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6 GLUING

Due to the high dimensional stability of Accoya wood, the annual ring orientation and the amount of balancing of layers is of less importance.

6.6 Best practice in design of structural laminate

The physical and chemical changes associated with acetylation, can affect the curing process of the glue line. In particular adhesives which require moisture for hardening can be affected by the particularly low moisture content of Accoya.

Testing has so far been undertaken on Accoya wood by Dynea and Henkel, in accordance with EN301 and EN 302-1 (PRF adhesives) or EN 15425 (PU adhesives), to confirm that their adhesives are suitable for structural bonding of Accoya. It may be possible to use other adhesives, but these would need to be confirmed by the relevant manufacturers.

Whilst EN14080:2013 suggests that the durability of glued laminated products shall be taken as the natural durability according to EN 350-2 of the timber from which they are made, and therefore DC1 with Accoya, professional bodies such as the Structural Timber Association (STA) in the UK consider the use of well-maintained water-repellent stain finishes together with rain screening and other protection measures as essential when used in Glulam applications, and therefore the Accoya Warranty will only apply to Glulam applications where this guidance and moisture exclusion is achieved and maintained.

Please contact your Accsys sales manager for best practice guidelines related to structural laminate design and maintenance.

6.7 Best practice in designing for moisture management in glulam beams includes:

- Protecting end grain
- Orienting lamella to achieve vertical grain on surfaces to mimimise checking and water ingress points
- A robust adhesive to prevent delamination and moisture ingress
- Regular inspection for identification and repair of splits or delamination
- A maintained, film forming coating
- Drainage, particularly on horizontal surfaces and ventilation.

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7 CONTACT WITH OTHER MATERIALS

METALS

All wood contains organic acids, although the quantity varies by species. In moist conditions, these organic acids contribute to the corrosion of metal fasteners used in wood. Accoya wood has comparable acid levels to many other durable species such as oak and western red cedar. In wet circumstances, the Accoya wood will have a pH in the range of 4 – 5.5. For a list of system suppliers in your region, please visit the More about Accoya / System Suppliers section of our website **www.accoya.com**

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, corrosion resistant aluminium or naval brass products be used in areas exposed to moisture or condensation. When stainless steel, corrosion resistant aluminium or naval brass is not available it is important to take precautions using lesser grade metals. The metal and/or the Accoya wood should be coated or otherwise separated to avoid direct contact between the wood and these metals. Similar good practices that are commonly used in the industry for reference species such as oak and western red cedar should be adopted.

Indirect contact issues can occur in non-ventilated high humidity areas with a high risk of condensation (for example lock rebates, swimming pool enclosures, bathrooms). High quality hardware and/or corrosion avoiding techniques described further on in this section should be considered for these areas. 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.

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7 CONTACT WITH OTHER MATERIALS METALS

7.1 Stainless steel

The use of corrosion-resistant stainless steel fasteners and fixtures that conform to EN 10088-1 is recommended, such as widely used 1.4301 (A2) or 1.4401 (A4) quality stainless steel. The A4 quality should be used in particularly challenging environments, such as in coastal regions or near highly polluted industrial zones. An international comparison of grade specifications is shown in the table below.

These comparisons are approximate only since exact properties vary by standard. 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.

7.2 Naval brass and aluminium

Corrosion testing on naval brass (brass containing tin) and higher quality aluminium products show that these metals are highly corrosion resistant in direct contact with Accoya and may be considered as well.

For example the following aluminium grades performed well in internal testing: 3003, 6005, 6060 and 6063. Accsys anticipate the following grades will also perform well: 6061, 5154, 5052, 3052 and 1100, since they are commonly used in industrial manufacture and transport of acetic acid.

7.3 Coated hardware

When stainless steel fixtures or other corrosion resistant metals are not available, coated fixtures (such as with epoxy, lacquer, polyurethane or powder coating) can be considered for those locations where moisture and condensation exposure risk is low (for example the dry side of windows and doors). Damage to the coating during installation should be prevented to reduce risk of corrosion. For example, by predrilling for fasteners.

It should be noted that the performance of coated fixtures varies, and no particular standard that can be cited.

STAINLESS STEEL GRADE SPECIFICATIONS

USA	UNS No	Old British BS	EN	Euronorm No	Name	ISO 3506	French AFNOR	Swedish SS	Japanese JIS
304	S30400	304S31	58E	1.4301	X5CrNi 18-10	A2	Z 6 CN 18 09	2332	SUS 304
304L	S30403	304S11	-	1.4306	X2CrNi 19-11	-	Z 2 CN 18 10	2352	SUS 304L
316	S31600	316S31	58H, 58J	1.4401	X5CrNiMo 17-12-2	A4	Z 6 CND 17.11	2347	SUS 316
316L	S31603	316S11	-	1.4404	X2CrNiMo 17-13-2	-	Z 2 CND 18.13	2348	SUS 316L

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7 CONTACT WITH OTHER MATERIALS METALS

7.4 Other metals

Galvanized metals or zinc alloys are not corrosion-proof when used with Accoya wood. The surface of certain aluminium alloys, copper, lead and other metals may also oxidise. Experience to date on the use of solid brass has been positive, especially on brass that is factory clear coated to retain brightness. Chrome plated steel performed very well in testing but if the protective layer is damaged this product will be susceptible to local accelerated corrosion.

7.5 Coated steel fasteners approved for pressure treated lumber

Although stainless steel decking screws are commonplace and the best option, proprietary coated steel fasteners such as the coated deck screws approved for use in pressure treated lumber, may be used as a lesser alternative. However, damage of the screw coating should be avoided and pre-drilling is advised.

7.6 Avoiding corrosion

Corrosion of lesser grade metals can be substantially reduced when direct contact with Accoya wood is avoided, by:

- Coating the wood or the metal component with an effective sealer to provide a protective barrier.
- Physically isolating hardware from direct contact such as the use of plastic (or stainless steel) spacers, providing enough space for sufficient water drainage and fresh airflow is allowed for.
- The concentration of acetic acid in confined spaces, such as door lock houses, can rise and increase the risk of accelerated corrosion. Metals in these areas should also be sealed (for example with a vapour-proof epoxy or end grain sealer) even if there is no direct contact between metal and Accoya wood.
- Avoiding condensation of moisture on metal components will help reduce potential corrosion issues, for example by effective ventilation around those components, as will avoiding high humidity non-ventilated areas.
- Avoiding moisture build up, specifically in engineered wood such as large size laminated sections through good design and with effective coatings. Cracks and fissures should be repaired. Regular inspections and proper maintenance is recommended to avoid problems occurring.
- Avoid damage to metal hardware during storage and transport (**section 3**).

For additional temporary protection it is recommended to spray all sides of the metal hardware before assembly, using a water repellent spray (such as PTFE or silicon based spray) or rust inhibitor. This is also useful when the coating layer has been compromised. Take care not to spray onto bare wood surface as these products may influence coating adhesion and/or maintenance of metal hardware. Preferably pre-drill for screws and other larger diameter fasteners. When installing smaller pieces of Accoya, the use of staples, such as those made of 18 gauge A2 stainless steel, is recommended to reduce split risk.

Further information may be obtained directly from suppliers of fasteners, hinges and locks.

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7 CONTACT WITH OTHER MATERIALS NON-METAL PRODUCTS

Accoya wood has been tested for compatibility with a wide variety of products commonly used in a wide range of applciations and regions. The information below is a summary of these findings, partly based on internal research and partly on extensive testing by system suppliers experienced with Accoya.

7.7 Sealants, gaskets and related parts

Rare examples are known where the small amount of residual acetic acid in Accoya wood has influenced the curing process or the long-term performance of sealants.

If not already tested and approved, it is strongly recommended that the sealant supplier performs a compatibility check. This applies to glazing sealants (silicon, polyurethane, MS-polymer) as well as to sealants used in double-pane glass (e.g. polysulphide, silicone and polyvinyl butyral). When installing unfinished Accoya wood, adhesion can be improved by applying a primer before applying the sealant.

7.8 Cleaning agents on uncoated wood

Cleaning agents vary tremendously in chemical composition and use. In general, cleaning agents are quite aggressive chemicals that need to be handled carefully.

Firstly, after using a cleaner, extensive washing with clean water is strongly recommended. Some of these products contain chemicals that can impact the (long term) performance and/ or aesthetics of Accoya wood. Chemicals which degrade wood in general (such as strong acids and bases) can also degrade Accoya, these chemicals should be avoided. An exposure to products above a pH value of 9 can invalidate* any warranty.

**** This excludes the brief exposure to high alkali coatings up to the point they cure.***

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7 CONTACT WITH OTHER MATERIALS NON-METAL PRODUCTS

7.9 Fire retardants

As with other woods, fire retardant chemicals will generally have an impact on compatibility and/or performance of coatings, adhesives as well as other products. For more information on fire retardants please refer to **section 10**.

Please note that certain fire retardant chemicals products might invalidate the Accoya warranty. Please contact your local Accoya sales manager to discuss compatibility of fire retardant chemicals with Accoya in respect to the Accoya warranty.

7.10 Wood repair products

For Accoya wood products that will be finished with an opaque film-forming coating system it is recommended to repair all mechanical damage, checks and unsound knots prior to finishing. This is to prevent water ingress which could reduce the service life of the coating system.

It is important to adhere to the instructions of the supplier and verify any possible interaction of the repair system with other components. It is strongly advised to use a repair system that has been tested for paint adhesion, shrinkage behaviour, practical workability and resistance against moisture, UV light and high temperature. Two component systems (e.g. epoxy or polyurethane) are strongly preferred. One component systems that tend to be hydrophilic or shrink after drying (creating capillaries) should be avoided.

7.11 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-grain be effectively sealed. It is advisable to use a product that has been tested for its ability to reduce liquid water uptake by the wood, adhesion and UV resistance.

Coating manufacturers often produce their own end grain sealers. In all cases, the end grain sealer should be approved as compatible by the coating manufacturer.

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7 CONTACT WITH OTHER MATERIALS NON-METAL PRODUCTS

7.12 Pressure treated wood products

Typical pressure treated lumber (used e.g. as sub-frame battens or decking joists) containing metal salts such as CCA, ACQ and MCQ can leach copper.

It has been reported, particularly with recently treated and damp pressure treated lumber have been presented where the copper in the pressure treated lumber was wicked into the Accoya and resulted in green staining on the surface of Accoya wood. To prevent this staining risk, isolation techniques such as plastic (or stainless steel) strips or spacers and barrier coatings are recommended. Design of the structure to allow quick drying of the pressure treated wood also reduces this staining risk. Alternatively, Accoya can be considered as a higher performing alternative to pressure treated lumber in these applications and will also eliminate green staining showing through.

Further information may be obtained directly from suppliers of barrier products.

WICKING OF PRESSURE TREATED SOFTWOOD FRAMING CHEMICALS THROUGH ACCOYA

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8 WEATHERING UNCOATED ACCOYA WOOD

From a technical performance perspective, in respect of attributes such as durability and dimensional stability, there is no need to finish Accoya wood for cladding and decking applications. Joinery applications are more complex so it is recommended that you seek expert advice before using Accoya for uncoated windows and doors.

Like any natural wood species, Accoya wood is susceptible to weathering in outdoor circumstances. All materials exposed to exterior conditions are degraded by a series of chemical, biological and physical processes. The surface of any wood will be blemished by a combination of UV, moulds, algae, mildew, yeasts and pollution. Accoya is no exception and the initial light colour of uncoated Accoya may cause early moulds and blemishes to stand out more than on other wood types, prior to it weathering further to grey.

8.1 Greying

Because Accoya wood has a very high resistance against wood destroying fungi, a popular choice is to use it in various applications uncoated. It will weather naturally to a silvery-grey colour, due to physical and biological processes that take place within the board surfaces:

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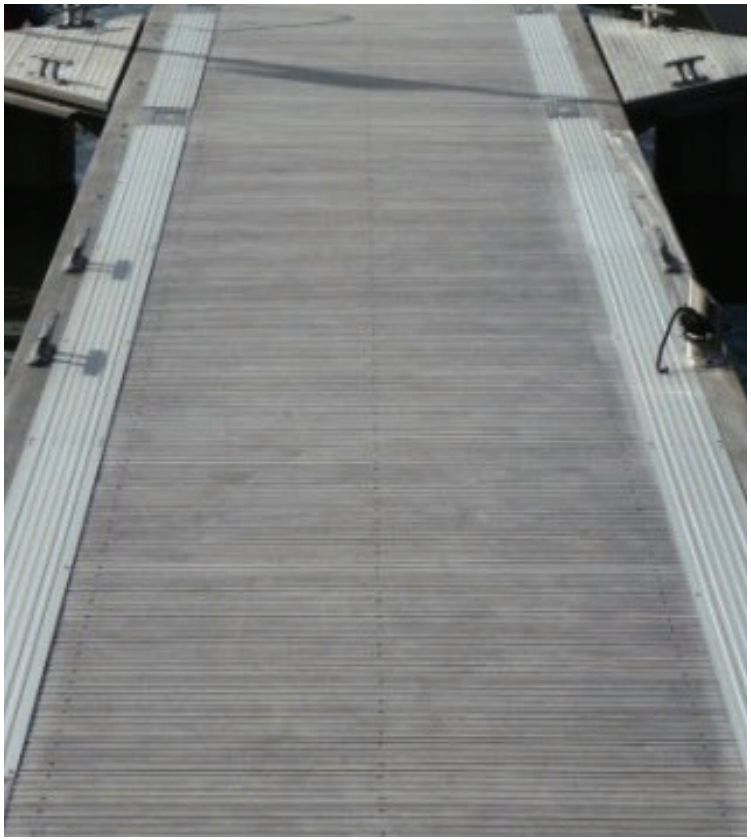

WEATHERED UNCOATED ACCOYA

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8 WEATHERING
UNCOATED ACCOYA WOOD

- UV light partly degrades the surface lignin. As this lignin holds the wood cells together, this degradation will lead to a rougher and more open surface.
- This opened surface structure will both cause a change in colour and also allow surface moulds, yeasts, mosses and algae to penetrate and develop faster.
- These types of growths can use many sources of nutrients, including extractives in the wood, free sugars, starch, dirt, pollution and other available organic compounds, but do not degrade the Accoya structure itself. However, pigment produced by these moulds and yeasts may discolour the surface.

The rate of weathering, eventual colour and level of surface growth will vary according to the amount of UV, elevation on a building, the surroundings, the installation details (particularly those related to ventilation) and the surface texture of the boards. Accoya wood will generally grey at a similar rate as most other wood species, but partial shading of a surface will lead to uneven greying and some visible mould stains, particularly as the initial Accoya colour is relatively light and does not camouflage these occurrences in early stages of weathering. See examples right.

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WEATHERED UNCOATED ACCOYA

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8 WEATHERING UNCOATED ACCOYA WOOD

However, prior to turning grey, uncoated Accoya wood will go through a phase of bleaching where it turns a lighter shade of its normal colour. Surface growths are particularly apparent in this intervening period and can vary in level from board to board. This will become less distinguishable after full (even) greying, but in this transition period the Accoya wood surface may look blotchy.

8.2 Appearance

A wet and a dry board may vary in appearance, generally darker and less attractive when wet and brighter in dry weather. Due to the installation details, the presence of a shaded area and the natural differences in the wood between boards, as for instance density variation or grain orientation, some may dry quicker than others. Not only does this reflect on the appearance of a surface while drying, it will also have an influence on the development of moulds, algae and other surface growths.

CLADDING PROJECT, NORTH AMERICA

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8 WEATHERING UNCOATED ACCOYA WOOD

8.3 Surface growths

Acetylation of wood as such – a non toxic process – does not seem to have an influence on the resistance against surface mould and yeast growth. Independent review by BM Trada finds that Accoya is similar or less prone to mould and yeast growth than un-modified pine. However, in damp and/or shaded areas there is a high risk that surface growths will develop on Accoya wood, as they would on other (soft) wood species.

Levels of mould or yeast developing on the surface during weathering of the Accoya wood will highly depend on (macro) climatic factors such as moisture, temperature and sunlight. Other influences are location specific, such as proximity to vegetation, pollution, dirt accumulation and the naturally occurring differences in the wood.

8.4 Surface fibres

Uncoated Accoya wood may show a degree of surface fibres after being exposed for some time, due to the natural degradation of lignin in wood surfaces by UV light. As this lignin holds the wood cells together, this degradation will lead to a rougher and more open surface. This may be evident as fine fibres on the surface, which will eventually erode.

The higher the amount or intensity of UV the surface is subject to, the faster this process will develop. It should be noted that these fibres are formed on all exposed wood species, including Accoya wood, particularly on flat surfaces like decking. A ribbed deck profile will tend to cause an accumulation of these fibres, making it all the more noticeable.

In rare cases, certain harsh climatic conditions may lead to a special form of surface fibres unrelated to UV-degradation. Typically, this involves an apparently extreme amount of surface fibres in spring, usually after a prolonged snow cover. A lengthy moisture load combined with a repeated freeze-thaw cycle during winter may lead to a mechanical disintegration of the (uppermost) wood surface.

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Rough sawn surfaces are more conducive to build-up

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8 WEATHERING
UNCOATED ACCOYA WOOD

The Holzforschung institute of Austria has indicated that Robinia and thermally modified woods are particularly badly affected, but also larch, teak and sapele are prone to such behaviour. In all of these cases the durability of the Accoya wood is not compromised in any way. It is recommendable to periodically wash any loose fibres off, as they may flock together and become a spot for organisms to settle, which may lead to disfigurements.

Inappropriate use of pressure washers can increase occurrence of surface fibres. Using such cleaning devices with too high a pressure will lead to the damage of the uppermost surface layer of wood. Accoya wood being softwood in nature, it is therefore important to limit the pressure used.

