2006

AS Latvijas Finieris

plywood handbook

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Proposals

Proposals and comments please send to info@finieris.lv with reference *Handbook*.

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The list of Standards in Section 8 is not complete; please, visit *European Standardisation Committee* site http://www.cenorm.be for actual information.

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Introduction

Wood is widely used in many industries of national economy. One of the primary advantages of wood is natural regeneration, comparing to other materials. This material is ecological, environment friendly, easy processable and esthetic material. In order to process wood into other products, consumption of energy is substantially smaller than in processing of other materials. Important argument for choose of wood products is their competitive, economical profitability and efficiency, comparing to other materials. The utilization of wood after its service time is simple and environment friendly.

Plywood is the most popular of wood products, it has high physical- mechanical properties. People know this product for centuries, and over the years the usage possibilities of plywood are increased in national economy (for example, in transport, shipbuilding, furniture and in other industries).

AS *Latvijas Finieris* has long traditions in plywood production. Despite of this fact, company is developing and improving, and by the time we develop new plywood products and productions technologies in order to offer the products according to customers' requirements and contribute customers' satisfaction.

Handbook is developed in order to help you to choose birch plywood products made by AS *Latvijas Finieris* according to yours needs and requirements, as well as its target is to describe production processes in our company, plywood physical- mechanical properties, possibilities of usage and load bearing possibilities in different cases.

Many employees in AS *Latvijas Finieris* and specialists of this industry participated in development of this handbook. We have obtained information by using reports of plywood tests in different institutes and research institutions, as well as by performing research works at laboratories in AS *Latvijas Finieris*.

1

description of the enterprise

1.1. History of plywood production

One may find start of plywood production in Latvia in 1873, the year of *Latvijas Berzs*, Joint Stock Company, foundation. At the beginning they were manufacturing school blackboards and pencils for carpenter, but in 1909 the hydraulic press was installed at the factory and plywood production was started.

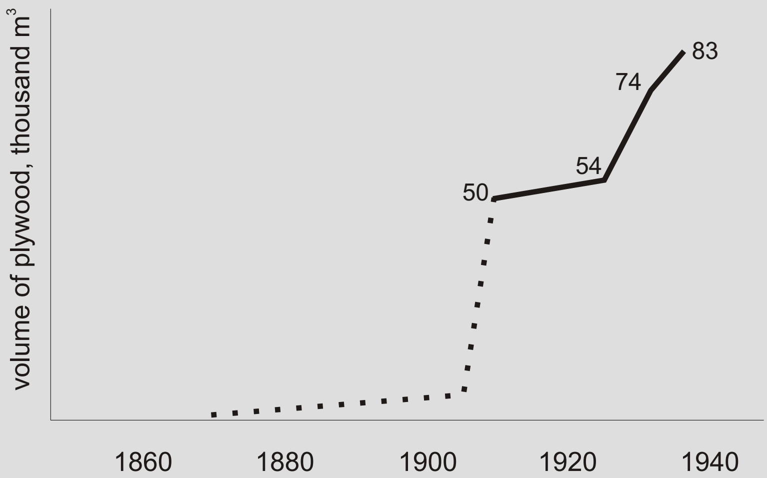
In 1913 there were three plywood factories in Latvia producing about 50 thousand cubic meters of plywood per year. *Furniers*, Plywood Factory, founded in 1923, was the biggest plywood manufacturer for export at that time. Besides, the factory produced special plywood for aviation as well.

In 1929 the Joint Stock Company *Lignums* was founded - the most modern veneer and plywood manufacturer at the time, producing 15 thousand cubic meters of plywood per year, including aviation and water-proof grades.

In 1940 up to 3'000 employees worked for the three mentioned factories as well as for 10 other small plywood manufacturers producing 83 thousand cubic meter of plywood per year. About half of this volume had been exported mainly to England, Germany, Denmark and other countries. All the plywood was made of Latvian birch wood. Development of plywood production in Latvia was progressing until the beginning of World War II. In 1940 Joint Stock Companies were transformed into State-owned Enterprises.

During the Soviet occupation (1945 - 1991) mainly low quality packing plywood of Russian round timber (about 70%) was produced in Latvia. Basically, produced plywood had been sold in the Republics of the Soviet Union (Russia, the Ukraine, Georgia, Azerbaijan, Moldavia, Uzbekistan, etc.). Up to 15% of Latvian plywood was sold in Western countries via the Soviet Union (*Eksportles* - a centralized Soviet Export organization).

Figure 1.1. **Plywood production in Latvia from 1913 to 1940, thousand m^3**



Mainly 1525*1525 mm interior plywood of different grade and thickness was produced. After the World War II until 1975 plywood in Latvia was manufactured by 4 factories *Latvijas Berzs, Lignums, Furniers* in Riga and *Vulkans* in Kuldiga.

In 1975 the three manufacturers (*Latvijas Berzs, Lignums* and *Furniers*) jointly established the *Plywood Production Union of Latvia*, State-owned Enterprise. By the end of 80's significant decline of plywood production took place. The reason for that was the near collapse of the Soviet Union.

In 1991, on restoration of the Latvian State independence, the resumption of glued products and plywood production development took place. Import of veneer logs from Russia was stopped. Plywood was made of local (Latvian) birch wood.

In 1992 there was established *Latvijas Finieris*, Private Joint Stock Company, consisting of three plywood producers keeping longtime plywood manufacturing traditions: Furniers, *Lignums* and *Latvijas Berzs*.

The range of produced plywood was rapidly expanded: overlaid plywood, interior and exterior plywood, precious wood veneered plywood, varnished and painted plywood, plywood for processing with laser cutting tools, etc. Broad range of these plywood types as to thickness, lenght and width is available.

Figure 1.2. **Volume of production of glued products in Latvia (as part of the Soviet Union), thousand m^3**

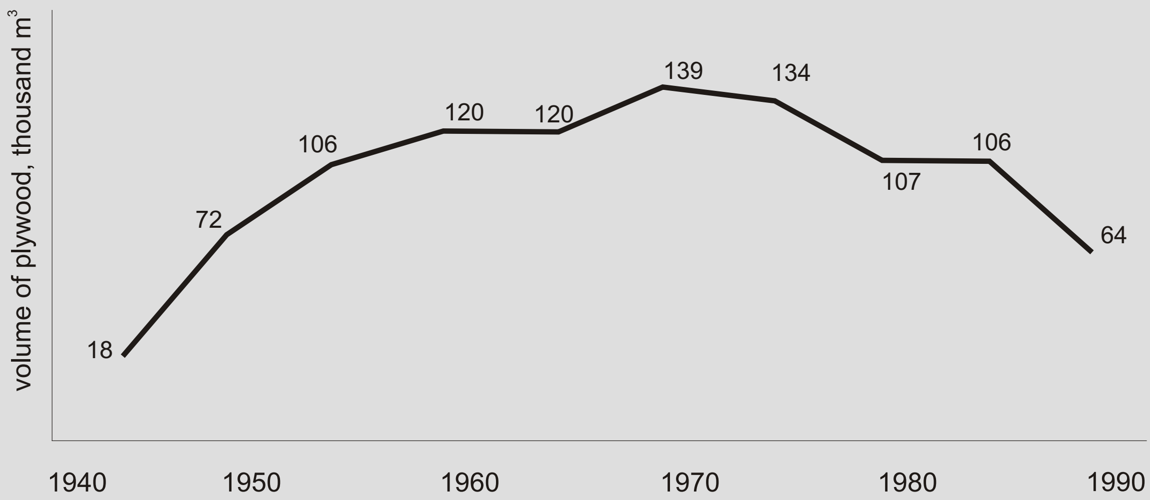
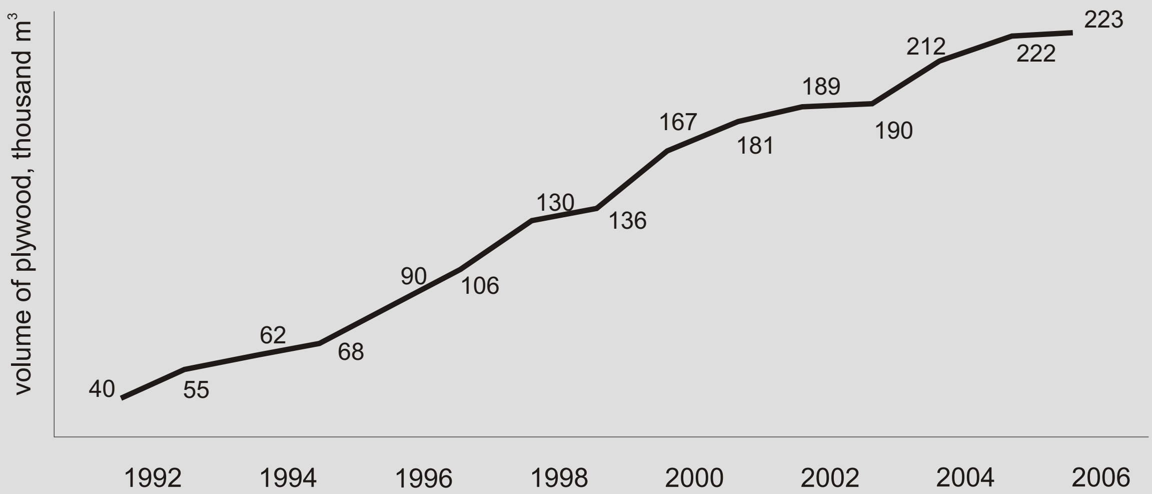


Figure 1.3. **AS *Latvijas Finieris* production of glued products, thousand m^3**



Lignums and *Furniers* productions were principally modernised. In 2004 AS *Latvijas Finieris* employing 3000 people produced 212 thousand m^3 of glued products, including 197 thousand m^3 of plywood. 166 thousand m^3 of plywood was exported. *Lignums* mill has become one of the biggest birch plywood manufacturers in the world (135 thousand m^3 in 2004).

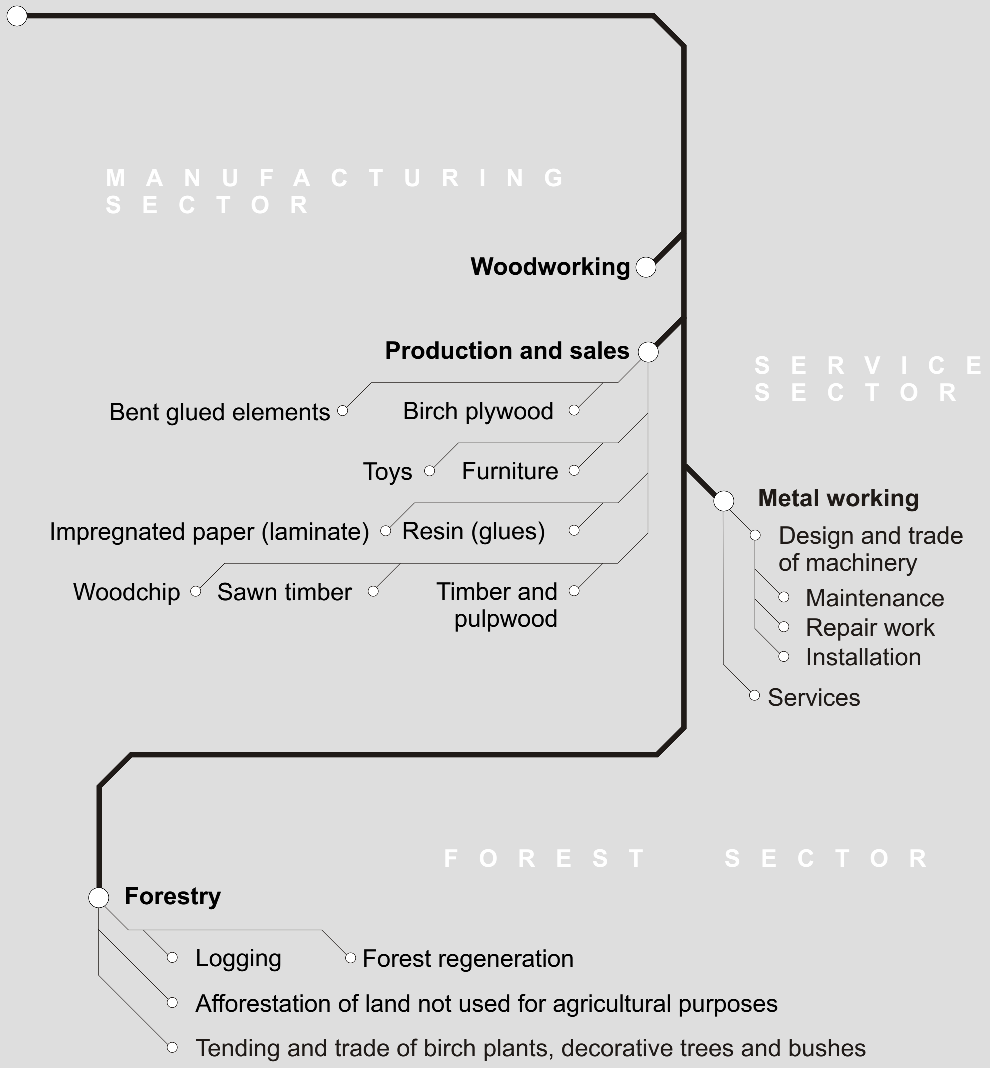
AS *Latvijas Finieris* aims to become a stable employer for the company staff, as well as a long-term partner for people who grow forests and who purchase its products. One of the Company goals is to gain the position of the world leading birch plywood and plywood products manufacturer.

1.2. Description and Structure of Enterprise

Business activities of AS *Latvijas Finieris* make closed cycle, from birch growing to manufacturing of broad range of plywood products.

AS *Latvijas Finieris* have business partners in more than 40 countries in the world and the following sales offices: *Riga Wood Iberica SL, Riga Wood North America Inc, Riga Wood GmbH, Riga Wood Sweden AB, Riga Wood Ltd, Riga Wood France S.A.R.L., Riga Wood Finland Oy, Riga Wood Sàrl., Riga Wood Holland BV and Riga Wood Japan.*

Figure 1.4. **Directions of *Latvijas Finieris* actions**



The structure of AS *Latvijas Finieris* consists of four mills: *Latvijas Berzs, Furniers, Hapaks, Lignums*. The latter is one of the biggest birch plywood manufacturers in the world. In recent time the enterprise has expanded with several new modern productions. In recent time the enterprise has expanded with several new modern production sites, the most significant of which is RSEZ SIA *Verems*. During the years of its functioning AS *Latvijas Finieris* has become a multiple-branch enterprise producing plywood fit for diverse application as basic product; it has significant share at the European market.

1.3. Quality and Environment Protection

Modern business world is changing rapidly. Requirements of customers and other business related partners to the product and services quality are becoming more multiple. AS *Latvijas Finieris* provide continuous control of manufactured products and services offered, precisely defining production procedures, testing and quality control systems. This way the competitive power of products is improved. Control systems are applied to evaluate and meet customers' requirements, as well as to improve production procedures and results. The aforesaid systems are planned to extend self-control procedure during the process of production and the role of testing made by the enterprise laboratory.

In 1999 Quality Control System of AS *Latvijas Finieris* was certified in accordance with ISO 9002:1994 requirements. Certificate of Conformity was issued by *Bureau Veritas Quality International*. In 2002 re-certification of the Quality Control System of the enterprise took place in accordance with new ISO 9001:2000 Standard requirements.

The Declaration on Quality and Environment policy of AS *Latvijas Finieris*, officially certifies that one of the main business directions of the enterprise is provision of long-term and expedient measures aimed to guarantee production processes that are harmless for human health and environment, as well as to accomplish implementation and maintenance of vigorous forest management systems that would be nature friendly and favorable for society. Possible unfavourable effect of production procedures on environment is ivestigated by the enterprise. Practical measures aimed to indentify and reduce the negative impact on environment are taken.

In 2003 the *Lignums* production of AS *Latvijas Finieris* was certified to meet the Environment Protection System requirements of ISO 14001:1996. The certification was carried out by *Bureau Veritas Quality International*.

Figure 1.5. **Certification of systems and production in AS *Latvijas Finieris***

Plywood, production systems of plywood, planning and supply certified by:

ISO 9001
BUREAU VERITAS
Certification
BUREAU VERITAS 1828
WKI
PEFC
PEFC/12-44-15
FSC ©
SW-COC-519
By buying products with the FSC label you are supporting the growth of responsible forest management worldwide.
FSC Trade mark ©1996 Forest Stewardship Council A.C.

AS *Latvijas Finieris* 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 munufactured by AS *Latvijas Finieris* 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.

In turn the *Forest Stewardship Council (FSC)* Certificate issued to the enterprise proves that the timber processing system, from logging and veneer log purchase to manufacturing and selling of products meets internationally recognized *FSC* forest long-term sustainability principles. Timber of certified wood origin and identity is provided for the process of production.

AS *Latvijas Finieris* recognizes and follows in its business activities the European Union initiatives concerning legal purchase of timber resources aware of its own significance for the Latvian wood sector and shall seriously stick to the conformity of required wood purchase with the principles of forest long-term sustainability.

AS *Latvijas Finieris* purchase only wood of legal origin for production purposes. It means that a seller shall provide all necessary documents, verifying the origin of wood, as well as payment of all taxes and fees stipulated by the Latvian legislation. Timber from protected territories, national parks, natural preserves shall not be purchased. Employees of the company make regular audit of suppliers concerning timber origin and documentation conformity from wood felling site purchase to timber delivery to the enterprises of *Latvijas Finieris* in accordance with *FSC* rules and legal normative documents related to the branch that are issued by *Latvia's State Forests*, State Joint Stock Company.
The enterprise has more than 250 wood suppliers, closely cooperating with the company in the area of timber resources purchase and forest regeneration. The enterprise organises different training sessions and seminars aimed to provide information to private forest owners, wood suppliers, and other interested parties. The aforesaid is done in order to understand and implement long-term forest sustainability for application of modern technologies both in forestry and in wood processing, as well as for diverse ecology protection.

AS *Latvijas Finieris* support the certification procedures of *Programme for the Endorsement of Forest Certification schemes (PEFC)* initiated in Latvia.

1.4. *CE* marking

In 1988 the *89/106/EEC EC Construction Product Directive (CPD)* was accepted. In 2002 *European Standardisation Organisation (CEN)* approved *EN 13986* Harmonised Standard *Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking*. These normative documents issued by the *European Community* provide tools focused on:
(1) protection of European market against insecure construction materials, guarantee harmlessness and safety of goods for human life, health, property and for the environment;
(2) provision of free movement of goods;
(3) coordination of national legislative requirements and standards harmonization;
(4) mutual acceptance of conformity certification systems.

Simultaneously these documents define procedures of construction product conformity certification in the area of concern, as well as the order for construction market supervision. In accordance with *CPD* a construction product is any material, element of manufactured single unit structure that is permanently or temporarily installed in a building, or that is designed for use in construction. So, from April 1, 2004 each wood-based panel used for construction products shall bear *CE* mark.

The enterprise had been certified according to the *2+* system requirements to guarantee conformity of products manufactured by AS *Latvijas Finieris* with *CPD* requirements, i.e., an independent institution providing regular conclusions concerning production procedures control and quality statistic data processing.

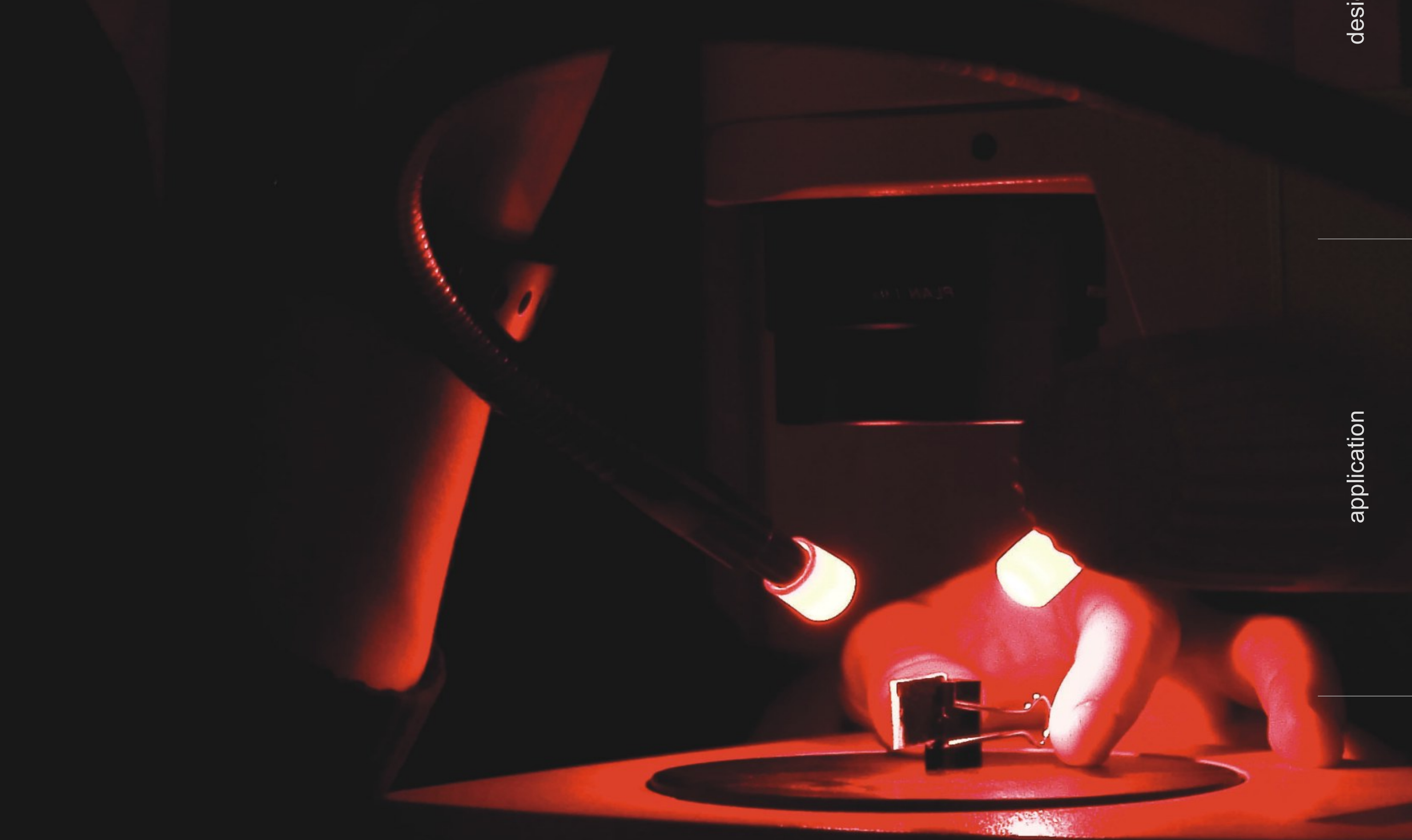
1.5. Research

1.5.1. Abilities of Laboratory

There are established laboratories in plywood production facilities designed for product quality indices monitoring.

