

The Accoya® Wood Information Guide



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

This Guide has been compiled 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.

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► 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



Non-toxic. The Accoya® wood manufacturing process adds nothing to the wood that does not already naturally occur in it



Improved mold and insect barrier performance



Class 1 durability – the best available



Resistance to UV light darkening degradation when translucent coated



Outstanding dimensional stability and improved hardness



Easy to machine and manually process



Improved thermal insulation in comparison with commonly used wood species



Available as Forest Stewardship Council (FSC)



Consistent and measurable modification quality – from the surface to the core of every sample



Environmentally compatible. 100% recyclable and naturally renewable



Retained natural strength and beauty

► 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/m³	
Equilibrium moisture content	3-5 % (65% Relative Humidity, 20°C or 68°F)	
Shrinkage (wet – dry)	Radial	0.7%
	Tangential	1.5%
Bending strength	39 N/mm²	5656 psi
Bending stiffness	8790 N/mm²	12,700 psi
Hardness (Janka)	Side	4100 N or 922 LBF
	End	6600 N or 1484 LBF
Thermal Conductivity	=0.13 Wm⁻¹K⁻¹ via EN 12667 standard	
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 EN350-1 & EN335-1.

► **Classification of the Natural 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

Use class	Conditions of use	Wetting	Wood moisture content <i>*Short-term: a couple days to 1 week</i>
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%

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.

► **Detailed Acetylation Information** The Accoya® wood brochure and website, www.accoya.info, provide a detailed description of the acetylation process and the properties of Accoya® wood. In addition, official test reports may be obtained from us.

► **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.

► **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.

- **Technical Data** This table shows the average properties of Accoya® wood and has been compiled using data extracted from Chinese official test reports in accordance with GB/T1927~1943-1991 standards, copies of which are available upon request.

Water absorption	110.5%		
Moisture content	2.0%		
Density	0.57 g/cm³		
Rate of the shrinkage absolute-dry	radial section	0.5%	
	tangential section	0.6%	
	volume	1.7%	
air-dry	radial section	0.2%	
	tangential section	0.1%	
	volume	0.7%	
Rate of the swelling air-dry	radial section	0.3%	
	tangential section	0.4%	
	volume	0.9%	
after water absorption	radial section	0.7%	
	tangential section	1.3%	
	volume	2.2%	
Formaldehyde emission	0.1 mg/L via GB18580-2001		
pH Value	4.42 via GB/T6043-1999		
Toughness of wood	52 kJ/m²		
Bending strength of wood	91.0 Mpa		
Modulus of elasticity in static bending of wood	8750 MPa		
Hardness of wood	tangential section	4460 N	
	radial section	4380 N	
	end section	6790 N	
Compressive strength parallel to grain of wood	36.3 MPa		
Tensile strength parallel to grain of wood	87.5 MPa		
Shearing strength parallel to grain of wood	tangential section	10.5 MPa	
	radial section	9.4 MPa	
Compression perpendicular to grain of wood	tangential direction	22.7 Mpa	
	radial direction	26.4 Mpa	
Tensile strength perpendicular to grain of wood	tangential direction	3.90 Mpa	via
	radial direction	1.43 Mpa	GB/T14017-1992
Cleavage strength of wood	tangential section	9 N/mm	
	radial section	7 N/mm	
Nail holding power of wood	tangential section	71.6 N/mm	via
	radial section	64.4 N/mm	GB/T14018-1992
	end section	44.6 N/mm	

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

Density (CNS 451)	ρ (12)	0.60 g/cm ³
	ρ (0)	0.54 g/cm ³
	ρ (v)	0.52 g/cm ³
Moisture content (CNS 452)		3.3%
Radial shrinkage (CNS 459)	β (%)	0.08%
	β (u)	0.35%
	β (m)	0.63%
Radial swelling (CNS 14926)	α (u)	0.26%
	α (max)	0.65%
Tangential shrinkage (CNS 459)	β (%)	0.02%
	β (u)	0.11%
	β (m)	0.14%
Tangential swelling (CNS 14926)	α (u)	0.06%
	α (max)	0.18%
Longitudinal shrinkage (CNS 459)	β (%)	0.02%
	β (u)	0.09%
	β (m)	0.12%
Longitudinal swelling (CNS 14926)	α (u)	0.07%
	α (max)	0.24%
Water absorption (MC: 3.4%) (CNS 6714)		0.10 g/cm ²
Abrasion depth (CNS 458)		0.368mm