8.4 Naturally occurring surface fibres on decking

8.4 Fibres may get trapped in ribbed surface profiling

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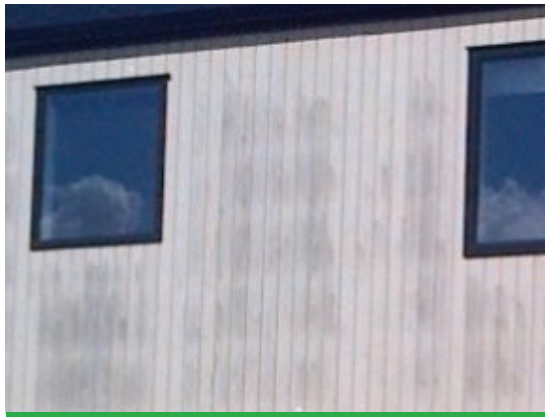
8 WEATHERING UNCOATED ACCOYA WOOD

8.5 Other staining

Other occurrences of disfiguring stains on Accoya wood have been identified as:

- Resins; in rare cases individual uncoated boards may exhibit a reddish brown staining after installation. This is the result of natural extractives being transported to the surface or condensing around (even corrosion resistant) metal fixings as moisture in the boards evaporates. These discolourations will tend to fade and wash out over time.
- Aggressive cleaning agents can cause discolouration and may even affect the Accoya wood itself (**section 7**) if left to soak.
- Fasteners; staining around fasteners may occur when non-corrosion resistant steel is used (**section 7**). Also, fasteners may transport water to and from the subframe, which can contain natural extractives.
- Sub-frame silhouette; in some projects a distinct pattern reflecting the sub-frame behind Accoya and other types of wood cladding such as western red cedar, has been observed. This is caused by heat transfer from the building to the Accoya boards, which will decrease the average moisture content at the location of the interface. Dryer conditions mean less mould growth, which is why the interfaces are clear whereas the rest of the board surface shows mould. Adversely, inadequate ventilation of the cavity increases the potential for prolonged wetting of the battens and cladding. This may encourage the growth of surface mould on the Accoya cladding in line with the battens, visible as a darker discolouration band.
- Pressure treated wood used as a sub-frame: these products may contain metal salts such as CCA, ACQ and MCQ. Copper leaching from this treatment may result in green staining on the surface of Accoya wood (see **section 7.12**). To prevent this staining risk, isolation techniques such as plastic (or stainless steel) strips or spacers and coatings are recommended. Design of the structure to promote quick drying of the pressure treated wood also reduces this staining risk.



8.5 A New Zealand housing project with a very distinct batten (sub-frame) silhouette showing in the cladding surface

8.5 Reddish brown staining

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8 WEATHERING UNCOATED ACCOYA WOOD

8.6 Preventive measures

Good design and maintenance is critical in minimising the incidence of surface moulds. Surface mould development can be reduced by decreasing the level of moisture the wood is subject to, for example by creating effective ventilation, avoiding water traps and shedding water naturally.

8.7 Cleaning

Especially exterior horizontal surfaces will form a biofilm that will hold water and reduce the speed of drying of the board, and a large build-up of such a layer should be prevented. Without the use of preventive measures, regular cleaning will be needed to control the build-up of such a biofilm.

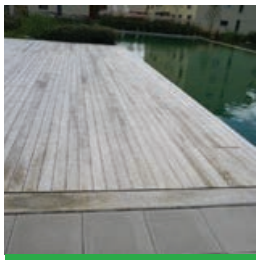
In normal situations a wooden deck should be cleaned once a year, preferably in spring. More frequent cleaning may be necessary in case permanently shaded areas can't be avoided, e.g. on the north side of a house or in the immediate vicinity of bush or tree cover. Flowerpots and plant troughs should always be lifted from the ground, for example, by spacer strips.

Polluted surfaces can be cleaned with a nylon brush and clean water (refresh the water regularly until it stays clear); planed surfaces are easier to clean than sawn surfaces. Pressure washers can be used but only with a suitable control device as a direct high pressure water spray can damage all wood – including Accoya. If using a pressure washer it should be carried out with some experience and due care. Cleaning coated surfaces with a pressure washer should be avoided.

Persistent stains may be taken care of by using deck cleaners, which may also cause the surface of the wood to bleach to some extent. It is important to adhere to the instructions of the supplier. Make sure to wet the boards thoroughly before using such cleaning products, and after cleaning to rinse with plenty of clean water.

POOL DECKING IN OESINGEN, SWITZERLAND

Newly installed



10 months of weathering

30 months of weathering

OFFICE CLADDING, VROOMSHOOP, THE NETHERLANDS

2 months of weathering

2 years of weathering

4 years of weathering

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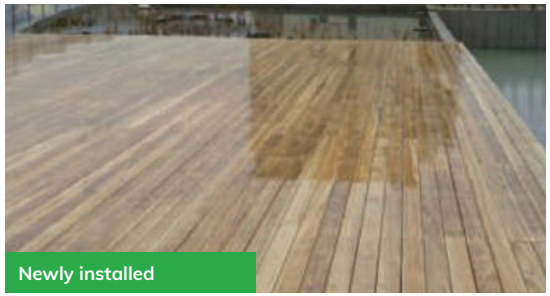
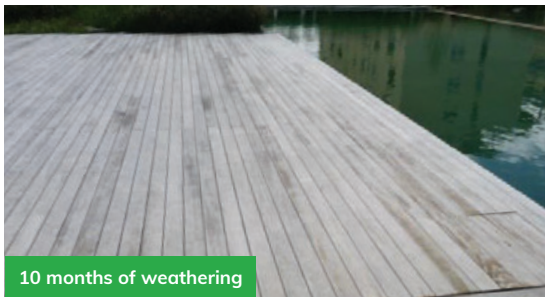
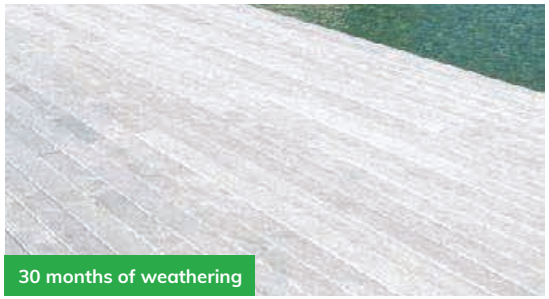
8 WEATHERING
UNCOATED ACCOYA WOOD





CLADDING PROJECT, NORTH AMERICA



POOL DECKING IN OESINGEN, SWITZERLAND

OFFICE CLADDING, VROOMSHOOP, THE NETHERLANDS

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9 COATINGS

Despite Accoya wood's excellent compatibility with a wide range of coating types, it is highly recommended having the coating manufacturer involved in the process, as they have in-depth knowledge of their products, suitable application techniques and how to assess the performance of the finished product.

Several leading coating companies have more than 10 years experience in testing and industrial application of their coatings on Accoya. In any case, the manufacturers recommendations should be followed to attain best application performance.

Please note that coating formulations vary per manufacturer (and possibly by region) and processes vary depending on the application equipment used and the end product design.

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9 COATINGS

9.1 Preparation

- Accoya wood should be clean, dry (below 8% mc) and free of dust, grease and other pollution.
- Where possible, finish the wooden parts on all sides before mounting or assembling them.
- When using a primer, a high quality product that contains resin-bleed blockers and fungicides is recommended. Resin blocking primers are essential for white paint finishes. Resin blocking primers are typically used on hardwood species and western red cedar.
- Accoya wood can absorb a high amount of water through the end grain – those should be effectively sealed (**section 4**).
- Due to its superior dimensional stability, the integrity of most film or semi film forming coatings will last considerably longer when applied to Accoya wood compared to other woods. Coatings formulated for outdoor use that include fungicides combined with an appropriate maintenance cycle in accordance with the manufacturers recommendations, will also prolong their overall and cosmetic appearance.
- Always follow the wet/dry film thickness recommendations from the coating manufacturer to optimize and preserve the coatings efficacy.
- In certain circumstances (more so with translucent coating systems), suitable and appropriate pre-coating surface preparation can help to achieve a more consistent, clean, uniform finish and improve the surface film application, appearance and performance. Planed surfaces that are left for a period of time before coating benefit from surface preparation (sanding / fladding or textured brushing) to remove any surface contamination.
- Accoya wood in contact with water will have a pH in the range of 4 to 5.5.

For processing guidelines, please consult **section 5**.

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9 COATINGS

9.2 Penetrating oils

Oils such as tung, linseed, and walnut oil, whether pure or oil/varnish mixtures, may be used with pleasing aesthetic results. Longevity of such non-film forming finishes on Accoya is typically no longer than on traditional wood types.

Please note that oils can be a food source to fungi and thus oils containing a mouldicide are recommended. Accoya wood 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.

9.3 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. It is recommended for both cases to apply multiple coats and follow maintenance intervals as prescribed by the coating manufacturer. Note that the first layer of some oil based products tends to get absorbed by the Accoya wood more quickly.

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

Non-film forming coatings typically last no longer on Accoya than on other wood types. Testing of a wide range of semi film forming coating brands on Accoya typically shows longer maintenance intervals on Accoya.

Clear or very light pigmented non or semi-film forming coatings are not recommended. See **section 9.5**.

9.4 Opaque and translucent coating (film forming)

Before a film forming coating is applied, it is recommended that all mechanical damage or wood defects are repaired with a suitable product. Opaque and translucent coating systems should be applied on all sides corresponding 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.

The rate of drying and/or curing of each individual coating layer might be different with Accoya wood. Coating company guidelines for coating Accoya should be obtained and followed to achieve the required performance levels.

Coating performance on Accoya wood in joinery and cladding is improved and maintenance intervals are often prolonged. Film forming coatings further extend the maintenance intervals due to their high film builds, illustrated by leading international coating companies through numerous case study projects. Do not over apply the coating wet film thicknesses as this extends the drying process without adding to or enhancing performance.

Clear or very light pigmented non or semi-film forming coatings are not recommended. See **section 9.5**.

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9 COATINGS

9.5 Best practices for joinery

Accsys, working with leading coating companies, has gained valuable experience of joinery coating over the years. Although practices may vary from country to country, in line with best joinery practices and coating manufacturers advice, it is important to note the following guidance when coating Accoya wood.

These guidelines are supplemental to advice from coating manufacturers, please consult your coating supplier at all times:

- A fully factory applied joinery coating is strongly recommended. If site finishing is required, then at least a primer and mid coat should be applied in the factory and the top coat must be applied before the joinery gets wet on site.
- Accoya wood must be dry, clean and free from dust when coated. This is critical when brush applying top coats on site. Please see **section 4** for moisture testing techniques.
- Opaque coatings with an excess of calcium carbonate (chalk) fillers can cause coating blistering on Accoya and must be avoided. Please consult your coatings provider.
- When using an opaque base coat, preferably an effective and well applied anti-stain blocking primer is included and this is critical for white coatings.
- Translucent coating systems should contain an effective mouldicidal component to protect the wood from unattractive moulds and mildew. As with other wood types and being a natural material, the porosity of Accoya may vary. Therefore when applying translucent stains, it is advisable to test a sample area first.
- Clear or very lightly pigmented coatings are best avoided. They break down more rapidly in UV exposure and are particularly susceptible to disfiguring stains on or behind the coating. As an alternative to retain the original Accoya look, a translucent stain with a pigment level similar to the original Accoya wood should be considered.

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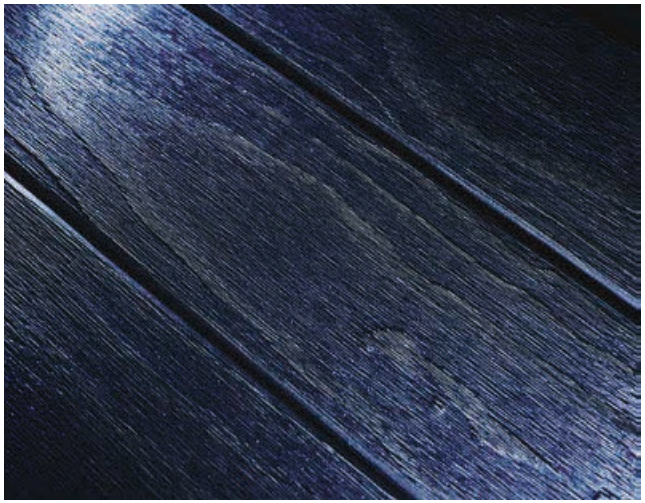

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- Sealers must be effectively used on all end grain throughout the joinery, with a product that is compatible with the paint system and approved by the coating manufacturer.
- Dip, flood and flow coat application of the first coating layer is widely practiced for all wood joinery and is particularly effective in forming an all-encompassing first coat. Monitor and control the level of wetting of Accoya wood during the flow coat, dipping and deluge application process. Accoya wood tends to be more porous than hardwood and some softwoods. Excessive wetting should be avoided as this can significantly extend drying times.
- Coating manufacturer's application methods and guidance should be followed with particular focus on avoiding aeration in the coating film when spraying, avoiding cold coatings (should typically be above 15°C (60°F) at application), correct film thickness and appropriate drying techniques/conditions.
- Coatings should be thoroughly cured in a humidity and temperature controlled environment and in line with coating manufacturers guidelines. This often involves overnight drying between layers. Control is particularly important in colder months.
- Coated joinery should be stored on site as per coating manufacturers guidelines.
- It is strongly recommended to use corrosion proof hardware with Accoya joinery. However, applying three layers of paint behind hardware that may be prone to corrosion helps create an isolation barrier between it and the wood. It is also good joinery practice to spray inside any lock housings and apply end grain sealer. Please see **section 7** for more details on contact with metals.

Accoya wood contains a small amount of acetic acid. In some circumstances this can disturb the factory coating processes that have re-circulation of the coating (as in flow coating). By adding a buffer in the coating, potential problems can be prevented. Please consult your coating supplier.

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9 COATINGS

9.6 Deck coatings

To obtain a “natural appearance” of an Accoya wood deck with reduced potential discolouration issues, a translucent non film-forming coating, an oil-based stain or some other type of hydrophobic agent is an option. Darker or more highly pigmented coatings typically have longer maintenance intervals.

Note that film-forming systems are not recommended for decking boards because of possible slip risk and a risk of moisture accumulation when the coating is compromised by mechanical damage.

- A fully factory applied coating system is strongly recommended. Coating should be applied on all surfaces, with a minimum dry film thickness that corresponds to the requirements of the end product and/or paint supplier’s instructions to prevent risks of water absorption prior to coating and other in field complications.
- As moulds are capable of growing on and also through coating layers, to reduce risk of growth on and beneath the coating, at least the first layer of a stain should contain an effective mouldicidal component to help protect the wood from possible disfigurement. Generally, the darker the pigment, the greater the maintenance interval.
- Clear or lightly pigmented coatings are not recommended for Accoya decks. They will generally provide little protection to weathering and greying and can make cleaning of the surface more difficult if disfigurement occurs beneath them.
- Pigmented coating systems will camouflage mould/yeast disfigurement. However, it is advisable to test a sample area first with pigmented stains, because as with other wood types and being a natural material, the porosity of Accoya wood may vary.
- Using somewhat thicker and/or multiple coating layers will help reduce moisture absorption and therefore the risk of mould and/or yeast growth on and through coatings. This will also lead to a more resilient coating in the sense of wear and tear, and may lead to a longer life expectancy of the coating.
- If so required, slip resistant coatings or applied strips can be used on Accoya wood in the same way as on other timber decking.

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9 COATINGS

9.7 Service life

The service life of a decking coating will depend highly on the quality and thickness of the coating layers, the coating colour, regional differences in UV-intensity, the average moisture level and the use intensity.

Whilst a specific service life of any deck coating system can only be given by the coating manufacturer, generally speaking a maintenance interval of more than one year will be rare – in line with other typical deck wood species. A seasonal maintenance involving a cleaning and re-coat is most common and good practice.

- The machining (including planing and/or sanding) of the Accoya wood may have an influence on the performance of the coating applied.
- For optimum life expectancy of any specific system, please adhere to the maintenance recommendations of the coating manufacturer. This includes applying the optimum coating film thickness as coating system performance can be affected where films are too low or high.
- Generally speaking, regular localised remedial work in areas with high use intensity will prolong the interval for a complete renovation of the coating.
- Regular cleaning (preferably with a soft brush and clear water) will help reduce the risk of moulds growing through the coating.
- The ease of cleaning of non-film forming deck coatings generally improves when the coating is weathered.
- Pressure washing should be avoided with coated surfaces as the high pressure water could damage the coating layer and decrease the service life.

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10 FIRE BEHAVIOUR

10.1 EU – Product standard

Accoya wood is part of the scope of EN14915:2013 + A2:2020 'Solid wood panelling and cladding characteristics, evaluation of conformity and marking'.

This harmonised European standard defines solid wood boards for use in panelling and cladding and specifies the relevant characteristics and the appropriate test methods to determine these characteristics in both internal and external use, and it provides for the evaluation of conformity as well as the requirements for marking these products.

One of the properties this standard deals with is the reaction to fire for cladding applications. This property is one that covers the entire cladding system; including fasteners, detailing, sub-frame and substrate backing the cavity. This means that it is not possible to classify Accoya wood on its own.

cont on page 49...

EN 14915 excerpt Product	Product detail	Mean density ≥	Board thickness ≥ max/min	End-use condition	Class
Panelling / cladding	Wood pieces with or without tongue and groove & with or without profiled surface	390 kg/m³	9 / 6mm	Without air gap or with closed air gap	D-s2, d2
		390 kg/m³	12 / 8mm	Without air gap or with closed air gap	D-s2, d0
Panelling / cladding	Wood pieces with or without tongue & groove and with or without profiled surface	390 kg/m³	9 / 6mm	With open air gap ≤ 20mm behind	D-s2, d0
		390 kg/m³	18 / 12mm	Without air gap or with closed air gap	D-s2, d0
Wood ribbon elements	Wood pieces mounted on a support frame	390 kg/m³	18mm	Surrounded by open air on all sides	D-s2, d0

NB: The above table is based on table 1 of EN14915:2013 + A2:2020. For further details please refer to this standard.