Samples of average dimensions can be tested at the laboratories in accordance with *EN 789 Timber structures - Test methods - Determination of mechanical properties of wood based panels* at maximum braking force up to 40 tn, tests of wear resistance of different coatings and other tests. There are installed chambers for sample acclimatization under different weather conditions; simulation of *UV* radiation effect is possible. Test data are stored and processed for the analysis of test results. Taking into account importance of the laboratory, it was fit out with new testing equipment.

The staff of the laboratory are qualified managers and employees. Contacts with the academic staff from different institutes and universities are established. Employees make tests in accordance with internationally recognised or self-developed methods. Using equipment of the laboratory, students of Forest Faculty of Latvia University of Agriculture (LUA) carry out research work aimed to the defence of Bachelor's or Master's Degrees. Some of them start to work for AS *Latvijas Finieris* after graduation from the LUA.



Operation areas of *Latvijas Finieris* laboratories are as follows:

1 provision of product quality control in accordance with *EN 13986 Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking*;

2 provision of new products development;

3 improvement of production technologies.

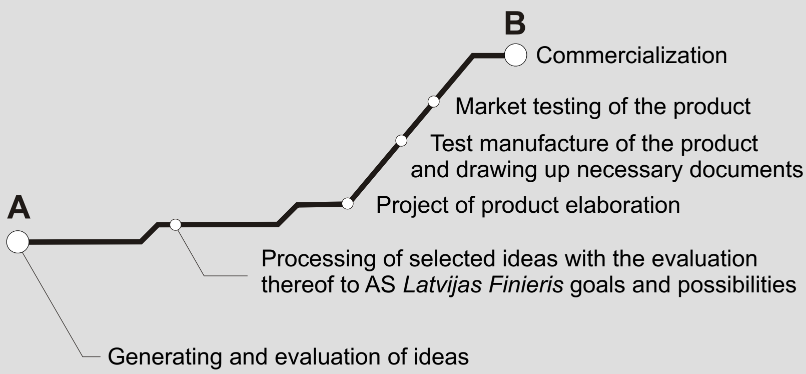
1.5.2. Cooperation with Research Institutions

For many years AS *Latvijas Finieris* cooperates with Scientific Laboratory of Wood and Wood Materials of the LUA; as well as with Wood and Wood Protection and Emission Testing Laboratory of the Latvian State Institute of Wood Chemistry. Checking data obtained at the Laboratory are used to provide customers with independent conclusion concerning conformity of products with requirements of regulatory documents. Besides the obtained results are used for standardized products improvement and new product development. Both laboratories are provided with financial support intended for the purchase of modern testing equipment.

AS *Latvijas Finieris* have experience of participation in international research projects. For example, at the end of 2002 the enterprise became a participant of *G6RD-CT2000-00273 European Plywood Project*, along with 9 leading European wood and wood material research institutes and 2 plywood manufacturers. Resulting from the project there was designed and developed method of gluing quality evaluation in accordance with *EN 314-1* and *EN 314-2*, as well as data base and software for computerised evaluation of scanned images.

Knowledge and practical experience are required for successful birch selection, young birch plants growing, birch cultivation on plots non used for agricultural purposes, and new growth raising. Research allows to gain knowledge and practical experience. In 2000 AS *Latvijas Finieris* concluded a long-term contract with LVMI *Silava* and Forest Faculty of the Latvian University of Agriculture for research of birch planting (field) establishment and growing and for the study of physical and mechanical properties of birch wood. The research performed on birch field establishment and growing technology development has already given results assisting not only the operation of AS *Latvijas Finieris* but other birch foresters as well.
The enterprise has designed *New Product Development System* intended for successful development of new products.

Figure 1.6. **New Product Development System**



1.5.3. Development of new products

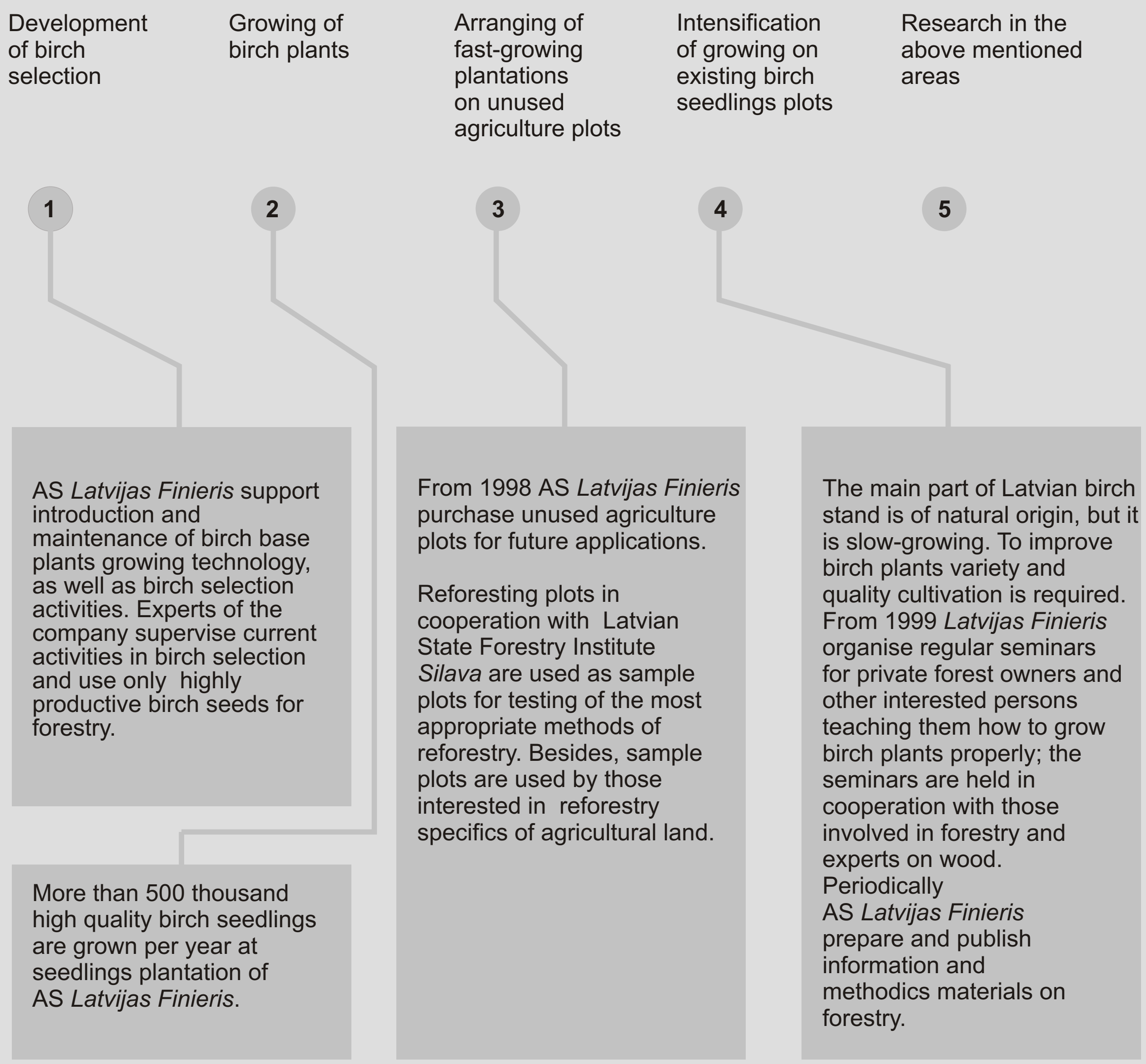
The *New Product Development System* provides investigation of new product potential, testing of the product properties, production technology development, analysis of project for the product manufacturing and introduction, evaluation of competitiveness, development of marketing plan. The system defines the order of procedure thus protecting against mistakes due to incomplete previous information.
The main purpose of the system is to promote successful development and satisfy new requirements and needs of customer. To realize this aim the system provides active cooperation between trade agents and end consumers, enquiring not only current needs and requirements of end consumers but future plans as well.

1.5.4. Birch Program

AS *Latvijas Finieris* is the biggest birch wood working enterprise in Latvia and is aware of its place in the Latvian timber sector. The company is careful to observe that the wood supplied for production shall be in conformity with the long-term sustainable forest maintenance requirements.

The enterprise is actively involved in the maintenace of forestry vertical integration required for reproduction of natural resources. As long-term forester, AS *Latvijas Finieris*, is participating in forestry cycle from new forest growing to harvest gathering. Simultaneously preservation of forest biological variety should be taken care of; the same refers to the value connected thereto - stability of ecological system and forest ecological function that are to be saved and extended.

Figure 1.7. **The main lines of the *Birch program***



In 1996 AS *Latvijas Finieris* introduced *Birch Program* to promote birch growing and provide qualitative and efficient extension of birch plantations in Latvia. The main lines of the program are shown in figure 1.7.

Figure 1.8. **Birch plants at tree nursery *Zābaki***

2

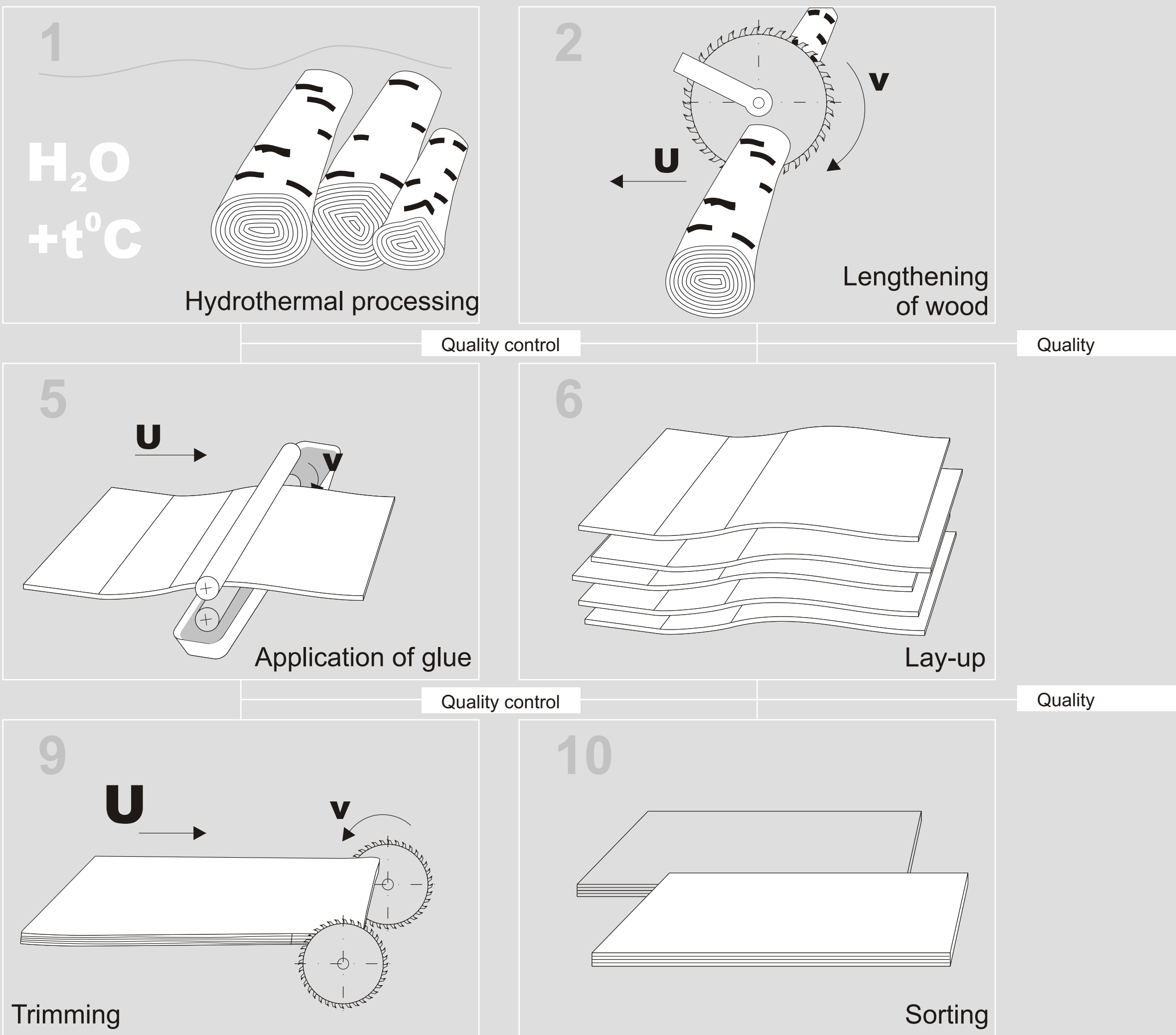
description of production process

Wood raw materials required for plywood production is purchased by AS *Latvijas Finieris* mainly from long-term Latvian suppliers, who follow long-term sustainable forest maintenance (*FSC, PEFC*) requirements.

Wood hydro-thermal processing is made at factories in order to enhance plasticity contributing to peeling and quality of veneer.

After hydro-thermal processing wood is debarked and cut by length. Then wood is rotary peeled. For better use of wood there are installed laser devices on edges for plywood log centering.

Figure 2.1. **Plywood production diagram**

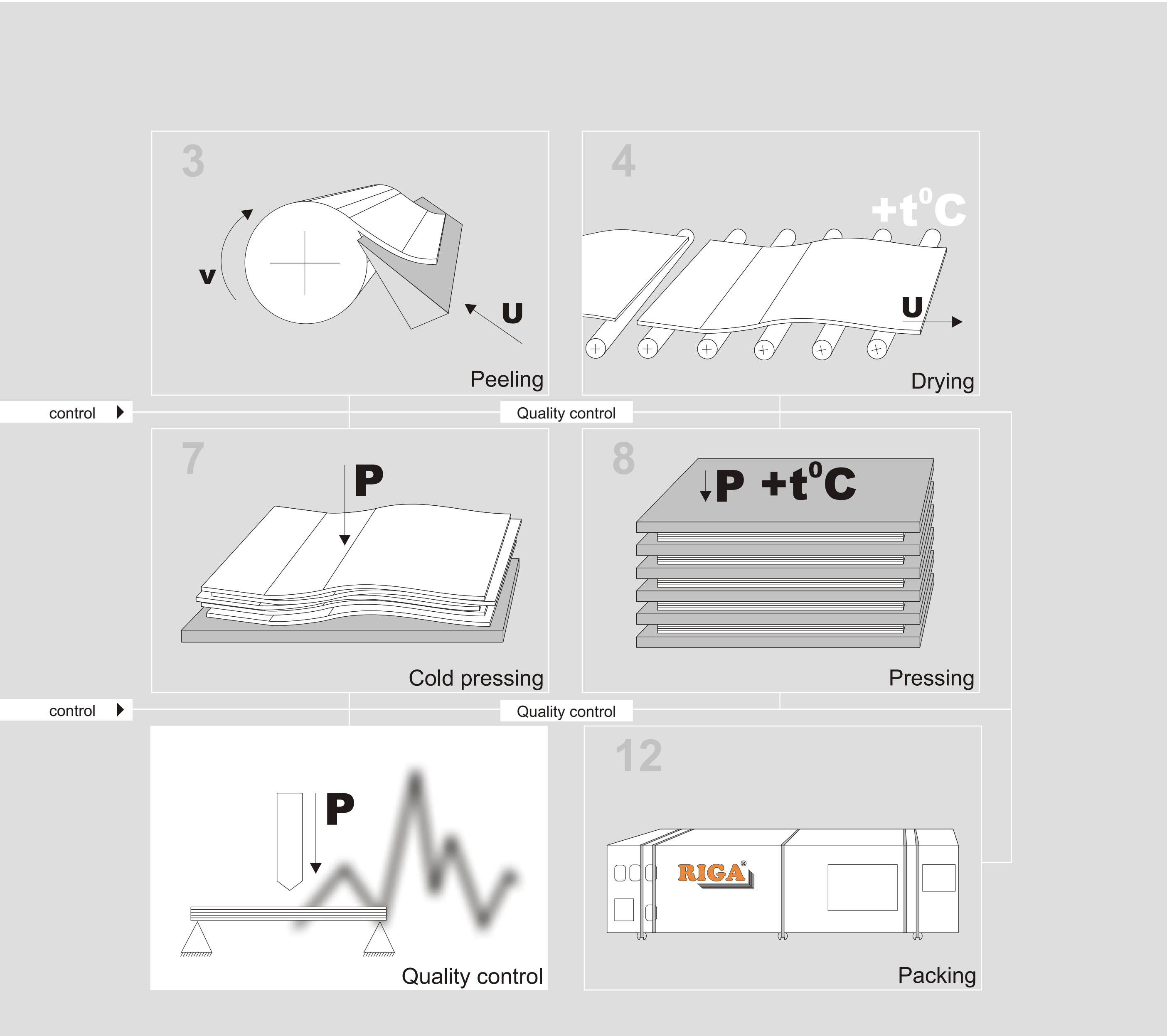


Rotary-cut veneer sheet is cut to required length and dried in dryers. Then dry veneer is sorted in sorting line depending on wood defects, veneer format; the veneer feed that is not dry enough is monitored for further processing. The veneer that does not completely meet the requirements for plywood sheets in quality and dimensions comes about in the process of production, so veneer cutting to size is made, wood defects cut out and next these pieces are both composed and scarf jointed providing veneer sheets of required dimensions. At knot patching veneer defects are cut out and replaced with high quality inserts.

Dry and sorted veneer is fed to plywood lay-up lines. Glue is applied on veneer and plywood lay-up of full format and construction is made.

After lay-up high cold pre-pressing takes place thus avoiding individual veneer sheets displacement in hot press. During hot pressing plywood is made. Pressure applied to plywood sandwich presses veneer sheets together providing required glue and veneer contact. Pressure is maintained during the whole process of pressing to keep glue and veneer in contact and decrease tension in glue line. Tension accompanies the decrease of glue layer thickness during drying.

Before future processing plywood is kept until dimensions, humidity and temperature stabilisation. Then plywood trimming takes place each of four sides are trimmed producing plywood sheet of required dimensions and quality.



After trimming plywood is sanded providing more accurate thickness and decrease thickness variations over the sheet. After sanding plywood is sorted and packed in accordance with dimensions and quality.

Coatings of different materials may be applied on sorted plywood during the process of production, or it may be processed mechanically (drilled, cut, etc.).

3

products description

3.1. Types of products

AS *Latvijas Finieris* offer 20 types of plywood products.

Unprocessed plywood

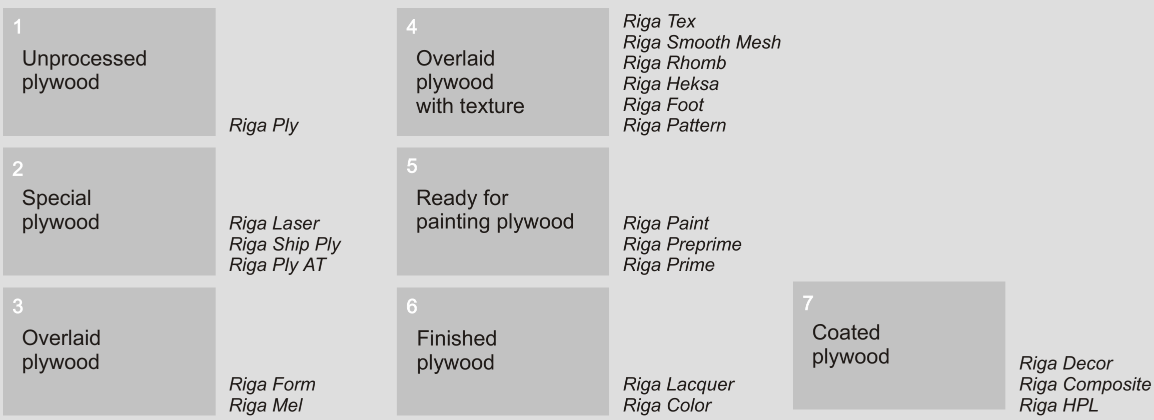
Riga Ply - plywood made of 1.4 mm birch peeled veneer using phenol-formaldehyde resin based glue. Direction of grains adjoining the existing layers of plywood is perpendicular. This plywood is the basis for all other types of plywood products. Plywood grades are presented in Table 3.2.

Special plywood

Riga Laser - plywood of advanced requirements as regards internal veneer layers specially designed for laser cutting. Glue is colorless, for humidity resistant modifications, based on urea-formaldehyde and melamine resins. Indices of gluing strength are in accordance with: 1 class in accordance with *EN 314-1* and *EN 314-2*, *IW 67* type in accordance with *Part 1* of *DIN 68705 1*, and *H2* type (*MR* before) in accordance with *BS 1203*. It may be covered with primer, varnish, or melamine film for surface protection against contamination.

Riga Ship Ply - plywood of advanced requirements as regards physical and mechanical properties. Internal layers of veneer are of highest quality, produced especially for sea containers designed for liquified gas transportation. Plywood is glued using special water-resistant phenol-formaldehyde glue. Production procedure and product quality are in accordance with requirements set by *Gaztrasport & Technigaz*, are continuously monitored by one of Certification Institutions - *Bureau Veritas, Det Norske Veritas, American Bureau of Shipping* or *Lloyd's Register*.

