 30 minutes and allowed to remain for a further 30 minutes in a container with at least three times the volume of water as of specimens. Water shall be drained from the containers and replaced with an equal amount of clean water. The containers shall be placed in a shaking water bath maintained at 35°C for 5-7 days with the water changed daily during five of the days. Specimens shall then be placed on drying racks for two days to surface dry.

Exposure. Test specimens shall be exposed to at least one species of subterranean termite. If only one species is to be used then the preferred species is to be *Coptotermes acinaciformis*. However, if the preservative is intended for use North of the Tropic of Capricorn then *Mastotermes darwiniensis* also shall be used.

The test shall occur within steel exposure containers. The exposure containers should be constructed such that they prevent the ingress of precipitation, but they should also be ventilated to prevent build up of excessive moisture during the course of the field trial. The dimensions of exposure containers may be varied as appropriate for the size of test specimens to be evaluated; containers with volumes of between 20 and 30 L have proven to be appropriate for most field tests.

The bases of exposure containers should be lined with a layer of highly susceptible timber substrate (bait-wood). Test specimens, interspersed with additional bait-wood, should then be placed on the bait-wood base. Additional layers of test specimens and bait-wood may then be added as required. Test specimens shall be randomly arranged and care taken to avoid contact with each other. A further layer of bait-wood shall be placed on top of the bait-wood / test specimen assembly. The volume of bait-wood shall be equal to or greater than the volume of test specimens to be exposed. Moistening the bait-wood with water prior to installation will aid the attraction and retention of termites.

Containers shall be connected to active galleries of the target species of termite. A useful, proven approach when targeting *C. acinaciformis* is to drill into standing trees and connect the exposure containers to the active galleries via a short length of PVC piping; partially filling the connecting pipe with moistened susceptible timber substrate will encourage termites to enter the containers. When targeting *M. darwiniensis*, exposure containers may simply be placed over exposed stumps containing active termite galleries. Insulation of the containers can be beneficial to encourage and maintain termite activity.

Test specimens shall be exposed to a minimum of three separate colonies of the target termite species. This can be facilitated by ensuring that the distance between containers exceeds the likely foraging distance of individual colonies. The test duration shall be a minimum of 16 weeks, although usually 6-12 months or until such time as all susceptible timber materials have been largely consumed (60%+ mass loss) and termites have vacated the exposure containers.

Performance criteria. At the conclusion of the exposure period, test specimens shall be returned to the laboratory and cleaned. Test

Hazard Class H2 and H3 *continued*

specimens shall then be visually rated for any termite attack using a scale which estimates the amount of wood remaining. Mass loss of the specimens shall also be determined. The test will be valid when the mean mass losses for untreated or solvent-treated controls are equal to or greater than 60%.

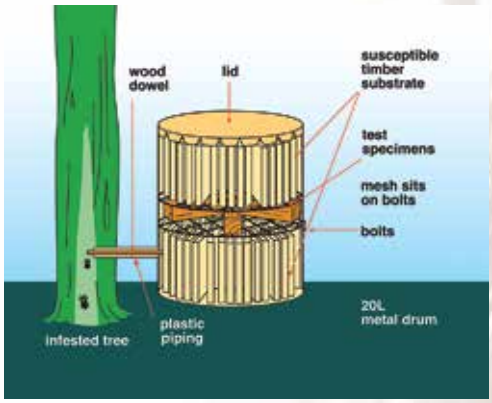


Figure 3. *Field exposure to subterranean termites using the drum technique.*

Approval criteria. When the candidate preservative has a mean rating equal to or above an estimated 95% wood remaining then the lowest of the retentions meeting this criterion will be recommended for approval. For H2F treatments, test specimens must be rated as either sound or with superficial attack/ grazing only, i.e. attack by termites must not breach the depth of the treated envelope.

Brick-assembly technique

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. Test specimens shall be a minimum of 25 x 25 x 100 mm sapwood. In the case of H2F treatments, the cross section of test specimens shall be the maximum size to be produced commercially. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention for each termite species or vacuum oven control. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested. H2 and H3 treatments shall achieve full sapwood penetration, while more limited penetration is accepted for H2F envelope treatments (e.g. treated by spray or dip). Test specimens with full sapwood penetration shall be weighed before and after treatment allowing calculation of individual piece retention. For H2F treatments, the retention and penetration of the candidate preservative in the envelope treated zone of spare test specimens shall be confirmed by chemical analysis.

