



Performance Testing Guide
Imbue Radiata

ImbueTM



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Imbue Radiata Timber

A Trusted Choice in High Performing Heat Tempered Timber

Imbue Radiata heat tempered timber is a new generation of wood product that presents a renewable and high performing alternative to old growth timbers that are often from unsustainable sources.

Imbue Radiata products are made from heat tempering clear grade FSC® certified New Zealand Radiata Pine. World class proprietary heat tempering is achieved by using steam and high temperatures on or above 230°C. The unique modification process is made in purpose-built computer-controlled kilns. A quality control process is in place that measures selected parameters to ensure every piece of timber is modified to the core with the correct specification and quality.

Imbue Radiata has been tested extensively for over 15 years, both in lab and long-term accelerated field trials. This is combined with over a decade of real-world in-service history, so you can be confident of performance and durability for a lifetime.

This document provides a summary of the test performance of Imbue Radiata.

Not all heat tempered wood performs equally!

- Heat tempering is more than making wood brown and not all heat tempered wood performs equally.
- Careful work is required to create a heat tempering schedule that is dedicated to a specific species.
- Lower durability timbers may not be adequately durable when generic thermal modification schedules are followed.
- Any heat tempered timber should be modified to a specific schedule and field tested in decay tests to establish actual durability class.
- Imbue Radiata is single species focused and has a modification schedule that has been perfected over 20 years, this reinforces the performance attributes of Imbue Radiata.



Imbue Radiata Cladding

-7.56kg/m2



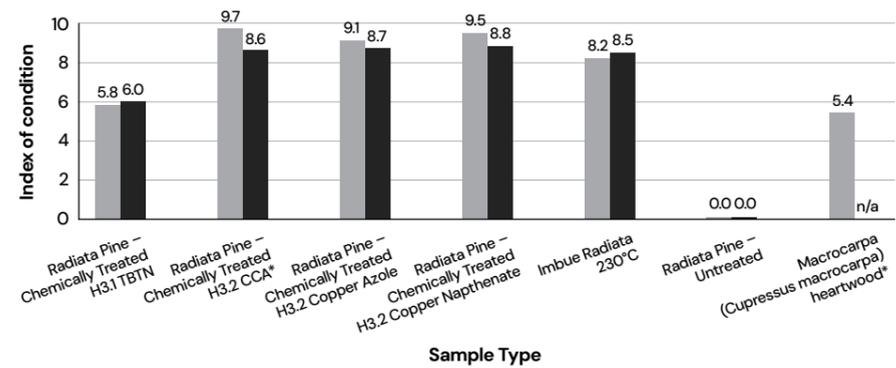


Durability Reports

We have one of the longest running exterior durability testing programmes for heat tempered radiata in the world, including at SCION in Rotorua for over 11 years and at our own test site at our HQ in Auckland. These accelerated decay tests show Imbue Radiata performs similarly or better than preservative treated radiata pine and other naturally durable species.

Accelerated Above Ground Field Test – Whakarewarewa, New Zealand

Graph 1: Decking Panels – Condition After 11 Years



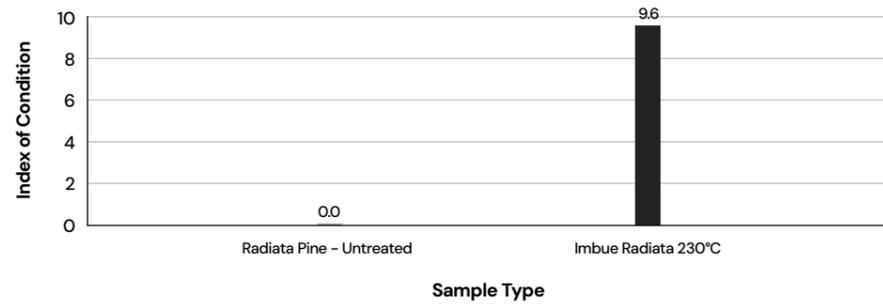
Key: ■ Treated Bearer ■ Untreated Bearer

*Samples assessed after 13 years.

Samples were installed horizontally onto bearers with one end fixed to an untreated radiata pine bearer and the other end fixed to CCA treated bearer.

Graph 2: Flat Panels – Condition After 11 Years

Samples were installed onto racks at a 45° angle with one end resting on an untreated radiata pine bearer.