Figure 3.1. **Groups of Plywood Products**



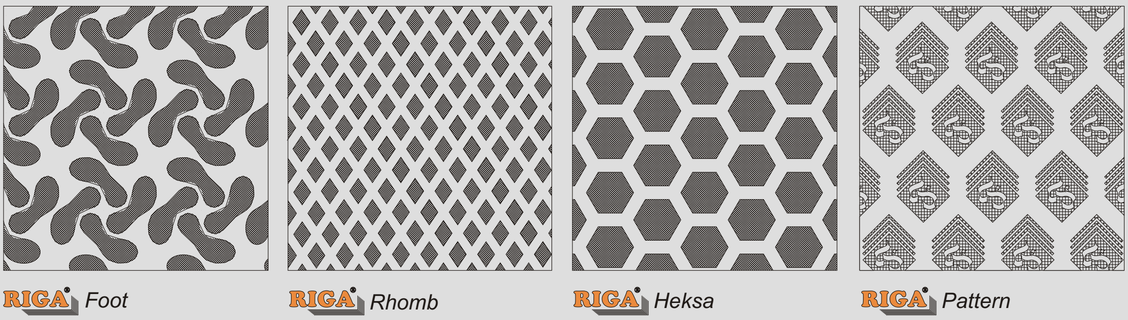
Riga Ply AT - birch plywood that meets Australian quarantine requirements, i.e., wood is protected against insects, including thermits. Plywood may have coatings of different kind, for example, *Riga Form AT, Riga Tex AT*, etc. In the production of birch plywood *Riga Ply AT*, *Riga Tex AT* and *Riga Form AT* special preservative containing Proxim is used, which has been currently approved by *Australian Quarantine and Inspection Service* (*AQIS*) (see *AQIS Quarantine aspects and procedures*). Veneer glue line is treated with WOLSIT T20. The minimum retention rate of Proxim stated by *AQIS* is being kept. The analysis on treated birch plywood, air control in the premises have been performed and statements on product conformity with the requirements of *AQIS* have been issued by an independent institution *Tauw Engineering Bureau*.

Overlaid plywood

Riga Form - birch plywood (*Riga Ply*) from both sides overlaid with phenol-formaldehyde impregnated paper (film). Phenol films are of different colour (see Table 3.1.). Application of several layers of phenol film is offered as well.
Edges are of surface colour sealed.

Overlaid plywood with texture

Figure 3.2. **Types of special pattern**



Riga Tex - birch plywood (*Riga Ply*) from both sides overlaid with phenol film. Normally netted structure is seen on the surface of one side, it is possible to make such a structure for both sides. There are two types of mesh: small mesh - 4.5 cells per 1 cm (type W); large mesh - 2.5 cells per 1 cm (type WL). The most popular film is of dark brown colour but other films are available as well (see Table 3.1). Application of several layers of phenol film is offered too. Edges are of surface colour sealed.

Riga Smooth Mesh - birch plywood (*Riga Ply*) from both sides covered with phenol film. Surface of one side is of smooth, dull netted structure (type W or WL). Phenol films are of different colour (see Table 3.1). Edges are of surface colour sealed.

Riga Rhomb - birch plywood (*Riga Ply*) overlaid with phenol film on both sides. Surface of one side is of pressed rhomboid pattern (see Figure 3.2). Plywood of two different resistent to-wear surface is offered. The product is available in 2 colours: grey and brown. Edges are sealed in grey or brown colour.

Riga Heksa - birch plywood (*Riga Ply*) overlaid with phenol film on both sides. One side surface is of pressed special relief (pattern) similar to bee tree structure (see Figure 3.2). Plywood of different resistent-to-wear surface is offered. The product is available in 2 colours: grey and brown. Edges are sealed in grey or brown colour.

Riga Foot - birch plywood (*Riga Ply*) overlaid with phenol film on both sides. On one side the surface is of pressed special pattern (see Figure 3.2). Phenol films of different colour are offered. Edges are of surface colour sealed.

Riga Pattern - birch plywood (*Riga Ply*) overlaid with phenol film on both sides. On one side the surface is of pressed special pattern (see Figure 3.2). Phenol films of different colour are offered. Edges are of surface colour sealed.

Table 3.1. **Characteristics of phenol films**

Film colour	Phenol film weight, g/m^2	*Riga Form*	*Riga Tex*	*Riga Smooth Mesh*
Brown	120	●	●	●
Dark brown	130, 167, 220	●	●	●
Black	120	●	●	●
Grey	174	●	○	●
Light brown	120	●	○	○
Transparent	120	●	○	●
Yellow, transparent	120	●	○	●
Yellow, non transparent	167	●	●	●
Green, transparent	120	●	●	●
Red	220	●	○	●

Riga Mel - birch plywood (*Riga Ply*) coated with melamine film of white or grey colour on one or both sides. Edges are sealed with white or grey acrilyc base paint.

Ready for painting plywood

Riga Paint - birch plywood (*Riga Ply*) coated with paper designed for priming or painting on one or both sides.

Riga Preprime - birch plywood (*Riga Ply*) coated with paper impregnated with primer on one or both sides. Plywood with such coating is designed for painting process simplification and paint consumption decrease. Use of epoxy, polyurethane, alkyd or water soluble alkyd based paint is recommended. Edges are sealed with grey alkyde paint.

Riga Prime - birch plywood (*Riga Ply* or *Riga Paint*) coated with *UV*, *PU* primer on one or both sides. Such a surface finish simplifies future finishing works and decreases finishing material consumption.

Finished plywood

Riga Lacquer - high quality (*B, S, BB*) birch plywood (*Riga Ply*) varnished on one or both sides.

Riga Color - birch plywood (*Riga Paint* or *Riga Preprime*) painted on one or both sides.

Coated playwood

Riga HPL - birch plywood (*Riga Ply*) coated with HPL (High Pressure Laminate) on one or both sides. Compensating material (balance paper) may also be applied on the reverse side. HPL is a homogeneous material made through pressing together of several layers of impregnated with phenol resin paper under high pressure and temperature press. Top layer of HPL may be made of decorating paper impregnated with melamine resin. HPL coating is glued using *D2, D3, D4* class glue in accordance with *EN 204* Standard requirements.

Riga Decor - birch plywood (*Riga Ply*, grade *BB/BB*) veneered with various wood species on one or both sides.

Riga Composite -standard birch plywood, composed of 1.4 mm veneers by cross bonding, overlaid with a special material on one or both sides; this material can be also be used as a core layer of plywood.

3.2. Grades

Grade of plywood is defined by type and quantity of visible defects.
Such a classification may be used for the selection of certain plywood type of application (transparent finish, painting, coating with other materials, etc.).

WGE is *WG* plywood, where all of splits, knot holes, picks, imprints and holes are repaired.

C plywood is unsanded.

Riga Ply grading conditions are in compliance or more strict in comparison with requirements set by the following regulatory documents:
SFS 2413 Birch Plywood Quality Evaluation by Visual Inspection;
ISO 139 Recommendations and Conditions Drawn by Work Group II of the Technical Committee (1994);
EN 635-2 Plywood - Classification by Surface Appearance – Part 2. Hard Wood.

Table 3.2. **Grade compilance**

	Grade			
AS Latvijas Finieris	*B*	*S*	*BB*	*WG*
SFS 2413	I (*B*)	II(*S*)	III(*BB*)	IV(*WG*)
ISO recommendations	I	II	III	IV
EN 635-2	I	II	III	IV

mechanical properties design application literature

Table 3.3. **Limitations on defects for *Riga Ply***

Categories of defects	Plywood grades				
	B	**S**	**BB**	**WG**	**C**
Pin knots (Sound intergrown knots ≤↓ 3 mm)	Permitted	Permitted	Permitted	Permitted	Permitted
Sound intergrown knots	Permitted ≤Ø6 mm, ∑≤12 mm/m²	Permitted ≤Ø20 mm, ∑≤50 mm/m²	Permitted ≤Ø25 mm, ∑≤60 mm/m²	Permitted ≤Ø65 mm, ∑≤600 mm/m²	Permitted
Unsound adhering knots	Not permitted	Not permitted	Not permitted	Permitted ≤Ø20 mm, ∑≤200 mm/m²	Permitted
Other knots and holes	Not permitted	Not permitted	Permitted ≤Ø6 mm, ∑≤25 mm/m², repaired	Permitted ≤Ø15 mm, ∑≤100 mm/m²	Permitted ≤Ø40 mm, ≤10/m²
Irregularities in the structure of the wood	Permitted, but slight	Permitted	Permitted	Permitted	Permitted
Curly grain	Not permitted	Not permitted	Permitted	Permitted	Permitted
Open splits and checks	Not permitted	Permitted for an individual width up to 2 mm and of an individual length ≤200 mm and ≤1 per metre of panel width, repaired	Permitted for an individual width up to 2 mm and of an individual length ≤200 mm and ≤1 per metre of panel width, repaired	Permitted for an individual width up to 4 mm and ≤2 per metre of panel width	Permitted for an individual width up to 10 mm and of an individual length ≤400 mm and ≤5 per metre of panel width
Closed splits and checks	Not permitted	Permitted for an individual legth up to 200 mm and in number up to 2 per metre of panel width	Permitted for an individual legth up to 200 mm and in number up to 2 per metre of panel width	Permitted	Permitted
Discolouration	Permitted, but slight (not at the edges of panel) ≤15% of panel surface				
Discolouration and coloured streaks	Not permitted	Permitted up to an extent of 15% of the panel surface, some streaks of colour and minerals	Permitted up to an extent of 30% of the panel surface	Permitted	Permitted
Brown, but not rot	Not permitted	Not permitted	Permitted up to an extent of 30% of the panel surface	Permitted	Permitted
Brown, rot at the initial period	Not permitted	Not permitted	Not permitted	Not permitted	Permitted
Inserts	Not permitted	Permitted ≤1/m²	Permitted up to an extent of 3% of the panel surface	Permitted	

Cntinuation of Table 3.3.

Categories of defects	Plywood grades				
	B	**S**	**BB**	**WG**	**C**
Open joints	Not permitted	Not permitted	Permitted an individual width up to 2 mm, and of an individual length ≤200 mm and ≤1 per metre of panel width, repaired	Permitted an individual width up to 3 mm	Permitted an individual width up to 7 mm
Imprints and bumps	Not permitted	Not permitted	Permitted, but slight, 2 cm^2 per panel	Permitted, but slight	Permitted
Roughness	Not permitted	Not permitted	Permitted, but slight (up to 10 cm^2/m^2, repaired) - three defects per panel	Permitted	Permitted
Sanding through	Not permitted	Not permitted	Permitted ≤10 cm^2/m^2	Permitted ≤20 cm^2/m^2	
Glue penetration	Not permitted	Occasionally	Permitted up to an extent of 5% of the panel surface	Permitted	Permitted
Unsanded areas (for sanded plywood)	Not permitted	Not permitted	Not permitted	Permitted up to an extent of 5% of the panel surface	
Defects at the edges due to sanding or trimming	Permitted up to 5 mm from the edge (if the glue is not visible)	Permitted up to 5 mm from the edge, not in all length, repaired	Permitted up to 5 mm from the edge, not in all length, repaired	Permitted up to 5 mm from the edge	Permitted up to 5 mm from the edge
Total number of permitted defects	≤3	≤6	≤9	Unlimited	Unlimited
Composed face veneers		Permitted, if composed properly, conformable colour	Permitted	Permitted	Permitted

Table 3.4. **Limitations on defects of *Riga Form* and *Riga Tex* plywood**

Defects and requirements	Limitation on defects for grades	
	Grade A	Grade 1
1. Veneer putting off	Not allowed	Not allowed
2. Laminate gluing	Laminate shall be clean, smooth, and firmly glued to plywood surface	Laminate shall be clean, smooth, and firmly glued to plywood surface
3. Dull spots on laminate surface	Allowed on the left side up to 125 cm^2 over the surface or cut out 35 cm^2/m^2	Allowed on the left sideup to 500 cm^2 over the sheet or cut out 125 cm^2/m^2
4. Scorch laminate	Not allowed	Not allowed
5. Several layers of laminate gluing (laminate overlap) in the way of dark areas	Not allowed	Allowed firmly glued
6. Breaks of laminate before pressing	Not allowed	Allowed on one side of plywood providing careful covering
7. Laminate missing on surface or delamination after pressing	Not allowed	Not allowed
8. Glued laminate residues on the surfaces	Allowed minor (from 2 to 3 pieces) residues on the left side, severally of size up to 1 cm^2	Allowed minor residues
9. Imprints	Allowed not deep, minor imprints, if laminate on the left side is not damaged	Allowed minor imprints, if laminate is not damaged
10. Scrapes and dirty	Allowed isolated (1÷2) minor scrapes on the left side if laminate is not scraped through	Allowed minor scrapes if laminate is not scraped through
11. Diffuse strips on surface (variations of colour tone)	Allowed minor strips on the left side	Allowed
12. Loss of peeled veneer	Not allowed	Allowed for one veneer layer of 3 mm width up to length of 100 mm. Edges of plywood shall be firm, if dimensions are standardized
13. Overlap of laminated surface with edges paint	Allowed up to 3 mm paint overlap on laminated surface. Paint film on edges shall be even	Allowed up to 5 mm paint overlap on laminated surface. Paint film on edges shall be even
14. Minor rough spots	Allowed minor separate spots with size up to 5 cm^2 on the left side over surface with total area up to 25 cm^2	Allowed up to 125 cm^2 over the surface
15. Net displacement	Not allowed	Not allowed
16. Mechanical defects	Not allowed	Not allowed
17. Notchs	Not allowed	Not allowed

Continuation of Table 3.4.

Defects and requirements	Limitation on defects for grades	
	Grade A	Grade 1
18. Total number of allowed defects	There shall be no defects on one side, no more than 2 types of defects on reverse side	No more than 2 defects on one side, no more than 5 types of defects on reverse side

Table 3.5. **Limitation on defects of *Riga Mel***

Defects and requirements	Limitation on defects for grades	
	Grade A	Grade 1
1. Veneer putting off	Not allowed	Not allowed
2. Laminate gluing	Laminate shall be clean, smooth, and firmly glued to plywood surface	Laminate shall be clean, smooth, and firmly glued to plywood surface
3. Dull spots on laminate surface	Allowed on the left side up to 125 cm^2 over the surface or cut out 35 cm^2/m^2	Allowed up to 500 cm^2 over the sheet or cut out 125 cm^2/m^2
4. Scorch laminate	Not allowed	Not allowed
5. Several layers of laminate gluing (laminate overlap) in the way of dark areas	Not allowed	Not allowed
6. Breaks of laminate before pressing	Not allowed	Not allowed
7. Laminate missing on surface or delamination after pressing	Not allowed	Not allowed
8. Glued laminate residues on the surfaces	Allowed minor (from 2 to 3 pieces) residues on the left side of 1 cm^2 in size	Allowed minor residues
9. Imprints	Allowed not deep, minor imprints, if laminate on the left side is not damaged	Allowed minor imprints, if laminate is not damaged
10. Scrapes and dirty	Allowed isolated (1÷2) minor scrapes on the left side if laminate is not scraped through	Allowed minor scrapes if laminate is not scraped through
11. Diffuse strips on surface (variations of colour tone)	Allowed minor strips on the left side	Allowed
12. Loss of peeled veneer	Not allowed	Allowed for one veneer layer of 3 mm width up to length of 100 mm. Edges of plywood shall be firm, if dimensions are standardized

Continuation of Table 3.5.

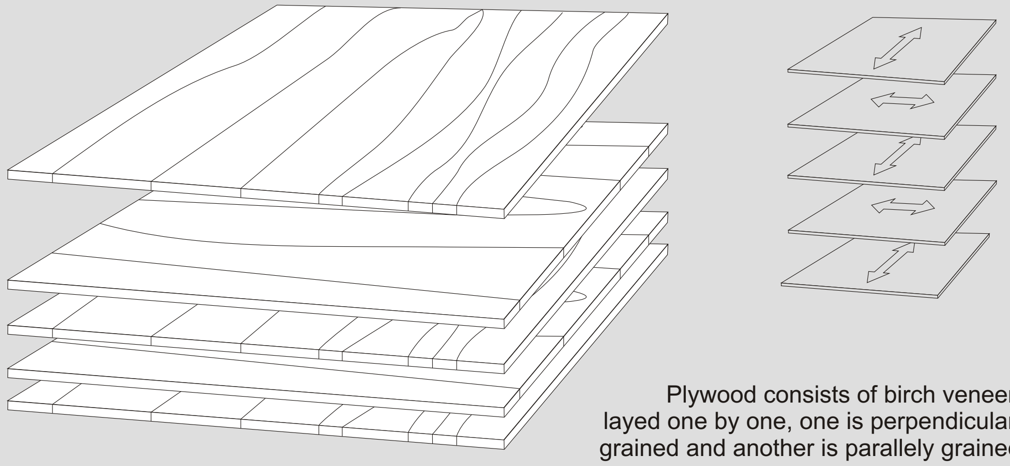
Defects and requirements	Limitation on defects for grades	
	Grade A	Grade 1
13. Overlap of laminated surface with edges paint	Allowed up to 3 mm paint overlap on laminated surface. Paint film on edges shall be even	Allowed up to 5 mm paint overlap on laminated surface. Paint film on edges shall be even
14. Minor spots of roughness	Allowed minor separate spots up to 5 cm^2 on the left side over surface with total area up to 25 cm^2	Allowed up to 125 cm^2 over the surface
15. Net displacement	Not allowed	Not allowed
16. Mechanical defects	Not allowed	Not allowed
17. Notchs	Not allowed	Not allowed
18. Total number of allowed defects	There shall be no defects on one side, no more than 2 types of defects on reverse side	No more than 2 defects on one side, no more than 5 types of defects on reverse side
19. Pressed in dust visible as small flecks on the surface	Not allowed	Allowed minor amount of dust

3.3. Dimensions and structure

Plywood is made by gluing of several veneer layers. Physical and mechanical properties of wood are different for different grain directions. To make plywood as homogeneous as possible, veneer lay-up is arranged in such a way as make wood grain direction of adjoining veneer layers perpendicular.

Phenol glue is used for standard plywood veneer layers gluing. It is possible to use urea-formaldehyde or modified melamine-urea-formaldehyde resin glue, as well as add special

Figure 3.3. **Plywood lay-up scheme**



Plywood consists of birch veneers layed one by one, one is perpendiculary grained and another is parallely grained.

additives to glue improving plywood characteristics, for example, resistance against insects or incombustibility.

3.3.1. Thickness

Plywood *Riga Ply* rating thickness and tolerances are presented in Table 3.6.

Table 3.6. **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	51.1
Average actual thickness, mm	3.8	6.4	9.2	12.0	14.9	17.7	20.5	23.4	26.5	29.4	35.0	38.7	43.6	49.6

Thickness tolerances are in accordance with *EN 315* requirements.
Other panel thicknesses are available on the request.

Table 3.7. **Nominal thickness of plywood produced by AS *Latvijas Finieris***

Riga Ply	**4**	**6.5**	**9**	**12**	**15**	**18**	**21**	**24**	**27**	**30**	**35**	**40**	**45**	**50**
Riga Form	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Riga Tex	●	●	●	●	●	●	●	●	●	●	●	●	○	○
Riga Smooth Mesh	●	●	●	●	●	●	●	●	●	●	●	●	○	○

Continuation of Table 3.7.

Riga Ply	4	6.5	9	12	15	18	21	24	27	30	35	40	45	50
Riga Paint	●	●	●	●	●	●	●	●	●	●	●	●	○	○
Riga Preprime	○	●	●	●	●	●	●	●	●	●	●	●	○	○
Riga HPL	○	●	●	●	●	●	●	●	●	●	●	○	○	○
Riga Laser	○	○	●	●	●	●	●	●	○	○	○	○	○	○
Riga Prime	○	●	●	●	●	●	●	●	●	●	○	○	○	○
Riga Lacquer	○	●	●	●	●	●	●	●	●	●	○	○	○	○
Riga Color	○	●	●	●	●	●	●	●	●	●	○	○	○	○
Riga Mel	○	○	●	●	●	●	●	●	●	●	●	○	○	○
Riga Ply AT	○	○	○	○	○	●	●	●	●	●	○	○	○	○

3.3.2. Length and width

Length and width of *Riga Ply* plywood are presented in Table 3.8.

Table 3.8. **Birch plywood length and width**

Plywood, cross grain, mm

1200 × 1200 / 1500 / 1800 / 2100 / 2400 / 2700 / 3000
1220 × 1220 / 1525 / 1830 / 2135 / 2440 / 2745 / 3050
1250 × 1250 / 1500 / 1800 / 2150 / 2500 / 2750 / 3000
1500 × 1500 / 1800 / 2100 / 2500 / 2700 / 3000
1525 × 1525 / 1830 / 2135 / 2440 / 2745 / 3050

Plywood, long grain, mm

2440 × 1220 / 1250 / 1525
2500 × 1220 / 1250 / 1500

Dimensions may be different in different product and grade groups.

3.3.3. Dimensions tolerances

Allowed dimensions tolerances are presented in Table 3.9.

Table 3.9. **Dimensions tolerances**

Index	Tolerances
Length, width (mm)	
<1000	1 mm
1000 ... 2000	2 mm
> 2000	3 mm
Right angle	1 mm / 1 m
Side edges straightness	1 mm / 1 mm

Tolerances are in accordance with *EN 315* requirements.

3.4. Gluing

The main part of plywood is glued using **phenol-formaldehyde resin based glue**. Such gluing is resistant against environment, weather conditions, microorganisms, cold and hot water, steam and dry hot influence. Phenol-formaldehyde resin based gluing strength characteristics are in accordance with: *Class 3* in accordance with *EN 314-1* and *EN 314-2*, *BFU 100* Type in accordance with *Part 3* of *DIN 68705 3, H4 Type* (*WBP before*) in accordance with *BS 1203*.

Plywood glued using **urea-formaldehyde resin based glue**. This gluing is resistant against cold water influence, but is not resistant against influence of microorganisms. Glued with this glue plywood is designed for indoor applications. Strength characteristics of urea-formaldehyde resin based gluing are in accordance with: *Class 1* in accordance with *EN 314-1* and *EN 314-2* and *H1 Type* (*INT* before) in accordance with *BS 1203*.

