

The Accoya® Wood Information Guide



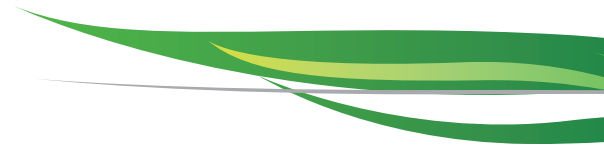
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Welcome to the Accoya® Wood Information Guide which has been compiled to provide detailed information and recommendations for the handling and use of Accoya® wood.

This Guide has been written for professionals wishing to use Accoya® wood to create beautiful, reliable and highly durable end products. Should you require further information or have any comments about this Guide, please contact us.

This is version 3.1 of the Wood Information Guide, to confirm currency and check for other potentially useful information please check the Download section of www.accoya.com



01 Accoya® Wood Properties

Introduction

Accoya® wood represents a major development in wood technology that has made the consistent supply of durable, dimensionally stable and reliable wood a reality.

Accoya® wood's performance credentials have been extensively researched and repeatedly demonstrated. Accoya® has properties that exceed those of the world's best woods yet it is manufactured by modifying wood sourced from well-managed sustainable forests without the introduction of toxins.

Properties



OUTSTANDING DURABILITY

- Lasting 50 years above ground, 25 years in-ground/freshwater
- Class 1 durability, surpassing even teak
- Virtually rot proof



PERFECT FOR COATING

- Improved stability means coatings often last 3 to 4 times longer
- Easier to coat, less preparation and sanding required



DIMENSIONAL STABILITY

- Swelling and shrinkage reduced by 75% or more
- Doors and windows open effortlessly year round
- Reduced maintenance costs



EXCELLENT MACHINABILITY

- Easy to machine and process
- No special tools are required



INSECT BARRIER

- Indigestible to a wide range of insects, including termites
- Greatly reduced vulnerability



UV RESISTANT

- Superior resistance to UV degradation when translucent coated
- Natural appearance lasts longer
- The ultimate substrate and coating life is increased



SUSTAINABLY SOURCED

- Including FSC, PEFC and other regionally certified woods
- Naturally renewable



NATURALLY INSULATING

- Offers improved thermal insulation in comparison with commonly used wood species
- Ideal for applications where energy conservation is important



CONSISTENT QUALITY THROUGHOUT

- Consistent, measured modification quality from surface to core
- No need to apply chemical preservatives when cut or planed



NATURALLY BEAUTIFUL WOOD

- Process does not compromise the wood's natural beauty



RETAINED STRENGTH & HARDNESS

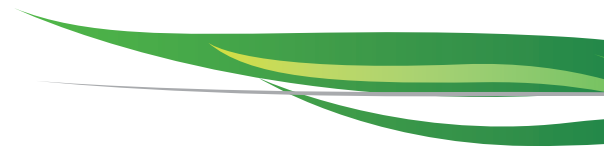
- The process does not compromise the wood's strength
- Hardness is increased
- High strength to weight ratio makes it suitable for challenging applications



NON TOXIC & RECYCLABLE

- Protects the environment from the harmful effects of common treatments
- May be safely reused and recycled





01 Accoya® Wood Properties

Summary Technical Data

This table shows the average properties of Accoya® wood and has been compiled using data extracted from official test reports, copies of which are available upon request.

Durability class	1
Density	510 kg/m ³
Equilibrium moisture content (65% rel. humidity, 20 °C)	3-5 %
Swelling (oven dry - wet)	Radial 0,7%
Tangential	1.5%
Bending strength	39 N/mm ²
Bending stiffness	8790 N/mm ²
Hardness (Janka)	Side 4100 N
End	6600 N
Thermal Conductivity via EN 12667 standard	$\lambda = 0.13 \text{ Wm}^{-1}\text{K}^{-1}$
Fire Rating	Class C via ASTM E-84*

* Higher ratings can be obtained through coatings and fire retardant treatments

Appearance

Accoya® is supplied as rough sawn and planed wood in various sizes and grades. Finger jointed and glue laminated beams can be produced to meet larger needs.

Acetylation & Durability

Accoya® wood is modified throughout the cross section, not just at the surface. The quality of the modification of each batch produced is validated by a range of sophisticated and proven tests that take place in Titan Wood's laboratories. Thus consistent quality and performance in accordance with set standards is assured. Accoya® wood always meets the requirements of Durability Class 1 for Use Classes 1-4 in accordance with EN 350-1 & EN 335-1.

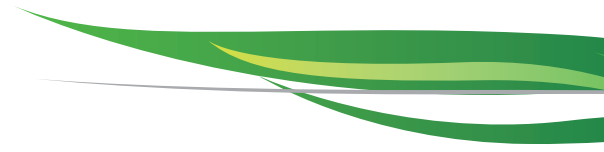
Accoya® wood is resistant to salt and can be used around saltwater (for instance as marina decking). Permanent emersion of Accoya® in salt and brackish water (i.e pilings) is not recommended since the acetylation treatment is not warranted for resistance against marine borers and other marine organisms.

Accoya® has been proven in multiple tests against various insect species in multiple geographies to have improved performance. Please see Section 10 for more details on available test results.

Classification of the Natural Wood Durability to Wood-Destroying Fungi

Durability Class	Description	Average Life Span
1	Very Durable	25 years and more
2	Durable	15 - 25 years
3	Moderately Durable	10 - 15 years
4	Slightly Durable	5 - 10 years
5	Not Durable	Less than 5 years





01 Accoya® Wood Properties

Use class	Conditions of use	Wetting	Wood moisture content <small>*Short-term: a couple days to 1 week</small>
1 ✓	No contact with the ground, sheltered and dry	Permanently dry	Permanently dry < 20%
2 ✓	No contact with the ground, sheltered with little chance of becoming wet	Occasionally exposed to moisture	Incidental, short-term exposure* >20%
3 ✓	No contact with the ground, not sheltered in all weather conditions	Regularly exposed to moisture	Regular, short-term exposure* >20%
4 ✓	In contact with the ground or fresh water	Permanently exposed to water	Permanent exposure >20%
5	In contact with salt or brackish water	Permanently exposed to salt water	Permanent exposure >20%

Detailed Acetylation Information

The Accoya® wood brochure and website, www.accoya.com, provide a detailed description of the acetylation process and the properties of Accoya® wood. In addition, official test reports may be obtained upon request.

