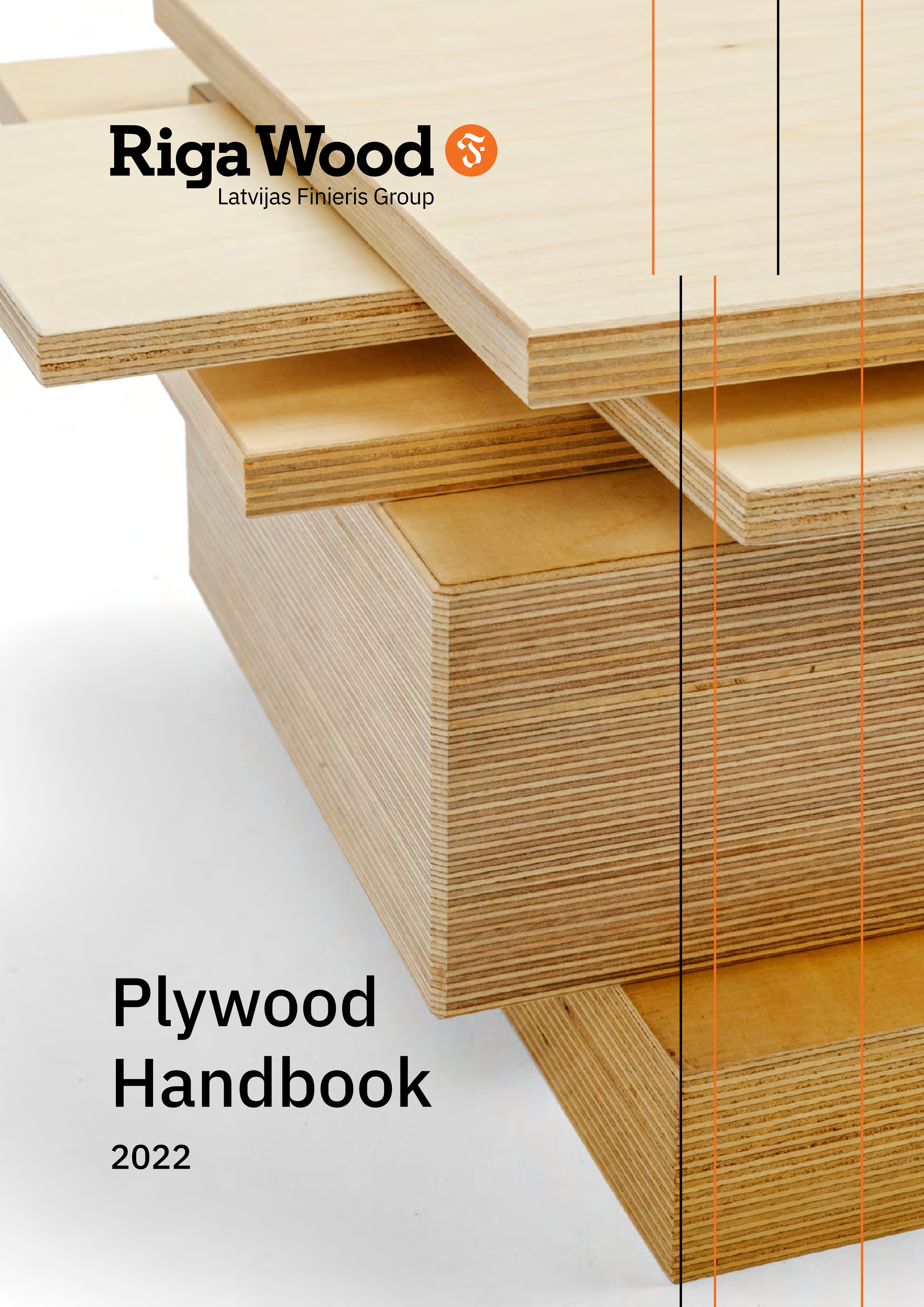
RigaWood
Latvijas Finieris Group



Plywood Handbook

2022

Amendment proposals and comments should be sent to info@finieris.lv with reference to Plywood Handbook.

Please note that the handbook will be regularly updated. The latest version will always be available on www.finieris.lv website.

Introduction

Birch plywood with its outstanding mechanical properties and vast variety of applications is truly a unique material. Indispensable in many industries, but under one essential precondition – you must know how to use it most effectively.

We at Latvijas Finieris Group are not only producers of birch plywood. Thanks to many years of experience, research and knowledge accumulated over generations, we are focused on performance oriented birch plywood based product solutions. By fully understanding the needs of our customers, the potential of birch wood and technical possibilities of combining it with different other materials, we are constantly developing new birch plywood products with properties which had never been seen before. Day by day we are opening even more opportunities for birch plywood to become the ideal solution for your industry.

This is not a handbook just for manufacturers, architects, technicians, or sales people. We believe that this is a road map of the immense world of plywood opportunities that allows each user to take advantage of the unique properties of birch plywood. A road map, where each page contains data validated by laboratories, field trials and client experience.

I sincerely hope that this Plywood Handbook will also provide valuable information for your project.

Jānis Ciems
CEO
Latvijas Finieris

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1. Enterprise

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1.1. Values, mission, vision

Latvijas Finieris Group's business approach is based on our values:

SAFETY
We create a safe environment and act in a sustainable manner.

RESPECT
We respect each other and promote honesty, loyalty and mutual trust.

DEVELOPMENT
We strive for self-improvement and encourage the growth of others.

LEADERSHIP
We are the owners of our work, we take initiative to get the job done.

Our Vision

To be the global leader of performance oriented birch plywood based product solutions.

Our Mission

To enable customers, forest owners, cooperation partners, employees and other stakeholders of the company to develop long-term partnerships: responsible work, responsible profit and responsible investments.

Our Conviction

Plywood products are and will remain among the most beneficial industrial uses of birch wood. At the same time, other birch based products will play an increasing role in bioeconomy development.


Grown by Nature.
Tailored by Us.

1.2. Plywood experts since 1873

We do not know who the first to come up with the brilliant idea of plywood as a material was. However, historical evidence suggests that it happened in ancient Egypt. Sarcophaguses from primitive plywood, formed by six layers of glued wood, have been found in the pyramids.

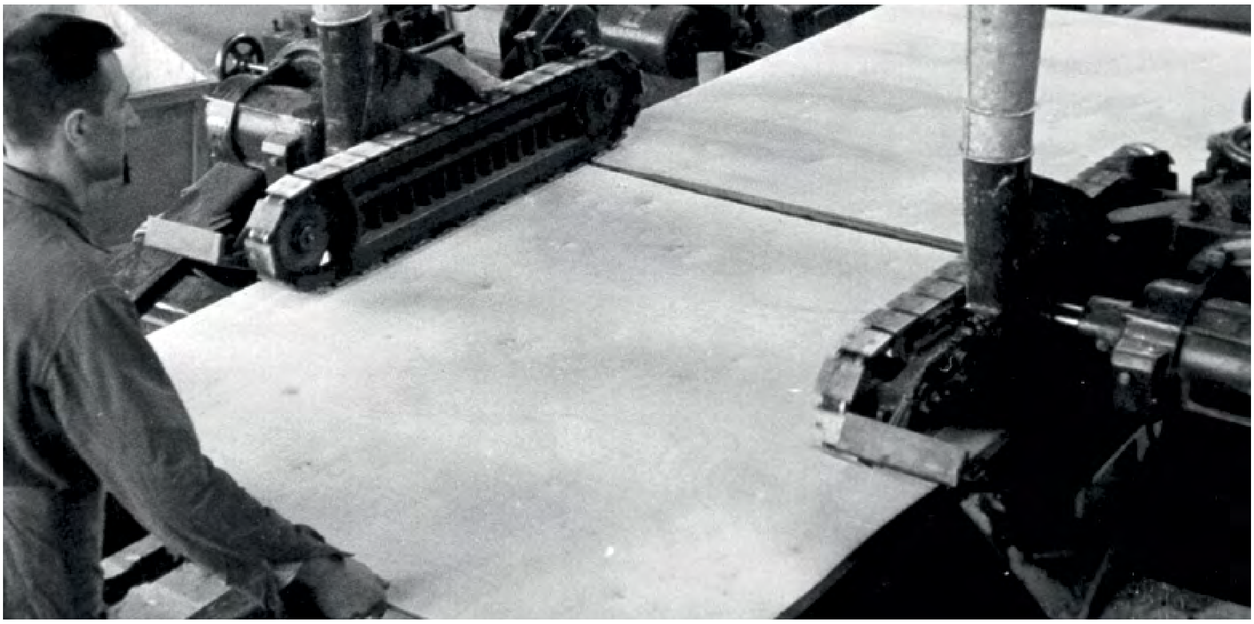
It took almost five millennia until a new plywood manufacturing industry began to emerge in the world at the turn of the 19th and 20th centuries. Development of industrial veneer peeling technologies and suitable glue composition paved the way, and one of the main regions where that happened was the territories of Estonia and Latvia on the coast of the Baltic Sea. An important industrial hub of the time with highly-skilled engineers and vast wood resources.

The origins of Latvijas Finieris Group can be traced back to the Latvijas Bērzs factory established in 1873 where the production of plywood was launched for the first time in Latvia at the beginning of the 20th century. After the First World War, as European and international trade once again expanded, a number of plywood companies were established in Latvia and Estonia. Among them were also the Furniers and Lignums mills which soon became two of the world's most advanced producers of birch veneer and birch plywood products gaining international recognition. Indeed, the whole Baltic region was a centre of knowledge and technology development for plywood production at that time.

After the Second World War, during the Soviet occupation (1945–1991) the production of plywood continued. There was no gap in technical knowledge, but unfortunately product development was almost completely stopped. During the Soviet era, Latvijas Bērzs, Lignums and Furniers factories were joined together, creating the state company Latvian Veneer Production Association.

Latvia re-gained independence in 1991 and a year later a significant number of factory workers united to form the private corporation Latvijas Finieris. Since then, most of the company's shareholders have always been its employees.

So, we can proudly say that this is our company. And we at Latvijas Finieris Group are also proud that we are the direct successors of the Baltic plywood production knowledge and experience accumulated over generations, now taking it to new heights.



1.3. Profile of enterprise

AS Latvijas Finieris is a closed joint-stock company. Together with numerous subsidiary companies, it forms the multi-sector Latvijas Finieris Group. Our core competence is birch-based products, mainly excellence in birch plywood production under the brand Riga Wood, development of new birch plywood products, and supply of related services. Our birch veneer and plywood production facilities are located in Latvia, Lithuania, Estonia, and Finland.

We are convinced that plywood production is and will remain one of the most beneficial industrial uses of birch wood, still presenting considerable development opportunities – in the nearest future this will ensure our core business profitability. However, the growing potential of bioeconomy calls for active and regular assessment of other birch-based products and wood products in general – their technological and commercial readiness to fully utilise the Latvijas Finieris Group's core competence in birch products and learn new ones. Active and ongoing marketing, sales and product development processes are key factors for our success.

Today our products are sold in more than 60 countries, providing high-quality service and tailored technology solutions to customers. A network of 12 fully owned Riga Wood product development and sales offices cover Europe and key markets overseas. This enables our customers to have direct and professional contacts with our product development.

Other key activities of the Latvijas Finieris Group include birch nursery and planting, forestry and logging, production of synthetic resins, phenol films and wood-plastic composite overlays, as well as purchase and distribution of complementary panel products. We are also active in machinery manufacture. Overall, the Group provides work to an average of 2,400 people.

Name and location of production sites

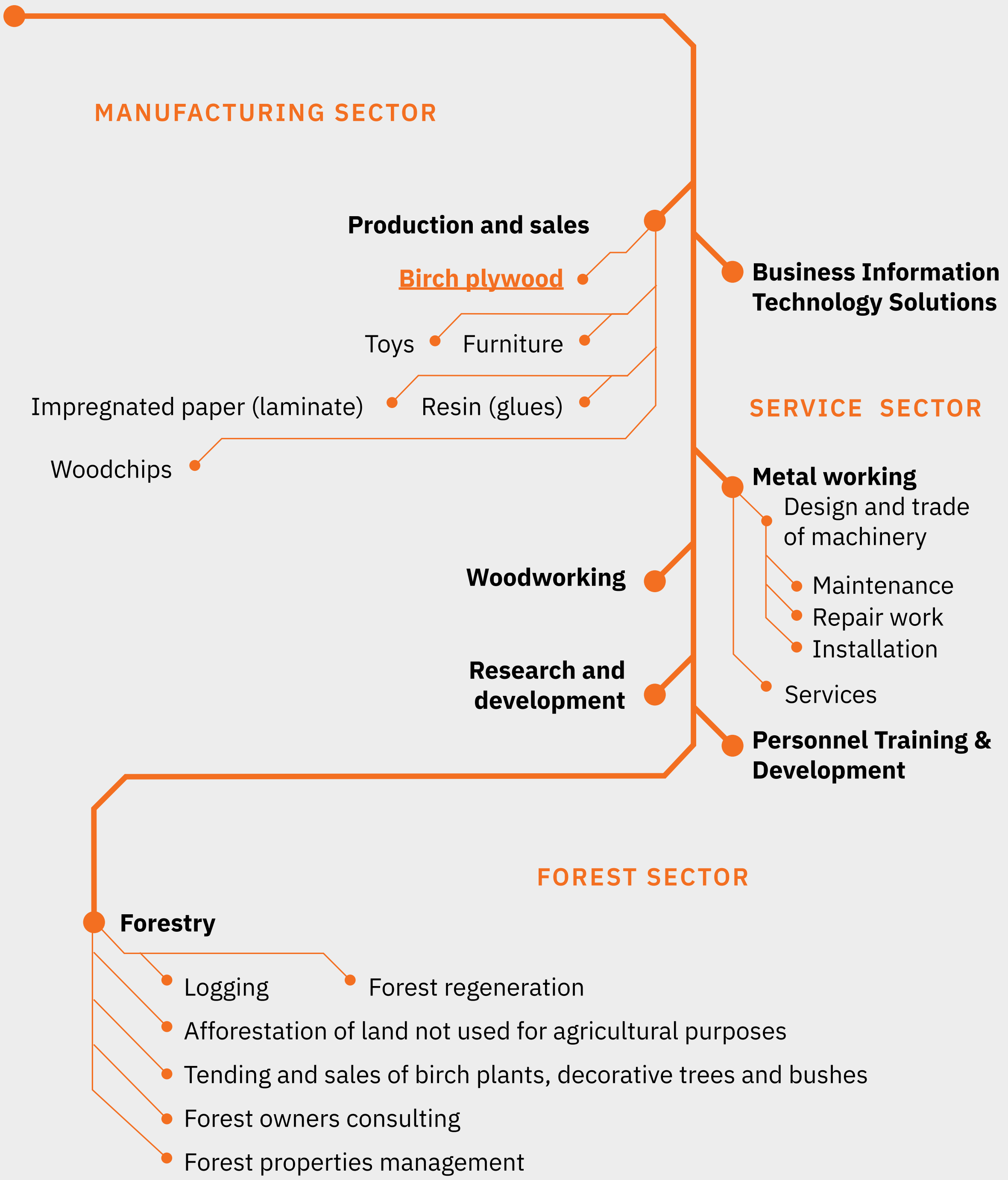
Birch veneer mills
- Likmere in Ukmergė, Lithuania
- Sastamala Mill in Sastamala, Finland

Birch plywood mills
- Lignums in Riga, Latvia
- Furniers in Riga, Latvia
- Verems in Rezekne County, Latvia
- Kohila Vineer in Kohila, Estonia

Birch plywood further processing units
- Hapaks in Riga, Latvia
- Troja in Riga, Latvia

Research and development
- Plywood Product Research Laboratory, Latvia
- Betulin Lab, Latvia

Figure 1.1. Business activities of Latvijas Finieris Group in Northern Europe




RigaWood
RigaWood

1.4. Sustainability approach

Know more about our plywood

As you already know, we in Latvijas Finieris Group produce high quality plywood products tailored to specific applications, but there is more to the story! We would like to share some of our sustainability efforts that are deeply rooted in our company's values and traditions.

Forests. It's where our products' life starts

We understand the importance of correct forest management to ensure environmental and economic balance. We manage our own forests in collaboration with forest research organisations to further develop well-established traditional ways of forest management and to cultivate forests with healthy and strong seedlings we grow and develop ourselves. The faster a tree grows in mass, the more CO_2 it stores.

Society and education

We organise annual forest themed, educational and tree planting events and welcome to participate our clients, schools, local municipalities and our company employees. For example, in 2021 we planted 438 000 spruces, pines, birches.

Encouraging social responsibility

It is our duty to be socially responsible. We evaluate our service providers and encourage them to be more socially responsible to their employees and pay their taxes.

Production sites. Reducing the environmental impact – efficiency is key

Practice makes perfect as they say. We have been producing plywood for generations and our accumulated experience and implemented cleaner production techniques in every production process have helped us in reducing waste, energy and water consumption. We are reusing excess heat where possible and are mainly producing energy from wood residues and by-products to reduce fossil CO_2 emissions.

Cut to size on site – limit your waste

We offer tailored solutions is not just a slogan. We can pre-machine, cut or drill our produced plywood right on site according to your needs so you won't have to, thus minimising your waste and additional logistics.

Life cycle assessment and environmental product declaration – knowing what to improve

Life cycle thinking is an approach that takes into account the product's whole life cycle from material extraction to its processing, transportation, use, reuse and end of life. This way of thinking gives a complete view on a product's impact on the environment through a few standardised parameters like global warming potential of CO_2 equivalent.

We have adapted life cycle thinking to create an environmental product declaration for our plywood products with the aim of knowing the impact of our product today and analysing the points of highest impact to reduce them in near future.

Our own developed and produced lignin resins – ecological breakthrough

Life cycle thinking also helped us to appreciate what we already had known to be right – we mainly produce our own resins and paper overlay in-house to ensure top quality and to reduce the environmental impact of transporting ready-made materials.

We have developed and created lignin based phenol-formaldehyde resins. Lignin is produced from wood and can substitute some of the content of phenol and formaldehyde in traditional resins used in glue for plywood. As lignin is biogenic and not hazardous it greatly reduces the environmental impact of our plywood.

1.5. Product research and development

Birch plywood is Latvijas Finieris Group core business, where the company invests in the latest technologies, research, and innovations. We believe in technological advancement, sustainable solutions and products that add tangible value. Our product development concept focuses on specific end-use application according to market needs and global trends, as well as an individual approach to each customer and project.

Latvijas Finieris Group is well aware of the need to change the existing industrial patterns to build a sustainable and safe future. Therefore, we invest to integrate sustainability principles deeply into our production processes and product concept.

Riga ECOlogical is our technological breakthrough in green gluing solutions, where bio based and renewable lignin is used as a replacement for traditional fossil products. Bonding with Riga ECOlogical improves the major environmental indicators of Riga Wood plywood all the way from production to final end-use applications, enhancing sustainable innovations without compromising on technical performance.

1.5.1. Product Development Approach

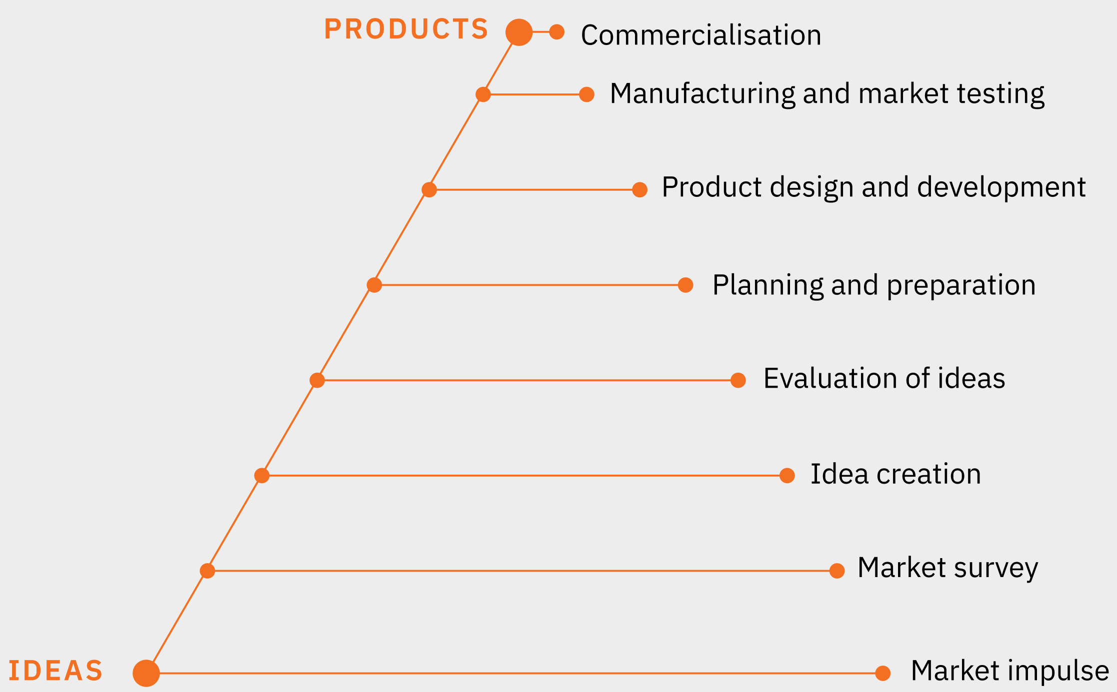
Latvijas Finieris Group Product Development Approach offers a well-structured framework for a successful product development process. This process aims to find performance oriented birch plywood based product solutions to fulfil requirements identified in the market. Latvijas Finieris Group world-wide network of sales and product development offices is the main driving force in observing the current and future industry needs and trends. Industry driven product development is supported by our product research and development department.

Latvijas Finieris Group considers a product or service as new or innovative if it is developed or provided by Latvijas Finieris Group and if it offers new possibilities to the customer or production process. Latvijas Finieris Group Product Development System framework, Figure 1.2, defines the order of development sub-procedures:

- market impulse – understanding and actively reacting to the market needs and demands
- market survey – analysing needs, potential risks and opportunities
- idea creation – generating ideas in line with innovation, sustainability, technologies
- evaluation of ideas – according to companies' vision and objectives
- planning and preparation – cross-functional project management including all the stakeholders
- product design and development – sourcing, prototyping, validating and testing
- manufacturing and market testing – ensuring the long-term viability of the product, getting feedback
- commercialisation – product launch and market development

Thus, the Product Development System forms a pyramid where all the stakeholders are equally involved, uniting real-world industry requirements with excellent product expertise.

Figure 1.2. Product Development System



1.5.2. Product testing

Latvijas Finieris Group laboratory units are designed for product development needs and equipped with modern and accurate measuring instruments. Testing is performed according to internationally recognised industry standards or innovative, self-developed methods. Test data is stored and processed for the analysis of test results. The highly qualified laboratory staff closely collaborates with various institutes and universities to promote research and innovation. To foster education and the future of the forest sector and related industries, Latvijas Finieris Group supports forest industry students by providing the time, knowledge and laboratory equipment to carry out research work.

1.6. Quality

The modern business environment is rapidly changing. Requirements of customers and other business partners for the quality of products are increasing multiple times over. In order to match this, Latvijas Finieris Group effectuates continuous controls throughout the well-structured production process. In addition, testing of ready-made products is carried out in Latvijas Finieris Group's laboratories.

Since 1999, the Quality Management System of Latvijas Finieris is certified in accordance with ISO 9001 requirements by certification body Bureau Veritas Certification.

1.6.1. Quality, safety, energy and environment management systems

Latvijas Finieris Group has established strict measures in order to guarantee that production processes are harmless for human health as well as for the environment. In addition, Latvijas Finieris Group implements and supports a sustainable forest management system which is friendly to nature and the surrounding societies.

Latvijas Finieris Group is certified by Bureau Veritas Certification to meet the requirements of the Environment Protection System ISO 14001.

Safety is one of the values of Latvijas Finieris Group and safety management is part of the general management system. It is a daily component at all levels. A safe working environment, as harmless to health as possible, is the foundation for building long-term relationships with employees. Monitoring of workplaces and reduction of risks to the working environment, investigation of near misses, involvement of employees in improving workplaces and regular training are key elements in building a safety culture.

Latvijas Finieris Group has implemented an occupational health and safety management system, which is certified in the Equipment Factory in accordance with the standard of this system – ISO 45001. Information on personal protective equipment during the plywood processing process is included in the plywood safety data sheet.

Latvijas Finieris Group's energy management system is certified by Bureau Veritas as complying to ISO 50001. The certificate demonstrates that the company follows a systematic approach in achieving continual improvement of energy performance, including energy efficiency, security, use and consumption. This gives more confidence to customers, stakeholders and employees that the company continually reduces its energy use and greenhouse gas emissions.

Latvijas Finieris Group holds the Forest Stewardship Council® (FSC®, license FSC-C001599) and Program for the Endorsement of Forest Certification (PEFC) certificates confirming that the Latvijas Finieris Group's timber processing system, from logging to manufacture and delivery, meets the internationally recognised sustainable forest management principles.

Latvijas Finieris Group acknowledges and vigorously applies the European Union initiatives on the legality of timber sources. According to the Latvijas Finieris Group's purchasing policy, the company accepts roundwood exclusively from legal and verified sources, with all taxes and fees paid. Specialists of Latvijas Finieris Group make regular supply and supplier audits, in order to assure that they meet FSC® or PEFC requirements.

Figure 1.3. System certifications at Latvijas Finieris Group

ISO 9001 BUREAU VERITAS Certification

ISO 45001 BUREAU VERITAS Certification

ISO 14001 BUREAU VERITAS Certification

ISO 50001 BUREAU VERITAS Certification

PEFC PEFC/12-31-001 Promoting Sustainable Forest Management www.pefc.org

Latvijas Finieris Group ensures consistent quality of its products and services, the competitiveness of its products and guarantees that the operations are environmentally friendly.

Independent reports conclude that the products manufactured by Latvijas Finieris Group and services offered meet the requirements of legislation and international standards and that these have been made by independent certification institutions, state inspections as well as our cooperation partners.

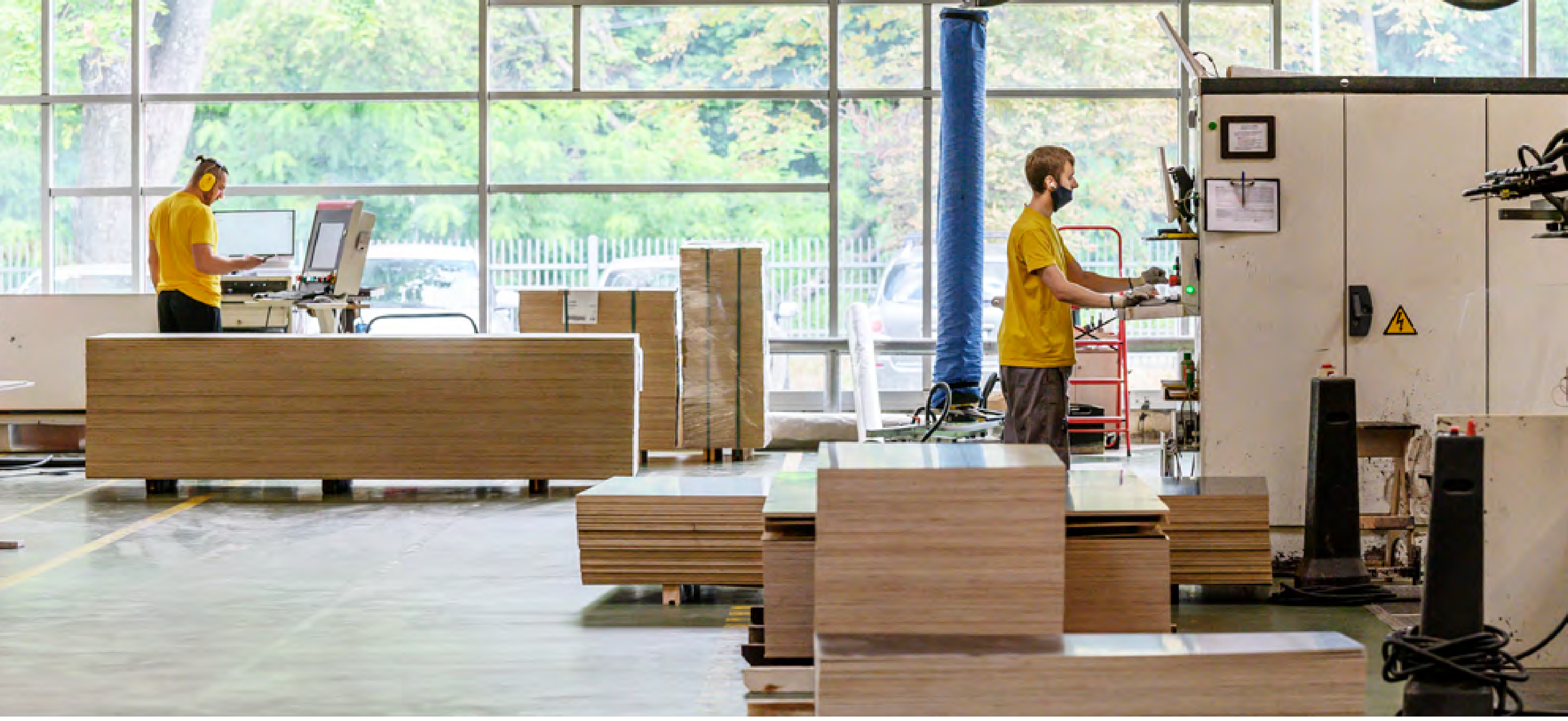
1.6.2. CE marking

EU Regulation No.305/2011 of the European Parliament and of the Council laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC has been in force since March 2011. The regulation determines basic requirements relating to the mechanical and fire resistance for construction works, as well as to the essential aspects of public benefit relating to sustainable use of natural resources, energy economy, heat retention, protection against noise, health, hygiene and other issues. Compliance of plywood to the Regulation should be demonstrated by meeting requirements of the EN 13986 Wood-based panels for use in construction – characteristics, evaluation of conformity and marking.

1.6.3. UKCA marking

The UKCA (United Kingdom Conformity Assessment) mark is the new product marking scheme to replace CE marking for the Great Britain market (England, Wales and Scotland) that came into effect with BREXIT, from 1 January 2021 and becoming mandatory on 1 January 2023.

Riga Wood plywood has been assessed according to UK Construction Products Regulation 2013, UK Statutory Instrument I 2013 1387 and BS EN 13986. Construction used in Riga Wood plywood is UKCA marked.



1.6.4. Certification, international standards, compliance

Independent conclusions concerning the Latvijas Finieris Group's products' conformity with requirements of different norms and international standards have been provided by:

- Fraunhofer Wilhelm Klauditz Institut, Germany
- Institut Entwicklungs- und Prüflabor Holztechnologie GmbH, Germany
- Eurofins Expert Services OY (former VTT), Finland
- Forest and Wood Product Research and Development Institute – MEKA, Latvia
- Latvian State Institute of Wood Chemistry, Latvia
- State of California Air Resources Board, USA
- Eco-INSTITUT GmbH, Germany
- Building Information Ltd., Finland
- RISE Research Institutes of Sweden (former TRATEK and SP), Sweden
- Japan Ministry of Land, Infrastructure, Transport and Tourism, Japan
- Japan Testing Center of Construction Materials, Japan
- Danish Technological Institute – DTI, Japan
- Institute für Arbeitsschutz der DGUV (IFA), Germany
- Centre Scientifique et Technique du Bâtiment – CSTB, France
- CENTEXBel, Belgium
- Laboratorio Prevenzione Incendi LAPI, Italy
- Centro Ricerche-Svillupo e Laboratori Prove CATAS, Italy
- Georg-August-University Göttingen, Germany
- Riga Technical University, Latvia
- University of Latvia, Latvia

2. Riga Wood plywood products

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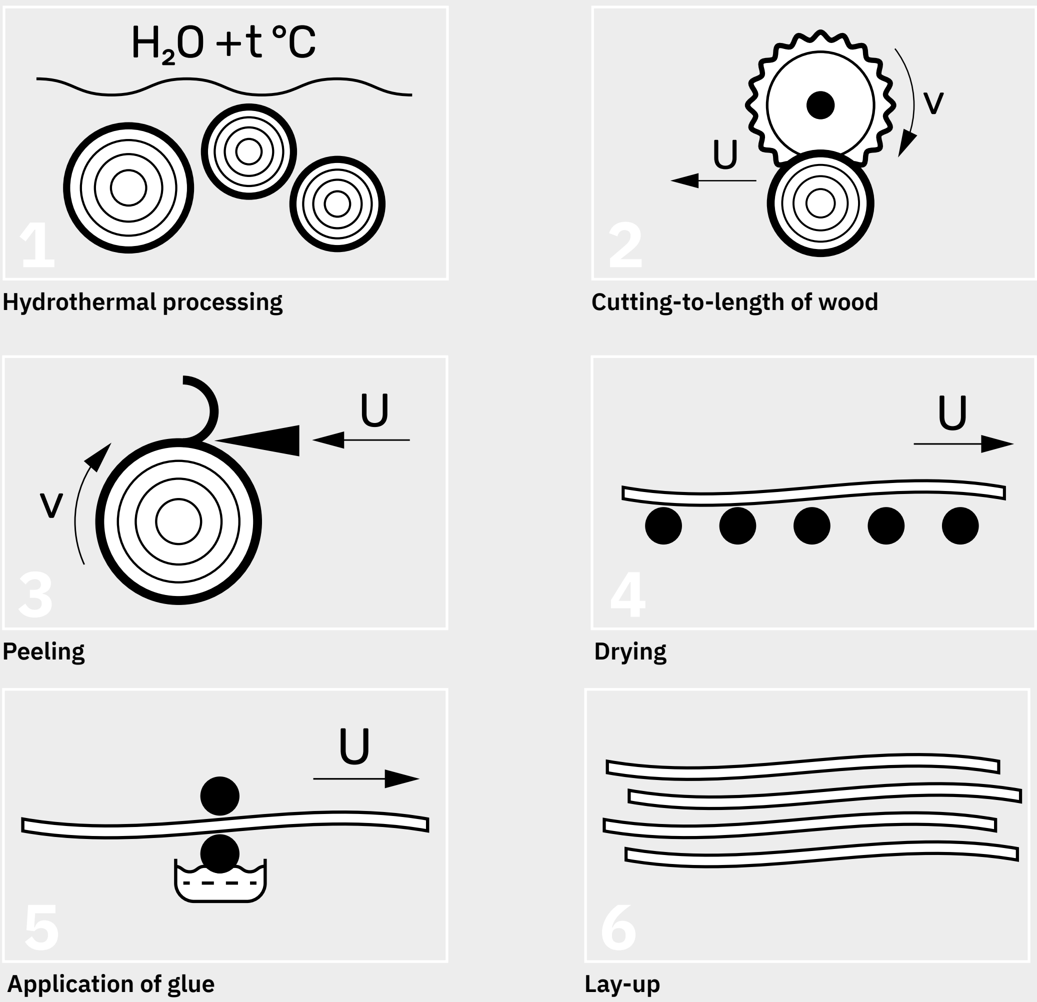
2.1. Overview on the production process

Before entering the production line, the quality graded logs go through a hydro-thermal processing in warm water ponds, in order to enhance the wood's plasticity. This contributes to the peeling results and to the quality of veneer.