Plywood glued with modified **melamine-urea-formaldehyde resin based glue**. Such gluing is resistant against air humidity influence during several years. It is resistant against cold water influence, as well as against warm water impact during limited time. However it did not pass test of boiling water. The gluing is resistant against microorganisms influence. Plywood of this gluing is designed for indoor applications; it is suitable for further processing with laser cutting tools.

Strength of melamine-urea-formaldehyde resin based gluing is in accordance with: *1 Class* in accordance with *EN 314-1* and *EN 314-2*, *IW 67 Type* in accordance with *Part 1* of *DIN 68705*, and *H2 Type* (*MR* before) in accordance with *BS 1203*.

Indices of gluing strength are daily controlled by laboratories of the production. Testing methods, periodicity of control and data statistical processing are in accordance with requirements set by *EN 13986*. Periodical independent conclusions concerning gluing strength conformity with *BFU-100* requirements provide *Fraunhofer Wilhelm Klauditz Institut*. This gives the enterprise right to mark plywood of phenol-formaldehyde based gluing with *BFU-100* register on German market.

3.5. Biological durability

Plywood biological durability assessment guidance is described by *ENV 1099 Plywood – Biological durability – Guidance for the assessment of plywood for use in different hazard classes*. This guidance indicates that plywood biological durability assessment may be made in accordance with *Part 2* of *EN 350-2 Durability of wood and wood-based products – Natural durability of solid wood – Part 2*: *Guide to natural durability and treat-ability of selected wood species of importance in Europe*. In accordance with *EN 350-2 Betula pubescens Ehrh*., *Betula pendula Roth* birch wood biological durability shall be as follows:
(1) Stability against *fungi* influence – *5* Class of stability;
(2) Stability against *Hylotrupes bajulus*, *Anobium punctatum*, *Lyctus brunneus* and *Hesperophanes cinnereus* bugs – *S* Class susceptible;
(3) stability against thermites – *S* Class susceptible.

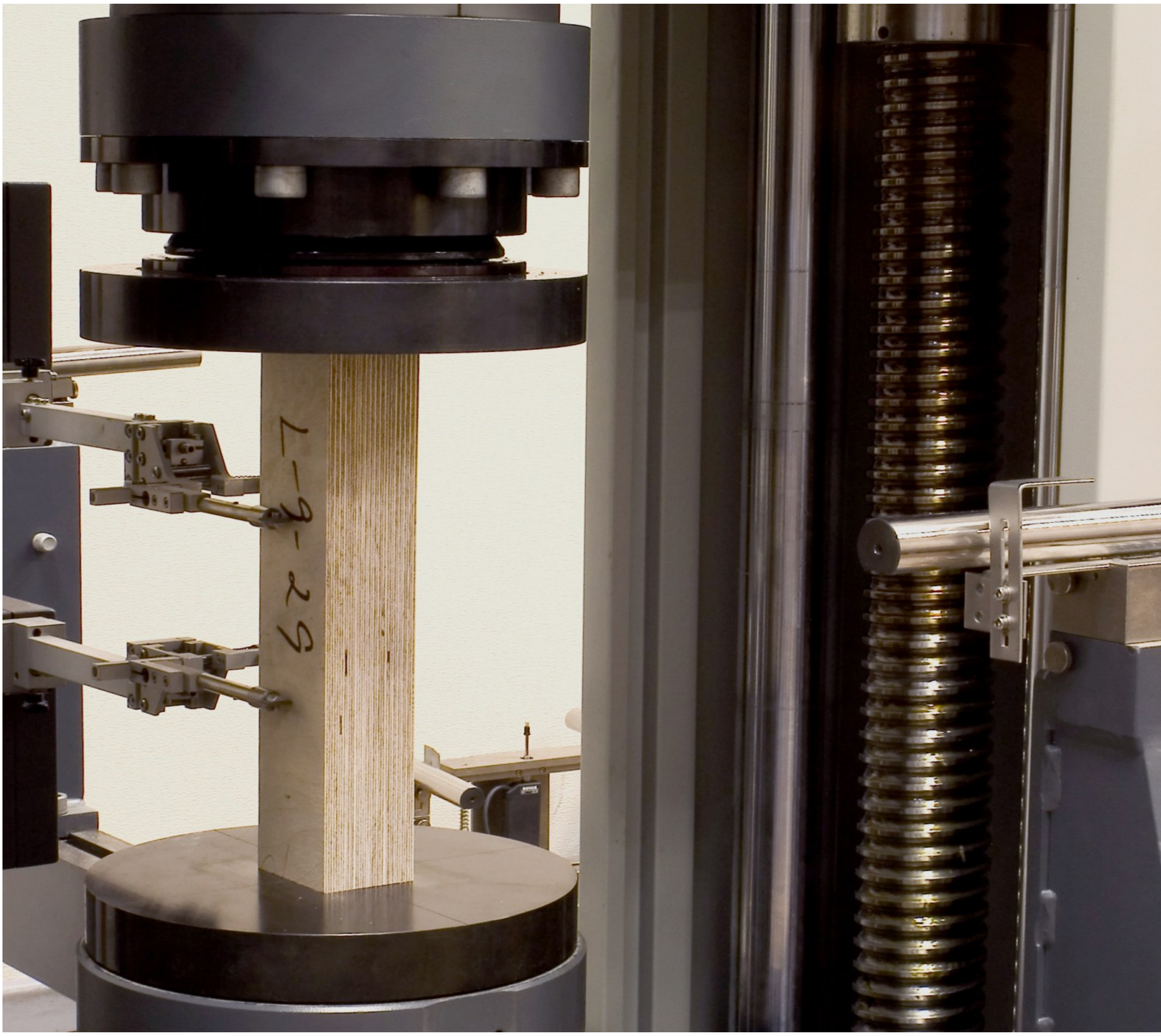
3.6. Emission of free formaldehyde

Requirements of European norms to free formaldehyde emission from wood-based products are determined as *E1 Class* in accordance with *EN 13986* and *A Class* in accordance with *EN 1084*. Allowed emission intensity is of 3.5 mg HCHO/m^{2}h. It is determined using *EN 717-2* Testing Method.

Indices of free formaldehyde emission for glued with phenol-formaldehyde resin based glue *Riga Ply, Riga Form, Riga Tex, Riga Smooth Mesh* plywood are significantly below standard requirements. Emission indices are less than 0.2 … 0.4 mg HCHO/m^{2}h for conditioned test samples. This is proved by results gained during both long-term self - control in laboratory of the enterprise, and by periodical tests made by independent institutions.
As well, indices of free formaldehyde emission for plywood glued with melamine-urea-formaldehyde and urea-formaldehyde resin based glue are stable and significantly below standard requirements. Emission indices for these products are less than 0.5...1.0 mg HCHO/m^{2}h for conditioned test samples.

3.7. Content of pentachlorophenol (PCP)

European Standards *EN 13986* sets that content of pentachlorophenol in wood shall be below 5 ppm (1 ppm = 1 mg/kg). Chemical substances containing PCP are not used for plywood production procedure. However this characteristic is under control to assure product harmlessness for consumer health. Having made testing the independent institution concluded that PCP content is below minimum limit of measurement range or less than 0.1 ppm.

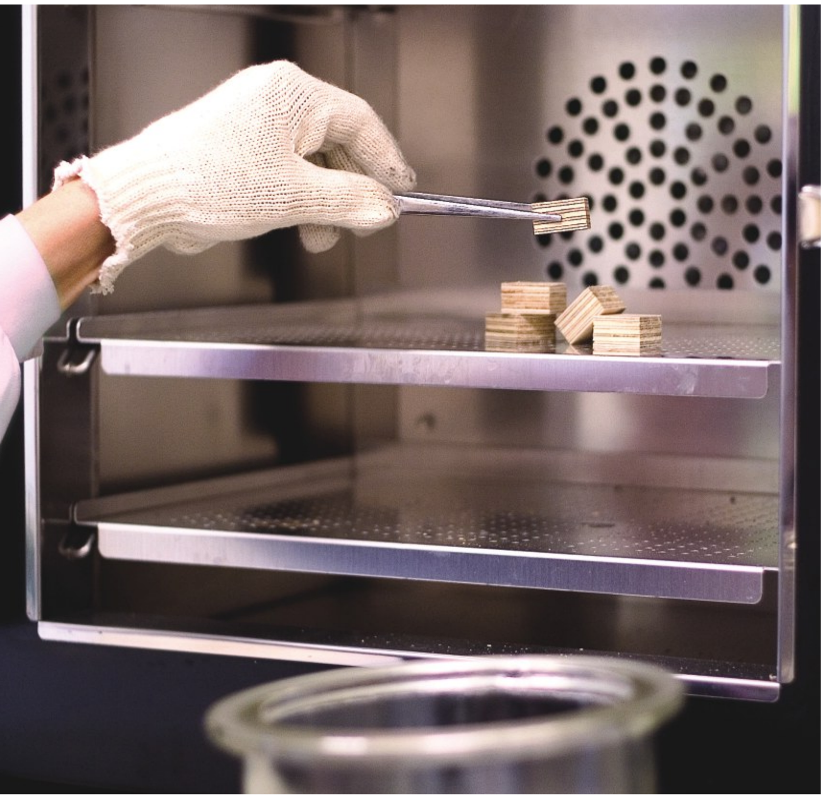


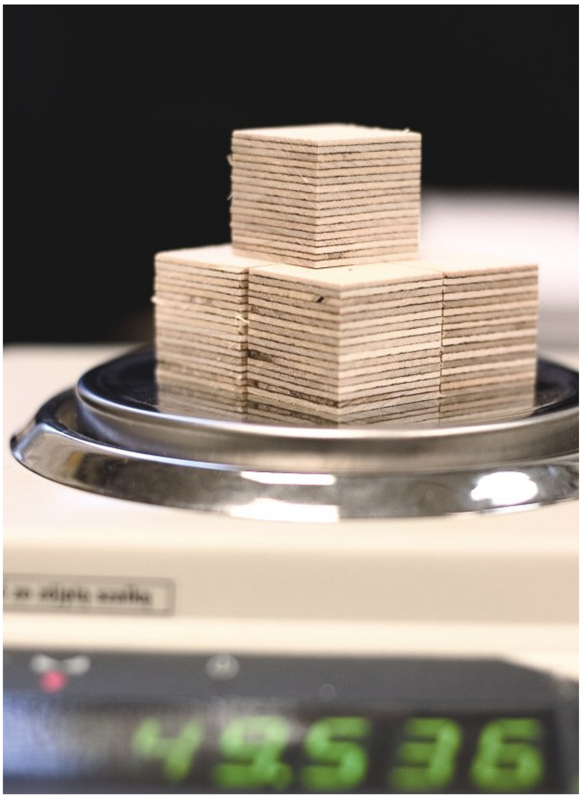
PCP content is defined according to national testing methods. Standard European testing methods *CEN TC 38* are under development at the moment.

3.8. Moisture content

Limits of moisture content for produced plywood are from 7% to 10%. Due to the fact that wood is a hygroscopic material, the level of plywood moisture content directly depends on ambient temperature and air relative humidity. The level of moisture content may vary during transportation and storage.

While storage at ambient temperature of 20°C and relative humidity of 65%, the plywood moisture content is of 10 ± 2%.





▲ Figure 3.5. **Drying of plywood samples for fixing moisture and density**

▲ Figure 3.6. **Weighing of plywood samples for fixing moisture and density**

◀ Figure 3.4. **Compressive strenght perpendicular to the bending plane**

3.9. Density

Wood density depends on several factors, for example, timber growing conditions, peripheral or core wood, etc. Plywood density is of 15% above wood density, at least.
Plywood density depends not only on the density of wood used for production but also on pressing level, moisture content, and other factors.

Density of birch plywood produced by AS *Latvijas Finieris* is within the limits from 650 kg/m^3 to 750 kg/m^3 at air temperature of 20 ^{0}C and relative humidity of 65%.

3.10. Factory production control

AS *Latvijas Finieris* ensures and guaranties a stable quality of its products and services, facilitates the competitiveness of the products by precisely defining the production processes, including testing, control and inspection systems.

There are laboratories in every mill of company, their task is to follow the production processes, product quality and to develop new products and technology. Laboratories are upgraded with different technical equipment for inspection of production processes and

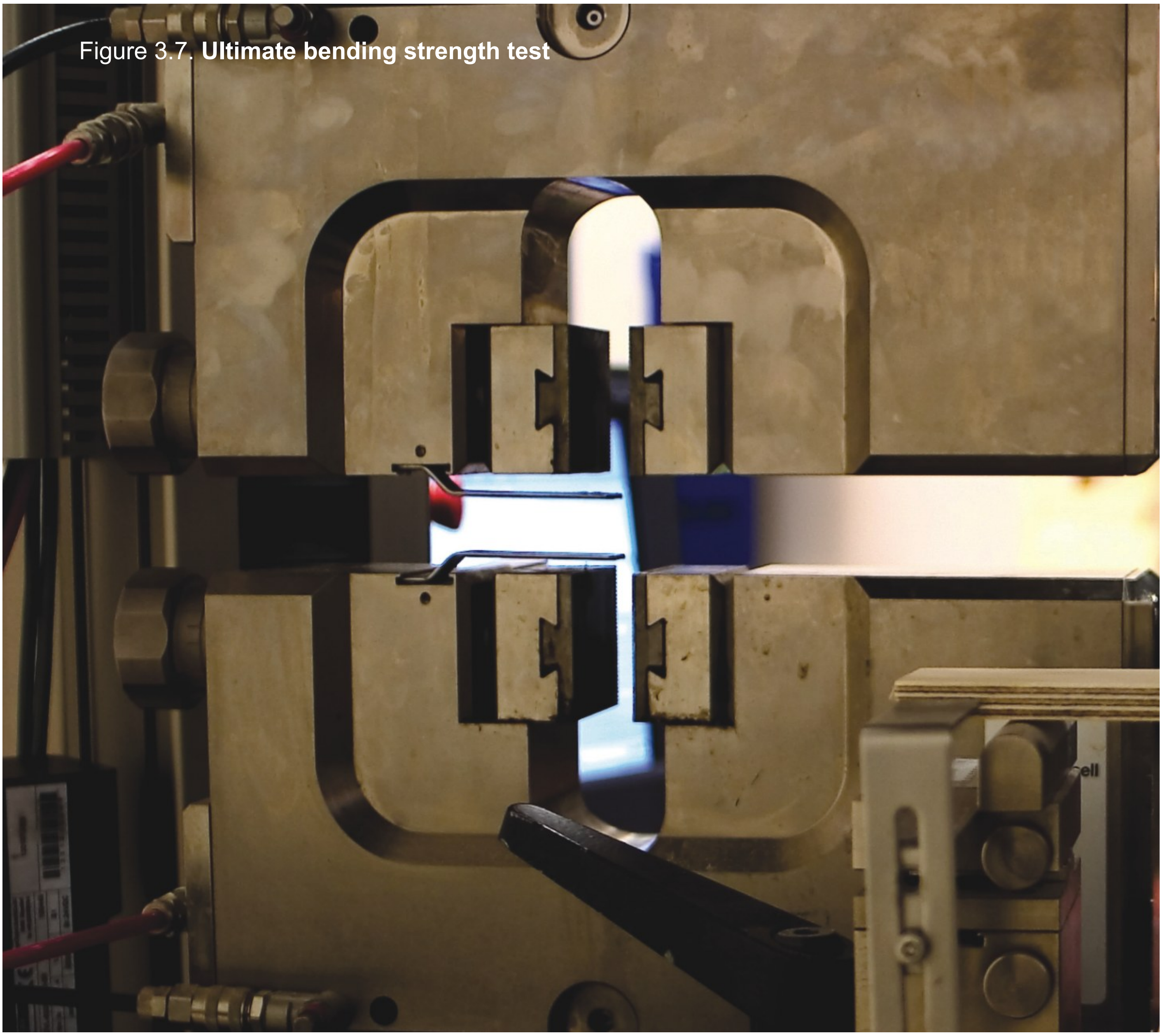


Figure 3.7. **Ultimate bending strength test**

testing physical-mechanical properties of product.

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 certificate was issued by *Fraunhofer Wilhelm Klauditz Intitute*, EU notification 0765.

Plywood *Riga Ply* bonding quality data (2004) according to factory production control are presented in Table 3.10. Test was done according to *EN 314-1*.

Riga Ply (unsanded) bending strength and stiffness (modulus of Elasticity) values (till August 2005) correspond to lower 5 quantile values determined according to *EN 310* test method and calculated according to *EN 326-1*, plywood moisture content 8 ± 2%.

Table 3.10. **Plywood *Riga Ply* bonding quality according to factory production controls**

Pretreatments according to *EN 314-1*	Average failing force, N/mm^2	Lower 5% quantile, N/mm^2	Average cohesive wood failure percentage
Immersion for 24 h in water at 20 ± 3°C	2.75	1.97	62.7
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	2.29	1.67	60.4
Immersion for 72 ± 1 h in boiling water, followed by cooling in water at 20 ± 3°C for at least 1 h	2.07	1.50	71.5

Table 3.11. **Plywood *Riga Ply* bending strength and stiffness according to factory production controls**

Nominal thickness, mm	Along the grain				Perpendicular the grain			
	Lower 5% quantile of strenght,		Lower 5% quantile of modulus of elasticity,		Lower 5% quantile of strenght,		Lower 5% quantile of modulus of elasticity,	
	N/mm^2	Class	N/mm^2	Class	N/mm^2	Class	N/mm^2	Class
4	102.8	F 60	7786	E 70	13.6	F 15	750	E 5
6.5	80.4	F 50	8720	E 80	37.8	F 20	2848	E 25
9	77.0	F 50	7380	E 70	43.4	F 25	2717	E 25
12	74.2	F 40	8039	E 80	47.0	F 30	4339	E 40
15	69.1	F 40	7922	E 70	47.8	F 30	4592	E 40
18	63.9	F 40	7925	E 70	46.3	F 30	5046	E 50
21	58.5	F 30	7405	E 70	44.6	F 30	4378	E 40
24	62.8	F 40	7023	E 70	45.2	F 30	4873	E 40
27	60.4	F 40	7422	E 70	47.9	F 30	5111	E 50
30	55.4	F 30	7628	E 70	49.9	F 30	5287	E 50
35	58.6	F 30	6885	E 60	49.2	F 30	5494	E 50
40	56.2	F 30	7112	E 70	48.4	F 30	5968	E 50

Table 3.12. **Plywood *Riga Laser* bending strength and stiffness according to factory production controls**

Nominal thickness, mm	Along the grain				Perpendicular the grain			
	Lower 5% quantile of strenght,		Lower 5% quantile of modulus of elasticity,		Lower 5% quantile of strenght,		Lower 5% quantile of modulus of elasticity,	
	N/mm^2	Class	N/mm^2	Class	N/mm^2	Class	N/mm^2	Class
12	73.2	F 40	8712	E 80	44.9	F 25	4889	E 40
15	66.9	F 40	7855	E 70	47.5	F 30	4560	E 40
18	64.6	F 40	7509	E 70	45.4	F 30	4865	E 40

3.11. Certificates

Independent conclusions concerning conformity of manufactured by AS *Latvijas Finieris* products with requirements of different norms and international standards had been provided by:
Fraunhofer Wilhelm Klauditz Institut, Germany;
Lignotesting A.S, Slovakian Institute;
ГОСТ Р, Russian State Standard Certification System;

Wood Technology Institute of Poznan (Poland);
State Health Centre of Ministry of Public Health of Lithuania;
Latvian State Wood Chemistry Institute;
Berufsgenossenschafliches Institut für Arbeitsschutz – BIA;
Swedish Institute for Wood Technology Research – TRATEK;
Swedish National Testing and Research Institute – SP;
Technical Research Centre of Finland – VTT;
Danish Technological Institute – DTI,
Etc.

4

characteristics of products

4.1. 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 a large number of samples. The more is the number of tested samples, the more reliable testing results are gained.

For calculation there are used different methods of data statistical characteristics – arithmetic mean, standard deviation, coefficient variation, etc.

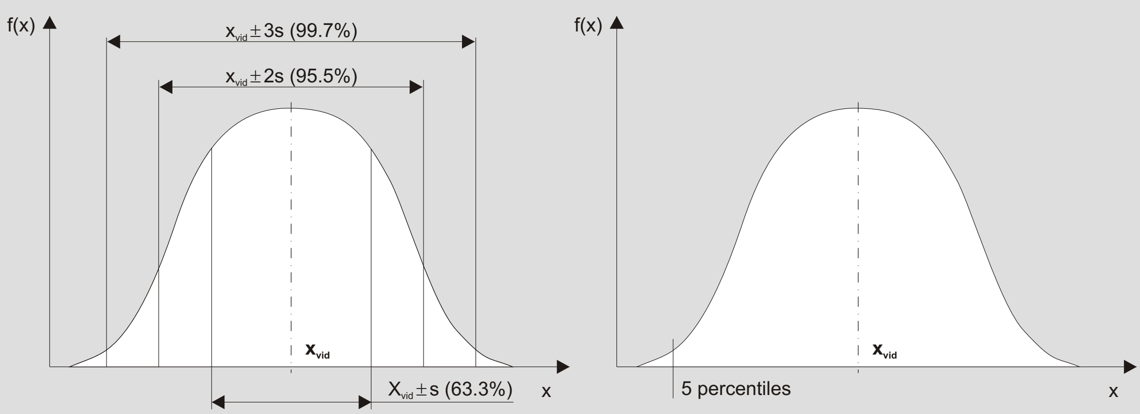
Arithmetic mean (mean value) describes (reflects) average value of characteristic.

Standard Deviation describes dispersion in respect of arithmetic mean. The smaller is standard deviation, the smaller is data dispersion relatively 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 Wood-based panels – Sampling, cutting and inspection – Part 1: Sampling and cutting of test pieces and expression of test results and EN 1058 Wood based panels – Determination of characteristic values of mechanical properties and density*.

Having standard deviation and arithmetic mean, it is possible to calculate probability that the data (index, characteristic) are within interval $x_{vid} \pm s$; $x_{vid} \pm 2s$; $x_{vid} \pm 3s$. If database is of gaussian distribution, probabilities are:
within interval x_{vid} - s to x_{vid} + s - 68,3% of data;
within interval x_{vid} - 2s to x_{vid} + 2s – 95,5% of data;
within interval x_{vid} - 3s to x_{vid} + 3s – 99,7% of data.