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10 FIRE BEHAVIOUR

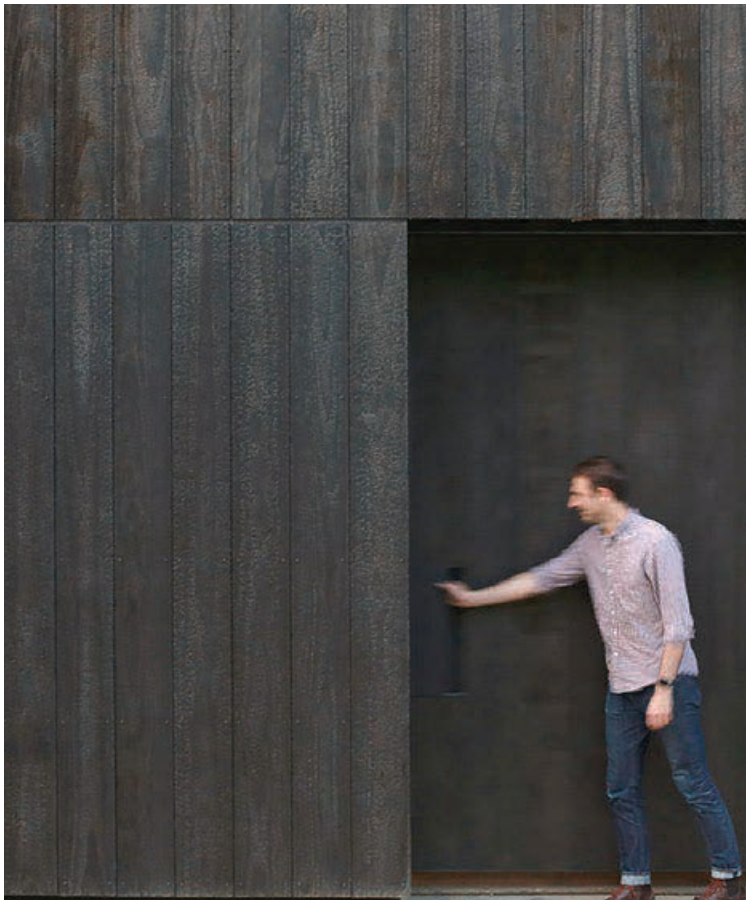
To avoid testing all possible cladding systems according to EN 13501-1 (single burning item or SBI test), the EN 14915 standard gives guidelines for certain cladding systems that are classified without the need for further testing (table on previous page), in which untreated chemically modified wood is classified as Class D, the same class as other softwoods.

If certain local regulations or building codes call for it, Accoya cladding can meet higher requirements, up to Class B, by giving it a fire retardant treatment. This can be done by impregnating fire retardant chemicals. The Wood Protection Association provides guidance on selection and use of fire retardant treatments.

Since the chemical 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 by an independent and accredited body. The Wood Protection Association provides a guidance document on the test requirements. Please contact your Accsys sales representative for fire retardant treatment options available in your region.

As with other woods, fire retardant chemicals used with Accoya generally have an impact on compatibility and/or performance of coatings, adhesives and other products. These products should be tested first to ensure they will meet end-product performance requirements. Fire retardants can affect the Accoya decay and dimensional stability warranty position and Accsys should be contacted to check queries pertaining to this.

For more information please visit **www.thewpa.org.uk/flame-retardants**



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10 FIRE BEHAVIOUR

10.2 USA – Flame spread test

Southwest Research Institute (SwRI) performed Flame Spread Tests and Smoke Developed Tests in accordance with the standard test method for surface burning characteristics of building materials NFPA 255 (ASTM E84, ANSI, UL 723 & UBC 8-1).

The conclusion of the Flame Spread Test results is that Accoya wood can be classified within the range of standard timber species and achieves Class C in this US rating system.

ASTM E84 CLASSIFICATION TABLES

Flame spread classification	Flame spread rating or index
Class I (or A)	0 - 25
Class II (or B)	26 – 75
Class III (or C)	76 – 200

* Data source - USDA - United States Dept of Agriculture Wood Handbook. Lower numbers equal a lower flame spread or less smoke.

** Note that the classifications presented on this page are valid for untreated Accoya wood. Higher ratings can be achieved when using fire retardants.

10.3 Australia

Bush fire risk based zoning is a consideration in Australian building regulations. They have been adjusted to include requirements on resistance to bush fire for building constructions on a zonal system from low to high categories, described in the standard AS 3959.

Some species of timber are listed in Appendix E of this standard:

- Bushfire Resistant Timber
- E1: density 750 kg/m³ or greater
- E2: density 650 kg/m³ or greater

With an average density of 515 kg/m³, Accoya wood (radiata pine) is classified, as other softwoods, outside of these lists.

10.4 New Zealand

New Zealand uses the same fire testing principles as Europe (the so-called room corner test or SBI), but has different limits for the classification: the Time To Flashover [s] instead of heat release and fire growth. Based on indicative cone testing, Accoya wood is likely to be a group number 4 material, comparable to other softwoods.

Wood / species	Flame spread index*	Smoke developed index*
Accoya**	95	155
Douglas fir	70	80
Eastern white pine	85	122
Lodgepole pine	93	210
Oak	100	100
Sitka spruce	74	74
Southern pines	103-195	n/a
Western red cedar	70	213

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11 CONTACT

Get in touch

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accoya®
Approved manufacturer

Accsys run an Approved Manufacturer Training Programme and we would encourage all manufacturers planning to use Accoya to contact their distributor or Accsys directly to arrange for this training programme. The Approved Manufacturer status also brings a number of benefits which support market activity.

PERFORMANCE • FINISH • SUSTAINABILITY •

Attachment 2:
Lumber grading specifications

innovation in wood

LUMBER GRADING SPECIFICATIONS

Grade Names & Definitions
for Accoya® Radiata Pine
Version 9.1

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03 Rough Accoya® wood
04 A1 quality
06 FJ (finger jointed)
08 A2 quality
10 B quality
12 General specifications
13 Surfacing considerations
14 Allowed bow
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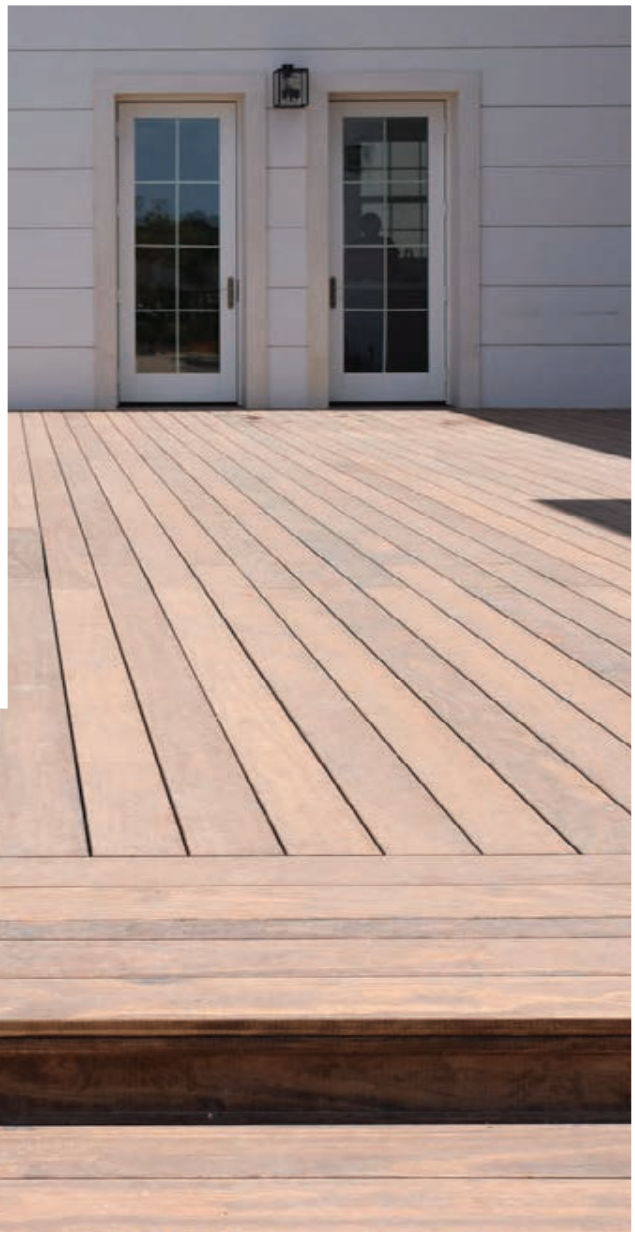


ROUGH
ACCOYA® WOOD

A1 MINIMUM GRADE DEFINITION

4 sides primarily clear with total allowance (combination of all sides) of the following:

LESS THAN 50 MM THICKNESS:

Up to 3 of the following defects or equivalent:
- Knot (pin): 8 mm or less
- Bark or resin pocket: 8 mm wide, 50 mm long or equivalent.

50 MM THICKNESS AND GREATER:

Up to 6 of the following defects or equivalent:
- Knot (intergrown, partially intergrown and tight encased): 15 mm
- Bark or resin pocket: 10 mm wide, 100 mm long or equivalent.

RESIN STREAKS

Three up to 8 mm wide, 100 mm long or equivalent, slightly more for a short distance.

SURFACE CHECKS

- Three up to 1 mm wide, 250 mm long or equivalent, slightly more for a short distance.
- For boards 200-300 mm wide the following additional allowance applies: Up to 1 surface check per 50 mm width, no wider than 1 mm, 250 mm long or equivalent, slightly more for a short distance.

SPLITS

Short split, up to width of board and not to exceed 200 mm.

NEEDLE FLECK/ BIRDS EYE

Medium birds eye or fleck.

WARP

As given in tables 1,2,3,4.

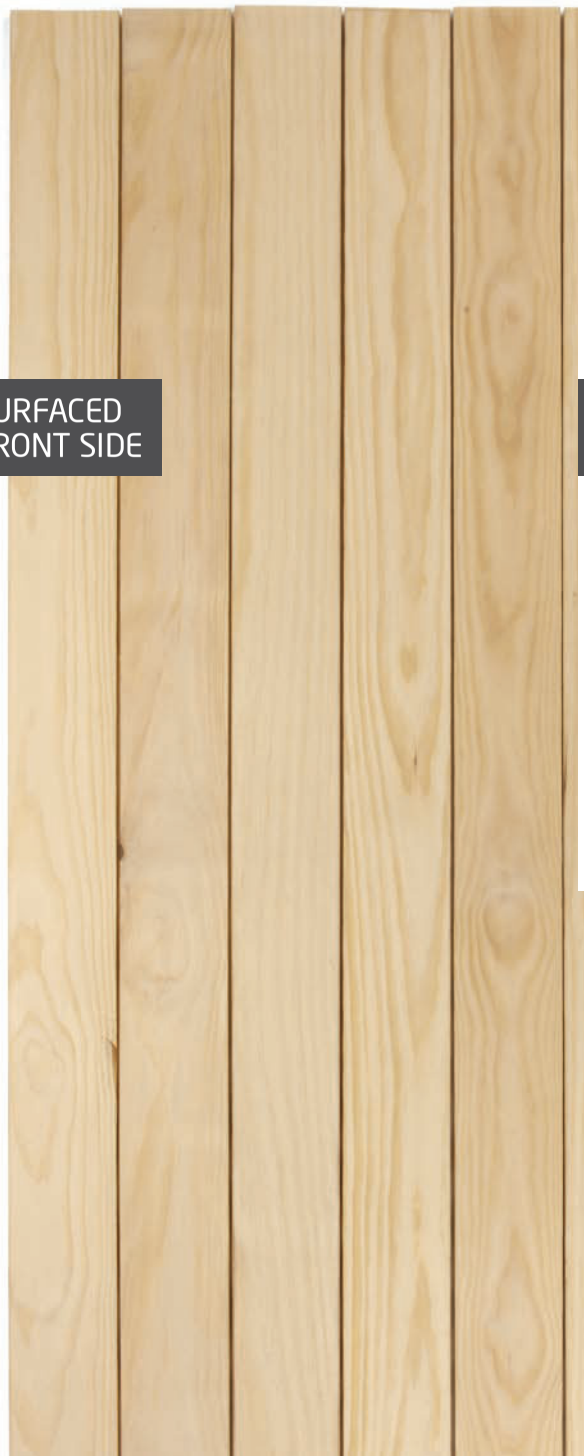
WANE

Up to 8mm in depth, ¼ length of board of equivalent, slightly more for short distance. Transport damage is permitted within the same wane limits.

SURFACE FINISH

Supplied sawn.

A1



FJ MINIMUM GRADE DEFINITION

DELIVERED SIZES		
48 x 100	62 x 100	74 x 100
48 x 125	62 x 125	74 x 125
48 x 150	62 x 150	74 x 150
48 x 200	62 x 200	74 x 200

LENGTHS		
4,200	4,800	6,000
Custom lengths (3,500 to 7,100mm - 10m³ minimum order)		

TOLERANCE	
WIDTH	THICKNESS
-1mm / +3mm	+/- 1mm

JOINT DISTANCE		
MINIMUM	TYPICAL	MAXIMUM
250mm	500mm	1,000mm

Accoya® finger jointed is bonded with EPI adhesive. It offers fixed width, engineered sections for joinery under the KOMO joinery certificate for finger joint quality. Accoya® has been finger jointed under the KOMO scheme successfully since 2007, predominantly for the Dutch market.

NOTE: Finger joints are rated for use as joinery and not in-ground.

FINGER JOINT QUALITY CERTIFICATION FOR OPAQUE JOINERY USE:

Cert. no. 33058/07
BRL 0605 Modified Timber
Accoya® is suitable for in use class 1, 2, 3 and 4 (EN 335-1)

NO DEFECTS ALLOWED WITH EXCEPTION:

- Sound full-grown knots, not bigger than 5mm in the nearness of the finger joint, are not considered as defect
- Bigger sound full-grown, max. 15 mm, knots are only allowed if the distance from knot to finger joint is at least 3 times the center-line of the knot, with a maximum of 2 knots on a block.
- Maximum size (center-lined) of the knots are: With timber up till width of 150 mm - 15 mm
- In-ring checking with a maximum of 5% is allowed
- Internal resin pockets are allowed with a maximum of 5%
- No cracks and checks or shell shake on the surface are allowed
- No collapse, end-, heart-, felling- or ring shake are allowed
- Calibrated on at least 2-sides (one square angle)
- Allowed deviations (complete beam)
  - Thickness: +/- 0,5 mm
  - Width: +/- 1,5 mm
- No wane is allowed
- Surface discolouring
- Resin channel

NOT ALLOWED:

- Not full grown knot
- Sound full grown cracked knot
- Sound not completely grown splay knot
- Defects in general
- Bark- and Resin pocket
- Not calibrated
- Small parts (to small width between the finger jointed blocks)

FINGER JOINTED

FINGER JOINTED
FRONT SIDE

A2 MINIMUM GRADE DEFINITION

A2 thinner dimensions < 50 mm

BETTER FACE AND EDGE COMBINED TOTAL:

Up to 4 of the following defects or equivalent:
- Knot (intergrown, partially intergrown and tight encased): 15 mm or equivalent smaller.
- Bark or resin pocket: 10 mm wide, 100 mm long or equivalent.

REVERSE FACE AND EDGE COMBINED TOTAL:

Up to 6 of the following defects or equivalent:
- Knot (intergrown, partially intergrown and tight encased): 30 mm or equivalent smaller.
- Bark or resin pocket: 10 mm wide, 100 mm long or equivalent.

COLLAPSE

Insufficient to affect dry-dressed dimensions.

RESIN STREAKS

One 1/5 width, 1/3 length or equivalent, slightly more for a short distance.

SURFACE CHECKS

- Three up to 1 mm wide, 250 mm long or equivalent, slightly more for a short distance.
- For boards 200-300 mm wide the following additional allowance applies: Up to 1 surface check per 50 mm width, no wider than 1 mm, 250 mm long or equivalent, slightly more for a short distance.

SPLITS

Short split, up to the width of board and no more than 200 mm.

NEEDLE FLECK/ BIRDS EYE

Medium birds eye or fleck.

WANE

Up to 8mm in depth, ¼ length of board of equivalent, slightly more for short distance. Transport damage is permitted within the same wane limits.

SURFACE FINISH

Supplied sawn.

A2 thicker dimensions > 50 mm

FRONT 1 (GOOD) SIDE AS A1:

KNOTS AND RESIN POCKETS

Up to 6 of the following defects or equivalent:
- Knot (intergrown, partially intergrown and tight encased) 15 mm or less.
- Bark or resin pocket: 10 mm wide, 100 mm long or equivalent.
- Resin streaks, three up to 8 mm wide, 100 mm long or equivalent, slightly more for a short distance.

SPLITS

Short split, up to width of board and not to exceed 200 mm.

SURFACE CHECKS

- Three up to 1 mm wide, 250 mm long or equivalent, slightly more for a short distance.
- For boards 200-300 mm wide the following additional allowance applies: up to 1 surface check per 50 mm width, no wider than 1 mm, 250 mm long or equivalent, slightly more for a short distance.

NEEDLE FLECK/ BIRDS EYE

Medium birds eye or fleck.

FRONT BACKSIDE + SIDES:

KNOTS AND RESIN POCKETS

Single large defect or defect area of any type allowed, provided it is covering an area of <500 mm. Or, a maximum of 2 large defects (25 mm width).

SPLITS

Short split, up to width of board and not to exceed 200mm.

SURFACE CHECKS

Checks in knots are allowed.

WANE

Up to 12 mm in depth, 1/2 length of board or equivalent, slightly more for a short distance. Transport damage is permitted within the same wane limits.

WARP

As given in tables 1, 2, 3, 4.

A2

B PRIMARILY FOR FINGER JOINTING USAGE

Both faces containing knots, bark or resin pockets with total allowance of the following:

50 MM THICKNESS AND GREATER:

BARK OR RESIN POCKETS

20 mm wide, 100 mm long or equivalent, slightly more for a short distance.

CHECKS

Knot checks and surface checks not more than 150 mm.

SPLITS

Up to twice the width of the board, not more than 300mm.

COLLAPSE

Insufficient to affect dry-dressed dimensions more than 1 mm per side.

HOLES, LOOSE KNOTS, AND DECAYED KNOTS

20 mm (40 mm in pieces exceeding 150 mm wide or 50 mm in thickness, 4 per length).