After the hydro-thermal processing the logs are debarked and cut-to-length. Before the rotary peeling, the logs are centralised with the help of laser devices, in order to maximise the yield of veneer.

The rotary cut veneer sheets are cut into required lengths and dried. The dry veneer is quality graded and sorted according to format. Veneers with too high moisture are put aside for further drying. Veneers not meeting the strict quality and dimension requirements will not be forwarded to plywood production. Veneers are then cut-to-size, defects eliminated, knots are patched and sheets are jointed according to needs. Dry, graded and sorted veneers are fed to plywood lay-up lines. Glue is applied on veneers and plywood lay-up of full format and appropriate construction is made.

Figure 2.1. Plywood production diagram

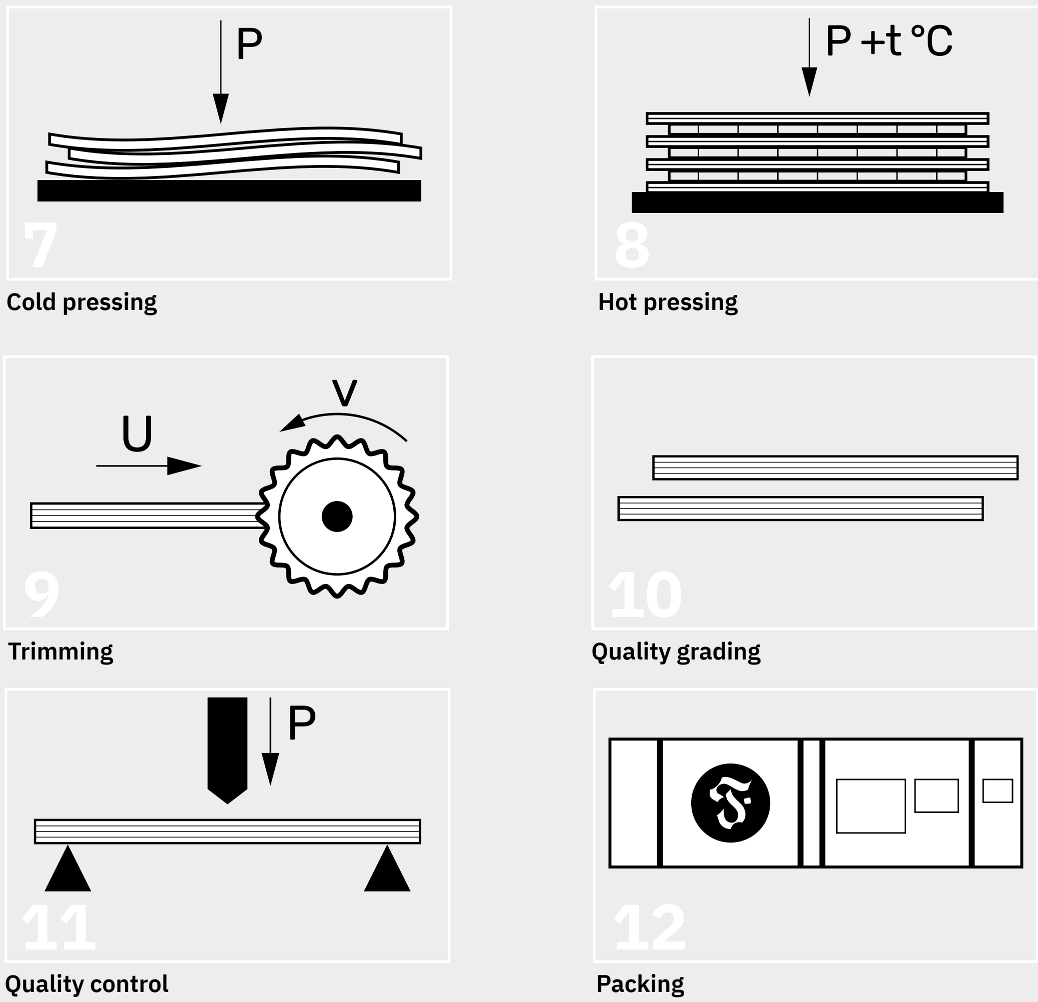


After lay-up the cold pre-pressing takes place, in order to prepare the panels for hot pressing. Hot pressing is the part of the process where plywood panels are made. A multi-day light hot press creates and maintains the required contact between the glue and the veneers. It also decreases the tension in the glue line and the thickness of the glue layer.

After hot pressing, and before further processing, the panel temperature, moisture content and dimensions have to stabilise. When stabilised, the panels are trimmed from all four sides. The faces are sanded to reach accurate panel thickness and to decrease thickness variations.

After sanding, the panels are quality graded and packaged in accordance with dimension and quality. Raw plywood may be overlaid with various materials for different end-uses. The panels can also be machined (cut-to-size, profiled, drilled, etc.).

Figure 2.1. Plywood production diagram



Watering seedlings in Latvijas Finieris Groups' nursery, 2021

2.2. Types of products

2.2.1. List of products

1 Raw plywood	Riga Ply
2 Plywood with overlay	Riga Form Riga Mel
3 Plywood with textured overlay	Riga Tex Riga Heksa Riga Heksa Plus Riga Smooth Mesh Riga Rhomb Riga Foot Riga Trans Riga Superwire Riga Dot Riga Frost Riga Diamond Riga Timber Riga Pattern+
4 Plywood ready for painting	Riga Paint Riga Preprime Riga Prime
5 Plywood with decorative finish	Riga Decor Riga Lacquer Riga Color Riga HPL
6 Special overlay and composite construction	Riga Composite Riga Poliform Riga Silent Riga Grip
7 Special plywood	Riga Shipply Riga Lacquer FR Riga AT-FT

Raw plywood

Riga Ply is a high-quality birch throughout plywood with both faces sanded and is designed for a wide range of applications, where the best strength properties are required. Made of 1.45 mm thick cross bonded birch veneers, face veneers are available in long and cross grain. For customer specific requirements, specially designed oriented veneer constructions can be used to improve the bending strength and stiffness properties.

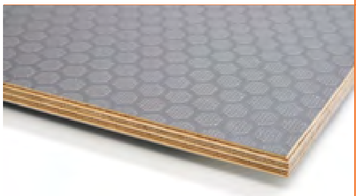
Overlaid plywood

Riga Form is a birch throughout plywood, overlaid on both faces with specially designed films for intensive, heavy-duty uses.

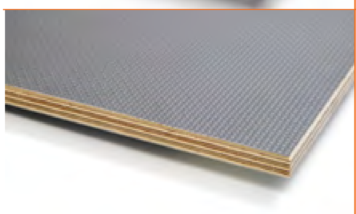
Riga Mel is a birch throughout plywood, overlaid with melamine film on one or both faces, combining durability and aesthetic appearance.

Plywood with textured overlay

Riga Tex is a birch throughout plywood, overlaid with a hard wearing film with a rough wire mesh pattern (see Figure 2.2.), it can be used anywhere anti-slip properties are required.

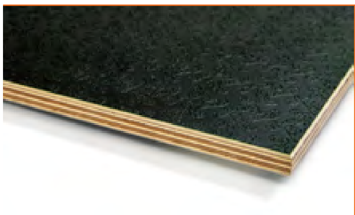


Riga Heksa, Riga Heksa Plus are birch throughout plywoods, overlaid with a hard wearing film with a special hexagonal pattern (see Figure 2.2.), combining both functionality and aesthetic visual appearance.

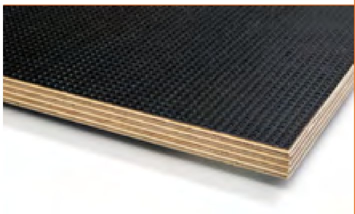


Riga Smooth Mesh is a birch throughout plywood, overlaid with a hard wearing special smooth wire mesh phenol pattern (see Figure 2.2.), combining both functionality and a decorative visual appearance.

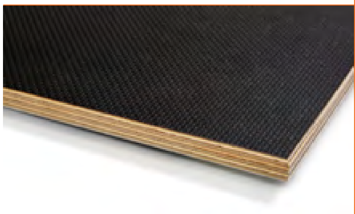
Riga Rhomb is a birch throughout plywood, overlaid with a hard wearing film with a rhomboid pattern surface (see Figure 2.2.), combining both functionality and a decorative visual appearance.



Riga Foot is a birch throughout plywood, overlaid with a hard wearing film with a unique foot print pattern (see Figure 2.2.), combining both functionality and aesthetic visual appearance.



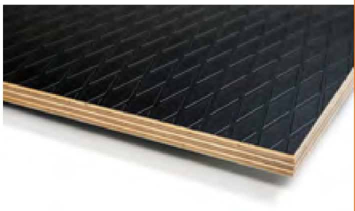
Riga Trans is a birch throughout plywood, designed (see Figure 2.2.) for the highest industrial demanding flooring applications, where high wear resistance and excellent anti-slip properties are required.



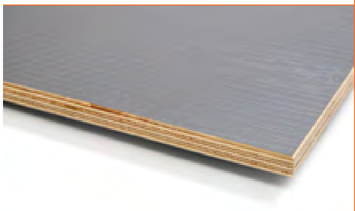
Riga Superwire is a birch throughout plywood, overlaid with a hard wearing special wire pattern (see Figure 2.2.) on both faces, combining both functionality and a decorative visual appearance.

Riga Dot is a birch throughout plywood, overlaid with a hard wearing film with a unique glossy dotted pattern (see Figure 2.2.), combining both functionality and an aesthetic visual appearance.

Riga Frost is a birch throughout plywood, overlaid with a hard wearing film with a special slightly textured pattern (see Figure 2.2.), combining durability, functionality and a decorative visual appearance.



Riga Diamond is a birch throughout plywood, overlaid with a hard wearing film with a special diamond pattern (see Figure 2.2.), combining both functionality and a decorative visual appearance.



Riga Timber is a birch throughout plywood, overlaid with a hard wearing film with a special wooden structure pattern (see Figure 2.2.), combining both functionality and a decorative visual appearance.

Riga Pattern+ is a birch throughout plywood, overlaid with a hard wearing film that combines the latest decorative industry techniques (see Figure 2.2.). with exceptional flexibility. This technique enables customers to explore a diverse range of textures and colours, enabling the creation of truly innovative designs on direct-pressed birch plywood surfaces.

Plywood ready for painting

Riga Paint is a birch throughout plywood, designed for long-lasting and easy painting. Riga Paint is overlaid with a painting film for further priming or painting.

Riga Preprime is a birch throughout plywood, designed for long-lasting and easy painting. Riga Preprime is overlaid with a preprimed painting film and is ready for final coating.

Riga Prime is a birch throughout plywood with a primed surface on either one or both sides, prepared for further surface treatment or immediate use.

Plywood with decorative finish

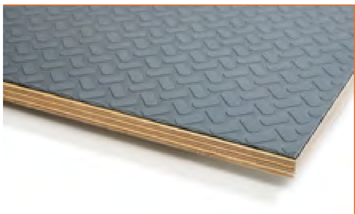
Riga Decor is a birch throughout plywood veneered on one or both faces with various noble wood surfaces for decorative appearance, depending on customer requirements and intended use.

Riga Lacquer is a birch throughout plywood with a lacquered surface finish on one or both faces.

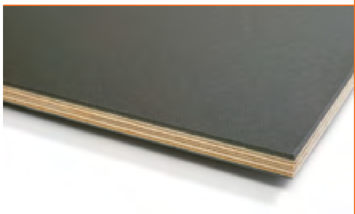
Riga Color is a birch throughout plywood with an industrial solid colour lacquered finish on one or both faces.

Riga HPL is a birch throughout plywood, overlaid with CPL or HPL laminates on one or both sides, for decorative and/or heavy-duty applications.

Special overlay and composite construction



Riga Composite combines birch throughout plywood with high quality coating or core materials to improve mechanical properties and/or visual appearance for a variety of end uses.



Riga Poliform is a birch throughout plywood, overlaid with a high performance and highly durable wood-plastic composite (WPC) material.

Riga Silent is a birch throughout plywood composite panel with a sound reduction material core, designed to provide improved sound insulation and absorb vibrations.

Riga Grip combines birch throughout plywood with a high-quality epoxy paint system coating with plastic shots, to improve mechanical properties for customised varieties of industrial end uses.

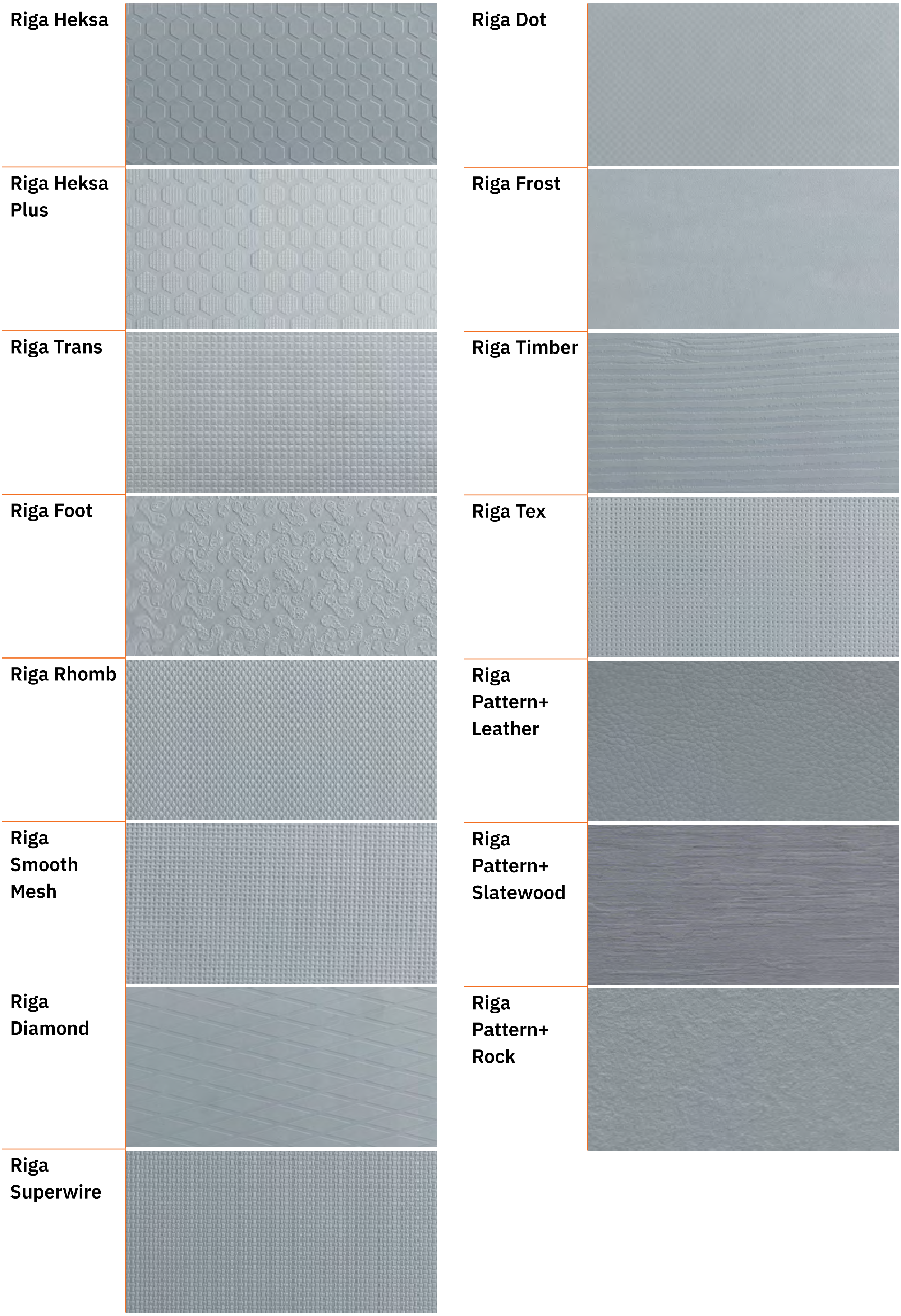
Special plywood

Riga Shipply is the highest quality birch throughout plywood with outstanding mechanical properties, designed especially for LNG cargo containment systems.

Riga Lacquer FR is a birch throughout plywood with both faces sanded and covered with a flame retardant coating system on one face.

Riga AT-FT is a birch throughout plywood, treated with wood preservative for preventive protection against wood destroying fungi (FT) or insects, including termites (AT).

Figure 2.2. A Guide to Patterns



2.2.2. Film types

Riga Wood plywood can be overlaid with resin impregnated film, which is hot-pressed onto the sheet surface, ensuring a covered and protected surface. Depending on the specific needs of the industry, various film types are available. Riga Wood experts will advise the most appropriate overlay depending on the end use.

- **Phenolic / Modified phenolic surface film** is impregnated with phenol formaldehyde resin. Phenolic surface film can be used in a variety of end-uses. The overlaid surface endures severe weather conditions, resists commonly used chemicals (alkali, diluted acids, organic solvent) and is durable and dense, improving panel resistance against mechanical damage and wearing. A wide variety of colours is available.
- **Modified melamine resin film** is impregnated with modified melamine resin. The overlaid surface is hard and durable, with improved crack, commonly used chemicals, and light/UV resistance.

Table 2.1. Film weight, g/m^2

To enhance the product properties, it is possible to use multi-layer constructions or apply underlays.

Film colour	Phenolic / Modified phenolic resin film	Melamine / Modified melamine resin film
Dark brown	120, 220	
Light brown	120	
Black	120, 130*, 220	
Light grey		220
Multigrey		190
Silver grey		220
White		205
Opal white		120, 240
Transparent		120
Blue		200
Yellow	167	
Green	120	
Honey		120

* film with improved wear resistance

2.2.3. Tailored solution options

Riga Wood birch plywood products can be tailored and customised for the needs of specific industries and targeted applications.

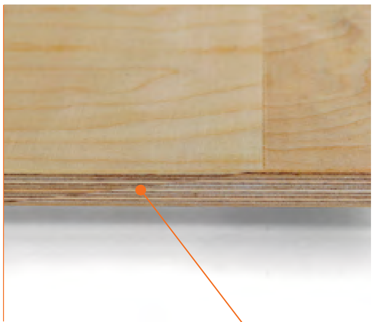
Panel thicknesses and dimensions

Besides of a wide range of standard panel thicknesses, the number of veneer plies can be adjusted to reach a specific panel thickness.

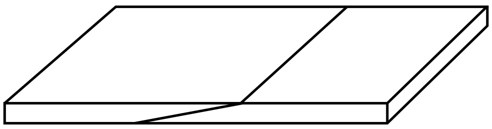
Scarf jointed panels

To enable customers to reach their needed plywood size, it is possible to scarf joint panels. Angled surfaces of two panels are joined, applying waterproof glue and joining them together. The bonded structure maintains a uniform thickness at the joint section. Latvijas Finieris Group can scarf joint plywood panels up to 14,000 mm long with thicknesses up to 50 mm. Scarfing is available both for raw and overlaid panels. The strength of scarf jointed panel is up to 90% in comparison with non-jointed panel strength.

Scarf jointed raw panel, Riga Ply



Scarf jointed overlaid panel, Riga Tex



Customised tolerances

In addition to the standard tolerances for dimensions of plywood panels and tolerances for squareness and edge straightness specified in the requirements of the EN 315 standard, customised tolerances for all panel sizes are possible, but must be agreed on separately.

Special lay-up plywood

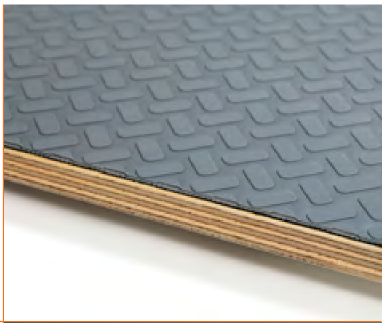
Plywood is constructed of an odd number of veneer layers with grain of adjacent layers perpendicular to each other. If special mechanical properties are required, the veneer lay-up grain orientation can be modified. The different plywood lay-up combinations pass strict quality control tests, with results showing that mechanical properties (bending strength, stiffness) can be adjusted for specific end use requirements.

Composite structures

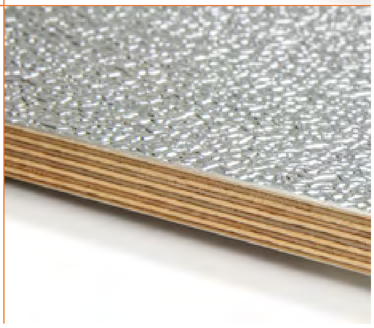
Customised composite structures are used to increase certain product properties or visual appearance. Different materials like linoleum, rubber, cork, aluminium, polypropylene (PPL), thermoplastic polyolefin (TPO) and special wooden composite material (WPC) among others can be overlaid on one or both faces or used as a core.

Riga Composite PPL

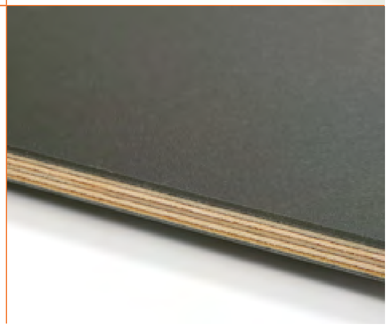
Riga Composite TPO



Riga Composite ALU



Riga Poliform, WPC



Overlays & coatings

Riga Wood plywood can be overlaid with different types of films and coating materials in a variety of colours and structures. To enhance the product properties, it is possible to use multi-layer constructions or apply underlays.

Printing on plywood

Monochrome printing on standard size plywood panels or parts of it with a customer logo or other information is available on request. An area up to a width of 50 mm in the longitudinal direction of the plywood panel can be imprinted with a single logo or continuous pattern. A variety of print colours is available, including fluorescent paint (visible only under UV light). With custom printed films it is possible to create a unique design panel.

Cutting-to-size, other machining

Riga Wood plywood can be further processed in many different ways, including cut-to-size, CNC, drilling, milling, jointing, edge machining, assembling in sets. More information in section 2.6. Machining and finishing.

Special treatments

Riga Wood plywood can be treated with wood preservative for preventive protection against wood destroying fungi or insects, including termites. A flame retardant coating system meeting the requirements of class B-s1, d0 is available.

2.3. Plywood grades

The quality grade of plywood is defined by the type and quantity of visible defects.

2.3.1. Uncoated plywood grades

Riga Ply grading conditions are in compliance with or stricter than requirements set by the following regulatory documents (see Table 2.2):

- EN 635-2 Plywood, Classification by Surface Appearance, Part 2. Hardwood.;
- SFS 2413 quality requirements for appearance of plywood with outer plies of birch;
- ISO 139 Recommendations and Conditions Drawn by Work Group II of the Technical Committee (1994).

Table 2.2. Grade compliance

	Grade		
EN 635-2	II	III	IV
Latvijas Finieris Group	S	BB	WG
SFS 2413	II (S)	III (BB)	IV (WG)
ISO 139 recommendations	II	III	IV

Recommended applications of Riga Ply, depending on grade

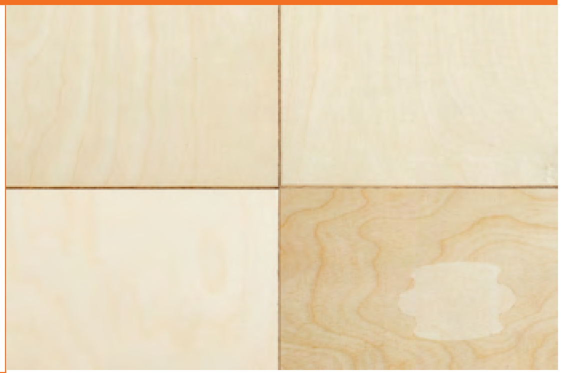
Grade	Recommended application	
S (II)	For good quality staining and lacquering.	
BB (III)	For finishing and coating with transparent and non-transparent thicker overlays and films, veneering and applications where a solid face is required.	
WG (IV)	For use where surface appearance is not important, reverse grade.	
WGE	Plywood of WG grade without open defects (repaired with filler), for overlaying with non-transparent finishing material.	

Table 2.3. Quality requirements for Riga Ply

Category of defect	Plywood grades		
	S	BB	WG
1. Pin knots	Permitted	Permitted	Permitted
2. Sound intergrown knots	Permitted up to an individual max Ø 20 mm, if the cumulative Ø does not exceed 50 mm/m²	Permitted up to an individual max Ø 25 mm, if the cumulative Ø does not exceed 60 mm/m²	Permitted up to an individual max Ø 65 mm, if the cumulative Ø does not exceed 600 mm/m²
3. Unsound adhering knots	Not permitted	Not permitted	Permitted up to an individual max Ø 20 mm, if the cumulative Ø does not exceed 200 mm/m²
4. Other knots and holes	Not permitted	Permitted up to an individual max Ø 6 mm, if the cumulative Ø does not exceed 25 mm/m²	Permitted up to an individual max Ø 15 mm, if the cumulative Ø does not exceed 100 mm/m²
5. Irregularities in the structure of the wood	Permitted	Permitted	Permitted
6. Curly grain	Not permitted	Permitted	Permitted
7. Open splits and checks	Not permitted	Not permitted	Permitted for an individual max width up to 4 mm, not more than 2 per meter of panel width
8. Open splits and checks, repaired by putty	Permitted for an individual max width up to 2 mm and for an individual max length up to 200 mm, not more than 1 per meter of panel width	Permitted for an individual max width up to 2 mm and for an individual max length up to 200 mm, not more than 1 per meter of panel width	Permitted for an individual max width up to 4 mm, not more than 2 per meter of panel width
9. Closed splits and checks	Permitted for an individual max length up to 200 mm and not more than 2 per meter of panel width	Permitted for an individual max length up to 200 mm and not more than 2 per meter of panel width	Permitted
10. Wood discolouration	Permitted slightly	Permitted	Permitted
11. Coloured streaks	Permitted slightly	Permitted	Permitted

Category of defect	Plywood grades		
	S	BB	WG
12. Wood discoloration, other discoloration, coloured streaks. Brown, but not rot	Not permitted	Permitted up to 30% of the surface area	Permitted
13. Inserts	Permitted, if properly inserted and matching the plywood colour, not more than 1/m²	Permitted up to 3% of the surface area	Permitted
14. Open joints	Not permitted	Permitted up to an individual max width 2 mm and individual max length 200 mm, not more than 1 per meter of panel width, repaired with putty	Permitted up to an individual max width 3 mm
15. Overlap	Not permitted	Not permitted	Not permitted
16. Peeling defects (imprints and bumps)	Not permitted	Permitted slightly, up to 2 cm² per panel	Permitted slightly
17. Roughness	Not permitted	Permitted slightly, up to 10 cm²/m², if repaired with putty – max 3 defects per panel	Permitted
18. Sanding through	Not permitted	Permitted ≤ 10 cm²/m²	Permitted ≤ 20 cm²/m²
19. Glue penetration	Permitted, if occasional	Permitted up to 5% of the surface area	Permitted
20. Unsanded areas	Not permitted	Not permitted	Permitted up to an extent of 5% of the panel surface
21. Composed face veneers	Permitted, if composed properly, consistent colour	Permitted	Permitted
22. Defects at the edges caused by the sanding or trimming	Permitted up to 5 mm from the edge, not in whole length	Permitted up to 5 mm from the edge, not in whole length	Permitted up to 5 mm from the edge
Total number of permitted categories of defects per panel	≤ 6	≤ 9	Unlimited

If the machined panel is smaller than the minimum unit defined in the table (1 m², 1 meter of width), then from the point of view of quality assessment its size shall be equated to 1 m² or 1 meter of width.

2.3.2. Laminated plywood grades

The quality grade of laminated plywood is defined by the type and quantity of visible defects. The limitations described in Table 2.4 refer to the following Riga Wood laminated plywood products:

Riga Form	Patterns	Colored
Riga Tex		Transparent
Riga Form (dark brown, black)	Riga Diamond	Riga Form (light brown, silver grey, etc.)
Riga Tex (dark brown, black)	Riga Dot	Riga Mel
	Riga Foot	Riga Preprime
	Riga Frost	Riga Paint
	Riga Heksa	
	Riga Heksa Plus	
	Riga Rhomb	
	Riga Smooth Mesh	
	Riga Superwire	
	Riga Timber	
	Riga Trans	

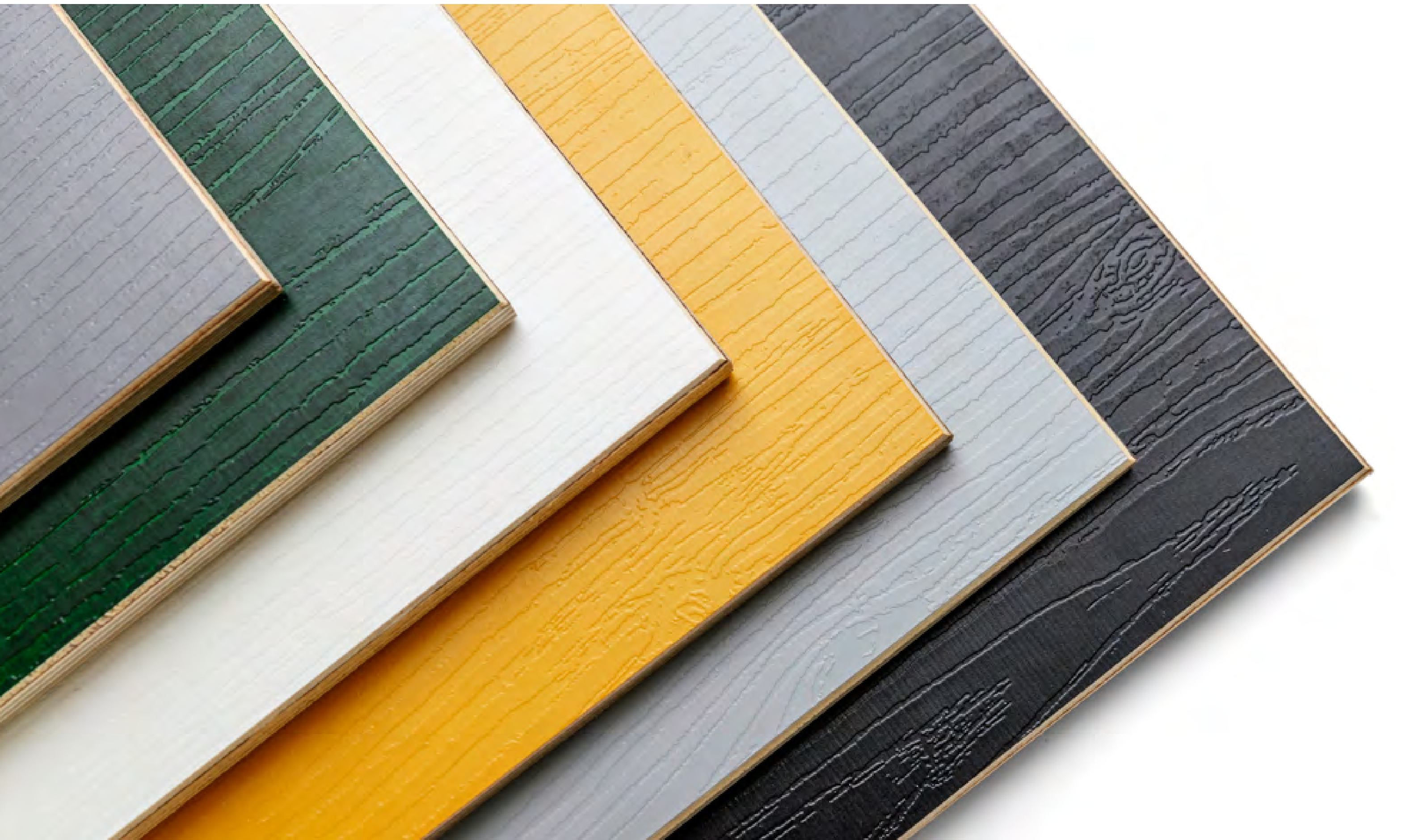


Table 2.4. Quality requirements for laminated Riga Wood plywood

DEFECT	GRADE	FORM	PATTERNS	COLORED
		TEX		TRANSPARENT
1. Plywood delamination	A	Not permitted	Not permitted	Not permitted
	I	Not permitted	Not permitted	Not permitted
	II	Permitted 100 cm^2/m^2	Permitted 100 cm^2/m^2	Permitted 100 cm^2/m^2
2. Matt surface	A	Not permitted	Not permitted	Not permitted
	I	Permitted > 50% of surface area	Not permitted	Not permitted
	II	Permitted	Permitted	Permitted
3. Scorched laminate as strips and spots	A	Not permitted. If grade A on both faces, permitted on one face: Strips: < 5 mm in width, 1 pc/width m Spots: < Ø 20 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	Not permitted on pattern face. Permitted on reverse face: Strips: < 5 mm in width, 1 pc/width m Spots: < Ø 20 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	Not permitted. If grade A on both faces, permitted on one face: Strips: < 5 mm in width, 1 pc/width m Spots: < Ø 20 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm
	I	Permitted. Strips: < 10 mm in width, 1 pc/width m Spots: < Ø 30 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	Permitted. Strips: < 10 mm in width, 1 pc/width m Spots: < Ø 30 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	Permitted. Strips: < 10 mm in width, 1 pc/width m Spots: < Ø 30 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm
	II	Permitted	Permitted	Permitted
4. Damaged pattern, uneven pattern	A	Not permitted	Not permitted	n/a
	I	Permitted. Strips: < 10 mm in width, 1 pc/width m Spots: < Ø 30 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	Permitted. Strips: < 5 mm in width, 1 pc/width m Spots: < Ø 20 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	n/a
	II	Permitted	Permitted	n/a
5. Displacement of wire mesh or pattern	A	Not permitted	Not permitted	n/a
	I	Not permitted	Not permitted	n/a
	II	Permitted	Permitted	n/a
6. Film overlaps as dark strips	A	Not permitted. If grade A on both faces, permitted on one face firmly glued < 10 mm in width.	Not permitted on pattern face. Permitted on reverse face firmly glued < 10 mm in width.	Not permitted. If grade A on both faces, permitted on one face firmly glued < 10 mm in width.
	I	Permitted without limitations firmly glued < 20 mm in width.	Not permitted on pattern face. Permitted on reverse face firmly glued < 20 mm in width.	Not permitted. If grade I on both faces, permitted on one face firmly glued < 20 mm in width.
	II	Permitted	Permitted	Permitted

