NORDIC TIMBER

Grading rules for pine and spruce sawn timber
(Pinus silvestris) (Picea abies)

Commercial grading based on evaluation of the four sides of sawn timber

Published by

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Preface

Föreningen Svenska Sågverksmän, Suomen Sahateollisuusmiesten Yhdistys and Treindustriens Tekniske Forening, Norway, (the Association of Swedish Sawmillmen, the Association of Finnish Sawmillmen and The Norwegian Sawmillmen?s Association) in co-operation have updated the so-called Green Book in accordance with current grading practice. The common Nordic grading rules of 1994 have been named NORDIC TIMBER.
In order to update the Swedish and Finnish so-called "Green Books" as well as the rules of "Östlandets Skurlastmålings reglemang", Norway, to the present grading practice, the Nordic sawn timber grading committees of 1991 have carried out extensive meetings and test gradings. Test gradings have been carried out in Sweden, Finland and Norway.

In Sweden, the committee for revision has included Messrs. Frans Ohisson, chairman FSS, Hans Olof Olsson, AB RåstorpSågen as well as Kjell Bernhardsson and Siverth Groth, Sveriges Skogsindustriförbund (ARBIO AB). Assisting members in the Swedish committee have been Messrs. Björn Bergkvist, Bergkvist-lnsjön AB, Birger Åström, lggesund Timber AB as well as Sven Casselbrant, Björn Esping and Rune Rydell, Trätek.

In Finland, the committee has included Messrs. Kalevi Asikainen, Kaukas Oy, Jaakko Mikkola, Veitsiluoto Oy, Riku Hokkanen, Seppo Mäntylä and Jaakko Lehto, Yhtyneet Sahat Oy, Eino Selander and Timo Pöljö, Metsä-SerIa Oy, Seppo Vainio, Enso-Gutzeit Oy as well as Markku Paavilainen, Metsäteollisuus r. y. and Suomen Sahateollisuusmiesten Yhdistys.

In Norway, the committee has included Messrs. Magnar Müller and Michael Foslie, Norsk Treteknisk Institutt, Hans Hordvik, Brandval Sag A/S, Hans T. Strand, Norske Skog-industrier A. S. etc.

Trätek (the Swedish Institute for Wood Technology Research), Metsäteollisuus r. y. (the Finnish Forest Industries Federation) and Norsk Treteknisk Institutt (The Norwegian Institute of Wood Technology) have all contributed to this project with basic facts and content.

NORDIC TIMBER will be published in several languages. All editions will contain the same text, form and layout as the original Swedish edition.

If the translated edition and the Swedish edition, NORDISKT TRÄ, do not conform, the text in the latest Swedish edition of NORDISKT TRÄ will take precedence.

NORDIC TIMBER will replace the following grading rules:

- "Sortering av sägat virke av furu och gran" (English edition: "Guiding Principles for Grading of Sawn Timber", 1976), the Swedish "Green Book" published by the Association of Swedish Sawmillmen in 1960, last revised in 1982 and completed in 1987.

- "Vientisahatavaran Lajitteluohjeet" (English edition: "Instructions for the Grading of Export Timber"), the Finnish "Green Book", published in 1960 by the Association of Finnish Sawmillmen. Latest revision 1979.

- "Östlandets Skurlastmalings reglemang" from 1932. Revised in 1955.

The replaced grading rules will not be published any more.

The grading rules in the Nordic countries originate from 1888. At that time the first written rules: "Regler och Antydningar för Sortering af Plankor, Battens och Bräder" ("Rules and Hints for Grading of Deals, Battens and Boards") were published, see chapter 8. Short history.

We are very grateful to NUTEK (the Swedish National Board for Industrial and Technical Development), Trätek, Sveriges Skogsindustriförbund, and Svenska Trävaruexpörtforeningen (the Swedish Wood Exporters? Association), and the Finnish Forest Industries Federation, the Norwegian Institute of Wood Technology and Trelastindustriens Landsforening (the Norwegian Sawmill Industries Association) for their support and contribution.

We would also like to thank all the sawmills we visited in Sweden, Finland and Norway for their contribution of opinions and time.

Without all this support the revision could not have been accomplished.

Stockholm/Helsinki/Oslo in March, 1994.

The Association of Swedish Sawmillmen Frans Ohisson	*The Association of Finnish Sawmillmen Kari Anttilainen*	*The Norwegian Sawmillmen?s Association Andreas Granhus*

Supporting trade organisations

The Swedish Wood Exporters' Association, the Finnish Forest Industries Federation and the Norwegian Sawmill Industries Association have contributed to the revision and updating of the "Green Book" into the present NORDIC TIMBER.

These grading rules form a valuable tool for the work with quality assurance, training and development.

The Swedish Wood Exporters' Association	*The Finnish Forest Industries Federation*	*The Norwegian Sawmill Industries Association*
Mikael Westin	*Ilkka Poyhonen*	*Finn Johansen*

Introduction

The GRADES listed in NORDIC TIMBER reflect qualities that the forest sector produces on a sustained basis and which the sawmills are able to continuously deliver to the markets.

The NORDIC TIMBER grading practice, which will be applied in all the Nordic countries, illustrates the potential for sawmills to adjust themselves to delivering sawn timber which meets the end-users demand and requirements.

NORDIC TIMBER applies to both the export and domestic markets. It divides the sawn timber into GRADES according to the wood features. NORDIC TIMBER gives the maximum permitted values of wood features for each GRADE.

It is very seldom that several wood features with the maximum permissible values appear at the same time in one piece of sawn timber. Therefore, a parcel with a normal distribution of wood features will be considerably below the maximum permitted values.

NORDIC TIMBER forms a basis for grading.

NORDIC TIMBER will form a tool for training of graders and others who work in the timber trade.