A set of H2F test specimens shall be tested with at least one end docked after treatment. If one or more of the docked test specimens are attacked through the exposed end-grain, then a trial is needed to show that termites cannot enter test specimens when an unsealed end abuts another test specimen's treated surface. The join between the two test specimens (such as in a T-piece assembly) should not be perfect, but have a gap of at least 2 mm between test specimens. Also required is a test of exposed docked ends, as would occur in wall frame corners, where the docked ends are resealed by the process that would occur commercially (e.g. a brush or spray treatment).

A minimum of three retentions of each candidate preservative shall be tested. Retentions may be based on the threshold value or on any other values specified by the supplier.

Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a basis on which to assess the candidate.

Field. Termites

Hazard Class H2 and H3 *continued*

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Pre-test conditioning of test specimens. Test specimens shall be dried in vacuum ovens at 40°C and -95 kPa for five days to remove any residual solvents and volatiles.

Envelope (H2F) treated test specimens shall be exposed to natural weathering outdoors for a minimum of four weeks. Test specimen orientation will not be altered during this time. The uppermost exposed face with most UV and weathering exposure shall remain identifiable during field testing to aid inspection. H2 and H3 treated test specimens do not require UV conditioning.

Test specimens being tested by this procedure for H3, shall be leached prior to vacuum oven drying. Test specimens shall be vacuum-impregnated with water for 30 minutes and allowed to remain for a further 30 minutes in a container with at least three times the volume of water as of specimens. Water shall be drained from the containers and replaced with an equal amount of clean water. The containers shall be placed in a shaking water bath maintained at 35°C for 5-7 days with the water changed daily during five of the days. Specimens shall then be placed on drying racks for two days to surface dry. Exposure. Test specimens shall be exposed to at least one species of subterranean termite. If only one species is to be used then the preferred species is to be *Coptotermes acinaciformis*. However, if the preservative is intended for use north of the Tropic of Capricorn then *Mastotermes darwiniensis* also shall be used.

The test shall occur within, for example, a 6 L plastic container. Test specimens shall be randomly arranged and alternated with highly susceptible feeder specimens (e.g. *Eucalyptus regnans*: 25 x 25 x 100 mm). Test specimens and feeder specimens shall be separated by corrugated cardboard. All containers shall be placed on hollow masonry bricks (100 mm thick). The bricks shall be on timber-filled trenches, which are known to contain infestation of the target species of termite. Wooden pegs (200 mm long) aid termite access through the bricks and into the containers (Fig. 4). Each container shall be covered with insulating material and secured with soil. The test duration shall be a minimum of 16 weeks, although usually 6-12 months, or until such time as all susceptible timber materials have been largely consumed (60%+ mass loss) and termites have vacated the exposure containers.

Performance criteria. At the conclusion of the exposure period, test specimens shall be returned to the laboratory and cleaned. Test specimens shall then be visually rated for any termite attack using a scale which estimates the amount of wood remaining. Mass loss of the specimens shall also be determined.

Approval criteria. When the candidate preservative has a mean rating equal to or above an estimated 95% wood remaining then the lowest of the retentions meeting this criterion will be recommended for approval. For H2F treatments, test specimens must be rated as either sound or with superficial attack/grazing only, i.e. attack by termites must not breach the depth of the treated envelope.

Figure 4. *Field exposure to subterranean termites using a brick-assembly technique.*

Hazard Class H3, H4 and H5

Timber species. The timber species shall be representative of the country or region of proposed end-use: It may be necessary to utilise both softwood and hardwood substrates.

Test specimens. Test specimens shall be sapwood with a minimum dimension of 20 x 20 x 10 mm. The 10 mm dimension is in the longitudinal direction for soil-block bioassays. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention for each fungus or sterile control. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a broad guide on which to assess the candidate. Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated blocks. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Pre-test conditioning of specimens for soil jar test. Test specimens shall be placed in jars and vacuum impregnated with water. The volume of water in the jars shall be at least three times the volume of the specimens. The jars shall be placed in a shaking water bath maintained at 35°C for 5-7 days with the water changed during five of those days. Specimens shall be dried in a vacuum oven at 40°C and -95 kPa for 5 days. The weathered specimens shall be reconditioned to 12% m.c., weighed (or weighed at 0% m.c. following vacuum oven drying at 40°C), and sterilised, for example, by γ-irradiation.