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

Density (CNS 451-2005)		499 kg/cm ³
Moisture Content (CNS 452-2005)		3.10%
Compress Strength (CNS 453-2005)	Longitudinal direction	623 kgf/cm ²
	Radial direction	126 kgf/cm ²
	Tangential direction	89 kgf/cm ²
Modulus of Rupture in Bending (CNS 454-2005)	Full-size specimens	781 kgf/cm ²
	Small clear specimens	Load is perpendicular to radial section 717 kgf/cm ² Load is perpendicular to tangential section 616 kgf/cm ²
Modulus of Elasticity in Bending (CNS 454-2005)	Full-size specimens	73631 kgf/cm ²
	Small clear specimens	Load is perpendicular to radial section 62851 kgf/cm ² Load is perpendicular to tangential section 49540 kgf/cm ²
Ultimate Shearing Stress Parallel to Grain (CNS 455-2005)	Radial section	56 kgf/cm ²
	Tangential section	28 kgf/cm ²
Tensile Strength (CNS 456-2005)	Longitudinal direction	70 kgf/cm ²
Hardness (CNS 460-2005)	Radial section	1.74 kgf/cm ²
	Tangential section	1.46 kgf/cm ²
	Cross section	5.53 kgf/cm ²

- ▶ **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.

Diamond Wood supplies Accoya® wood in rough sawn dimensions in dry condition (wood moisture content <8%).
- ▶ **Transportation** Both Diamond Wood and Titan Wood ship ex-works under INCOTERMS 2000 or to otherwise agreed handling terms for delivery in accordance with the customer's order. The recipient at the delivery address must ensure that Accoya® wood packages are unloaded carefully, preferably using a fork-lift truck or another device with pallet jacks.
- ▶ **Storage** Accoya® wood that needs further processing, gluing or coating should be carefully stored, preferable in closed or well ventilated sheds to prevent water/moisture uptake. Please see Section 3 for more details on determining if Accoya® has absorbed excess water and for drying considerations.
- ▶ **Traceability** Accoya® wood is primarily identified by its packaging labels, which feature the Accoya® wood and Diamond Wood or 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 end 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 claim.
- ▶ **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 very 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 assemble. Direct exposure to water and changing climate (temperature and relative humidity) should still be avoided.
- ▶ **Storage and Transport of Products** 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 to pack the Accoya® product in a breathable barrier / "vapor-open" plastic.

Accoya® Wood Products As with other wood species, storage at the building site is recommended to be a minimum 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 molds.
- ▶ **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 at the building site, appropriate fasteners and fixtures to use for final installation and related considerations should be communicated.

- ▶ **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 lumina), 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; therefore, it is essential that the moisture content of the wood is determined prior to processing, gluing and coating.

- ▶ **Definition** The wood moisture content is the mass of the water contained in wood, expressed as a percentage of the mass of absolutely dry wood.

- ▶ **Wood Moisture Content of Accoya® Wood** 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”. 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.

- ▶ **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 measurement for possible excess water should be to the core of boards.

► 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 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.

► 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.

► General Processing Advice

To obtain the best results:

- Make sure that knives are straight 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 machining marks and “smuttering” of the surface will be visible in the coated product. Special care is needed.
- The feeding of rough Accoya® through machines (sawing, planing, ect.) should be done more as you would feed hardwood than softwood. A feeding speed of 500 linear meters (m1) per hour and blade rotation velocity of 12000 rpm typically gives a very smooth and high quality result.
 - When you are machining Accoya® for the first time it is best to produce some testruns to see what the best parameters are.
 - Where a lesser quality is needed, feeding speed of 1000 m1/hour and 6000 rpm can be used.
- The in-feed rollers can be of aluminum but the out feed rollers of equipment should preferably be rubber to prevent damage on the surface. The complete working table must be cleaned and aligned and the tables may not show any wear out of the steel to ensure the precise machining appropriate for Accoya®

- ▶ **Visual Quality** Accoya® wood is an ultra-high performance all-natural solid wood, and as such offers the beauty, versatility and charm of the original wood species. 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 surface quality desired.
- ▶ **Extraction System** As Accoya® wood shavings are often finer than other woods, the exhaust system should have enough capacity to keep shavings from being hit by knife heads onto the material. 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 wetted.
- ▶ **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 the shavings are finer and can be electro-statically 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 'wetting' the wood surface with an oil-based lubricant (to reduce static-energy).
- ▶ **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.
- ▶ **Bending** The Accoya® wood production process does not weaken the original wood species, nor does it compromise bending strength. As an example of its properties, Accoya® made of Radiata and planed to a thickness of 20 mm can be successfully bent into a circular arc with radius as small as 25 cm.