Great effort has been taken to make the book easy to understand. The language has been simplified and clarified. Terms, definitions and measuring rules have been specified and conform in principle with other rules used in Europe. Text and tables have been formed in a more pedagogic and logical way. All this is to make it easier to use in grading, training and as a guideline for the trade of sawn timber.

The process automation and data management within the sawmill industry requires exactly defined grading criteria. The requirements of the latest technology have been considered as far as possible. Numerical limit values have been given to all measurable features.
NORDIC TIMBER divides the sawn timber into grades according to the wood features.

The main grades are GRADE A, GRADE B, GRADE C, and GRADE D.

The NORDIC TIMBER classification of different qualities gives a guideline to division into the GRADES. The division of GRADES is not binding. The sawmills can after agreement with the buyer compile individual grades with their own GRADE names adapted to customer and product needs. This is done by using a GRADEMIX based on the features of the main grades.

In order to avoid misunderstandings when discussing grades, *the former names of quality grades,* U/S, Fifths and Sixths, *should not be used any more.*

1. Properties of Nordic sawn timber

Raw material

The Nordic countries Sweden, Finland, and Norway, produce approx. 25 million m^3 of sawn timber, *pine (Pinus silvestris) and spruce (Picea abies)* annually. The raw material, approx. 50 mill.m^3, is of high quality with good wood properties and fulfils the highest requirements of end-users.

The forests are a renewable natural resource, and are managed according to the principle of sustainable development. About 80 % of the total growing stock in the forests is pine and spruce.

The growing habitats of different species have been chosen by natural selection. The best quality pine grows on dry, firm forest land. Spruce, however, favours luxuriant sites. The type of soil as well as the geographical location in north-south direction have great effect on the properties of growing trees and their by-products.

Both pine and spruce, which grow in the north, form tall and straight trunks. Due to the growth, the medium width of the annual growth rings will remain small. As a criterium for slow growth, 10 annual rings per 25 mm is used. Trunks with small taper produce long logs with even form, which guarantees sawn timber with favourable length distribution.

Pine and spruce trunks have different but typical knot zones. The pine trunk has an almost knotfree butt part, followed by a middle part with dead knots and a top part with sound knots. The spruce trunk has usually a butt part of about one log length with dead knots, whereas the other part of the trunk contains sound knots.

Sawn timber

Nordic sawn timber is produced by well-trained people. The technology required for production and handling of sawn timber is kept up-to-date by continuous new investments.

Good accuracy of measurements, smooth and even sawn surfaces and a moisture content required by the specific end-users are technical properties which allow the use of *main grades* of sawn timber in various end-uses without further machining and handling. The same properties are important also for further processing of sawn wood. They allow for small processing allowances and reduce waste.

Sawn softwood is easy to machine and has an aesthetic appearance with good inner structure. The high percentage of heartwood is an advantage in the industrial use of sawn timber.

The good stability of sawn timber is achieved in the sawing process through log dividing according to *Nordic practice*, in which the internal stresses are removed by heart splitting. Most of the pith also disappears due to the saw kerf in heart splitting.

Due to the favourable strength/density relationship, Nordic sawn timber is also suitable for all kinds of load bearing constructions.

The good hygroscopic and insulation properties are of advantage when using wood as building material: *a wooden house is environmentally sound and pleasant to live in.*

Wood is a product of nature, which is renewable and belongs to the natural cycle. The by-products produced in all stages of the production process can be industrially utilized in many ways without ecological problems.

2. Nordic sawing practice

Log dividing according to Nordic practice

Log dividing according to Nordic practice requires splitting of the log in the middle with a saw cut - heart splitting , see figure 2.1.

Other cuts divide the log into centre yield and side yield. The centre yield contains two or more pieces, which can be of the same or different thicknesses. Deviation from this sawing practice is special sawing (e.g. heart-free sawing).

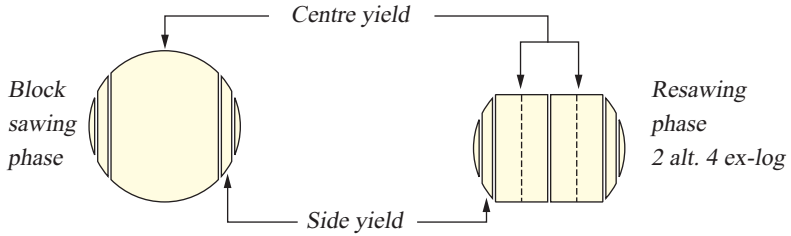


Figure 2.1
Heart splitting

Heart-free sawing

Heart-free sawn timber is produced by cutting one sawn timber piece from the centre of the log, thus removing the pith and the possible defects within it, see figure 2.2.

Heart-free sawing and other exceptions from the Nordic sawing practice are special sawing methods, which must be defined in the contract.

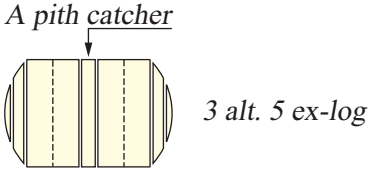


Figure 2.2
Heart-free sawing

3. Sawn timber terminology

Sawn timber

Sawn timber is the general term for pieces of wood sawn from saw logs, see figure 3.1.

Centre yield

Centre yield is the sawn timber sawn from the central part of the log. Centre yield with a thickness of minimum 32 mm is mostly called battens.

Side yield

Side yield is sawn timber produced from the parts outside the centre of the log. Side yield with a thickness under 32 mm is usually called boards.