DEFECT	GRADE	FORM TEX	PATTERNS	COLORED TRANSPARENT
7. Film folds	A	Not permitted	Not permitted	Not permitted
	I	Permitted, < 10% of surface area	Not permitted	Not permitted
	II	Permitted	Permitted	Permitted
8. Lack of film or film delamination after laminating	A	Not permitted	Not permitted	Not permitted
	I	Not permitted	Not permitted	Not permitted
	II	Permitted, on 1/3 of the sheet on one face	Permitted, on 1/3 of the sheet on one face	Permitted, on 1/3 of the sheet on one face
9. Glued laminate residues on the surface	A	Not permitted. If grade A on both faces, permitted on one face: < 3 pcs, if residues are (< 1 cm^2) in the same colour as surface	Not permitted on pattern face. Permitted on reverse face: < 3 pcs, if residues are (< 1 cm^2) in the same colour as surface	Not permitted. If grade A on both faces, permitted on one face: < 3 pcs, if residues are (< 1 cm^2) in the same colour as surface
	I	Permitted < 10 cm^2/m^2 if residues are in the same colour as surface	Permitted < 10 cm^2/m^2 if residues are in the same colour as surface	Permitted < 10 cm^2/m^2 if residues are in the same colour as surface
	II	Permitted	Permitted	Permitted
10. Other colour dust pressed on the surface	A	Not permitted. If grade A on both faces, permitted on one face: < 5% of surface area	Not permitted on pattern face. Permitted on reverse face: < 5% of surface area	Not permitted. If grade A on both sides, then permitted on one side: < 5% of surface area
	I	Permitted, < 10% of surface area	Permitted, < 10% of surface area	Permitted, < 10% of surface area
	II	Permitted	Permitted	Permitted
11. Imprints, if film is not damaged	A	Not permitted. If grade A on both faces, permitted on one face: < 1 cm^2/m^2, if the width of an imprint < 3 mm and the sum of the length < 30 mm/m^2	Not permitted on pattern face. Permitted on reverse face: < 1 cm^2/m^2 if the width of an imprint < 3 mm and the sum of the length < 30 mm/m^2	Not permitted. If grade A on both faces, permitted on one face: < 1 cm^2/m^2, if the width of an imprint < 3 mm and the sum of the length < 30 mm/m^2
	I	Permitted < 2.5 cm^2/m^2, if the width of an imprint < 5 mm and the sum of the length < 50 mm/m^2	Permitted < 2.5 cm^2/m^2, if the width of an imprint < 5 mm and the sum of the length < 50 mm/m^2	Permitted < 2.5 cm^2/m^2, if the width of an imprint < 5 mm and the sum of the length < 50 mm/m^2
	II	Permitted	Permitted	Permitted

DEFECT	GRADE	FORM	PATTERNS	COLORED
		TEX		TRANSPARENT
12. Ridges, bumps	A	Not permitted. If grade A on both faces, permitted on one face. Spots: < Ø 15mm, 1 pc/m^2 or unlimited, if < Ø5 mm	Not permitted on pattern face. Permitted on reverse face. Spots: < Ø 10 mm, 1 pc/m^2 or unlimited, if < Ø 5 mm	Not permitted. If grade A on both faces, permitted on one face. Spots: < Ø 10 mm, 1 pc/m^2 or unlimited, if < Ø 5 mm
	I	Permitted. Strips: < 10 mm in width, < 300 mm in length and 1 pc/width m; < 5 mm in width, unlimited length, < 1 pc/width m Spots: < Ø 20 mm, 1 pc/m^2 or unlimited, if < Ø 10 mm	Permitted. Strips: < 5 mm in width, < 300 mm in length and 1 pc/width m; < 3 mm in width, unlimited length, < 1 pc/width m Spots: < Ø 15 mm, 1 pc/m^2 or unlimited, if < Ø 5 mm	Permitted. Strips: < 3 mm in width, < 200 mm in length and 1 pc/width m Spots: < Ø 15 mm, 1 pc/m^2 or unlimited, if < Ø 5 mm
	II	Permitted	Permitted	Permitted
13. Scratches	A	Not permitted. If grade A on both faces, permitted minor scratches on one face (< 2 pcs), if the laminate is not scratched through	Not permitted on pattern face. Permitted minor scratches on reverse face (< 2 pcs), if the laminate is not scratched through	Not permitted. If grade A on both faces, permitted minor scratches on one face (< 2 pcs), if the laminate is not scratched through
	I	Permitted, if the laminate is not scratched through	Permitted, if the laminate is not scratched through	Permitted, if the laminate is not scratched through
	II	Permitted	Permitted	Permitted
14. Diffuse strips on surface (variations in colour tone or gloss)	A	Not permitted. If grade A on both faces, permitted minor on one face	Not permitted on pattern face. Permitted minor on reverse face	Not permitted. If grade A on both faces, permitted minor on one face
	I	Permitted minor	Permitted minor	Permitted minor
	II	Permitted	Permitted	Permitted
15. Lack of veneer on edges	A	Not permitted	Not permitted	Not permitted
	I	Permitted in one layer of veneer with a depth < 3 mm. Edges shall be firm if standard size	Permitted in one layer of veneer with a depth < 3 mm. Edges shall be firm if standard size	Permitted in one layer of veneer with a depth < 3 mm. Edges shall be firm if standard size
	II	Edges shall be firm if standard size	Edges shall be firm if standard size	Edges shall be firm if standard size
16. Edge sealing paint on laminated surface	A	Permitted ≤ 5 mm paint overlap on the laminated surface. Paint film on the edges shall be even	Permitted ≤ 5 mm paint overlap on the laminated surface. Paint film on the edges shall be even	Permitted ≤ 5 mm paint overlap on the laminated surface. Paint film on the edges shall be even
	I	Permitted ≤ 5 mm paint overlap on the laminated surface. Paint film on the edges shall be even	Permitted ≤ 5 mm paint overlap on the laminated surface. Paint film on the edges shall be even	Permitted ≤ 5 mm paint overlap on the laminated surface. Paint film on the edges shall be even
	II	Permitted	Permitted	Permitted

DEFECT	GRADE	FORM	PATTERNS	COLORED
		TEX		TRANSPARENT
17. Minor rough spots	A	Not permitted. If grade A on both faces, permitted on one face: < 25 cm^2 over the surface, with separate spots < 5 cm^2	Not permitted on pattern face. Permitted on reverse face: < 25 cm^2 over the surface, with separate spots < 5 cm^2	Not permitted. If grade A on both faces, permitted on one face: < 25 cm^2 over the surface, with separate spots < 5 cm^2
	I	Permitted < 125 cm^2 over the surface	Permitted < 125 cm^2 over the surface	Permitted < 125 cm^2 over the surface
	II	Permitted	Permitted	Permitted
18. Mechanical defects	A	Not permitted	Not permitted	Not permitted
	I	Not permitted	Not permitted	Not permitted
	II	Permitted	Permitted	Permitted
19. Notches	A	Not permitted	Not permitted	Not permitted
	I	Not permitted	Not permitted	Not permitted
	II	Permitted one with a length < 10 cm	Permitted one with a length < 10 cm	Permitted one with a length < 10 cm
Total number of defects	A	There shall be no defects on one face. Reverse face < 2 categories of defects	There shall be no defects on one face. Reverse face < 2 categories of defects	There shall be no defects on one face. Reverse face < 2 categories of defects
	I	One face < 2 categories of defects. Reverse face < 5 categories of defects	One face < 2 categories of defects. Reverse face < 5 categories of defects	One face < 2 categories of defects. Reverse face < 5 categories of defects
	II	Unlimited	Unlimited	Unlimited

If the machined panel is smaller than the minimum unit defined in the table (1 m^2, 1 meter of width), then from the point of view of quality assessment its size shall be equated to 1 m^2 or 1 meter of width.

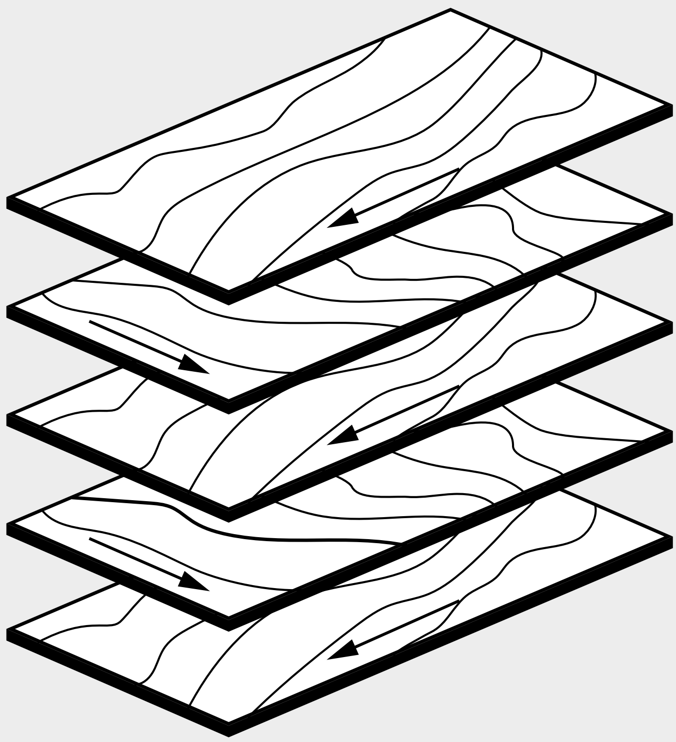
2.4. Dimensions and structure

The mechanical properties of wood vary according to the wood grain direction. To reach a solid and well-balanced result, plywood is produced by cross-bonding. Lignin-phenol-formaldehyde or phenol-formaldehyde glue is used for gluing together standard plywood veneer layers. It is also possible to use modified melamine-urea-formaldehyde resin glue. With special additives to glue, some characteristics of plywood can be improved, such as resistance to insects and fire.

2.4.1. Plywood lay-up scheme

To construct a plywood panel, veneer sheets with perpendicular and parallel grain are laid together one after another in accordance with the following standard lay-up scheme ("/" – cross grain; "-" – long grain).

By changing the veneer lay-up scheme, it is possible to increase the strength properties of the plywood either parallel or perpendicular to the longitude, adjusting the product for a specific end-use application. In the last decade more than 60 different lay-up schemes have been developed and successfully produced in Latvijas Finieris Group and the number keeps on growing.



2.4.2. Thickness

Riga Ply thicknesses and thickness tolerances are shown in Table 2.6, the values may vary by plywood product and size.

Table 2.5. Riga Wood plywood product range by nominal thickness

	4	6.5	9	12	15	18	21	24	27	30	35	40	45	50
Riga Ply	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Form	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Mel		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Tex	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Smooth Mesh		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Rhomb		●	●	●	●	●	●	●	●	●	●			
Riga Foot		●	●	●	●	●	●	●	●	●	●			
Riga Heksa	●	●	●	●	●	●	●	●	●	●	●			
Riga Heksa Plus	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Trans			●	●	●	●	●	●	●	●	●			
Riga Paint		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Preprime		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Prime		●	●	●	●	●	●	●						
Riga Lacquer		●	●	●	●	●	●	●						
Riga Color		●	●	●	●	●	●	●						
Riga Decor		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga HPL		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Poliform			●	●	●	●	●	●	●	●	●	●	●	●
Riga Silent					●	●	●							
Riga Superwire		●	●	●	●	●	●	●	●	●	●			
Riga Frost		●	●	●	●	●	●	●	●	●	●			
Riga Dot		●	●	●	●	●	●	●	●	●	●			
Riga Diamond		●	●	●	●	●	●	●	●	●	●			
Riga Composite		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Timber		●	●	●	●	●	●	●	●	●	●			
Riga Shipply*			●	●	●	●	●	●	●	●	●	●	●	●
Riga Grip		●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Pattern+		●	●	●	●	●	●	●	●	●	●			

* For Riga Shipply 92 mm, 102 mm available.

Table 2.6. Nominal thickness

Nominal thickness, mm	4	6.5	9	12	15	18	21	24	27	30	35	40	45	50
Number of veneer layers	3	5	7	9	11	13	15	17	19	21	25	29	32	35
Minimum limit, mm	3.5	6.1	8.8	11.5	14.3	17.1	20.0	22.9	25.8	28.7	33.6	38.4	43.3	48.1
Maximum limit, mm	4.1	6.9	9.5	12.5	15.3	18.1	20.9	23.7	26.8	29.9	35.4	41.2	46.4	51.4

Thickness tolerances fulfil the requirements of EN 315.
Moisture content affects plywood dimensions; indicated sizes and thicknesses relate to a moisture content 9 ± 3%.

Other panel thicknesses are available upon request.

2.4.3. Birch plywood length and width

Plywood, cross grain, mm

1220 / 1250 x 2440 / 2500 / 2745 / 2750 / 3000 / 3050 / 3340 / 3660
1500 / 1525 x 2440 / 2500 / 2745 / 2750 / 3000 / 3050 / 3340 / 3660
1830 / 1850 x 3050 / 3340 / 3660 / 3850
2150 x 3050 / 3340 / 3850 / 4000
2290 x 4000

Plywood, long grain, mm

2440 / 2500 x 1220 / 1250
Dimensions may be different in different product and quality grade groups.

Table 2.7. Dimension tolerances

Parameter	Tolerance
Length, width (mm) <1000	±1 mm
1000 ... 2000	±2 mm
>2000	±3 mm
Squareness tolerance	1 mm/m
Edge straightness	1 mm/m

Size, squareness and thickness tolerances fulfil the requirements of EN 315.

2.5. Gluing

Riga Wood birch plywood is bonded with glue, consisting of three main components: resin, bio-based hardener and recycled wash water. The core component resin is available either as lignin-phenol-formaldehyde, phenol-formaldehyde or melamine-urea-formaldehyde (see Table 2.7). Birch plywood panels have excellent physical-mechanical strength properties and very low free formaldehyde emissions, significantly below indicated limit values. Chemicals used in production of Riga Wood plywood bonding glue meet the requirements of REACH registration and do not contain any substances in the REACH Annex for prohibited hazardous substances.

Bonding strength indicators are controlled daily by laboratories at the production sites. Testing methods, periodicity of control and statistical data processing are in accordance with requirements set by EN 13986.

Table 2.8. Glue types

	Description	Bonding quality
Lignin-phenol-formaldehyde resin based glue Riga ECOlogical	In Riga ECOlogical, the green bio-based renewable lignin is used as a replacement for traditional fossil products including phenol and formalin. Such gluing is resistant against environment, weather conditions, microorganisms, cold and hot water, steam and dry hot impact.	Weather and boil-proof complying to EN 314/Class 3 Exterior
Phenol-formaldehyde resin based glue	Such gluing is resistant against environment, weather conditions, microorganisms, cold and hot water, steam and dry hot impact.	Weather and boil-proof complying to EN 314/Class 3 Exterior
Modified melamine-urea-formaldehyde resin based glue	Such gluing is resistant against air humidity for several years. It is resistant against cold water, as well as warm water for a limited time. However, it does not pass the test of boiling water. The gluing is resistant against cold water, but does not resist microorganisms' influence. Suitable for further processing with laser cutting tools.	Moisture resistant complying to EN 314/Class 1 Interior

2.6. Machining

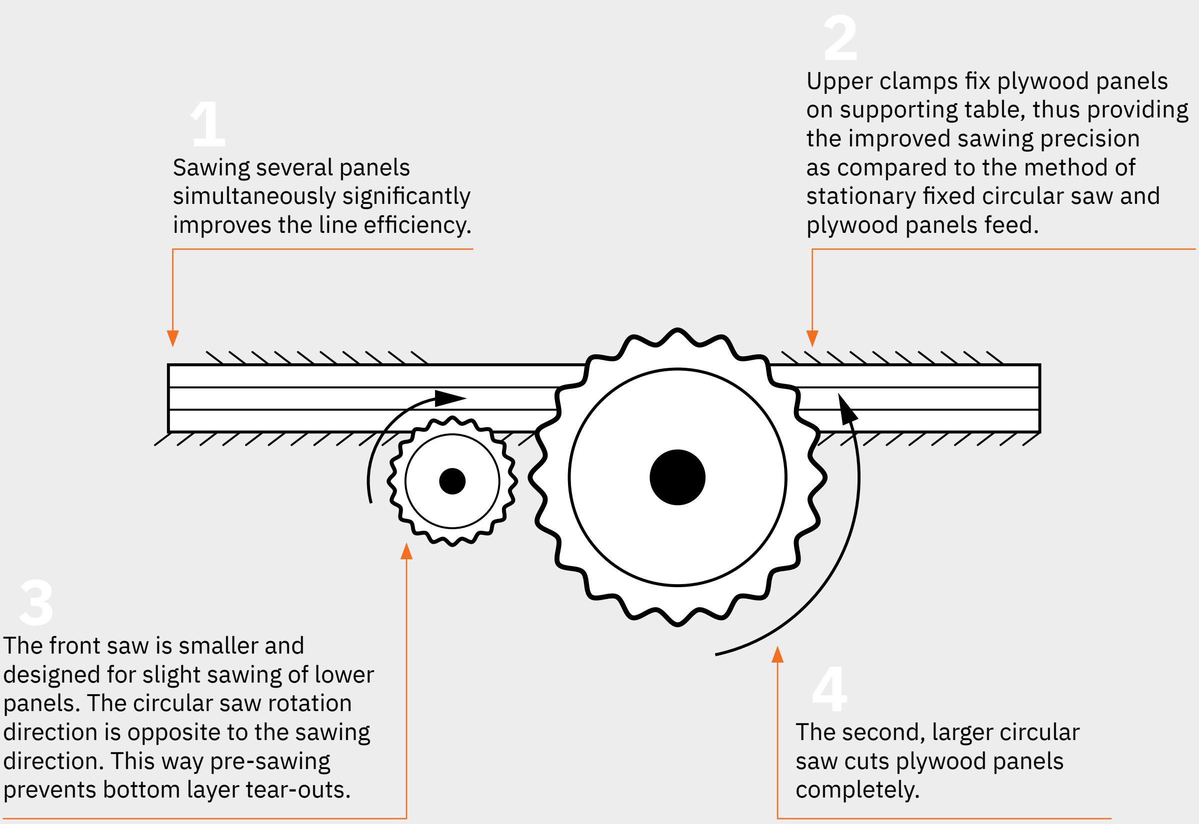
Riga Wood birch plywood has excellent machinability, due to its core quality, accurate thickness, and smooth surface. Consisting of several layers of veneer and glue, plywood is hard material, therefore use of appropriate woodworking tools is required. In case of specific coatings or composite materials, usage of special tools might be needed. When working with a new material for the first time, a trial with a small sample should be carried out. If needed, Riga Wood professionals or local representatives of cutting tool suppliers should be consulted.

Riga Wood plywood can be further processed according to one's needs and specification already at the mill: cut-to-size, CNC-machined, drilled, milled, jointed, edge machined, scarf jointed. All Riga Wood raw, coated and overlaid plywood can be CNC machined with high geometric accuracy.

Cutting-to-size

In addition to the wide range of standard sizes, plywood sheets can also be cut already at the mill to fit specific size requirements. When cutting plywood, it is recommended to first cut cross grain and then in the grain direction to avoid tearing of the upper veneer layer in the panel corners. Plywood must be machined both horizontally and level, with the upper side up. Using a double circular saw provides the cleanest cut, preventing chipping on both panel faces. A higher rotating blade speed and lower feed speed is recommended for the best result.

Figure 2.3. Plywood cutting scheme



The following sizes can be cut in Latvijas Finieris Group's mills

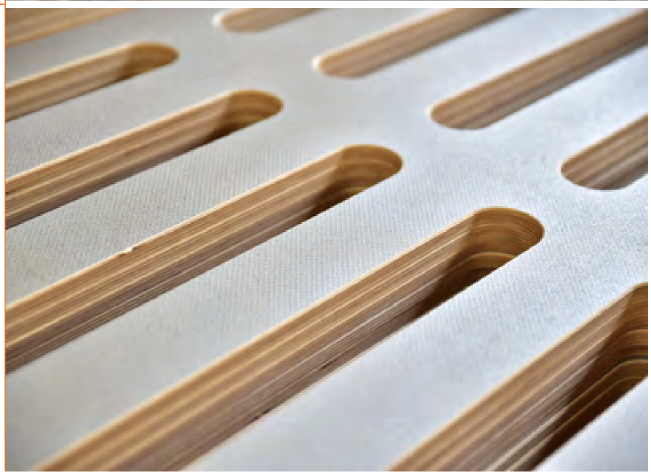
Size	Tolerances
Length: 100 – 4100 mm	Length and width: up to 500 mm ± 0.5 mm over 500 mm ± 1 mm
Width: 20 – 4000 mm	Squareness of elements: 1 mm/m
Thickness: up to 120 mm	Edge straightness: 1mm/m

Other sizes available upon request

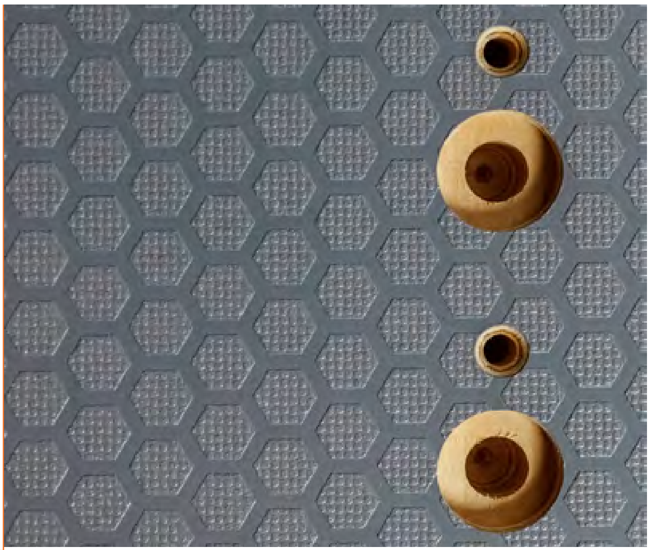
CNC machining

Plywood is easy to CNC machine, offering a clean and precise machining without damaging the surface. Using high quality core plywood prevents tear-outs and splintering. No difficulties should be experienced, if the correct material mounting, feed and speed rate are applied, aside from the common need to remove wood particles when working on larger projects. Plywood does not emit hazardous fumes during CNC machining, though common safety measures should be applied. To save time and manpower, Riga Wood plywood can be CNC machined in mills according to customers' specification in any required configuration and dimensions, including milling, drilling, perforating, and grooving.

Milling plywood is fast and extremely accurate. The main parameters affecting the quality are the spindle speed and feed rate. To avoid tearing and chipping, using high quality core plywood is recommended.



For drilling, the appropriate wood processing tools should be used with the panels placed face up and evenly supported to avoid splintering on the reverse face. Through, stopped, angled, overlapping and counter-sunk holes are possible in plywood.



For acoustic performance and sound insulation, CNC machined perforated and grooved acoustic panels are available.

The standard perforation distance and diameter are indicated in Table 2.9, however, tailored solutions with different values are possible.

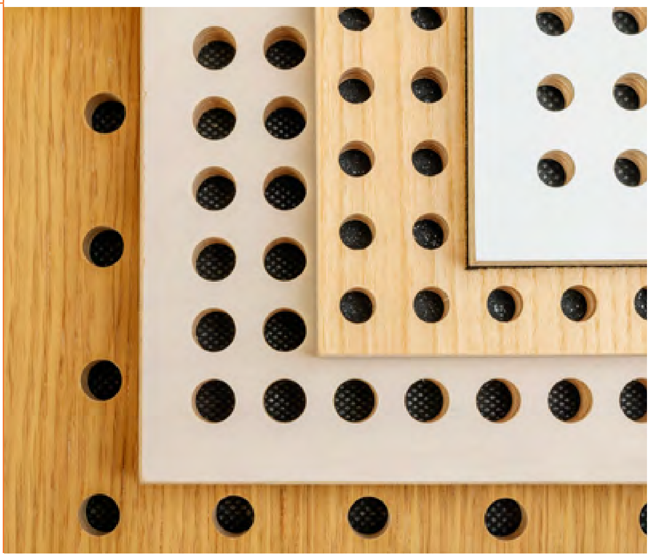


Table 2.9. Machining and treatment of perforated acoustic panels

Distance between drilling centres (mm)	Perforation diameter (mm)	Drillholes, %
16	5	8
	8	19
32	8	5
	10	8
	12	11

Acoustic panels are grooved with a distance of 16 mm and width 4 mm on the decorative face of panel, and with a distance of 16, 32 or 64 mm on the reverse face. However, tailored solutions with different values are possible.

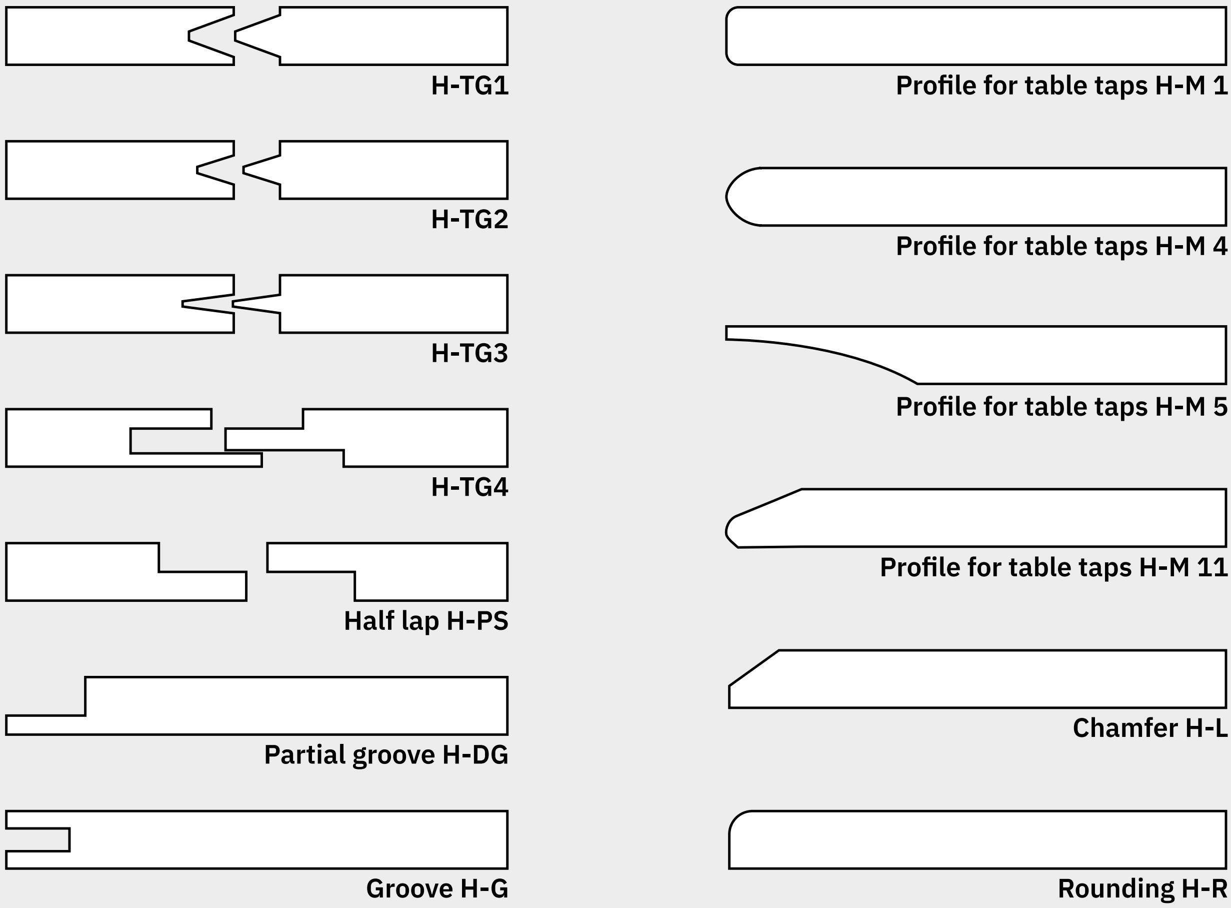
Edge machining

Edge-machined plywood will save manpower and manufacturing costs for the end-user, ensuring the highest quality panel machining for both uncoated and coated Riga Wood plywood products.

The following panels can be edge-machined in Latvijas Finieris Group's mills.

Size
Length: up to 4200 mm
Width: up to 3500 mm
Thickness: up to 50 mm
Tolerances
Length, width after machining (mm) <500 mm: ±0.5 mm
Length, width after machining (mm) >500 mm: ±1 mm
Difference of diagonals: 1 mm
To centre of tongue and groove from base line: 0.5 mm

Figure 2.4. Standard edge machining profiles



Edge sealing, other profiles and sizes, specific tolerances available upon request.

2.7. Overlays and coatings

Riga Wood has a wide range of sustainable products for applications where both functionality and specific finishing are needed. Riga Ply, Riga Paint, Riga Preprime or Riga Decor can be coated in many different ways, priming, varnishing, painting and staining included. Different overlays can be used to improve specific properties, for example, wear, moisture, scratch, surface impact resistance and visual appearance.

Coatings

Riga Ply is sanded on both faces, forming a smooth and durable surface, which is suitable for a variety of coatings:

- priming with UV hardening (UV) primer
- painting with CC-INT acid and solvent based colour or epoxy paint
- lacquering with acid catalysed solvent based (LC) coating, acrylic based polyurethane (LPU) or UV hardening (LUV) lacquering coating staining with water-based stains
- surface treatment with wood preservatives
- covered with lacquer and flame retardant coating system (FRC)
- covered with high-quality epoxy paint system coating with plastic shots (Riga Grip)

Sizes

- Length: up to 4000 mm
- Width: up to 1525 mm
- Thickness: 6.5 – 30 mm
- Available coatings may vary by sizes.

Overlays

- overlaying with phenol un melamine films on one or both faces
- veneering with rotary cut or sliced veneer of such wooden species as birch, beech, European ash, European oak and pine (Riga Decor), other species available on request
- overlaying with continuous-pressure laminates (CPL) and high-pressure laminates (HPL) (Riga HPL)
- overlaying with thermoplastic polyolefin (TPO), polypropylene (PPL) or aluminium (Riga Composite), cork (Riga Silent) and other materials
- overlaying with highly durable wood-plastic composite (WPC) material (Riga Poliform)

Sizes

- Length: up to 3660 mm
- Width: up to 1525 mm
- Thickness: up to 50 mm
- Available overlays may vary by sizes

2.8. Plywood application

Riga Wood birch plywood products are developed with a focus on quality and targeted applications, bearing in mind the specifics of each industry. Due to its technical properties, our birch plywood combines functionality with endurance and aesthetic visual appearance. By applying various overlays and processing techniques, its application options expand, allowing one to realise even the most ambitious of projects.

Heavy building

Strength and durability ease the construction process, helping to achieve qualitative results.

Light building

Functionality is combined with appealing visual appearance in indoor and outdoor solutions.

Road transport

From highly wear resistant floors of heavy trailers to customised interior solutions of trucks and vans.

Sea transport

Birch plywood maintains its strength and original dimensions even at extremely low temperatures, thereby meeting the needs of the technically demanding LNG tanker industry.

Rail transport

Effective sound insulation in passenger wagons and heavy duty performance in cargo wagons.

Air transport

Applicable for production of premium quality flight cases where functionality, resistance and light weight must be combined with aesthetics.

Packaging

From technical to elegant packaging solutions for multiple industries.

Wholesale & Distribution

The wide range of Riga Wood products and services enable our distribution partners to satisfy the most demanding requirements of their industrial and commercial customers.

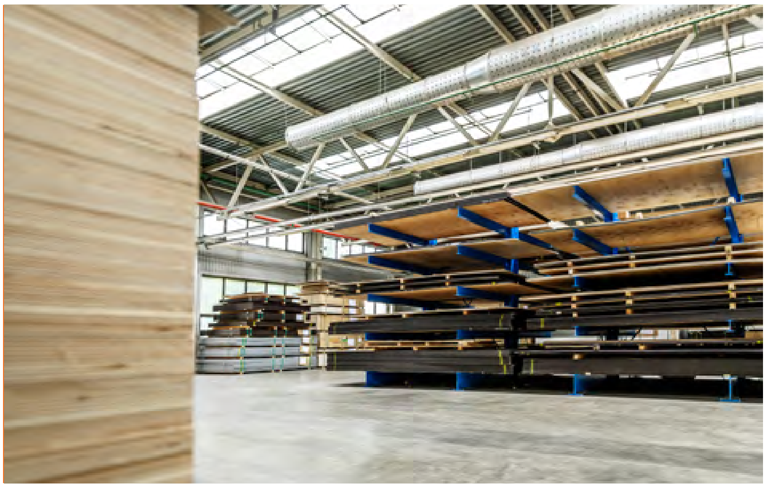


Table 2.10. Main plywood applications

Application	Riga Ply	Riga Form	Riga Poliform	Riga Mel	Riga Tex	Riga Smooth Mesh	Riga Rhomb, Riga Rhomb Heavy	Riga Heksa, Riga Heksa Plus	Riga Foot	Riga Trans, Riga Trans Heavy	Riga Superwire	Riga Diamond	Riga Timber	Riga Dot	Riga Frost	Riga Paint	Riga Preprime	Riga Prime	Riga Lacquer	Riga Color	Riga Decor	Riga Shipply	Riga Composite	Riga Silent	Riga HPL	Riga Grip	Riga Lacquer FR	Riga Pattern+
Heavy building																												
Formwork systems		X	X																						X			
Loose shuttering		X	X										X															
Precasting		X	X																									
Scaffolding		X			X			X	X																			
Light building																												
Decorative wall & Ceiling linings	X												X	X		X	X		X	X	X				X		X	X
High-end flooring	X					X									X													
Industrial wall & Ceiling linings		X		X		X																					X	
Joinery, furniture & Shopfittings	X			X		X	X	X	X		X	X	X	X	X	X	X		X	X	X		X		X			X
Outdoor solutions					X	X	X		X	X	X		X			X	X										X	
Panels for overlaying	X																	X									X	
Parquet	X																											
Stage systems & Industrial flooring					X	X	X	X	X	X	X	X	X	X	X			X								X		X

Application	Riga Ply	Riga Form	Riga Poliform	Riga Mel	Riga Tex	Riga Smooth Mesh	Riga Rhomb, Riga Rhomb Heavy	Riga Heksa, Riga Heksa Plus	Riga Foot	Riga Trans, Riga Trans Heavy	Riga Superwire	Riga Diamond	Riga Timber	Riga Dot	Riga Frost	Riga Paint	Riga Preprime	Riga Prime	Riga Lacquer	Riga Color	Riga Decor	Riga Shipply	Riga Composite	Riga Silent	Riga HPL	Riga Grip	Riga Lacquer FR	Riga Pattern+
Road transport																												
Buses		X					X	X	X		X	X							X					X			X	
Passenger cars	X					X					X	X	X		X				X				X		X		X	
Heavy commercial vehicles				X	X		X	X	X	X	X	X				X	X									X		
Light commercial vehicles	X	X		X			X	X	X		X	X	X		X	X	X						X		X		X	X
Heavy trailers				X					X	X						X	X						X			X		
Light trailers									X		X					X	X						X					
Reefer trailers	X																									X		
Speciality trailers				X	X					X	X							X					X			X		
Rail transport																												
Passenger wagons		X			X																		X	X			X	
Cargo wagons		X			X					X														X				
Sea transport																												
Cargo ships				X																						X		
Containers					X					X												X				X		
LNG tankers																						X						
Yachts & Boats				X	X											X	X						X	X				
Air transport																												
Specific air solutions						X		X																				
Packaging																												
Die boards	X	X																X	X									
High-end packaging	X											X		X	X			X										X

2.9. Key advantages of birch plywood

High performance Riga Wood birch plywood stands out as one of the most durable and environmentally friendly materials with excellent strength-to-weight ratio and stability, with a wide range of application options, for example concrete shuttering, transportation, flooring, interior fittings, die-cutting, farming and many other industries. Even more, our birch plywood products meet requirements of such technically demanding industries like liquid natural gas (LNG) tanker building. Easy processing, various overlay options and special treatments compliment the excellence of birch wood itself.