Figure 4.1. **Gaussian distribution of data**

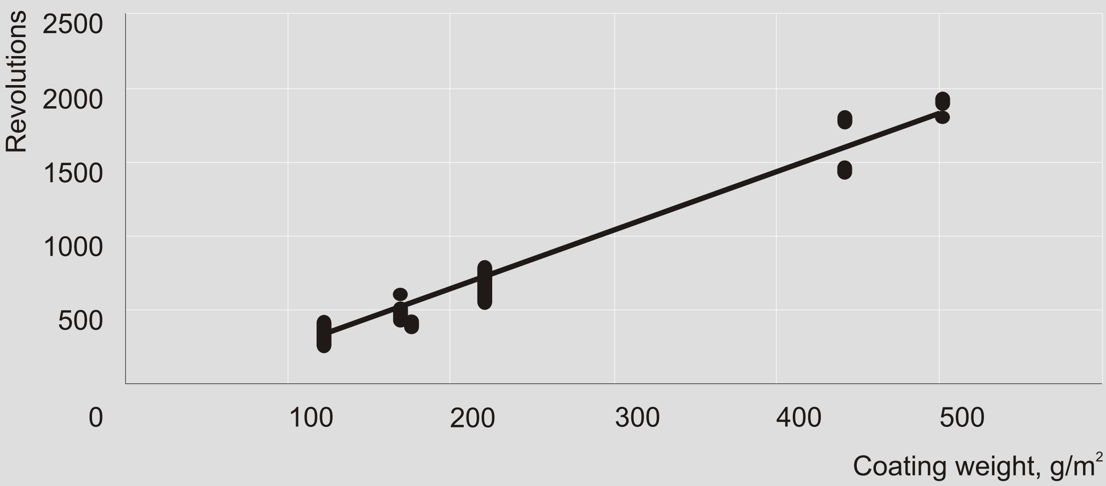


4.2. Wear resistance of overlaid plywood

Overlay wearing resistance determination method is described by *EN 438 Decorative high-pressure laminates (HPL) - Sheets based on thermosetting resins - Part 2: Determination of properties*.

Loaded rollers act on rotating sample; the rollers are coated with sanding paper, so simulating actual operation loads. Wear level is evaluated visually and the result is expressed in revolutions (it is called as Taber value as well).

Figure 4.2. **Results of wear resistance of *Riga Form* plywood**



Wear resistance depends on various factors, for example, ambient temperature and moisture content, so it is reasonable to provide not a definite result, but wear resistance class.

Wear resistance classes of plywood products manufactured by AS *Latvijas Finieris* are presented in Table 4.1.

Tables 4.2. - 4.5. provide plywood coatings wear resistance classes.

Table 4.1. **Wear resistance classes of overlaid plywood products**

Class	1	2	3	4	5	6	7	8	9	10	11
From revolutions	0	26	101	251	401	601	901	1501	2501	5001	10001
To revolutions	25	100	250	400	600	900	1500	2500	5000	10000	…

To increase plywood overlay wear resistance it is possible to make overlay of several film layers or from special films of improved wear resistance.

For different products it is possible to determine overlay wear resistance, wear resistance of pattern, and upper layer wear resistance (for case of overlay consisting of several film layers of different colour).

Table 4.2. **Wear resistance classes of overlaid products**

Film weight, g/m^2	Number of coating layers, pcs.	Total weight, g/m^2	*Riga Form*	*Riga Tex*, small	*Riga Tex*, large	*Riga Smooth Mesh*, small	*Riga Smooth Mesh*, large
120	1	120	4	4	4	4	4
167	1	167	5	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
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 4.3. **Wear resistance classes of overlays with improved wear resistance films**

Product	Overlay weight, g/m^2			
	130	260	350	390
Riga Form	10			
Riga Tex, small	9		10	
Riga Tex, large	9	11	10	11

Table 4.4. **Wear resistance classes of special pattern products**

Product	Overlay colour	Wear resistance class
Riga Foot	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
	Grey	7
Riga Rhomb Heavy	Dark brown	10
Riga Pattern	Dark brown	6
	Grey, green, black	7
Riga Pattern Heavy	Dark brown	11

Table 4.5. **Wear resistance classes of products with overlay of melamine film**

Product	Overlay colour	Wear resistance class
Riga Mel	White	5
	Grey	5

4.3. 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 loaded swivel castor on overlaid plywood. The aim of this Rolling test is to imitate the effect caused by loaded swivel castor on plywood overlay material (laminate). Testing device is shown on figure 4.3.

Overlaid material is trafficked by 300 kg loaded swivel castor (a width of the castor 40 +/-1 mm and diameter 115 +/- 5 mm). The castor moves backwards and forwards until plywood overlay is damaged. (Splits and cracking appear on the overlay surface). Results are registered as number of cycles till occurance of damage in the material). Results are shown in table 4.6 and 4.7.

Figure 4.3. **Determination of the effect of loaded heavy duty castors**

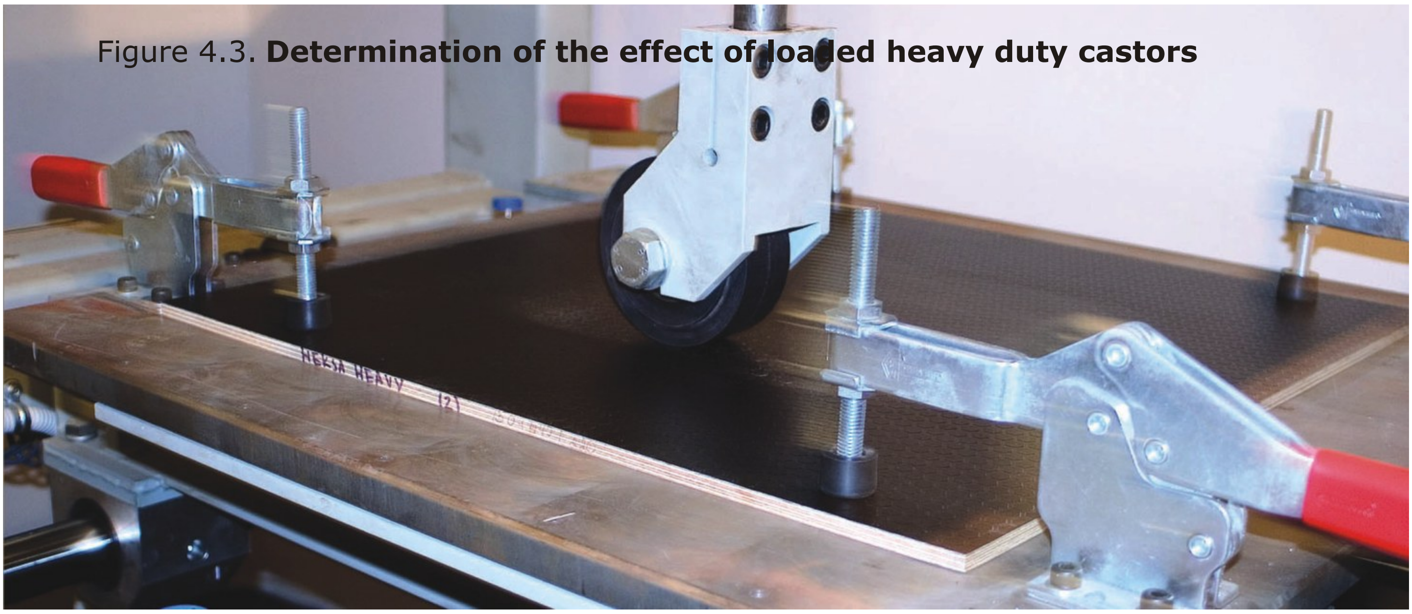


Table 4.6. **Resistance of overlayed plywood**

Product	Number of cycles
Riga Rhomb	> 10000
Riga Foot	> 2000
Riga Heksa	> 10000

Table 4.7. **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

4.4. Reaction on fire impact

In accordance with *EN 13986* standard, fire impact classes may be determined using *EN 13501 - 1* standard or expressed in values set by Table 8 of *EN 13986* (here Table 4.8).

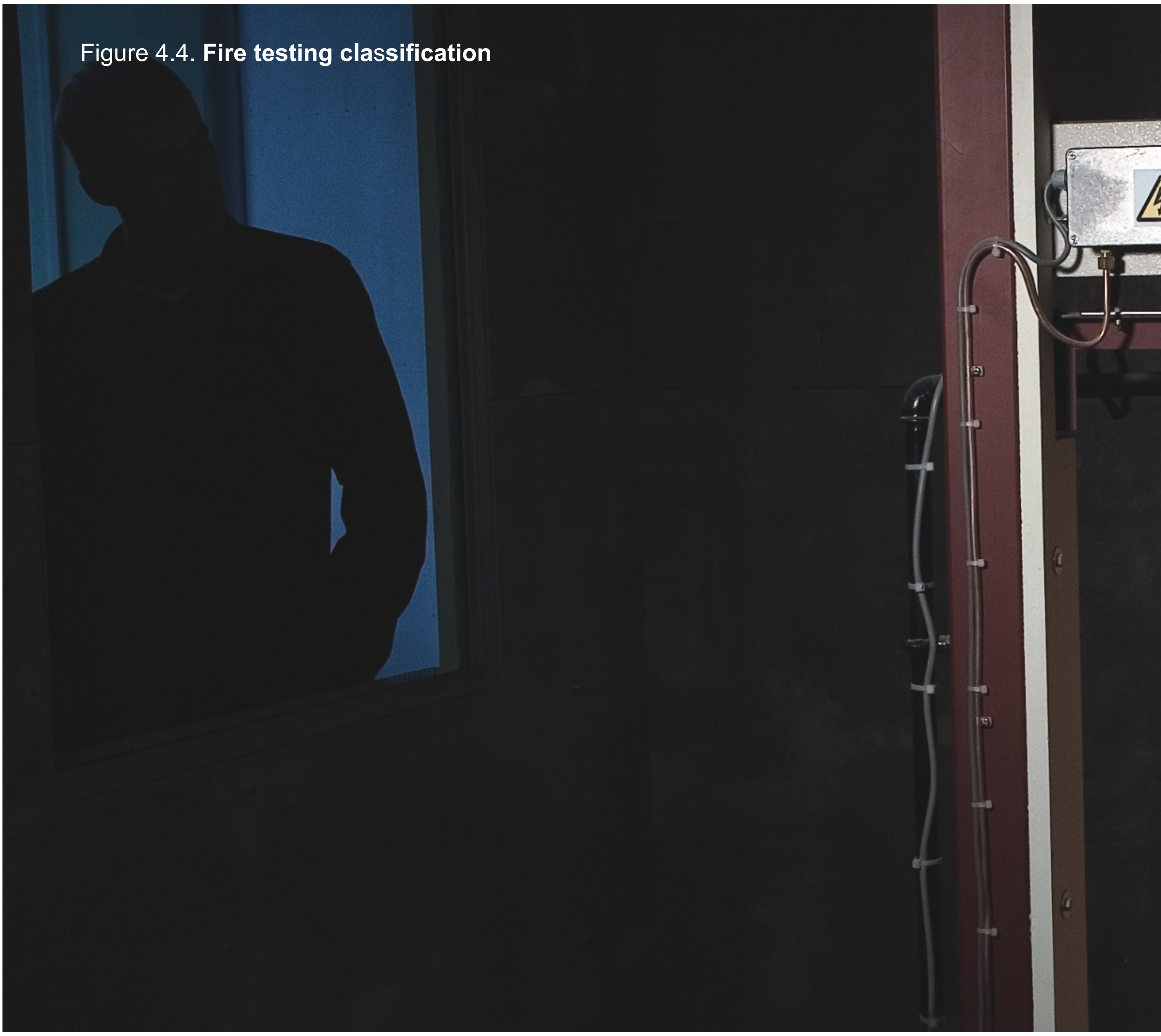


Figure 4.4. **Fire testing classification**

Table 4.8. **Extract from Table 5.8 of *EN 13986***

Wood based panel	Minimum density, kg/m^3	Minimum thickness, mm	Class[b], with the exception of floor	Class[c], for floor
Plywood	400	9	*D - s2, d0*	D_{FL} *- s1*

[b] class, as set by Commission Decision 2000/147/EC Annex Table 1
[c] class, as set by Commission Decision 2000/147/EC Annex Table 2

Standard birch plywood *Riga Ply* 4 mm is of **E class** reaction to fire.

Standard plywood *Riga Ply* 6.5 mm is of **D class** reaction to fire.

Additional classification of 6.5 mm plywood concerning smoke formation is in accordance with **s2** class.

Additional qualification of 6.5 mm plywood concerning smoke formation is in accordance with **d2** class.

Standard plywood *Riga Ply* 6.5 mm classification is ***Dfl class***.

Additional classification of *Riga Ply* 6.5 mm plywood concerning smoke formation is in accordance with ***s1 class***.

Table 4.9. **Reaction to fire of birch standard plywood *Riga Ply* samples at single-flame source test in accordance with *EN ISO 11925-2:2002***

Test method	Sample description	Place of flame application	Does ignition take place?	Does flame runs as high as 150 mm mark?	During what time does flame run as high as 150 mm, s
EN ISO 11925-2 Bottom side and surface fire resistance to 30s flame application	*Riga Ply* 4 mm	Bottom side	Yes	No	-
	Riga Ply 4 mm	Surface	No	No	-
	Riga Ply 6.5 mm	Bottom side	Yes	No	-
	Riga Ply 6.5 mm	Surface	No	No	-

Table 4.10. **Reaction to fire of birch standard plywood *Riga Ply* 6.5 mm samples at single-flame source test in accordance with *EN 13823* – for construction materials (except floor structures)**

Test method	Sample description	Parameters	Testing parameters (m)	Allowed parameters
EN 13823	*Riga Ply* 6.5 mm	$FIGRA_{0.2MJ}$ (W/s)	530	(-)
		$FIGRA_{0.4MJ}$ (W/s)	530	(-)
		LFS < edge	(-)	Yes
		THR_{600s} (MJ)	67.0	(-)
		SMOGRA (m^2/s^2)	9	(-)
		TSP_{600s} (m^2)	101	(-)
		Liesmas daļa	(-)	Yes

Table 4.11. **Results of birch plywood samples testing in accordance with *EN ISO 9239-1* for floor structures**

Product	Wood grain direction of sample	Duration of ignition *HF-30* (kW/m^2)	Critical combustion before go out (kW/m^2)	Obscuration integral of smoke formation
Riga Ply	L - lengthwise	-	5.59	113
	C - transversal	-	3.27/3.45/3.1	56/57/49
	C - transversal		Average 3.27	Average 54

Fire reaction of plywood samples with different overlays in accordance with *EN 11925-2:2002*, single-flame source test.

Samples:
Riga Form (Colour - Dark brown, Weight - 120 g/m²); 6.5 mm;
Riga Form (Colour - Dark brown, Weight - 220 g/m²); 6.5 mm;
Riga HPL; 12 mm;
Riga Tex (Colour - Dark brown, Weight - 120 g/m², grade - large); 6.5 mm;
Riga Tex (Colour - Dark brown, Weight - 120 g/m², grade - small); 6.5 mm;
Riga Preprime (Colour - Preprime film, Weight - 390g/m²); 6.5 mm;
Riga Paint (Colour - Paint film, Weight - 215 g/m²), 6.5 mm;
Riga Lacquer - (Acryl - coloured); 12 mm.

Products of AS *Latvijas Finieris* with reference to *EN 13501-1:2002*, in accordance with *EN 11925-2:2002*:
Riga Form (Colour - Dark brown Weight- 120 g/m²); 6.5 mm;
Riga Form (Colour - Dark brown, Weight - 220g/m²); 6.5 mm;
Riga HPL; 12 mm;
Riga Tex (Colour - Dark brown, Weight - 120 g/m², large mesh); 6.5 mm;
Riga Tex (Colour - Dark brown, Weight - 120 g/m², small mesh); 6.5 mm;
Riga Preprime (Colour - Preprime film, Weight - 390 g/m²); 6.5 mm;
Riga Paint (Colour - Paint film, Weight - 215 g/m²), 6.5 mm;
Riga Lacquer - (Acryl - coloured); 12 mm - are at least of ***E class*** fire resistance.

Table 4.12. **During testing of plywood samples overlays no sample run as high as 150 mm mark**

Sample description	Flame application place	Duration of flame application, s	Does ignition take place?	Does flame run as high as 150 mm mark?	How fast does the flame run as high as 150 mm mark?
Riga Form 120 g/m^2	Bottom side	30	Yes	No	-
Riga Form 120 g/m^2	Surface	30	No	No	-
Riga Form 220 g/m^2	Bottom side	30	Yes	No	-
Riga Form 220 g/m^2	Surface	30	No	No	-
Riga HPL	Bottom side	30	No	No	-
Riga HPL	Surface	30	No	No	-
Riga Tex large mesh	Bottom side	30	Yes	No	-
Riga Tex large mesh	Surface	30	No	No	-
Riga Tex small mesh	Bottom side	30	Yes	No	-
Riga Tex small mesh	Surface	30	No	No	-
Riga Preprime	Bottom side	30	Yes	No	-
Riga Preprime	Surface	30	No	No	-
Riga Paint	Bottom side	30	Yes	No	-
Riga Paint	Surface	30	No	No	-
Riga Lacquer	Bottom side	30	Yes	No	-
Riga Lacquer	Surface	30	No	No	-

4.5. Slipping

Anti-slipping property describes the ability of floor planking to prevent slipping.

It is determined in accordance with *BGR 181* (*bisher ZH1/571*) and *DIN 51130*. In accordance with this method the anti-slipping property is described as angle at which a person is slipping moving forward and back over the tested surface. The tested material and footwear sole are slightly oiled with *10W30* oil. Two persons determining the average acceptance angle make the test. The group is evaluated depending on the average accepted angle surface.

Table 4.13. **Anti-slipping property evaluation groups**

Average acceptance angle	Anti-slipping 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 4.14. **Anti-slipping property evaluation**

Product	Anti-slipping property evaluation group
Riga Foot	R 10
Riga Tex	R 13

4.6. 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 there are used for testing: acetone, coffee, sodium hydroxide (25%), hydrogen peroxide (30%), shoe polish, and citric acid (10%). The results are presented in Table 4.15.

The following finished and overlaid plywood is tested: *Riga Tex, Riga HPL, Riga Decor, Riga Prime, Riga Lacquer, Riga Color, Riga Form*. Each reagent is kept in contact with sample surface within 24 hours.

Grades of surface stability tests are as follows:
Grade 5: no visible alterations.
Grade 4: minor gloss / colour alterations visible at certain angle of view.
Grade 3: moderate gloss or colour alterations.
Grade 2: significant gloss and / or colour alterations.
Grade 1: damages of surface and / or bubbling.