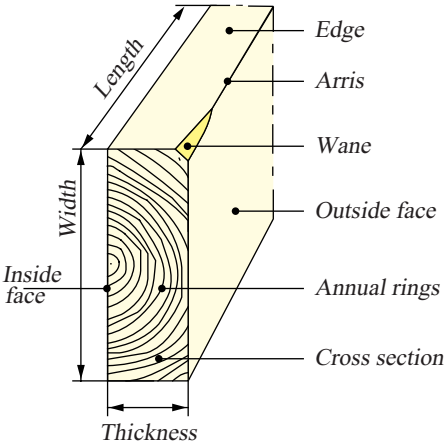


Figure 3.1
A piece of sawn timber

Studs

Studs are pieces of sawn timber with a thickness of 38-50 mm and 75-150 mm in width. Studs with guaranteed sizes and form properties can be delivered on agreement.

Spars

Spars are pieces of small square sawn timber with four sawn sides with a thickness of 75 mm or more and with width the same as the thickness or with a deviation not more than 25 mm.

The spars are usually sawn without splitting the heart and with a big wane. The saw blade must, however, touch all the four sides through the whole length of the piece. Smaller wane can be separately defined in the contract. This can be stated as e.g. minimum 30 %, 50 % etc. sawn surface, which refers to the smallest width of the sawn surface on each side.

Beams

Beams are large square pieces of timber, centre yield, with four sawn sides, intended for structural purposes, such as floor joists and load bearing elements in wall and rafter constructions. The difference between the width and thickness is usually more than 25 mm.

It is usually a requirement for structural timber that it is graded for strength, according to special rules.

Resawn timber

Example 1: 63 x 175 mm resawn to 32 x 175 mm
Example 2: 32 x 175 mm resawn from 63 x175 mm

In the first example the sawn timber has been sold as 63 x 175 mm and graded accordingly without considering what the quality of the resawn 32x175 mm would be.

The second example assumes that the goods are resawn *from* 63 x 175 mm and that the normal negative size deviation 2 mm caused by resawing is acceptable, but the goods are graded according to the rules for 32x175 mm.

It has to be exactly defined in the contract according to which size the sawn timber shall be graded.

Slating battens and strips

Slating battens are resawn timber 12-38 mm in thickness and 25-63 mm in width. The normal negative size deviation 2 mm caused by resawing is acceptable.

4. Quality classes and terminology

4.1 Division into GRADES

The sawn timber is divided into the following classes according to the quality features. These are called GRADES:

GRADES			
A A1 A2 A3 A4	B	C	D

The main grades are GRADE A, GRADE B, GRADE C, and GRADE D.

GRADE A

A is the highest main grade, which includes falling share of sub-grades A1 - A4 from the production. Of these A1 is the highest.

GRADE B

Falling GRADE B at the grading of the production.

GRADE C

Falling GRADE C at the grading of the production.

GRADES B and C are not divided into sub-grades.

GRADE D

No numerical values are given for GRADE D. In GRADE D all features contained in a piece of sawn timber are permitted. The piece must, however, hold together. The saw-blade must have touched the main part of all the sides of the piece. It can be accepted for side yield that 1/3 of the length on one side is not touched by the blade.

Sawn timber will be graded according to the contract with either *each GRADE separately or by combining different GRADES e.g. according to the following examples:*

GRADE AB

includes falling unspecified share of GRADES A - B of the production.

GRADE ABC

includes *falling unspecified share of GRADES A - C* of the production.

In the examples above, the unspecified distribution of each GRADE can be different:

- ☐ in different geographical locations
- ☐ in different dimensions
- ☐ between different sawmills even in the same regions.

Other GRADE combinations are also possible by agreement.

SCHAALBOARDS

Schaalboards are side yields of standard thickness and 75-125 mm in width which fulfil at least GRADE C requirements and which have at least 1/4 wide sawn surface in each edge and the outside face throughout the whole length of the piece. Deviating requirements for the size of sawn surface must be defined in the contract.

KNOTFREE, THREE SIDES

The outside face and both edges have to be fully knotfree and have to fulfil other features of GRADE Al requirements. The inside face has to fulfil GRADE A3 requirements. Wane requirements are defined in the contract.

"HALVRENA"

This term is divided into two categories:

A "Halvrena" side yield has to fulfil GRADE A requirements or in contract named GRADE with minimum 1/2 sawn surface in the outside face and each edge throughout the whole length of the piece.

B "Halvrena" centre yield has to fulfil GRADE C requirements with minimum 1/3 sawn urface in the outside face and each edge throughout the whole length of the piece.

4.2 Market oriented end-use grading

GRADEMIX

This is specifying a *mix of grades for a specific end-use* with permitted wood features from *main GRADES A, B, C, and D.* The GRADES and the features which are included in the mix shall be specified in the contract.

Example: The contract specifies GRADE A with seasoning shakes according to GRADE A3, pitch pockets according to GRADE B and wane according to GRADE C etc.

KNOTTY SAWN TIMBER

Knotty sawn timber is a special grade. The number and size of sound knots and other requirements are set according to the agreed GRADEMIX.

STAMMWARE

Stammware consists of unedged sawn timber, sawn from externally knot- and bump-free butt logs, see figure 4.1.

A It is the responsibility of the seller to ensure that the sawn timber fulfils the contract requirements such as straight grain, fine-ringed, required sizes and qualities. The width of a stammware piece is measured in the middle of the narrower face (outside face) to a notional arris or as agreed.

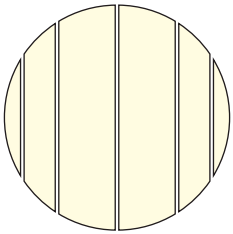


Figure 4.1
Stammware

B If the buyer has inspected and approved the logs prior to sawing, only fissures, warp, moisture content, discolouration, thickness deviation and handling damage will be considered in the grading.