Pre-test conditioning of specimens for nutrient medium test. Half of the test specimens shall be leached. Leaching involves the re-saturation of blocks with water, after which they shall be placed in nine times their volume of distilled water. Every two days for 14 days, the distilled water shall be changed. After leaching the blocks shall be air dried. After air- drying, all the leached and unleached blocks shall be conditioned in a 20°C and 65% RH controlled room to equilibrium moisture content (EMC).

Test fungi. Test specimens shall be exposed to both brown-rot and white-rot fungi. At least five (for Australia) or three (for New Zealand) different species of fungi selected from the following list shall be used. The selection shall include at least one brown-rot and one white-rot fungus.

BROWN-ROT FUNGI	WHITE-ROT FUNGI
Coniophora olivacea	*Perenniporia tephropora*
Coniophora puteana	*Pycnoporus coccineus*
Serpula lacrymans	*Lopharia crassa*
Fomitopsis lilacinogilva	*Trametes versicolor*
Gloeophyllum abietinum	
Antrodia xantha	
Fibroporia vaillantii	
Neolentinus lepideus	
Paxillus panuoides	
Oligoporus placenta	
Polyporus verecundus	

Strains of the above species may be specified to suit local exposure conditions.

Laboratory. Decay

Hazard Class H3, H4 and H5 *continued*

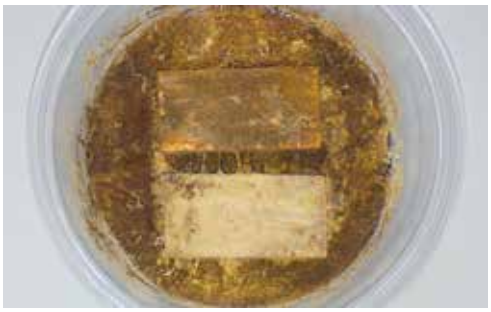
Test method for soil jar. Decay tests shall occur in soil jars. Each jar shall contain 150 g of soil moistened to at least 100% water holding capacity. Two susceptible sapwood veneer feeder strips previously soaked overnight in 1% malt extract solution shall be placed on the soil in each jar. The jars shall be autoclaved for 1.5 hours. The feeder strips shall then be inoculated with the chosen fungi. One set of jars shall be left uninoculated as a sterile control, to determine if there is any mass loss or gain not attributable to fungal attack.

After the fungi have grown sufficiently on the feeder strips (~10 days) the test specimens shall be placed into the appropriate jars. Each jar shall contain two replicate specimens or one specimen if the preservative is volatile (e.g. creosote). Specimens shall also be placed into sterile control jars. All jars shall be incubated at 25°C and 75% RH for 12 weeks (with the exception of S. lacrymans, which requires incubation at 20°C).

Specimens shall then be removed from jars, reconditioned to 12% m.c., weighed (or weighed at 0% m.c. following vacuum oven drying at 40°C) and adjusted to accommodate changes recorded in sterile controls to obtain individual mass losses. The test will be valid, for those brown-rotting fungi that produce a mean mass loss of more than 40% in the softwood untreated controls, and for those white-rotting fungi that produce a mean mass loss of more than 15% in the hardwood untreated controls. Decay is controlled when mean mass loss is 3% or less.

Test method for nutrient media. Decay tests shall occur in containers with prepared fungal growth. The prepared containers shall contain autoclaved malt-agar nutrient medium, poured into sterilised culture vessels. Upon cooling, the media shall be cultured with the test fungus and incubated at 22-25°C and 70-75% RH.

Treated and conditioned blocks shall be packaged and sterilised by exposure to ethylene oxide gas. The blocks shall then be placed in prepared containers with active fungal growth. The containers shall be incubated for 6-16 weeks (depending on test method: Sutter test 6 weeks; EN 113 test 16 weeks) at 22-25°C and 70 - 75% RH. Following incubation, the blocks shall be brushed to remove fungal growth, weighed, dried and reweighed. The percentage mass loss of each block shall be calculated and the mean determined for each fungus/ treatment combination.



Performance criteria. The toxic threshold value for each fungus and preservative under test is the lowest retention which prevented a mean mass loss of more than 3%.

Data generated in these laboratory tests provide information on performance against fungi of known importance. However, the data cannot be used solely to establish commercial retention levels, but may be used to support field data. In addition the laboratory data may be used as a basis for establishing retentions for field testing.