KNOTS (INTERGROWN, PARTIALLY INTERGROWN, TIGHT ENCASED)

100 mm (singly), sum of sizes in any combination half of the width of the piece.

SOUND SPIKE KNOTS AND SOUND DOUBLE SPIKE KNOTS, INTERGROWN OR PARTIALLY INTERGROWN

50 mm wide, projected length two-thirds of width of piece.

PITH

up to 12 mm wide, 50% of length or equivalent, slightly more for a short distance.

RESIN STREAKS

1/5 width, 1/3 length or equivalent, slightly more for a short distance.

SHAKES OTHER THAN THROUGH SHAKES

1/5 of length.

NEEDLE FLECK/ BIRDS EYE

unrestricted.

WARP

As given in tables 1,2,3,4.

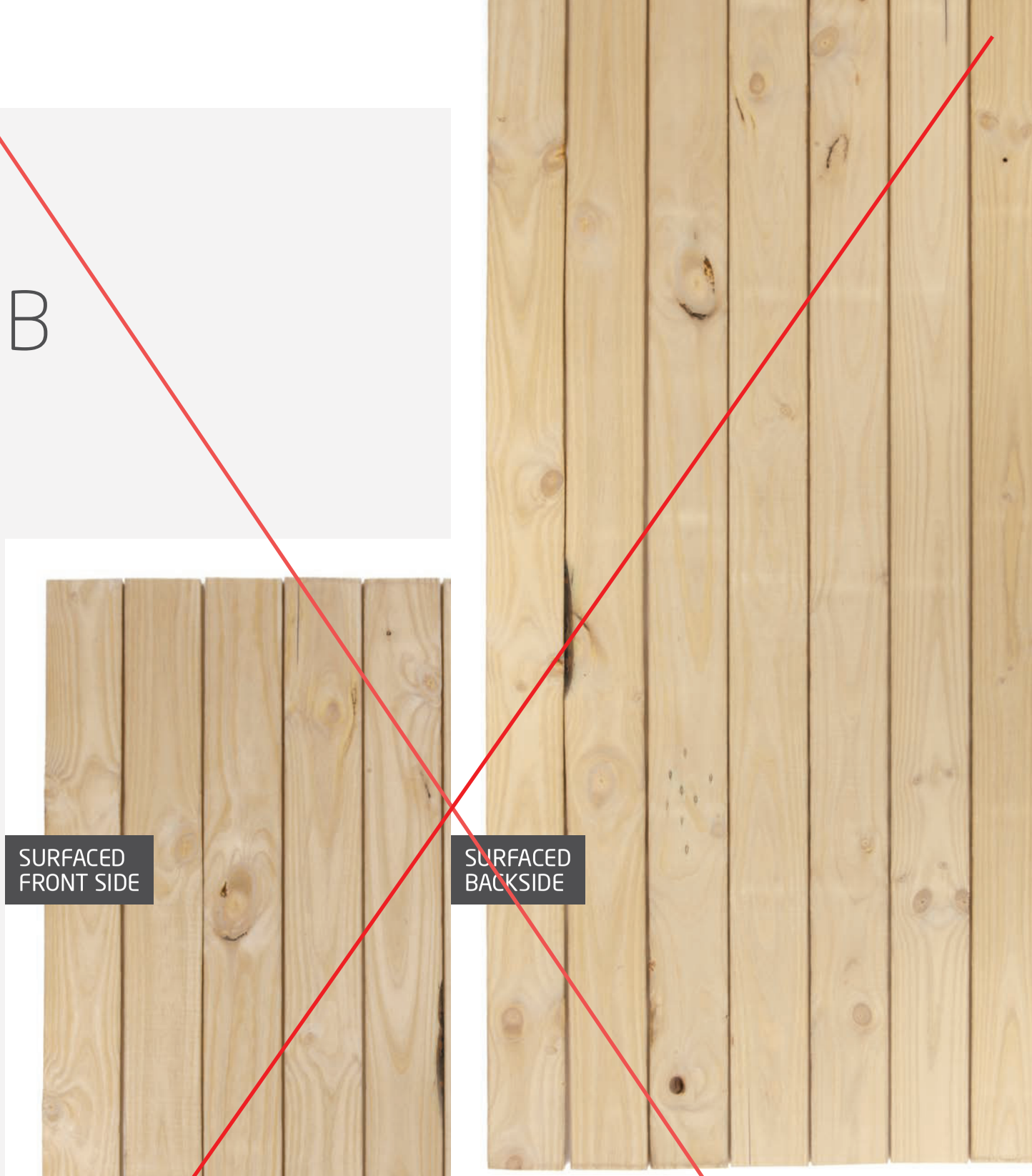
WANE

Up to 18 mm width, 50% of length or equivalent, slightly more for a short distance. Transport damage is permitted within the same wane limits.

SURFACE FINISH

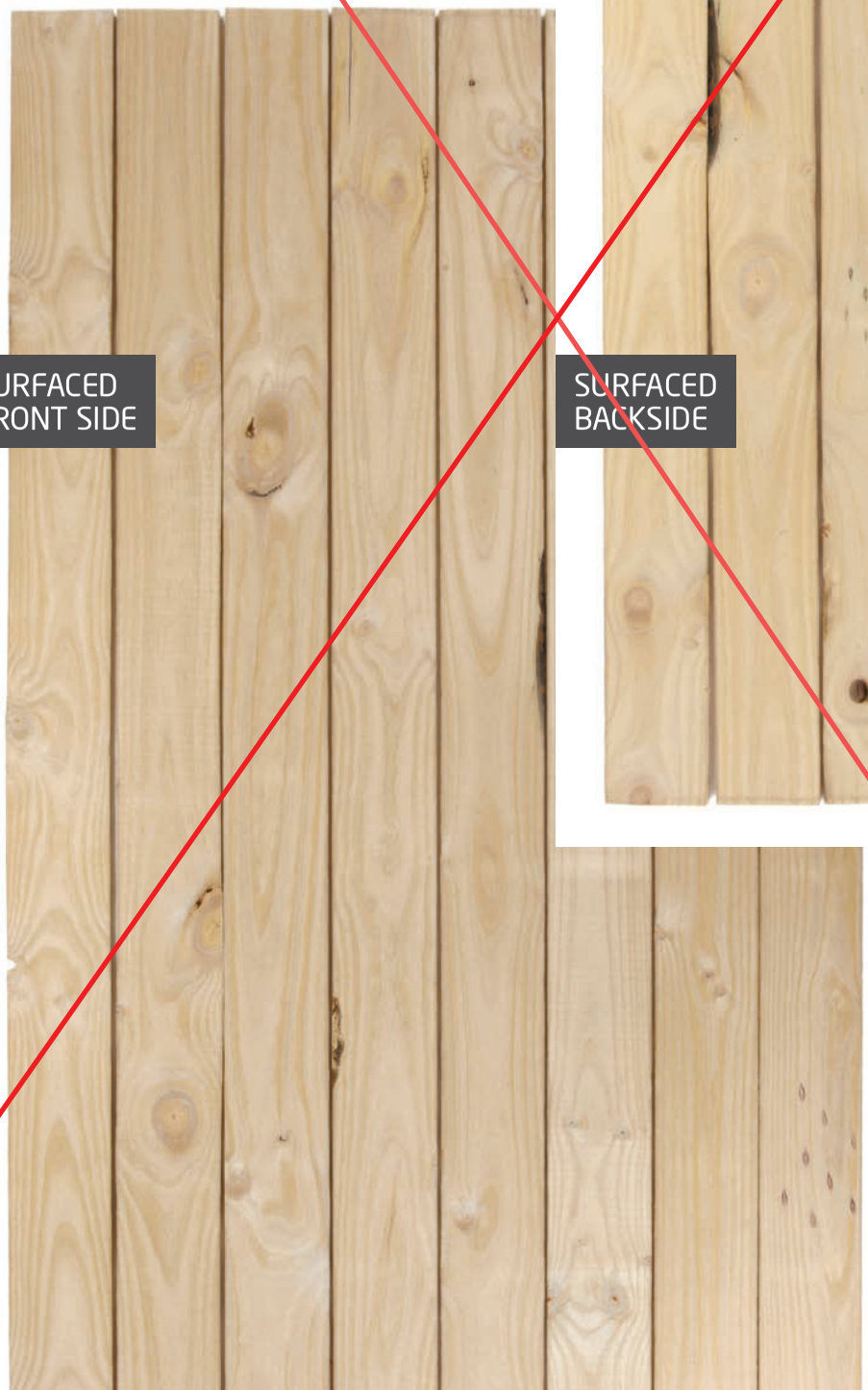
Supplied sawn.

B



SURFACED
FRONT SIDE

SURFACED
BACKSIDE



GENERAL SPECIFICATIONS

PROPERTY	SPECIFICATION
Thickness	No more than 1 mm less than the specified size.
Width	No more than 1 mm less than the specified size.
Length	No more than 20 mm shorter than nominal length.
Moisture Content	Less than 10%.

SURFACE FINISH AND DIMENSION

Accoya® boards can be rough sawn or dressed to a smaller dimension. The dressed dimensions have been selected with the intent of enabling production of the same final products. Boards are sold and classified according to their original sawn (nominal) dimension. 25 and 32mm boards have one hit and miss back face and one smooth appearance face. The hit and miss back side will generally have more process discolouration. This orientation should be maintained in finished product manufacture.

ADDITIONAL GRADE SPECIFICATIONS

Internal Defects Not Visually Present on Surface: Accoya® wood is produced from a natural resource. All wood has natural variation from tree to tree and board to board. This natural variation results in a product that can have defects naturally present within the wood. Furthermore, the process of cutting trees into lumber and drying of the lumber can induce defects such as shakes, cracks and checks. Accoya® wood is produced from lumber visually inspected on the surface to meet the grade specifications, however upon further processing internal defects can be discovered.

MANUFACTURING IMPERFECTIONS

Lumber may have slight manufacturing related imperfections.

OVERALL DEVIATION FROM SPECIFICATIONS

Up to 5% of boards off grade shall be deemed acceptable.

SURFACING CONSIDERATIONS

DISCOLOURATION

The acetylation process can result in discolouration and sticker marks upto 6mm in depth, and on occasion due to wood's natural variation slightly deeper. This is typically over come in an application such as decking by milling 1mm off the back side and a higher proportion from the appearance side. Removal of discolouration is not typically required when opaque coatings are used.

TABLE 1: ALLOWED BOW

LENGTH [M]	THICKNESS [MM]					
	22 & 25	32	38	50	63	75
1.8	15	15	10	10	10	5
2.1	25	20	15	10	10	10
2.4	30	25	20	15	15	10
2.7	40	30	25	20	20	15
3.0	45	40	30	25	25	15
3.3	55	45	35	30	30	20
3.6	65	55	40	35	35	25
3.9	80	65	50	40	40	25
4.2	90	75	55	45	45	30
4.5	105	90	65	55	55	35
4.8	120	100	75	60	60	40

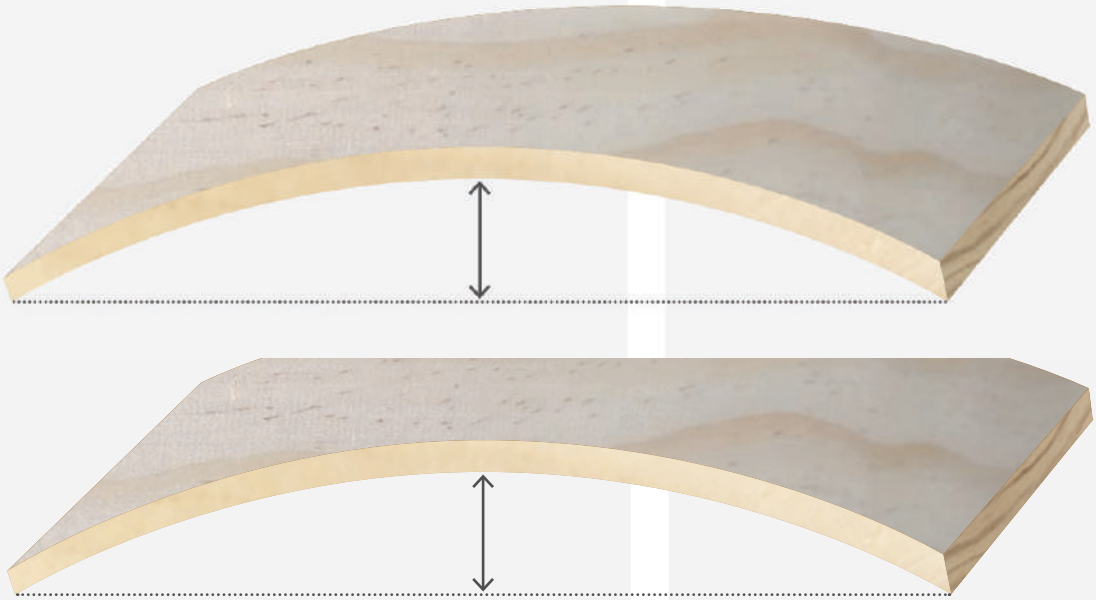


TABLE 2: ALLOWED CROOK

LENGTH [M]	WIDTH [MM]					
	75	100	125	150	200	>200
1.8	5	4	3	3	2	2
2.1	10	5	5	4	3	2
2.4	10	10	5	5	4	3
2.7	15	10	10	5	5	4
3.0	15	10	10	10	5	5
3.3	20	15	10	10	5	5
3.6	25	15	15	10	10	5
3.9	25	20	15	15	10	10
4.2	30	25	20	15	10	10
4.5	35	25	20	20	15	10
4.8	40	30	25	20	15	10

TABLE 3: ALLOWED TWIST PER 100 MM WIDTH

LENGTH [M]	THICKNESS [MM]					
	22 & 25	32	38	50	63	75
1.8	10	10	5	5	5	3
2.4	10	10	10	5	5	4
3.0	15	15	10	10	10	5
3.6	20	15	10	10	10	5
4.2	20	20	15	10	10	5
4.8	25	20	15	10	10	10

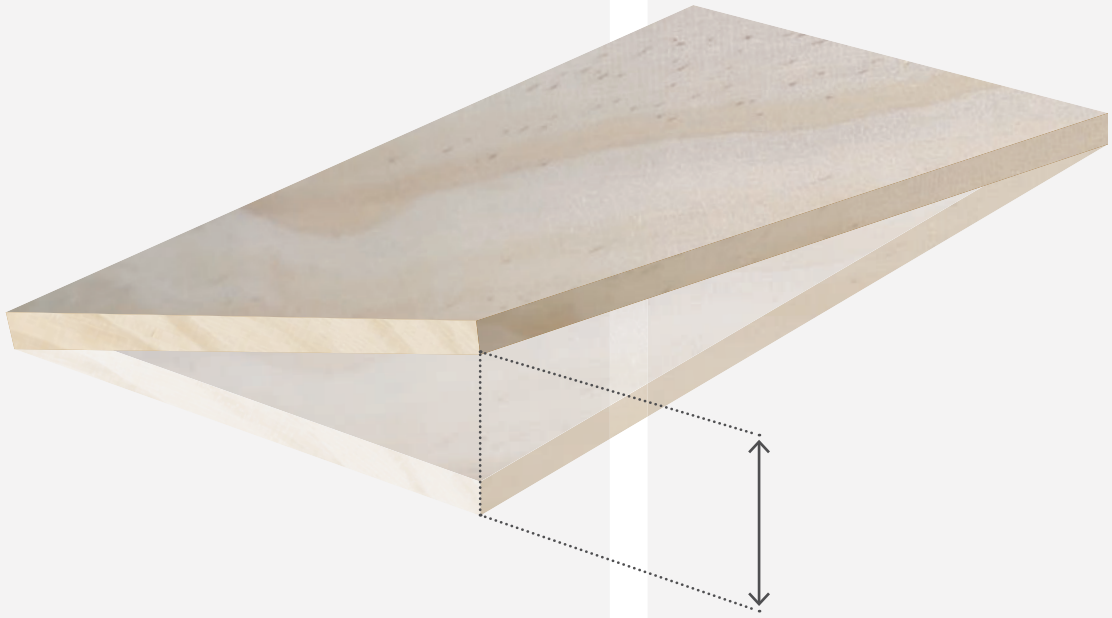
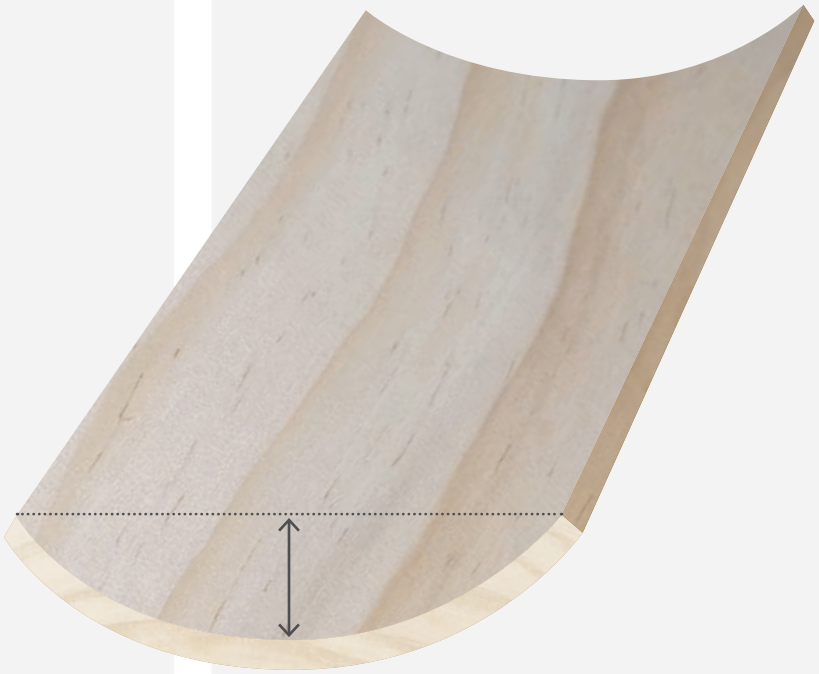