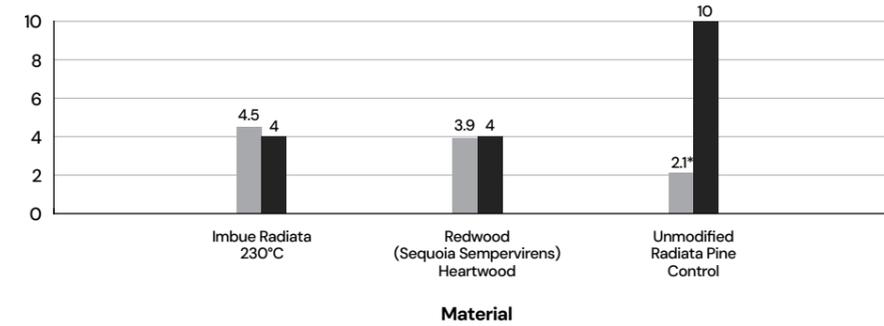
Flat panels Imbue Radiata 230°C after 11 years exposure, Rotorua.



Graveyard In-ground Stake Test – Whakarewarewa, New Zealand

20mm x 20mm stakes were installed in ground contact and the condition was assessed by Scion Research after 5 years.

Graph 3: Condition of Stakes After 5 Years



Key: ■ Index of Condition ■ Number Failed

*Average life 7.1 years

CONCLUSION: While heat tempered wood is most suited to above ground applications, this test suggests performance similar to redwood.



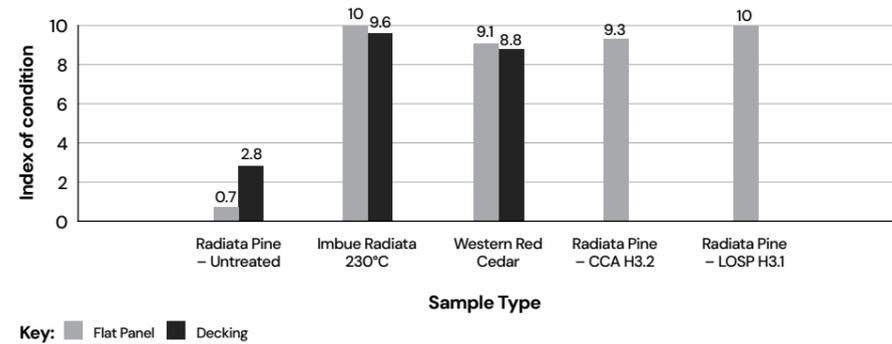


Above Ground Accelerated Durability Field Trial After 6 years – Imbue Mangere

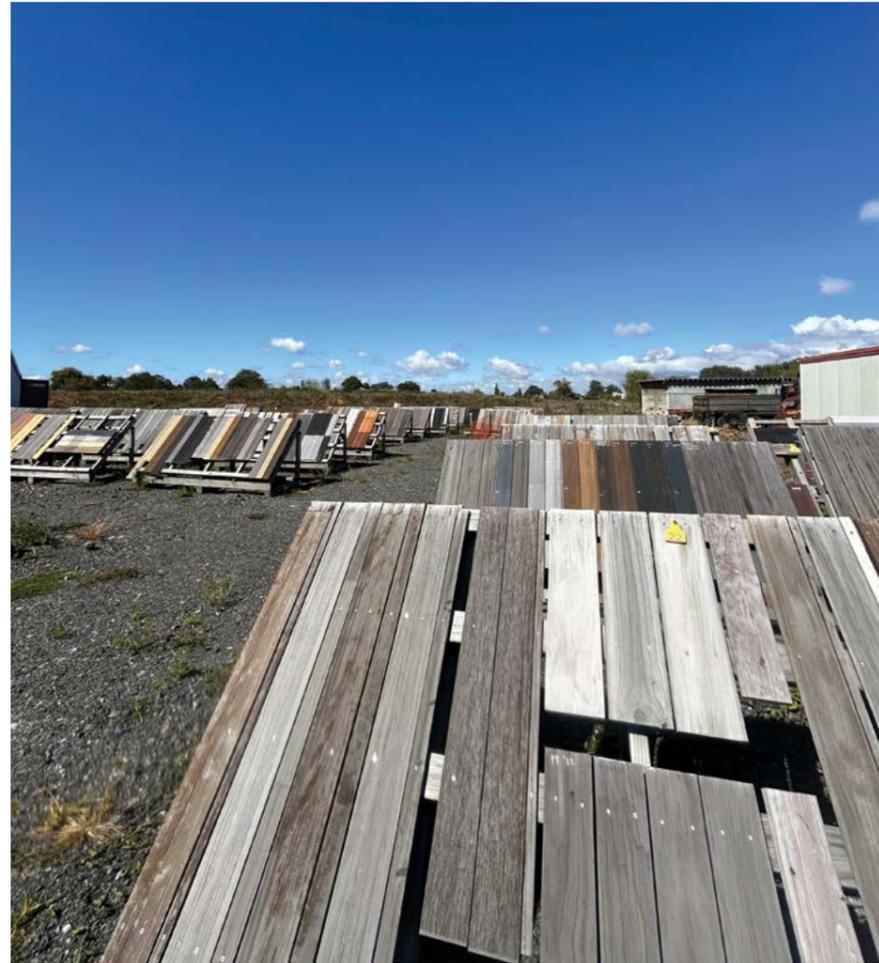
Assessments by Jeanette Drysdale, Independent Wood Protection Consultant.