Table 4.15. **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
Riga Form	4	5	2	5	2	5
Riga Tex	5	5	2	4	2	5
Riga Prime	5	5	1	5	1	5
Riga Mel	4	5	4	4	3	5
Riga HPL	4	5	5	5	1	5

EN 13986 standard allows to indicate some specific plywood properties without testing, using tables published in the standard. The following properties are attributed to plywood in accordance with these tables (see Table 4.16):

Table 4.16. **Properties of plywood in accordance with *EN 13986***

Properties	Standard	Unit	Value or class													
Nominal thickness		mm	4	6.5	9	12	15	18	21	24	27	30	35	40	45	50
Density	EN 323	Kg/m^3	650 - 750													
Surface weight	EN 315	Kg/m^2	2.8	4.6	6.3	8.4	10.5	12.6	14.7	16.8	18.9	21	24.5	28	31.5	35
Reaction to fire	EN 13986	Class	-		D-s2, d0 / D_{FL}-s1											
Steam permeability	EN 13986 Wet cup µ		90													
	EN 13986 Dry cup µ		220													
Air sound isolation	EN 13986	dB	-		24.4	26.0	27.3	28.3	29.2	29.9	30.6	31.2	32.1	32.8	33.5	34.1
Sound absorption From 250 Hz to 500 Hz From 1000 Hz to 2000 Hz	EN 13986	Coefficient	0.10 0.30													
Thermal conductivity	EN 13986	W/(m*K)	0.17													

5

mechanical properties

5.1. Characteristic strength and stiffness

The strength and stiffness values given for birch plywood - *Riga Ply* are given in Tables 5.1 to 5.21. These values corresponding 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 5.1. **The thickness t, area A, section modulus W and second moment of area I of birch plywood *Riga Ply***

Nominal thickness and number of veneers	Unsanded				Sanded			
	t, mm	A, mm^2	W, mm^3	I, mm^4	t,mm	A, mm^2	W, mm^3	I, mm^4
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

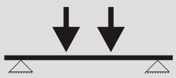
Table 5.2. **The ratios A/A_{eff}, W/W_{eff}, and I/I_{eff} of unsanded birch plywood *Riga Ply***

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 5.3. **The ratios A/A_{eff}, W/W_{eff}, and I/I_{eff} of sanded birch plywood *Riga Ply***

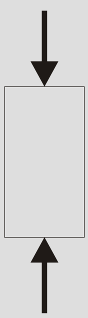
Nominal thickness and number of veneers	Along the grain direction of the face veneers			Across the grain direction of the face veneers		
	A/A_{eff}	W/W_{eff}	I/I_{eff}	A/A_{eff}	W/W_{eff}	I/I_{eff}
4/3	1.636	1.062	1.062	2.571	6.613	17.003
6.5/5	1.778	1.374	1.374	2.286	2.411	3.674
9/7	1.840	1.536	1.536	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 5.4. **The characteristic bending strength f_{mk} of birch plywood *Riga Ply***



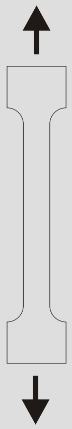
Nominal thickness and number of veneers	Unsanded		Sanded	
	$f_{mk}\parallel$, N/mm^2	$f_{mk}\perp$, N/mm^2	$f_{mk}\parallel$, N/mm^2	$f_{mk}\perp$, N/mm^2
4/3	77.0	8.9	75.3	12.1
6.5/5	63.4	27.7	58.2	33.2
9/7	56.9	32.3	52.1	36.7
12/9	53.2	34.4	49.0	38.0
15/11	50.8	35.6	47.2	38.6
18/13	49.2	36.4	45.9	38.9
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 5.5. **The characteristic compression strength f_{ck} of birch plywood *Riga Ply***



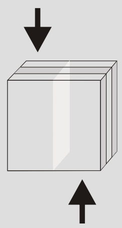
Nominal thickness and number of veneers	Unsanded		Sanded	
	$f_{ck}\parallel$, N/mm^2	$f_{ck}\perp$, N/mm^2	$f_{ck}\parallel$, N/mm^2	$f_{ck}\perp$, N/mm^2
4/3	38.7	19.3	35.4	22.6
6.5/5	34.8	23.2	32.6	25.4
9/7	33.1	24.9	31.5	26.5
12/9	32.2	25.8	30.9	27.1
15/11	31.6	26.4	30.6	27.4
18/13	31.2	26.8	30.3	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 5.6. **The Characteristic tension strength f_{tk} of birch plywood *Riga Ply***



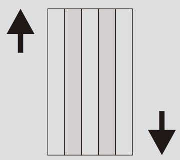
Nominal thickness and number of veneers	Unsanded		Sanded	
	$f_{tk} \parallel$, N/mm^2	$f_{tk} \perp$, N/mm^2	$f_{tk} \parallel$, N/mm^2	$f_{tk} \perp$, N/mm^2
4/3	52.0	26.0	47.7	30.3
6.5/5	46.8	31.2	43.9	34.1
9/7	44.6	33.4	42.4	35.6
12/9	43.3	34.7	41.6	36.4
15/11	42.5	35.5	41.1	36.9
18/13	42.0	36.0	40.8	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 5.7. **The characteristic shear strength in panel shear f_{pak} of birch plywood *Riga Ply***



Nominal thickness and number of veneers	Unsanded		Sanded	
	$f_{pak} \parallel$, N/mm^2	$f_{pak} \perp$, N/mm^2	$f_{pak} \parallel$, N/mm^2	$f_{pak} \perp$, N/mm^2
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 5.8. **The characteristic shear strength in planar shear f_{plk} of birch plywood *Riga Ply***



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
45/32	0.91	2.14	0.90	2.17
50/35	2.26	2.14	2.24	2.17

Table 5.9. **The mean modulus of elasticity E in bending of birch plywood *Riga Ply***

Nominal thickness and number of veneers	Unsanded		Sanded	
	E ∥ ,N/mm²	E ⊥ ,N/mm²	E ∥ ,N/mm²	E ⊥ ,N/mm²
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 5.10. **The mean modulus of elasticity E in tension and compression of *Riga Ply***

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 5.11. **The mean modulus of rigidity G in panel shear of birch plywood *Riga Ply***

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 5.12. **The mean modulus of rigidity G in planar shear of birch plywood *Riga Ply***

Nominal thickness and number of veneers	Unsanded		Sanded	
	$G\parallel$, N/mm^2	$G\perp$, N/mm^2	$G\parallel$, N/mm^2	$G\perp$, N/mm^2
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 5.13. **The characteristic bending moment capacity M of birch plywood *Riga Ply* for the full cross-section along and perpendicular to the grain**

Nominal thickness and number of veneers	Unsanded		Sanded	
	$M\parallel$, Nm	$M\perp$, Nm	$M\parallel$, Nm	$M\perp$, Nm
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 5.14. **The characteristic compression capacity N_c of birch plywood *Riga Ply***

Nominal thickness and number of veneers	Unsanded		Sanded	
	$N_c\parallel$, MN	$N_c\perp$, MN	$N_c\parallel$, MN	$N_c\perp$, MN
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 5.15. **The characteristic tension capacity N_t of birch plywood *Riga Ply***

Nominal thickness and number of veneers	Unsanded		Sanded	
	$N_t \parallel$,MN	$N_t \perp$,MN	$N_t \parallel$,MN	$N_t \perp$,MN
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 5.16. **The characteristic shear capacity in panel shear V_{pa} of birch plywood *Riga Ply* for the full cross-section along and perpendicular to the grain**

Nominal thickness and number of veneers	Unsanded		Sanded	
	$V_{pa} \parallel$, kN	$V_{pa} \perp$,kN	$V_{pa} \parallel$,kN	$V_{pa} \perp$,kN
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 5.17. **The characteristic shear capacity in planar shear V_{pl} of birch plywood *Riga Ply* for the full cross-section along and perpendicular to the grain**

Nominal thickness and number of veneers	Unsanded		Sanded	
	$V_{pl} \parallel$,kN	$V_{pl} \perp$,kN	$V_{pl} \parallel$,kN	$V_{pl} \perp$,kN
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
45/32	27.1	64.1	26.4	64.1
50/35	73.7	69.9	72.1	69.9

Table 5.18. **The mean stiffness EI in bending of birch plywood *Riga Ply***

Nominal thickness and number of veneers	Unsanded		Sanded	
	EI ∥, kNm^2	EI ⊥, kNm^2	EI ∥, kNm^2	EI ⊥, kNm^2
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 5.19. **The mean stiffness EA in tension and compression of birch plywood *Riga Ply* for the full cross-section along and perpendicular to the grain**

Nominal thickness and number of veneers	Unsanded		Sanded	
	EA∥ ,MN	EA⊥ ,MN	EA∥ ,MN	EA⊥ ,MN
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 5.20. **The mean shear rigidity GA in panel shear in bending of birch plywood *Riga Ply* for the full cross-section along and perpendicular to the grain**

Nominal thickness and Number of veneers	Unsanded		Sanded	
	GA ∥ ,MN	GA ⊥ ,MN	GA ∥ ,MN	GA ⊥ ,MN
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 5.21. **The mean shear rigidity GA in planar shear of birch plywood *Riga Ply* for the full cross-section along and perpendicular to the grain**

Nominal thickness and number of veneers	Unsanded		Sanded	
	GA ∥, MN	GA ⊥, MN	GA ∥, MN	GA ⊥, MN
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

6

design

6.1. General explanatory notes

According to AS *Latvijas Finieris* order to *VTT* institute in 2004, *VTT* was evaluating load resistance values of plywood in different cases. The design is carried out in accordance with *prEN 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 $f_{m,d}$:

$$\sigma_{m,d} \leq f_{m,d} \quad [6.1.]$$

The design bending stress is calculated from the design load. The design load is given by combining the characteristic loads multiplied with 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. Hence,

$$\sigma_{m,d} = \gamma_q \sigma_{m,k} \quad [6.2.]; \qquad f_{m,d} = \frac{k_{mod}}{\gamma_m} f_{m,k} \quad [6.3.],$$

where: $\sigma_{m,k}$ - the characteristic bending stress;
k_{mod} - factor taking into account the effect of duration of load and moisture content.

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

$$\tau_{v,d} \leq f_{v,d} \quad [6.4.].$$

The design shear stress is calculated from the design load. The design load is given by combining the characteristic loads multiplied with 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,

$$\tau_{v,d} = \gamma_q \tau_{v,k} \quad [6.5.]; \qquad f_{v,d} = \frac{k_{mod}}{\gamma_m} f_{m,k} \quad [6.6.],$$

where: $\tau_{v,k}$ - the characteristic shear stress;
k_{mod} - factor taking into account the effect of duration of load and moisture content (see Table 6.1).

Table 6.1. **Values of k_{mod}***

Service class **	Load duration 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

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

** Service class description is given in table 6.2
*** Load - duration class description is given in table 6.3

Table 6.2. **Service classes****

Service class	Description of service class	Average moisture contents for plywood, %
1	Characterized by moisture content in the materials corresponding to a temperature of 20^{0}C and the relative humidity of the surrounding air only exceeding 65% for a few weeks per year.	11
2	Characterized by moisture content in the materials corresponding to a temperature of 20^{0}C and the relative humidity of the surrounding air only exceeding 85% for a few weeks per year.	17
3	Characterized by climatic conditions leading to higher moisture contents than in service class 2.	above 17

Table 6.3. **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 1week	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 u_{fin} is less than the pre-set deflection value u_{preset}.

$$u_{fin} = u_{fin,permanent} + u_{fin,quasi,permanent} \leq u_{preset} \quad [6.7.],$$

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

$$u_{fin,permanent} = u_{inst}\,(1+k_{def}) \quad [6.8.]; \qquad u_{fin,quasi,permanent} = u_{inst}\,(1+\psi_2 k_{def}) \quad [6.9.],$$

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 6.4.

Table 6.4. **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 birch plywood *Riga Ply* are given in the chapter *Mechanical properties*.

6.2. 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 [6.10] and [6.11], respectively. The critical deflection $u_{M+V} \approx u_M$ is given by the first term of equation [6.12]. 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 6.5.

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

$$\sigma = \frac{M_{cri}}{W} = \alpha \frac{qL^2_{span}}{W} \quad [6.10.],$$

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 6.5.

The critical shear stress τ is given by

$$\tau = \frac{3}{2}\frac{V_{cri}}{A} = \frac{3}{2}\beta\frac{qL_{span}}{A} \quad [6.11.],$$

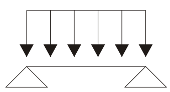
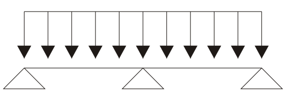
where: A - (= t) is the area of the full cross-section of the plate strip;
β - is given in Table 6.5.

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

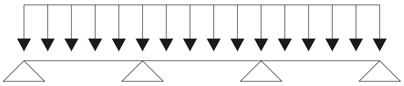
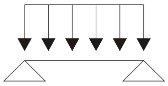
$$u_{M+V} = \varphi \frac{qL^4_{span}}{EI} + \psi \frac{qL^2_{span}}{\frac{5\,GA}{6}} \quad [6.12.],$$

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 6.5.

Table 6.5. ***α, β, φ* and *ψ* factors to be used in equations [6.10.] - [6.12]**

Number of spans		α	β	φ	ψ
	Strip	0.125	0.500	0.0130	0.125
	Strip	0.125	0.625	0.0054	0.149

Continuation of Table 6.5.

Number of spans		α	β	φ	ψ
	Strip	0.100	0.600	0.0069	0.133
	Plate	0.041 - 0.125	0.226 - 0.500	0.0043 - 0.0130	-

6.3. Floors - Uniform load

The object of this section is to present and document tabulated uniformly distributed load resistance values for floors of birch plywood *Riga Ply* produced by AS *Latvijas Finieris* is carried out in accordance with VTT research protocol *RTE 3968-04* and *prEN 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 6.6 - 6.8 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 humid) and load duration class Medium - term (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

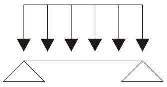
$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.2*1.5}{0.80} \quad [6.13.]$$

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

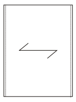
$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.24} k_{load,corr} \quad [6.14.]$$

The deflection values given in Tables 6.6 - 6.8 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.

Table 6.6. **Load resistance for a uniformly distributed load on a sanded single span plate strip**



Simply supported
single span plate strip

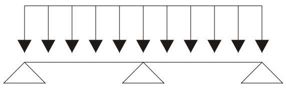


Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

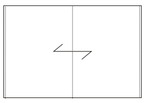
Span c/c mm	Uniformly distributed load *q* (kN/m²) and deflection *u* (mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	q		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*
300	6.4	b	13	16	b	7.4	29	b	5.3	46	b	4.2	68	b	3.5	82	b	2.7	92	b	2.1
400	3.6	b	23	8.8	b	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	Uniformly distributed load *q* (kN/m²) and deflection *u* (mm) Nominal thickness (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	b	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 6.7. **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			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	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	75	1.2	b	52	1.9	b	40	2.7	b	33	3.7	b	28	4.9	b	24

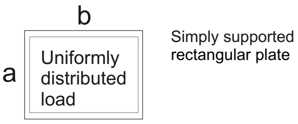
Span c/c mm	Uniformly distributed load *q* (kN/m²) and deflection *u* (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	q		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*
300	84	s	0.83	93	s	0.73	104	s	0.67	123	s	0.58	142	s	0.53	63	s	0.21	171	s	0.48
400	63	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

Continuation of Table 6.7.

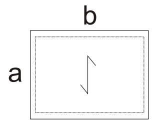
Span c/c mm	24 q		24 u	27 q		27 u	30 q		30 u	35 q		35 u	40 q		40 u	45 q		45 u	50 q		50 u
750	25	b	5.8	31	b	5.4	38	b	5.0	49	s	4.1	57	s	3.3	25	s	1.2	69	s	2.6
1000	14	b	10	18	b	8.9	21	b	8.2	30	b	7.2	40	b	6.5	19	s	2.4	51	s	5.1
1200	10	b	14	12	b	13	15	b	11	21	b	10	28	b	8.8	16	s	3.8	40	b	7.7
1500	6.3	b	21	7.8	b	19	10	b	17	13	b	15	18	b	13	13	s	7.0	26	b	11

Uniformly distributed load q (kN/m^2) and deflection u (mm), nominal thickness (mm)

Table 6.8. **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

Uniformly distributed load q (kN/m^2) and deflection u (mm), nominal thickness (mm)

Span c/c mm *a*b*	4 q		4 u	6.5 q		6.5 u	9 q		9 u	12 q		12 u	15 q		15 u	18 q		18 u	21 q		21 u
300*300	-		-	18	s	4.7	49	b	3.5	77	s	2.5	109	s	1.8	133	s	1.3	164	s	1.1
300*600	-		-	18	b	8.5	32	b	4.8	55	b	3.8	79	s	3.0	96	s	2.2	108	s	1.6
300*900	-		-	16	b	8.5	30	b	4.9	48	b	3.8	70	s	3.1	85	s	2.3	95	s	1.7
300*∞	-		-	16	b	8.5	29	b	5.0	46	b	3.8	68	s	3.1	82	s	2.3	92	s	1.7
400*400	-		-	10	s	8.4	27	b	6.2	52	b	5.3	82	s	4.4	100	s	3.2	123	s	2.5
400*800	-		-	9.9	b	15	18	b	8.5	31	b	6.8	46	b	5.5	64	b	4.6	81	s	3.8
400*1200	-		-	9.0	b	15	17	b	8.8	27	b	6.8	40	b	5.5	55	b	4.6	72	s	3.9
400*∞	-		-	8.8	b	15	16	b	8.9	26	b	6.8	38	b	5.5	53	b	4.6	69	s	4.0
500*500	-		-	6.5	b	13	18	b	10	33	b	8.2	54	b	7.1	79	b	6.2	98	s	4.9
500*1000	-		-	6.3	b	24	12	b	13	20	b	11	30	b	8.6	41	b	7.2	55	b	6.2
500*1500	-		-	5.8	b	24	11	b	14	17	b	11	26	b	8.6	35	b	7.2	47	b	6.3
500*∞	-		-	5.7	b	24	10	b	14	17	b	11	25	b	8.6	34	b	7.2	44	b	6.3
600*600	-		-	4.5	b	19	12	b	14	23	b	12	38	b	10	55	b	8.9	76	b	7.9
600*1200	-		-	4.4	b	34	8.1	b	19	14	b	15	21	b	12	29	b	10	38	b	9.0
600*1800	-		-	4.0	b	34	7.4	b	20	12	b	15	18	b	12	24	b	10	32	b	9.0
600*∞	-		-	3.9	b	34	7.3	b	20	12	b	15	17	b	12	23	b	10	31	b	9.0
750*750	-		-	2.9	b	30	7.8	b	22	15	b	19	24	b	16	35	b	14	49	b	12
750*1500	-		-	2.8	b	53	5.2	b	30	8.9	b	24	13	b	19	18	b	16	24	b	14
750*2250	-		-	2.6	b	53	4.7	b	31	8.7	b	24	11	b	19	16	b	16	21	b	14
750*∞	-		-	2.5	b	53	4.6	b	31	7.4	b	24	11	b	19	15	b	16	20	b	14
1000*1000	-		-	1.6	b	53	4.4	b	39	8.4	b	33	14	b	28	20	b	25	27	b	22
1000*2000	-		-	1.6	b	94	2.9	b	53	5.0	b	42	7.4	b	34	10	b	29	14	b	25
1000*3000	-		-	1.4	b	95	2.7	b	55	4.3	b	42	6.4	b	34	8.8	b	29	12	b	25
1000*∞	-		-	1.4	b	95	2.6	b	55	4.2	b	43	6.1	b	35	8.4	b	29	11	b	25
1200*1200	-		-	1.1	b	76	3.0	b	56	5.8	b	47	9.4	b	41	14	b	35	19	b	31
1200*2400	-		-	1.1	b	136	2.0	b	76	3.5	b	61	5.1	b	50	7.1	b	42	9.5	b	36
1500*1500	-		-	0.73	b	118	2.0	b	87	3.7	b	74	6.0	b	64	8.8	b	55	12	b	49
1500*3000	-		-	0.70	b	212	1.3	b	119	2.2	b	95	3.3	b	77	4.6	b	65	6.0	b	56

Uniformly distributed load q (kN/m^2) and deflection u (mm), nominal thickness (mm)

Span c/c mm *a*b*	24 q		24 u	27 q		27 u	30 q		30 u	35 q		35 u	40 q		40 u	45 q		45 u	50 q		50 u
300*300	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
300*600	125	s	1.3	138	s	1.0	154	s	0.83	183	s	0.58	213	s	0.43	94	s	0.18	257	s	0.30
300*900	110	s	1.3	121	s	1.0	135	s	0.86	168	s	0.61	186	s	0.45	82	s	0.18	224	s	0.31
300*∞	105	s	1.3	117	s	1.1	130	s	0.87	154	s	0.61	178	s	0.46	79	s	0.19	214	s	0.31

Continuation of Table 6.8.

Span c/c mm *a*b*	Uniformly distributed load *q* (kN/m²) and deflection *u* (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	q		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*
400*400	141	s	2.0	164	s	1.6	183	s	1.3	225	s	1.0	267	s	0.72	130	s	0.32	331	s	0.50
400*800	94	s	3.0	104	s	2.4	116	s	2.0	138	s	1.4	160	s	1.0	71	s	0.4	193	s	0.71
400*1200	82	s	3.1	91	s	2.5	101	s	2.0	120	s	1.4	139	s	1.1	62	s	0.4	168	s	0.73
400*∞	79	s	3.1	87	s	2.5	97	s	2.1	115	s	1.5	133	s	1.1	59	s	0.4	161	s	0.74
500*500	113	s	3.8	132	s	3.2	146	s	2.6	180	s	1.9	214	s	1.4	104	s	0.6	265	s	1.0
500*1000	70	b	5.5	83	s	4.7	93	s	3.8	110	s	2.7	128	s	2.0	57	s	0.8	154	s	1.4
500*1500	59	b	5.5	73	s	4.8	81	s	4.0	96	s	2.8	111	s	2.1	49	s	0.9	134	s	1.4
500*∞	57	b	5.5	70	s	4.9	78	s	4.0	92	s	2.8	107	s	2.1	47	s	0.9	128	s	1.5
600*600	94	s	6.6	110	s	5.4	122	s	4.5	150	s	3.2	178	s	2.4	86	s	1.1	221	s	1.7
600*1200	49	b	7.9	61	b	7.1	74	b	6.4	92	s	4.7	106	s	3.5	47	s	1.4	129	s	2.4
600*1800	41	b	7.9	51	b	7.1	62	b	6.4	80	s	4.9	93	s	3.6	41	s	1.5	112	s	2.5
600*∞	39	b	7.9	49	b	7.1	59	b	6.4	77	s	4.9	89	s	3.6	39	s	1.5	107	s	2.5
750*750	64	b	11	82	b	10	98	s	8.7	120	s	6.3	142	s	4.7	69	s	2.1	177	s	3.3
750*1500	31	b	12	39	b	11	47	b	10	67	b	8.3	85	s	6.8	38	s	2.8	103	s	4.7
750*2250	26	b	12	33	b	11	40	b	10	56	b	8.3	74	s	7.0	33	s	2.9	90	s	4.8
750*∞	25	b	12	31	b	11	38	b	10	53	b	8.3	71	s	7.1	31	s	2.9	86	s	4.9
1000*1000	36	b	20	46	b	18	57	b	16	83	b	14	107	s	11	52	s	5.0	133	s	7.9
1000*2000	17	b	22	22	b	20	27	b	18	38	b	15	51	b	13	28	s	6.6	73	b	11
1000*3000	15	b	22	18	b	20	22	b	18	32	b	15	43	b	13	25	s	6.8	62	b	11
1000*∞	14	b	22	18	b	20	21	b	18	30	b	15	40	b	13	24	s	6.9	58	b	11
1200*1200	25	b	28	32	b	25	40	b	23	58	b	20	79	b	17	43	s	8.7	110	s	14
1200*2400	12	b	32	15	b	28	18	b	25	26	b	21	35	b	18	24	s	11	51	b	15
1500*1500	16	b	44	21	b	40	25	b	36	37	b	31	51	b	27	35	s	17	75	b	23
1500*3000	7.8	b	49	10	b	44	12	b	40	17	b	33	22	b	29	19	s	22	33	b	24

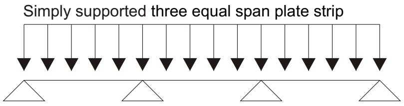
6.4. Concrete formworks - Uniform load

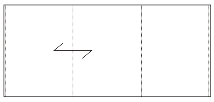
The object of this section is to present and document tabulated uniformly distributed load resistance values for concrete formwoorks of birch plywood - *Riga Ply* produced by JSC *Latvijas Finieris* is carried out in accordance with *VTT* research protocol *RTE 3971-04* and *prEN 1995-1-1 Eurocode 5, 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 6.9 - 6.10 are calculated according to the following assumptions: γ_q=1.2; γ_m=1.2; k_{mod}=0.70. Hence, the characteristic load acting in service class 3 (exterior) and load duration class Short - term (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 [6.15.].

The deflection values given in Tables 6.9 - 6.10 are calculated according to the following assumptions: k_{def}=2.5; ψ_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 [6.16.].