TABLE 4: ALLOWED CUPPING

WIDTH [MM]	ALLOWED CUPPING [MM]
75	1
100	1
125	2
150	2
200	3
225	4
250	5
300	6



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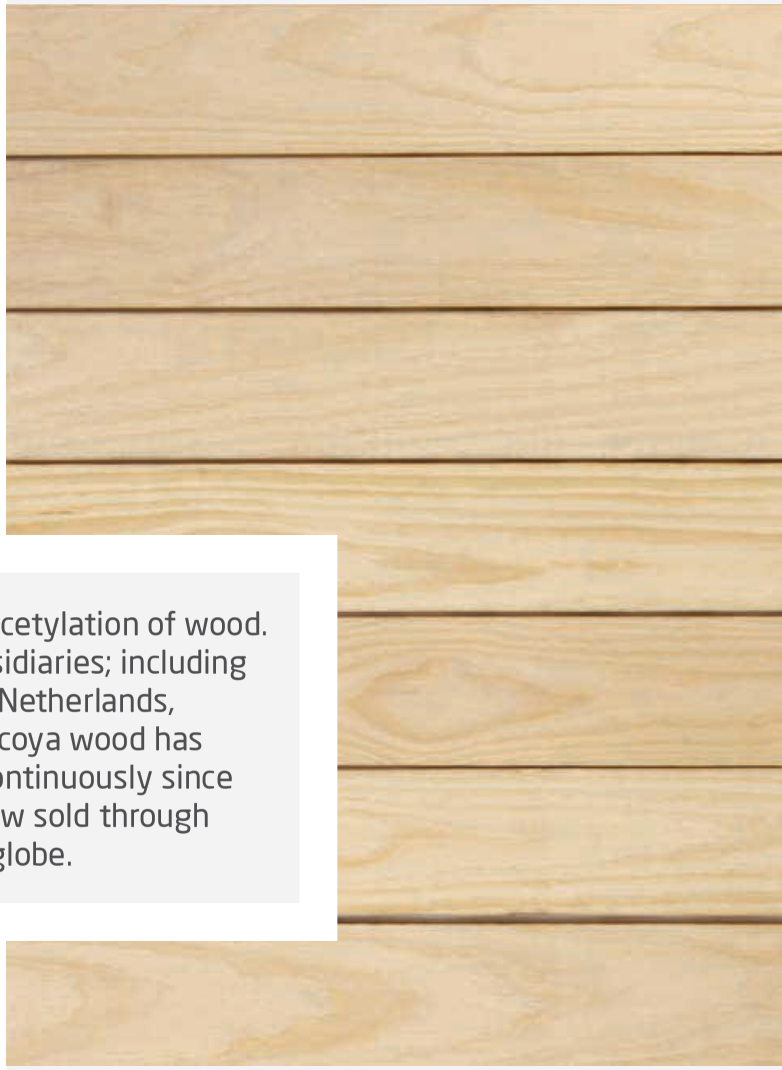

Accsys is a chemical company focused on the acetylation of wood. The company operates four wholly owned subsidiaries; including a commercial scale Accoya wood facility in the Netherlands, and offices in the Netherlands, USA and UK. Accoya wood has been produced by Accsys in the Netherlands continuously since 2007. Volume has grown each year and it is now sold through distribution and selected partners around the globe.

WWW.ACCOYA.COM

FSC
www.fsc.org
FSC® C012330
The mark of responsible forestry

CERTIFIED
cradle to cradle
GOLD

ACCSYS
GROUP

Attachment 3:
Contribution of Accoya towards Leed V4

CONTRIBUTION OF ACCOYA TOWARDS LEED V4

Accoya® wood may contribute to several credits of the U.S. Green Building Council's LEED Program (Leadership in Energy & Environmental Design). After years of development, in Fall 2013 USGBC launched the latest update of LEED, version 4.

The update has made Accoya eligible for additional credits in recognition of LEED's more comprehensive sustainability considerations, in particular in the Building Design & Construction (BD+C) and Interior Design & Construction (ID+C), sections of the various rating systems. The table below gives a good overview for which LEEDv4 credits application of Accoya can provide a contribution. For a memo with more detailed background information please contact us at sustainability@accsysplc.com.

CREDIT NAME	MAXIMUM POSSIBLE CONTRIBUTION	RATIONALE / EVIDENCE
SUSTAINABLE SITES		
SS5 Heat island reduction	2 points (option 1)	Non roofing measures: Accoya has an initial solar reflectance (SR) of 0.70 (report Intertek).
MATERIAL & RESOURCES		
MRC1 Building life-cycle impact reduction	3 points (option 4)	LCA studies (ISO 14040/44 compliant) and carbon footprint studies, show large improvement over common building materials.
MRC2 Building product disclosure and optimization - environmental product declarations	2 points (option 1 and/or option 2)	Option 1 - disclosure of environmental performance: Accoya LCA study and Type III third-party EPD certification publicly available. Option 2 - optimization environmental performance: LCA studies (ISO 14040/44) and carbon footprint studies, show large improvement over common building materials.
MRC3 Building product disclosure and optimization - sourcing of raw materials	2 points (option 1 and/or option 2)	Option 1 - CSR reporting: Social Impact Report of Accsys Technologies publicly available on the Social Stock Exchange website. Option 2 - Certified wood: Accoya is FSC or PEFC certified.
MRC4 Building product disclosure and optimization - Material Ingredients	2 points (option 1, 2 and option 3)	Option 1 & 2 - Material ingredients optimization: Accoya is C2C Gold Certified Option 3 - Supply chain optimization: Accsys operates under a QSHE management system and is independently assessed. Certificate available here.
INNOVATION		
IC1 Innovation	5 points	Innovative use: Accoya opens up applications for wood where it was never used before Exemplary performance: For some credits Accoya can help reach double the criteria limit

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ACCSYS GROUP

www.accoya.com

Attachment 4:
Certificate Cradle to Cradle

Accsys Technologies

has successfully achieved **Cradle to Cradle Certified® Gold**
for the product(s) under the name:

Accoya® Wood

Accoya® Wood

Certification Number
5093

Standard Version
3.1

Lead Assessment Body
MBDC

Material Health
Assessment Body
MBDC

Effective Date
23 September 2021

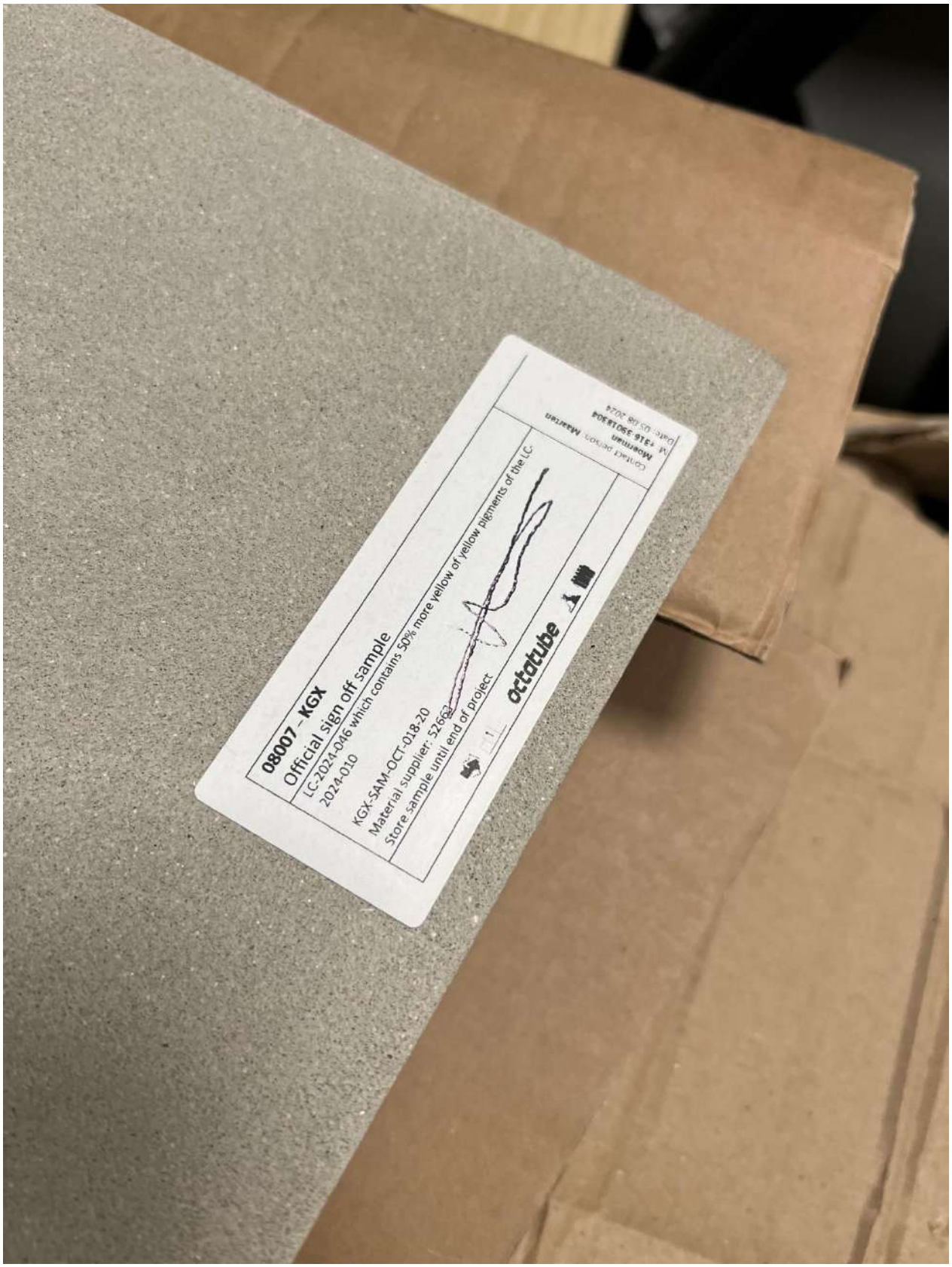
Expiration Date
09 August 2023

President & CEO
Cradle to Cradle Products Innovation Institute

03 - Skirtings
Glass Reinforced Concrete

GRC Samples
Approved Sample

2. Sign off sample



LC-2027-046 which contains 50% more yellow of yellow pigments of the LC-2024-010.

GRCA
INTERNATIONAL
FULL MEMBER

CERTIFICATE OF GRCA FULL MEMBERSHIP

This is to certify that the GRC manufacturing plant of:

LINDNER

ISOLIERTECHNIK & INDUSTRIESERVICE GMBH

at: **Zeppelinstrasse 8, KOLKWITZ, 03099 GERMANY**

has been independently assessed on behalf of:

The International Glassfibre Reinforced Concrete Association (GRCA)

in accordance with the GRCA Full Member Regulations, and

Lindner Isoliertechnik & Industrieservice has been accepted in to the:

FULL MEMBER grade of GRCA Membership

for: Sprayed GRC & Premix GRC

GRCA Full Membership Number: 1120/FM

Certificate Valid for the Period:

1st April 2022 to 31st March 2023

Approved by:

Chair of GRCA Council

(To check the current validity of this certificate please visit the GRCA website at www.grca.online)

The International Glassfibre Reinforced Concrete Association
www.grca.online info@grca.online +44 (0) 330 111 GRCA (4722)
PO Box 1454, NORTHAMPTON, NN2 1DZ. United Kingdom
A Company Limited By Guarantee, Registered in England: 01398450. VAT: GB 113 9195 20
Registered Office: Fairfax House, 6a Mill Field Road, Cottingley Business Park, Bradford BD16 1PY England

ZERTIFIKAT ◆ CERTIFICATE ◆ 認證證書 ◆ СЕРТИФИКАТ ◆ CERTIFICADO ◆ CERTIFICAT

Management Service

CERTIFICATE

The Certification Body
of TÜV SÜD Management Service GmbH

certifies that

Lindner Isoliertechnik & Industrieservice GmbH
Bahnhofstraße 29, 94424 Arnstorf, Germany

for the scope of application

Development, Installation of Insulation for Industry and Heating, Ventilation and Air Conditioning (HVAC), Noise Protection, Structural Fire Protection as well as Clearance of Harmful Substances and glass fibre reinforced concrete (GRC) elements and steel constructions

Lindner Isoliertechnik & Industrieservice GmbH
Zeppelinstraße 8, 03099 Krieschow, Germany

for the scope of application

Manufacture of glass fibre reinforced concrete (GRC) elements and steel constructions

Lindner Isoliertechnik & Industrieservice GmbH
Stahlgruberring 43, 81829 München, Germany
Im Rotfeld 9, 66115 Saarbrücken, Germany
Südstraße 6, 06179 Teutschenthal, Germany

for the scope of application

Installation and Manufacture of Technical Insulation for Industry and Heating, Ventilation and Air Conditioning (HVAC), Noise Protection, Structural Fire Protection

has established and applies a Quality Management System.

An audit was performed, Order No. **70005394**.

Proof has been furnished that the requirements according to

ISO 9001:2015

are fulfilled.

The certificate is valid in conjunction with the main certificate from **2021-11-14** until **2024-11-13**.

Certificate Registration No.: **12 100 8663/04 TMS**.

Head of Certification Body
Munich, 2021-11-05

IAF

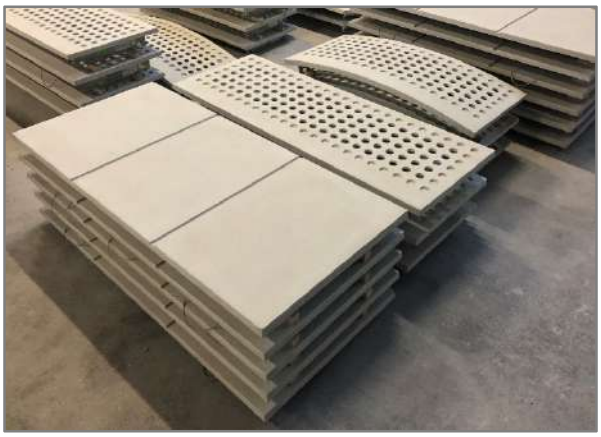
DAkkS Deutsche Akkreditierungsstelle D-ZM-14143-01-00

LINCRETE
GLASS-FIBRE REINFORCED CONCRETE (GFRC)

Glass-fiber reinforced concrete or GFRC is a type of fibre-reinforced concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented. The character of fibre-reinforced concrete changes with varying mixtures, element geometries and surfaces. The product is also known as GRC in British English.
Lindner manufactures premium GFRC products and normally uses spray methods in the production processes. Sprayed GFRC is generally stronger than premix vibration cast processes. The thin-walled design results in enormous weight savings compared to conventional types of concrete. Especially for cladding and elements with high aesthetic demands on 3D shapes, surfaces and colours, LinCrete GFRC offers project-specific solutions combining the well-established advantages of Lindner Group's facade and interior construction products.

PROPERTIES

+ Inherently stable
+ Solvent-resistant
+ Temperature/frost-resistant
+ UV-resistant
+ Weatherproof



APPLICATIONS

+ Facades and Roofing
+ Cladding for interior suspended ceilings and walls
+ Renovation of historic buildings and structures
+ Railway station and tunnel claddings
+ Noise barriers
+ Public elements and artificial landscaping
+ Regious buildings
+ Balustrades
+ Custom 3D-shaped structures
+ And many further applications

CERTIFICATES / ASSOCIATION MEMBERSHIPS

FVF Fachvereinigung Faserbeton e.V.

GRCA INTERNATIONAL

Mitglied der DGNB

LEED

Institut Bauen und Umwelt e.V.

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gfrc@Lindner-Group.com | www.Lindner-Group.com

LINCRETE
GLASS-FIBRE REINFORCED CONCRETE (GFRC)

TECHNICAL DATA

Density	2,000 – 2,600 kg/m³
Compressive strength	40 – 80 N/mm²
Flexural strength	8 – 40 N/mm²
Water diffusion resistance	50 – 200 μ
Linear expansion	E-5: 1.00 – 1.50 x 10^{-5} 1/K
Glass-fibre content	Average of 5% of total weight

DIMENSIONS

Element width	Standard up to 3,000 mm*
Element length	Standard up to 6,000 mm*
Material thickness	Min. 6 mm for interior fit-out elements; min. 12 mm for façade elements / typical exterior applications
Joint width	Min. 10 mm for individual demountability

*Please note that larger elements (e.g. length up to 11000 mm) are producible, however, very large sizes might result in unwieldy and therefore also uneconomic elements if appropriate logistics chain methods and sufficient space on the transportation routes and on the building site can not be ensured.