Technical advantages
Excellent strength-to-weight ratio
Strength, durability and high impact resistance
Dimensional stability and high bending strength
Warping and bowing resistance
Good machining properties
Multiple options of size, overlays, shape, special construction and treatment
Functional and decorative design
Resistance of commonly used chemicals
Easy to clean, multiple uses

Environmental advantages
Long life span, recyclable and reusable
Made of renewable resources
Raw material sourcing fully traceable
Raw material from sustainably managed forests
100% use of by-products / side streams
Low emission of volatile organic compounds (VOC)
Bonding with green adhesive Riga ECOlogical
Perfect fit for sustainable building concept

3. Characteristics of products

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3.1. Moisture properties

The average moisture content of plywood after production is from 6% to 10% according to EN 322 Wood-based panels – Determination of moisture content. Due to the fact that wood is a hygroscopic material, the level of the moisture content of plywood directly depends on ambient temperature and relative air humidity. The level of moisture content may vary during transportation and storage.

While storage at an ambient temperature of 20 °C and relative humidity of 65%, the plywood moisture content is 9 ±3%. Moisture content change will result in plywood dimension variations (for details see Chapter 5.4).

3.2. Density

Wood density depends on several factors, for example, timber growing conditions, sapwood or core wood, etc. Plywood density is at least 15% higher than the density of the raw wood material used for it.

Plywood density depends not only on the density of wood used for production but also on pressing level, moisture content, and other factors.

The density of birch plywood produced by Latvijas Finieris Group is within the limits of 670 kg/m³ to 760 kg/m³ at an air temperature of 20 °C and relative humidity of 65% according to EN 323 Wood-based panels – Determination of density.

3.3. Thermal properties

Thermal properties of wood-based panels include thermal conduction, expansion, combustion and temperature influence on mechanical properties. Thermal properties depend on density, moisture content and grain direction.

Plywood has good thermal insulation properties, especially in the direction perpendicular to the plane of the board but its thermal conductivity is affected by relative humidity and moisture content. As the relative humidity increases, its moisture content and thermal conductivity increase as well. According to standard EN 13986, thermal conductivity (λ) for plywood with density 700 kg/m³ is 0.17 W/(m · K).

Due to the loss of moisture under heat, plywood thermal expansion is offset by shrinkage, therefore net dimensional changes will be negative. Nevertheless, the changes are quite small and can be ignored in case of considerable swelling and shrinking. Thermal expansion may be important only where plywood is used in assemblies with other materials.

Plywood will burn exposed to extreme heat. Its self-ignition temperature is around 270 °C while at temperatures of 400 °C and more spontaneous combustion will occur.

Plywood is widely used as an insulation material in transport ships carrying liquefied natural gas (LNG). It has been experimentally proven that plywood does not significantly lose its mechanical strength in the temperature range from −163 °C to 100 °C.

3.4. Reaction to fire

The class of reaction to fire performance of wood based panels could be determined either:

- without further testing if the board meets the requirements of a class given in Decision of the Commission 2007/348/EC as presented in Table 3.1.
- or as presented in Table 3.2 based on testing of the panel according to the relevant test methods, given in standards referred to in EN 13501-1 when a higher classification than (1) is sought or if the panel does not meet the requirements of Table 3.1.

Table 3.1. Classes of reaction to fire performance for plywood

End use condition (6)	Minimum density, kg/m³	Minimum thickness, mm	Class (7) (excluding flooring)	Class (8) (flooring)
without an air gap behind the panel (1), (2), (5)	400	9	D-s2, d0	Dfl-s1
with a closed or an open air gap not more than 22 mm behind the panel (3), (5)	400	9	D-s2, d2	_
with a closed air gap behind the panel (4), (5)	400	15	D-s2, d1	Dfl-s1
with an open air gap behind the panel (4), (5)	400	18	D-s2, d0	Dfl-s1
any (5)	400	3	E	Efl

(1) Mounted without an air gap directly against class A1 or A2-s1, d0 products with minimum density 10 kg/m³ or at least class D-s2, d2 products with minimum density 400 kg/m³.

(2) A substrate of cellulose insulation material of at least class E may be included if mounted directly against the wood-based panel, but not for floorings.

(3) Mounted with an air gap behind. The reverse face of the cavity shall be at least class A2-s1, d0 products with minimum density 10 kg/m³.

(4) Mounted with an air gap behind. The reverse face of the cavity shall be at least class D-s2, d2 products with minimum density 400 kg/m³.

(5) Veneered, phenol- and melamine-faced panels are included for class excl. floorings.

(6) A vapour barrier with a thickness up to 0.4 mm and a mass up to 200 g/m² can be mounted in between the wood-based panel and a substrate if there are no air gaps in between.

(7) Class as provided for in Table 1 of the Annex to Decision 2000/147/EC.

(8) Class as provided for in Table 2 of the Annex to Decision 2000/147/EC

Table 3.2. Classes of reaction to fire for Riga Wood plywood according to EN 13501-1

Product	Thickness range, mm	End use conditions	Class (excluding flooring)	Class (flooring)
Riga Lacquer LC	≥9	Without air gap to a substrate of any A1 or A2-s1 having a density ≥525 kg/m³	D-s1, d0	-
Riga Lacquer LPU-INT	≥9		D-s1, d0	-
Riga Lacquer LUV	≥9		D-s1, d0	-
Riga Prime PUV2-INT	≥9		D-s1, d0	-
Riga Prime PUV3-INT	≥9		D-s1, d0	-
Riga Lacquer FR	9 - 15		B-s1, d0	-
Riga Lacquer FR	18 - 30	With and without ventilated or non-ventilated air gap to a substrate of any A1 or A2-s1, d0 and with the air gap constructed by wooden battens of class D-s2, d0 or better or any A1 or A2-s1, d0 product with a minimum density 525 kg/m³	B-s1, d0	-
Riga Tex dark brown 120 g/m²	15 - 40	Mounting without substrate directly on metal profiles	-	Cfl-s1
Riga Tex dark brown 220 g/m²	12 - 30	Mounting on substrates of reaction to fire class A1 or A2-s1, d0 or without substrates	-	Cfl-s1
Riga Heksa Plus dark brown 220 g/m²	12 - 30		-	Cfl-s1
Riga Tex multigrey 190 & 358 g/m²	9 - 30		-	Bfl-s1
Riga Heksa Plus multigrey 358 g/m²	9 - 30		-	Bfl-s1
Riga Heksa Plus silver grey 220 g/m²	15 - 30	Mounting on wood based substrates at least 18 mm thick or substrates of Euroclass A1fl or A2fl at least 6 mm thick, having a density ≥ 510 kg/m3 Mounting with an air gap	-	Bfl-s1

3.4.1. Compliance to other fire safety requirements

According to the Regulation No 118 of the Economic Commission for Europe of the United Nations (UN/ECE), Riga Heksa Plus silver grey 220 g/m2 fulfils the requirements of paragraph 6.2.2 and is suitable for interior installation in a horizontal position in a vehicle of category M3.

Riga Ply (thickness 5 mm and 9 mm) and Riga Tex (12 mm) meet fire requirements S4.3 according to FMVSS 302. Burn rate is below 102 mm/min. Flaming stops in 50 seconds from the start and burn is not more than 1 mm.

Table 3.3. NF P 92-501: Safety against fire: Building materials – Reaction to fire tests. Used for rigid material or flexible materials thicker than 5 mm. French Standard.

Product	Thickness range, mm	Class	Application
Riga Ply Riga Form dark brown 120 g/m² Riga Tex dark brown 120 g/m²	6.5 – 18	M3	AM 9 – textured decoration elements AM 14 – sliding partitions AM 15 and 16 – large furniture and main layout AM 18 – seat (structure)/train

Table 3.4. EN 45545-2: Fire protection of railway vehicles – Part 2: Requirement for fire behaviour of materials and components R10).

Product	Thickness, mm	Class	Application
Riga Tex dark brown 220 g/m²	12, 15, 18	HL1, HL2, HL3	Comply with the requirements of R10 floor composites
Riga Form dark brown 220 g/m²	16, 18		
Riga Tex multigrey 190 g/m²	12, 15		
Riga Silent W/F dark brown 120 g/m², ACM 15 (3 mm)	15		
Riga Rhomb dark brown 220 g/m²	18		
Riga Heksa Plus dark brown 220 g/m²	18		
Riga Foot dark brown 220 g/m²	18		
Riga Diamond dark brown 220 g/m²	18		
Riga Superwire dark brown 220 g/m²	18		

3.5. Biological durability

In EN 350-2, guidance is given on the durability of solid wood to degradation by a range of organisms:

wood-destroying fungi, dry wood destroying fungi, termites and marine organisms. In the classification of natural durability to wood-destroying fungi, five class systems are used:

- 1 – very durable; 2 durable; 3 – moderately durable; 4 - slightly durable; 5 – not durable.
- In accordance with EN 350-2 birch wood (Betula pubescens Ehrh., Betula pendula Roth), stability against the influence of fungi meets the 5th Class of natural durability (not durable).

- Plywood biological durability assessment guidance is given in CEN/TS 1099 (see table 2.8). The natural durability of solid timber (EN 350-2) and other factors specific for plywood are taken into account (CEN/TS 1009 Annex A):
  - Wood species;
  - Sapwood and heartwood;
  - Thickness of plies;
  - Adhesive content;
  - Preservative treatment.

Table 3.5. Guidance on the application of natural durability classes of wood species to plywood used in various use classes

Use class for plywood[b]	Durability class of wood species used in the plies[a]				
	1	**2**	**3**	**4**	**5**
1	O	O	O	O	O
2	O	O	O	(O)	(O)
3	O	O	(O)	(X)	(X)
4	O	(O)	(X)	X	X
5	O	(X)	(X)	X	X

[a] Sapwood of all species is regarded as belonging to durability class 5

[b] The use of plywood is only recommended in use class 4 and class 5 if adequately modified (see EN 335-3, Annex and product standards)

Key

O natural durability sufficient

(O) natural durability is normally sufficient but, in certain end uses, treatment can be advisable (see EN 460, Annex A)

X preservative treatment necessary

(X) preservative treatment is normally advisable but, in certain end uses, natural durability can be sufficient (see EN 460, Annex A)

As plywood produced by Latvijas Finieris Group is made of ≤1.5 mm thick veneers, durability against various insects, termites and marine organisms shall be assessed as:

- durable against Hylotrupes bajulus (DH_y), Anobium punctatum (D_A), Lyctus brunneus (D_L);
- susceptible to termites (S_T);
- susceptible to marine organisms (S_{Ma}).

The five use classes are defined in EN 335:

- UC 1 – interior, dry;
- UC 2 – interior, or under cover, not exposed to weather. Possibility of water condensation;
- UC 3 – exterior, above ground, exposed to the weather (3.1 – limited wetting conditions; 3.2 – prolonged wetting conditions);
- UC 4 – exterior in ground contact and/or fresh water;
- UC 5 – permanently or regularly submerged in salt water.

Plywood should be selected according to its relevant use classes defined in EN 335 or service classes defined in EN 1995-1; both systems are based on different criteria for classification. The comparison is given in the table below (EN 335 Annex A).

Table 3.6. Service classes and their possible corresponding use classes

Service class according to EN 1995-1-1	Possible corresponding use class according to EN 335
Service class 1	Use class 1
Service class 2	Use class 1 Use class 2 if the component is in a situation where it could be subjected to occasional wetting caused by e.g., condensation
Service class 3	Use class 2 Use class 3 or higher if used externally

The guide to the durability requirements for wood and wood-based products to be used in different hazard classes is given in EN 460.

3.6. Compliance to REACH

AS Latvijas Finieris meets all the requirements of the REACH Regulation. Riga Wood birch plywood does not contain SVHC listed on the REACH candidate list for authorisation exceeding concentration 0.1 % by weight.

3.7. Emission of free formaldehyde

Formaldehyde. What is it?

At room temperature, formaldehyde is a colourless gas with a pungent odour. It is a fairly simple organic compound composed of carbon, hydrogen and oxygen. Formaldehyde is a naturally occurring organic substance present in foodstuffs and the environment, including humans. Formaldehyde is biodegradable; it breaks down in air within a few hours by sunlight or by organisms present in water and soil. Due to its properties, formaldehyde is an important chemical widely used by industry to manufacture building materials and numerous household products from cleaners up to medicines and cosmetics.

Formaldehyde is a natural trace element of plant tissues. Hence all wood products emit a small amount of formaldehyde.

Why is formaldehyde used for plywood manufacturing?

For a long time, formaldehyde has been widely used in production of urea-formaldehyde, phenol, and melamine resins. These resins are commonly used in adhesives such as those used in plywood. Based on its chemical reactivity, formaldehyde is an ideal component for adhesives. It forms a strong, resistant, and cost-effective bond.

The formaldehyde emissions of modern wood-based panels vary between very small values just above the values of natural wood particles, if bonded with lignin-phenol-formaldehyde resins or diisocyanate adhesives, and values in the range of emission class E1 and above, if bonded with urea-formaldehyde resins. The formaldehyde emissions by urea-formaldehyde resins can be significantly reduced through enforcement with melamine.

Free formaldehyde emissions from Riga Wood plywood. Conformity certificates.

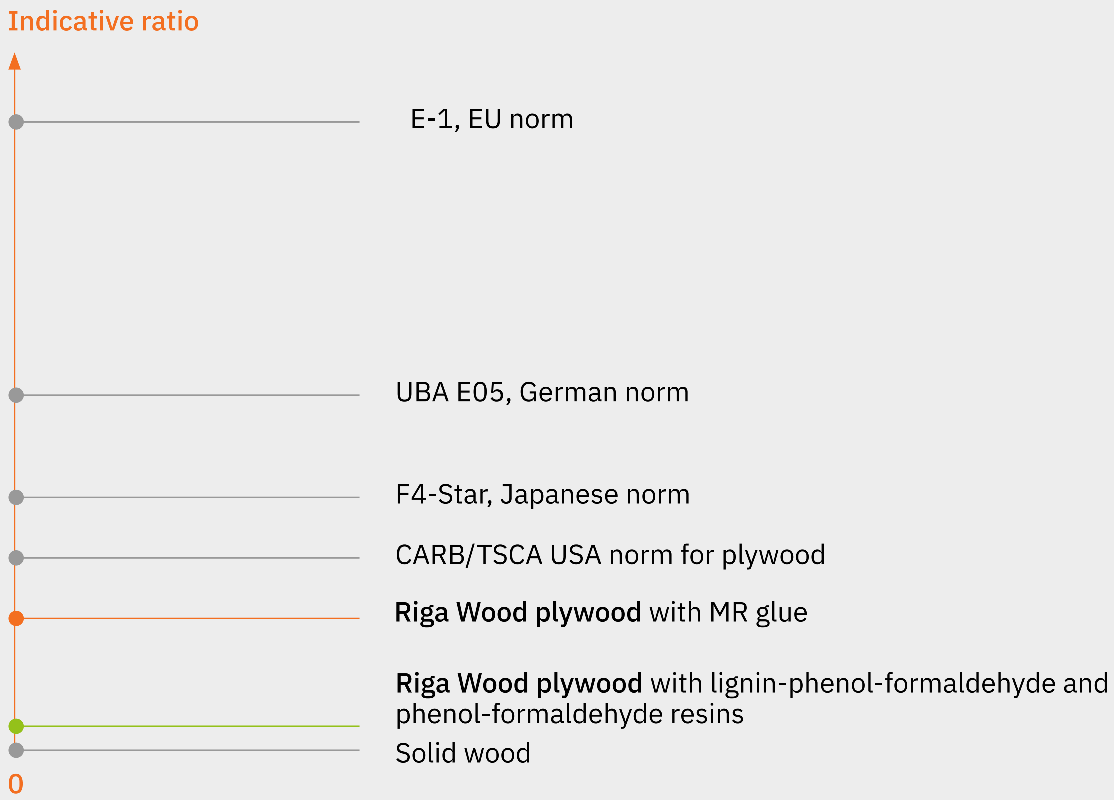
Free formaldehyde emissions from Riga Wood plywood comply with E1 according to EN 13986, CARB Phase 2 and EPA TSCA Title VI.

This is proved by results gained during both long-term control in the laboratory of the enterprise, and periodical tests made by independent institutions – Fraunhofer Wilhelm-Klauditz-Institute WKI and Institut Entwicklungs- und Prüflabor Holztechnologie GmbH EPH.

Riga Wood plywood bonded with lignin-phenol-formaldehyde, phenol-formaldehyde and melamine-urea- formaldehyde resins are certified as complying to CARB Phase 2 and EPA TSCA Title VI. This demonstrate that free formaldehyde emissions from the certified products are constantly below the CARB Phase 2 and EPA standards (see Figure 3.1.).

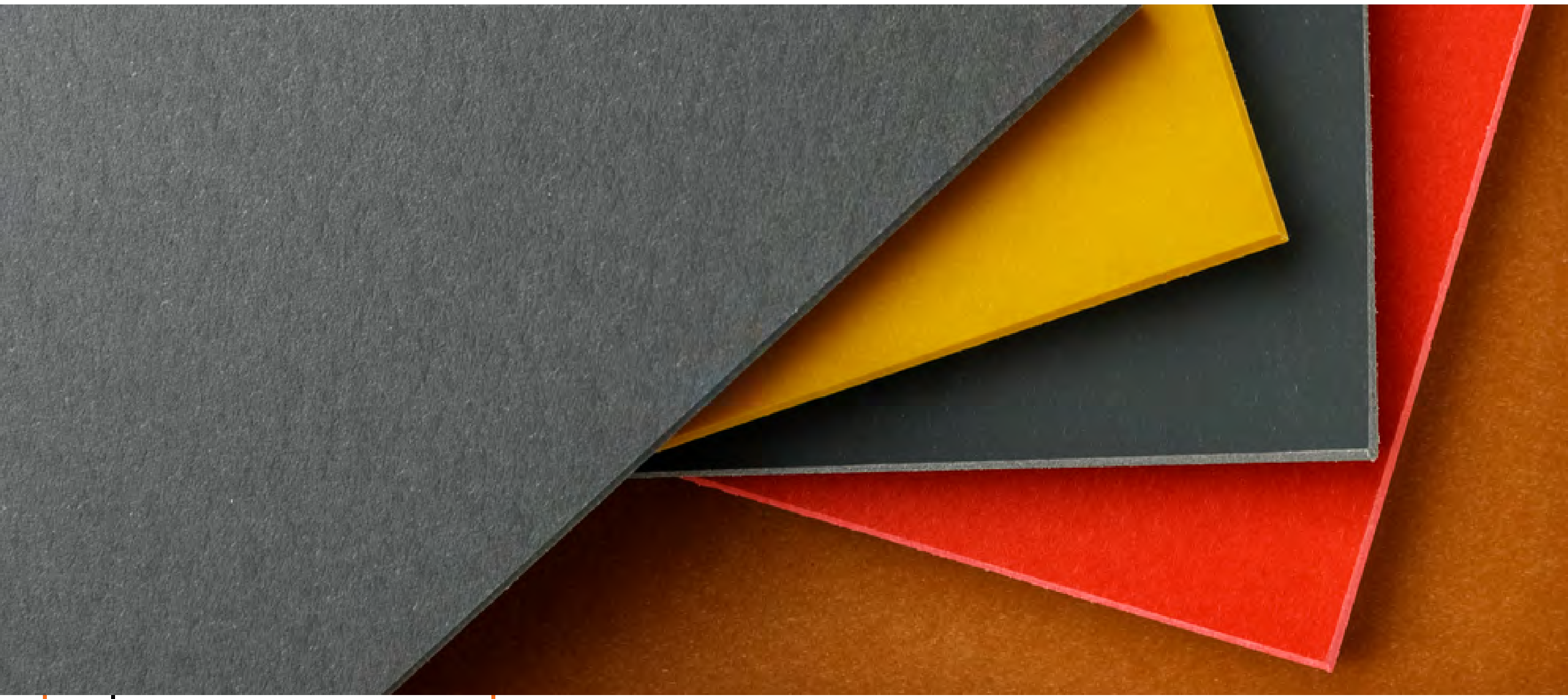
The laboratory of the enterprise is attested and supervised to perform free formaldehyde emission tests according to European E1, California CARB Phase 2 and US EPA TSCA Title VI requirements.

Figure 3.1. Formaldehyde emissions, indicative ratio



3.8. Content of pentachlorophenol (PCP)

European Standard EN 13986 sets that performance of PCP shall be tested only for panels made of recycled material that contain PCP. Content of PCP in wood-based panels shall be below 5 ppm. Riga Wood Plywood does not contain raw materials that include PCP.



3.9. Sound insulation

Riga Wood plywood sound properties and acoustic performance can be significantly improved either by using composite materials or further processing of the panel:

- Riga Silent is a composite panel with sound reduction cork/rubber material core, designed to provide sound insulation and absorb vibrations. Airborne sound insulation according to EN ISO 717, reaches 31 dB (100-5000 Hz) and higher. The sound insulation performance may vary depending on the thickness and construction of the plywood.
- Riga Wood Acoustic panels are mechanically processed by grooving or making perforations to absorb noise and echo. More information and testing results are available in the Acoustic panel leaflet.

3.10. Overlaid plywood

3.9.1. Friction

The friction tests (anti-slip properties) are determined according to the DIN 51131 method. The test platform of 5 kg is pulled on the sample within 800 mm paths; under the platform, three SBR rubbers with the dimensions 10x25 mm and hardness 49±2 according to the Shore hardness scale are glued, and the force resisting the motion is recorded. Results are determined as dynamic friction force and coefficient of friction. The dynamic friction force and coefficient of friction are calculated as an average force and coefficient within the testing (measurement) path (from 200 – 700 mm).

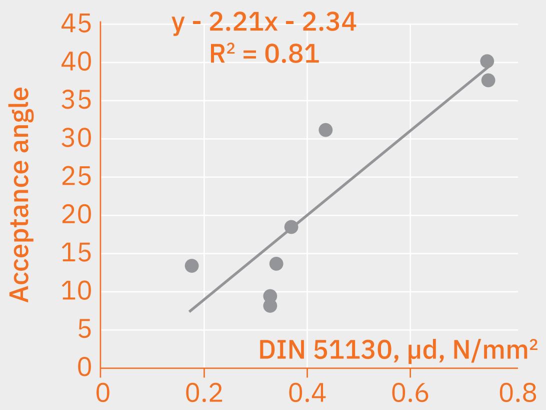
Friction values of birch plywood covered with 10W30 oil are shown in Table 3.7.

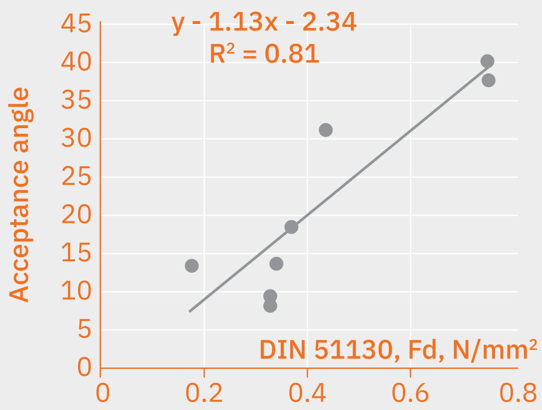
Table 3.7. Friction of overlaid plywood

Product	Coefficient of friction	Dynamic friction force, N/mm²
Riga Form	0.28	14.0
Riga Foot	0.17	8.5
Riga Heksa	0.32	15.9
Riga Heksa Plus	0.37	18.0
Riga Rhomb	0.34	16.6
Riga Trans	0.16	8.0
Riga Trans Heavy	0.24	11.8
Riga Tex W 120 g	0.29	14.4
Riga Tex W 220 g	0.75	36.6
Riga Tex WL 120 g	0.32	15.9
Riga Tex WL 220 g	0.43	21.2

The correlation between DIN 51131 and the ramp test acceptance angle is shown on Figure 3.2.

Figure 3.2. Correlation between DIN 51131 and ramp test





Latvijas Finieris Group does not publish any general uncommented sliding friction coefficients. The sliding friction coefficient of a friction-increasing surface depends on the combination of materials involved, the temperature, the condition of the material surfaces and the anti-slip mat (soiling, moisture, etc.). The contact surfaces of the load and floor must be swept clean, grease-free and dry in order to achieve optimum anti-slip properties.

Capability of anti-slip property flooring surfaces to prevent slipping.

This is determined in accordance with EN 16165 Annex B, DIN 51130 and ASR A1.5/1,2. In accordance with this method the anti-slip property is described as the angle at which a person slips when moving forwards and backwards over the tested surface. The tested material and footwear sole are slightly oiled with 10W30 oil. The anti-slip group is defined according to the average accepted angle.

Table 3.8. Anti-slip property evaluation groups

Average acceptance angle	Anti-slip property evaluation group
From 10° to 19°	R 10
From 19° to 27°	R 11
From 27° to 35°	R 12
Above 35°	R 13

Table 3.9. Anti-slip property evaluation

Product	Anti-slip property evaluation group
Riga Grip	R10
Riga Foot	R12
Riga Tex	R13
Riga Heks	R 9
Riga Heksa Plus	R10 – R12*
Riga Trans	R13
Riga Trans Heavy	R13
Riga Rhomb	R12
Riga Smooth Mesh	R9
Riga Frost	R9
Riga Timber	R9

*evaluation group varies among the film types

3.9.2. Wear resistance of overlaid plywood

The method for determining the wear resistance of overlays is described by EN 438-2 Decorative high-pressure laminates (HPL) - Sheets based on thermosetting resins – Part 2: Determination of properties.

Loaded rollers act on the rotating sample; the rollers are coated with sandpaper, simulating actual operation loads. The degree of wear is evaluated visually and the result is expressed in revolutions (Taber unit).

Wear resistance varies according to testing conditions, such as ambient temperature and relative moisture content. Therefore, it is more relevant to provide a resistance class, instead of definite values.

Wear resistance classes of plywood products manufactured by Latvijas Finieris Group are presented in Tables 3.11 to 3.13.

Figure 3.3. Wear resistance of Riga Form plywood

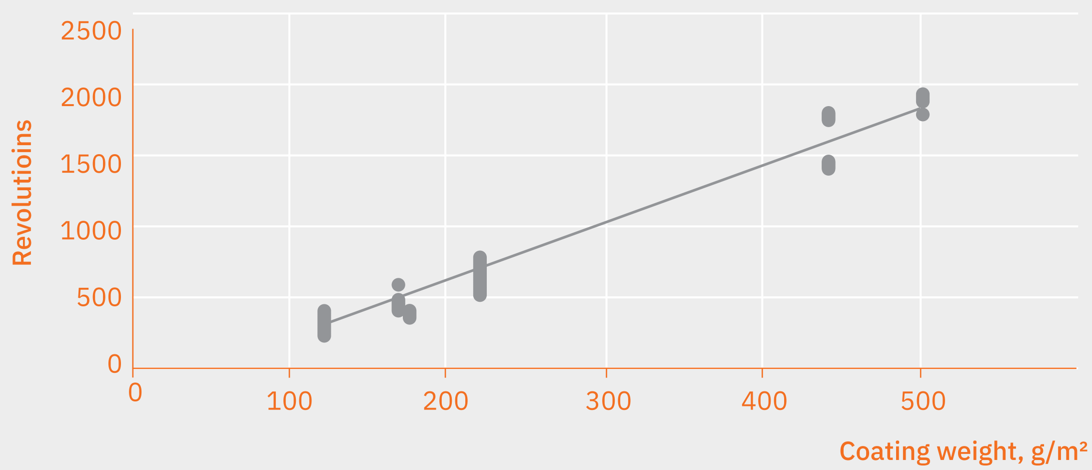


Table 3.10. Wear resistance classes of overlaid plywood products

Class	1	2	3	4	5	6	7	8	9	10	11
From revolutions	0	26	100	250	400	600	900	1500	2500	5000	10000
To revolutions	25	99	249	399	599	899	1499	2499	4999	9999	...

To increase the wear resistance of plywood overlay, it is possible to apply overlays of several film layers or special films with improved wear resistance. For all overlaid products it is possible to determine the overlay wear resistance, wear resistance of pattern, and upper layer wear resistance (in cases where the overlay consists of several film layers e.g., of different colours).

Table 3.11. Wear resistance classes of overlaid plywood products

Film weight, g/m²	Number of coating layers, pcs.	Total weight, g/m²	Riga Form	Riga Tex, Small mesh	Riga Tex, Large mesh	Riga Smooth Mesh, Small mesh	Riga Smooth Mesh, Large mesh
120	1	120	4	4	4	4	4
167	1	167	4	5	5	5	4
174	1	174	5	5	5	5	4
220	1	220	6	6	5	6	5
174	2	348	7		7		7
220	2	440	8	8	8		
174	3	522	8		8		
220	3	660		9	9	8	8
220	4	880			9	9	9

Table 3.12. Wear resistance classes of overlays with improved wear resistance film

Product	Overlay weight, g/m²			
	130	260	350	390
Riga Form	9			
Riga Tex, Small mesh	9		10	
Riga Tex, Large mesh	9	11	10	11

Table 3.13. Wear resistance classes of special pattern plywood products

Product	Overlay colour	Wear resistance class
Riga Foot	Silver grey	7
	Dark brown, green	6
Riga Foot Heavy	Dark brown	11
Riga Heksa	Dark brown, grey, black	8
Riga Heksa Heavy	Dark brown	11
Riga Rhomb	Dark brown	6
	Silver grey	7
Riga Rhomb Heavy	Dark brown	10
Riga Heksa Plus	Dark brown	5
	Silver grey	7
	Green	6
Riga Heksa Plus Heavy	Dark brown	10
Riga Trans	Dark brown	7
Riga Trans Heavy	Dark brown	9

3.9.3. The effect of loaded heavy duty castors on overlaid plywood

Testing method described by EN 1818 Resilient floor coverings - Determination of the effect of loaded heavy duty castors is used to test the effect of a loaded swivel castor on overlaid plywood. The aim of this Rolling test is to simulate the effect caused by a loaded swivel castor on plywood overlay material (laminate). The testing device is shown in Figure 3.4.

A 300 kg loaded swivel castor travels over the overlaid material (width of the castor 40 ± 1 mm and diameter 115 ± 5 mm). The castor moves backwards and forwards until the plywood overlay is damaged. Splits and cracks appear on the overlay surface. Results are registered as the number of cycles till the occurrence of damage in the material. Results are shown in Table 3.14 and 3.15.

Figure 3.4. Determination of the effect of loaded heavy duty castors

Table 3.14. Resistance of overlaid plywood

Product	Number of cycles
Riga Trans	> 6000
Riga Rhomb	> 10000
Riga Heksa	> 10000
Riga Heksa Plus	> 10000

Table 3.15. Resistance of Riga Tex

Film weight, g/m^2	Type of mesh	Number of cycles
120	Small	> 6000
130	Small	> 9000
167	Small	> 7000
220	Small	> 8000

3.9.4. Chemical stability of overlaid plywood

Tests are made in accordance with EN 438-2 Decorative high-pressure laminates – Sheets based on thermosetting resins – Part 2: Determination of properties (ISO 4586 – 2:1988 Modified).

The following reagents are used for testing: acetone, coffee, sodium hydroxide (25%), hydrogen peroxide (30%), shoe polish, and citric acid (10%). The results are presented in Table 3.14.

The following finished and overlaid plywood is tested: Riga Tex, Riga HPL, Riga Mel, Riga Prime, Riga Form. Each reagent is kept in contact with the sample surface for 24 hours.

Grades of surface stability tests are as follows:

- Grade 5: no visible alterations.
- Grade 4: minor gloss/colour alterations visible at a certain angle of view.
- Grade 3: moderate gloss or colour alterations.
- Grade 2: significant gloss and/or colour alterations.
- Grade 1: damage to surface and/or bubbling.

Table 3.16. Results of chemical stability tests

Product	Agent						
	Acetone, grade	Coffee, grade	Sodium hydroxide (25%), grade	Hydrogen peroxide (30%), grade	Shoe polish, grade	Citric acid (10%), grade	Red wine, grade
Riga Form	4	5	2	5	2	5	5
Riga Tex	5	5	2	4	2	5	5
Riga Prime	5	5	1	5	1	5	5
Riga Mel	4	5	4	4	3	5	5
Riga HPL	4	5	5	5	1	5	5

3.11. Production quality control

Latvijas Finieris Group ensures and guarantees the stable quality of its products and services, improving the competitiveness of the products by precisely defining the production processes, including testing, control and inspection systems.

There are laboratories at each mill; their task is to observe the production processes, product quality and to develop new products and technology. Laboratories are equipped with sophisticated technical equipment for the inspection of production processes and testing the physical-mechanical properties of the product. The type, performance and frequency of the factory production control correspond to the requirements of standards EN 13986 and EN 326-2.

Conformity assessment of factory production control was performed, and certificates were issued by Fraunhofer Wilhelm Klauditz Institut, EU notification 0765, and Eurofins Expert Services Oy, EU notification 0809.

Plywood Riga Ply bonding quality data according to factory production control are presented in Table 3.17. The test was performed according to EN 314-1.

Riga Ply (sanded) bending strength and stiffness (modulus of elasticity) values correspond to the lower 5% quantile and average values determined according to EN 310 test method and calculated according to EN 326-1, plywood moisture content 8 ± 2% are presented in Table 3.18 and 3.19.