Table 6.9. **Load resistance for a uniformly distributed load on a sanded continuous plate strip with three equal span lengths**





Service Class 1

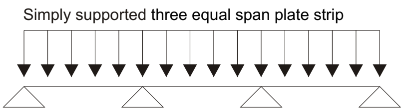
K_{mod}=0.7 Ψ_2=0.2 γ_m=1.2

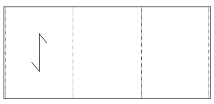
K_{def}=2.5 Γ_q=1.2

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			27			30			35			40			45			50		
	q		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*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

Table 6.10. **Load resistance for a uniformly distributed load on a sanded continuous plate strip with three equal span lengths. Face grain parallel to studs**





Service Class 1

K_{mod}=0.7 Ψ_2=0.2 γ_m=1.2

K_{def}=2.5 Γ_q=1.2

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	-		-	54	s	0.70	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

Continuaton of Table 6.10.

Span c/c mm	Uniformly distributed load q (kN/m^2) and deflection u (mm) Nominal thickness (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	265	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	0.48	199	s	0.43	232	s	0.40	259	s	0.37	284	s	0.37
250	105	s	0.90	120	s	0.81	132	s	0.72	159	s	0.62	186	s	0.56	207	s	0.51	227	s	0.51

Values of uniformly distributed load values following to different conditions from basic conditions (γ_q=1.2; γ_m=1.2; k_{mod}=0.70), are calculated multiplying tabulated values by a correction factor $k_{load,corr}$, given by

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.2*1.2}{0.70} \quad [6.15.]\ .$$

Values of plywood deflection following to different conditions from basic conditions (k_{def}=2.5; ψ_2=0.2), are calculated multiplying tabulated values by a correction factor $k_{def,corr}$, given by

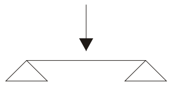
$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.5} k_{load,corr} \quad [6.16.]\ .$$

Continuation of Table 6.10.

Span c/c mm	Uniformly distributed load q (kN/m^2) and deflection u (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	q		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*	*q*		*u*
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

6.5. Concentrated load

Table 6.11. ***α, β* and *φ* factors to be used in equations [6.17] - [6.19.]**

Number of spans		α	β	φ
	Strip	0.176 - 0.481	0.855 - 1.061	0.0148 - 0.0217

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

$$\sigma = \frac{M_{cri}}{W} = \alpha \frac{F}{W} \quad [6.17.],$$

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, mm;
α - factor is given in Table 6.11.

The critical shear stress τ is given by

$$\tau = \frac{3}{2}\frac{V_{cri}}{A} = \frac{3}{2}\beta\frac{Fb}{A} \quad [6.18.],$$

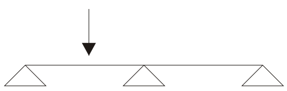
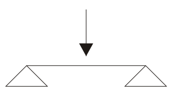
where: *A* - (= 2t(180 + 80)) or (= 2t(50 + 50)) is the punched shear area, mm^2;
β - factor is given in Table 6.11.

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

$$u_{M+V} \approx u_M = \varphi \frac{FL^2_{span} b}{EI} \quad [6.19.],$$

where: *I* - (= t3/12) is the second moment of plane area of the full cross-section of the plate strip, mm^4 [6.20.];
E - the modulus of elasticity, N/mm^2;
φ - factor is given in Table 6.11.

Continuation of Table 6.11.

Number of spans		α	β	φ
	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

6.6. Concentrated load over an area of 50*50 mm

The object of this section is to present and document tabulated uniformly distributed load resistance values for concrete formwoorks of birch plywood *Riga Ply* produced by AS *Latvijas Finieris* is carried out in accordance with *VTT* research protocol *RTE 3969-04* and *prEN 1995-1-1 Eurocode 5, Design of timber structures, Part 1:1 General - Common rules and rules for buildings*.

Values of plywood load resistance following to different conditions from basic conditions (γ_q=1.5; γ_m=1.2; k_{mod}=0.80), are calculated multiplying tabulated values by a correction factor $k_{load,corr}$, given by

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.2*1.5}{0.80} \quad [6.21.]\,.$$

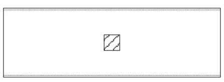
Values of plywood deflection following to different conditions from basic conditions (k_{def}=0.8; ψ_2=0.3), are calculated multiplying tabulated values by a correction factor $k_{def,corr}$, given by

$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.24} k_{load,corr} \quad [6.22.]\,.$$

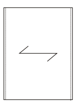
The load resistance values for: a concentrated load over an area of 50*50 mm on a single span plate strip; a concentrated load over an area of 50*50 mm on a double span plate strip; a concentrated load over an area of 50*50 mm on a simple supported plate given in Tables 6.12 - 6.14 are calculated according 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 humid) and load duration class Medium - term (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 [6.21.].

The deflection values given in Tables 6.12 - 6.14 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 [6.22].

Table 6.2. **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



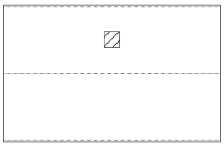
Service Class 1
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2
k_{def}=0.8 γ_q=1.5

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	0.53	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

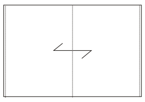
Continuation of Table 6.12.

Span c/c mm	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*
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
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 6.13. **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

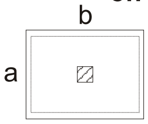
k_{mod}=0.8 ψ_2=0.3 γ_m=1.2

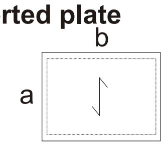
k_{def}=0.8 γ_q=1.5

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	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*
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 6.14. **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*b*	Concentrated load *F* (kN) 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*300	-		-	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
300*600	-		-	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
300*900	-		-	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
300*∞	-		-	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*400	-		-	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
400*800	-		-	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
400*1200	-		-	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
400*∞	-		-	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*500	-		-	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
500*1000	-		-	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
500*1500	-		-	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
500*∞	-		-	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*600	-		-	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
600*1200	-		-	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
600*1800	-		-	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
600*∞	-		-	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
750*750	-		-	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
750*1500	-		-	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
750*2250	-		-	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
750*∞	-		-	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
1000*1000	-		-	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
1000*2000	-		-	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
1000*3000	-		-	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
1000*∞	-		-	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
1200*1200	-		-	0.17	b	19	0.49	b	18	1.0	b	16	1.6	b	14	2.3	s	11	2.9	s	9.4
1200*2400	-		-	0.18	b	24	0.52	b	24	1.0	b	22	1.7	s	19	2.1	s	14	2.6	s	11
1500*1500	-		-	0.16	b	28	0.46	b	26	0.91	b	23	1.5	b	20	2.1	s	17	2.6	s	13
1500*3000	-		-	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*b*	Concentrated load *F* (kN) and deflection *u* (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	q		u	q		u	q		u	q		u	q		u	q		u	q		u
300*300	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
300*600	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
300*900	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
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*400	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
400*800	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
400*1200	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
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	0.13	7.1	s	0.27
500*500	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
500*1000	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
500*1500	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
500*∞	3.0	s	1.6	3.5	s	1.3	3.9	s	1.1	4.8	s	0.79	5.7	s	0.60	2.7	s	0.21	7.1	s	0.42
600*600	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
600*1200	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
600*1800	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
600*∞	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

Continuation of Table 6.14.

Span c/c mm *a**b*	Concentrated load *F* (kN) and deflection *u* (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	q	|	u	q	|	u	q	|	u	q	|	u	q	|	u	q	|	u	q	|	u
750*750	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
750*1500	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
750*2250	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
750*∞	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
1000*1000	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
1000*2000	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
1000*3000	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
1000*∞	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
1200*1200	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
1200*2400	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
1500*1500	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
1500*3000	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

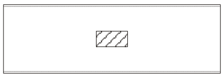
6.7. Concentrated load over an area of 80*180 mm

The object of this section is to present and document tabulated uniformly distributed load resistance values for concrete formwoorks of birch plywood *Riga Ply* produced by AS *Latvijas Finieris* is carried out in accordance with *VTT* research protocol *RTE 3970-04* and *prEN 1995-1-1 Eurocode 5, Design of timber structures, Part 1:1 General - Common rules and rules for buildings*.

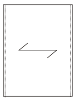
The load resistance values for: a concentrated load over an area of 80*180 mm on a single span plate strip; a concentrated load over an area of 80*180 mm on a double span plate strip; a concentrated load over an area of 80*180 mm on a simple supported plate given in Tables 6.15 - 6.17 are calculated 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 load duration class Short - term (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 [6.23].

The deflection values given in Tables 6.15 - 6.17 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 [6.2].

Table 6.15. **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

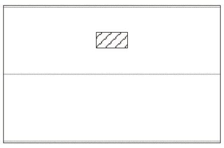
k_{mod}=0.9 ψ_2=0.0 γ_m=1.0

k_{def}=1.0 γ_q=1.0

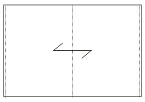
Span c/c mm	Concentrated load *F* (kN) and deflection *u* (mm) Nominal thickness (mm)																				
	4			6.5			9			12			15			18			21		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	0.06	b	1.9	1.6	b	8.9	3.4	b	6.6	5.6	b	5.1	8.4	b	4.1	12	b	3.5	15	s	2.8
400	0.04	b	2.7	1.2	b	13	3.0	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	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*
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
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 6.16. **Load resistance for a concentrated load over an area of 80*180 mm on a sanded double span plate strip**



Simply supported double 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	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

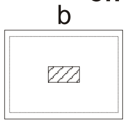
Span c/c mm	Concentrated load *F* (kN) and deflection *u* (mm) Nominal thickness (mm)																				
	24			27			30			35			40			45			50		
	F		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*	*F*		*u*
300	13	s	1.3	14	s	1.0	16	s	0.9	19	s	0.60	22	s	0.45	10	s	0.15	27	s	0.31
400	14	s	2.7	16	s	2.2	17	s	1.8	21	s	1.3	24	s	0.93	11	s	0.31	29	s	0.64

Continuation of Table 6.16.

Span c/c mm	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*
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	16	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

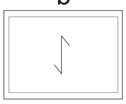
Table 6.17. **Load resistance for a concentrated load over an area of 80*180 mm on a sanded simple supported plate**

b

a 

Simply supported
Rectangular plate

b

a 

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*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*300	-		-	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
300*600	-		-	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
300*900	-		-	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
300*∞	-		-	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*400	-		-	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
400*800	-		-	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
400*1200	-		-	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
400*∞	-		-	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*500	-		-	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
500*1000	-		-	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
500*1500	-		-	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
500*∞	-		-	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
600*600	-		-	0.76	b	16	2.1	b	14	4.2	b	13	6.8	b	11	10.1	b	10	14	b	8.5
600*1200	-		-	0.85	b	22	2.5	b	21	4.2	b	17	6.3	b	14	8.7	b	11	12	b	10
600*1800	-		-	0.86	b	22	2.5	b	22	4.1	b	17	6.2	b	14	8.6	b	11	12	b	10
600*∞	-		-	0.86	b	22	2.5	b	22	4.1	b	17	6.2	b	14	8.6	b	11	12	b	10
750*750	-		-	0.66	b	22	1.9	b	21	3.7	b	18	6.1	b	15	9.0	b	14	12	b	12
750*1500	-		-	0.73	b	30	2.1	b	30	3.9	b	25	5.8	b	20	8.1	b	17	11	b	14
750*2250	-		-	0.74	b	30	2.1	b	30	3.8	b	25	5.7	b	20	8.0	b	17	11	b	14
750*∞	-		-	0.74	b	30	2.1	b	30	3.8	b	25	5.7	b	20	8.0	b	17	11	b	15
1000*1000	-		-	0.57	b	35	1.6	b	32	3.2	b	28	5.3	b	25	7.8	b	22	11	b	19
1000*2000	-		-	0.62	b	45	1.8	b	45	3.5	b	40	5.3	b	33	7.3	b	27	9.8	b	24
1000*3000	-		-	0.62	b	46	1.8	b	46	3.5	b	41	5.2	b	33	7.3	b	28	9.7	b	24
1000*∞	-		-	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*1200	-		-	0.52	b	46	1.5	b	43	3.0	b	38	4.9	b	33	7.2	b	29	10	b	26
1200*2400	-		-	0.57	b	60	1.7	b	60	3.3	b	54	5.0	b	45	6.9	b	38	9.3	b	32
1500*1500	-		-	0.47	b	66	1.4	b	62	2.7	b	54	4.4	b	47	6.6	b	42	9.2	b	37
1500*3000	-		-	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*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*
300*300	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
300*600	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
300*900	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

Continuation of Table 6.17.

Span c/c mm *a*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*
300*∞	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
400*400	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	0.71
400*800	17	s	4.2	19	s	3.3	21	s	2.7	25	s	1.9	29	s	1.4	13	s	0.47	36	s	0.97
400*1200	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
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	0.99
500*500	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
500*1000	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
500*1500	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
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*600	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
600*1200	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
600*1800	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
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*750	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
750*1500	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
750*2250	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
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*1000	14	b	17	18	b	16	21	s	13	26	s	10	30	s	7.0	13	s	2.3	36	s	4.8
1000*2000	13	b	21	16	b	18	19	b	17	26	s	13	30	s	10	13	s	3.2	36	s	6.7
1000*3000	12	b	21	16	b	19	19	b	17	26	s	13	30	s	10	13	s	3.3	36	s	6.8
1000*∞	12	b	21	16	b	19	19	b	17	26	s	13	30	s	10	13	s	3.3	36	s	6.8

Values of concentrated load values following to different conditions from basic conditions (γ_q=1.0; γ_m=1.0; k_{mod}=0.90), are calculated multiplying tabulated values by a correction factor $k_{load,corr}$, given by:

$$k_{load,corr} = \frac{k_{mod}}{\gamma_m \gamma_q} \frac{1.0*1.0}{0.90} \quad [6.23.] .$$

Values of plywood deflection following to different conditions from basic conditions (k_{def}=1.0; ψ_2=0.0), are calculated multiplying tabulated values by a correction factor $k_{def,corr}$, given by

$$k_{def.corr} = \frac{1 + \psi_2 k_{def}}{1 + 0.0} k_{load,corr} \quad [6.24.] .$$

Continuation of Table 6.17.

Span c/c mm *a*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*
1200*1200	13	b	23	17	b	21	21	b	19	26	s	14	30	s	10	13	s	3.4	36	s	7.0
1200*2400	12	b	28	15	b	25	18	b	23	26	s	19	30	s	14	13	s	4.7	36	s	9.7
1500*1500	12	b	34	16	b	31	19	b	28	26	s	22	30	s	16	13	s	5.3	36	s	11
1500*3000	11	b	42	14	b	37	17	b	34	24	s	28	30	s	22	13	s	7.3	36	s	15

application

7.1. Storage, acclimatization, transportation

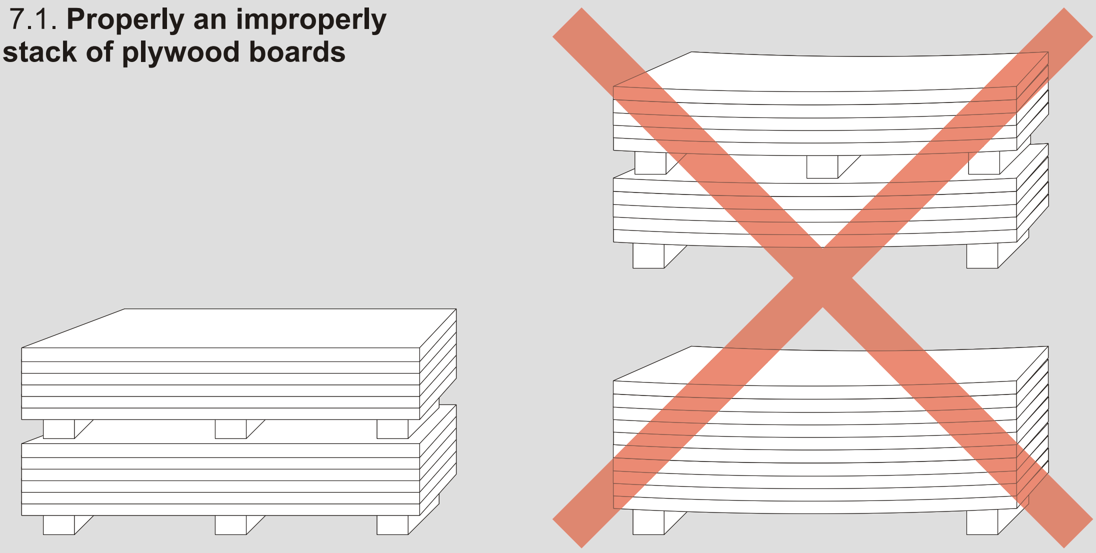
Proper storage and transportation of plywood during application and future processing is very important. Analysis of customer's complaints concerning delivered goods indicates that many complaints are due to lack of information (improper storage, transportation and processing technique selection). The aim of this section is provision of instructions on plywood products storage and transportation. The instructions had been drawn on the basis of experience and *ENV 12872 Standard - Wood - based panels - Guidance on the use of load bearing boards in floors, walls and roofs*.

7.1.1. Storage

One of the most significant storage conditions is proper selection of storage place. Plywood shall be located in protected against water (rain, snow) places (sheds) or in premises with good air circulation.

It is recommended to store plywood boards on concrete or coated floor. If stack is made on the ground the first board shall be at the distance not less than 8 cm from the ground to protect boards from drops (water, mud, other liquids). Boards shall not be placed on the floor; they shall be placed on pallets. Height of pallets or beams shall be selected in such way that distance between the first board and ground is about 8 cm. Boards shall be placed in horizontal stacks on pallets or beams. Pallets or beams shall be of equal height and in the same horizontal line. The stack shall be supported by at least 3 beams or pallets located at the distance of about 800 mm. When plywood stacks are placed one on to another, intermediate beams shall be at the same horizontal line as it is shown on Figure 7.1.

Figure 7.1. **Properly an improperly made stack of plywood boards**



7.1.2. Acclimatization

Plywood similar to other wood materials is hygroscopic, so moisture absorbing material. At moisture content variation (from 0% to about 30%) alteration of plywood dimensions takes place - plywood swells or shrinks. So, for future mechanical processing it is significant to accomplish plywood acclimatization, providing equilibrium moisture content most close to final application equilibrium moisture. Equilibrium moisture content is the moisture that wood (plywood in this case) gains during long time period under constant air conditions (air relative humidity and temperature).

Taking into account the above mentioned, there should be selected storage place with air parameters similar to parameters of final application place. Placing plywood for acclimatization in stacks the height of stack shall be minimum to provide short period of acclimatization. Some stack is shown on Figure 7.1 and 7.2. In ideal case, intermediate beams shall separate every board in stack. Plywood in tight stack absorbs or releases moisture uniformly via not covered surfaces of the plate, i.e. edges and uncovered upper and bottom surfaces of the board. In turn, in stack with boards separated by intermediate beams moisture exchange takes place via other surfaces of the board as well. This leads to significant reduce of duration of acclimatization (a week at least). The period required for plywood acclimatization depends on various factors: (1) difference of equilibrium moisture

Figure 7.2. **Stack of plywood for acclimatization**

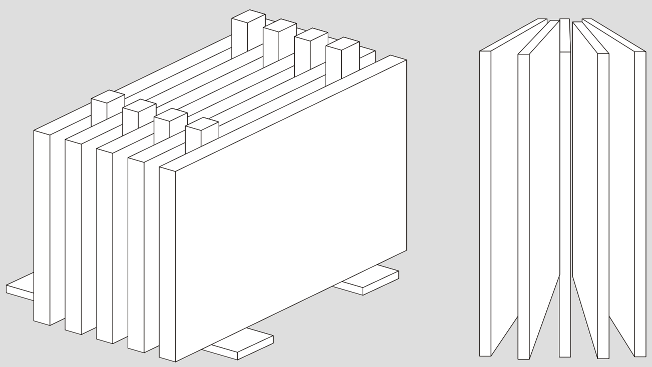
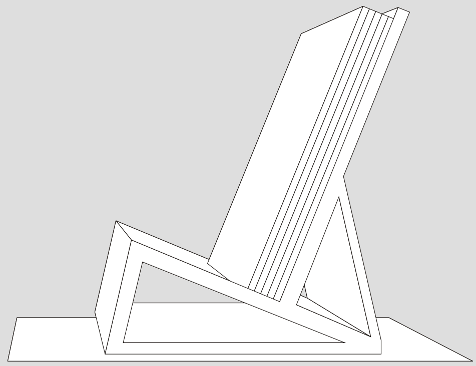


Figure 7.3. **Stack of plywood boards**



content values - the difference between equilibrium plywood moisture content and equilibrium moisture content of respectful environment; (2) air flow; (3) thickness of the board; (4) other factors. It is concluded that a board gains equilibrium moisture content if weight remains constant within 24 hours.

The edges of board shall not rest (placed) on floor or wall (Figure 7.3).

At placing of plywood packs in humid environment, packing strips (usually made of metal or plastic) shall be opened, because strips may damage edges of board due to swelling. Absorption or release of 1% of moisture, leads to the following alterations of the plywood board dimensions: length 0.02%, width 0.02%, and thickness 0.3%.

7.1.3. Transportation of boards

Taking plywood board from pack or stack, it shall be lifted, not pulled over surface of the bottom plate, because any hard particle (sand or film remainder) between boards can lead to damage of processed or coated surface of the plywood board.

Care shall be taken at transportation of a pack of plywood with no strapping by forklift, because surface of film faced board may be very sliding, for example, *Riga Form* F/F. It may lead to sliding of the stack.

Remember!

Packs of plywood board are transported by forklift.
To avoid any mechanical damage, the boards shall be loaded and unloaded carefully.
Separate sheets are lifted and transported by hand (two workers).
It is not allowed to pull plates over ground or floor.

7.1.4. Loading and storage of packs at end user site

In this case the abovementioned instructions shall be observed and: the best way of storage is plywood storage in original packing; packs of plywood shall be protected against direct effect of rain and snow; packs are to be transported with forklift; to avoid any mechanical damage, boards shall be loaded and unloaded carefully; pack should be stacked properly.

7.1.5. Utilization

Service life of both plywood and products made from plywood may vary significantly. For example, at designed operation conditions plywood in construction applications may serve over 50 years.