Imbue Radiata heat tempered timber samples were installed in flat panel and decking configurations according to Australasian Wood Preservations Committee (AWPC) protocols. Flat panel samples were installed onto racks at a 45° angle with one end resting on an untreated radiata pine bearer. Decking samples were installed horizontally onto bearers with one end fixed an untreated radiata pine bearer and the other end fixed to CCA treated bearer.

Graph 4: Flat Panel and Decking – Condition of Samples After 6 Years



CONCLUSION: After 6 years the Imbue Radiata 230°C is performing better than old growth western red cedar and similarly to chemically treated radiata pine.



Accelerated weathering exposure, New Zealand.

Laboratory Testing – CEN/TS 15083-1: 2005

We work with EPH at IHD Dresden in Germany for European compliance testing, they are one of Europe’s most respected wood testing and certification facilities.

A durability test of heat tempering radiata pine against a laboratory test against wood decay basidiomycetes according to the laboratory test DIN CEN/TS 15083 1:2005.

Table 1: Mass Losses and Corresponding Durability of Heat Tempered Radiata Pine

Material	Results with Coniophora Puteana			Results with Poria Placenta		
	Mean Dry Mass Loss [%]	Median Value of Dry Mass Loss [%]	Durability Class	Mean Dry Mass Loss [%]	Median Value of Dry Mass Loss [%]	Durability Class
Imbue Radiata 230°C	0.04 (n=30)	0.00 (n=30)	1	2.48 (n=30)	2.98 (n=30)	1
Reference Wood (Scots Pine)	32.12 (n=20)	30.70 (n=20)	5	26.44 (n=20)	25.06 (n=20)	4

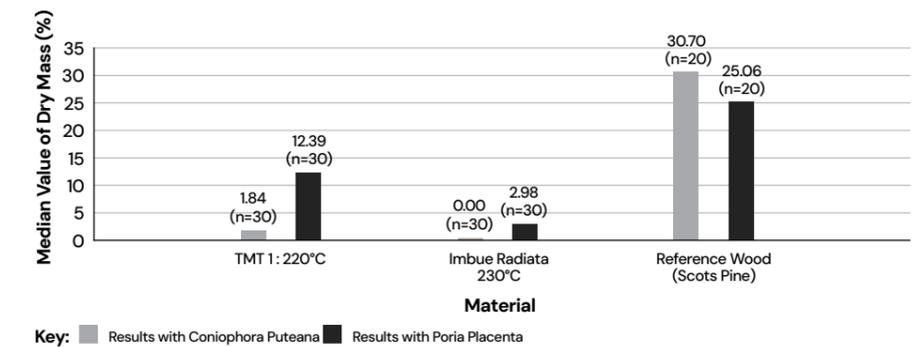
Table 2: Classification of Durability to EN350 Based on Laboratory Tests

Durability Class (EN350)	Description	Median Dry Mass Loss [%] According to DIN CEN/TS 15083-1
1	Very durable	≤ 5
2	Durable	> 5 bis ≤ 10
3	Moderately durable	> 10 bis ≤ 15
4	Slightly durable	> 15 bis ≤ 30
5	Not durable	> 30

RESULT: Evaluation according to Durability Class 1 (EN350).



Graph 5: Mass Losses and Corresponding Durability Classes of Heat Tempered Radiata Pine



Key: Results with Coniophora Puteana Results with Poria Placenta



Durability Assessments

Imbue Radiata timber has been assessed by global wood durability experts who have confirmed the long term durability and suitability of this timber for exterior use.

AS5604–2005 Australian Durability Assessment Class 2 Above Ground

Assessment by Australian Forest Research Company.

“With reference to AS5604–2005. Durability of Imbue Radiata 230°C is comparable to western red cedar (Thuja plicata Donn ex D.Don) and macrocarpa (Monterey cypress) (Cupressus macrocarpa Hartw.) heartwood, referenced in AS5604–2005 (refer to Table 1). Additional accelerated field testing indicates that Imbue Radiata is potentially more durable than macrocarpa heartwood. This would indicate that the timber will achieve durability Class 2 for exterior above–ground applications.”