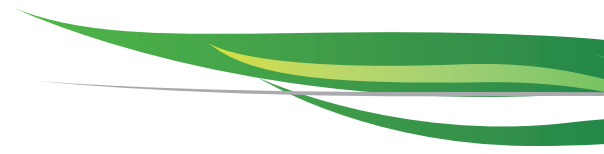
Health and Safety Considerations

Health and safety tests have been successfully performed against a wide range of standards in multiple geographies. Details of tests performed are listed in Section 10. A Material Safety Data Sheet is available upon request.

Structural Applications

The Accoya® process has minimum but important effects on strength characteristics of wood. The values reflected in the Summary Technical Data table are only averages for Accoya® made of appearance grade wood. Structural grades have much higher ratings and are recommended for any actual structural application.





02 Transportation and Storage

Accoya® Wood Packages

All Accoya® wood undergoes inspection before leaving the plant. Accoya® wood is strapped with binding tape into standard labeled packages, each with a unique number. Titan Wood supplies Accoya® wood in rough sawn dimensions in dry condition (wood moisture content <8%).

Transportation

Titan Wood ships ex-works under INCOTERMS 2000 or to otherwise agreed handling terms for delivery in accordance with the accepted orders. The recipient at the delivery address must ensure that Accoya® wood packages are unloaded carefully, preferably using a forklift truck or another device with pallet jacks.

Storage

Accoya® wood that needs further processing, gluing or coating should be carefully stored, preferably in closed or well ventilated sheds to prevent water/moisture uptake. Please see Section 3 for more details on determining whether Accoya® has absorbed excess water and for drying considerations.

Storage of Machined Parts

Accoya® wood can be manufactured into parts often with long intervals before assembly. Unlike many wood species, changes in size and shape of parts due to dimensional stability issues are minimal and thus it is typically possible to pre-manufacture for many days worth of assembly versus having to keep tight schedules between time of machining and assembly. Direct exposure to water and changing climate (temperature and relative humidity) should still be avoided.

Storage & Transport

In order to prevent damage, especially if coating is to be done on-site, products made of Accoya® should be carefully transported. Protection of joints is especially important. To prevent water uptake during transport, storage and at the building site, it is strongly recommended that Accoya® is covered in a breathable barrier / "vapor-open" plastic.

As with other wood species, storage at the building site should be a minimum of 10 cm above concrete flooring and 30 cm above ground. Additional protection from rain with plastic sheets is strongly recommended but sufficient ventilation underneath the sheets is required to prevent mold.

Traceability

Accoya® wood is primarily identified by its packaging labels, which feature the Accoya® wood and Titan Wood logos. In case of doubt, we will verify the product's authenticity. In addition, Accoya® wood can generally be traced by its packaging number. It is therefore imperative to retain all relevant documents and to record the movements of each package through to the manufacture of the products. This tracking is also needed if you intend to offer products with certified sustainable wood certifications. The packaging number is to be quoted in the case of any queries, complaints or warranty claims. Accoya® wood can be ordered as a certified sustainable wood, such as with FSC or PEFC certification.

Information Transfer

It may be important to inform the principal and third parties doing installation that Accoya® has been used in the production of your product. Portions of this guide such as proper storage to the building site, appropriate fasteners and fixtures to use for final installation and related considerations should be communicated.



03 Wood Moisture Content

Introduction

Wood releases moisture in dry climates and absorbs moisture in humid conditions. The moisture within wood takes two forms: “free water”, which is contained in the cell cavities (or lumen), and “bound water”, which is contained in the cell wall matrix. While Accoya® wood in any conditions will have minimal bound water, which is what accounts for many of its superior properties, it can still contain free water. Final product quality can be harmed by excessive free water; it is therefore essential that the moisture content of the wood is determined prior to processing, gluing and coating.

Definition

Wood moisture content, as expressed in this guide, is the mass of the water contained in wood, expressed as a percentage of the mass of absolutely dry wood.

Wood Moisture Content

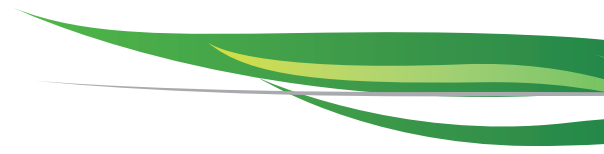
We supply Accoya® wood in dry condition (wood moisture content < 8%). This allows Accoya® wood to be processed into products for both interior and exterior applications directly after being delivered.

Measuring for Excess Water

The typical wood moisture content of Accoya® wood cannot be measured with standard moisture meters prior to processing because its moisture content is below the measuring range. However, standard moisture meters may be used to determine whether Accoya® wood has an excess of “free water”. For pin-type (electric) moisture meters no Accoya setting is available. For indicative measurement either Radiata pine or another pine setting may be used. For capacitive meters a density setting of 510 kg/m³ should be used. If the measurement shows a moisture content of 8% or more this may indicate the presence of “free water” and the wood should be allowed to dry before processing, gluing or coating.

Water Absorption Properties

Accoya® wood typically absorbs moisture more slowly than other species other than through its end-grain. However, (liquid) water absorption can be deep and it takes longer to dry out than most species. This is one reason that extra care should be taken in storage and why measurement for possible excess water should be to the core of boards.



04 Processing

General

Processing of Accoya® wood does not affect its unique properties, such as durability and dimensional stability, as the wood is modified throughout the cross section and is not leachable. Accoya® is easy to process and can be compared, in general, to a harder softwood species. Exceptions are noted below. Special tools are not required; for example, to do cross cutting, ripping, planing, routing, or drilling. Sanding before finishing is often not required, due to the superior machining properties of Accoya®.

It should be noted that a light vinegar smell may become apparent when Accoya® wood is processed. With proper suction / ventilation this can be reduced to a minimum. Health and safety tests have been successfully performed against a wide range of tests in many geographies and have shown no issues.

As with other wood species with higher acid levels, caution should be taken to prevent long term exposure of wood machinery and exhaust systems to dust and shavings to prevent corrosion.

Prior to machining the wood, moisture content should be checked (see Section 2). A moisture content reading showing < 8% indicates suitability for processing.