After application firing or placing in dump may easily utilize plywood. For plywood firing it is recommended to use high temperature furnace, because not every plywood component combusts at low temperature.

7.2. Machining

Plywood can be easily machined. It may be cut, drilled, and shaped manually or using electric tools. Due to the fact that plywood consists of several veneer and glue layers, it is recommended to use wood processing tools with sharp cutting edges.

When cutting plywood it is recommended to saw in the opposite direction of the upper layer grain first and then in the grain direction thus avoiding the tearing of plywood upper layer at the plate corners.

To avoid tearing and provide good quality surface, plywood shall be placed face up. Using double circular saw with score disc, chipping does not take place both on upper and on bottom side (see Figure 7.4). High sawing speed and low feed speed are recommended for the best result.

For *Riga Laser* plywood cutting laser cutting equipment may be used, because this plywood is glued with modified urea-formaldehyde resin based glue and there is strict requirements set for internal plywood layer.
At drilling plywood shall be placed face up relatively to the hole (at upper location) and certainly sharp proper wood processing tools shall be used. If through holes are made in plywood, the part shall be placed on smooth supporting surface preventing this way tears on reverse surface, or recess of 45^0 shall be made to put screw deeper (counter sinking).

High milling cutter speed and low feed speed are recommended for plywood machining on milling equipment similarly to sawing.

Depending on requirements to surface quality, it may be sanded both with grain and not with grain using abrasive paper of different grade; usually it is No.80 or No.100. To get high quality surface it is recommended to sand plywood with grain. For surface preparation for finishing, it is sanded using abrasive paper No.150 or No.180, or using abrasive paper of different grade, if necessary.

7.3. Finishing

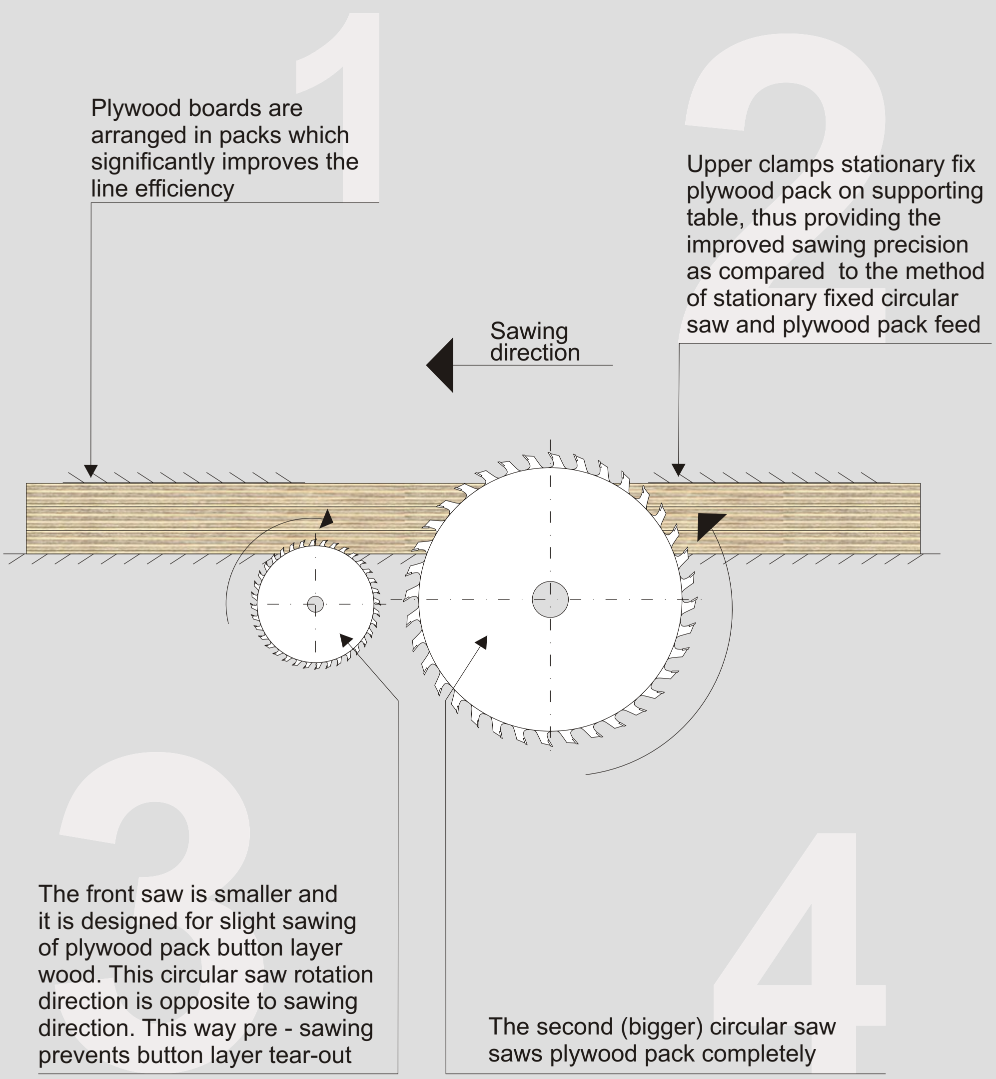
AS *Latvijas Finieris* offer plywood of different types designed for further finishing.

Riga Ply plywood shall be prepared for finishing, i.e. to be sanded with the help of abrasive paper of recommended grade (No.150 or No.180). Then it may be stained with preservative, coated with prime, varnish, or paint. Applying several finishing layers there shall be made interim sanding using abrasive paper No.320, 400, or different grade, this way providing high quality of finished surface.

Riga Paint plywood is covered with special paper and is ready for primer and paint application. Surface ofthis plywood is smooth and less likely to absorb painting materials.

Riga Preprime plywood is specially designed for painting, preparation of the surface for finishing is not required. Surface of this plywood is covered with paper impregnated with primer and is ready for painting. This layer makes painting work easier and provides significant saving of painting material. Painting being finished the boards of this plywood may be used for outer walls facing or for other applications. Its surface does not crack.

Figure 7.4. **Scheme of cutting**



Riga Prime plywood may be varnished or painted, depending on the type of primer applied. It provides significant saving of labor and painting material similar to the above-mentioned plywood types.

Unfinished surface of plywood shall be coated with different materials protecting wood against blueing and moulding.

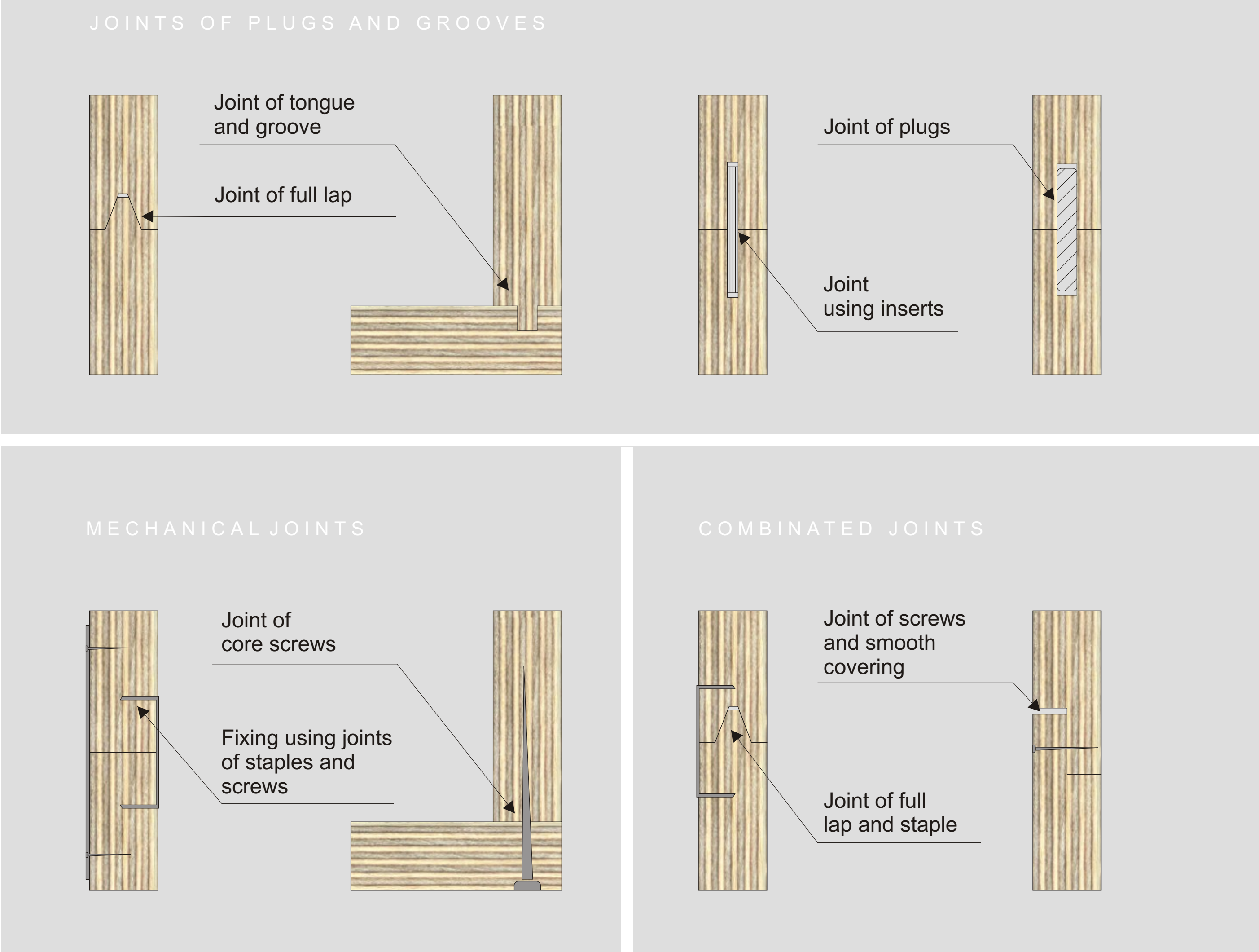
Broad range of finishing materials may be used for plywood finishing: UV curing primer, varnishes, or paints; water based finishing materials: polyurethane, nitrocellulose, alkyd acryl or acid curing and painting materials.

7.4. Installation

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 joint not requiring resistance against moisture. It is recommended PVA dispersion adhesive to glue plywood together with plastic or metal, or glue of different type designed to glue such materials together. Before gluing, it is recommended to clean surfaces from dust,

Figure 7.5. **Joint types**



metal surfaces are to be degreased.

When gluing plywood to the material of different value of coefficient of temperature expansion, the glue that is able to compensate dimension alteration of material under the influence of temperature shall be used.

When selecting adhesive for gluing of different materials it is recommended to consult glue manufacturers.

Joint types

The following joints (see Figure 7.5) can be used for plywood connection: (1) tongue and groove joints; (2) mechanical joints (bolts, rivets, clamps, wood screws and other joints); (3) combined joints.

Adhesive selection depending on plywood type (outdoor or internal applications) for tongue and groove joint reinforcement is recommended. Glue line provides higher joint resistance in comparison with joints of mechanical type. To protect groove against moisture effect, it should be filled with moisture resistant type filler or wax. Ends of grooves may be protected

Figure 7.6. **Plywood plate (18 mm) overlaid (with phenol film) dimensions alteration in percents, 2 cm from edge, after immersion in water for 48 hours and drying**

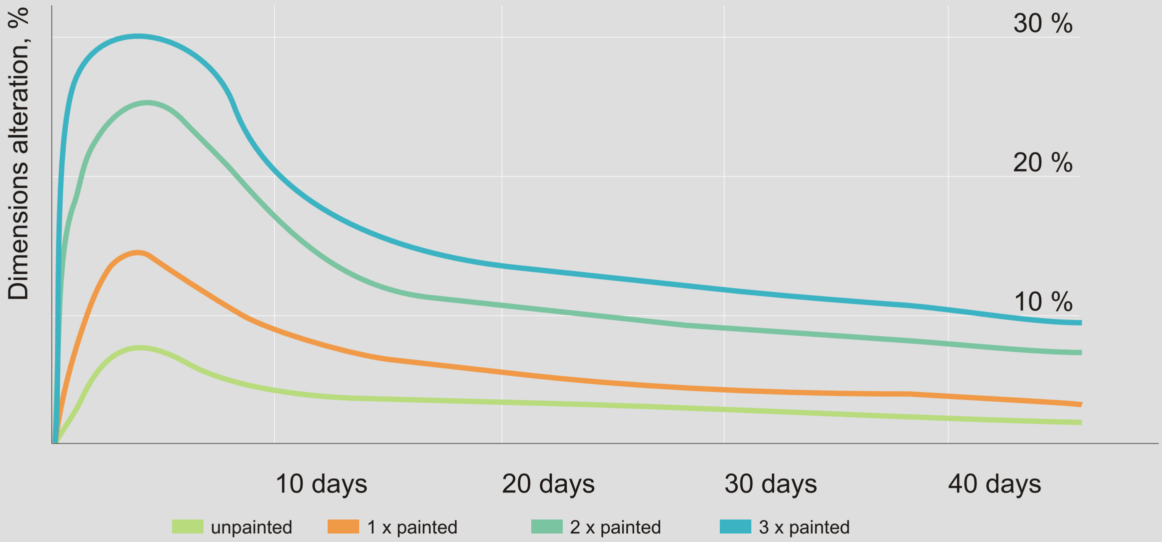
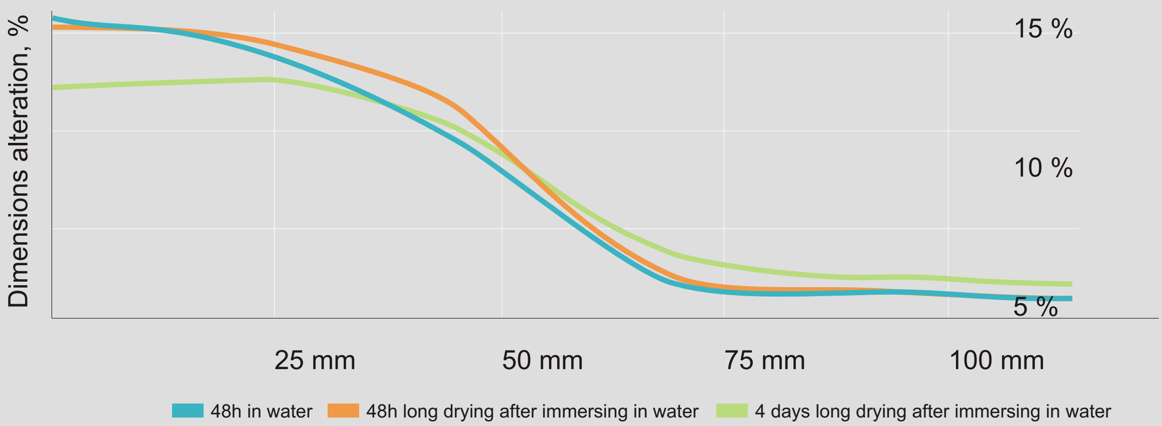


Figure 7.7. **Dimensions alteration**



with water resistant protecting material (paint, filler).

For mechanical joints it is necessary to make drilling before screw application. Hole diameter for bolt or rivet joint shall be equal or slightly bigger than bolt or rivet diameter. The distance from plywood edge to the hole shall be at least two times bigger than 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 it is recommended to take care if plywood external layer is not deformed.

For wood screw joint hole diameter shall be less than screw head diameter. This provides an easier plywood joint accomplishment. 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 strips on tongue and groove joint, thus decreasing possibility of warping.

Plywood edge sealing

It is necessary to protect plywood board edges for outdoor applications against moisture using water resistant materials, coating edges with water resistant materials (paint, filler, etc.). Sealing may be accomplished by spraying several plywood boards in stack or sealing each board of plywood sheet individually, applying material by roller or brush. Edge sealing protects against water or moisture penetration via edges.

In Figure 7.6 there is shown variation of dimensions (in percents) of plywood (18 mm) overlaid with phenol film, 2 cm from the edge after immersion in water for 48 hours and drying. If edges of plywood sheet are not protected, the alteration value is up to of three times bigger than when the edges are coated with water resistant paint.

Moisture content after the sample has been taken out of water continues to equalize in the direction to plywood center, the same time leading to edges shrivel (see Figure 7.7).

7.5. Main plywood applications

Latvijas Finieris, manufactures plywood of different types. Each type is designed for specific applications. Each plywood product of *Latvijas Finieris* is marked by trademark **RIGA**

Main applications are listed in Table 7.1. It does not limit possibility of plywood use for different applications if plywood parameters meet requirements stated for material.

Table 7.1. Main plywood applications

Application	*Riga Ply*	*Riga Laser*	*Riga Form*	*Riga Mel*	*Riga Paint*	*Riga Preprime*	*Riga Prime*	*Riga Tex*	*Riga Smooth Mesh*	*Riga Rhomb*	*Riga Rhomb Heavy*	*Riga Heksa*	*Riga Heksa Heavy*	*Riga Foot*	*Riga Lacquer*	*Riga Color*	*Riga HPL*	*Riga Shipply*
Construction																		
Interior walls	●	○	○	●	●	●	●	○	○	○	○	○	○	○	●	●	●	○
External walls	○	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Inter-wall structures	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Bins for agriculture products storage	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Floor covering	●	○	○	○	○	○	○	●	○	○	○	○	○	●	○	○	○	○
Parquet flooring blanks	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Steps of stairs	●	○	○	○	○	○	○	○	○	●	●	●	●	●	○	○	○	○
Bottom roof deck	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Material of structures	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Industrial floor	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Warehouse floor	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Scaffolding	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Trestles	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Platforms	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Pedestrian passes and bridges	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Children playgrounds	○	○	●	○	●	●	○	○	○	○	○	○	○	○	○	○	○	○
Shuttering	○	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Furniture manufacturing																		
Framework of cabinet furniture	●	●	○	●	○	○	●	○	○	○	○	○	○	○	●	●	●	○
Working surfaces	○	○	○	●	○	○	○	○	○	○	○	○	○	○	●	○	●	○
Transport industry	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Floor of trailer	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Floor of vans, buses	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Floor of container	○	○	○	○	○	○	○	●	○	●	●	●	●	●	○	○	○	○
Lining of trailer walls and ceiling	○	○	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Insulation panels of liquefied gas tankers	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	●
Packing																		
Matrix blanks	○	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Packing (of high quality)	○	○	●	○	○	○	●	○	●	●	●	●	●	●	○	○	○	○
Packing (of low quality)	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Other																		
Advertisement stands	○	○	●	●	○	●	○	○	○	○	○	○	○	○	○	○	○	○
Traffic signs and indicators	○	○	●	○	○	○	○	●	○	○	○	○	○	○	○	○	○	○

Table 7.2. **Recommended applications of *Riga Ply* plywood, depending on grade**

Grade	Recommended application
B	High quality - Transparent and semitransparent finishing of high quality, stain with preservative, varnishing.
S	Good quality - stain with preservative, varnishing or coating with transparent finishing materials.
BB	Standard grade (improved) - finishing by paint of interior applications and coating with different transparent and semitransparent laminates and films, as well as veneering. Building construction, painted of finished.
WGE	Plywood with no obvious defects, improved for coating with not transparent finishing materials (films, laminate).
WG	Application for building structures and packing when the outlook of upper plywood layer is not significant.
C	Application for building structures and packing when the outlook of upper plywood layer is not significant. Unsanded.

8

literature

Products manufactured by *Latvijas Finieris* 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 635-2	Plywood – Classification by surface appearance – Part 2: Hardwood
EN 636	Plywood – Specifications
EN 13986	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking
SFS 2413	Quality requirements for apearance of plywood with outer plies of birch
DIN 68705-3	Sperrholz - Bau-Furniersperrholz

AS *Latvijas Finieris* use the following standard methods for plywood quality control

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 methods
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 635-5	Plywood – Classification by surface appearance – Part 5: Methods for measuring and expressing characteristics and defects
EN 717-2	Wood-based panels – Determination of formaldehyde release – Part 2: Formaldehyde release by the gas analysis method
EN 717-3	Wood-based panels – Determination of formaldehyde release – Part 3: Formaldehyde release by the flask analysis method

EN 789	Timber structures – Test methods – Determination of mechanical properties of wood based panels
EN 1058	Wood-based panels – Determination of characteristic values of mechanical properties and density
EN 1084	Plywood – Formaldehyde release classes determined by the gas analysis method
EN 1156	Wood-based panels – Determination of duration of load and creep factors
EN ISO 9239-1	Reaction to fire tests for floorings - Part 1: Determination of the burning behaviour using a radiant heat source
EN ISO 11925-2	Reaction to fire tests - Ignitability of building products subjected to direct impingement of flame - Part 2: Single-flame source test
EN 13823	Reaction to fire tests for building products - Building products excluding floorings exposed to the thermal attack by a single burning item
EN 13986	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking

Other standards applying to plywood

EN 313-1	Plywood – Classification and Terminology – Part 1: Classification
EN 313-2	Plywood – Classification and Terminology – Part 2: Terminalogy
EN 326-3	Wood-based panels – Sampling, cutting and inspection – Part 3: Inspection of a consignment of panels
EN 335-5	Durability of wood and wood-based products – Definition of hazard classes of biological attack – Part 3: Application to wood-based panels
EN 350-2	Durability of wood and wood-based products – Natural durability of solid wood – Part 2: Guide to natural durability and treatability of selected wood species of importance in Europa
EN 635-1	Plywood – Classification by surface appearance – Part 1: General
EN 635-3	Plywood – Classification by surface appearance – Part 3: Softwood
EN 1072	Plywood – Description of bending properties of structural plywood
EN 1084	Plywood – Formaldehyde release classes determined by the gas analysis method
EN 1099	Plywood - Biological durability - Guidance for the assessment of plywood for use in different hazard classes
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
ENV 1995- -1-1	Eurocode 5 – Design of timber structures – Part 1-1: General rules and rules for buildings
ENV 12872	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
DIN 51130	Bestimmung der rutschhemmenden Eigenschaft
BGR 181	Merkblatt für Fußböden in Arbeitsräumen und Arbeitsbereichen mit Rutschgefahr (bisher ZH 1/571)

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

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