ACOUSTICS

Sound absorption	
Tested to EN ISO 354	Up to αw = 0.60, sound absorption class C
Tested to EN ISO 354 rated to ASTM C 423	Up to NRC = 0.70

FIRE PROTECTION

GFRC element including acoustic tissue and mineral wool backing	
Tested to EN 13501-1	A2-s1, d0

SAFETY PROTECTION

Seismic protection	Earthquake-proof design available on request
Bomb-blast resistance	Average 150 kPa peak pressure for minimum material thickness of 6mm

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gfrc@Lindner-Group.com | www.Lindner-Group.com

SUBSTAINABLILITY

Environmental product declaration (EPD)	
According to ISO 14021	Self-declared

CERTIFICATION

EN 1169 / 1170 / 12467 / 12878 / 14649 / 15191 / 15422

ADDITONAL EQUIPMENT / SUBSTRUCTURE OPTIONS

Lindner pin channel substructure	With profiles embedded in the GFRC element
Undercut anchor fastening	Combinable with different substructure systems (e.g. with agraffe profile substructure systems approved for GFRC cladding elements)
Self-standing by means of floor-mounted studs	
Self-standing without substructure	E.g. if used as foundation element on the ground
Lindner wall cladding substructure or partition studs systems	
Lindner hook-on ceiling substructure systems	
Project-specific customised substructure systems by Lindner	

SURFACES

Sandblasted	Grades: light | medium | heavy; individually as agreed upon
Acid etched	
Grinded	
Polished	
Painted	Paintable with standard concrete paint
Printed	For further information see LinCrete print
Plaster surface	
Various performance coatings	E.g. hydrophobized (coated water-repellant and / or mass-hydrophobized), anti-graffiti coating

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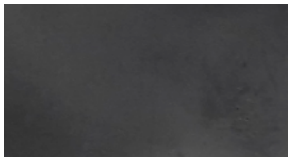
LINCRETE
GLASS-FIBRE REINFORCED CONCRETE (GFRC)

TABLE OF COLOURS – STANDARD COLOURS

Customised, project-specific solutions possible

	SANDBLASTED (MEDIUM)	SMOOTH FINISH
SLATE GRAY		
PASTEL VIOLET		
GREY BEIGE		
BEIGE GREY		
BEIGE		
YELLOW GREY		
RESEDA GREEN		
ORANGE BROWN		

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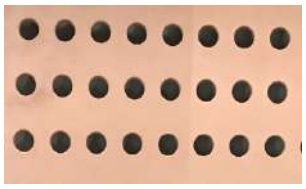
LINCRETE
GLASS-FIBRE REINFORCED CONCRETE (GFRC)

POSSIBILITIES OF MOULDING / TEXTURED SURFACES

Customised, project-specific solutions possible

FLOOR TILES			
LINEAR SLAT APPEARANCE			
PERFORATION			
ROUGH PLASTER			
FINE PLASTER			
WOODLIKE APPEARANCE			
STONE / TERRAZZO SURFACE			
BRICK WALL APPEARANCE			

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ARCHITECTURAL GFRC LINCRETE

SELF-DECLARATION ACC. TO DIN EN ISO 14021

Holder of the declaration: Lindner Isoliertechnik & Industrieservice GmbH | Bahnhofstrasse 29 | 94424 Arnstorf | Germany

Content of the declaration: Product information
Certification system DGNB
Certification system LEED
Certification system BREEAM
Circular Economy

Lindner | Building New Solutions

PRODUCT INFORMATION

Green Building Statement

We already consider all relevant aspects of sustainability during the development phase of our products. In this connection we act as one of the specialists within the range of sustainable building since many years. Supported by our internal technical department “Green Building“ we ensure the sustainability target of your building project.

Product description

Glass-fibre reinforced concrete LinCrete

Glass-fibre reinforced concrete (GFRC) is a type of fibre-reinforced concrete containing alkali-resistant glass fibres. By adding reinforcement to the concrete using short discrete glass fibres that are uniformly distributed and randomly oriented, the resilience, impact resistance and tensile strength of the concrete is increased allowing for the production of more filigree and thin-walled elements compared to concrete produced with conventional methods. The character of fibre-reinforced concrete changes with varying concretes, fibre materials, geometries, distribution, orientation, and densities. For the architectural GFRC elements, Lindner uses spray-technologies for the production as these provide for an efficient manufacturing regarding raw material and energy consumption among other advantages for the final product.

Application area

LinCrete products offer a wide scope of application such as linings in subway stations, facade claddings, suspended ceilings, roofing etc. The environmental product declaration is related to LinCrete cladding elements.

Base material

Base material per kg GFRC		
System components	**Material**	**Weight proportion (%)**
Silica sand (crystal sand)	Graded size 0.1 – 1.2 mm	~ 39.1
Cement	Cement CEM I 52,5 R	~ 39.1
Water	Process water acc. to DIN EN 1008	~ 11.7
Alkali-resistant glass fibres	AR glass fibres	~ 4
Superplasticizer	Superplasticizer	~ 2
Colour pigments	Colour pigments (powdered)	~ 2
Curing accelerator agent	Curing accelerator agent	~ 2

*data sheets available on request

Material explanation

Silica sand

The crystal quartz sands used for LinCrete are characterised by a high SiO_2 content exceeding 97 MA .-% as well as their rounded grain shape, light, uniform colour, monocrystalline structure, and its purity (free of organic impurities). The use of modern processing technology and modern quality and environmental management ensures high quality with the best possible consideration for our environment.

Cement

Cement is a hydraulically hardening building material. It consists of a mixture of finely ground, non-metallic, inorganic components and is generally produced in accordance with: DIN EN 197-1, DIN EN 14216, or in Germany also in accordance with DIN 1164, parts 10, 11 and 12.

Water

The water used for the production of LinCrete is process water that is commercially available at the production site. The water characteristics with regard to the usability for the production of GFRC are generally stipulated by DIN EN 1008.

Alkali-resistant glass fibres

Alkali-resistant glass fibres provide for exceptional results in terms of compressive and flexural strength due to their high resistance to the fundamentally high alkalinity of cement, leading to a strong yet light end product. Lindner uses high quality fibers with a high minimum content of zirconium oxide for the production of LinCrete.

Die Lindner Group ist Mitglied der DGNB[1]
Deutsche Gesellschaft für Nachhaltiges Bauen
German Sustainable Building Council

CERTIFICATION SYSTEM DGNB

Not listed characteristics do not apply to this product.

Environmental Quality

ENV 1.1 Building life cycle assessment

Project-specific eco-balance data can be issued contemporary.
In this context an additional expenditure of time and cost shall be considered if applicable.

ENV 1.2 Local environmental impact

Components	Weight proportion (%)	VOC	GISCODE	Other
Silica sand (crystal sand)	~ 39.1	-	-	-
Cement	~ 39.1	-	ZP 1	-
Water	~ 11.7	-	-	-
Alkali-resistant glass fibres	~ 4	-	-	-
Colour pigments	~ 2	-	-	-
Superplasticizer	~ 2	-	-	-
Curing accelerator agent	~ 2	-	-	-
Total	**100**	**-**		

„-“ for „not relevant“ according to DGNB 2018

Up to quality level 4 can be achieved.

ENV 1.3 Sustainable resource extraction

The product LinCrete contains no timber-based materials. Therefore, a FSC / PEFC proof is not required.

ENV 2.2 Potable water demand and waste water volume

During the production of LinCrete products we pay attention to reduce the water demand to the actually required extent. No waste water is generated with the production of LinCrete products.

Economic Quality

ECO 1.1 Life cycle costs

Lindner LinCrete cladding elements are manufactured to the highest international standards. LinCrete elements can be expected to remain durable for 50 years or more (acc. to BBSR table, code no. 335.511, issue 02/2017, published by the Federal Institute for Research on Building, Urban Affairs and Spatial Development).

ECO 2.1 Flexibility and adaptability

Depending on customer requirements, a cladding made up of LinCrete elements can be designed in such a way that every panel can be individually demounted, moved or replaced. The GFRC elements can possibly be reused depending on the requirements of the alternative use.

ECO 2.2 Commercial viability

LinCrete products are continuously adapted to the current market demands.

Sociocultural & Functional Quality

SOC 1.2 Indoor air quality

In general, Lindner LinCrete products are made of purely mineral materials containing no emissions of e.g. VOC or formaldehyde.

Die Lindner Group ist Mitglied der DGNB[1]
Deutsche Gesellschaft für Nachhaltiges Bauen
German Sustainable Building Council

Sociocultural & Functional Quality

SOC 1.3 Acoustic comfort
Perforated LinCrete cladding elements in combination with acoustically effective backing can achieve sound absorption values up to 0.60 depending on the type of execution. The values are tested in a reverberation room in accordance with ISO 354 and rated in accordance with DIN EN ISO 11654. Non-perforated LinCrete elements can be realised as noise barriers.

SOC 1.4 Visual comfort
LinCrete cladding elements can be furnished with a large variety of shapes and surfaces, e.g. as back-ventilated facade cladding, providing a unique recognition factor for the building envelope and thus contributing significantly to a cityscape's particular design.

SOC 1.7 Safety and security
Building products made of LinCrete in combination with appropriate fasteners can contribute in many respects to the building's safety and security measurements. Using individual mould design and construction, sharp edges that might lead to injuries can be avoided. Furthermore, there is a wide variety for product customisation allowing for LinCrete products that prove their tested resistance against impact loads (fall protection), seismic loads or the forces occurring during an explosion.

SOC 2.1 Design for all (Accessibility)
LinCrete products can be customised in many ways. Therefore, they can be adapted to fulfil all requirements of the generally accepted rules of technology. Thereby the architect or authorised expert in charge are supported during planning and execution phase of the project.

Technical Quality

TEC 1.5 Ease of cleaning building components
LinCrete elements can be cleaned with water and mild cleaning agents which are customary in the trade. For strong soiling on exterior surfaces, high-pressure cleaning instruments can be used. Additionally, LinCrete elements can be furnished with an anti-graffiti coating system facilitating the cleaning of stubborn contamination from spray and other paints. The respective instructions on cleaning are to be observed.

TEC 1.6 Ease of recovery and recycling
LinCrete elements are produced on a project-specific basis and therefore in such a way that they can be installed on site with as little waste as possible. Waste that cannot be avoided on site is put into recycling processes by means of waste management facilities. Every GFRC element can be demounted and replaced in a non-destructive manner. Material recycling of GFRC elements is possible in small proportions as recycled aggregate for the production of similar products or to the full extent in other business fields, e.g. for road construction.

TEC 1.7 Immissions control
Lindner GFRC elements can be realised as noise barriers. Thus they can be used to reduce noise pollution on busy streets and on building facades.

Process Quality

PRO 1.5 Documentation for sustainable management
User-, maintenance- and cleaning guidelines and instructions are created to the usual extent and are available upon request.

PRO 2.1 Construction site / construction process
The compliance with project-related requirements regarding a low-waste, low-noise and low-dust construction site as well as all measures regarding soil- and ground water protection are ensured by specialised in-house departments. An appropriate verification can be produced and implemented on request by specialist staff. Due to the delivery of finished GFRC elements that do not have to be processed on site, the product contributes to a noise-free and dust-free site.

PRO 2.2 Quality assurance of the construction
If required, data sheets for the used products and components can be provided.

CERTIFICATION SYSTEM LEED

Not listed characteristics do not apply to this product.

Sustainable Site

Construction Activity Pollution Prevention
The compliance with project-related requirements of an ESC plan is ensured by specialised in-house departments. A complete ESC plan can be produced and implemented on request by specialist staff.

Materials and Resources

Construction and Demolition Waste Management Planning
Waste that cannot be avoided on site will be preferentially returned to recycling processes via waste management companies. A complete CWM plan can be issued and implemented by the specialists on request.

Building Life Cycle Impact Reduction
Lindner LinCrete products are manufactured to the highest international standards and therefore are designed for a high longevity. GFRC is expected to remain durable for minimum 50 years (acc. to BBSR table, 335.511, issued 02/2017, published by the Federal Institute for Research on Building, Urban Affairs and Spatial Development).

Building Product Disclosure and Optimization – Environmental Product Declaration
Furthermore, project-specific eco-balance data can be issued contemporary.
In this context an additional expenditure of time and cost shall be considered if applicable.

Building Product Disclosure and Optimization – Sourcing of Raw Materials

Components	Weight proportion (%)	Recycling content (%)		Production site
		Pre-Consumer	Post-Consumer	
Silica sand (crystal sand)	~ 39.1	0	0	Kolkwitz
Cement	~ 39.1	~ 7	0	Kolkwitz
Water	~ 11.7	0	0	Kolkwitz
Alkali-resistant glass fibres	~ 4	0	0	Kolkwitz
Colour pigments	~ 2	-	-	Kolkwitz
Superplasticizer	~ 2	-	-	Kolkwitz
Curing accelerator agent	~ 2	-	-	Kolkwitz
Total	**100**	**1.4**		

The product LinCrete contains no timber-based materials. Therefore, a FSC / PEFC proof is not required.

Building Product Disclosure and Optimization – Material Ingredients
As manufacturer of products Lindner fulfils the obligations towards the EU chemical directive „REACH“ and created its own REACH declaration.
The aim of the **REACH** regulation (**R**egistration, **E**valuation and **A**uthorization of **CH**emicals) is to capture materials produced and used in the EU and to determine and record their impact on health and environment.

Construction and Demolition Waste management
The compliance with project-related requirements regarding low-waste, low-noise and low-dust site as well as measures for soil and ground water protection are ensured by specialised in-house departments. An appropriate verification can be created and implemented on request by specialist staff. Due to the delivery of finished GFRC elements that do not have to be processed on site, the product contributes to a noise-free and dust-free site. The packaging is selected project-related to produce as little waste as possible.

Indoor Environmental Quality

Minimum Acoustic Performance
Lindner GFRC elements can be realised as noise barriers. Thus they can be used to reduce noise pollution on busy streets and on building facades improving the well-being of people and nature.

Low Emitting Materials
In general, Lindner LinCrete products are made of purely mineral materials containing no emissions of e.g. VOC or formaldehyde.

Construction Indoor Air Quality Management Plan
The compliance with project-related requirements of an IAQ plan is ensured by specialised in-house departments.
A complete IAQ plan can be produced and implemented on request by specialist staff.

Indoor Air Quality Assessment
In general, Lindner LinCrete products are made of purely mineral materials containing no emissions of e.g. VOC or formaldehyde.

Daylight
By using special coating systems or applying metal sheet as top surface, Lindner GFRC elements can be furnished in such a way to fulfill requirements on high light reflection suitable for daylight control.

Acoustic Performance
Perforated LinCrete cladding elements in combination with acoustically effective backing are suitable for the improvement of room acoustics. Depending on the type of execution, sound absorption values up to α_w 0.60, resp. NRC 0.70 can be achieved. The values are tested in a reverberation room in accordance with ISO 354 and rated in accordance with DIN EN ISO 11654 resp. ASTM C 423. Non-perforated LinCrete elements can be realised as noise barriers.

CERTIFICATION SYSTEM BREEAM

Not listed characteristics do not apply to this product.

Management

Man 02 Life cycle cost and service life planning
Lindner products have a long life expectancy (due to the raw materials, production processes and high production quality). Moreover, certain products can systematically be dismantled and reused after small processing (Circular Economy). GFRC elements can be expected to remain durable for minimum 50 years (acc. to BBSR table, code no. 335 211, state 02/2017, published by the Federal Institute for Research on Building, Urban Affairs and Spatial Development).

Man 03 Responsible construction practices
All companies of the Lindner Group meet the requirements of an environmental management system.
For ISO 14001, ISO 50001, SCC** and OHSAS certified companies within the Lindner Group, additional specific environmental and safety objectives are defined in conjunction with the annual management review.
The implementation of environmental protection and the relevant legal regulations are defined in the Lindner internal guideline "Environmental Protection".

Health and Wellbeing

Hea 01 Visual comfort
By using special coating systems or applying metal sheet as top surface, Lindner GFRC elements can be furnished in such a way to fulfill requirements on high light reflection suitable for daylight control.

Hea 02 Indoor air quality
In general, Lindner LinCrete products are made of purely mineral materials containing no emissions of e.g. VOC or formaldehyde.

Hea 05 Acoustic performance
Perforated LinCrete cladding elements in combination with acoustically effective backing are suitable for the improvement of room acoustics. Depending on the type of execution, sound absorption values up to α_w 0.60, resp. NRC 0.70 can be achieved. The values are tested in a reverberation room in accordance with ISO 354 and rated in accordance with DIN EN ISO 11654. Non-perforated LinCrete elements can be realised as noise barriers.

Hea 18 Volatile organic compounds (only existing buildings)
In general, Lindner LinCrete products are made of purely mineral materials containing no emissions of e.g. VOC or formaldehyde.

Materials

Mat 01 Life cycle impacts
We can provide product-specific data for the assessment of the building. Due to the long-life cycle of LinCrete GFRC elements, Lindner guarantees a reuse of products over the whole useful life.

Mat 03 Responsible sourcing of construction products
Lindner GFRC elements are made from materials containing recycled content. Local suppliers are preferred.
The company Lindner is certified according to the environmental management system according to DIN EN ISO 14001.

Mat 06 Material efficiency
LinCrete elements are produced on a project-specific basis and therefore in such a way that they can be installed on site with as little waste as possible. Waste that cannot be avoided on site is put into recycling processes by means of waste management facilities.

Waste

Wst 01 Construction waste management
LinCrete elements are designed and produced tailor-made to match the individual project requirements and therefore minimizing processing waste during their installation on site. Waste that cannot be avoided on site is put into recycling processes by means of waste management facilities.
Due to the controlled assembly in the factory, unnecessary sources of error can be avoided.
A complete CWM plan can be issued and implemented by the specialists on request.

Wst 06 Functional adaptability (non-residential only)
Lindner products have a long life expectancy (due to the raw materials, production processes and high production quality). Moreover, certain products can systematically be dismantled and reused after small processing (Circular Economy). GFRC elements can be expected to remain durable for minimum 50 years (acc. to BBSR table, code no. 335 211, state 02/2017, published by the Federal Institute for Research on Building, Urban Affairs and Spatial Development).
LinCrete is a product featuring good reuse and further use possibilities.
Lindner products are designed in a way that they can be easily dismantled without any damages what enables to easy changes of the use of the building.