4.3 Examples of various end-use areas for the different grades of sawn timber

End-use areas	A				B	C	D
	A1	A2	A3	A4			
Visible joinery							
Sawn timber for construction							
Formwork, underfloring							
Mouldings							
Interior cladding							
Linings, handrails							
Slatting battens and strips							
Europallets							
Disposable pallets							
Packaging material							
Flooring boards							
Covered floorings							
T & G Shaalboards							
Fencing							
Covered internal cladding							
Wind and snow fences							
Schaalboards							
Boatbuilding, decking							
Handicrafts							
Sauna material							
Knotty sawn timber							
Window and door frames							
Furniture and glulam panels							

5. Instructions and rules

Nordic grading practice

The basis for NORDIC TIMBER grading rules is that the sawn timber to be graded has been sawn according to the Nordic sawing practice and that the grade is defined from a sawn timber piece trimmed to the final length, or if not trimmed, to the intended length.

Species

Redwood (pine) and whitewood (spruce) are graded separately. Unless otherwise agreed, sawn timber pieces of wrong species, which are by mistake mixed with the other species, will be graded into GRADE D.

Determination of GRADE

The GRADE is determined on the basis of the number, location, type and the maximum permitted values of the wood features according to the tables.

** Each side of the piece shall be graded separately*

* The maximum values of wood features which in each GRADE are permitted *on the worst one meter of length* are given in the tables

* The *GRADE* is decided on the basis of the *outside face and both edges*

* The inside face may be *one GRADE lower*

When evaluating features, which are defined in percentages of the total volume, the (*) marked points in the frame above are not considered. In those cases the whole piece of sawn timber has to be considered in the determination of GRADE.

Values

The values given in the tables are the lower limits of the permitted wood features in each respective GRADE. They are related to standard sizes at 20 % moisture content. No values are given for GRADE D, see GRADE D, page 17.

Standard sizes for sawn timber

Thicknesses 16, 19, 22, 25, 32,38, 44, 50, 63 and 75 mm
Widths 75, 100, 115, 125, 150, 175, 200 and 225 mm
Lengths 1800-5400 mm or - 6000 in 300 mm alternatively 100 mm modules. Other lengths and modules can be separately agreed.

- ☐ The given sizes are the nominal *measures* of sawn timber *at 20 % moisture content*.

- ☐ Sizes which are not mentioned above are *special sizes*. These can usually be obtained by special agreement.

Special sizes are graded according to values of the nearest bigger standard size. Sizes over 75 x 225 mm are, however, graded according to rules for 75 x 225 mm.

Permitted size deviations

The nominal sizes are applicable at 20 % moisture content. The following deviations from the nominal sizes of sawn timber are permitted:

Thickness and width	up to 100 mm	-1 mm	+ 3 mm
	more than 100 mm	-2mm	+ 4 mm
Lengths 1800-6000 mm		- 0 mm	+50 mm

The average thickness and width of the sawn timber lot may not, however, be less than the nominal size.

Shrinkage of knots is not considered if it stays within the permitted size deviations, otherwise the classification is done as for loose knot or knot hole, see table I, page 26.

Discolouration, which can be measured and is deeper than the permitted negative size deviation, will be evaluated and classified according to the values for log blue stain, see table 3, page 31.

Handling damage, which can be measured and is deeper than the permitted negative size deviation, will be evaluated and classified according to the values for barkringed knot, see table I, page 26-27.

Moisture content

The maximum moisture content for all sawn timber sizes is 24 %. The moisture content requirement applies to at least 97,7 % of the number of pieces within the parcel. Requirements which deviate from this rule have to be defined in the contract.

When determining the moisture content of a sawn timber piece or a lot, *moisture content standard INSTA 141* can be applied.

At the change of moisture content to less than 20 %, the following has to be considered:

A The actual thickness and width can become smaller than the nominal size, which applies at 20 %. The relation of I % shrinkage to 4 % reduction of moisture content holds true as a guideline.

Example: Nominal size 50x100 mm at 20 % moisture content equals size 49 x 98 mm at
12 % moisture content.

B The occurrence of fissures and warp may increase and exceed the table values if the timber is dried to moisture content below 20 %.

Insect damage

Insect damage is not permitted. Such insect damages (holes) under 2 mm that cannot be discerned at grading, will be permitted provided that the depth does not exceed the permitted negative size deviation.

Width of annual rings

The width of annual rings varies according to the growing conditions of different forest areas. Requirements concerning the average width of annual rings are therefore not given. If special requirements are needed, they have to be defined in the contract between the seller and the buyer.

Other GRADE-inclusion

The guideline is that at least 90 % of the pieces in the lot shall not have wood features with values exceeding the maximum permitted values for a contracted GRADE.

Other grading applications

If there are specific reasons to deviate from these grading rules, e.g. because of different species etc., or to consider a wood feature outside these rules, it must be agreed in the contract.

6. Classification tables

The values for wood features are presented in tables on the following pages in the order given below. The content has been grouped according to various end-use requirements.

Tables 1-3 present the maximum permitted values for GRADES A, B and C.
Tables 4-6 present respective values for Al - A4.
Tables 7-12 present the maximum permitted values for one GRADE only in each table

In order to make interpretation easier, tables 1-6 are provided with comments. These comments apply also to the other tables.

Definitions and measuring systems for different features are presented in paragraph 7, page 50.

Table 1: Main grades - Number of knots

Wood features		GRADE A	B	C
Number of knots Sound and/or dead knots	per face	4	5	6
total number of max. size on the worst 1 m	per edge	2	3	4
Of which barkringed knots	per face	2	3	4
and/or unsound knots		-	3	4
Of which barkringed knots	per edge	1	2	3
and/or unsound knots		-	2	3

Knots 10 mm or smaller

Sound knots and dead knots which are 10 mm or smaller are not considered in GRADES A4 - C.

Tight knots

The knots have to be tight in GRADES A and B.

Barkringed knots

A barkringed knot which is encircled by bark for less than 1/4 is evaluated and classified as a dead knot.