Visual Quality

Accoya® wood is an high performance, all-natural solid wood and as such offers the beauty, versatility and charm of the original wood species. Accoya is available in a range of different qualities. Consistent with the grade purchased, the timber may show certain visual defects after being processed, such as distortion, internal cracks, bark and resin pockets.

As a result of kilning and our production process, newly produced Accoya® wood may show some surface irregularities, such as discoloration (brown) and sticker marks. To achieve a uniform appearance, it may be necessary to plane or saw off a few millimeters depending on the visual quality desired

Changed Properties

Due to the acetylation process, a number of wood properties have been altered that are of importance for proper machining of Accoya® wood:

- ▶ The Janka hardness increases from the original wood used to produce Accoya®. Please see Section 1 for ratings. As a rough guide, Accoya® wood is more comparable in machining to species like Hard Maple, American Cherry or American Walnut.
- ▶ Density has increased (avg. 510 kg/m³). Processing characteristics are equivalent to working with denser softwoods (for example Southern Yellow Pine).
- ▶ Since the typical moisture content of Accoya® is below 8%, this can make the material a little more brittle.

Collection Systems

As Accoya® wood shavings are often finer than other woods, the dust collection system should have enough capacity to prevent shavings being thrown onto the material by the knives. If this happens an impression of the chip may show in the finished product. This is because with the minor density and flexibility of the fibers in Accoya®, impressions may not disappear even when dampened.



04 Processing

General Processing Advice

To obtain the best results:

- ▶ Make sure that knives are aligned and sharp because Accoya®, when planed properly, will be very smooth after machining.
- ▶ Every flaw or dent in the knives will leave a permanent mark on the wood. Therefore it is advised that if working with multiple species, and knives that are rapidly dulled, to machine Accoya® first before the other species, to get the best results.
- ▶ Due to the smooth surface all knife marks in the surface will be visible in the coated product. Special care is needed.
- ▶ When molding, the feeding of rough Accoya® through machines (should be done more as though you are feeding hardwood than softwood. For optimal quality a feed speed of 500 linear meters per hour and spindle rotation velocity of 12000 rpm typically gives a very smooth result.
- ▶ In a typical production environment, a feeding speed of 1000 linear meters/hour and spindle speeds of 6000 rpm can be used.
- ▶ When you are machining Accoya® for the first time it is best to produce some test runs to see what the best parameters are. The in-feed rollers can be aluminum but the out feed rollers of equipment should preferably be rubber to prevent surface damage. The complete working table must be cleaned and aligned and the tables should not show any wearing of the steel to ensure the precise machining appropriate for Accoya®.

Sawing

Accoya® wood is easily cut in any direction. Skillful sawing will give a smooth appearance with very few flaws. Standard techniques such as using backer boards can be used when very fine results are desired. Similar to other wood species rip-sawing of Accoya® boards can reveal stresses created during drying and processing. Distortion (warping) and surface checking limits of boards only applies to their state as received.

Planing & Profiling

Accoya® wood is easily planed to a very smooth surface finish. Special tools are not required. It is, however, important to avoid machining marks during processing and to avoid contact with products that will discolor the surface, such as oil or rust, particularly if the wood is to be translucent coated.

Since Accoya® wood has a low wood moisture content shavings are finer and may be electrostatically loaded due to friction with the routing blades. This can lead to impressions of shavings if the exhaust system has too little power and a large section of the wood is profiled in one run. Solutions include increasing the blade rotation velocity (rpm) or using anti-friction lubricants (to reduce static-energy).

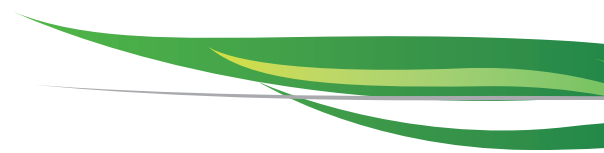
Bending

The Accoya® wood production process does not generally weaken the original wood species, nor does it compromise bending properties.

Accoya® wood bends well using most conventional techniques including steam bending. In this case Accoya® has comparable bending properties like softwoods and bending should also be done in a similar fashion. Impregnation with ammonia to ease bending should not be done.

Drilling

Accoya® wood drills in a manner and quality consistent with most softwoods. For deep drilling, care may be needed to remove debris, given the fine smaller shavings that are produced by Accoya®. For dowel connections it is important that the diameter of the drill is no smaller than the diameter of the plug to prevent splitting.



04 Processing

Fasteners & Fixings

Accoya® wood can be fixed in the same way as other commonly used softwood species and the same general rules regarding pre-drilling, countersinking and keeping sufficient distance from the edges should be applied. Like most durable woods, Accoya® contains a small amount of acid. It is therefore strongly recommended that corrosion-resistant fixings, such as high quality stainless steel, are used. For further information, please refer to Section 06, "Contact with Metals".

Accoya® wood is extremely dimensionally stable but this does not mean it is completely inert. Changes in humidity can cause slight changes in Accoya® wood's volume and these should be taken into account for product design and installation. In extreme conditions (and for the purposes of Accoya's warranty) the tolerances noted below should be allowed. Installation guides that cover dimensional stability considerations for normal wood products should be more than sufficient for Accoya® wood. For more specific information on dimensional stability values please contact us.

Dimensional Stability Comparison

Species	Avg. radial	Avg. tangential	Warranty maximum ³
Douglas Fir ¹	4,8%	7,6%	-
Teak ¹	2,5%	5,8%	-
Meranti ¹	3,0%	6,6%	-
Merbau ¹	2,7%	4,6%	-
Sapele ¹	4,6%	7,4%	-
Radiata Pine ²	3,4%	7,9%	-
Accoya® Radiata Pine ²	0,7%	1,5%	2,5%

¹ Wood Handbook, USDA Forest Products Laboratory. Green to Oven Dry measurements

² Dimensional stability of Accoya® wood under different moisture conditions, SHR Report 6.322

³ Accoya® wood - Certificate of Warranty

Expansion/Contraction across typical decking or cladding (130 mm or 5 1/8" actual width)

Species	Avg. quarter sawn (in / mm)	Avg. plain sawn (in / mm)	Warranty maximum (in / mm)
Douglas Fir	0.26 / 6,7	0.42 / 10,6	-
Teak	0.14 / 3,5	0.32 / 8,1	-
Meranti	0.17 / 4,2	0.36 / 9,2	-
Merbau	0.15 / 3,8	0.25 / 6,4	-
Sapele	0.25 / 6,4	0.41 / 10,4	-
Radiata Pine	0.18 / 4,8	0.43 / 11,1	-
Accoya® (Radiata Pine)	0.04 / 1,0	0.08 / 2,1	0.14 / 3,5

Although Accoya® wood's enhanced dimensional stability often allows for greater sizes than previously possible (for example, greater widths on cladding without excessive cupping), the amount of tolerance should still be adjusted proportionally with size.