Table 3.17. Riga Ply plywood bonding quality according to factory production controls

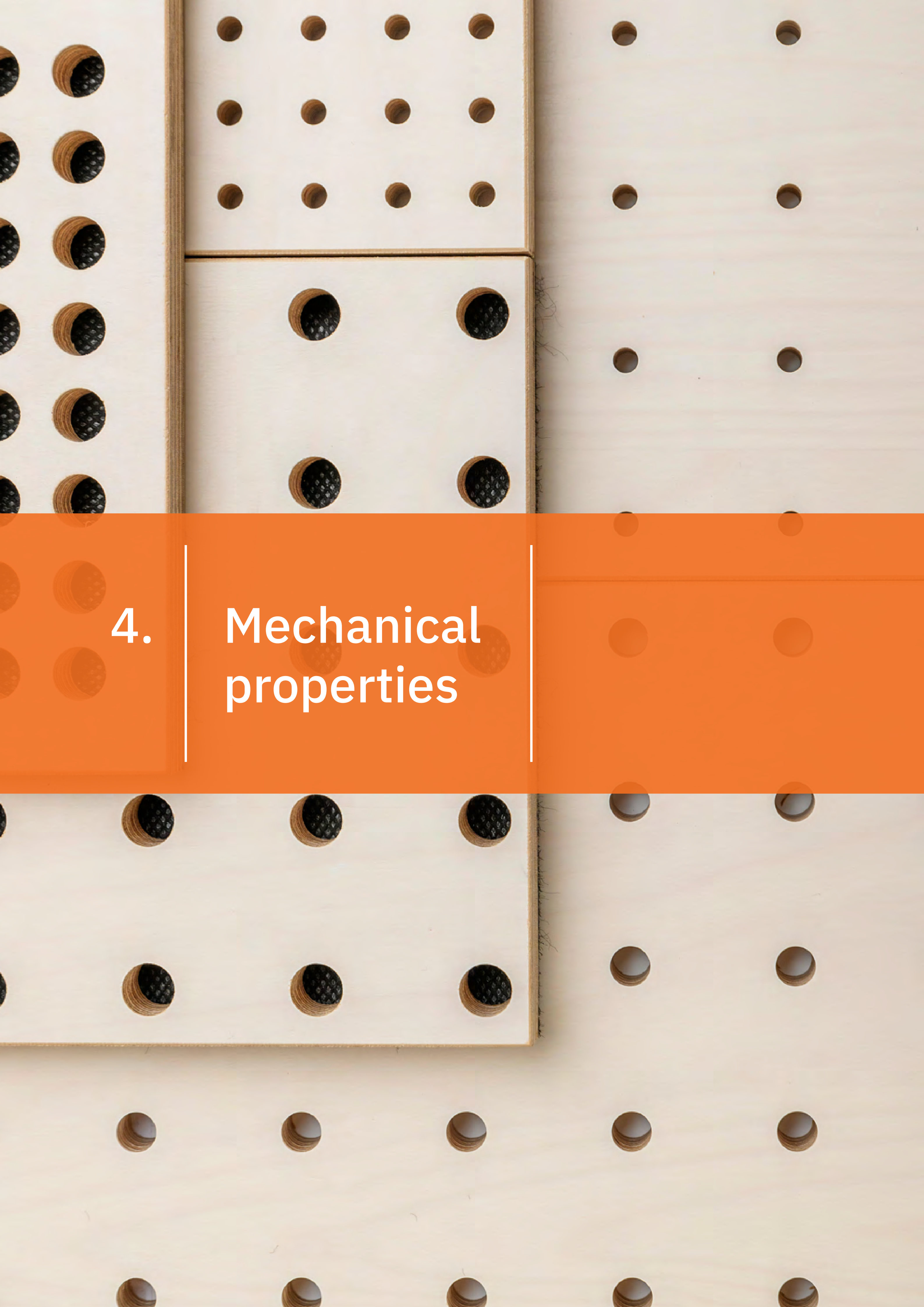
Pretreatments according to EN 314-1	Average failing force, N/mm²	Lower 5% quantile, N/mm²	Average cohesive wood failure percentage
Immersion for 24 h in water at 20 ±3 °C	2.53	1.81	59.1
Immersion for 4 h in boiling water, then drying in the ventilated drying oven for 16 to 20 hours at 60 ±3 °C, then immersion in boiling water for 4 hours, followed by cooling in water at 20 ±3 °C for at least 1 h	2.07	1.47	60.4
Immersion for 72 ±1 h in boiling water, followed by cooling in water at 20 ±3 °C for at least 1 h	1.92	1.32	66.4

Table 3.18. Riga Ply plywood lower 5% quantile values of bending strength and stiffness according to factory production controls

Nominal thickness, mm	Along the face grain				Perpendicular the face grain			
	Strength		Modulus of elasticity		Strength		Modulus of elasticity	
	N/mm²	Class	N/mm²	Class	N/mm²	Class	N/mm²	Class
4	85.2	F 50	10486	E 100	23.8	F 15	1052	E 10
6.5	80.1	F 50	8831	E 90	42.9	F 25	2873	E 30
9	74.4	F 40	8323	E 90	54.7	F 35	4446	E 40
12	70.6	F 40	7886	E 80	53	F 35	4782	E 50
15	66.5	F 40	7776	E 80	53.4	F 35	5400	E 60
18	61.7	F 40	7423	E 80	52	F 35	5566	E 60
21	59.8	F 35	7219	E 80	50.1	F 30	5876	E 60
24	58.7	F 35	7420	E 80	51.5	F 30	5767	E 60
27	55.9	F 35	7306	E 80	55.1	F 35	6184	E 60
30	58.7	F 35	7440	E 80	51.9	F 30	6222	E 60
35	58.4	F 35	6900	E 70	53.0	F 35	6242	E 60
40	55.1	F 35	6948	E 70	54.8	F 35	6292	E 60
45	57.0	F 35	7004	E 70	50.0	F 30	6652	E 60
50	54.1	F 35	7021	E 70	48.5	F 30	5407	E 60

Table 3.19. Riga Ply plywood average values of bending strength and stiffness according to factory production controls

Nominal thickness, mm	Along the face grain		Perpendicular the face grain	
	Strength	Modulus of elasticity	Strength	Modulus of elasticity
	N/mm²	N/mm²	N/mm²	N/mm²
4	123.1	13808	30.6	1531
6.5	102.2	10920	56.5	4169
9	93.6	10116	69.1	5869
12	89.4	9854	69.9	6364
15	84.1	9532	70.1	6806
18	77.7	8993	68.1	6898
21	70.7	8424	67.0	7065
24	71.0	8577	65.1	7081
27	65.8	8227	65.8	7265
30	68.1	8439	61.3	6882
35	64.9	7800	67.1	7372
40	63.1	7885	63.6	7452
45	64.9	7974	62.2	7435
50	63.0	8130	59.8	7179



4. Mechanical properties

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4.1. Characteristic strength and stiffness

Tests were conducted in accordance with EN 789 Timber structures – Test methods – Determination of mechanical properties of wood based panels.

The strength and stiffness values of Riga Ply birch plywood are given in Tables 4.1 to 4.21. These values correspond to VTT research protocol RTE-3367-04.

These values can be used in design according to Eurocode 5 – Design of timber structures – Part 1:1 General rules and rules for buildings.

Table 4.1. Thickness t, area A, section modulus W and second moment of area I of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded				Sanded			
	t, mm	A, mm²	W, mm³	I, mm4	t, mm	A, mm²	W, mm³	I, mm4
4/3	4.20	4.20	2.94	6.17	3.60	3.60	2.16	3.89
6.5/5	7.00	7.00	8.17	28.6	6.40	6.40	6.83	21.8
9/7	9.80	9.80	16.0	78.4	9.20	9.20	14.1	64.9
12/9	12.6	12.6	26.5	167	12.0	12.0	24.0	144
15/11	15.4	15.4	39.5	304	14.8	14.8	36.5	270
18/13	18.2	18.2	55.2	502	17.6	17.6	51.6	454
21/15	21.0	21.0	73.5	772	20.4	20.4	69.4	707
24/17	23.8	23.8	94.4	1123	23.2	23.2	89.7	1041
27/19	26.6	26.6	118	1568	26.0	26.0	113	1465
30/21	29.4	29.4	144	2118	28.8	28.8	138	1991
35/25	35.0	35.0	204	3573	34.4	34.4	197	3392
40/29	40.6	40.6	275	5577	40.0	40.0	267	5333
45/32	44.8	44.8	335	7493	44.2	44.2	326	7196
50/35	49.0	49.0	400	9804	48.4	48.4	390	9448

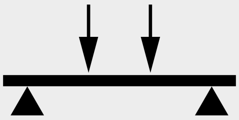
Table 4.2. Ratios A/A, W/W, and I/I of unsanded Riga Ply birch plywood

Nominal thickness and number of veneers	Along the grain direction of the face veneers			Across the grain direction of the face veneers		
	A/A_{eff}	W/W_{eff}	I/I_{eff}	A/A_{eff}	W/W_{eff}	I/I_{eff}
4/3	1.500	1.038	1.038	3.000	9.001	27.000
6.5/5	1.667	1.263	1.263	2.500	2.885	4.808
9/7	1.750	1.406	1.406	2.333	2.475	3.465
12/9	1.800	1.503	1.503	2.250	2.324	2.988
15/11	1.833	1.573	1.573	2.200	2.245	2.744
18/13	1.857	1.626	1.626	2.167	2.197	2.597
21/15	1.875	1.667	1.667	2.143	2.165	2.498
24/17	1.889	1.701	1.701	2.125	2.142	2.427
27/19	1.900	1.728	1.728	2.111	2.124	2.374
30/21	1.909	1.750	1.750	2.100	2.111	2.333
35/25	1.923	1.786	1.786	2.083	2.091	2.272
40/29	1.933	1.813	1.813	2.071	2.077	2.231
45/32	2.000	1.829	1.829	2.000	2.069	2.207
50/35	1.944	1.842	1.842	2.059	2.062	2.187

Table 4.3. Ratios A/A, W/W, and I/I of sanded Riga Ply birch plywood

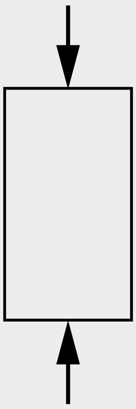
Nominal thickness and number of veneers	Along the grain direction of the face veneers			Across the grain direction of the face veneers		
	A/A_{eff}	W/W_{eff}	I/I_{eff}	A/A_{eff}	W/W_{eff}	I/I_{eff}
4/3	1.636	1.062	1.062	2.571	6.613	17.003
6.5/5	1.778	1.374	1.374	2.286	2.411	3.674
9/7	1.840	1.536	1.536	2.190	2.181	2.866
12/9	1.875	1.633	1.633	2.143	2.108	2.581
15/11	1.897	1.696	1.696	2.114	2.074	2.436
18/13	1.913	1.742	1.742	2.095	2.055	2.348
21/15	1.925	1.775	1.775	2.082	2.043	2.290
24/17	1.933	1.801	1.801	2.071	2.035	2.248
27/19	1.940	1.822	1.822	2.063	2.030	2.217
30/21	1.946	1.838	1.838	2.057	2.025	2.193
35/25	1.955	1.864	1.864	2.048	2.020	2.158
40/29	1.961	1.883	1.883	2.041	2.016	2.133
45/32	2.028	1.893	1.893	1.973	2.014	2.119
50/35	1.967	1.903	1.903	2.034	2.012	2.108

Table 4.4. Characteristic bending strength f of Riga Ply birch plywood



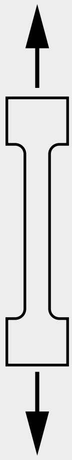
Nominal thickness and number of veneers	Unsanded		Sanded	
	f_{mk} ∥, N/mm²	f_{mk} ⊥, N/mm²	f_{mk} ∥, N/mm²	f_{mk} ⊥, N/mm²
4/3	77.0	8.9	75.3	12.1
6.5/5	63.4	27.7	58.2	33.2
9/7	56.9	32.3	52.1	36.7
12/9	53.2	34.4	49.0	38.0
15/11	50.8	35.6	47.2	38.6
18/13	49.2	36.4	45.9	38.9
21/15	48.0	37.0	45.1	39.2
24/17	47.0	37.4	44.4	39.3
27/19	46.3	37.7	43.9	39.4
30/21	45.7	37.9	43.5	39.5
35/25	44.8	38.3	42.9	39.6
40/29	44.1	38.5	42.5	39.7
45/32	43.7	38.7	42.3	39.7
50/35	43.4	38.8	42.0	39.8

Table 4.5. Characteristic compression strength f of Riga Ply birch plywood



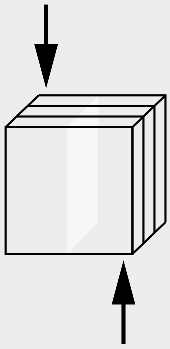
Nominal thickness and number of veneers	Unsanded		Sanded	
	f_{ck} ∥, N/mm²	f_{ck} ⊥, N/mm²	f_{ck} ∥, N/mm²	fck ⊥, N/mm²
4/3	38.7	19.3	35.4	22.6
6.5/5	34.8	23.2	32.6	25.4
9/7	33.1	24.9	31.5	26.5
12/9	32.2	25.8	30.9	27.1
15/11	31.6	26.4	30.6	27.4
18/13	31.2	26.8	30.3	27.7
21/15	30.9	27.1	30.1	27.9
24/17	30.7	27.3	30.0	28.0
27/19	30.5	27.5	29.9	28.1
30/21	30.4	27.6	29.8	28.2
35/25	30.2	27.8	29.7	28.3
40/29	30.0	28.0	29.6	28.4
45/32	29.0	29.0	28.6	29.4
50/35	29.8	28.2	29.5	28.5

Table 4.6. Characteristic tension strength f of Riga Ply birch plywood



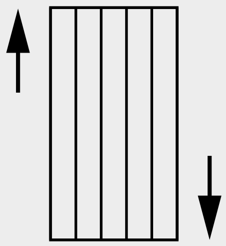
Nominal thickness and number of veneers	Unsanded		Sanded	
	f_{tk} ∥, N/mm²	f_{tk} ⊥, N/mm²	f_{tk} ∥, N/mm²	f_{tk} ⊥, N/mm²
4/3	52.0	26.0	47.7	30.3
6.5/5	46.8	31.2	43.9	34.1
9/7	44.6	33.4	42.4	35.6
12/9	43.3	34.7	41.6	36.4
15/11	42.5	35.5	41.1	36.9
18/13	42.0	36.0	40.8	37.2
21/15	41.6	36.4	40.5	37.5
24/17	41.3	36.7	40.3	37.7
27/19	41.1	36.9	40.2	37.8
30/21	40.9	37.1	40.1	37.9
35/25	40.6	37.4	39.9	38.1
40/29	40.3	37.7	39.8	38.2
45/32	39.0	39.0	38.5	39.5
50/35	40.1	37.9	39.6	38.4

Table 4.7. Characteristic shear strength in panel shear f of Riga Ply birch plywood



Nominal thickness and number of veneers	Unsanded		Sanded	
	f_{pak} ∥, N/mm²	f_{pak} ⊥, N/mm²	f_{pak} ∥, N/mm²	f_{pak} ⊥, N/mm²
4/3	10.0	10.0	10.0	10.0
6.5/5	10.0	10.0	10.0	10.0
9/7	10.0	10.0	10.0	10.0
12/9	10.0	10.0	10.0	10.0
15/11	10.0	10.0	10.0	10.0
18/13	10.0	10.0	10.0	10.0
21/15	10.0	10.0	10.0	10.0
24/17	10.0	10.0	10.0	10.0
27/19	10.0	10.0	10.0	10.0
30/21	10.0	10.0	10.0	10.0
35/25	10.0	10.0	10.0	10.0
40/29	10.0	10.0	10.0	10.0
45/32	10.0	10.0	10.0	10.0
50/35	10.0	10.0	10.0	10.0

Table 4.8. Characteristic shear strength in planar shear f of Riga Ply birch plywood



Nominal thickness and number of veneers	Unsanded		Sanded	
	$f_{plk} \parallel$, N/mm^2	$f_{plk} \perp$, N/mm^2	$f_{plk} \parallel$, N/mm^2	$f_{plk} \perp$, N/mm^2
4/3	2.38	-	2.44	-
6.5/5	2.72	1.43	2.81	1.56
9/7	2.40	1.94	2.36	2.07
12/9	2.47	1.86	2.45	1.96
15/11	2.35	2.02	2.31	2.10
18/13	2.38	1.99	2.35	2.06
21/15	2.32	2.06	2.28	2.12
24/17	2.34	2.05	2.30	2.10
27/19	2.30	2.09	2.27	2.14
30/21	2.31	2.08	2.28	2.12
35/25	2.29	2.10	2.26	2.14
40/29	2.28	2.12	2.25	2.15
50/35	2.26	2.14	2.24	2.17

Table 4.9. Mean modulus of elasticity E in bending of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	$E \parallel$, N/mm^2	$E \perp$, N/mm^2	$E \parallel$, N/mm^2	$E \perp$, N/mm^2
4/3	17333	667	16941	1059
6.5/5	14256	3744	13101	4899
9/7	12805	5195	11720	6280
12/9	11975	6025	11026	6974
15/11	11441	6559	10611	7389
18/13	11069	6931	10335	7665
21/15	10795	7205	10140	7860
24/17	10585	7415	9994	8006
27/19	10418	7582	9881	8119
30/21	10284	7716	9791	8209
35/25	10079	7921	9657	8343
40/29	9930	8070	9562	8438
45/32	9844	8156	9507	8493
50/35	9771	8229	9461	8539

Table 4.10. Mean modulus of elasticity E in tension and compression of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	E ∥, N/mm²	E ⊥, N/mm²	E ∥, N/mm²	E ⊥, N/mm²
4/3	12000	6000	11000	7000
6.5/5	10800	7200	10125	7875
9/7	10286	7714	9783	8217
12/9	10000	8000	9600	8400
15/11	9818	8182	9486	8514
18/13	9692	8308	9409	8591
21/15	9600	8400	9353	8647
24/17	9529	8471	9310	8690
27/19	9474	8526	9277	8723
30/21	9429	8571	9250	8750
35/25	9360	8640	9209	8791
40/29	9310	8690	9180	8820
45/32	9000	9000	8878	9122
50/35	9257	8743	9149	8851

Table 4.11. Mean modulus of rigidity G in panel shear of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	G ∥, N/mm²	G ⊥, N/mm²	G ∥, N/mm²	G ⊥, N/mm²
4/3	750	750	750	750
6.5/5	750	750	750	750
9/7	750	750	750	750
12/9	750	750	750	750
15/11	750	750	750	750
18/13	750	750	750	750
21/15	750	750	750	750
24/17	750	750	750	750
27/19	750	750	750	750
30/21	750	750	750	750
35/25	750	750	750	750
40/29	750	750	750	750
45/32	750	750	750	750
50/35	750	750	750	750

Table 4.12. Mean modulus of rigidity G in planar shear of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	G ∥, N/mm²	G ⊥, N/mm²	G ∥, N/mm²	G ⊥, N/mm²
4/3	172	-	155	-
6.5/5	187	103	183	113
9/7	191	134	189	142
12/9	192	149	190	156
15/11	192	157	190	163
18/13	192	162	189	168
21/15	191	166	189	171
24/17	191	169	188	173
27/19	190	171	188	174
30/21	190	172	188	176
35/25	189	174	187	177
40/29	188	176	187	178
45/32	178	188	176	190
50/35	188	177	176	179

Table 4.13. Characteristic bending moment capacity M of Riga Ply birch plywood for the full cross-section along and perpendicular to the grain

Nominal thickness and number of veneers	Unsanded		Sanded	
	M ∥, Nm/m	M ⊥, Nm/m	M ∥, Nm/m	M ⊥, Nm/m
4/3	226	26	163	26
6.5/5	517	226	397	226
9/7	911	517	735	517
12/9	1408	911	1176	911
15/11	2010	1408	1722	1408
18/13	2716	2010	2371	2010
21/15	3526	2716	3126	2716
24/17	4441	3526	3985	3526
27/19	5460	4441	4948	4441
30/21	6584	5460	6016	5460
35/25	9146	7813	8465	7813
40/29	12125	10583	11332	10583
45/32	14635	12934	13758	12934
50/35	17378	15522	16417	15522

Table 4.14. Characteristic compression capacity N of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	$N_c \parallel$, MN/m	$N_c \perp$, MN/m	$N_c \parallel$, MN/m	$N_c \perp$, MN/m
4/3	0.162	0.081	0.128	0.081
6.5/5	0.244	0.162	0.209	0.162
9/7	0.325	0.244	0.290	0.244
12/9	0.406	0.325	0.371	0.325
15/11	0.487	0.406	0.452	0.406
18/13	0.568	0.487	0.534	0.487
21/15	0.650	0.568	0.615	0.568
24/17	0.731	0.650	0.696	0.650
27/19	0.812	0.731	0.777	0.731
30/21	0.893	0.812	0.858	0.812
35/25	1.056	0.974	1.021	0.974
40/29	1.218	1.137	1.183	1.137
45/32	1.299	1.299	1.264	1.299
50/35	1.462	1.380	1.427	1.380

Table 4.15. Characteristic tension capacity N of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	$N_t \parallel$, MN/m	$N_t \perp$,MN/m	$N_t \parallel$, MN/m	$N_t \perp$, MN/m
4/3	0.218	0.109	0.172	0.109
6.5/5	0.328	0.218	0.281	0.218
9/7	0.437	0.328	0.390	0.328
12/9	0.546	0.437	0.499	0.437
15/11	0.655	0.546	0.608	0.546
18/13	0.764	0.655	0.718	0.655
21/15	0.874	0.764	0.827	0.764
24/17	0.983	0.874	0.936	0.874
27/19	0.092	0.983	1.045	0.983
30/21	1.201	1.092	1.154	1.092
35/25	1.420	1.310	1.373	1.310
40/29	1.638	1.529	1.591	1.529
45/32	1.747	1.747	1.700	1.747
50/35	1.966	1.856	1.919	1.856

Table 4.16. Characteristic shear capacity in panel shear Vpa of Riga Ply birch plywood for the full cross-section along and perpendicular to the grain

Nominal thickness and number of veneers	Unsanded		Sanded	
	V_{pa} ‖, kN/m	V_{pa} ⊥, kN/m	V_{pa} ‖, kN/m	V_{pa} ⊥, kN/m
4/3	42	42	36	36
6.5/5	70	70	64	64
9/7	98	98	92	92
12/9	126	126	120	120
15/11	154	154	148	148
18/13	182	182	176	176
21/15	210	210	204	204
24/17	238	238	232	232
27/19	266	266	260	260
30/21	294	294	288	288
35/25	350	350	344	344
40/29	406	406	400	400
45/32	448	448	442	442
50/35	490	490	484	484

Table 4.17. Characteristic shear capacity in panel shear Vpl of Riga Ply birch plywood for the full cross-section along and perpendicular to the grain

Nominal thickness and number of veneers	Unsanded		Sanded	
	V_{pl} ‖, kN/m	V_{pl} ⊥, kN/m	V_{pl} ‖, kN/m	V_{pl}⊥, kN/m
4/3	6.7	-	5.9	-
6.5/5	12.7	6.7	12.0	6.7
9/7	15.7	12.7	14.5	12.7
12/9	20.7	15.7	19.6	15.7
15/11	24.1	20.7	22.8	20.7
18/13	28.9	24.1	27.5	24.1
21/15	32.5	28.9	31.0	28.9
24/17	31.7	32.5	35.6	32.5
27/19	40.8	37.1	39.3	37.1
30/21	45.3	40.8	43.8	40.8
35/25	53.5	49.0	51.9	49.0
40/29	61.7	57.3	60.1	57.3
50/35	73.7	69.9	72.1	69.9

Table 4.18. Mean stiffness EI in bending of Riga Ply birch plywood

Nominal thickness and number of veneers	Unsanded		Sanded	
	EI ∥, kNm²	EI ⊥, kNm²	EI ∥, kNm²	EI ⊥, kNm²
4/3	0.107	0.004	0.066	0.004
6.5/5	0.407	0.107	0.286	0.107
9/7	1.004	0.407	0.761	0.407
12/9	1.996	1.004	1.588	1.004
15/11	3.482	1.996	2.866	1.996
18/13	5.561	3.482	4.696	3.482
21/15	8.331	5.561	7.174	5.561
24/17	11.891	8.331	10.400	8.331
27/19	16.341	11.891	14.473	11.891
30/21	21.778	16.341	19.491	16.341
35/25	36.001	28.302	32.760	28.302
40/29	55.381	45.004	50.996	45.004
45/32	73.759	61.114	68.412	61.114
50/35	95.796	80.678	89.392	80.678

Table 4.19. Mean stiffness EA in tension and compression of Riga Ply birch plywood for the full cross-section along and perpendicular to the grain

Nominal thickness and number of veneers	Unsanded		Sanded	
	EA ∥, MN/m	EA ⊥, MN/m	EA ∥, MN/m	EA ⊥, MN/m
4/3	50	25	40	25
6.5/5	76	50	65	50
9/7	101	76	90	76
12/9	126	101	115	101
15/11	151	126	140	126
18/13	176	151	166	151
21/15	202	176	191	176
24/17	227	202	216	202
27/19	252	227	241	227
30/21	277	252	266	252
35/25	328	302	317	302
40/29	378	353	367	353
45/32	403	403	392	403
50/35	454	428	443	428

Table 4.20. Mean shear rigidity GA in panel shear in bending of Riga Ply birch plywood for the full cross-section along and perpendicular to the grain

Nominal thickness and number of veneers	Unsanded		Sanded	
	GA ∥, MN/m	GA ⊥, MN/m	GA ∥, MN/m	GA ⊥, MN/m
4/3	3.15	3.15	2.70	2.70
6.5/5	5.25	5.25	4.80	4.80
9/7	7.35	7.35	6.90	6.90
12/9	9.45	9.45	9.00	9.00
15/11	11.55	11.55	11.10	11.10
18/13	13.65	13.65	13.20	13.20
21/15	15.75	15.75	15.30	15.30
24/17	17.85	17.85	17.40	17.40
27/19	19.95	19.95	19.50	19.50
30/21	22.05	22.05	21.60	21.60
35/25	26.25	26.25	25.80	25.80
40/29	30.45	30.45	30.00	30.00
45/32	33.60	33.60	33.15	33.15
50/35	36.75	36.75	36.30	36.30

Table 4.21. Mean shear rigidity GA in planar shear of Riga Ply birch plywood for the full cross-section along and perpendicular to the grain

Nominal thickness and number of veneers	Unsanded		Sanded	
	GA ∥, MN/m	GA ⊥, MN/m	GA ∥, MN/m	GA ⊥, MN/m
4/3	0.723	-	0.556	-
6.5/5	1.310	0.723	1.169	0.723
9/7	1.873	1.310	1.735	1.310
12/9	2.419	1.873	2.277	1.873
15/11	2.955	2.419	2.807	2.419
18/13	3.486	2.955	3.331	2.955
21/15	4.012	3.486	3.852	3.486
24/17	4.536	4.012	4.370	4.012
27/19	5.057	4.536	4.888	4.536
30/21	5.577	5.057	5.404	5.057
35/25	6.614	6.096	6.435	6.096
40/29	7.649	7.132	7.465	7.132
45/32	7.971	8.416	7.783	8.416
50/35	9.197	8.682	9.008	8.682

4.2. Screw withdrawal force

Screw withdrawal force is determined according to standard EN 320 Fiberboards – determination of resistance to axial withdrawal of screws. Screws with diameter 4.2 mm are screwed in plywood in predrilled holes (2.7 mm diameter and 19 mm depth). If plywood is thinner than 15 mm, the screw is screwed so that its conic part of the thread protrudes the plywood. Screw withdrawal force is the force that is necessary to withdraw a screw from a plywood sample. The force to withdraw screws from plywood is determined by both face and edge (see Table 4.22). According to standard EN 320 edge withdrawal is only determined on boards of 15 mm thickness or more.

Table 4.22. Mean Riga Ply screw withdrawal force, kg

Nominal thickness, mm	Face	Edge
4	60	–
6.5	135	–
9	175	–
12	240	–
15...50	285	210

4.3. Design

4.3.1. General explanatory notes

According to Latvijas Finieris Group's order to the VTT institute in 2004, VTT evaluated load resistance values of plywood in different cases. The design is carried out in accordance with EN 1995-1-1 Eurocode 5 – Design of timber structures – Part 1:1 General – Common rules and rules for buildings.

In design it shall be proven that the design bending stress $\sigma_{m,d}$ is less than the design bending strength $f_{m,d}$:

$$\sigma_{m,d} \leq f_{m,d} \quad [4.1.]$$

The design bending stress is calculated from the design load. The design load is given by combining the characteristic loads multiplied by their respective partial safety factors γ_q. The design bending strength is given by dividing the characteristic bending strength $f_{m,k}$ by the partial safety factor γ_m for materials (for plywood 1.2). Hence,

$$\sigma_{m,d} = \gamma_q \, \sigma_{m,k} \quad [4.2.]$$

$$f_{m,d} = k_{mod} / \gamma_m * f_{m,k} \quad [4.3.]$$

where:

$\sigma_{m,k}$ - the characteristic bending stress;

k_{mod} - the factor taking into account the effect of duration of load and moisture content.

In design it shall be proven that the design shear stress $T_{v,d}$ is less than the design shear strength $f_{v,d}$:

$$T_{v,d} \leq f_{v,d} \quad [4.4.]$$

The design shear stress is calculated from the design load. The design load is given by combining the characteristic loads multiplied by their respective partial safety factors γ_q. The design shear strength is given by dividing the characteristic shear strength $f_{v,k}$ by the partial safety factor γ_m for materials. Hence,

$$T_{v,d} = \gamma_q \, T_{v,k} \quad [4.5.]$$

$$f_{v,d} = k_{mod} / \gamma_m * f_{v,k} \quad [4.6.]$$

where:

$T_{v,k}$ - the characteristic shear stress;

k_{mod} - the factor taking into account the effect of duration of load and moisture content (see Table 4.23).

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* According to Eurocode 5 – Design of timber structures – Part 1:1 General – Common rules and rules for buildings
** Load duration class description is given in Table 4.25
*** Service class description is given in Table 4.24

Table 4.23. Values of k_{mod}*

	Load duration class**				
Service class ***	Permanent action	Long term action	Medium term action	Short term action	Instantanious action
1	0.60	0.70	0.80	0.90	1.10
2	0.60	0.70	0.80	0.90	1.10
3	0.50	0.55	0.65	0.70	0.90

Table 4.24. Service classes

Service class	Description of service class	Average moisture content for plywood %
1	Characterised by moisture content in the materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 65% for a few weeks per year	11
2	Characterised by moisture content in the materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 85% for a fw weeks per year	17
3	Characterised by climatic conditions leading to higher moisture content than in service class 2	above 17

Table 4.25. Load duration classes

Load duration class	Order of accumulated duration of characteristic load	Example of load
Permanent	more than 10 years	Net weight
Long term	6 months - 10 years	Actual load
Medium term	1 week - 6 months	Snow, temporary load
Short term	less than 1 week	Wind, snow load
Instantaneous		Wind, occasional load
Note: Since climatic loads (snow, wind) vary between countries, information on their load duration assignment may be specified in the National annex.		

Furthermore, it shall be proven that the design final deflection ufin is less than the pre-set deflection value upreset.

$$u_{fin} = u_{fin,\ permament} + u_{fin,\ quasi,\ permament} \leq u_{preset}$$ [4.7.],

where the final deformation calculated from the permanent loads $u_{fin,permanent}$ and the final deformation calculated from the quasi-permanent loads $u_{fin,quasi,permanent}$ are given by

$$u_{fin,\ permament} = u_{inst} = (1+K_{def})$$ [4.8.]; $$u_{fin,\ quasi,\ permament} = u_{inst}\ (1+\Psi_2 K_{def})$$ [4.9.],

where:

u_{inst} - the instantaneous deformation;

ψ_2 - the factor for the quasi-permanent value of a variable load;

k_{def} - factor taking into account the effect of duration of load and moisture content.

The pre-set deflection value depends on the construction and it is usually given as a deflection related to the span length, for example $L_{span}/300$ or $L_{span}/200$. However, absolute pre-set deflection values may also be given. k_{def} is a factor taking into account the effect of duration of load and moisture content and given in Table 4.26.

Table 4.26. Values k_{def}*

Standard	Service class		
	1	2	3
EN 636	0.80	1.00	2.50

* According to Eurocode 5 – Design of timber structures, Part 1:1 General – Common rules and rules for buildings.

Furthermore, the section properties as well as the strength and stiffness values of Riga Ply birch plywood are given in the chapter in the chapter 4.1.

4.3.2. Uniform load

In the stress and deflection calculations, a plate strip of unite width (b = 1 mm) is considered. This means that the cross-section area A is given in mm^2/mm, section modulus W is given in mm^3/mm and second moment of plane area I is given in mm^4/mm. For a uniformly distributed load on a simple supported plate, the critical bending stress and shear stress are given by equations [4.10] and [4.11], respectively. The critical deflection $u_{M+V} \approx u_M$ is given by the first term of equation [4.12]. The shorter side of the plate shall be used as the span length L_{span}. The factors, α, β and φ are given in Table 4.27.

For a uniformly distributed load on a continuous plate strip with equal span lengths the critical bending stress σ is given by

$$\sigma = \frac{M_{cri}}{W} = \alpha \frac{qL^2_{span}}{W} \qquad [4.10.],$$

where: *q* - the uniformly distributed load per area;
L_{span} - the span length;
W - *(=* $t^2/6$*)* is the section modulus of the full cross-section of the plate strip;
t - the thickness of the plate strip;
α - is given in Table 4.27.

The critical shear stress τ is given by

$$\tau = \frac{3}{2}\frac{V_{cri}}{A} = \frac{3}{2}\beta\frac{qL_{span}}{A} \qquad [4.11.],$$

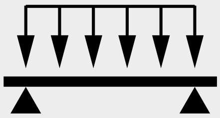
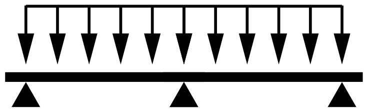
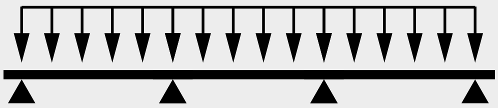
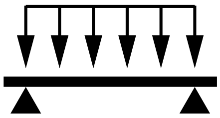
where:
A - *(= t)* is the area of the full cross-section of the plate strip;
β - is given in Table 4.27.

The critical deflection u_{M+V} is given by

$$u_{M+V} = \varphi\frac{qL^4_{span}}{EI} + \psi\frac{qL^2_{span}}{\frac{5\,GA}{6}} \qquad [4.12.],$$

where:
I - *(=* $t^3/12$*)* is the second moment of plane area of the full cross-section of the plate strip;
E - the modulus of elasticity;
G - the shear modulus;
φ, ψ - given in Table 4.27.