Table 3: Probable Life Expectancy (Years) of Naturally Durable Timbers

Durability Class	In–ground	Above–ground
1	>25	>40
2	15–25	15–40
3	5–15	7–15
4	0–5	0–7

European and UK Durability Assessment to UC3

Assessment by Andy Pittman, BM Trada.

“Independent testing (according to AWPC methods) has shown that out-of-ground Imbue Radiata is performing as well as North American sourced Western red Cedar which is listed as DC2 Durable, in EN 350. For this reason, BM Trada believe Imbue Radiata may be expected to achieve a 30–year desired service life uncoated, against rot out of ground contact as cladding or joinery non load–bearing) in the UK. When coated (and provided the coating is maintained) BM Trada believe Imbue Radiata may be expected to achieve a 60–year desired service life for the same applications.

North America Durability Assessment to UC3B

Assessment by Jeff Morrell, Oregon State University.

“Field tests of Imbue Radiata 230°C show that performance against decay fungi is similar to that of pines treated with traditional preservatives for Use Category 3B where termites are not present. This material has little or no resistance to termite attack and must be supplementally treated with a termiticide to perform where termites are present. Imbue Radiata 230°C should perform similarly to western red cedar in above ground applications such as cladding in terms of resistance to fungal decay.”

Table 4: Comparison of Durability Between Common Naturally Durable Species and Imbue Radiata 230°C

Species 1	Durability Class
Imbue Radiata 230°C	UC3B (indicative)
Western Red Cedar Heart	UC3B
Coast Redwood (NZ grown)	UC3A



New Zealand Building Code Durability Assessment

Assessment by Oculus Engineering.

“NZS3602 section 111.2.5 states that both Cypress Heartwood (Macrocarpa is a variety of Cypress) and H3.2 treated Radiata Pine can be used as uncoated or stained timber cladding as part of an acceptable solution, whereas H3.1 treated radiata pine cannot.

Extrapolating from this, it would be logical to state that if the timber in question were more durable than the timber types in the acceptable solution, then the timber would perform better than the acceptable solution and therefore be acceptable and fit for purpose.

In field trials the 4 types of timber (H3.1, H3.2, Macrocarpa and Imbue Radiata 230°C) were left exposed for approximately 11 years, and the following was observed:

- Imbue Radiata 230°C was shown to be more durable than Macrocarpa heartwood. In order of durability: H3.1 was worst, then Macrocarpa, then Imbue Radiata 230°C, then H3.2 CCA was best. Since Macrocarpa is a species of heart cypress, which is permitted for a no–finish or stained finish within NZS3602 clause 111.2.5, any timbers that are more durable than this would logically also be fit for purpose as a no–finish or stained finish cladding.
- Therefore since Imbue Radiata 230°C is more durable than macrocarpa, it can be used as no–finish or stained cladding as well.
- It would appear that the threshold between a timber cladding requiring a paint versus being acceptable with a no–finish or stained finish rests between H3.1 and Cypress.
- Since Imbue Radiata 230°C is above that threshold, it can be used as cladding without a finish or otherwise in stain or paint application.”





Termite Testing Australia

Heat tempered timber can be susceptible to termite attack without further preservative treatment. We have conducted termite trials with our anti-termite chemically treated Imbue Radiata products in various locations including Australia and Taiwan to accepted international standards.

Imbue Radiata – TPX Treated

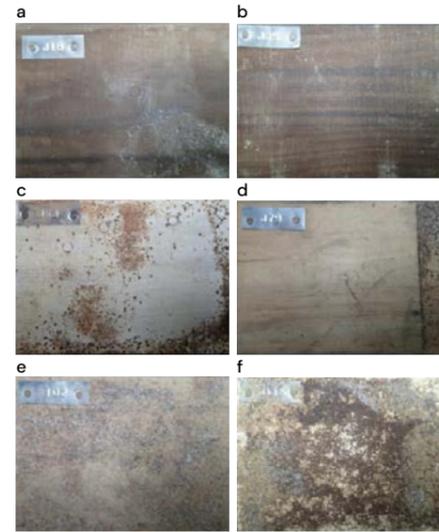
TPX has been field tested termite according to Australasian Wood Preservation Committee (AWPC) and CNS15756 standards.