04 Processing

Waste wood & end of life considerations

Accoya® wood waste can be handled in the same way as untreated wood. Accoya wood is non-toxic and does not require any special disposal considerations. Given its long life, multiple applications and non-toxicity, Accoya wood® is suited to re-use and recycling.

In the end-of-life phase, we recommend the adoption of the “preferential sequence for wastemanagement”. This model largely follows the guidelines of the popular Cradle to CradleSM (C2C) philosophy developed by William McDonough and Michael Braungart to close biological and technological cycles as far as possible to re-use materials. The model consists of the following possible waste management scenarios in which prevention is the most desirable option and dumping is the least.

- ▶ Avoiding of waste
- ▶ Designing products that integrate waste avoidance and re-use at the end of their life
- ▶ Re-use of the product
- ▶ Re-use of the material
- ▶ Use for energy production (incineration)
- ▶ Burning
- ▶ Dumping

We recommend to integrate Accoya® wood’s performance into the overall design strategy of a product and apply an appropriate maintenance interval for Accoya® wood for the intended application and life time requirements. Further we recommended to design in such manner that product or material re-use is warranted since the life time of Accoya® wood might be succeeding the life time of the product.

If this is not possible, we recommend that Accoya® wood is used for energy production through incineration. The renowned German wood research institute Wilhelm-Klauditz-Istitut (WKI)* has confirmed that Accoya® wood may be incinerated for energy production in the same manner as untreated wood. The last resort should be composting, Accoya® wood can be handled in the same way as untreated wood, bearing in mind that this process may take longer than for untreated wood because of Accoya® wood’s resistance to fungal decay.

Use of shavings as animal bedding is not recommended.

05 Gluing

General

As with all wood species, the right choice of glue will depend on the application and the required performance of the glue bond. Accoya® wood has been tested with various types of adhesives for many applications. In general Accoya® can be glued using most commonly used wood adhesive systems. Particularly good results are obtained with polyurethane (PU), emulsion polymer isocyanate (EPI), epoxy and phenol resorcinol formaldehyde (PRF) adhesives. The results of gluing with polyvinyl acetate (PVA) and melamine urea formaldehyde (MUF) can vary greatly.

When gluing Accoya® wood it is strongly recommended to test first and if needed contact your adhesive supplier(s) as they have in-depth knowledge of the gluing process and their adhesives.

Changed Properties

Comprehensive testing has shown that Accoya® wood has good gluing properties. However, it is imperative that the product's modified properties are taken into account. This is of particular importance because common wood adhesives (PVAc, EPI, PU, PRF) either harden on contact with moisture or part of the water content of the adhesive needs to be absorbed by the wood.

The acetylation process substantially reduces the ability of the wood to swell. This can impact properties such as the ability of joints to 'self clamp'. Another effect is that the equilibrium moisture content of Accoya® wood is substantially lower than untreated wood in the same climatic conditions. While this makes Accoya® wood dimensionally very stable, it can mean that absorption properties of the wood are different due to the hydrophobic nature of the wood surface in its first minutes. Adhesives that require water as a catalyst and those consisting of two or more components that could migrate differently, may have weaker bonds.

For further information about the moisture content of Accoya® wood, please refer to Section 03 "Wood Moisture Content". The aspects that require extra attention for the effective gluing of Accoya® wood are detailed below.

The presence of a low amount of acetic acid in Accoya® wood, as with many other durable woods, can affect the adhesive, especially acid catalyzed adhesives and adhesives with a large amount of alkaline additives.

Optimizing the Adhesion Process

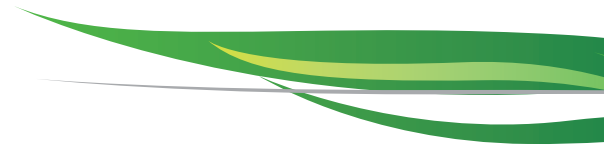
It is highly recommended that you consult your adhesive supplier in order to obtain the best results for gluing Accoya® wood. Points to consider include:

- ▶ The quantity of adhesive to be applied should, if possible, be even on both sides in accordance with the adhesive manufacturer's instructions.
- ▶ Possibly a longer "open-closed" time, which gives Accoya® wood more time to absorb the water element of the adhesive.
- ▶ The applied pressure during gluing should be adapted to the strength of Accoya® wood, as should the temperature if heat is applied. Accoya® should be treated as moderately hard softwood in this context.
- ▶ The curing time and the best curing conditions.

Joints

It is strongly advised that any end-grain that will be exposed be sealed using a suitable product as recommended by the supplier. For a long lasting result, we emphasize the importance of a proper frame corner joint. Despite the improved durability and dimensional stability of Accoya® wood, it is still important to make the frame corner joint connection watertight to avoid possible paint and other damage.

The use of dowels, biscuits and similar devices, if not made out of Accoya® wood, should take into account that they may swell much more than Accoya®. For dowel connections it is important that the diameter of the drill is exactly the same as the diameter of the plug. This is to prevent splitting of the ends.



05 Gluing

Finger Jointing

Good results have been achieved with EPI, PRF and MUF. Special care is required to produce the fingers. Sharp knives without any damage need to be used to create perfect fingers. Blunt knives can result in "broken" fingers. Due to the short-term hydrophobicity of Accoya[®] wood it might be necessary to increase pressing time and curing time. The pressure of the pressing should be set for softwoods.