Table 4.27. α, β, φ and ψ factors to be used in equations [4.10.] – [4.12]

Number of spans		α	β	φ	ψ
	Strip	0.125	0.500	0.013	0.125
	Strip	0.125	0.625	0.005	0.149
	Strip	0.100	0.600	0.007	0.133
	Plate	0.041 - 0.125	0.226 - 0.500	0.0043 - 0.0130	-

4.3.3. Floors - Uniform load

The objective of this section is to present and document tabulated uniformly distributed load resistance values for floors of Riga Ply birch plywood produced by Latvijas Finieris Group. The calculation is carried out in accordance with VTT research protocol RTE 3968-04 and EN 1995-1-1 Eurocode 5 – Design of timber structures – Part 1:1 General – Common rules and rules for buildings.

The load resistance values for: a uniformly distributed load on a single span plate strip; a uniformly distributed load on a double span plate strip; a uniformly distributed load on a simple supported plate given in Tables 4.28 to 4.30 are calculated according to the following assumptions: $\gamma_q = 1.5; \gamma_m = 1.2; k_{mod} = 0.80$. Hence, the characteristic load acting in service classes 1 or 2 (dry or humid) and medium term load duration class (1 week to 6 months) shall not exceed the tabulated values.

The deflection values given in Tables 4.28.–4.30. are calculated according to the following assumptions: $k_{def} = 0.8; \psi_2 = 0.3$; the load used is the tabulated load resistance assumed to be totally quasi-permanent.

In Tables 4.28.–4.30. letter 's' means shear strength limitation and 'b' means bending strength limitation.

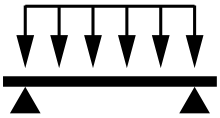
For other assumptions the tabulated load resistance values shall be multiplied by a correction factor $k_{load,corr}$ given by

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.2 \times 1.5}{0.80} \quad [4.13.]$$

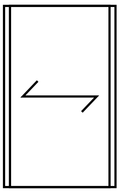
For other assumptions the tabulated deflection values shall be multiplied by a correction factor $k_{def,corr}$ given by

$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.24} k_{load,corr} \quad [4.14.]$$

Table 4.28. Load resistance for a uniformly distributed load on a sanded single span plate strip



Simply supported
single span plate strip

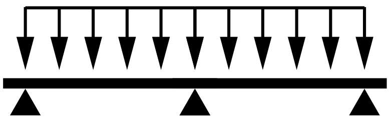


Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

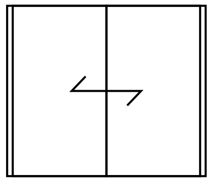
Span c/c mm	Uniformly distributed load q (kN/m²) and deflection u (mm) Nominal thickness (mm)						
	4	6.5	9	12	15	18	21
	q *u*	*q* *u*	*q* *u*	*q* *u*	*q* *u*	*q* *u*	*q* *u*
300	6.4 b 13	16 b 7.4	29 b 5.3	46 b 4.2	68 b 3.5	82 b 2.7	92 b 2.1
400	3.6 b 23	8.8 b 13	16 b 9.2	26 b 7.1	38 b 5.9	53 b 5.1	69 b 4.5
500	2.3 b 36	5.7 b 20	10 b 14	17 b 11	25 b 9.0	34 b 7.7	44 b 6.8
600	1.6 b 51	3.9 b 29	7.3 b 20	12 b 16	17 b 13	23 b 11	31 b 10
750	1.0 b 80	2.5 b 45	4.6 b 31	7.4 b 24	11 b 20	15 b 17	20 b 15
1000	0.58 b 142	1.4 b 80	2.6 b 56	4.2 b 43	6.1 b 35	8.4 b 29	11 b 26
1200	0.40 b 204	1.0 b 115	1.8 b 80	2.9 b 62	4.3 b 50	5.9 b 42	7.7 b 37
1500	0.26 b 319	0.6 b 180	1.2 b 125	1.9 b 96	2.7 b 78	3.7 b 66	4.9 b 57

Span c/c mm	24	27	30	35	40	45	50
	q *u*	*q* *u*	*q* *u*	*q* *u*	*q* *u*	*q* *u*	*q* *u*
300	105 s 1.7	117 s 1.5	130 s 1.3	154 s 1.0	178 s 0.85	79 s 0.32	214 s 0.71
400	79 s 3.7	87 s 3.0	97 s 2.6	115 s 2.0	133 s 1.6	59 s 0.58	161 s 1.3
500	57 b 6.1	70 s 5.5	78 s 4.7	92 s 3.5	107 s 2.8	47 s 1.0	128 s 2.1
600	39 b 8.5	49 b 7.7	59 b 7.1	77 s 5.7	89 s 4.4	39 s 1.5	107 s 3.3
750	25 b 13	31 b 12	38 b 11	53 b 9.2	71 s 8.1	31 s 2.8	86 s 5.9
1000	14 b 23	18 b 20	21 b 18	30 b 16	40 b 14	24 s 6.1	58 s 12
1200	10 b 32	12 b 29	15 b 26	21 b 22	28 b 19	20 s 10	40 b 16
1500	6.3 b 50	7.8 b 45	10 b 41	13 b 34	18 b 30	16 s 20	26 b 25

Table 4.29. Load resistance for a uniformly distributed load on a sanded double span plate strip



Simply supported double span plate strip

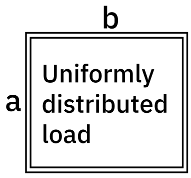


Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

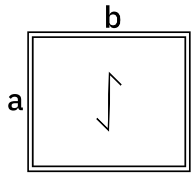
Span c/c mm	Uniformly distributed load q(kN/m²) and deflection u (mm) Nominal thickness (mm)						
	4 *q u*	6.5 *q u*	9 *q u*	12 *q u*	15 *q u*	18 *q u*	21 *q u*
300	6.4 b 5.5	16 b 3.2	29 b 2.4	46 b 2.0	68 b 1.4	82 b 1.1	92 b 0.94
400	3.6 b 10	8.8 b 5.6	16 b 4.0	26 b 3.2	38 b 2.8	53 b 2.3	69 b 1.8
500	2.3 b 15	5.7 b 8.5	10 b 6.1	17 b 4.8	25 b 4.1	34 b 3.6	44 b 3.2
600	1.6 b 21	3.9 b 12	7.3 b 8.6	12 b 6.8	17 b 5.6	23 b 4.9	31 b 4.4
750	1.0 b 33	2.5 b 19	4.6 b 13	7.4 b 10	11 b 8.5	15 b 7.3	20 b 6.5
1000	0.58 b 59	1.4 b 33	2.6 b 23	4.2 b 18	6.1 b 15	8.4 b 13	11 b 11
1200	0.40 b 85	1.0 b 48	1.8 b 33	2.9 b 26	4.3 b 21	5.9 b 18	7.7 b 16
1500	0.26 b 133	0.6 b 5	1.2 b 52	1.9 b 40	2.7 b 33	3.7 b 28	4.9 b 24

Span c/c mm	24 *q u*	27 *q u*	30 *q u*	35 *q u*	40 *q u*	45 *q u*	50 *q u*
300	84 s 0.83	93 s 0.73	104 s 0.67	123 s 0.58	142 s 0.53	63 s 0.21	171 s 0.48
400	63 s 1.6	70 s 1.3	78 s 1.2	92 s 1.0	107 s 0.86	47 s 0.33	128 s 0.75
500	51 s 2.7	56 s 2.3	62 s 2.0	74 s 1.6	85 s 1.3	38 s 0.50	103 s 1.1
600	39 b 4.0	47 s 3.6	52 s 3.1	61 s 2.4	71 s 2.0	31 s 0,72	86 s 1.6
750	25 b 5.8	31 b 5.4	38 b 5.0	49 s 4.1	57 s 3.3	25 s 1.2	69 s 2.6
1000	14 b 10	18 b 8.9	21 b 8.2	30 b 7.2	40 b 6.5	19 s 2.4	51 s 5.1
1200	10 b 14	12 b 13	15 b 11	21 b 10	28 b 8.8	16 s 3.8	40 b 7.7
1500	6.3 b 21	7.8 b 19	10 b 17	13 b 15	18 b 13	13 s 7.0	26 b 11

Table 4.30. Load resistance for a uniformly distributed load on a sanded simple supported plate



Simply supported rectangular plate



Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

Span c/c mm a x b	Uniformly distributed load q (kN/m²) and deflection u (mm) Nominal thickness (mm)						
	4	6.5	9	12	15	18	21
	q u	q u	q u	q u	q u	q u	q u
300x300	- -	18 s 4.7	49 b 3.5	77 s 2.5	109 s 1.8	133 s 1.3	164 s 1.1
300x600	- -	18 b 8.5	32 b 4.8	55 b 3.8	79 s 3.0	96 s 2.2	108 s 1.6
300x900	- -	16 b 8.5	30 b 4.9	48 b 3.8	70 s 3.1	85 s 2.3	95 s 1.7
300x∞	- -	16 b 8.5	29 b 5.0	46 b 3.8	68 s 3.1	82 s 2.3	92 s 1.7
400x400	- -	10 s 8.4	27 b 6.2	52 b 5.3	82 s 4.4	100 s 3.2	123 s 2.5
400x800	- -	9.9 b 15	18 b 8.5	31 b 6.8	46 b 5.5	64 b 4.6	81 s 3.8
400x1200	- -	9.0 b 15	17 b 8.8	27 b 6.8	40 b 5.5	55 b 4.6	72 s 3.9
400x∞	- -	8.8 b 15	16 b 8.9	26 b 6.8	38 b 5.5	53 b 4.6	69 s 4.0
500x500	- -	6.5 b 13	18 b 10	33 b 8.2	54 b 7.1	79 b 6.2	98 s 4.9
500x1000	- -	6.3 b 24	12 b 13	20 b 11	30 b 8.6	41 b 7.2	55 b 6.2
500x1500	- -	5.8 b 24	11 b 14	17 b 11	26 b 8.6	35 b 7.2	47 b 6.3
500x∞	- -	5.7 b 24	10 b 14	17 b 11	25 b 8.6	34 b 7.2	44 b 6.3
600x600	- -	4.5 b 19	12 b 14	23 b 12	38 b 10	55 b 8.9	76 b 7.9
600x1200	- -	4.4 b 34	8.1 b 19	14 b 15	21 b 12	29 b 10	38 b 9.0
600x1800	- -	4.0 b 34	7.4 b 20	12 b 15	18 b 12	24 b 10	32 b 9.0
600x∞	- -	3.9 b 34	7.3 b 20	12 b 15	17 b 12	23 b 10	31 b 9.0
750x750	- -	2.9 b 30	7.8 b 22	15 b 19	24 b 16	35 b 14	49 b 12
750x1500	- -	2.8 b 53	5.2 b 30	8.9 b 24	13 b 19	18 b 16	24 b 14
750x2250	- -	2.6 b 53	4.7 b 31	8.7 b 24	11 b 19	16 b 16	21 b 14
750x∞	- -	2.5 b 53	4.6 b 31	7.4 b 24	11 b 19	15 b 16	20 b 14
1000x1000	- -	1.6 b 53	4.4 b 39	8.4 b 33	14 b 28	20 b 25	27 b 22
1000x2000	- -	1.6 b 94	2.9 b 53	5.0 b 42	7.4 b 34	10 b 29	14 b 25
1000x3000	- -	1.4 b 95	2.7 b 55	4.3 b 42	6.4 b 34	8.8 b 29	12 b 25
1000x∞	- -	1.4 b 95	2.6 b 55	4.2 b 43	6.1 b 35	8.4 b 29	11 b 25
1200x1200	- -	1.1 b 76	3.0 b 56	5.8 b 47	9.4 b 41	14 b 35	19 b 31
1200x2400	- -	1.1 b 136	2.0 b 76	3.5 b 61	5.1 b 50	7.1 b 42	9.5 b 36
1500x1500	- -	0.73 b 118	2.0 b 87	3.7 b 74	6.0 b 64	8.8 b 55	12 b 49
1500x3000	- -	0.70 b 212	1.3 b 119	2.2 b 95	3.3 b 77	4.6 b 65	6.0 b 56

Span c/c mm a x b	Uniformly distributed load q (kN/m²) and deflection u (mm) Nominal thickness (mm)						
	24 *q u*	27 *q u*	30 *q u*	35 *q u*	40 *q u*	45 *q u*	50 *q u*
300x300	189 s 0.83	219 s 0.68	244 s 0.56	300 s 0.40	356 s 0.30	173 s 0.14	442 s 0.21
300x600	125 s 1.3	138 s 1.0	154 s 0.83	183 s 0.58	213 s 0.18	94 s 0.18	257 s 0.30
300x900	110 s 1.3	121 s 1.0	135 s 0.86	168 s 0.61	82 s 0.18	82 s 0.18	224 s 0.31
300x∞	105 s 1,3	117 s 1.1	130 s 0.87	154 s 0.61	79 s 0.19	79 s 0.19	214 s 0.31
400x400	141 s 2.0	164 s 1.6	183 s 1.3	225 s 1.0	130 s 0.32	130 s 0.32	331 s 0.50
400x800	94 s 3.0	104 s 2.4	116 s 2.0	138 s 1.4	71 s 0.4	71 s 0.4	193 s 0.71
400x1200	82 s 3.1	91 s 2.5	101 s 2.0	120 s 1.4	62 s 0.4	62 s 0.4	168 s 0.73
400x∞	79 s 3.1	87 s 2.5	97 s 2.1	115 s 1.5	59 s 0.4	59 s 0.4	161 s 0.74
500x500	113 s 3.8	132 s 3.2	146 s 2.6	180 s 1.9	104 s 0.6	104 s 0.6	265 s 1.0
500x1000	70 b 5.5	83 s 4.7	93 s 3.8	110 s 2.7	57 s 0.8	57 s 0.8	154 s 1.4
500x1500	59 b 5.5	73 s 4.8	81 s 4.0	96 s 2.8	49 s 0.9	49 s 0.9	134 s 1.4
500x∞	57 b 5.5	70 s 4.9	78 s 4.0	92 s 2.8	47 s 0.9	47 s 0.9	128 s 1.5
600x600	94 s 6.6	110 s 5.4	122 s 4.5	150 s 3.2	86 s 1.1	86 s 1.1	221 s 1.7
600x1200	49 b 7.9	61 b 7.1	74 b 6.4	92 s 4.7	47 s 1.4	47 s 1.4	129 s 2.4
600x1800	41 b 7.9	51 b 7.1	62 b 6.4	80 s 4.9	41 s 1.5	41 s 1.5	112 s 2.5
600x∞	39 b 7.9	49 b 7.1	59 b 6.4	77 s 4.9	39 s 1.5	39 s 1.5	107 s 2.5
750x750	64 b 11	82 b 10	98 s 8.7	120 s 6.3	69 s 2.1	69 s 2.1	177 s 3.3
750x1500	31 b 12	39 b 11	47 b 10	67 b 8.3	38 s 2.8	38 s 2.8	103 s 4.7
750x2250	26 b 12	33 b 11	40 b 10	56 b 8.3	33 s 2.9	33 s 2.9	90 s 4.8
750x∞	25 b 12	31 b 11	38 b 10	53 b 8.3	31 s 2.9	31 s 2.9	86 s 4.9
1000x1000	23 b 20	46 b 18	57 b 16	83 b 14	52 s 5.0	52 s 5.0	133 s 7.9
1000x2000	17 b 22	22 b 20	27 b 18	38 b 15	28 s 6.6	28 s 6.6	73 b 11
1000x3000	15 b 22	18 b 20	22 b 18	32 b 15	25 s 6.8	25 s 6.8	62 b 11
1000x∞	14 b 22	18 b 20	21 b 18	30 b 15	24 s 6.9	24 s 6.9	58 b 11
1200x1200	25 b 28	32 b 25	40 b 23	58 b 20	43 s 8.7	43 s 8.7	110 s 14
1200x2400	12 b 32	15 b 28	18 b 25	26 b 21	24 s 11	24 s 11	51 b 15
1500x1500	16 b 44	21 b 40	25 b 36	37 b 31	35 s 17	35 s 17	75 b 23
1500x3000	7.8 b 49	10 b 44	12 b 40	17 b 33	19 s 22	19 s 22	33 b 24

4.3.4. Concrete formworks - uniform load

The objective of this section is to present and document tabulated uniformly distributed load resistance values for concrete formworks of Riga Ply birch plywood produced by Latvijas Finieris Group. The calculation is carried out in accordance with VTT research protocol RTE 3971-04 and EN 1995-1-1 Eurocode 5 – Design of timber structures – Part 1:1 General – Common rules and rules for buildings.

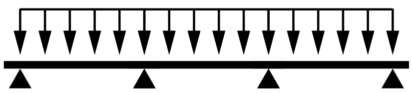
The load resistance values for a uniformly distributed load on a plate strip with three equal span lengths given in Tables 4.31 to 4.32 are calculated according to the following assumptions: $\gamma_q = 1.2; \gamma_m = 1.2; k_{mod} = 0.70.$ Hence, the characteristic load acting in service class 3 (exterior) and short term load duration class (less than one week) shall not exceed the tabulated values.

For other assumptions, the tabulated load resistance values shall be multiplied by a correction factor $k_{load,corr}$ given by equation [4.15.].

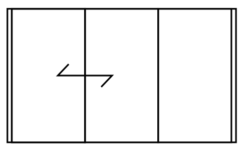
The deflection values given in Tables 4.31 to 4.32. are calculated according to the following assumptions: $k_{def} = 2.5; \psi_2 = 0.2$; The load used is the tabulated load resistance assumed to be totally quasi-permanent. For other assumptions the tabulated deflection values shall be multiplied by a correction factor $k_{def,corr}$ given by equation [4.16.].

In Tables 4.31.–4.32. letter ‘s’ means shear strength limitation and ‘b’ means bending strength limitation.

Table 4.31. Load resistance for a uniformly distributed load on a sanded continuous plate strip with three equal span lengths



Simply supported rectangular plate



Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 Γ_q=1.5

Span c/c mm	Uniformly distributed load q (kN/m²) and deflection (u mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	q		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*
100	47	s	0.95	97	s	0.55	117	s	0.32	159	s	0.27	185	s	0.22	223	s	0.21	251	s	0.19
150	32	s	2.8	65	s	1.5	78	s	0.78	106	s	0.60	123	s	0.46	149	s	0.41	167	s	0.36
200	20	b	5.3	48	b	3.2	59	s	1.6	79	s	1.2	92	s	0.85	112	s	0.72	126	s	0.60
250	13	b	8.1	31	b	4.8	47	s	2.9	64	s	2.0	74	s	1.4	89	s	1.2	100	s	1.0
300	8.8	b	12	21	b	6.7	39	s	4.8	53	s	3.3	62	s	2.3	74	s	1.8	84	s	1.4
350	6.5	b	16	16	b	9.0	29	b	6.4	45	s	5.0	53	s	3.4	64	s	2.7	72	s	2.1
400	4.9	b	20	12	b	12	22	b	8.3	36	b	6.6	46	s	4.9	56	s	3.8	63	s	2.9
500	3.2	b	31	7.7	b	18	14	b	13	23	b	9.9	34	b	8.3	45	s	7.0	50	s	5.3
600	2.2	b	45	5.4	b	26	10	b	18	16	b	14	23	b	12	32	b	10	42	s	8.8

Span c/c mm	Uniformly distributed load q (kN/m²) and deflection (u mm) Nominal thickness (mm)						
	24 q u	27 q u	30 q u	35 q u	40 q u	45 q u	50 q u
100	288 s 0.19	319 s 0.18	355 s 0.18	420 s 0.17	486 s 0.17	215 s 0.07	586 s 0.16
150	192 s 0.33	213 s 0.31	236 s 0.30	280 s 0.28	324 s 0.27	143 s 0.11	390 s 0.26
200	144 s 0.55	159 s 0.49	177 s 0.46	210 s 0.42	243 s 0.39	107 s 0.16	293 s 0.37
250	115 s 0.84	128 s 0.75	142 s 0.69	168 s 0.60	194 s 0.54	86 s 0.22	234 s 0.50
300	96 s 1.2	106 s 1.1	118 s 1.0	140 s 0.83	162 s 0.73	72 s 0.29	195 s 0,65
350	82 s 1.8	91 s 1.5	101 s 1.4	120 s 1.1	139 s 1.0	61 s 0.37	167 s 0.84
400	72 s 2.5	80 s 2.1	89 s 1.8	105 s 1.5	122 s 1.3	54 s 0.47	146 s 1.1
500	58 s 4.4	64 s 3.6	71 s 3.1	84 s 2.4	97 s 2.0	43 s 0.74	117 s 1.6
600	48 s 7.1	53 s 5.9	59 s 5.0	70 s 3.8	81 s 3.1	36 s 1.1	98 s 2.4

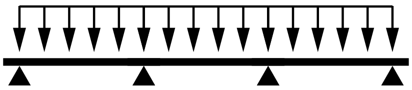
Uniformly distributed load values under conditions different from the basic ones *(γ_q=1.2; γ_m=1.2; k_{mod}=0.70)*, are calculated by multiplying tabulated values by a correction factor $k_{load,corr}$, given by

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \, \frac{1.2 \times 1.2}{0.70} \qquad [4.15.].$$

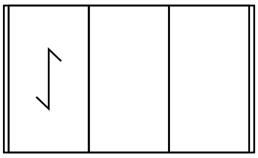
Plywood deflection values under conditions different from the basic ones *(k_{def}=2.5; ψ_2=0.2)*, are calculated by multiplying tabulated values by a correction factor $k_{def,corr}$, given by

$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.5} \, k_{load,corr} \qquad [4.16.].$$

Table 4.32. Uniformly distributed load resistance on a sanded continuous plate strip with three equal span lengths. Face grain parallel to studs



Simply supported rectangular plate



Service Class 1
$k_{mod}=0.7$ $\psi_2=0.2$ $\gamma_m=1.2$
$k_{def}=2.5$ $\Gamma_q=1.2$

Uniformly distributed load q (kN/m²) and deflection (u mm) — Nominal thickness (mm)

Span c/c mm	4			6.5			9			12			15			18			21		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u
100	-		-	54	s	0.7	103	s	0.45	127	s	0.29	168	s	0.25	196	s	0.22	234	s	0.20
150	-		-	36	s	2.0	69	s	1.2	85	s	0.69	112	s	0.54	131	s	0.43	156	s	0.39
200	-		-	27	s	4.5	51	s	2.5	64	s	1.4	84	s	1.0	98	s	0.78	117	s	0.67
250	-		-	18	b	7.0	40	b	4.5	51	s	2.5	67	s	1.8	78	s	1.3	93	s	1.1
300	-		-	12	b	10	28	b	6.2	42	s	4.0	56	s	2.8	65	s	2.0	78	s	1.7
350	-		-	9.0	b	13	21	b	8.3	36	b	6.2	48	s	4.3	56	s	3.1	67	s	1.24
400	-		-	6.9	b	17	16	b	10.7	28	b	7.9	42	s	6.2	49	s	4.4	58	s	3.4
500	-		-	4.4	b	27	10	b	16.4	18	b	12	27	b	9.6	39	b	8.0	47	s	6.2
600	-		-	3.1	b	39	7.0	b	23.5	12	b	17	19	b	13	27	b	11	37	b	9.8

Span c/c mm	24			27			30			35			40			45			50		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u
100	263	s	0.19	301	s	0.19	330	s	0.18	398	s	0.17	465	s	0.17	518	s	0.16	567	s	0.16
150	175	s	0.35	200	s	0.33	220	s	0.30	365	s	0.28	310	s	0.27	345	s	0.25	378	s	0.26
200	132	s	0.58	150	s	0.53	165	s	0.84	199	s	0.43	232	s	0.40	259	s	0.32	284	s	0.37
250	105	s	0.90	120	s	0.81	132	s	0.27	159	s	0.62	186	s	0.56	207	s	0.51	227	s	0.51
300	88	s	1.4	100	s	1.2	110	s	1.0	133	s	0.86	155	s	0.76	173	s	0.68	189	s	0.67
350	75	s	2.0	86	s	1.7	94	s	1.4	114	s	1.2	133	s	1.0	148	s	0.89	162	s	0.86
400	66	s	2.7	75	s	2.3	82	s	2.0	99	s	1.6	116	s	1.3	130	s	1.2	142	s	1.1
500	53	s	4.9	60	s	4.1	66	s	3.4	80	s	2.6	93	s	2.1	104	s	1.8	113	s	1.7
600	44	s	8.0	50	s	6.6	55	s	5.4	66	s	4.1	77	s	3.2	86	s	2.8	95	s	2.5

4.3.5. Concentrated load

For a concentrated load over an area of 80×180 mm or 50×50 mm on a continuous plate strip with equal span lengths the critical bending stress is given by

$$\sigma = \frac{M_{cri}}{W} = \alpha \frac{F}{W} \qquad [4.17.],$$

where: F - the concentrated load, N;
W - the section modulus of the full cross - section of the plate strip, (= $t^2/6$), mm^3;
t - the thickness of the plate strip;
α - factor is given in Table 4.33.

The critical shear stress τ is given by

$$\tau = \frac{3}{2}\frac{V_{cri}}{A} = \frac{3}{2}\beta\frac{Fb}{A} \qquad [4.18.],$$

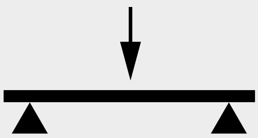
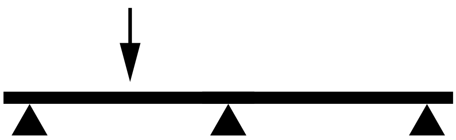
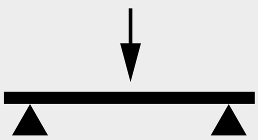
where:
A - (= $2t(180 + 80)$) or (= $2t(50 + 50)$) is the punched shear area, mm^2;
β - is given in Table 4.33.

The critical deflection u_{M+V} is given by

$$u_{M+V} \approx u_M = \varphi \frac{FL^2_{span} b}{EI} \qquad [4.19.],$$

where: I - (= t3/12) is the second moment of plane area of the full cross-section of the plate strip, mm^4 [4.19];
E - the modulus of elasticity, N/mm^2;
φ - factor is given in Table 4.33.

Table 4.33. α, β and φ factors to be used in equations [4.17.] – [4.19.]

Number of spans		α	β	φ
	Strip	0.176 - 0.481	0.855 - 1.061	0.0148 - 0.0217
	Strip	0.152 - 0.486	0.876 - 1.360	0.0115 - 0.0158
	Plate	0.123 - 0.436	0.851 - 1.026	0.0093 - 0.0217

4.3.6. Concentrated load over an area of 50×50 mm

The objective of this section is to present and document tabulated concentrated load resistance values for concrete formworks of Riga Ply birch plywood produced by Latvijas Finieris Group. The calculation is carried out in accordance with VTT research protocol RTE 3969-04 and EN 1995-1-1 Eurocode 5 – Design of timber structures – Part 1:1 General – Common rules and rules for buildings.

Concentrated load values under conditions different from the basic ones *(γ_q=1.5; γ_m=1.2; k_{mod}=0.80)*, are calculated by multiplying tabulated values by a correction factor $k_{load,corr}$, given by

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.2 \times 1.5}{0.80} \quad [4.20.]$$

Plywood deflection values under conditions different from the basic ones *(k_{def}=0.8; ψ_2=0.3)*, are calculated by multiplying tabulated values by a correction factor $k_{def,corr}$, given by

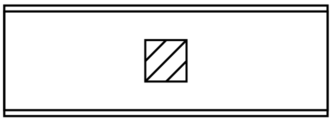
$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.24} k_{load,corr} \quad [4.21.]$$

The load resistance values for: a concentrated load over an area of 50×50 mm on a single span plate strip; a concentrated load over an area of 50×50 mm on a double span plate strip; a concentrated load over an area of 50×50 mm on a simple supported plate given in Tables 4.34 to 4.35 are calculated according to the following assumptions: *γ_q = 1.5; γ_m = 1.2; k_{mod} = 0.80*. Hence, the characteristic load acting in service classes 1 or 2 (dry or q m mod humid) and medium term load duration class (1 week to 6 months) shall not exceed the tabulated values. For other assumptions, the tabulated load resistance values shall be multiplied by a correction factor $k_{load,corr}$ given by equation [4.20.].

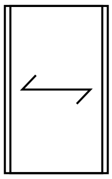
The deflection values given in Tables 4.34 to 4.35 are calculated according to the following assumptions: *k_{def} = 0.8; ψ_2 = 0.3*; the load used is the tabulated load resistance assumed to be totally quasi-permanent. For other assumptions the tabulated deflection values shall be multiplied by a correction factor $k_{def,corr}$ given by equation [4.21.].

In Tables 4.34.–4.36. letter 's' means shear strength limitation and 'b' means bending strength limitation.

Table 4.34. Load resistance for a concentrated load over an area of 50×50 mm on a sanded single span plate strip



Simply supported single span plate strip



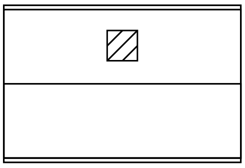
Service Class 1
$k_{mod}=0.8$ $\psi_2=0.3$ $\gamma_m=1.2$
$k_{def}=0.8$ $\gamma_q=1.2$

Concentrated load F (kN) and deflection u (mm)
Nominal thickness (mm)

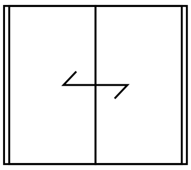
Span c/c mm	4			6.5			9			12			15			18			21		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	0.01	b	0.53	0.31	s	2.5	0.84	s	2.3	1.2	s	1.5	1.7	s	1.2	2.1	s	0.87	2.6	s	0.70
400	0.01	b	0.82	0.27	s	3.9	0.79	b	4.0	1.2	s	2.7	1.7	s	2.1	2.1	s	1.6	2.6	s	1.3
500	0.01	b	1.2	0.24	s	5.6	0.72	b	5.7	1.2	s	4.3	1.7	s	3.3	2.1	s	2.5	2.6	s	2.0
600	0.01	b	1.5	0.23	s	7.5	0.67	b	7.7	1.2	s	6.2	1.7	s	4.8	2.1	s	3.6	2.6	s	2.8
750	0.01	b	2.2	0.21	s	11	0.61	b	11	1.2	s	10	1.7	s	7.7	2.1	s	5.7	2.6	s	4.5
1000	0.01	b	3.5	0.19	b	17	0.56	b	18	1.1	b	16	1.7	s	14	2.1	s	10	2.6	s	8.0
1200	0.01	b	4.8	0.18	b	24	0.52	b	24	1.0	b	22	1.7	b	20	2.1	s	15	2.6	s	11
1500	0.01	b	6.9	0.16	b	35	0.49	b	36	1.0	b	33	1.6	b	29	2.1	s	23	2.6	s	18

Span c/c mm	24			27			30			35			40			45			50		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	3.0	s	0.55	3.5	s	0.46	3.9	s	0.38	4.8	s	0.28	5.7	s	0.21	2.7	s	0.07	7.1	s	0.15
400	3.0	s	1.0	3.5	s	0.83	3.9	s	0.68	4.8	s	0.50	5.7	s	0.38	2.7	s	0.14	7.1	s	0.27
500	3.0	s	1.6	3.5	s	1.3	3.9	s	1.1	4.8	s	0.78	5.7	s	0.59	2.7	s	0.21	7.1	s	0.42
600	3.0	s	2.3	3.5	s	1.9	3.9	s	1.5	4.8	s	1.1	5.7	s	2.86	2.7	s	0.31	7.1	s	0.61
750	3.0	s	3.5	3.5	s	2.9	3.9	s	2.4	4.8	s	1.8	5.7	s	1.3	2.7	s	0.5	7.1	s	1.0
1000	3.0	s	6.3	3.5	s	5.3	3.9	s	4.3	4.8	s	3.2	5.7	s	2.4	2.7	s	0.9	7.1	s	1.7
1200	3.0	s	9.1	3.5	s	7.6	3.9	s	6.2	4.8	s	4.6	5.7	s	3.5	2.7	s	1.2	7.1	s	2.4
1500	3.0	s	14	3.5	s	12	3.9	s	10	4.8	s	7.1	5.7	s	5.4	2.7	s	1.9	7.1	s	3.8

Table 4.35. Load resistance for a concentrated load over an area of 50×50 mm on a sanded double span plate strip



Simply supported double span plate strip

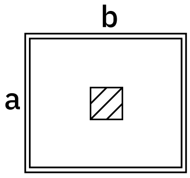


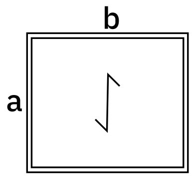
Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

Span c/c mm	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	0.01	b	0.46	0.33	s	2.1	0.84	s	1.9	1.2	s	1.2	1.7	s	0.95	2.1	s	0.70	2.6	s	0.56
400	0,01	b	0.70	0.29	s	3.3	0.84	s	3.4	1.2	s	2.2	1.7	s	1.7	2.1	s	1.3	2.6	s	1.0
500	0.01	b	1.0	0.26	s	4.7	0.76	b	4.8	1.2	s	3.5	1.7	s	2.7	2.1	s	2.0	2.6	s	1.6
600	0.01	b	1.3	0.24	s	6.3	0.70	b	6.4	1.2	s	5.1	1.7	s	3.9	2.1	s	2.9	2.6	s	2.3
750	0.01	b	1.9	0.22	s	9.1	0.64	b	9.2	1.2	s	8.0	1.7	s	6.1	2.1	s	4.5	2.6	s	3.6
1000	0.01	b	3.0	0.20	b	15	0.58	b	15	1.1	b	14	1.7	s	11	2.1	s	8.0	2.6	s	6.4
1200	0.01	b	4.0	0.18	b	20	0.55	b	20	1.1	b	18	1.7	s	16	2.1	s	12	2.6	s	9.3
1500	0.01	b	5.8	0.17	b	29	0.51	b	30	1.0	b	27	1.7	s	24	2.1	s	18	2.6	s	14