Table 5: AWPC – Drum method – Coptotermes Acinaciformis Northern Territory Australia

Treatment	Mass Loss	Pass / Fail
Untreated pine control	75.5%	
H3LOSP Azole and permethrin treated rad pine	1.1%	
TPX treated Imbue Radiata 230°C leached	0.2%	Pass
Allowable mass loss	<5%	

Table 6: CNS15756 – Coptotermes Formosanus (Formosan termite) Taiwan

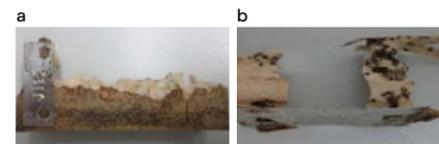
Treatment	Mass Loss	Pass / Fail
Untreated pine control	25.1%	
H3OPX Azole and permethrin treated Imbue Radiata 230°C	1.1%	Pass
TPX treated Imbue Radiata 230°C	0.7%	Pass
Allowable mass loss	<3%	



Example of termite attack to treated test specimens after exposure to C. acinaciformis in a Hazard Class H3 field trial for 38 weeks: a) Imbue Radiata 230°C TPX uncoated, b) Imbue Radiata 230°C TPX stained, c) Imbue Radiata 230°C TPX painted, d) radiata pine, uncoated, e) radiata pine TPX, uncoated, LOSP, and f) radiata pine, painted, LOSP.



Example of attack by C. acinaciformis termites to bait-wood after 38 weeks' exposure in a Hazard Class H3 field trial.



Examples of the range of termite attack and damage to non-treated radiata pine sapwood control test specimens after exposure to C. acinaciformis in a Hazard Class H3 field trial for 38 weeks: a) 86.5% mass loss, and b) 99.3% mass loss. (Mean mass loss for seven test specimens = 95.5%).

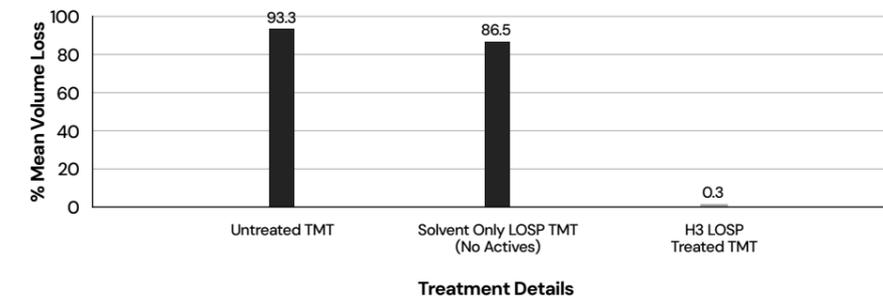
Imbue Radiata – Azole and Permethrin Treated

Azole and permethrin treated Imbue Radiata 230°C was exposed for a period of approximately 6 months to Coptotermes acinaciformis termites in Northern Queensland, Australia following the Brick-assembly technique described by the Australasian Wood Preservations Committee (AWPC).

70 x 30 mm cross section Imbue Radiata 230 degrees C was LOSP treated with preservative actives targeting the minimum AS/NZS 1604.1:2021 retention of 0.02% permethrin for H3 treated timber (plus azoles for decay control). These actives are the same type and retention as used in Abodo OPX treatment.

A leaching step was performed consisting of 7 days in a 35°C shaking water bath with the water replaced 5 times. All treatments were kept separate. Finally, all samples were vacuum dried at 40°C and -95 kPa for 5 days.

Graph 6: Treatment Volume Loss



CONCLUSION: The AWPC protocols allow a maximum of 5% volume loss for any treatment before it has deemed to have failed the test. In this trial, the treated samples had less than 5% volume loss so is deemed to be efficacious.



Comparative performance of Imbue Radiata 230°C untreated (left) vs LOSP Azole and permethrin treated (right), when exposed to Coptotermes acinaciformis termites in AWPC H3 field test, Queensland.





Imbue Radiata – Formosan Termites

Testing of Imbue Radiata with LOSP, OPX and TPX treatments was performed by LSU AgCenter’s Wood Durability Laboratory in accordance with American Wood Protection Association (AWPA) E1-23 Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites (AWPA 2024). The choice test method was used, except for the Imbue Radiata TPX group as no-choice test.

After 28 days of exposure, the samples were removed and cleaned with distilled water. The following AWPA E1-23 Rating Scale was used to visually rate each sample.

Rating Scale:

- 10 Sound.
- 9.5 Trace, surface nibbles permitted.
- 9 Slight attack, up to 3% of cross-sectional area affected.
- 8 Moderate attack, 3-10% of cross-sectional area affected.
- 7 Moderate/severe attack, penetration, 10-30% of cross-sectional area affected.
- 6 Severe attack, 30-50% of cross-sectional area affected.
- 4 Very severe attack, 50-75% of cross-sectional area affected.
- 0 Failure.