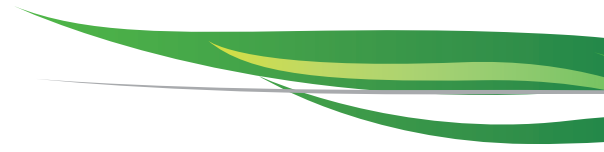
Laminating

Good results can be achieved with PU (both 1 and 2 component types) and PRF. It is important to work on a flat surface and not apply too much pressure because Accoya[®] wood is smoother and may expel adhesives from the gluing surface. For load bearing applications, applicable local regulations should be followed. Due to the high dimensional stability of Accoya[®] wood, the annual ring orientation and the amount of layers is of less importance. For instance vertical lamination (edge gluing) to 100x150 mm has been proven possible with two unevenly distributed lamella (2:3 configuration).

Further Information

Further information may be obtained directly from adhesive suppliers. We can provide contact details if necessary.





06 Contact with Metals

General

All wood contains organic acids, although the quantity varies by species. These organic acids are the main cause of corrosion of metal fasteners used in wood. Accoya® wood has comparable acid levels to other durable species such as oak and western red cedar.

Tests have shown that base metals and galvanized metals that are in direct or indirect contact with wood containing acids will corrode in damp climatic conditions. It is therefore strongly recommended that high quality stainless steel products be used where possible. When stainless steel is not

available, metals and/or the Accoya® wood should be coated or otherwise separated to avoid the two coming into direct contact. Indirect contact issues can occur in non-ventilated areas where condensation related corrosion is possible (for example, lock rebates).

As with any installation, pit or galvanic corrosion must also be avoided by using fasteners that are compatible with the metals used in hinges, locks and other hardware. Please consult your fixings supplier to avoid any issues.

Stainless Steel

The use of corrosion-resistant steel fasteners that conform to EN 10088-1 is recommended, such as A2 or A4 or AISI Type 304 or 316 quality stainless steel. Stainless steel fixtures should also be used when available. An international comparison of grade specifications is provided below:

USA	UNS No	Old British BS	En	Euronorm No	Name	ISO 3506	Swedish SS	Japanese JIS
304	S30400	304S31	58E	14.301	X5CrNi18-10	A2	2332	SUS 304
304L	S30403	304S11	-	14.306	X2CrNi19-11	-	2352	SUS 304L
304H	S30409	304S51	-	14.948	X6CrNi18-11	-	-	-
316	S31600	316S31	58H, 58J	14.401	X5CrNiMo17-12-2	A4	2347	SUS 316
316L	S31603	316S11	-	14.404	X2CrNiMo17-12-2	-	2348	SUS 316L
316H	S31609	316S51	-	-	-	-	-	-

Note: These comparisons are approximate only. The list is intended as an example of commonly available highly corrosion resistant stainless steel fasteners known to work well with Accoya®. Many other grades of stainless steel exist, of which many are also highly corrosion resistant, but it is best to work with your supplier to understand the compatibility of these other grades with Accoya® wood.

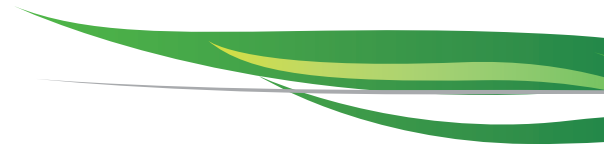
Coated Steel

When stainless steel fixtures are not available and coated fixtures (such as with epoxy and polyurethane) must be used, they should be designed for outdoor use. Pre-drilling is advised to help prevent damage to the coating.

Other Metals

Galvanized metals are not corrosion-proof when used with Accoya® wood. The surface of aluminum, copper, lead and other metals may also oxidize. Testing and experience to date with the use of solid brass has been positive and polished naval brass has found to be highly resistant to corrosion. Aircraft anodized aluminum (6061 or 6063) and chrome plated steel performed very well in testing but if the protective layer is compromised these products will be susceptible to accelerated corrosion.





06 Contact with Metals

Avoidance of Corrosion

Metal corrosion can be substantially reduced if direct contact between metals and Accoya® wood is avoided. This can be achieved by:

- ▶ Coating the wood with a proper sealant. Coating the metal with an acid-resistant coating, sealer, or other protective layer.
- ▶ Physically isolate hardware from direct contact such as the use of plastic (or stainless steel) spacers.
- ▶ Enclosed areas containing metals, such as around lock rebates, should also be sealed (for example with epoxy) even if there will not be direct metal contact. If these areas are not sealed, off-gassing acetic acid can build up in these confined spaces and increase the risk of accelerated condensation related corrosion.

For additional temporary protection the spraying of all sides of the metal hardware before assembly/mounting is recommended using a water repellent spray (such as PTFE or silicon based spray) or rust inhibitor coating. This is also useful in case coated metals have been scratched during installation. Please note that these sprays can influence adhesion of coatings and maintenance of metal hardware.

Preferably pre-drill for screws and other larger diameter fasteners. For attaching smaller pieces of Accoya®, such as glazing rods, the use of staples, such as those made of 18 gauge A2 stainless steel, is recommended to minimize the chances of splitting (for detailed information see Section 04).

Avoid Condensation

Ventilation of construction areas to avoid condensation on metal in contact with Accoya® can be useful in helping to avoid potential corrosion issues.

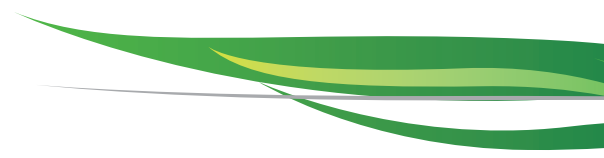
Proper Storage & Transport

See Section 02.

Further Information

Further information may be obtained directly from suppliers of fasteners, hinges and locks. We can provide a list of suppliers most familiar with Accoya®.





07 Contact with Other Products

Introduction

Accoya® wood has been tested for compatibility with a wide variety of products likely to be used in given applications and geographies. The information below is a summary of these findings. Some is based on internal research and other parts come from extensive testing with supply partners. If you would like more information on any topic please contact us.

Sealants, Gaskets & Related Parts

We have seen rare examples where the small amount of acetic acid in Accoya® wood can influence the curing process or the long-term performance of sealants. Thus, it is strongly recommended that the sealant supplier performs a compatibility check if their product has not already been tested. This applies to glazing sealants (silicon, poly-urethane, MS-polymer) as well as to sealants used in double-pane glass (for example, Poly-sulfide, silicone and Polyvinylbutyral). When applying products on unfinished Accoya® wood, adhesion can be improved by applying a primer before applying the sealant.