Hazard Class H3

A minimum of one of the five test procedures described in this Section shall be required for H3.1 (New Zealand) and specimens shall be exposed in Australia or New Zealand. Additionally, for H3.2 (New Zealand) and H3 (Australia) results from a second H3 field test are required from a different test site (including overseas sites) or if from the same Australia/ New Zealand test site then using a different H3 method. At least one of the H3 tests should be conducted with test specimens no more than 300 mm off the ground. These tests primarily target decay; nevertheless, termite damage is acceptable (and shall be rated separately from decay) but is not sufficient on its own as a termite test. If termite data are required (for use in Australia) these should be obtained from separate H3 termite field test Protocols. Some variations on the test specimen sizes are permitted, although note that smaller test specimens may give slower decay rates. In any event, a minimum test specimen wood volume of 62.5 cm3 is required (i.e. allows specimens down to 25 x 25 x 100 mm, which is the same size as test specimens used in the termite drum test).

Decking test

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. If softwood, test specimens shall be nominally 40 x 90 x 1000 mm clear sapwood. The minimum test specimen size shall be 20 x 70 x 200 mm. If hardwood, with a thin sapwood band, the width and depth of the specimen shall be the maximum achievable from sawn timber to contain maximum sapwood only specimens. Alternatively, test specimens may contain both sapwood and heartwood, but then, evaluation of the sapwood of spare unexposed samples will be necessary to confirm penetration and retentions determined by weight uptake. Specimens shall be cut to size prior to treatment and have a moisture content between 10-15%. For softwoods, both ends shall be sealed with an impervious coating. A hole to take a 50 mm nail shank or a screw fitting shall be drilled 25 mm from each end of specimens. All specimens shall be finished to smooth condition. Sufficient specimens shall be treated to each preservative retention of reference and candidate preservative to permit selection of ten exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ± 10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each candidate preservative (CP) shall be tested. Retentions may be based on the threshold value or on values specified by the supplier.

Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative (Ref.) selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. Reference test specimens shall be treated to 1.0x, 0.5x, 0.25x of approved retention for the preservative selected and shall be referred to, respectively, as Ref. 1, Ref. 2, Ref. 3 levels (see Field Preservative Assessment-Approval Criteria on page 32).

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example,

Field. Decay

Hazard Class H3 *continued*

chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Exposure frames. Exposure frames shall be two pieces (bearers) of 100 x 100 mm or 100 x 75 mm timber either preservative treated to H4 retention or highly durable species. Spacing pieces 100 x 25 mm or 75 x 25 mm shall be fixed to each bearer. One spacing piece shall be treated timber (approved H3), the other, untreated non-durable timber. Note these may have to be replaced from time-to-time as and when they fail.

Fixing samples. Decking samples shall be nailed to the spacing pieces through the pre-drilled holes. There shall be a 5 mm gap between each fixed decking specimen. Ten untreated, or in the case of non-water based preservatives, solvent only treated, specimens shall be included in each test.

Performance criteria. Each specimen shall be inspected at least annually, typically at the interface between the piece and the spacing pieces, and rated for decay and termite attack (if appropriate) using any internationally recognised system.

Approval criteria. See Field Preservative Assessment-Approval Criteria on page 32.

L-joint test

This test shall be used to assess formulations which will be used to treat commodities in their final shape and form.

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. The following specimen preparation procedures are to be carried out before preservative treatment.

Test specimens shall be L-shaped with a mortise and tenon joint (Fig. 5). Test specimens shall have at least 25 mm sapwood at the thickest point and all joints shall be machined as a single piece and finished to a smooth condition. Specimens shall be cut to size prior to treatment, and have a moisture content between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

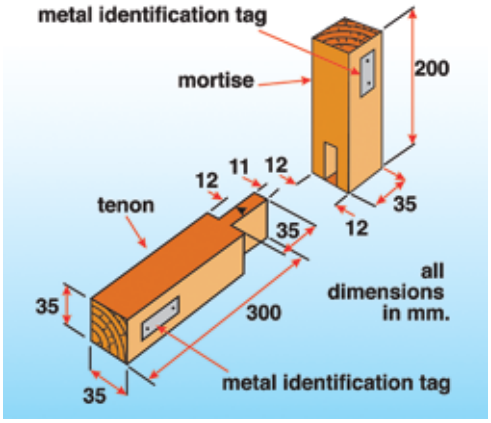


Figure 5. *The L-joint specification.*

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each candidate preservative (CP) shall be tested. Retentions may be based on the threshold value or on values specified by the supplier.

Specimens shall be weighed before and after treatment and their width, depth and length measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

Hazard Class H3 *continued*

A reference preservative (Ref.) selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. Reference test specimens shall be treated to 1.0x, 0.5x, 0.25x of approved retention for the preservative selected and shall be referred to, respectively, as Ref. 1, Ref. 2, Ref. 3 levels (see Field Preservative Assessment- Approval Criteria on page 32).