Table 7: Results – Coptotermes Formosanus Louisiana State University – USA Report #: WDL-2024-05

Treatment	Average Mass Loss	Average Rating
Radiata pine untreated	98.69%	0
Imbue Radiata untreated	52.36%	0
Imbue Radiata H3 LOSP treated	5.97%	9.7
Imbue Radiata untreated	91.71%	0
Imbue Radiata H3 OPX treated	5.40%	10
Imbue Radiata untreated	73.08%	0
Imbue Radiata TPX treated	1.30%	9.9
Radiata pine untreated	71.46%	0

CONCLUSION:

In the choice test, termites chose to feed more heavily on the untreated samples compared to the treated samples. The untreated control mortality, sample weight loss, and sample ratings were consistent with previous test results. The results from the untreated control samples indicate strong termite vigor and performance, and hence the test data are valid. The 3 treatments demonstrated enhanced resistance to termite attack.

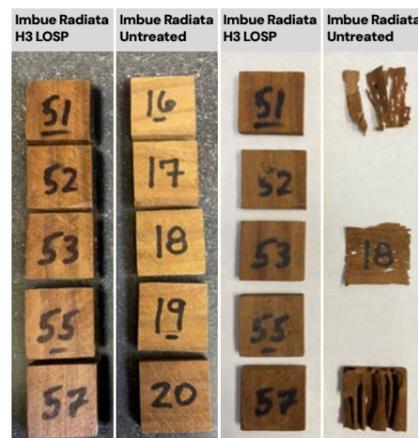


Figure 1. Samples before (left) and at the end of 28 days of testing (right).

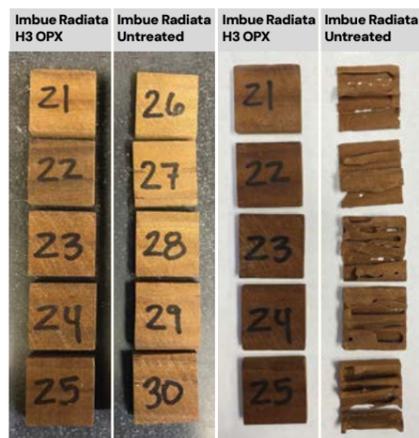


Figure 2. Samples before (left) and at the end of 28 days of testing (right).

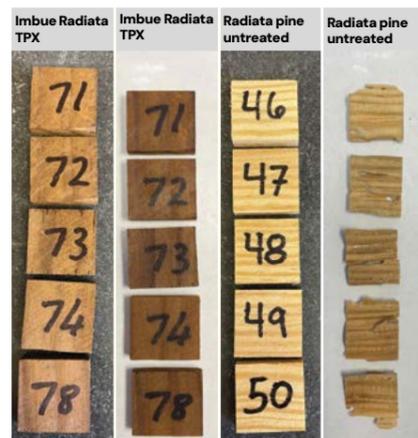


Figure 3. Samples before (left) and at the end (right) of 28 days of the no-choice test.



Exterior Weathering Tests

We have R&D weathering exposure New Zealand test sites running at Mangere and Ohinewai along with third party locations in Australia, USA and Europe.

Here we find out what works (or doesn’t work) in extreme weather conditions.

New Zealand has some of the most demanding weather conditions in the world in terms of UV, moisture and salty air so is a perfect testing ground for exterior timber, fixing systems and coatings.

Coatings Performance

The inherent stability, open cell structure and reduced resin content of Imbue Radiata heat tempered timber makes it an ideal substrate for coatings. Exterior weathering trials were conducted at our Tupare test site over a period of 3 years comparing Imbue Radiata Flatsawn timber and preservative treated clears grade radiata pine side by side with paint finish.

Two coats of oil borne primer plus 2 coats of Sonyx 101 exterior acrylic paint in Pitch Black colour were applied to the timber samples. The panels were exposed 45° angle facing North that give maximum sun exposure in the southern hemisphere.

The testing was observed and verified by Resene Paints Ltd.

RESULT: After three years exposure the paint finish on the Imbue Radiata cladding was in excellent condition with no failure. The paint finish on the radiata pine cladding had failed, with extensive flaking and cracking present due to the movement of the timber substrate.



Flat panel test racks, Mangere.



Imbue Radiata – Painted black, 3 years exposure.

Pressure Treated Clear Grade Radiata Pine, Painted black, 3 years exposure.



Solar Reflectance Index

The samples were tested by Resene Paints Ltd. as per procedures described in ASTM C1549: *Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer* and ASTM C1371: *Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emittance Meters*. The slide method was used for this set of Emittance tests.

The solar reflectance index was calculated in compliance with ASTM E 1980: *Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces*.

Standard solar and ambient conditions used for the calculation:

- Solar flux = 1000 W·m⁻².
- Ambient air temperature = 310 Kelvin.
- Ambient Sky temperature = 300 Kelvin.
- Convective coefficients = 5, 12, 30 W·m⁻²·K⁻¹ corresponding to low (0–2ms⁻¹), medium (2–6 ms⁻¹) and high (6– 10 ms⁻¹) wind conditions respectively.