Span c/c mm	24			27			30			35			40			45			50		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	3.0	s	0.44	3.5	s	0.37	3.92	s	0.30	4.7	s	0.22	5.4	s	0.16	2.4	s	0.05	6.6	s	0.11
400	3.0	s	0.80	3.5	s	0.66	3.90	s	0.55	4.7	s	0.39	5.4	s	0.29	2.4	s	0.09	6.6	s	0.20
500	3.0	s	1.3	3.5	s	1.0	3.90	s	0.89	4.7	s	0.61	5.4	s	0.45	2.4	s	0.15	6.6	s	0.31
600	3.0	s	1.8	3.5	s	1.5	3.90	s	1.2	4.7	s	0.89	5.4	s	0.66	2.4	s	0.22	6.6	s	0.45
750	3.0	s	2.9	3.5	s	2.4	3.90	s	2.0	4.7	s	1.4	5.4	s	1.0	2.4	s	0.34	6.6	s	0.71
1000	3.0	s	5.1	3.5	s	4.2	3.90	s	3.5	4.7	s	2.5	5.4	s	1.8	2.4	s	0.61	6.6	s	1.3
1200	3.0	s	7.3	3.5	s	6.1	3.90	s	5.0	4.7	s	3.6	5.4	s	2.7	2.4	s	0.87	6.6	s	1.8
1500	3.0	s	11	3.5	s	10	3.90	s	7.9	4.7	s	5.6	5.4	s	4.1	2.4	s	1.4	6.6	s	2.8

Table 4.36. Load resistance for a concentrated load over an area of 50×50 mm on a sanded simple supported plate





Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

Span c/c mm a x b	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)													
	4		6.5		9		12		15		18		21	
	F	*u*	*F*	*u*	*F*	*u*	*F*	*u*	*F*	*u*	*F*	*u*	*F*	*u*
300x300	-	-	0.29	s 1.9	0.82	b 1.8	1.2	s 1.1	1.7	s 0.86	2.1	s 0.63	2.5	s 0.50
300x600	-	-	0.31	s 2.5	0.82	s 2.3	1.2	s 1.5	1.7	s 1.1	2.1	s 0.85	2.5	s 0.68
300x900	-	-	0.31	s 2.5	0.82	s 2.3	1.2	s 1.5	1.7	s 1.2	2.1	s 0.86	2.5	s 0.69
300x∞	-	-	0.31	s 2.5	0.84	s 2.3	1.2	s 1.5	1.7	s 1.2	2.1	s 0.87	2.6	s 0.70
400x400	-	-	0.25	s 3.0	0.72	b 2.8	1.2	s 2.0	1.7	s 1.5	2.0	s 1.1	2.5	s 0.89
400x800	-	-	0.27	s 3.9	0.79	b 3.9	1.2	s 2.7	1.7	s 2.1	2.0	s 1.5	2.5	s 1.2
400x1200	-	-	0.27	s 3.9	0.79	b 4.0	1.2	s 2.7	1.7	s 2.1	2.0	s 1.5	2.5	s 1.2
400x∞	-	-	0.27	s 3.9	0.79	b 4.0	1.2	s 2.7	1.7	s 2.1	2.1	s 1.6	2.6	s 1.3
500x500	-	-	0.23	s 4.4	0.66	b 4.1	1.2	s 3.2	1.7	s 2.4	2.0	s 1.8	2.5	s 1.4
500x1000	-	-	0.24	s 5.6	0.71	b 5.6	1.2	s 4.2	1.7	s 3.2	2.0	s 2.4	2.5	s 1.9
500x1500	-	-	0.24	s 5.6	0.72	b 5.7	1.2	s 4.2	1.7	s 3.3	2.0	s 2.4	2.5	s 1.9
500x∞	-	-	0.24	s 5.6	0.72	b 5.7	1.2	s 4.3	1.7	s 3.3	2.1	s 2.5	2.6	s 2.0
600x600	-	-	0.21	s 5.9	0.62	b 5.5	1.2	s 4.6	1.7	s 3.5	2.0	s 2.6	2.5	s 2.0
600x1200	-	-	0.22	s 7.5	0.66	b 7.6	1.2	s 6.0	1.7	s 4.7	2.0	s 3.4	2.5	s 2.8
600x1800	-	-	0.23	s 7.5	0.67	b 7.7	1.2	s 6.1	1.7	s 4.7	2.0	s 3.5	2.5	s 2.8
600x∞	-	-	0.23	s 7.5	0.67	b 7.7	1.2	s 6.3	1.7	s 4.9	2.1	s 3.6	2.6	s 2.9
750x750	-	-	0.19	s 8.5	0.57	b 8.0	1.1	b 7.1	1.7	s 5.5	2.0	s 4.0	2.5	s 3.2
750x1500	-	-	0.21	s 11	0.61	b 11	1.2	s 10	1.7	s 7.3	2.0	s 5.4	2.5	s 4.3
750x2250	-	-	0.21	s 11	0.61	b 11	1.2	s 10	1.7	s 7.5	2.0	s 5.5	2.5	s 4.4
750x∞	-	-	0.21	s 11	0.61	b 11	1.2	s 10	1.7	s 7.7	2.1	s 5.7	2.6	s 4.6
1000x1000	-	-	0.18	b 14	0.52	b 13	1.0	b 12	1.7	s 10	2.1	s 7.3	2.6	s 5.8
1000x2000	-	-	0.19	b 17	0.55	b 18	1.1	b 16	1.7	s 13	2.1	s 10	2.6	s 7.8
1000x3000	-	-	0.19	b 17	0.56	b 18	1.1	b 16	1.7	s 13	2.1	s 10	2.6	s 7.9
1000x∞	-	-	0.19	b 17	0.56	b 18	1.1	b 16	1.8	b 15	2.1	s 10	2.6	s 7.9
1200x1200	-	-	0.17	b 19	0.49	b 18	1.0	b 16	1.6	b14	2.3	s 11	2.9	s 9.4
1200x2400	-	-	0.18	b 24	0.52	b 24	1.0	b 22	1.7	s 19	2.1	s 14	2.6	s 11
1500x1500	-	-	0.16	b 28	0.46	b 26	0.91	b 23	1.5	b 20	2.1	s 17	2.6	s 13
1500x3000	-	-	0.16	b 34	0.49	b 35	1.0	b 32	1.6	b 29	2.1	s 22	2.6	s 18

Span c/c mm a x b	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)						
	24 *F u*	27 *F u*	30 *F u*	35 *F u*	40 *F u*	45 *F u*	50 *F u*
300x300	3.0 s 0.39	3.4 s 0.32	3.8 s 0.27	4.7 s 0.19	5.6 s 0.15	2.8 s 0.05	7.0 s 0.10
300x600	2.9 s 0.54	3.4 s 0.45	3.8 s 0.37	4.7 s 0.27	5.6 s 0.20	2.7 s 0.07	7.0 s 0.14
300x900	2.9 s 0.55	3.4 s 0.45	3.8 s 0.38	4.7 s 0.27	5.6 s 0.21	2.7 s 0.07	7.0 s 0.15
300x∞	3.0 s 0.55	3.5 s 0.46	3.9 s 0.38	4.8 s 0.28	5.7 s 0.21	2.7 s 0.07	7.1 s 0.15
400x400	2.9 s 0.70	3.4 s 0.58	3.8 s 0.48	4.7 s 0.35	5.6 s 0.26	2.8 s 0.10	7.0 s 0.18
400x800	2.9 s 1.0	3.4 s 0.80	3.8 s 0.66	4.7 s 0.48	5.6 s 0.36	2.7 s 0.13	7.0 s 0.26
400x1200	2.9 s 1.0	3.4 s 0.81	3.8 s 0.67	4.7 s 0.49	5.6 s 0.37	2.7 s 0.13	7.0 s 0.26
400x∞	3.0 s 1.0	3.5 s 0.83	3.9 s 0.68	4.8 s 0.50	5.7 s 0.38	2.7 s 0.13	7.1 s 0.27
500x500	2.9 s 1.1	3.4 s 0.91	3.8 s 0.75	4.7 s 0.54	5.6 s 0.41	2.8 s 0.15	7.0 s 0.29
500x1000	2.9 s 1.5	3.4 s 1.3	3.8 s 1.0	4.7 s 0.76	5.6 s 0.57	2.7 s 0.21	7.0 s 0.40
500x1500	2.9 s 1.5	3.4 s 1.3	3.8 s 1.1	4.7 s 0.77	5.6 s 0.58	2.7 s 0.21	6.9 s 0.41
500x∞	3.0 s 1.6	3.5 s 1.3	3.99 s 1.1	4.8 s 0.79	5.7 s 0.60	2.7 s 0.21	7.1 s 0.42
600x600	2.9 s 1.6	3.4 s 1.3	3.8 s 1.1	4.7 s 0.79	5.6 s 0.60	2.8 s 0.22	7.0 s 0.42
600x1200	2.9 s 2.2	3.4 s 1. 8	3.8 s 1.5	4.7 s 1.1	5.6 s 0.83	2.7 s 0.30	7.0 s 0.59
600x1800	2.9 s 2.2	3.4 s 1.9	3.8 s 1.5	4.7 s 1.1	5.6 s 0.85	2.7 s 0.31	7.0 s 0.60
600x∞	3.0 s 2.3	3.5 s 1.9	3.9 s 1.6	4.8 s 1.1	5.7 s 0.87	2.7 s 0.31	7.1 s 0.61
750x750	2.9 s 2.5	3.4 s 2.1	3.8 s 1.7	4.7 s 1.2	5.6 s 0.94	2.7 s 0.34	7.0 s 0.66
750x1500	2.9 s 3.4	3.4 s 2.9	3.8 s 2.4	4.7 s 1.7	5.6 s 1.3	2.7 s 0.47	7.0 s 0.92
750x2250	2.9 s 3.5	3.4 s 2.9	3.8 s 2.4	4.7 s 1.8	5.6 s 1.3	2.7 s 0.48	7.0 s 0.94
750x∞	3.0 s 3.6	3.5 s 3.0	3.9 s 2.5	4.9 s 1.8	5.8 s 1.4	2.7 s 0.48	7.2 s 0.97
1000x1000	3.0 s 4.5	3.5 s 3.8	3.9 s 3.1	4.8 s 2.2	5.7 s 1.7	2.7 s 0.61	7.1 s 1.2
1000x2000	3.0 s 6.2	3.5 s 5.1	3.9 s 4.2	4.8 s 3.1	5.7 s 2.3	2.7 s 0.84	7.0 s 1.7
1000x3000	3.0 s 6.3	3.4 s 5.2	3.8 s 4.3	4.8 s 3.2	5.7 s 2.4	2.7 s 0.86	7.0 s 1.7
1000x∞	3.0 s 6.3	3.4 s 5.2	3.8 s 4.3	4.8 s 3.2	5.7 s 2.4	2.7 s 0.86	7.0 s 1.7
1200x1200	3.3 s 7.4	3.9 s 6.1	4.3 s 5.0	5.3 s 3.6	6.2 s 2.7	2.7 s 0.87	7.5 s 1.8
1200x2400	3.0 s 9.0	3.5 s 7.5	3.9 s 6.2	4.8 s 4.5	5.7 s 3.4	2.7 s 1.2	7.1 s 2.4
1500x1500	3.0 s 10	3.5 s 8.7	3.9 s 7.1	4.9 s 5.1	5.8 s 3.9	2.7 s 1.4	7.2 s 2.7
1500x3000	3.0 s 14	3.5 s 12	3.9 s 10	4.9 s 7.1	5.8 s 5.4	2.7 s 1.9	7.2 s 3.8

4.3.7. Concentrated load over an area of 80×180 mm

The objective of this section is to present and document tabulated concentrated load resistance values for floors of Riga Ply birch plywood produced by Latvijas Finieris Group. The calculation is carried out in accordance with VTT research protocol RTE 3970-04 and EN 1995-1-1 Eurocode 5.

The load resistance values for: a concentrated load over an area of 80×180 mm on a single span plate strip; a concentrated load over an area of 80×180 mm on a double span plate strip; a concentrated load over an area of 80×180 mm on a simple supported plate given in Tables 4.37 to 4.39 are calculated according to the following assumptions: γ_q = 1.0; γ_m = 1.0; k_{mod} = 0.90. Hence, the characteristic load acting in service classes 1 or 2 (dry or humid) and short term load duration class (less than one week) shall not exceed the tabulated values. For other assumptions the tabulated load resistance values shall be multiplied by a correction factor $k_{load,corr}$ given by equation [4.22].

The deflection values given in Tables 4.37 to 4.39 are calculated according to the following assumptions: k_{def} = 1.0; ψ_2 = 0.0; the load used is the tabulated load resistance assumed to be totally quasi-permanent. For other assumptions, the tabulated deflection values shall be multiplied by a correction factor $k_{def,corr}$ given by equation [4.23].

In Tables 4.37.–4.39. letter 's' means shear strength limitation and 'b' means bending strength limitation.

Concentrated load values under conditions different from the basic ones *(γ_q=1.0; γ_m=1.0; k_{mod}=0.90)*, are calculated by multiplying tabulated values by a correction factor $k_{def,corr}$, given by:

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.0\times1.0}{0.90}$$ [4.22.].

Plywood deflection values under conditions different from the basic ones *(k_{def}=1.0; ψ_2=0.0)*, are calculated by multiplying tabulated values by a correction factor $k_{def,corr}$, given by

$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.0} k_{load,corr}$$ [4.23.].

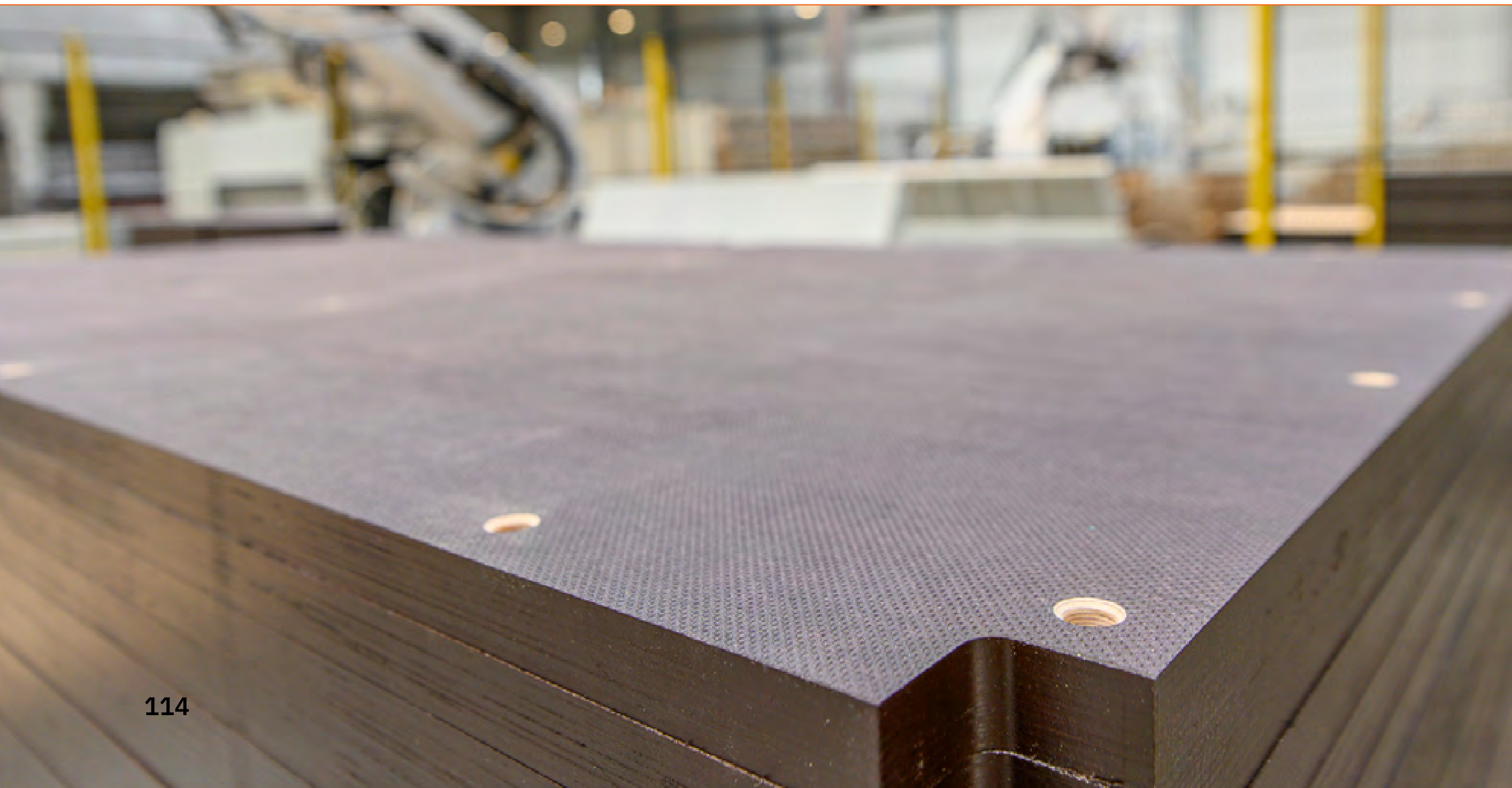
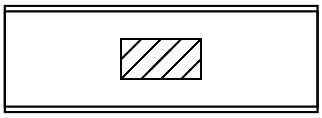
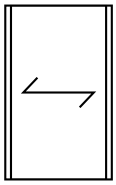


Table 4.37. Load resistance for a concentrated load over an area of 80×180 mm on a sanded single span plate strip



Simply supported single span plate strip

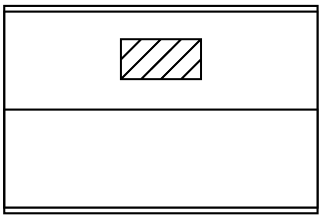


Service Class 1
k_{mod}=0.9 ψ_2=0.0 γ_m=1.0
k_{def}=1.0 γ_q=1.0

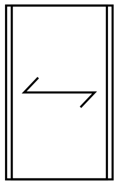
Span c/c mm a x b	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	0.06	b	1.9	1.6	b	8.9	3.4	b	6.6	5.6	b	5.1	8.4	b	4.1	12	b	3.5	15	s	2.8
400	0.04	b	2.7	1.2	b	13	3.0	b	11	4.9	b	8.4	7.3	b	6.8	10	b	5.7	14	b	4.9
500	0.03	b	3.6	0.98	b	17	2.7	b	16	4.5	b	12	6.7	b	10	9.3	b	8.4	12	b	7.2
600	0.03	b	4.6	0.86	b	22	2.5	b	22	4.1	b	17	6.2	b	14	8.6	b	11	12	b	10
750	0.02	b	6.3	0.74	b	30	2.1	b	30	3.8	b	25	5.7	b	20	8.0	b	17	11	b	15
1000	0.02	b	10	0.62	b	46	1.8	b	46	3.5	b	41	5.2	b	33	7.3	b	28	9.7	b	24
1200	0.02	b	13	0.57	b	61	1.7	b	61	3.3	b	56	4.9	b	45	6.9	b	38	9.2	b	33
1500	0.02	b	18	0.51	b	86	1.5	b	87	3.0	b	79	4.6	b	67	6.5	b	56	8.6	b	48

Span c/c mm a x b	24			27			30			35			40			45			50		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	17	s	2.2	19	s	1.8	21	s	1.5	25	s	1.0	29	s	0.76	13	s	0.25	35	s	0.52
400	17	s	4.3	19	s	3.4	21	s	2.8	25	s	2.0	29	s	1.5	13	s	0.48	35	s	1.0
500	16	b	6.3	19	s	5.5	21	s	4.5	25	s	3.2	30	s	2.4	13	s	0.78	36	s	1.6
600	15	b	8.7	18	b	7.7	22	s	6.7	26	s	4.7	30	s	3.5	13	s	1.1	36	s	2.4
750	14	b	13	17	b	11	21	b	10	26	s	7.5	30	s	5.5	13	s	1.8	36	s	3.8
1000	12	b	21	16	b	19	19	b	17	26	s	13	30	s	10	13	s	3.3	36	s	6.8
1200	12	b	29	15	b	26	18	b	23	25	b	19	30	s	14	13	s	4.8	36	s	10
1500	11	b	42	14	b	38	17	b	34	24	b	29	30	s	23	13	s	7.5	36	s	16

Table 4.38. Load resistance for a concentrated load over an area of 80×180 mm on a sanded double span plate strip



Simply supported
doube span plate strip

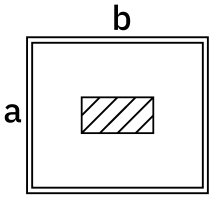


Service Class 1
k_{mod}=0.9 ψ_2=0.0 γ_m=1.0
k_{def}=1.0 γ_q=1.0

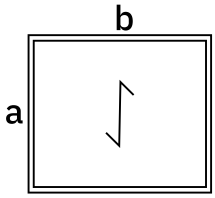
Span c/c mm a x b	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	0.07	b	1.8	1.9	s	8.1	3.9	b	5.9	6.5	b	4.6	8.1	s	3.1	10	s	2.3	11	s	1.7
400	0.05	b	2.5	1.4	b	11	3.3	b	10	5.6	b	7.5	8.3	b	6.1	11	s	4.7	12	s	3.4
500	0.04	b	3.3	1.1	b	15	3.0	b	14	5.0	b	11	7.5	b	8.8	10	b	7.4	13	s	5.9
600	0.03	b	4.1	0.94	b	19	2.7	b	19	4.6	b	15	6.9	b	12	9.6	b	10	13	b	8.7
750	0.03	b	5.6	0.80	b	26	2.3	b	26	4.2	b	22	6.3	b	18	8.8	b	15	12	b	13
1000	0.02	b	8.3	0.67	b	39	1.9	b	39	3.8	b	35	5.7	b	29	8.0	b	24	11	b	21
1200	0.02	b	11	0.60	b	51	1.8	b	52	3.5	b	47	5.4	b	39	7.5	b	33	10	b	28
1500	0.02	b	15	0.54	b	72	1.6	b	73	3.1	b	67	5.0	b	58	7.0	b	48	9.3	b	42

Span c/c mm a x b	24			27			30			35			40			45			50		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	13	s	1.3	14	s	1.0	16	s	0.9	19	s	0.60	22	s	0.45	10	s	0.15	27	s	0.31
400	14	s	2.7	16	s	2.2	17	s	1.8	21	s	1.3	24	s	0.93	11	s	0.31	29	s	0.64
500	14	s	4.4	16	s	3.5	17	s	2.9	21	s	2.0	24	s	1.5	11	s	0.52	29	s	1.0
600	14	s	6.5	16	s	5.2	17	s	4.2	21	s	3.0	24	s	2.2	11	s	0.77	29	s	1.5
750	14	s	10	16	s	8.2	17	s	6.8	21	s	4.8	24	s	3.5	11	s	1.2	29	s	2.4
1000	14	b	18	16b	b	15	17	s	12	21	s	8.6	24	s	6.4	11	s	2.2	29	s	4.4
1200	13	b	25	16	b	22	17	s	18	21	s	12	24	s	9.2	11	s	3.2	29	s	6.3
1500	12	b	37	15	b	33	17	s	28	21	s	20	24	s	15	11	s	5.0	29	s	10

Table 4.39. Load resistance for a concentrated load
over an area of 80×180 mm on a sanded simple supported plate



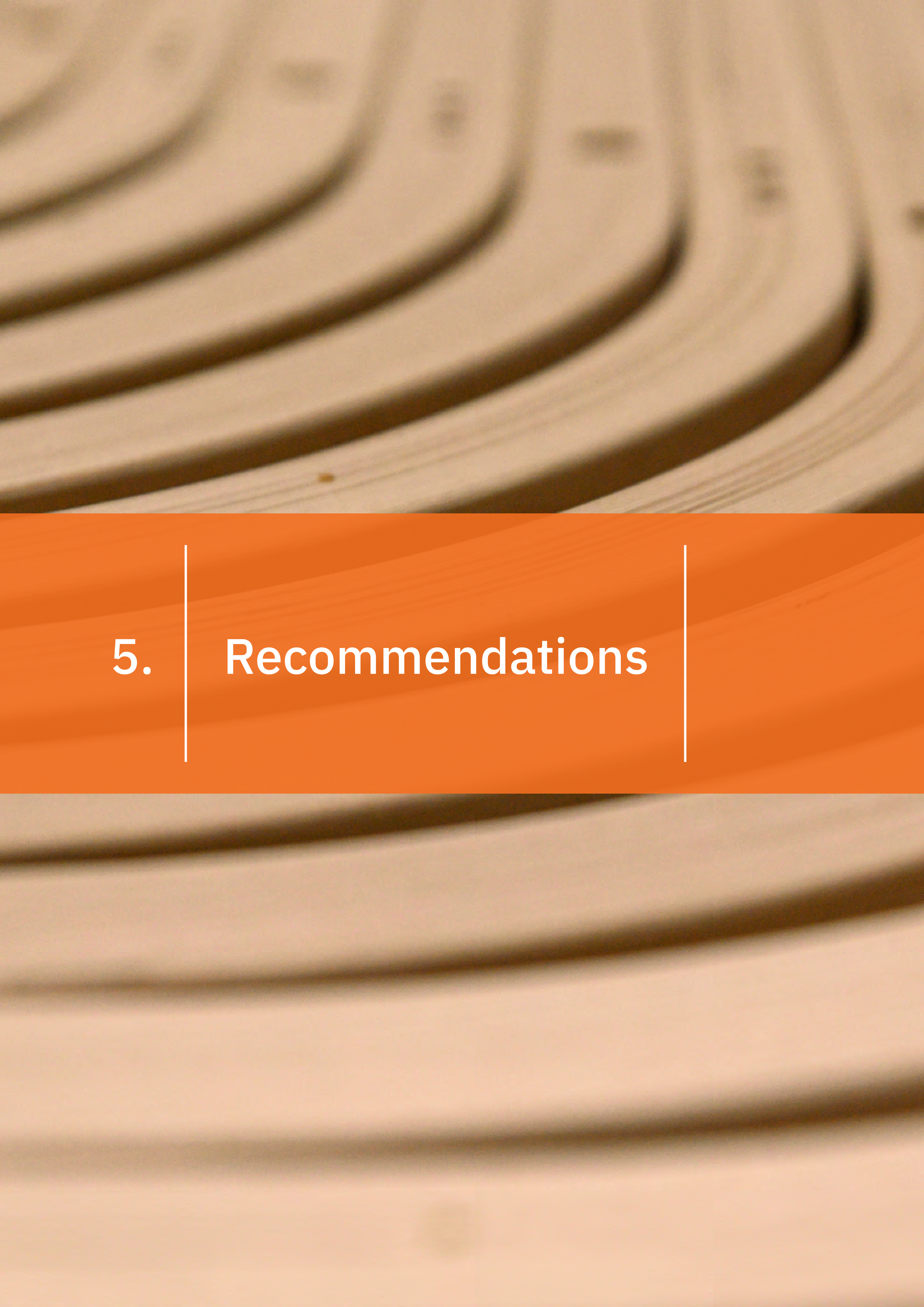
Simply supported
rectangular plate



Service Class 1
k_{mod}=0.9 ψ_2=0.0 γ_m=1.0
k_{def}=1.0 γ_q=1.0

Span c/c mm a x b	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	F		u	F		u	F		u	F		u	F		u	F		u	F		u
300x300	-		-	1.3	b	5.5	3.6	b	5.0	6.8	b	4.3	11	s	3.7	13	s	2.6	17	s	2.1
300x600	-		-	1.6	b	8.8	3.5	b	6.6	5.7	b	5.1	8.5	b	4.1	12	b	3.4	15	s	2.8
300x900	-		-	1.6	b	8.9	3.4	b	6.6	5.6	b	5.1	8.4	b	4.1	12	b	3.5	15	s	2.8
300x∞	-		-	1.6	b	8.9	3.4	b	6.6	5.6	b	5.1	8.4	b	4.1	12	b	3.5	15	s	2.8
400x400	-		-	1.0	b	8.6	2.8	b	7.8	5.4	b	6.7	8.9	b	5.8	13	s	5.0	16	s	3.9
400x800	-		-	1.2	b	12	3.0	b	11	5.0	b	8.3	7.4	b	6.8	10	b	5.7	14	b	4.9
400x1200	-		-	1.2	b	13	3.0	b	11	4.9	b	8.4	7.3	b	6.8	10	b	5.7	14	b	4.9
400x∞	-		-	1.2	b	13	3.0	b	11	4.9	b	8.4	7.3	b	6.8	10	b	5.7	14	b	4.9
500x500	-		-	0.86	b	12	2.4	b	11	4.7	b	9.5	7.6	b	8.2	11	b	7.2	15	s	6.2
500x1000	-		-	0.98	b	17	2.7	b	16	4.5	b	12	6.7	b	10	9.4	b	8.3	13	b	7.2
500x1500	-		-	0.98	b	17	2.7	b	16	4.5	b	12	6.7	b	10	9.3	b	8.4	12	b	7.3
500x∞	-		-	0.98	b	17	2.7	b	16	4.5	b	12	6.7	b	10	9.3	b	8.4	12	b	7.3
600x600	-		-	0.76	b	16	2.1	b	14	4.2	b	13	6.8	b	11	10.1	b	10	14	b	8.5
600x1200	-		-	0.85	b	22	2.5	b	21	4.2	b	17	6.3	b	14	8.7	b	11	12	b	10
600x1800	-		-	0.86	b	22	2.5	b	22	4.1	b	17	6.2	b	14	8.6	b	11	12	b	10
600x∞	-		-	0.86	b	22	2.5	b	22	4.1	b	17	6.2	b	14	8.6	b	11	12	b	10
750x750	-		-	0.66	b	22	1.9	b	21	3.7	b	18	6.1	b	15	9.0	b	14	12	b	12
750x1500	-		-	0.73	b	30	2.1	b	30	3.9	b	25	5.8	b	20	8.1	b	17	11	b	14
750x2250	-		-	0.74	b	30	2.1	b	30	3.8	b	25	5.7	b	20	8.0	b	17	11	b	14
750x∞	-		-	0.74	b	30	2.1	b	30	3.8	b	25	5.7	b	20	8.0	b	17	11	b	15
1000x1000	-		-	0.57	b	35	1.6	b	32	3.2	b	28	5.3	b	25	7.8	b	22	11	b	19
1000x2000	-		-	0.62	b	45	1.8	b	45	3.5	b	40	5.3	b	33	7.3	b	27	9.8	b	24
1000x3000	-		-	0.62	b	46	1.8	b	46	3.5	b	41	5.2	b	33	7.3	b	28	9.7	b	24
1000x∞	-		-	0.62	b	46	1.8	b	46	3.5	b	41	5.2	b	33	7.3	b	28	9.7	b	24
1200x1200	-		-	0.52	b	46	1.5	b	43	3.0	b	38	4.9	b	33	7.2	b	29	10	b	26
1200x2400	-		-	0.57	b	60	1.7	b	60	3.3	b	54	5.0	b	45	6.9	b	38	9.3	b	32
1500x1500	-		-	0.47	b	66	1.4	b	62	2.7	b	54	4.4	b	47	6.6	b	42	9.2	b	37
1500x3000	-		-	0.51	b	85	1.5	b	86	3.0	b	77	4.7	b	66	6.5	b	55	8.7	b	48

Span c/c mm a x b	Concentrated load F (kN) and deflection u (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300x300	19	s	1.6	21	s	1.3	24	s	1.1	28	s	0.74	33	s	0.55	15	s	0.18	40	s	0.37
300x600	17	s	2.2	19	s	1.7	21	s	1.4	25	s	1.0	29	s	0.74	13	s	0.24	35	s	0.51
300x900	17	s	2.2	19	s	1.8	21	s	1.4	25	s	1.0	29	s	0.75	13	s	0.25	35	s	0.52
300x∞	17	s	2.2	19	s	1.8	21	s	1.4	25	s	1.0	29	s	0.76	13	s	0.25	35	s	0.52
400x400	18	s	3.1	20	s	2.5	23	s	2.0	27	s	1.4	32	s	1.0	14	s	0.34	38	s	0.52
400x800	17	s	4.2	19	s	3.3	21	s	2.7	25	s	1.9	29	s	1.4	13	s	0.47	26	s	0.97
400x1200	17	s	4.3	19	s	3.4	21	s	2.8	25	s	2.0	29	s	1.4	13	s	0.48	35	s	0.99
400x∞	17	s	4.3	19	s	3.4	21	s	2.8	25	s	2.0	29	s	1.5	13	s	0.48	35	s	0.99
500x500	17	s	4.9	20	s	4.0	22	s	3.2	27	s	2.3	31	s	1.7	14	s	0.55	37	s	1.1
500x1000	16	b	6.3	19	s	5.4	22	s	4.4	26	s	3.1	30	s	2.3	13	s	0.76	36	s	1.6
500x1500	16	b	6.3	19	s	5.5	21	s	4.5	25	s	3.2	30	s	2.4	13	s	0.77	36	s	1.6
500x∞	16	b	6.3	19	s	5.5	21	s	4.5	25	s	3.2	30	s	2.4	13	s	0.78	36	s	1.6
600x600	17	s	7.0	20	s	5.8	22	s	4.8	26	s	3.3	31	s	2.5	14	s	0.81	37	s	1.7
600x1200	15	b	8.6	19	b	7.7	22	s	6.5	26	s	4.6	30	s	3.4	13	s	1.1	36	s	2.3
600x1800	15	b	8.7	18	b	7.7	22	s	6.7	26	s	4.7	30	s	3.5	13	s	1.1	36	s	2.4
600x∞	15	b	8.7	18	b	7.7	22	s	6.7	26	s	4.7	30	s	3.5	13	s	1.1	36	s	2.4
750x750	17	b	11	20	s	9.1	22	s	7.5	26	s	5.3	30	s	3.9	13	s	1.3	37	s	2.7
750x1500	14	b	13	17	b	11	21	b	10	26	s	7.3	30	s	5.4	13	s	1.8	36	s	3.7
750x2250	14	b	13	17	b	11	21	b	10	26	s	7.5	30	s	5.5	13	s	1.8	36	s	3.8
750x∞	14	b	13	17	b	11	21	b	10	26	s	7.5	30	s	5.5	13	s	1.8	36	s	3.8
1000x1000	14	b	17	18	b	16	21	s	13	26	s	10	30	s	7.0	13	s	2.3	36	s	4.8
1000x2000	13	b	21	16	b	18	19	b	17	26	s	13	30	s	10	13	s	3.2	36	s	6.7
1000x3000	12	b	21	16	b	19	19	b	17	26	s	13	30	s	10	13	s	3.3	36	s	6.8
1000x∞	12	b	21	16	b	19	19	b	17	26	s	13	30	s	10	13	s	3.3	36	s	6.8
1200x1200	13	b	23	17	b	21	21	b	19	26	s	14	30	s	10	13	s	3.4	36	s	7.0
1200x2400	12	b	28	15	b	25	18	b	23	26	s	19	30	s	14	13	s	4.7	36	s	9.7
1500x1500	12	b	34	16	b	31	19	b	28	26	s	22	30	s	16	13	s	5.3	36	s	11
1500x3000	11	b	42	14	b	37	17	b	34	24	s	28	30	s	22	13		s7.3	36	s	15



5. Recommendations

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Plywood panels need to be handled correctly not only in the production stage but subsequently in its finished state when being stored, transported, installed, and properly disposed. The further instructions are based on Latvijas Finieris Group's real-world, long-term experience and European Standard ENV 12872 on wood-based panels in structural applications.