Unsound knots

Unsound knots are not permitted on the outside face and the edges in GRADE A, irrespective of the size of the knots.

Compensation rule for the number of knots

If the knot size is smaller than the table value for the GRADE in question, a greater number of knots is permitted. The sum of knot sizes (= number of knots x diameter) cannot, however, be exceeded for the respective types of knots.

Loose knots and open knot holes

Sawn timber pieces, which contain loose knots or open knot holes maximum 15 mm or smaller, are classified as GRADE C. Pieces containing loose knots or knot holes above 15 mm are classified as GRADE D.

Table 1, cont.: Main grades - Knot size

Wood features			GRADE A	B	C
Sound knots	Timber thickness mm	Timber width mm	Knot size mm		
Faces	16-25	75-115	20	35	50
		125-150	25	40	55
		175-225	30	45	60
	32-38	75-115	25	40	55
		125-150	30	45	60
		175-225	35	50	65
	44-50	75-115	30	45	60
		125-150	35	50	65
		175-225	40	55	70
	63-75	75-115	35	50	65
		125-150	40	55	70
		175-225	45	60	75
Sound knots	Timber thickness mm		Knot size mm		
Edges	16-19		15	*	*
	22-25		20	*	*
	32-38		25	30	*
	44-50		30	40	*
	63-75		35	50	*
Other knots	Type of knot		Reduced to % of sound knot size		
	Knot cluster, per knot		70	70	80
	Dead knot		70	70	100
	Barkringed knot		50	60	90
	Unsound knot		-	50	90

* equal to the timber thickness

Fissures

Heart shakes are evaluated and classified according to the rules for drying checks.

Parallel drying checks run in one direction, parallel, through their whole length or part of the length. Drying checks can be oblique and they can also go through the arris (see below).

When deciding to which GRADE the piece belongs, one must calculate the total fissure length on each side of the piece as one unbroken fissure.

Edge shakes and shakes extending over the arris, irrespective of their length, are not permitted in GRADE A.

Splits longer than 100 mm are permitted only in GRADE D.

Wane

3 mm wane is generally allowed. This generally allowed 3 mm shall therefore be added to the permitted wane values for the outside face and the edges.

Wane, max 150 mm long, is permitted, if it is a maximum of one half of the thickness of the piece and if it is not longer than the width of the piece (however, maximum 150 mm). This wane is not permitted in the end of the piece. The number of this kind of pieces cannot be more than 3 %.

Arris damage

Arris damage is evaluated and classified according to the values for wane.

Surface bark

Sawn timber pieces with surface bark are classified as GRADE D.

Table 2: Main grades - Fissures and wane

Wood features		GRADE A	GRADE B	GRADE C
Fissures at 20 % moisture content				
Drying checks longer than 100 mm	Timber thickness mm	Total fissure length % of timber length outside face	outside face + edges	
	16-25	15	25	70
	32-50	25	35	90
	63-75	35	50	100
Ring shakes	All dim.	-	-	20
Wane (exceeding 3 mm)				
Timber thickness: max. 25 mm		% of timber length		
Length, each edge		20	30	40
one edge		30	40	50
Timber thickness: more than 25 mm				
Length, each edge		10	20	30
one edge		20	30	40
		% of timber thickness		
Depth	per edge	10	15	20
Width on the outside face		mm		
	each edge	7	12	17

Resin pockets

Resin pockets shorter than 20 ram are not considered in GRADES B - C.

Compensation rules for the number of resin pockets, bark pockets and scars

If the resin pockets (and equivalent) are shorter than permitted for each respective GRADE, a greater number will be permitted. The value for the total length (= number of resin pockets x length) in mm may not be exceeded.

Slope of grain

Slope of grain = a:b. Deviation (a) to be in proportion to the length (b), see definition on page 55.

Top rupture

a) If the defect caused by top rupture occurs in the form of a vertical knot, it will be evaluated and classified as a *splay knot.*
b) If the damage has caused visible distorted grain, it will be evaluated in percentages of the width and classified as *top rupture* .

Compression wood

Definition on page 56. Compression wood which does not affect the form of the piece and which is smaller than 1/3 of the width of the annual ring is not considered.

Soft rot

Soft rot is not permitted in GRADES A - C.

Warp: bow or twist

Bow or twist which are evenly distributed throughout the whole length of the piece, provided it has been caused by other reasons than compression wood, will not be considered in 25 mm and thinner goods.

Table 3: Main grades - Other features

Wood features		GRADE A	B	C
Resin pockets	Number, pcs.	2	2	2
on the worst 1 m	Length, mm	50	100	150
Bark pockets, scars *)	Number, pcs.	1	1	1
on the worst 1 m	Length, mm	100	200	300
Slope of grain	Max.	1:10	1:7	1:2
		% of timber width		
Top rupture		10	30	50
		% of the volume of the piece		
Compression wood, curly grain *)		10	20	50
Resin wood		5	30	70
Water stain, log blue stain, dote *)		-	5	30
Warp on the worst 2 m unit of length at 20 % moisture content				
	Timber size mm	Height mm		
Bow	Thickness max. 44	15		30
	more than 44	10		20
Spring	All widths	4		8
		% of timber width		
Cup		2		4
Twist	Thickness max. 44	10		20
	more than 44	6		10

*) each

Table 4: Sub-grades - Number of knots

Wood features		GRADE A1	A2	A3	A4
Number of knots Sound knots	per face	1	2	3	4
total number of max. size on the worst 1 m	per edge	-	1	1	2
Of which dead knots and/or	per face	-	1	3	4
barkringed knots		-	-	1	2
Of which dead knots and/or	per edge	-	1	1	2
barkringed knots		-	-	1	1

Small knots

a) Sound and dead knots, smaller than 7 mm, are not considered in GRADES A1 - A3.

b) Sound and dead knots, smaller than 10 mm, are not considered in GRADE A4.