Imbue Radiata (unweathered)

Thermal Emittance (e)	TSR	Solar Absorbance
0.90	0.35	0.65

Wind Condition	Low	Medium	High
Convective Coefficients	5	12	30
SRI	37	39	40

Dimensional Stability

Dimensional stability is a key property that determines how wood will perform in service. Wood changes dimensions with changes in moisture content, either from contact with liquid water, or from changes in air humidity. Having data on the dimensional stability of a particular type of wood (modified, or unmodified) is important for understanding the in-service behaviour of the wood.

SCION Research, a crown institute in Rotorua, tested comparative dimensional stability of Imbue Radiata flatsawn wood and commercially available wood commonly used in exterior joinery applications, using both swellometer and long-term humidity cycling methods.



Swellometer Test

Wood samples were equilibrated at 25°C, 65% RH and then soaked in water for three days continuously measuring the change in tangential dimension during soaking.

RESULTS:

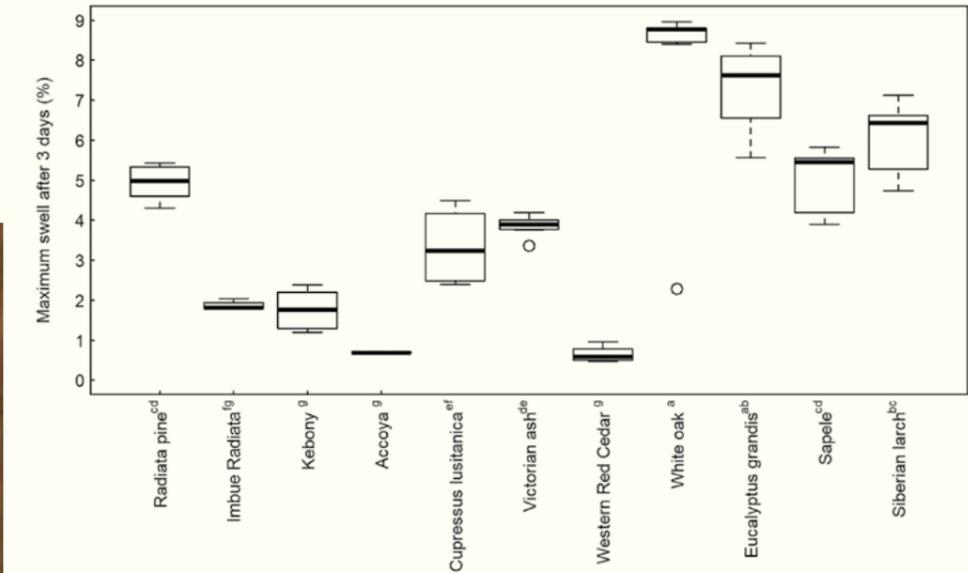


FIGURE 1. Maximum swelling following 3 days water soaking in the Swellometer test. Superscript letters indicate grouping that are not significantly different (95% confidence level).





Long-term Humidity Cycling Test

Wood samples were equilibrated to several environments ranging from low to high relative humidity and measuring the radial and tangential dimensions of the samples at each condition.

RESULTS:

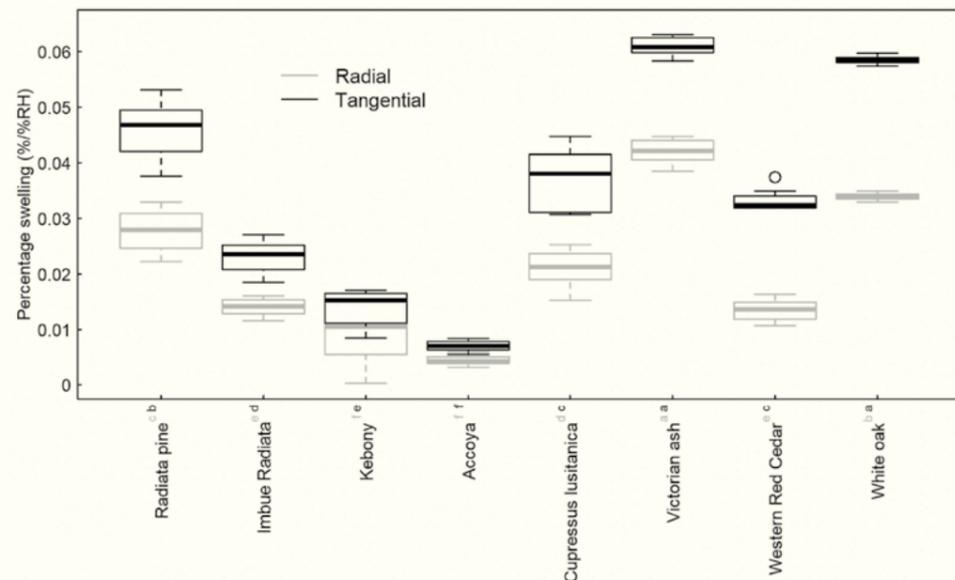


FIGURE 2. Percentage swelling for every 1% change in relative humidity for each wood type in the tangential and radial directions (shown as black and grey boxes respectively). Superscript letters indicate grouping that are not significantly different (95% confidence level).