Cleaning Agents

Cleaning agents vary tremendously in chemical composition and the way they are used. In general, cleaning agents are quite aggressive chemicals that need to be handled carefully. After applying a cleaning agent extensive washing with clean water is strongly recommended. It should be noted that some of these products can impact the (long term) performance and aesthetics of Accoya® wood. Additionally, exposure to alkaline conditions (pH-values >9) should be avoided and will invalidate any warranty on the durability performance of Accoya®. Other products, such as chlorine and oxalic acid, typically have a bleaching effect on the appearance of Accoya®.

Wood Repair Products

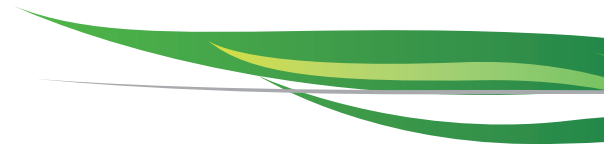
For Accoya® wood products that will be finished with a film-forming coating system it is recommended that all mechanical damage (for example, cracks and unsound knots) is repaired prior to finishing. This is to prevent (liquid) water uptake by the wood that could impact the lifetime of the coating system.

It is important to follow the instructions of the supplier and check on the possible interaction of the repair system with other components. It is strongly advised to use a repair system that has been tested for adhesion of paints, shrinkage behavior, practical workability and resistance against moisture, UV light and temperature. 2-Component systems (for example, epoxy or poly-urethane) are strongly preferred. One component systems, that tend to shrink after drying and create capillary holes, should not be used.

End-Grain Sealers

For Accoya® wood products that will be finished with a film-forming coating system it is strongly recommended that all exposed end-grains of the assembled product be sealed. It is advisable to use a product that has been tested for its ability to prevent liquid water uptake by the wood, adhesion with the wood, UV resistance and coating adhesion.





07 Contact with Other Products

Fire Retardant Treatment

As with other woods, in some cases Accoya® requires additional treatment with a fire retardant to meet application requirements per local regulations. Since the structure of Accoya® is modified, it is possible that the performance of the fire retardant will vary from normal woods. It is therefore important that the fire retardant performance is proven, preferably by an independent and accredited body.

Most fire retardants significantly reduce the strength of wood due to their moisture absorption properties and the impact of moisture on wood's strength. Tests on Accoya® wood indicate that its strength is not compromised in a similar manner and thus smaller dimensions may be acceptable to meet strength requirements. The parameters of any given structural application must be carefully planned and tested. Please contact us for more information.

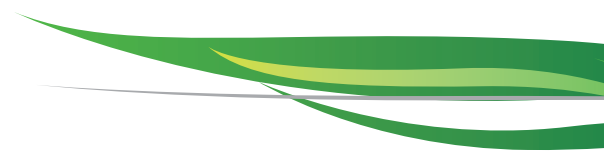
Bleaching Treatment

Bleaching of Accoya® can be performed with a mild solution of peroxide. Please contact us for procedure details. Since these kind of chemicals can have an effect on the performance of Accoya® wood, it is strongly recommended that after application the chemical is removed with a thorough amount of water (see also Cleaning Agents in this section).

Pressure Treated Wood Products

Typical pressure treated lumber containing metal salts such as CCA, ACQ and MCQ can leach copper. We have found a small number of cases where the copper in the pressure treated lumber was wicked into the Accoya and resulted in green staining of Accoya wood. To prevent the risk of Accoya wicking up copper from pressure treated lumber, we recommend isolation techniques such as plastic (or stainless steel) spacers, coatings and/or ensuring the design of the structure allows quick drying of the pressure treated wood.





08 Coating

General

Accoya® wood's compatibility with various coating systems compares well with wood in general and it may be finished with commonly used products. Please note: coating formulations vary from supplier to supplier and, of course, processes vary depending on the application equipment used and end-product design. We also know that formulations of some suppliers' products vary by geography. Despite Accoya® wood's excellent record of compatibility, we highly recommend having your coating suppliers involved in the process as they have in-depth knowledge of their products, application and how to determine the performance of the finished product.

Coating versus Unfinished Considerations

From a technical performance perspective, in respect of attributes such as durability and dimensional stability, there is no need to finish Accoya®. However, like any natural wood species, Accoya® wood is susceptible to weathering in outdoor circumstances. A series of chemical, biological and physical processes try to degrade wood. When used unfinished, Accoya® wood can exhibit various types of discoloration such as blue stains, molds and uneven UV weathering. Stains can also be caused by use of aggressive cleaning agents, foods and other substances inadvertently left on the wood. Also discoloration can occur around metal fasteners. In addition to discoloration of the surface, unfinished Accoya® wood's texture, when outdoors, will become rougher over time.

To obtain a "natural appearance" with reduced potential discoloration issues, a translucent (film-forming) coating, a non-film-forming coating, an oil-based stain or some other type of hydrophobic agent is recommended. Non-film-forming coatings can be applied if water uptake is not an issue. Oil-based stains and hydrophobic agents have water repellent properties, but often cannot prevent water uptake on horizontal parts.

Graying

Wood, including Accoya®, used outdoors will eventually "grey" due to two biological processes that take place within the wood and at its surface:

- ▶ 1 UV light partly degrades substances in the Accoya® wood structure leading to a lightening of the surface (natural wood species obtain a typically dark brown.). These substances are water soluble and the surface of the wood pales when washed with water.
- ▶ UV degraded wood has a more open structure and this allows surface molds, stains, mosses and algae to penetrate and develop. They do not, however, cause rot with Accoya®. The most common surface fungus is blue-stain, which is actually black but combines with the light color of the wood to give a grayish appearance on the surface.

Accoya® wood is all-natural and non-toxic so blue-stain growth can occur if Accoya® is left uncoated. Blue-stain can be avoided by using a high quality UV resistant coating. This also protects the wood from accidental staining such as spilled food.

Changed Properties

The wetting of Accoya® is different due to the hydrophobic nature of the wood surface in its first minutes of exposure. In the long term Accoya® wood can absorb (liquid) water. As a result of this trait, water-based stains may not penetrate as deeply or form as thickly on Accoya®.