Pollution

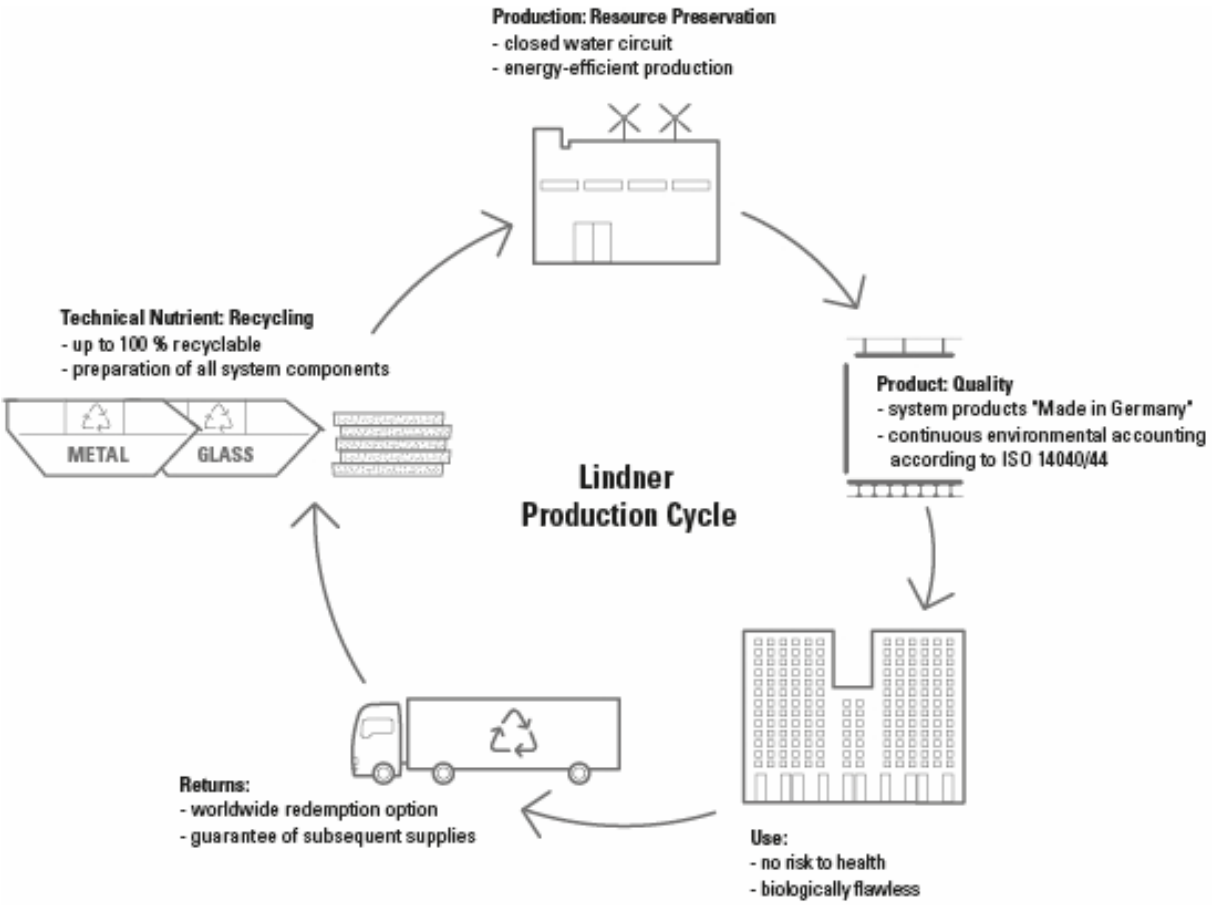
Pol 05 Reduction of noise pollution
Perforated LinCrete cladding elements in combination with acoustically effective backing are suitable for the improvement of room acoustics. Depending on the type of execution, sound absorption values up to α_w 0.60, resp. NRC 0.70 can be achieved. The values are tested in a reverberation room in accordance with ISO 354 and rated in accordance with DIN EN ISO 11654. Non-perforated LinCrete elements can be realised as noise barriers.

CIRCULAR ECONOMY

Information on Circular Economy

Due to the transfer of the Circular Economy thoughts we avoid waste, toxic substances and pollution.
The technical cycle we are striving for, allows for a certain separation and reuse of materials.
Environmental aspects already play a primary role when choosing our suppliers. Responsibility towards people and environment is as important for Lindner as the quality of the products. Due to this reason an environmental management system according to DIN EN ISO 14001 is established and mostly certified through the whole Lindner Group.

+ Protection of prospective generations and eco systems through care of natural resources
+ Security by choosing high-quality and contaminant-free materials
+ Health as supreme asset of humans
+ Safe environment for all building users



Material Health

The ingredients of LinCrete GFRC have to be secure and highly compatible for health and environment.
Lindner develops GFRC products which are environmentally friendly and also healthy for humans, from the production up to the usage and reuse.
We do know the chemical substances of all materials and run an ongoing process to develop safer products. To meet all criteria according to sustainability and human health, system components were modified and also replaced.
In general, Lindner LinCrete products are made of purely mineral materials containing no emissions of e.g. VOC or formaldehyde.

Material Reutilization

Lindner LinCrete products can be recycled or further recovered.
Therefore, complete components can be reused or become available as raw material, after transferring to recycling processes.

Renewable Energy

Through eco-management certification and our in-house environmental accounting, the whole Lindner Group campaigns for a reduction of the ecological footprint of their own production processes by using less energy.
The share of renewable energy is currently around 37 %.
Increasing the share of renewable energy in our production sites is an ongoing process. The reduction of energy within the production sites is our main goal.

Water Stewardship

Only resource-conserving processes and production methods are used during the production of LinCrete products. Therefore, the fresh water consumption is reduced to a minimum. During the production of LinCrete, water is only used for the production of the GFRC elements and is therefore completely bound. Accordingly, no waste water is generated in the production.

Social Fairness

The most important corporate principle is the focus on the individual employee. For this reason the compliance rules "Our Values" for employees were defined. The Lindner Group supports a number of social projects, which are distributed in regional and nationwide areas. Therefore, the charitable “Hans Lindner Stiftung” was founded in 1991.
As a responsible manufacturer, Lindner is certified in accordance to the international environmental management standard ISO 14001. This standard supports our further development of managing scarce resources and the environment in general.

Prüfungsbericht

KEIL Hinterschnitt Befestigung

Zertifiziert nach
DIN ISO 9001 (EN 29001)

Material

Bezeichnung :	LinCrete (Glasfaserbeton)
Plattengröße :	200 mm x 200 mm x 13,8 – 15,4 mm
Plattenhersteller / Lieferant :	Lindner Isoliertechnik und Industrieservice GmbH
Auftrag vom :	12.12.2022

Versuchsbeschreibung

Anker :	KEIL Hinterschnittanker KH
Setztiefe :	h_s = 10 mm
Bohrloch :	zylindrisch ø 7 mm Hinterschnitt ø 9 mm
geprüfter kleinster Randabstand :	100 mm
Bohrer :	KEIL Diamant Fassadenbohrer
Belastungsart :	zentrischer Zug
Abstützung :	ø 105 mm

Prüfergebnisse

Versuch-Nr.	Bruchlast [kN]	Versagensursache	
		Ausbruchkegel [mm]	Plattenbruch
1.1	2,69	75 x 80	
1.2	2,42	75 x 80	
1.3	2,41	Ø 60	
1.4	2,49	75 x 90	
1.5	2,44	75 x 65	
1.6	2,57	75 x 65	
1.7	2,63	Ø 90	
1.8	2,70	95 x 85	
1.9	2,78	80 x 90	
1.10	2,56	65 x 95	

Arithmetischer Mittelwert :	**2,57 kN**
Variationskoeffizient :	5,03 %
5 % Fraktile (Wahrsch. 75%) :	**2,31 kN**

Prüfungsbericht

KEIL Hinterschnitt Befestigung

Zertifiziert nach
DIN ISO 9001 (EN 29001)

Material

Bezeichnung :	LinCrete (Glasfaserbeton)
Plattengröße :	400 mm x 200 mm x 14,5 – 16,7 mm
Plattenhersteller / Lieferant :	Lindner Isoliertechnik und Industrieservice GmbH
Auftrag vom :	12.12.2022

Versuchsbeschreibung

Anker :	KEIL Hinterschnittanker KH
Setztiefe :	h_s = 10 mm
Bohrloch :	zylindrisch ø 7 mm Hinterschnitt ø 9 mm
geprüfter kleinster Randabstand :	100 mm
Bohrer :	KEIL Diamant Fassadenbohrer
Belastungsart :	Querzug

Prüfergebnisse

Versuch-Nr.	Bruchlast [kN]	Versagensursache	
		Ausbruchkegel [mm]	Plattenbruch
2.1	5,93	20 x 50	
2.2	4,76	25 x 30	
2.3	4,69	20 x 15	
2.4	4,48	40 x 35	
2.5	5,04	25 x 20	
2.6	6,10	20 x 15	
2.7	6,02	25 x 15	
2.8	6,28	25 x 15	
2.9	5,43	20 x 15	
2.10	5,74	25 x 15	

Arithmetischer Mittelwert :	**5,45 kN**
Variationskoeffizient :	12,11 %
5 % Fraktile (Wahrsch. 75%) :	**4,17 kN**

Prüfungsbericht

KEIL Hinterschnitt Befestigung

Zertifiziert nach
DIN ISO 9001 (EN 29001)

Material

Bezeichnung :	LinCrete (Glasfaserbeton)
Plattengröße :	200 mm x 200 mm x 29,8 – 31,3 mm
Plattenhersteller / Lieferant :	Lindner Isoliertechnik und Industrieservice GmbH
Auftrag vom :	12.12.2022

Versuchsbeschreibung

Anker :	KEIL Hinterschnittanker KH
Setztiefe :	h_s = 15 mm
Bohrloch :	zylindrisch ø 7 mm Hinterschnitt ø 9 mm
geprüfter kleinster Randabstand :	100 mm
Bohrer :	KEIL Diamant Fassadenbohrer
Belastungsart :	zentrischer Zug
Abstützung :	ø 105 mm

Prüfergebnisse

Versuch-Nr.	Bruchlast [kN]	Versagensursache	
		Ausbruchkegel [mm]	Plattenbruch
3.1	4,11	Ø 75	
3.2	4,19	85 x 10	
3.3	4,33	90 x 85	
3.4	4,50	70 x 60	
3.5	4,57	80 x 90	
3.6	4,83	Ø 85	
3.7	4,88	95 x 65	
3.8	4,53	90 x 95	
3.9	4,54	85 x 100	
3.10	4,94	Ø 80	

Arithmetischer Mittelwert :	**4,54 kN**
Variationskoeffizient :	6,20 %
5 % Fraktile (Wahrsch. 75%) :	**3,98 kN**

Prüfungsbericht

KEIL Hinterschnitt Befestigung

Zertifiziert nach
DIN ISO 9001 (EN 29001)

Material

Bezeichnung :	LinCrete (Glasfaserbeton)
Plattengröße :	400 mm x 200 mm x 29,5 – 31,3 mm
Plattenhersteller / Lieferant :	Lindner Isoliertechnik und Industrieservice GmbH
Auftrag vom :	12.12.2022

Versuchsbeschreibung

Anker :	KEIL Hinterschnittanker KH
Setztiefe :	h_s = 15 mm
Bohrloch :	zylindrisch ø 7 mm Hinterschnitt ø 9 mm
geprüfter kleinster Randabstand :	100 mm
Bohrer :	KEIL Diamant Fassadenbohrer
Belastungsart :	Querzug

Prüfergebnisse

Versuch-Nr.	Bruchlast [kN]	Versagensursache	
		Ausbruchkegel [mm]	Plattenbruch
4.1	8,74	55 x 75	
4.2	6,11	40 x 10	
4.3	9,21	65 x 60	
4.4	7,66	70 x 80	
4.5	7,93	30 x 16	
4.6	9,17	65 x 50	
4.7	7,79	50 x 80	
4.8	8,52	80 x 70	
4.9	8,27	60 x 100	
4.10	8,62	35 x 80	

Arithmetischer Mittelwert :	**8,20 kN**
Variationskoeffizient :	11,08 %
5 % Fraktile (Wahrsch. 75%) :	**6,34 kN**

Prüfungsbericht

KEIL Hinterschnitt Befestigung

Zertifiziert nach
DIN ISO 9001 (EN 29001)

Material

Bezeichnung : LinkCrete (Glasfaserbeton)
Plattengröße : 250 mm x 250 mm x 18,9 – 21,0 mm
Plattenhersteller / Lieferant : Lindner Isoliertechnik und Industrieservice GmbH
Auftrag vom : 12.12.2022

Versuchsbeschreibung

Anker : Senkkopfschraube M8 eingegossen
Setztiefe : von Kunden vormontiert geliefert
geprüfter kleinster Randabstand : 125 mm
Belastungsart : zentrischer Zug
Abstützung : ø 135 mm

Prüfergebnisse

Versuch-Nr.	Bruchlast [kN]	Versagensursache		Schrauben schief
		Ausbruchkegel [mm]	Plattenbruch	
1	6,91	120 x 80		
2	5,55	110 x 90		
3	5,36	120 x 110		
4	5,83	Ø 100		
5	4,08	100 x 90		X
6	6,44	Ø 90		
7	6,66	Ø 110		
8	6,12	120 x 135		
9	6,05	100 x 115		
10	5,67	100 x 80		
11	5,47	100 x 80		
12	4,62	70 x 90		X
13	5,35	100 x 90		
14	6,85	80 x 90		X
15	5,93	100 x 130		X
16	6,03	100 x 120		
17	6,82	110 x 125		
18	5,57	100 x 130		
19	5,74	90 x 100		X
20	5,73	120 x 110		

Die Prüfungen wurden sorgfältig durchgeführt. Eine Haftung für die vorgenannten Werte ist jedoch, soweit gesetzlich zulässig, auch gegenüber Dritten ausgeschlossen.
Die Versuchsergebnisse beziehen sich auf das geprüfte Probematerial. Es wird darauf hingewiesen, dass Auszugsversuche allein zu informatorischen Zwecken für unsere Kunden durchgeführt werden.
Zur Bestätigung der vorgenannten Werte von neutraler Stelle bieten wir Ihnen gerne unsere Unterstützung an. Die Proben sowie die Reststücke werden 4 Wochen aufbewahrt.

Arithmetischer Mittelwert :	**5,84 kN**
Variationskoeffizient :	12,25 %
5 % Fraktile (Wahrsch. 75%) :	**4,51 kN**

Versuch 5:

Versuch 12:

Versuch 14:

Versuch 15:

Versuch 19:

Technical Data Sheet

LONG RAKE SPAR EST 1867
Specialist Decorative Aggregates

Grantex Surfacing

Golden Flint

Size: 10mm **Shape:** Angular

Risk of Staining (RIS): **Hardness Value:**

Product Description:

Buff coloured angular chipping which deepens in colour when wet.

Rock Type: Flint

Grading Analysis:

Sieve Size	% Retained	% Passing	Range
12.50mm		100	
10.00mm		94.6	
4.00mm		15	
2.00mm		3.6	
0.063mm		0.2	

Physical Analysis:

Property	Value
Aggregate Abrasion Value - AAV	
Aggregate Crushing Value - ACV	
Aggregate Impact Value - AIV	
Hardness (Mohs)	
Magnesium Sulphate Soundess %	
Polished Stone Value (est) - PSV	
Skid Resistant Value - SRV	
Specific Gravity	
Relative Density (Sat. Surface Dried SSD)	
Relative Density (Apparent) - AP	
Oil Absorbtion (% by weight)	
10% Fines Value (Kn)	
Risk of Iron Staining (est) - RIS	
Performace Scale	

Chemical Analysis (typical):

Element	%
Aluminium Oxide (Al_2O_3)	1.45
Calcium Oxide (CaO)	24.80
Calcium Carbonate ($CaCO_3$)	
Iron Oxide (Fe_2O_3)	7.62
Magnesium Oxide (MgO)	0.19
Magnesium Carbonate ($MgCO_3$)	
Manganese Oxide (MnO)	0.09
Phosphorus Oxide (P_2O_5)	
Potassium Oxide (K2O)	0.90
Silicon Dioxide (SiO_2)	43.95
Sodium Oxide (Na_2O)	0.06
Sulfur Trioxide (SO_3)	0.1
Titanium Dioxide (TiO_2)	0.02
Loss of Ignition	20.40

Grantex Surfacing
Youlgrave
Near Bakewell
Derbyshire
DE45 1LW

Tel: 01629 630130
Email: grantex@longrakespar.co.uk
Website: www.longrakespar.co.uk

Document Number: LRS0100 Version Number: 1

MATERIAL PHYSICAL PROPERTY SHEET

SUPPLIER:	New Milton Sand & Ballast	
SOURCE:	Hurn	
AGG TYPE:	Gravel	
I	2-6.3mm	Year: 2023

PROPERTY		SIEVE SIZE (mm)	YEAR AVERAGE (%)	TARGET (%)
SHAPE INDEX (SI)		31.5	100	
MEAN LOOSE BULK DENSITY (Mg/m³)	1.22	20	100	
MEAN COMPACTED BULK DENSITY (Mg/m³)	1.26	16	100	
FLAKINESS (FI)		14	100	100-100
APPARENT PARTICAL DENSITY (Mg/m³)	2.62	10	100	98-100
PARTICAL DENSITY (OVEN DRIED) (Mg/m³)	2.24	8	100	
PARTICAL DENSITY SSD (Mg/m³)	2.38	6.3	89	80-99
WATER ABSORPTION (%)	6.50%	4	2	
LIGHTWEIGHT PARTICALS IN AGGREGATES		2.8	1	
DRYING SHRIKAGE (%)	0.02%	2	1	0-20
WATER SOLUBLE CHLORIDE (%)		1	1	0-5
ACID SOLUBLE SULPHATE (% by mass)		0.5	0	
WATER SOLUBLE MATTER (%)		0.25	0	
SULPHUR (%)		0.125	0	
CALCIUM CARBONATE EQUIVALENT (%)		0.063	0	0-1.5

Authorised By _____

Print Name Ian Harman

Date 2023.04.04

04 - Louvres
Anodised Aluminium Bronze tone

06 - Shopfronts
Natural Anodised Aluminium (Post finished with colour)


ALUMET
AVANTGARDE IN ANODIZING

ALUMET
AVANTGARDE IN ANODIZING

Anodising specifications

Layer type:	Aluminum oxide crystalline layer, electrolytic formation in sulphur acid
Possible alloys:	Al-1000, 5000, 6000 series
Appearance:	Matt to glossy metallic
Colour processes:	Electrolytic or absorption processes, no pigments used
Layer thickness:	5 to 25 micron
Corrosion resistance:	Very high, (salt spray > 300 hours ASTM-B117)
Temperature stability:	Resists temperatures till 200 degree Celsius
Hardness:	Better then steel, (200-350 micro Vickers ASTM-6507)
Wear resistance:	Extremely high, (Taber < 30 mg 10.000 cycles)
Electrical resistance:	High (4x10e15 Ohm.cm)
Puncturing Voltage:	High (>750 Volt, 20 micron ASTM-2376)
Fumigation:	Not applicable
Reflection:	Depends on mechanical pre-treatment
Light fastness:	Extremely high (suitable for outdoor applications)

Pre-treatment

Coding	Pre-treatment	
E0	No pre-treatment (VB0)	Anodizing for industrial applications
E1	Grinding (VB1)	Light grinding for matt etching, smooth surface
E2	Brushing (VB2)	Light grinding and brushing, visible brush marks
E3	Polishing (VB3)	Polishing without removing surface marks
E4	Grinding + Brushing (VB4)	Grinding and brushing, shiny, small brush marks
E5	Grinding + Polishing (VB5)	Light grinding and polishing, smooth shiny surface
→ E6	Chemical matt etching (VB6)	Matt etching

Anodising

Coding	Layer thickness	
A5	5 micron	indoor use
A10	10 micron	indoor use (standard indoor use)
A15	15 micron	outdoor use
A20	20 micron	outdoor use (standard outdoor use)
→ A25	25 micron	outdoor use (industrial / coastal area or BS)

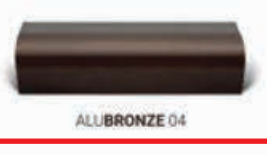
Anodising colours

Coding:	Colour:	Coding:	Colour:
→ AluNature	Natural (VOM1)	AluBrass01:	Light brown brass
AluGold01	Champagne – very light gold	AluBrass02:	Medium light brown brass
AluGold02	Gold (VOM2)	AluBrass03:	Medium dark brown brass
AluGold03	Dark gold (VOM3)	AluBrass04:	Dark brown brass
AluCopper 01	Orange - light copper	AluBronze01:	Titanium - light bronze (C31)
AluCopper02	Medium light copper	AluBronze02:	Medium – light bronze (C32)
AluCopper03	Medium dark copper	AluBronze03:	Medium – dark bronze (C33)
AluCopper04	Dark copper	AluBronze04:	Dark bronze (C34)
AluRed01:	Pink – light red	AluBlack:	Black (C35)
AluRed02:	Medium light red	AluGrey:	Anthracite dark grey
AluRed03:	Medium dark red	AluBlue:	Dark blue
AluRed04:	Dark Cardinal Red	AluGreen:	Dark green

Sample material AlMg1 or 5005 alloy, the use of other material might cause minor colour changes.