Compensation rule for the number of knots

See table I, Main grades, page 26.

Tight knots

The knots have to be tight in GRADES A1 - A4.

Knot clusters

Knot clusters are not permitted in GRADES A1 - A3.

Traversing dead knots

are not permitted in GRADES A I - A2.

Barkringed knots

A barkringed knot which is encircled by bark for less than I/4 is evaluated and classified as a dead knot.

Unsound knots

Unsound knots are not permitted on the outside face and the edges in GRADES A I - A4, irrespective of the size of the knots.

Table 4, cont: Sub-grades - Knot size

Wood features			GRADE A1	A2	A3	A4
Sound knots	Timber thickness mm	Timber width mm	Knot size mm			
Faces	16-25	75-115	8	10	10	20
		125-150	8	10	15	25
		175-225	8	15	20	30
	32-38	75-115	8	10	15	25
		125-150	8	15	20	30
		175-225	10	15	25	35
	44-50	75-115	8	15	20	30
		125-150	10	15	25	35
		175-225	10	20	30	40
	63-75	75-115	10	20	25	35
		125-150	15	20	30	40
		175-225	15	25	35	45
Sound knots	Timber thickness mm		Knot size mm			
Edges	16-19		-	8	10	15
	22-25		-	8	10	20
	32-38		-	10	15	25
	44-50		-	10	20	30
	63-75		-	15	25	35
Other knots	Type of knot		Reduced to % of sound knot size			
	Knot cluster, per knot		-	-	-	70
	Dead knot		-	70	70	70
	Barkringed knot		-	-	50	50
	Unsound knot		-	-	-	-

Fissures

Heart shakes are evaluated and classified according to the rules for drying checks.

Parallel drying checks run in one direction, parallel, through their whole length or part of the length. Drying checks can be oblique and they can also go through the arris (see below).

When deciding to which GRADE the piece belongs, one must calculate the total fissure length on the outside face of the piece as one unbroken fissure.

Edge shakes and shakes extending over the arris, irrespective of their length, are not permitted in GRADES A1 - A4.

Splits longer than 100 mm are permitted only in GRADE D.

Wane

3 mm wane is generally allowed. This generally allowed 3 mm shall therefore be added to the permitted wane values for the outside face and the edges.

Wane, max 150 mm long, is permitted, if it is a maximum of one half of the thickness of the piece and if it is not longer than the width of the piece (however, maximum 150 mm). This wane is not permitted in the end of the piece. The number of this kind of pieces cannot be more than 3 %.

Arris damage

Arris damage is evaluated and classified according to the values for wane.

Surface bark

Sawn timber pieces with surface bark are classified as GRADE D.

Table 5: Sub-grades - Fissures and wane

Wood features		GRADE A1	A2	A3	A4
Fissures at 20 % moisture content					
Drying checks longer than 100 mm	Timber thickness mm	Total fissure length on outside face % of timber length			
	16-25	-	-	5	15
	32-50	-	-	15	25
	63-75	-	-	25	35
Ring shakes	All dim.	-	-	-	-
Wane (exceeding 3 mm)					
Timber thickness: max. 25 mm		% of timber length			
Length, each edge		-	-	-	20
one edge		-	-	-	30
Timber thickness: more than 25 mm					
Length, each edge		-	-	-	10
one edge		-	-	-	20
		% of timber thickness			
Depth	per edge	-	-	-	10
		mm			
Width on the outside face	each edge	-	-	-	7

Compensation rules for the number of resin pockets, bark pockets and scars
If the resin pockets (and equivalent) are shorter than permitted for each respective GRADE, a greater number will be permitted. The value for the total length (= number of resin pockets x length) in mm may not be exceeded.

Slope of grain
Slope of grain = a:b. Deviation (a) to be in proportion to the length (b), see definition on page 55.

Top rupture
a) If the defect caused by top rupture occurs in the form of a vertical knot, it will be evaluated and classified as a splay knot.

a) If the damage has caused visible distorted grain, it will be evaluated in percentages of the width and classified as top rupture .

Compression wood
Definition on page 56. Compression wood which does not affect the form of the piece and which is smaller than 1/3 of the width of the annual ring is not considered.

Soft rot
Soft rot is not permitted in GRADES A1 - A4.

Warp: bow or twist
Bow or twist which are evenly distributed throughout the whole length of the piece, provided it has been caused by other reasons than compression wood, will not be considered in 25 mm and thinner goods.

Table 6: Sub-grades - Other features

Wood features		GRADE A1	A2	A3	A4
Resin pockets	Number, pcs.	-	1	1	2
on the worst 1 m	Length, mm	-	20	40	50
Bark pockets, scars *)	Number, pcs.	-	-	-	1
on the worst 1 m	Length, mm	-	-	-	100
Slope of grain	Max.	1:15		1:12	1:10
		% of timber width			
Top rupture		-	-	-	10
		% of the volume of the piece			
Compression wood, curly grain *)		-	-	-	10
Resin wood		-	-	-	5
Water stain, log blue stain, dote *)		-	-	-	-
Warp on the worst 2 m unit of length at 20 % moisture content					
	Timber size mm	Height mm			
Bow	Thickness max. 44	10		15	
	more than 44	5		10	
Spring	All widths	3		4	
		% of timber width			
Cup		2		2	
Twist	Thickness max. 44	6		10	
	more than 44	4		6	

*) each

Table 7: Grade table *GRADE A1*

Knots	
Number of knots Sound knots total number of max. size, on the worst 1 m	*1 knot* per face - *knot* per edge