Accoya® wood contains a small amount of acetic acid. This can disturb the flow coating process. By adding a buffer in the coating, potential problems with flaking can be prevented. Please consult your coating supplier.



08 Coating

Preparation

- ▶ The moisture content of the Accoya[®] wood to be finished should be dry ((below 8% mc)
- ▶ Where possible, it is preferable to finish the wooden parts on all sides before mounting or assembling them.
- ▶ Please contact your coating supplier for advice and processing instructions.
- ▶ When using a primer, a high quality product that contains resin-bleed blockers and fungicides is still recommended despite the improved performance of Accoya[®] wood.

Sanding

Sanding Accoya[®] wood presents no challenges. Tests have shown that it is often not necessary to sand Accoya[®] wood between coats of water based coatings since fibers scarcely 'bloom' or rough the surface after moisture absorbance.

Opaque & Translucent Coatings (Film-Forming)

Before a film-forming coating is applied, it is recommended that all mechanical damage (cracks, unsound knots) are repaired with a suitable product prior to finishing. Opaque and translucent coating systems should be applied on all sides with a minimum dry film thickness that corresponds to the requirements of the end product and/or paint supplier's instructions. End-grain should be sealed before coating with a suitable product so that the protection of all finished sides against water (liquid) uptake is approximately equal. Please contact your coating supplier for further advice.

Non-Film-Forming and Semi-Film Forming Systems

Accoya[®] wood may be finished with semi and non-film-forming paint systems such as stains and oils. Although it is acceptable to use both water and oil-based systems on Accoya[®] wood, the products tested to date show that the first layer is more quickly absorbed by Accoya[®] wood when using an oil-based product. In either case, it is recommended that multiple coats be applied. Please refer to your coating supplier for advice about the best way to apply their products.

Penetrating Oils

Oils such as tung, linseed, and walnut oil, whether pure or oil/varnish mixtures, may be used with good results. Please note that oils can be a food source to fungi and thus oils containing a fungicide/mildewcide are recommended if appearance is an important consideration.

Accoya[®] can absorb a great deal of oil. If you want to minimize absorption, it is recommended that you let the first coat of oil dry before applying additional coats.

Further Information

Further information may be obtained directly from coatings suppliers. We can provide contact details if necessary.

09 Certifications and Eco-Labels

Wood from Well Managed Forests

The responsible procurement of sustainable wood plays a fundamental role in enhancing the proposition of Accoya[®] wood as an environmentally responsible product. All Accoya[®] wood is produced from well managed, sustainable sources, including FSC, PEFC, other controlled wood sources.

Accoya[®] can be specified with FSC or PEFC (www.fsc.org / www.pefc.org) certification. Procedures are assessed annually by an independent certification body to ensure that they meet FSC and PEFC Chain of Custody guidelines.



Cradle to CradleSM Gold

The MBDC Cradle to Cradle certification evaluated our end product as well as the total production process of Accoya[®] wood, including the sourcing of the wood, energy, water and waste management. A prestigious Gold Certificate level was achieved. The report is available in the download section of our website: www.accoya.com/accoya_downloads.asp



Other Eco Certifications

Singapore Green Label

RAL (Germany)

Accoya[®] wood has been evaluated according to the VFF Merkblatt HO.06-4 for its suitability in RAL certified joinery. Final acceptance of Accoya[®] wood was given in April, 2010, after a provisional acceptance period, and it has been added to the "approved" wood species list of the VFF (Joinery and Facades Association).

KOMO (Netherlands)

Titan Wood's modification process and the end product, Accoya[®] wood, are inspected several times each year by the notified certification body, SKH (Netherlands), within the KOMO[®] guidelines for modified wood, in accordance with the assessment directive BRL 0605. Titan Wood's production is evaluated as follows:

- ▶ Uniformity and replication of the production process.
- ▶ Quality system.

Accoya[®] wood has been tested in accordance with SKH publication 97-04 in respect to durability, dimensional stability, mechanical properties, workability, gluability and finishing, and has been shown to satisfy the requirements demanded of a wood species for use in KOMO[®] certified joinery and façade cladding.

Window and Door Manufacturers Assc. Hallmark[®] (North America)

Titan Wood was certified by the Window and Door Manufacturers' Association (WDMA) as an approved material for Hallmark Certified producers after meeting the requirements of the WDMA I.S.4 "Industry Specification for Preservative Treatment for Millwork" in October, 2009. This rating certifies the quality of exterior millwork and gives government and private agencies a method of identifying windows and doors that are manufactured in accordance with the WDMA's highest standards. The WDMA Hallmark[®] is a mark of excellence among architects, contractors and other specifiers. Products eligible for Hallmark certification are subjected to a rigorous verification process in order to ensure conformance with requirements.

10 Standards and Regulations Testing

Introduction

Below is a sample of various standards and guidelines that Accoya® has been tested against, with passes or better results against set criteria. For more detailed information on these results, please contact us.

Europe

- | | | | |
|---|---|---|---|
| <p>EN 113
Wood preservatives - Test method for determining the protective effectiveness against wood destroying basidiomycetes - Determination of the toxic values.</p> | <p>EN 717-1
Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method.</p> | <p>EN 927-6
Paints and varnishes - Coating materials and coating systems for exterior wood - Part 6: Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water.</p> | <p>ISO 16000-9
Indoor air - Part 9: Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.</p> |
| <p>EN 320
Fibreboards - Determination of resistance to axial withdrawal of screws.</p> | <p>ENV 807
Wood preservatives - Determination of the effectiveness against soft rotting micro-fungi and other soil inhabiting micro-organisms.</p> | <p>EN 12667
Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance.</p> | <p>ISO 16000-11
Indoor air - Part 11: Determination of the emission of volatile organic compounds from building products and furnishing - Sampling, storage of samples and preparation of test specimens</p> |
| <p>EN 350-1
Durability of wood and wood-based products - Natural durability of solid wood - Part 1: Guide to the principles of testing and classification of the natural durability of wood.</p> | <p>EN 927-3
Paints and varnishes - Coating materials and coating systems for exterior wood - Part 3: Natural weathering test.</p> | <p>ISO 16000-6
Indoor air - Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/ FID</p> | |
| <p>EN 408
Timber structures - Structural timber and glued laminated timber - Determination of some physical and mechanical properties.</p> | <p>EN 927-5
Paints and varnishes - Coating materials and coating systems for exterior wood - Part 5: Assessment of liquid water permeability.</p> | | |