ALUMET

AVANTGARDE IN ANODIZING



All samples are matt etched (E6), 20mu anodised (A20).

ALUMET Nieuwe donk 7 4879 AC Etten-Leur T: +31(0)76-5043130 info@alumet.nl www.alumet.nl

05 - Fixed Signage
Stainless steel

Table 4 — Chemical composition (cast analysis) [a] of austenitic corrosion resisting steels

Steel designation		% by mass											
Name	Number	C	Si	Mn	P max.	S	N	Cr	Cu [c]	Mo	Nb	Ni	Others
X5CrNi17-7	1.4319	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,030	≤ 0,11	16,0 to 18,0	-	-	-	6,0 to 8,0	-
X10CrNi18-8	1.4310	0,05 to 0,15	≤ 2,00	≤ 2,00	0,045	≤ 0,015	≤ 0,11	16,0 to 19,0	-	≤ 0,80	-	6,0 to 9,5	-
X9CrNi18-9	1.4325	0,03 to 0,15	≤ 1,00	≤ 2,00	0,045	≤ 0,030	≤ 0,11	17,0 to 19,0	-	-	-	8,0 to 10,0	-
X2CrNiN18-7	1.4318	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,10 to 0,20	16,5 to 18,5	-	-	-	6,0 to 8,0	-
X2CrNi18-9	1.4307	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,5 to 19,5	-	-	-	8,0 to 10,5	-
X2CrNi19-11	1.4306	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	18,0 to 20,0	-	-	-	10,0 to 12,0 [d]	-
X5CrNiN19-9	1.4315	≤ 0,06	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	18,0 to 20,0	-	-	-	8,0 to 11,0	-
X2CrNiN18-10	1.4311	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	0,12 to 0,22	17,5 to 19,5	-	-	-	8,5 to 11,5	-
X5CrNi18-10	1.4301	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,5 to 19,5	-	-	-	8,0 to 10,5	-
X8CrNiS18-9 [e]	1.4305 [f]	≤ 0,10	≤ 1,00	≤ 2,00	0,045	0,15 to 0,35	≤ 0,11	17,0 to 19,0	≤ 1,00	-	-	8,0 to 10,0	-
X6CrNiTi18-10	1.4541	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	-	17,0 to 19,0	-		-	9,0 to 12,0 [d]	Ti:5xC to 0,70
X6CrNiNb18-10	1.4550	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015	-	17,0 to 19,0	-	-	10xC to 1,00	9,0 to 12,0 [d]	-
X4CrNi18-12	1.4303	≤ 0,06	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,0 to 19,0	-	-	-	11,0 to 13,0	-
X1CrNi25-21	1.4335	≤ 0,020	≤ 0,25	≤ 2,00	0,025	≤ 0,010	≤ 0,11	24,0 to 26,0	-	≤ 0,20	-	20,0 to 22,0	-
X2CrNiMo17-12-2	1.4404	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 13,0 [d]	-
X2CrNiMoN17-11-2	1.4406	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	0,12 to 0,22	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 12,5 [d]	-
X5CrNiMo17-12-2	1.4401	≤ 0,07	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,00 to 2,50	-	10,0 to 13,0	-
X1CrNiMoN25-22-2	1.4466	≤ 0,020	≤ 0,70	≤ 2,00	0,025	≤ 0,010	0,10 to 0,16	24,0 to 26,0	-	2,00 to 2,50	-	21,0 to 23,0	-
X6CrNiMoTi17-12-2	1.4571	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	-	16,5 to 18,5	-	2,00 to 2,50	-	10,5 to 13,5 [d]	Ti:5xC to 0,70
X6CrNiMoNb17-12-2	1.4580	≤ 0,08	≤ 1,00	≤ 2,00	0,045	≤ 0,015	-	16,5 to 18,5	-	2,00 to 2,50	10xC to 1,00	10,5 to 13,5	-
X2CrNiMo17-12-3	1.4432	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,50 to 3,00	-	10,5 to 13,0	-
X2CrNiMoN17-13-3	1.4429	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	16,5 to 18,5	-	2,50 to 3,00	-	11,0 to 14,0 [d]	-
X3CrNiMo17-13-3	1.4436	≤ 0,05	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	16,5 to 18,5	-	2,50 to 3,00	-	10,5 to 13,0 [d]	-
X3CrNiMo18-12-3	1.4449	≤ 0,035	≤ 1,00	≤ 2,00	0,045	≤ 0,015	≤ 0,08	17,0 to 18,2	≤ 1,00	2,25 to 2,75	-	11,5 to 12,5	-
X2CrNiMo18-14-3	1.4435	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,0 to 19,0	-	2,50 to 3,00	-	12,5 to 15,0	-
X2CrNiMoN18-12-4	1.4434	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,10 to 0,20	16,5 to 19,5	-	3,0 to 4,0	-	10,5 to 14,0 [d]	-
X2CrNiMo18-15-4	1.4438	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015 [b]	≤ 0,11	17,5 to 19,5	-	3,0 to 4,0	-	13,0 to 16,0 [d]	-
X2CrNiMoN17-13-5	1.4439	≤ 0,030	≤ 1,00	≤ 2,00	0,045	≤ 0,015	0,12 to 0,22	16,5 to 18,5	-	4,0 to 5,0	-	12,5 to 14,5	-
X1CrNiMoCuN24-22-8 [g]	1.4652 [h]	≤ 0,020	≤ 0,50	2,00 to 4,0	0,030	≤ 0,005	0,45 to 0,55	23,0 to 25,0	0,30 to 0,60	7,0 to 8,0	-	21,0 to 23,0	-
X1CrNiSi18-15-4	1.4361	≤ 0,015	3,7 to 4,5	≤ 2,00	0,025	≤ 0,010	≤ 0,11	16,5 to 18,5	-	≤ 0,20	-	14,0 to 16,0	-
X11CrNiMnN19-8-6	1.4369	0,07 to 0,15	0,50 to 1,00	5,0 to 7,5	0,030	≤ 0,015	0,20 to 0,30	17,5 to 19,5	-	-	-	6,5 to 8,5	-
X12CrMnNiN17-7-5	1.4372	≤ 0,15	≤ 1,00	5,5 to 7,5	0,045	≤ 0,015	0,05 to 0,25	16,0 to 18,0	-	-	-	3,5 to 5,5	-
X2CrMnNiN17-7-5	1.4371	≤ 0,030	≤ 1,00	6,0 to 8,0	0,045	≤ 0,015	0,15 to 0,20	16,0 to 17,0	-	-	-	3,5 to 5,5	-
X12CrMnNiN18-9-5	1.4373	≤ 0,15	≤ 1,00	7,5 to 10,5	0,045	≤ 0,015	0,05 to 0,25	17,0 to 19,0	-	-	-	4,0 to 6,0	-
X8CrMnNiN18-9-5	1.4374	0,05 to 0,10	0,30 to 0,60	9,0 to 10,0	0,035	≤ 0,030	0,25 to 0,32	17,5 to 18,5	≤ 0,40	≤ 0,50	-	5,0 to 6,0	-
X8CrMnCuNB17-8-3	1.4597	≤ 0,10	≤ 2,00	6,5 to 8,5	0,040	≤ 0,030	0,15 to 0,30	16,0 to 18,0	2,00 to 3,5	≤ 1,00	-	≤ 2,00	B: 0,000 5 to 0,005 0
X3CrNiCu19-9-2	1.4560	≤ 0,035	≤ 1,00	1,50 to 2,00	0,045	≤ 0,015	≤ 0,11	18,0 to 19,0	1,50 to 2,00	-	-	8,0 to 9,0	-
X2CrNiCu19-10	1.4650	≤ 0,030	≤1,00	≤ 2,00	0,045	≤ 0,015	≤ 0,08	18,5 to 20,0	≤ 1,00	-	-	9,0 to 10,0	-
X6CrNiCuS18-9-2 [e]	1.4570 [f]	≤ 0,08	≤1,00	≤ 2,00	0,045	0,15 to 0,35	≤ 0,11	17,0 to 19,0	1,40 to 1,80	≤ 0,60	-	8,0 to 10,0	-

Table A.3 — Guidance data on some physical properties of austenitic corrosion resisting steels

Steel designation		Density	Modulus of elasticity at						Mean coefficient of thermal expansion between 20 °C and					Thermal conductivity at 20 °C	Specific thermal capacity at 20 °C	Electrical resistivity at 20 °C	Magnetizable
			20 °C	100 °C	200 °C	300 °C	400 °C	500 °C	100 °C	200 °C	300 °C	400 °C	500 °C				
Name	Number	kg/dm³	GPa						$10^{-6} \times K^{-1}$					$\frac{W}{m \cdot K}$	$\frac{J}{kg \cdot K}$	$\frac{\Omega \cdot mm^2}{m}$	
X5CrNi17-7	1.4319	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X10CrNi18-8	1.4310	7,9	200	194	186	179	172	165	16,0	17,0	17,0	18,0	18,0	15	500	0,73	
X9CrNi18-9	1.4325	7,9	200	194	186	179	172	165	16,0	17,0	17,0	18,0	18,0	15	500	0,73	
X2CrNiN18-7	1.4318	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X2CrNi18-9	1.4307	7,9	200	194	186	179	172	165	16,0	16,5	17,0	18,0	18,0	15	500	0,73	
X2CrNi19-11	1.4306	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X5CrNiN19-9	1.4315	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X2CrNiN18-10	1.4311	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X5CrNi18-10	1.4301	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X8CrNiS18-9	1.4305	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X6CrNiTi18-10	1.4541	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X6CrNiNb18-10	1.4550	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X4CrNi18-12	1.4303	7,9	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	
X1CrNi25-21	1.4335	7,9	195	190	182	174	166	158	15,8	16,1	16,5	16,9	17,3	14	450	0,85	
X2CrNiMo17-12-2	1.4404	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMoN17-11-2	1.4406	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X5CrNiMo17-12-2	1.4401	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X1CrNiMoN25-22-2	1.4466	8,0	195	190	182	174	166	158	15,7	-	17,0	-	-	14	500	0,80	
X6CrNiMoTi17-12-2	1.4571	8,0	200	194	186	179	172	165	16,5	17,5	18,0	18,5	19,0	15	500	0,75	
X6CrNiMoNb17-12-2	1.4580	8,0	200	194	186	179	172	165	16,5	17,5	18,0	18,5	19,0	15	500	0,75	
X2CrNiMo17-12-3	1.4432	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMoN17-13-3	1.4429	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X3CrNiMo17-13-3	1.4436	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMo18-12-3	1.4449	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMo18-14-3	1.4435	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	no [a]
X2CrNiMoN18-12-4	1.4434	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,75	
X2CrNiMo18-15-4	1.4438	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	14	500	0,85	
X2CrNiMoN17-13-5	1.4439	8,0	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	14	500	0,85	
X1CrNiMoCuN24-22-8	1.4652	8,0	190	184	177	170	164	158	15,0	15,4	15,8	16,2	16,4	8,6	500	0,78	
X1CrNiSi18-15-4	1.4361	7,7	200	194	186	179	172	165	16,5	-	-	-	-	14	-	-	
X11CrNiMnN19-8-6	1.4369	7,9	190	186	179	172	165	158	16,5	17,0	18,0	18,5	19,0	15	500	0,70	
X12CrMnNiN17-7-5	1.4372	7,8	200	194	186	179	172	165	-	-	-	-	-	15	-	0,70	
X2CrMnNiN17-7-5	1.4371	7,8	200	194	186	179	172	165	17,0	17,5	18,0	18,5	-	15	500	0,70	
X12CrMnNiN18-9-5	1.4373	7,8	200	194	186	179	172	165	-	-	-	-	-	15	-	0,70	
X8CrMnNiN18-9-5	1.4374	7,8	199	192	185	170	165	158	16,7	17,3	18,2	18,4	18,6	12	500	0,73	
X8CrMnCuNB17-8-3	1.4597	7,8	200	194	186	179	172	165	16,0	16,5	17,0	17,5	18,0	15	500	0,73	

Table 10 — Mechanical properties at room temperature of austenitic steels in the solution annealed condition[a] (see Table A.4) and resistance to intergranular corrosion

Steel designation		Product form[b]	Thick-ness	0,2 %-proof strength	1 %-proof-strength	Tensile strength	Elongation after fracture		Impact energy (ISO-V)		Resistance to intergranular corrosion[h]	
Name	Number			$R_{p0,2}$	$R_{p1,0}$[c]	R_m	A_{80}[d, f] < 3 mm thick	A[d, g] ≥ 3 mm thick	KV > 10 mm thick		in the delivery condition	in the sensitized condition[i]
			mm max.	MPa[j] min.		MPa[e])	% min.	% min.	J min.	J min.		
				(tr.)[d,e]			(tr.)	(tr.)	(long.)	(tr.)		
Standard grades												
X10CrNi18-8	1.4310	C	8	250	280	600 to 950	40	40	-	-	no	no
X2CrNiN18-7	1.4318	C	8	350	380	650 to 850	35	40	-	-		
		H	13,5	330	370				90	60	yes	yes
		P[k]	75	330	370	630 to 830	45	45				
X2CrNi18-9	1.4307	C	8	220	250	520 to 700			-	-		
		H	13,5	200	240		45	45	100	60	yes	yes
		P[k]	75	200	240	500 to 700						
X2CrNi19-11	1.4306	C	8	220	250	520 to 700			-	-		
		H	13,5	200	240		45	45	100	60	yes	yes
		P[k]	75	200	240	500 to 700						
X2CrNiN18-10	1.4311	C	8	290	320				-	-		
		H	13,5	270	310	550 to 750	40	40	100	60	yes	yes
		P[k]	75	270	310							
X5CrNi18-10	1.4301	C	8	230	260	540 to 750	45[k]	45[k]	-	-		
		H	13,5	210	250	520 to 720			100	60	yes	no[l]
		P[k]	75	210	250		45	45				
X8CrNiS18-9	1.4305	P[k]	75	190	230	500 to 700	35	35	-	-	no	no
X6CrNiTi18-10	1.4541	C	8	220	250	520 to 720			-	-		
		H	13,5	200	240		40	40	100	60	yes	yes
		P[k]	75	200	240	500 to 700						
X4CrNi18-12	1.4303	C	8	220	250	500 to 650	45	45	-	-	yes	no[l]
X2CrNiMo17-12-2	1.4404	C	8	240	270	530 to 680	40	40	-	-		
		H	13,5	220	260				100	60	yes	yes
		P[k]	75	220	260	520 to 670	45	45				
X2CrNiMoN17-11-2	1.4406	C	8	300	330				-	-		
		H	13,5	280	320	580 to 780	40	40	100	60	yes	yes
		P[k]	75	280	320							
X5CrNiMo17-12-2	1.4401	C	8	240	270	530 to 680	40	40	-	-		
		H	13,5	220	260				100	60	yes	no[l]
		P[k]	75	220	260	520 to 670	45	45				
X6CrNiMoTi17-12-2	1.4571	C	8	240	270	540 to 690			-	-		
		H	13,5	220	260		40	40	100	60	yes	yes
		P[k]	75	220	260	520 to 670						
X2CrNiMo17-12-3	1.4432	C	8	240	270	550 to 700	40	40	-	-		
		H	13,5	220	260				100	60	yes	yes
		P[k]	75	220	260	520 to 670	45	45				
X2CrNiMo18-14-3	1.4435	C	8	240	270	550 to 700	40	40	-	-		
		H	13,5	220	260				100	60	yes	yes
		P[k]	75	220	260	520 to 670	45	45				
X2CrNiMoN17-13-5	1.4439	C	8	290	320		35	35	-	-		
		H	13,5	270	310	580 to 780			100	60	yes	yes
		P[k]	75	270	310		40	40				
X1NiCrMoCu25-20-5	1.4539	C	8	240	270	530 to 730			-	-		
		H	13,5	220	260		35	35	100	60	yes	yes
		P[k]	75			520 to 720						