Knot size mm						
Sound knots					Other knots Reduced to % of sound knot size	
Timber thickness mm	Faces Timber width, mm			Edges	Type of Knot	%
	75-115	125-150	175-225			
16-25	8	8	8	-	Knot cluster	-
32-38	8	8	10	-	Dead knot	-
44-50	8	10	10	-	Barkringed knot	-
63-75	10	15	15	-	Unsound knot	-

Fissures at 20 % moisture content		
Timber thickness mm	Drying checks longer than 100 mm	Ring shakes
	Total length on outside face % of timber length	% of timber length
16-25	-	-
32-50	-	-
63-75	-	-

Table 7, cont.: Grade table *GRADE A1*

Wane (exceeding 3 mm)				
Timber thickness mm	Length		Depth	Width
	% of timber length		% of timber thickness	mm
	Each edge	One edge	Per edge	Outside face, each edge
max. 25	-	-	-	-
over 25	-	-	-	-

Warp on the worst 2 m unit of length at 20 % moisture content				
Timber thickness, mm	Bow	Spring	Cup	Twist
	mm		% of timber width	
max. 44	10	3	2	6
over 44	5	3	2	4

Other features	
Resin pockets	-
Bark pockets, scars	-
Slope of grain	1:15
Top rupture	-
Compression wood, curly grain	-
Resin wood	-
Water stain	-
Log blue stain	-
Dote	-

Table 8: Grade table *GRADE A2*

Knots						
Number of knots Sound knots total number of max. size, on the worst 1 m				2 knots per face (of which 1 dead knot) 1 knot per edge (of which 1 dead knot)		
Knot size mm						
Sound knots					Other knots Reduced to % of sound knot size	
Timber thickness mm	Faces Timber width, mm			Edges	Type of Knot	%
	75-115	125-150	175-225			
16-25	10	10	15	8	Knot cluster	-
32-38	10	15	15	10	Dead knot	70
44-50	15	15	20	10	Barkringed knot	-
63-75	20	20	25	15	Unsound knot	-
Fissures at 20 % moisture content						
Timber thickness mm	Drying checks longer than 100 mm Total length on outside face % of timber length				Ring shakes % of timber length	
16-25	-				-	
32-50	-				-	
63-75	-				-	

Table 8, cont.: Grade table *GRADE A2*

Wane (exceeding 3 mm)				
Timber thickness mm	Length		Depth	Width
	% of timber length		% of timber thickness	mm
	Each edge	One edge	Per edge	Outside face, each edge
max. 25	-	-	-	-
over 25	-	-	-	-

Warp on the worst 2 m unit of length at 20 % moisture content				
Timber thickness, mm	Bow	Spring	Cup	Twist
	mm		% of timber width	
max. 44	10	3	2	6
over 44	5	3	2	4

Other features	
Resin pockets	1 piece (length 20 mm on the worst 1 m)
Bark pockets, scars	-
Slope of grain	1:15
Top rupture	-
Compression wood, curly grain	-
Resin wood	-
Water stain	-
Log blue stain	-
Dote	-

Table 9: Grade table *GRADE A3*

Knots						
Number of knots Sound knots total number of max. size, on the worst 1 m			3 knots 1 knot	per face (of which 1 barkringed) per edge (of which 1 barkringed)		
Knot size mm						
Sound knots					Other knots Reduced to % of sound knot size	
Timber thickness mm	Faces Timber width, mm			Edges	Type of Knot	%
	75-115	125-150	175-225			
16-25	10	15	20	10	Knot cluster	-
32-38	15	20	25	15	Dead knot	70
44-50	20	25	30	20	Barkringed knot	50
63-75	25	30	35	25	Unsound knot	-

Fissures at 20 % moisture content		
Timber thickness mm	Drying checks longer than 100 mm Total length on outside face % of timber length	Ring shakes % of timber length
16-25	5	-
32-50	15	-
63-75	25	-

Table 9, cont.: Grade table *GRADE A3*

Wane (exceeding 3 mm)				
Timber thickness mm	Length		Depth	Width
	% of timber length		%of timber thickness	mm
	Each edge	One edge	Per edge	Outside face, each edge
max. 25	-	-	-	-
over 25	-	-	-	-

Warp on the worst 2 m unit of length at 20 % moisture content				
Timber thickness, mm	Bow	Spring	Cup	Twist
	mm		% of timber width	
max. 44	15	4	2	10
over 44	10	4	2	6

Other features	
Resin pockets	1 piece (length 40 mm on the worst 1 m)
Bark pockets, scars	-
Slope of grain	1:12
Top rupture	-
Compression wood, curly grain	-
Resin wood	-
Water stain	-
Log blue stain	-
Dote	-

Table 10: Grade table *GRADE A4*

Knots						
Number of knots Sound knots and/or dead knots total number of max. size, on the worst 1 m	4 knots per face (of which 2 barkringed) 2 knots per edge (of which 1 barkringed)					
Knot size mm						
Sound knots					Other knots Reduced to % of sound knot size	
Timber thickness mm	Faces Timber width, mm			Edges	Type of Knot	%
	75-115	125-150	175-225			
16-19	20	25	30	15	Knot cluster	70
22-25	20	25	30	20	Dead knot	70
32-38	25	30	35	25	Barkringed knot	50
44-50	30	35	40	30	Unsound knot	-
63-75	35	40	45	35		
Fissures at 20 % moisture content						
Timber thickness mm	Drying checks longer than 100 mm Total length on outside face % of timber length				Ring shakes % of timber length	
16-25	15				-	
32-50	25				-	
63-75	35				-	

Table 10, cont.: Grade table *GRADE A4*

Wane (exceeding 3 mm)				
Timber thickness mm	Length		Depth	Width
	% of timber length		% of timber thickness	mm
	Each edge	One edge	Per edge	Outside face, each edge
max. 25	20	30	10	7
over 25	10	20	10	7