CONCLUSIONS:

Under conditions of both water soaking and air humidity changes, Imbue Radiata 230°C was significantly more dimensionally stable than unmodified radiata pine, and it performed similarly to old growth vertical grain Western Red Cedar, a species renowned for its dimensional stability.

Kebony and Accoya radiata pine were more dimensionally stable than heat tempered radiata pine in relation to changes in air humidity, while when soaked in water the levels of swelling were not significantly different to heat tempered radiata pine.

With the exception of Western Red Cedar, all the species swelled as much as, or more than unmodified radiata pine, and consequently swelled substantially more than heat tempered radiata pine.

Flame Spread and Smoke Development Testing

Imbue Radiata has been tested for fire performance with many globally recognised test methods.

NOTE: The below results are shown for guidance purposes only. Please consult with a professional fire engineer to establish compliance with local regulations before specification or commencement of construction. Full test report and certifications are available on request.

USA

ASTM E84 Tunnel Test

Test facility: QAI, USA.
Testing in accordance with ASTM E84.

Classification

Flame Spread Classification	Flame Spread Index	Smoke
Class B	65	95

Wildland Urban Interface (WUI)

Test facility: Intertek, USA.
Testing in accordance with SFM 12-7A-1.

Test Requirement

Test Requirement	Result
Absence of flame penetration through the wall assembly	PASS
Absence of glowing combustion on the interior of the assembly after 70 minutes	PASS



New Zealand / Australia

ISO5660 Cone Test

Test facility: BRANZ, New Zealand.
Testing in accordance with AS/NZS3837:1998 and ISO5660-1.
Classification according to NZBC C/VM2 Appendix A and AS5637:2015: **Group 3**.

United Kingdom / European Union

EN 13283:2020 European Single Burn Item (SBI)

Test facility: Meka, Latvia.
Testing according to EN 13283:2020 European Single Burn Item (SBI) Test and EN ISO 11925-2:2020.
Classification according to EN13501-1:2018: **Class D-s1-d0**.



WUI test.



ISO5660 Cone test.



Thermal Performance

Thermal Performance

Windows are generally accepted as the weakest point of a building's insulation envelope and should be a target to reduce operation carbon.

Imbue Radiata has created Imbue Radiata heat tempered wood with extremely low thermal conductivity even when compared with other timber products. Performance is up to 30% better than softwood and up to 60% better than hardwood.

Testing was conducted by Thermtest, Sweden according to ASTM C518, ISO 8301, and EN 12667 standards.

Test Method	Average Thickness (mm)	Average Temperature (°C)	Thermal Conductivity (W/mK)	R-value (m²K/W)
EN12667	42.55	10	0.095	0.4474

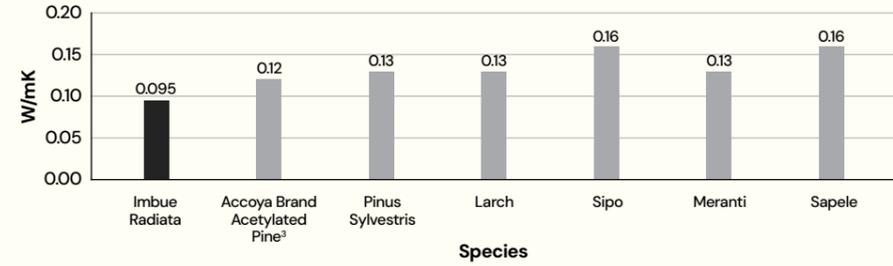


Sample configuration set up.

Imbue Radiata



Graph 7: Comparative Thermal Performance of Various Common Joinery Timbers



Sources: accoya.com/app/uploads/2020/04/Accoya_WoodInfoGuide-1.pdf, abodo.co.nz/uploads/resource/SKH-Independent-Certification.pdf

View all specification and technical information on imbuewood.com/resources

Accoya is a registered trade mark of Titan Wood Limited.



Imbue Radiata Decking, Whatawhata, New Zealand. Installed 2022.



Imbue Radiata



Imbue Radiata Decking, Rotorua, New Zealand. Installed 2020.



Imbue Radiata Cladding, Sydjylland, Denmark. Installed 2024.



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