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate making, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Exposure. Assembled L-joint specimens shall be painted with an acrylic primer and two (white) acrylic top coats over the outside of each assembled test piece, leaving the internal joint as bare wood. Once dry, the paint finish coating over the joint shall be broken by pulling the joint apart and reassembling prior to exposure. Fresh cut exposed ends (away from the joint zone) are to be sealed with an impervious bitumastic type sealant. The joints shall be exposed on weathering racks facing north at least 900 mm above ground level, 500 mm above vegetation and sloping at 10° to the horizontal.

Performance criteria. Each specimen shall be inspected at least annually, at the unpainted internal surfaces of the tenon member, and rated for decay using any internationally recognised system.

Approval criteria. See Field Preservative Assessment - Approval Criteria on page 32.

Flat panel test

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. If softwood, test specimens shall be 75 x 25 x 200 mm clear sapwood. If hardwood, with a thin sapwood band, the width and depth of the specimen shall be the maximum achievable from sawn timber to contain maximum sapwood only specimens. Alternatively, panels may contain both sapwood and heartwood, but then, chemical analysis of the sapwood of spare unexposed samples will be necessary to confirm retentions that were based on weight uptake. Specimens shall be cut to size prior to treatment, and have a moisture content between 10-15%. All specimens shall be finished to smooth condition. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each candidate preservative (CP) shall be tested.

Retentions may be based on the threshold value or on other values specified by the supplier.

Field. Decay

Hazard Class H3 *continued*

Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative (Ref.) selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. Reference test specimens shall be treated to 1.0x, 0.5x, 0.25x of approved retention for the preservative selected and shall be referred to, respectively, as Ref. 1, Ref. 2, Ref. 3 levels (see Field Preservative Assessment - Approval Criteria on page 32).

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Exposure. Exposure frames shall be supported at each end, at least 500 mm above ground and be of durable timber substrate or other biologically resistant framing. Specimens shall be placed on racks at an angle of 45°, facing north, and the bottom edge of the specimen on and against non-durable (sapwood or class 4 heartwood) timber supports. The supports provide a moisture trap and, when they commence decaying, a source of inoculum.

Performance criteria. Each specimen shall be inspected at least annually, typically at the interface between the specimen and the spacing pieces, and rated for decay using any internationally recognised system.

Approval criteria. See Field Preservative Assessment - Approval Criteria on page 32.

Ground proximity test

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. If softwood, test specimens should be 50 x 20 x 100 mm clear sapwood. If hardwood, with a thin sapwood band, the width and depth of the specimen shall be the maximum achievable from sawn timber to contain maximum sapwood only specimens. Alternatively, specimens may contain both sapwood and heartwood, but then, chemical analysis of the sapwood of spare unexposed samples will be necessary to confirm retentions that were based on weight uptake. Specimens shall be cut to size prior to treatment, and have a moisture content between 10-15%. All specimens shall be finished to smooth condition. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls.

Retentions shall be within ±10% of the target mean.

Preservative treatment. See details in other H3 Field Test Procedures.

Exposure. An exposure pad at least 1000 x 1000 mm and 100 mm thick shall be made from concrete blocks or pavers that are placed directly on the soil. Test specimens are placed in random order on the pad. The whole assembly is covered with porous agricultural shade cloth, usually fixed to a

Hazard Class H3 *continued*

treated timber frame that encompasses the pad and test specimens. Grass is permitted to grow between the concrete blocks, although it should be trimmed after each inspection.

Performance criteria. Each specimen shall be inspected at least annually and rated for decay and termite attack (if appropriate) using any internationally recognised system.

Approval criteria. See Field Preservative Assessment-Approval Criteria on page 32.

Embedded test

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. If softwood, test specimens shall be 75 x 25 x 200 mm clear sapwood. If hardwood, with a thin sapwood band, the width and depth of the specimen shall be the maximum achievable from sawn timber to contain maximum sapwood only specimens. Alternatively, panels may contain both sapwood and heartwood, but then, chemical analysis of the sapwood of spare unexposed samples will be necessary to confirm retentions that were based on weight uptake. Specimens shall be cut to size prior to treatment, and have a moisture content between 10-15%. All specimens shall be finished to smooth condition. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls.

Retentions shall be within ±10% of the target mean.

Preservative treatment. See details in other H3 Field Test Procedures.