5.1. Packaging

Latvijas Finieris Group's aim is to make sure that Riga Wood birch plywood arrives to our customer in perfect condition. Therefore, to secure quality during transportation and warehousing, for plywood packaging, mainly plywood, cardboard or stretch film is used. Packages are strapped with recycled plastic or metal straps; to not damage plywood panels, plastic or cardboard supporting brackets are used (see Figure 5.1.). The stretch film is light weight, protective and easily shaped material, which contains recycled film and is certified as a sustainable product (see Figure 5.2.). Packaging should be disposed of in the appropriate waste streams according to current legislation.

Figure 5.1. Riga Wood plywood standard size cardboard packaging

Figure 5.2. Riga Wood stretch film packaging

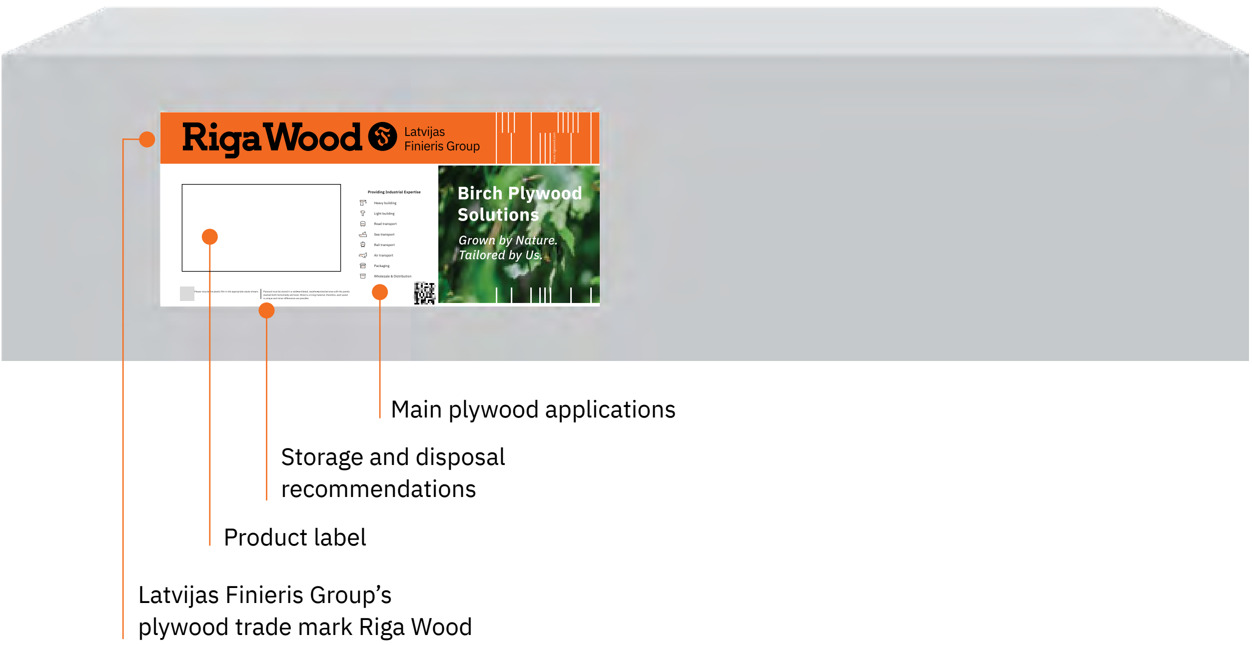


Figure 5.3. Label on the packaging

TRADE MARK	
PRODUCT NAME	Customer info
Product details	Product compliance to specific requirements
Packaging information	Certification
Identification number and barcode	

5.2. Transportation

Proper storage and transportation of plywood is of utmost importance. Analysis of customers' complaints concerning delivered goods indicate that many flaws and damages arise from lack of information (improper storage, transportation, and selection of processing technics).

To protect the plywood packages from moisture and mechanical damage during transportation and storage, as well as improve unloading safety and reduce loading and unloading time, the packaging is of great importance. Plywood sheets should be placed to ensure high package stability, so that the package does not fall apart or deform during transportation and storage. To avoid possible moisture penetration, plywood edges should be sealed with moisture resistant paint.

5.3. Storage

Correct storage and appropriate storage place are essential to maintain the quality of plywood. Plywood must be stored in a well-ventilated area, well protected against rain, sunlight and snow (a cool and dry place). Rapid temperature changes and humidity should be avoided. Moisture can enter the panel while storing in damp or humid areas before finishing, missing priming after installation or absence of edge sealing.

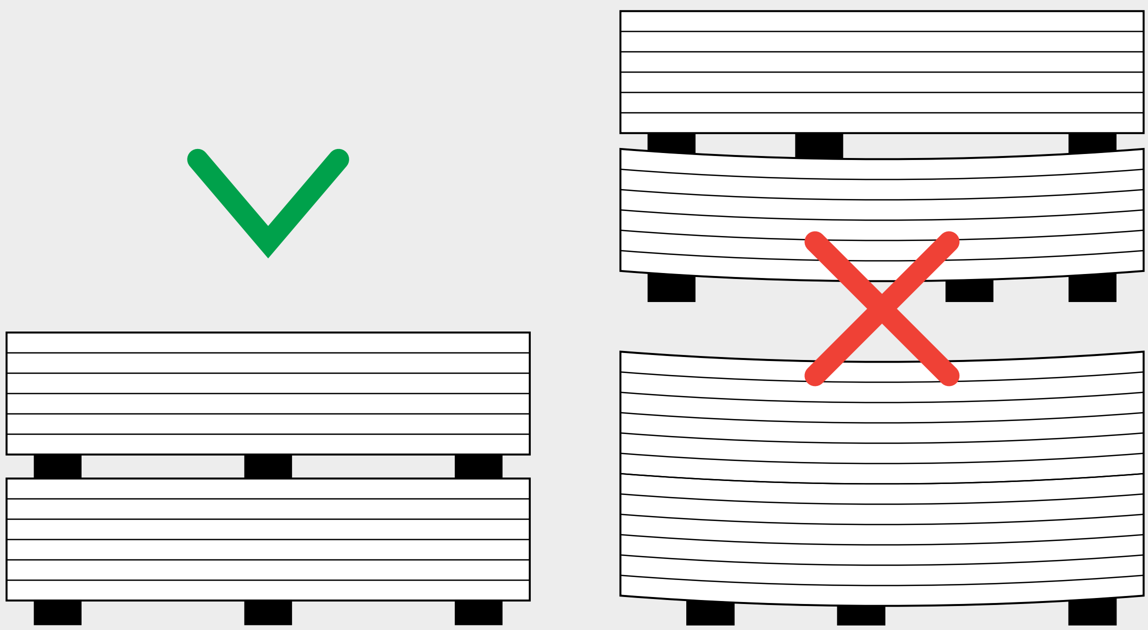
An appropriate storage place should have a coated floor either in concrete or other thick material. To prevent damages caused by drops of water, mud or other liquids and to avoid panels from absorbing moisture from the ground, plywood must not be stacked directly on the floor, but on pallets or bearers at least 80 mm high.

Panels must be stacked both horizontally and level, never on their edge. A stack must be supported by at least 3 bearers with a distance of about 800 mm or on pallets. When stacking plywood packages one upon another, the intermediate bearers must be at the same vertical line, as shown in Figure 5.4.

Plywood for decorative end-uses should be stored with special care and always covered to avoid dust, sand and other minerals spoiling the decorative surface.

If plywood is kept outside (at a construction site) it should be well covered and stacked on pallets and bearers.

Figure 5.4. Properly and improperly stacked plywood panels



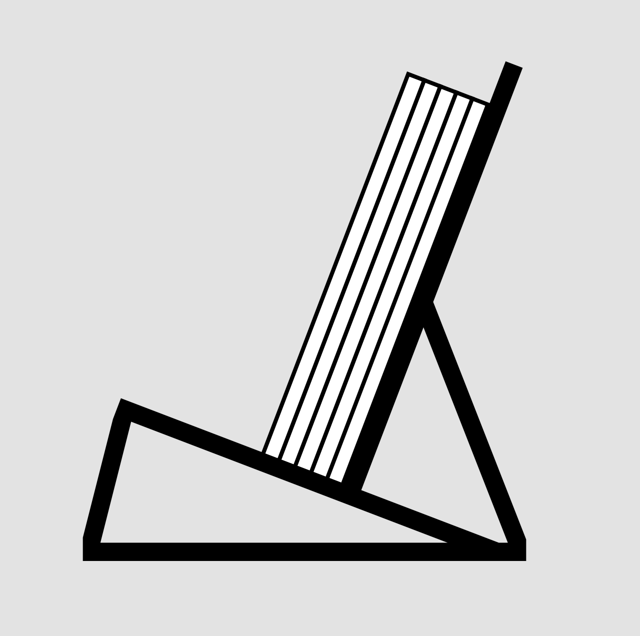
5.4. Acclimatisation

Plywood, as other wood materials, is hygroscopic, i.e. a moisture absorbing material. Moisture content variation causes swelling or shrinking of plywood. To obtain good results in further processing, it is therefore important that plywood is well acclimatised and reaches an equilibrium moisture content corresponding to the prevailing conditions at the further processing site. The equilibrium moisture content is what plywood reaches under constant relative humidity and temperature, during a long period.

Considering the above, a storage place with air parameters similar to parameters of the final application place must be selected. The height of stacks affects the acclimatisation time. Examples of stacks are shown in Figure 5.5. In an ideal case, intermediate beams separate every panel in a stack. Plywood in a tight stack absorbs or releases moisture uniformly through uncovered surfaces of the panels, i.e. only through the edges and the uncovered upper and bottom surfaces of the panels. When stacked panels are separated with intermediate beams, all faces and sides of the panels are uncovered, allowing a constant and equal panel acclimatisation, thus significantly reducing the required acclimatisation time. Plywood acclimatisation time depends on the difference between equilibrium moisture content between plywood and the respective environment, air flow, and panel thickness among others factors. A panel has reached the equilibrium moisture content if its weight remains constant for 24 hours. Panel edges must not touch the floor or the wall (Figure 6.5).

When stocking plywood packs in a humid environment, packing straps must be opened to not damage panel edges due to panel swelling. Absorption or release of 1% of moisture, leads to the following alterations of the plywood panel dimensions: length 0.02%, width 0.02%, and thickness 0.3%.

Figure 5.5. Stack of plywood panels



5.5. Safe handling

It is generally acknowledged that greatest damage to plywood panels may occur during various handling operations. Plywood should be handled correctly, both during the production process and warehousing. Handling plywood requires general safety procedures and proper equipment. Handling should be kept to a minimum, and for speed and efficiency, mechanical handling devices should be used whenever possible.

When taking a panel from a pack or a stack, it must be lifted, not pulled over the surface of the bottom panel, because any hard particle (sand or film particle) between panels can lead to damage of processed or coated surfaces. Plywood packs must be moved with a forklift and handled carefully to avoid any possible damages. Packs should only be lifted by forklift from the underside and never via metal/plastic packing straps. Film faced plywood panels are very slippery; sliding panels may lead a whole stack to collapse. Remember, separate sheets must be moved manually by two persons! Panels must not be pulled or pushed on the floor or ground.

5.6. Jointing and installation

5.6.1. Gluing

Application of phenol type glues is recommended for plywood joints requiring resistance against moisture. Urea type adhesive or other types of glue fit for wood are recommended for joints not requiring moisture resistance. It is recommended to use PVA dispersion adhesive to glue plywood with plastic or metal, or glue of different type designed for such materials. Before gluing, it is recommended to clean surfaces from dust; metal surfaces are to be degreased.

When gluing plywood to the material of different a value of coefficient of temperature expansion, a glue that is able to compensate dimension alteration of material under the influence of temperature should be used. When selecting adhesive for gluing of different materials, it is recommended to consult glue manufacturers.

5.6.2. Joint types

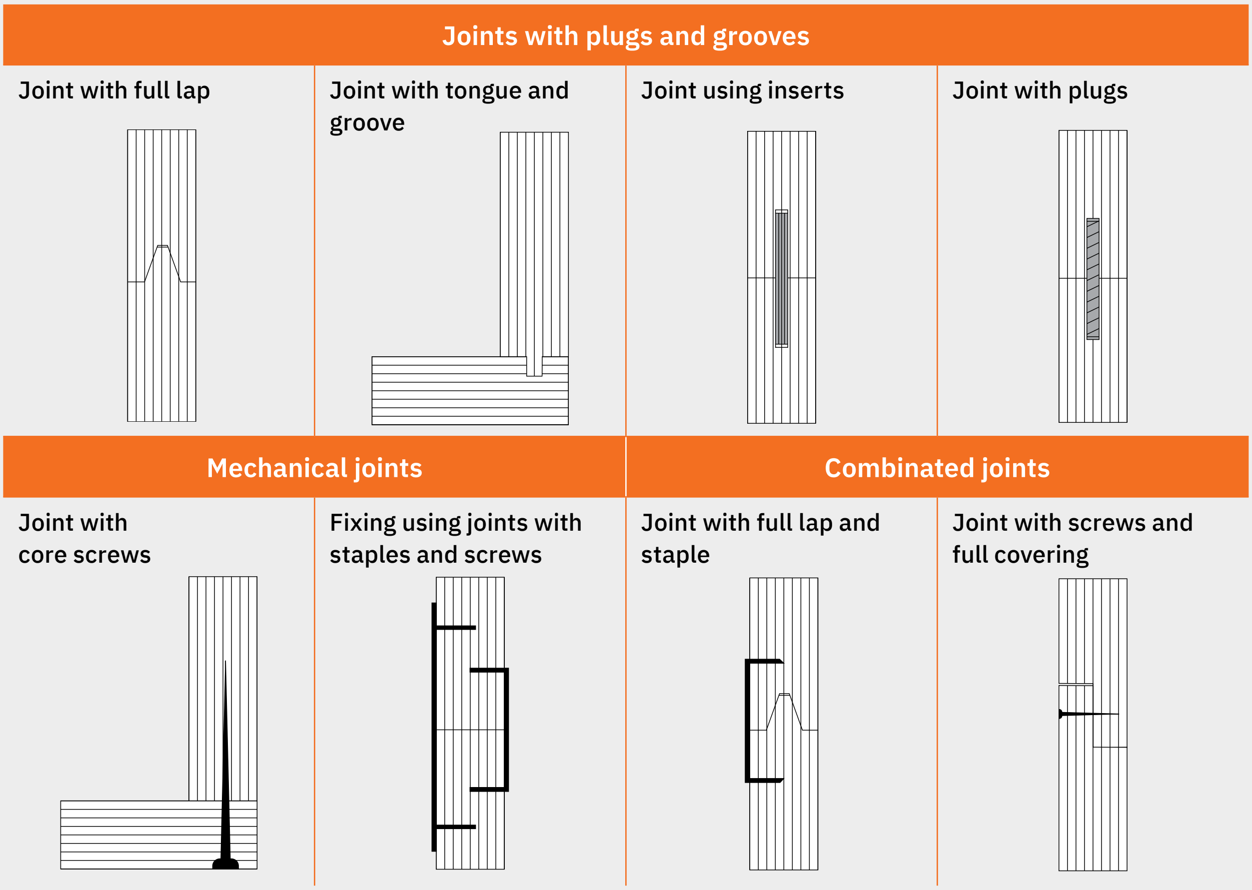
The following solutions (see Figure 5.6) can be used for plywood jointing: (1) tongue and groove joints; (2) mechanical joints (bolts, rivets, clamps, wood screws and other joints); (3) combined joints. Adhesive selection depends on plywood type (exterior or interior applications). For tongue and groove joints, reinforcement is recommended. Glue line provides higher joint resistance in comparison with mechanical type joints. To protect grooves against moisture, they should be filled with a moisture resistant type filler or wax. Ends of grooves may be protected with water resistant protecting material (paint, filler).

For mechanical joints, drilling is necessary before screw application. Hole diameter for bolt or rivet joints must be equal or slightly smaller than the bolt or rivet diameter. The distance from the plywood edge to the hole must be at least two times larger than the bolt or rivet head diameter. This protects the joint from deformation. The application of water resistant materials for protection against moisture is recommended. Applying bolt and rivet joints is recommended to avoid deforming of panels.

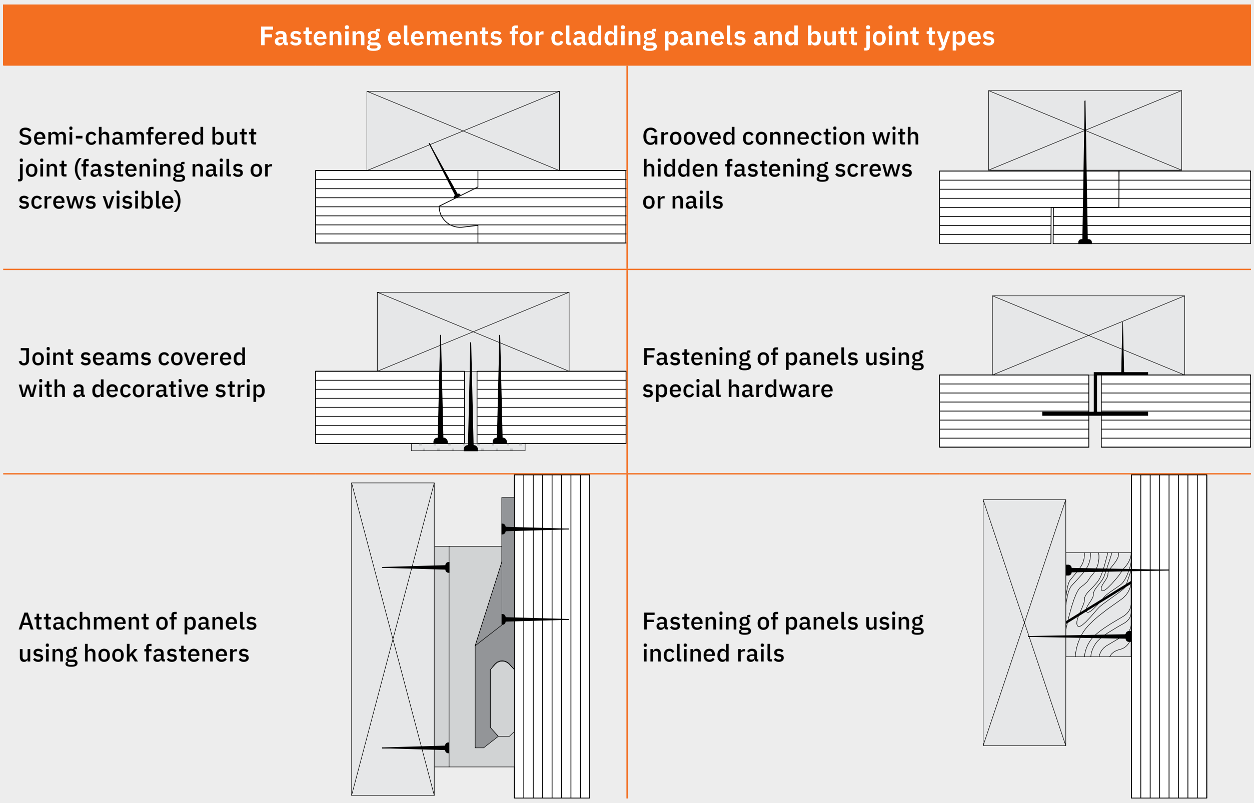
For wood screws, the joint hole diameter must be less than the screw head diameter. This provides an easier plywood joint accomplishment. The general recommendation concerning hole diameter is the following: hole diameter = 0.5 * screw diameter.

Combined joints are recommended for tongue and groove joint reinforcement, applying metal or plastic straps on tongue and groove joints, thus decreasing the possibility of warping.

Figure 5.6. Joint types



Depending on the intended type of fastening, wall cladding panels have semi-chamfers or fluting, with recesses milled along the entire perimeter of the panel.



5.6.3 Plywood edge sealing

For outdoor applications, panel edges must be protected against moisture, sealing with water resistant materials (paint, filler, etc.). Sealing can be accomplished by spraying plywood panels in a stack or sealing each panel individually, applying material by roller or brush. Edge sealing protects against water or moisture penetration via edges.

The Figure 5.7 shows variation of thickness (in percent) of plywood (18 mm) overlaid with phenol film, 2 cm from the edge after immersion in water for 48 hours and drying. If the edges of a panel are not protected, the alteration value is three times higher.

Figure 5.8 represents moisture content after the sample has been taken out of water, continuing to equalise in the direction of the plywood's centre, at the same time leading to edges shrivel. The Y-axis indicates the change in average plywood thickness during water absorption, while the X-axis indicates the distance from the edge of the sample to the measurement location to evaluate the impact on the whole sample surface.

Figure 5.7. Dimension alteration of 18 mm plywood panel overlaid with phenol film, in %, 2 cm from the edge, after immersion in water for 48 h and drying

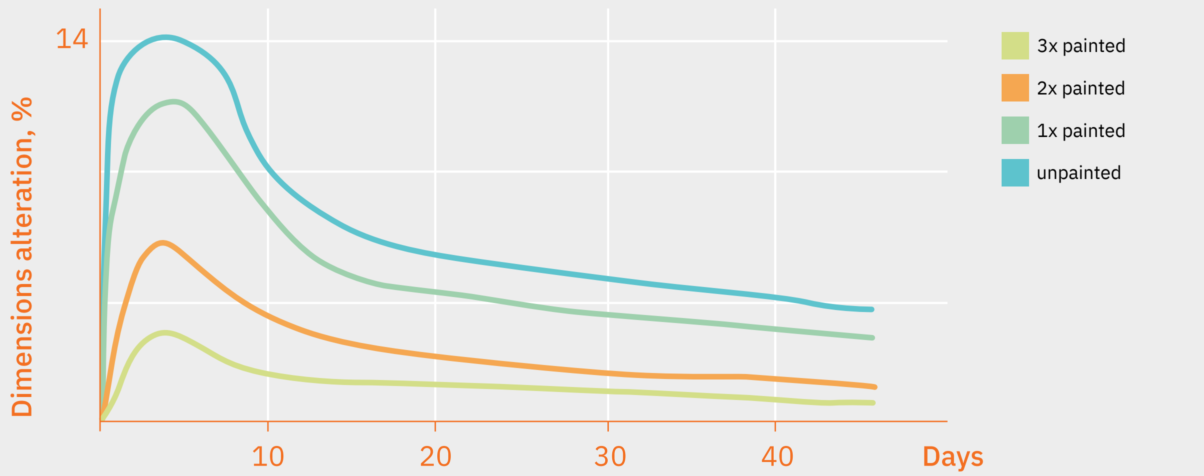
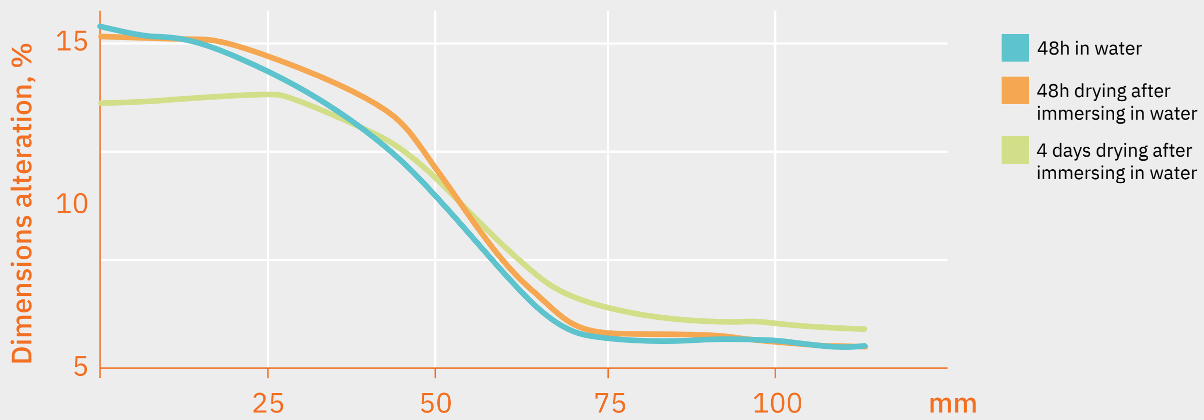


Figure 5.8. Dimension alteration



5.7. End of life and disposal

History repeats itself, therefore we strongly believe wood to be the future of building materials because of its physical properties and natural origins. Plywood is processed to be even stronger and more versatile than natural wood allowing it to be used in even more specific applications.

We encourage you to see the potential of our plywood and give it new purpose at the end of its first use because if properly maintained, wood can last a lifetime and even longer.

However, if you decide to use your plywood offcuts for heat energy production, we do not advise incinerating in conventional boilers due to the resin glue content in plywood.

If there is no other possible use, we recommend disposing in a local landfill as non-hazardous wood waste.

6. Additional information

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6.3. Riga Wood birch plywood equivalents to the U.S. plywood standard dimensions 137

6.1. Statistical processing of data

Indices of plywood strength can depend on numerous factors, for example, veneer log sort, lay-up scheme, moisture content, plywood finishing (sanded or unsanded), etc. To establish plywood characteristics, it is necessary to test many samples. The larger the number of tested samples, the more reliable testing results can be obtained.

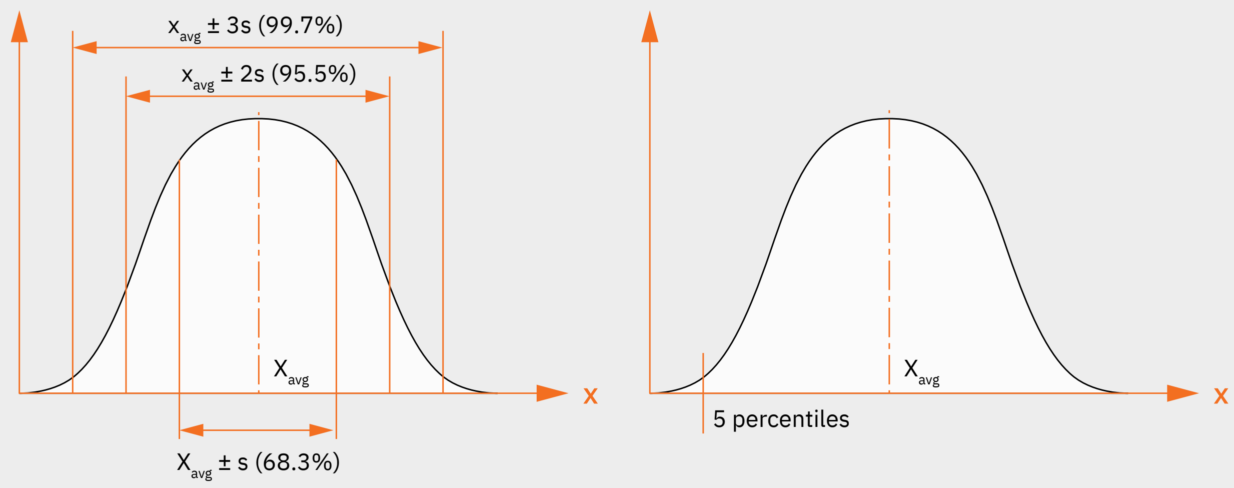
In calculations, various methods of statistical data processing are used, such as arithmetic mean, standard deviation, coefficient variation, etc.

Separate arithmetic mean (mean value) describes (reflects) the average value of the characteristic in question. Standard deviation describes dispersion in respect of arithmetic mean. The smaller the standard deviation, the smaller the data dispersion relative to arithmetic mean. Percentile or quantile are 1/100 parts of ranged data series. Methodical instructions on quantile calculation are provided by EN 326-1. Having standard deviation(s) and arithmetic mean (x_{avg}), it is possible to calculate the probability that the data (index, characteristic) are within interval x_{avg} ±s; x_{avg} ±2s; x_{avg} ±3s. If the database is of normal distribution,

probabilities are:

- within interval x_{avg} - s to x_{avg} + s – 68.3% of data;
- within interval x_{avg} - 2s to x_{avg} + 2s – 95.5% of data;
- within interval x_{avg} - 3s to x_{avg} + 3s – 99.7% of data.

Figure 6.1. Normal distribution of data



6.2. Used standards

Products manufactured by Latvijas Finieris Group are in accordance with requirements of the following standards

- EN 314-2 Plywood – Bonding quality – Part 2: Requirements
- EN 315 Plywood – Tolerances for dimensions
- EN 326-1 Wood-based panels – Sampling, cutting and inspection – Part 1: Sampling and cutting of test pieces and expression of test results
- EN 326-2 Wood-based panels – Sampling, cutting and inspection – Part 2: Quality control in the factory
- EN 326-3 Wood-based panels – Sampling, cutting and inspection – Part 3: Inspection of a consignment of panels
- EN 635-2 Plywood – Classification by surface appearance – Part 2: Hardwood
- EN 636 Plywood – Specifications
- EN 13501-1 Wood based panels for use in construction products and building elements – Part 1: Classification using data from reaction to fire tests
- EN 13986 Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking
- SFS 2413 Quality requirements for appearance of plywood with outer plies of birch

Products manufactured by Latvijas Finieris Group are tested in accordance with procedures of the following standards

- EN 310 Wood-based panels – Determination of modulus of elasticity in bending and of bending strength
- EN 314-1 Plywood – Bonding quality – Part 1: Test method
- EN 322 Wood-based panels – Determination of moisture content
- EN 323 Wood-based panels – Determination of density
- EN 324-1 Wood-based panels – Determination of dimensions of boards – Part 1: Determination of thickness, width and length
- EN 324-2 Wood-based panels – Determination of dimensions of boards – Part 2: Determination of squareness and edge straightness
- EN 325 Wood-based panels – Determination of dimensions of test pieces
- EN 438-2 Decorative high-pressure laminates (HPL) – Sheets based on thermosetting resins – Part 2: Determination of properties
- EN ISO 717-1 Acoustics – Rating of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation
- EN 789 Timber structures – Test methods – Determination of mechanical properties of wood based panels
- EN 1058 Wood-based panels – Determination of characteristic 5-percentile values and characteristic mean values
- EN 1156 Wood-based panels – Determination of duration of load and creep factors
- EN 1818 Resilient floor coverings – Determination of the effect of loaded heavy duty castors
- EN 1195 Timber structures – Test methods – Performance of structural floor decking
- EN ISO 9239-1 Reaction to fire tests for floorings – Part 1: Determination of the burning behaviour using a radiant heat source

- ISO 9239-2 Reaction to fire tests for floorings – Part 2: Determination of flame spread at a heat flux level of 25 kW/m2
- EN ISO 12460-3 Wood-based panels – Determination of formaldehyde release – Part 3: Gas analysis method
- EN 12871 Wood-based panels – Performance specifications and requirements for load bearing boards for use in floors, walls and roofs
- EN 13823 Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item
- EN 161516 Construction products – Assessment of release of dangerous substances – Determination of emissions into indoor air
- Directive 95/28/EC Burning behaviour of materials used in interior construction of certain categories of motor vehicles
- DIN 51130 Bestimmung der rutschhemmenden Eigenschaft

Other standards applying to plywood

- EN 313-1 Plywood – Classification and Terminology – Part 1: Classification
- EN 313-2 Plywood – Classification and Terminology – Part 2: Terminology
- EN 335 Durability of wood and wood-based products – Use classes: definitions, application to solid wood and wood-based products
- EN 350 Durability of wood and wood-based products – Testing and classification of the durability to biological agents of wood and wood-based materials
- CEN/TS 1099 Plywood – Biological durability – Guidance for the assessment of plywood for use in different hazard classes
- EN 1995-1-1 Eurocode 5 – Design of timber structures – Part 1-1: General – Common rules and rules for buildings
- EN 12369-2 Wood-based panels – Characteristic values for structural design – Part 2: Plywood
- CEN/TR Wood-based panels – Guidance on the use of load bearing boards in floors, walls and roofs
- EN 14272 Plywood – Calculation method for some mechanical properties

Please visit the European Standardisation Committee site http://www.cenorm.be or
the Latvian Standard site http://www.lvs.lv for actual information.

6.3. Riga Wood birch plywood equivalents to the U.S. plywood standard dimensions

Plywood manufacturing based on mm measurements

Thickness Conversion Table (in; mm)

U.S. Plywood thickness standards	in	5/32	1/4	11/32	3/8	7/16	15/32	1/2	19/32	5/8	23/32	3/4	13/16	7/8	1/1	1 - 1/8	
		0.1563	0.2500	0.3438	0.3750	0.4375	0.4688	0.5000	0.5938	0.6250	0.7188	0.7500	0.8125	0.8750	1.0000	1.1250	
Riga Wood nominal thickness	mm	4	6,5	8	9	10	12	12,7	15	16	18	19	21	24	25,4	28	30
	in	0.1575	0.2559	0.3150	0.3543	0.3937	0.4724	0.5000	0.5906	0.6299	0.7087	0.7480	0.8268	0.9449	1.0000	1.1024	1.1811
Number of plies		3	5	6	7	8	9	10	11	12	13	14	15	17	18	20	21

Number of veneer plies per thickness provides exceptional dimensional stability and long and cross grain strength characteristics

Thickness lower limit	mm	3,5	6,1	7,5	8,8	9,9	11,5	12,5	14,3	15,5	17,1	18,1	20	22,9	24,1	26,9	28,7
	in	0.1378	0.2402	0.2953	0.3465	0.3898	0.4528	0.4921	0.5630	0.6102	0.6732	0.7126	0.7874	0.9016	0.9488	1.0591	1.1299
Thickness upper limit	mm	4,1	6,9	8,5	9,5	11,1	12,5	12,9	15,3	16,7	18,1	19,7	20,9	23,7	25,2	28,5	29,9
	in	0.1614	0.2717	0.3346	0.3740	0.4370	0.4921	0.5079	0.6024	0.6575	0.7126	0.7756	0.8228	0.9331	0.9921	1.1220	1.1772

Exact product weight per m³ or per ft³ depends on the product and its specification

- Cut to size and CNC processed products available
- Ready to install customised product solutions available
- Thicknesses over 32 mm/ 1.25 in available
- Customised thicknesses and tolerances can be provided
- European (metric) standard plywood dimensions available
- Exact plywood tolerances depend on the product and format
- Certain products are available in limited specification range

Format Conversion Table (ft; in; mm)

ft			x	4’	8’	9’	10’	11’	12’	13’
	in		x	48’’	96’’	108’’	120’’	132’’	144’’	156’’
4’	48’’	1220	x		2440	2745	3050	3340	3660	
5’	60’’	1525	x		2440	2745	3050	3340	3660	
6’	72’’	1830	x				3050	3340	3660	3850
7’	84’’	2150	x				3050	3340	3660	3850
7’6’’	90’’	2290	x							
8’	96’’	2440	x	1220				mm		

<-- Grain direction -->
Panel width

Panel length

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