10 Standards and Regulations Testing

Germany

DIN 52184

Prüfung von Holz;
Bestimmung der Quellung
und Schwindung. (Testing
of wood; determination of
swelling and shrinkage)

DIN 5218

5 Prüfung von Holz;
Bestimmung der
Druckfestigkeit parallel zur
Faser. (Testing of wood;
compression test parallel to
grain)

DIN 52186

Prüfung von Holz;
Biegeversuch. (Testing of
wood; bending test)

DIN 52192

Prüfung von Holz;
Druckversuch quer zur
Faserrichtung. (Testing of
wood; compression test
perpendicular to grain)

AgBB:2008

Health-related Evaluation
Procedure for Volatile
Organic Compounds
Emissions (VOC and SVOC)
from Building Products.

DIN 52617

Bestimmung des
Wasseraufnahmekoeffi-
zienten von Baustoffen.
(Determination of the water
absorption coefficient of
building materials)

IFT Richtlinie DI-01/1

Verwendbarkeit von
Dichtstoffen. Teil 1 -
Prüfung von Materialien in
Kontakt mit dem Isolierglas-
Randverbund. (Application
of sealants. Part 1 - Testing
of products in contact with
sealants used in double
glass)

IFT Richtlinie FE-08/1

Rahmeneckverbindungen
für Holzfenster.
Anforderungen, Prüfung
und Bewertung (Window
corner joints for wooden
windows. Requirements,
testing and evaluation)

IFT Richtlinie HO-10/1

Massive, keilgezinkte und
lamellierte Profile für
Holzfenster. Anforderung
und Prüfung. (Solid, finger-
jointed and laminated
elements for wooden
windows. Requirements
and testing)

IFT Richtlinie 7/86

Verträglichkeit von
Dichtprofilen mit Anstrichen
auf Holz.

RAL-GZ 695

Fenster, Haustüren,
Fassaden und Wintergärten
- Gütesicherung (Windows,
doors, façades and patios -
quality assurance)

VFF Merkblatt HO.06-4

Holzarten für den
Fensterbau Teil 4:
Modifizierte Hölzer (Wood
species suitable for joinery).

Netherlands

BRL 0605

National Assessment Directive
for the KOMO[®] product
certificate modified timber.

BRL 1704-1

Finger-joined timber for load
bearing applications.

BRL 1704-2

Finger-joined timber for non-
load bearing applications.

BRL 2338

Adhesives for load-bearing
wooden building constructions.

BRL 2339

Adhesives for non-load bearing
applications.

BRL 2902

Optimized timber for non-load
bearing applications

SKH pub. 97-04

Basis of assessment for wood
species for use in KOMO
certified joinery; requirements
and testing methods

WVS_SHR_049

Determination of shrinkage
and swelling of solid timber.

10 Standards and Regulations Testing

North America

ASTM B117-0 7A

Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM D143- 94

Standard Test Method for Small Clear Specimens of Timber

ASTM E84

Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM G154-06

Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Non-metallic Materials

WDMA T.M. 1-06

Soil Block Test, Test Method to Determine Preservative Effectiveness in Preventing Wood Decay

WDMA T.M. 2-06

Swellometer Test, Test Method to Determine the Short-Term Anti-Swell Effectiveness of Treating Systems

WDMA I.S. 4

Industry Specification for Preservative Treatment for Millwork

AWPA E1-06

Standard Method of Laboratory Evaluation to Determining Resistance to Subterranean Termites

AWPA E10-01

Standard Method of Testing Wood Preservatives by Laboratory Soil-Block Culture

AWPA E12-94

Standard Method of Determining Corrosion of Metal in Contact with Treated Wood

AWPA E18

Standard Field Test for Evaluation of Wood Preservatives Intended for Use Category BB Applications Exposed, Out of Ground Contact, Uncoated Ground Proximity Decay Method

AWPA E20

Standard Method for Determining the Leachability of Wood Preservatives in Ground Contact

AWPA E22-07

Standard Accelerated Laboratory Method for Testing the Efficacy of Preservatives Against Wood Decay Fungi Using Compression Strength

AWPA E23-07

Accelerated Method of Evaluating Wood Preservatives in Soil Contact

AWPA E24-06

Standard Method of Evaluating the Resistance of Wood Product Surfaces to Mold Growth

General Standards

EN 335-1

Durability of wood and wood-based products - Definition of use classes - Part 1: General.

EN 460

Durability of wood and wood based products - Natural durability of solid wood - Guide to the durability requirements for wood to be used in hazard classes.

EN 10088

Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes.

10 Standards and Regulations Testing

Abbreviations

EN & ENV

EN stands for 'European Standard' and is the abbreviation used in the European classification system. ENV denotes a European pre-standard.

BRL & SKH

SKH is a Dutch notified certification body that is permitted to KOMO[®] certify timber, timber products, timber constructions and timber related products. The BRL represents the National Assessment Directive. For information about BRL and SKH publications contact Stichting Keuringsbureau Hout, SKH at T. +31(0)317 453425 or visit www.skh.org.

AWPA

The American Wood Protection Association standards are represented by the acronym AWPA. More information is available at www.awpa.com.

ASTM

ASTM stands for the American Society for Testing and Materials. More information is available at www.astm.org.

VFF & IFT

The VFF stands for "Verband der Fenster- und Fassadenhersteller" The "Gütegemeinschaft Fenster und Haustüren" is the beholder of the RAL certification (www.window.de). IFT Rosenheim is a test and certification body in Germany (www.ift-rosenheim.de).

ISO

ISO (International Organization for Standardization) is a network of the national standards institutes of some 162 countries, with a Central Secretariat in Geneva, Switzerland, that coordinates the system. Every full member of ISO has the right to take part in the development of any standard which it judges to be important to its country's economy. ISO standards are voluntary. As a non-governmental organization, ISO does not regulate or legislate. However, countries may decide to adopt ISO standards as regulations or refer to them in legislation. More information can be found on www.iso.org.



the world's leading high technology wood

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ACCSYS
TECHNOLOGIES

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