Exposure. Test specimens are embedded within a U-shaped holder made from untreated non-durable Pinus sp. (to encourage brown rot) and hardwood (to encourage white rot), and to increase water trapping surfaces. The feeder boards are typically made from 90 x 35 mm timber lengths (stud size), with a deep rebate (60 x 19 mm) cut along one edge so that when bolted together they formed a deep U-shaped groove within which the test specimens are inserted (Figure 6). The groove should be enough to allow for several mm of test specimen expansion (swelling) during exposure. Non-corrodible metal bolts (e.g. 75 mm long and 6-8 mm in diameter) are placed through holes drilled into the holder and separators (not test specimens) that clamp the holder in place, usually one bolt every 500-600 mm of holder length. The bolt head may be countersunk into the hardwood. These bolts can be loosened during inspections. Two untreated separators 35 x 35 x 45 mm long (defects allowed) of *Pinus sp.* are inserted into the groove, one upon the other with grain horizontal, between each test specimen so that the bottom 60 mm of test specimen is fully enclosed by untreated wood. The holders should be placed upon a treated timber bearer for support. The test assembly may be placed near-to-ground or raised, and tilted or vertically orientated.

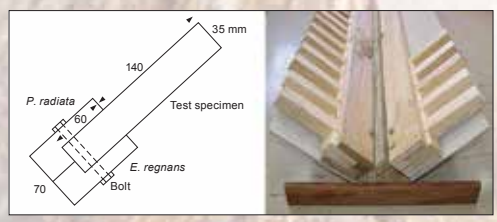


Figure 6. *The embedded test in tilted orientation.*

Performance criteria. Each specimen shall be inspected at least annually and rated for decay and termite attack (if appropriate), with most damage expected in the lower embedded end, using any internationally recognised system.

Approval criteria. See Field Preservative Assessment-Approval Criteria on page 32.

Accelerated Field Simulator (soil bed). Decay

Hazard Class H4 and H5

The Accelerated Field Simulator (AFS) provides an accelerated in-ground test method against decay fungi. AFS testing provides a severe decay hazard, often dominated by soft rot that can be difficult to duplicate in soil jar bioassays. AFS results are not a substitute for field trials, so that evidence of a concurrent field test must be provided to support determination of biocidal efficacy. As the AFS is a decay trial, evidence of termite resistance shall also be provided through H3 or H4 field tests.

Timber species. The timber species shall be representative of the country or region of proposed end-use, and if hardwoods are expected to be commercially treated, they must be included in this test.

Test specimens. Test specimens shall be a minimum of 20 x 20 x 100 mm clear sapwood. Specimens shall be cut to size prior to treatment and have a moisture content between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of ten exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ± 10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each candidate preservative (CP) shall be tested. Retentions may be based on the threshold value or on other values specified by the supplier.

Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative (Ref.) selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. Reference test specimens shall be treated to 1.0x, 0.5x, 0.25x of approved retention for the preservative selected and shall be referred to, respectively, as Ref. 1, Ref. 2, Ref. 3 levels (see Field Preservative Assessment- Approval Criteria on page 32).

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Pre-test conditioning of test specimens. Test specimens may be artificially weathered prior to exposure. In this case, test specimens shall be placed in containers and vacuum impregnated with water. The volume of water in the containers shall be three times the volume of the specimens. The containers shall be placed in a shaking water bath maintained at 35°C for 5-7 days with the water changed daily for five of the days. Specimens shall be dried in a vacuum oven at 40°C and -95 kPa for five days.

Exposure. Soil beds shall be at least 500 mm deep, and comprise lower layers of coarse pumice or gravel, and upper layers of soil that will pass a 4 mm sieve. Relative humidity shall be a minimum of 80%, and temperature 25-30°C. For each new test, the top 150 mm of soil at least shall be replaced with fresh soil. The soil beds shall be maintained throughout the test period at the field water holding capacity of the test soil being used.

Test specimens shall be randomly arranged in rows spaced at least 50 mm apart. The specimens shall be a minimum of 50 mm apart within rows. The specimens shall be buried half to three-quarters of their length in soil. All specimens shall be returned to

Accelerated Field Simulator (soil bed). Decay

Hazard Class H4 and H5 *continued*

the same position, orientation, and depth after inspection.

Performance criteria. Each specimen should be inspected every six months, and rated for decay using any internationally recognised system.