Accoya® wood bends well using most conventional techniques including steam bending. Impregnation with ammonia to ease bending should not be done.
- ▶ **Drilling** Accoya® wood drills in a manner and quality consistent with most soft woods. 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 exactly the same as the diameter of the plug to prevent splitting.
- ▶ **Fasteners & Fixing** Accoya® wood can be fixed in the same way as other commonly used soft wood 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".

► Installation Considerations

Accoya® wood is extremely dimensionally stable but this does not mean it is completely inert. Changes in humidity can cause slight changes in Accoya®'s volume and these should be taken into account for product design and installation. In extreme conditions (and for the purposes of our 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.

► Shrink/Swell Comparison Values

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

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		Avg. Plain Sawn		Warranty Maximum	
	(in.)	(mm)	(in.)	(mm)	(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	0.19	4.8	0.43	11.1	-	-
Accoya® (Radiata Pine)	0.04	1.0	0.08	2.1	0.14	3.5

While Accoya®'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.

► Waste wood treatment

Accoya® wood does not contain any toxic substance. Wood shavings and scrap can be disposed in the same way as commonly used species including as composting material. Since Accoya® wood has a small percentage of acetic acid it is not recommended for use as animal bedding material.

► 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 (PVAc) can vary greatly and is not recommended for exterior applications. Gluing with melamine urea formaldehyde (MUF), other than for finger jointing, is strongly discouraged.

When gluing Accoya® wood it is strongly recommended that adhesive suppliers are consulted 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 absorb moisture and, consequently, its behavior with regard to swelling and shrinking. 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. Due to the changed wood properties adhesives consisting of two or more components could migrate differently, causing 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.

► Optimising 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, if possible should be even on both sides, in accordance with the adhesive manufacturer's instructions, to avoid blistering.
- A possibly 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

Before gluing joints together, it is strongly advised that the end-grain 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 to prevent splitting of the ends.

► 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 or too sharp knives can result in “broken” fingers. Due to the 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 and PRF. It is important to work on a flat surface and not use 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 year 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 lamels.

► Further Information

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

► 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 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 fixtures. Please consult your fixings supplier to avoid any issues.

► Stainless Steel

The use of corrosion-resistant steel fastenings 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	1.4301	X5CrNi18-10	A2	2332	SUS 304
304L	S30403	304S11	-	1.4306	X2CrNi19-11	-	2352	SUS 304L
304H	S30409	304S51	-	1.4948	X6CrNi18-11	-	-	-
316	S31600	316S31	58H, 58J	1.4401	X5CrNiMo17-12-2	A4	2347	SUS 316
316L	S31603	316S11	-	1.4404	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

Coated fixtures (such as with epoxy and polyurethane) should be used when stainless steel fixtures are not available. When coated screws are used, 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.

- ▶ **Avoid Direct Contact with Accoya® Wood** 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 or by coating the metal with an acid-resistant coating, sealer, or other protective layer. 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.

For additional temporary protection spraying all sides of the metal hardware before assembly/mounting is recommended using a water repellent spray (such as PTFE or silicon based spray). 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.
- ▶ **Other Fastener Considerations** 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 used to help avoiding potential corrosion issues.
- ▶ **Proper Transport & Storage** 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®.

- ▶ **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 and 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 to let the sealant supplier perform a compatibility check if their product has not already been tested. This applies for glazing sealants (silicon, poly-urethane, MS-polymer) as well as 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 an extensive washing with clean water is strongly recommended. It needs to be noted that some of these products can impact the (long term) performance and esthetics 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 prior to finishing all mechanical damages (for example, cracks and unsound knots) are repaired. This is to prevent (liquid) water uptake by the wood that could impact the life time 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 end-grain is 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.

► Fire Retardant Treatment

As with other woods, in some cases Accoya® needs to be additionally treated 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. Therefore it is 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).

► 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 to 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 back to its elements. When used unfinished, Accoya® wood can exhibit various types of discolorations – For instance: blue stains and molds, discoloration, uneven UV weathering. Stains can also be caused by use of aggressive cleaning agents, foods and other substances inadvertently left on the wood. Besides a discoloration of the surface, unfinished Accoya®'s texture when outdoors will become rougher over time.