Approval criteria. Calculate the retention to be recommended for approval from the Field Preservative Assessment-Approval Criteria on page 32, and then add a 50% safety margin to the calculated retention. Justification for removal of this safety factor can be obtained through field testing. The approved retention based upon AFS results shall also be reviewed when field test results become available.

Field. Decay and Termites

Hazard Class H4 and H5

This procedure assesses both decay and termite resistance and thus the field site(s) should provide both types of hazards. A minimum of two field tests are required, with at least one from Australia or New Zealand sites. Untreated controls or other test specimens shall show evidence of both decay and termite attack during the life of the test. For end use in New Zealand the termite requirement is not necessary.

Timber species. The timber species shall be representative of the country or region of proposed end-use, and if hardwoods are expected to be commercially treated, they must be included in this test.

Test specimens. Test specimens shall be a minimum of 20 x 20 x 350 mm sapwood. Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each candidate preservative (CP) shall be tested. Retentions may be based on the threshold value or on other values specified by the supplier.

Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative (Ref.) selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. Reference test specimens shall be treated to 1.0x, 0.5x, 0.25x of approved retention for the preservative selected and shall be referred to, respectively, as Ref. 1, Ref. 2, Ref. 3 levels (see Field Preservative Assessment-Approval Criteria on page 32).

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Exposure. The specimens shall be placed half to two-thirds their length in formed holes, with at least 250 mm buried.

Alternative method. In bush fire prone areas, test specimens may be fully buried horizontally in soil as described by Lenz, M., Creffield, J.W. and Barrett, R.A. (1992). An improved field method for assessing the resistance of woody and non-woody materials to attack by subterranean termites. *Material und Organismen* 27(2): 89-115.

Performance criteria. Each specimen shall be inspected at least annually for the first five years, and rated for decay and termite attack using any internationally recognised appropriate system.

Approval criteria. See Field Preservative Assessment-Approval Criteria on page 32.

Hazard Class H6

Timber species. The timber species shall be representative of the country or region of proposed end-use.

Test specimens. Test specimens shall be sapwood with a minimum dimension of 5 (radial) x 10 (tangential) x 25 (longitudinal) mm. Specimens shall be cut to size prior to treatment, and have a moisture content of between 10-15%. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention for each borer species. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls. Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each preservative shall be tested. Specimens shall be weighed before and after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

A reference preservative selected from those currently approved in the relevant standard for the country or region of proposed end-use shall be used. It is intended that this preservative will monitor the overall procedure and serve as a broad guide on which to assess the candidate.

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Pre-test conditioning of specimens. Test specimens shall be placed in jars and filled with water. The volume of water in the jars shall be three times the volume of the specimens. The jars shall be placed in a shaking water bath maintained at 35°C for 14 days. The water shall be changed ten times over the 14 day period. Specimens shall be dried in a vacuum oven at 40°C and -95 kPa for five days. Specimens shall then be placed in jars and filled with seawater. The volume of seawater shall be three times the volume of specimens. The jars shall be placed in a shaking water bath maintained at 35°C for seven days and the seawater changed five times.

Bioassay. Test specimens shall be exposed to *Lyrodus pedicellatus* and/or *Limnoria tripunctata* in separate aquaria. The marine borer populations shall include fresh specimens collected from the sea within two months prior to exposure. Aquaria shall contain larger panels of untreated pine so that borers have an alternative food source and breeding site. Specimens shall be exposed for a minimum of one year. If specimens are exposed for more than one year, aquaria shall be again supplemented with fresh borers from the sea. Aquaria may operate as a closed recirculating system (in which case seawater shall be changed regularly), or an open system if a direct supply of seawater is available. Salinity shall be maintained at 30-35 parts per thousand, and temperature at 24°C for *L. tripunctata* and 20°C for *L. pedicellatus*.

Specimens shall be placed on the aquaria floor (for *Limnoria*) or just below the water surface (for *Lyrodus*), and arranged in a randomised pattern.

Performance criteria. At the end of test, specimens shall be examined under a dissecting microscope or X-rayed to determine depth and extent of attack. Toxic threshold values for the preservative under test are the lowest retention that prevents significant attack.

Data generated in this laboratory test cannot be used solely to establish commercial retention levels for H6, but must be combined with sea trial data.

Field. Marine Borers

Hazard Class H6

Timber species. The timber species shall be representative of the country of proposed end-use.

Test specimens. Test specimens shall be sapwood with a minimum dimension of 25 x 25 x 300 mm. Eucalyptus species may be of natural rounds greater than 40 mm in diameter. Specimens shall be cut to size prior to treatment, and have a moisture content between 10-15%. Any holes required for the attachment of specimens to exposure frames shall be drilled prior to treatment. Sufficient specimens shall be treated to each retention of reference and candidate preservative to permit selection of a minimum of six exposure specimens per retention. In addition, a similar number of specimens shall be used as untreated and, where applicable, solvent controls.

Retentions shall be within ±10% of the target mean.

Preservative treatment. The treatment process used to treat specimens shall be commensurate with the type of preservative being tested, achieve full sapwood penetration, and permit accurate calculation of individual piece retention.

A minimum of three retentions of each candidate preservative (CP) shall be tested. Retentions may be based on the threshold value or on any other values at the discretion of the supplier. Specimens shall be weighed before and after treatment and their width, depth and length dimensions measured after treatment to allow calculation of preservative retention. Retentions shall be checked by chemical analysis.

Immediately after treatment, specimens (excluding untreated controls) shall be wrapped in an appropriate material, e.g. aluminium foil, polyethylene film, etc., or enclosed in a container with restricted ventilation, sufficient to allow, for example, chemical fixation to occur, while at the same time preventing the growth of moulds on treated specimens. After this period specimens shall be air-dried for a minimum of two weeks.

Retentions shall be segregated during these procedures.

Marine borer exposure. The exposure site shall provide a hazard consistent with the expected hazard in service.

Test specimens shall be attached to resistant frames. The frames shall be constructed so as to minimise abrasion and avoid the effects of corrosion. Bolts shall also be corrosion resistant. Specimens within the frame shall be separated with spacers and randomly arranged. Test specimens shall be positioned to hang just below low tide level. If exposure to Sphaeroma is sought, specimens shall be suspended at mid-tide level.

Hazard Class H6 *continued*

Performance criterion. Each specimen shall be inspected annually and rated for attack using any internationally recognised system. Marine borer types on each specimen shall be recorded.

The following is an example of an inspection rating system for treated wood that may be used:

4.0	=	No attack. Serviceable.
3.5	=	Light attack, i.e. a few small patches of *Limnoria* to 3 mm deep, 1 to 6 small *Sphaeroma* or *Martesia* holes (for minimum stake size above), or teredinids totalling 1-80 mm in length. Serviceable.
3.0	=	Light-moderate attack. Serviceable.
2.5	=	Moderate attack. Serviceable.
2.0	=	Moderate-heavy attack. Specimen beginning to alter in outline (at least in patches) with *Limnoria* to 6 mm deep, or wood between *Sphaeroma*, *Martesia* or teredinid holes easily broken. In practice, specimen would be in need of physical barrier protection.
1.5	=	Heavy attack. In need of repair.
1.0	=	Heavy-severe attack. Unserviceable.
0.5	=	Severe attack. Unserviceable.
0.0	=	Destroyed or missing from frame. Unserviceable.

Approval criteria. See Field Preservative Assessment - Approval Criteria on page 32.

Field preservative assessment. Approval criteria

This section describes field and marine preservative assessments, which involve comparison of the candidate preservative (CP) with a reference preservative (Ref.), already approved for the relevant service condition. In order to expedite the field assessment, these comparisons are made at retentions lower than those expected to provide long-term effective service. Minimum field exposure is fixed, not in years, but by the time taken for the candidate preservative to reach a score relative to the reference preservative.

Reference preservative. Specimens shall be treated with the reference preservative at three retentions:

Ref. 1	The approved retention level
Ref. 2	One-half of the approved retention level
Ref. 3	One-quarter of the approved retention level

Candidate preservative. Specimens shall be treated with the candidate preservative at no fewer than three retentions.

Approval criteria. When Ref. 3 reaches less than 70% mean soundness, the lowest CP retention which scores above 70% mean soundness can be submitted for approval for use at four times this retention. The test will continue until Ref. 2 reaches 70% mean soundness. At that time, the lowest CP retention which scores above 70% mean soundness, will be recommended for approval for use at twice this retention. Similarly proportioned conversion factors shall be applied when the reference preservative retentions tested vary from those mentioned above (i.e. they are not strictly one-quarter, one-half or the actual approved retention level).

The test will continue on the above basis for a period which provides a high degree of confidence that CP will perform as well as Ref. 1. That is, when Ref. 1 reaches less than 70% soundness and CP shows comparable performance. These longer term data will be required to calibrate the retention level approved on the basis of Ref. 3 results.

Protocols for assessment of wood preservatives

Revision produced by Scion, Rotorua 3046.