To obtain a “natural appearance” of Accoya® with reduced potential discoloration issues, a translucent (film-forming) coating, a non-filmforming coating, an oil-based stain or some other type of hydrophobic agent is recommended. Non-filmforming coatings can be applied if water uptake is not an issue. Oil-based stains and hydrophobic agents have a water repellency behavior, 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: UV light degrades substances in 1. the wood structure leading to a typically brown discoloration for natural wood species (Accoya® wood becomes more pale). These substances are water soluble and the surface of the wood pales again when washed with water.

2. 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. However, due to the increased UV resistance of Accoya® wood there is improved performance against micro-organisms and fungi. 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 has 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.

- ▶ **Preparation**
 - The moisture content of the Accoya® wood to be finished should be dry (below 6% 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.

- ▶ **Sanding**

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

- ▶ **Opaque and Translucent Coatings (Film Forming)**

Before a film-forming coating is applied it is recommended that prior to finishing all mechanical damages (cracks, unsound knots) are repaired with a suitable product. 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 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**

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 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.

▶ 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 and other regionally certified woods.

Accoya® wood can be specified with FSC (www.fsc.org) certification. Procedures are assessed annually by an independent certification body to ensure that they meet FSC Chain of Custody guidelines.



Mixed Sources
Product group from well-managed forests and other controlled sources

Cert no. SW-COC-003953
www.fsc.org
© 1996 Forest Stewardship Council

▶ 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 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 Manufactures Assc. Hallmark® (North America)

Titan Wood was certified by the Window and Door Manufacturers' Association (WDMA) as a Hallmark Certified Supplier 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.

▶ RAL (Germany)

Accoya® wood has been evaluated according to the VFF Merkblatt HO.06-4 for its suitability in RAL certified joinery. A provisional acceptance of Accoya® wood has been given in October 2009 and it has been added to the "approved" wood species list of the VFF (Joinery and Facades Association).

► Introduction

Below is a sampling of various standards and guidelines where Accoya® has been tested with passing or better results when criteria exist. For more detailed information on these results, please contact us.

► Europe

EN 113	Wood preservatives - Test method for determining the protective effectiveness against wood destroying basidiomycetes - Determination of the toxic values.
EN 320	Fibreboards - Determination of resistance to axial withdrawal of screws.
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.
EN 408	Timber structures - Structural timber and glued laminated timber - Determination of some physical and mechanical properties.
EN 717-1	Wood-based panels - Determination of formaldehyde release - Part 1: Formaldehyde emission by the chamber method.
ENV 807	Wood preservatives - Determination of the effectiveness against soft rotting micro-fungi and other soil inhabiting micro-organisms.
EN 927-3	Paints and varnishes -Coating materials and coating systems for exterior wood -Part 3: Natural weathering test.
EN 927-5	Paints and varnishes -Coating materials and coating systems for exterior wood -Part 5: Assessment of the liquid water permeability.
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.
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.
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
ISO 16000-9	Indoor air - Part 9: Determination of the emission of volatile organic compounds from building products and furnishing - Emission test chamber method.
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

► 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.

► Germany

AgBB:2008	Health-related Evaluation Procedure for Volatile Organic Compounds Emissions (VOC and SVOC) from Building Products.
DIN 52184	Prüfung von Holz; Bestimmung der Quellung und Schwindung. (Testing of wood; determination of swelling and shrinkage)
DIN 52185	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)
DIN 52617	Bestimmung des Wasseraufnahmekoeffizienten 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. Part 4: modified wood species)

► 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 Nonmetallic 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

► China Mainland

GB/T 1927~1943-1991	density, moisture content, water absorption, rate of the shrinkage, rate of the swelling, compressive strength parallel to grain of wood, tensile strength parallel to grain of wood, shearing strength parallel to grain of wood, compression perpendicular to grain of wood, cleavage strength of wood
GB 18580-2001	Indoor decorating and refurbishing materials Limit of formaldehyde emission of wood based panels and finishing products
GB/T 6043-1999	Method of determination of pH of wood
GB/T 14017-1992	tensile strength perpendicular to grain of wood
GB/T 14018-1992	Nail holding power of wood

► Taiwan

CNS 14926	Wood-Determination of Longitudinal, radial and tangential swelling
CNS 452	Wood-Determination of moisture content for physical and mechanical tests
CNS 459	Wood-Determination of Longitudinal, radial and tangential shrinkage
CNS 6714	Wood-Determination of water absorption
CNS 451	Wood-Determination of density for physical and mechanical tests
CNS 458	Wood-Determination of abrasion

► 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.

► 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 allowed 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.