Warp on the worst 2 m unit of length at 20 % moisture content				
Timber thickness, mm	Bow	Spring	Cup	Twist
	mm		% of timber width	
max. 44	15	4	2	10
over 44	10	4	2	6

Other features	
Resin pockets	2 pieces (length 50 mm on the worst 1 m)
Bark pockets, scars *)	1 piece (length 100 mm on the worst \ m)
Slope of grain	1:10
Top rupture	10 % (of timber width)
Compression wood, curly grain *)	10 % (of the volume of piece)
Resin wood	5 % (of the volume of piece)
Water stain	-
Log blue stain	-
Dote	-

*) each

Table 11: Grade table *GRADE B*

<table>
<tr><td colspan="7">Knots</td></tr>
<tr><td colspan="3">Number of knots
Sound knots
and/or dead knots
total number of max. size,
on the worst 1 m</td><td colspan="4">5 knots per face
(of which 3 barkringed and/or unsound)
3 knots per edge
(of which 1 barkringed and/or unsound)</td></tr>
<tr><td colspan="7">Knot size
mm</td></tr>
<tr><td colspan="5">Sound knots</td><td colspan="2">Other knots
Reduced to % of sound knot size</td></tr>
<tr><td rowspan="2">Timber thickness mm</td><td colspan="3">Faces
Timber width, mm</td><td rowspan="2">Edges</td><td rowspan="2">Type of knot</td><td rowspan="2">%</td></tr>
<tr><td>75-115</td><td>125-150</td><td>175-225</td></tr>
<tr><td>16-25</td><td>35</td><td>40</td><td>45</td><td>*</td><td>Knot cluster</td><td>70</td></tr>
<tr><td>32-38</td><td>40</td><td>45</td><td>50</td><td>30</td><td>Dead knot</td><td>70</td></tr>
<tr><td>44-50</td><td>45</td><td>50</td><td>55</td><td>40</td><td>Barkringed knot</td><td>60</td></tr>
<tr><td>63-75</td><td>50</td><td>55</td><td>60</td><td>50</td><td>Unsound knot</td><td>50</td></tr>
<tr><td colspan="7">Fissures
at 20 % moisture content</td></tr>
<tr><td rowspan="2">Timber thickness mm</td><td colspan="3">Drying checks
longer than 100 mm</td><td colspan="3">Ring shakes</td></tr>
<tr><td colspan="3">Total length on outside face
% of timber length</td><td colspan="3">%
of timber length</td></tr>
<tr><td>16-25</td><td colspan="3">25</td><td colspan="3">-</td></tr>
<tr><td>32-50</td><td colspan="3">35</td><td colspan="3">-</td></tr>
<tr><td>63-75</td><td colspan="3">50</td><td colspan="3">-</td></tr>
</table>

* equal to the timber thickness

Table 11, cont.: Grade table *GRADE B*

Wane (exceeding 3 mm)				
Timber thickness mm	Length		Depth	Width
	% of timber length		% of timber thickness	mm
	Each edge	One edge	Per edge	Outside face, each edge
max. 25	30	40	15	12
over 25	20	30	15	12

Warp on the worst 2 m unit of length at 20 % moisture content				
Timber thickness, mm	Bow	Spring	Cup	Twist
	mm		% of timber width	
max. 44	15	4	2	10
over 44	10	4	2	6

Other features	
Resin pockets	2 pieces (length 100 mm on the worst 1 m)
Bark pockets, scars *)	1 piece (length 200 mm on the worst \ m)
Slope of grain	1:7
Top rupture	30 % (of timber width)
Compression wood, curly grain *)	20 % (of the volume of piece)
Resin wood	30 % (of the volume of piece)
Water stain	5 % (of the volume of piece)
Log blue stain	5 % (of the volume of piece)
Dote	5 % (of the volume of piece)

*) each

Table 12: Grade table *GRADE C*

Knots						
Number of knots Sound knots and/or dead knots total number of max. size, on the worst 1 m				6 knots per face (of which 4 barkringed and/or unsound) 4 4 knots per edge (of which 3 barkringed and/or unsound)		
Knot size mm						
Sound knots					Other knots Reduced to % of sound knot size	
Timber thickness mm	Faces Timber width, mm			Edges	Type of knot	%
	75-115	125-150	175-225			
16-25	50	55	60	*	Knot cluster	80
32-38	55	60	65	*	Dead knot	100
44-50	60	65	70	*	Barkringed knot	90
63-75	65	70	75	*	Unsound knot	90
Fissures at 20 % moisture content						
Timber thickness mm	Drying checks longer than 100 mm Total length on outside face % of timber length			Ring shakes % of timber length		
16-25	70			20		
32-50	90			20		
63-75	100			20		

* equal to the timber thickness

Table 12, cont.: Grade table *GRADE C*

Wane (exceeding 3 mm)				
Timber thickness mm	Length		Depth	Width
	% of timber length		% of timber thickness	mm
	Each edge	One edge	Per edge	Outside face, each edge
max. 25	40	50	20	17
over 25	30	40	20	17

Warp on the worst 2 m unit of length at 20 % moisture content				
Timber thickness, mm	Bow	Spring	Cup	Twist
	mm		% of timber width	
max. 44	30	8	4	20

Other features	
Resin pockets	2 pieces (length 150 mm on the worst 1 m)
Bark pockets, scars *)	1 piece (length 300 mm on the worst 1 m)
Slope of grain	1:2
Top rupture	50 % (of timber width)
Compression wood, curly grain *)	50 % (of the volume of piece)
Resin wood	70 % (of the volume of piece)
Water stain	30 % (of the volume of piece)
Log blue stain	30 % (of the volume of piece)
Dote	30 % (of the volume of piece)

*) each

7. Wood features: definitions and measurement practices

7.1 Knots

The location, number, size and type of knots are the decisive factors when deciding to which GRADE a piece of sawn timber belongs.

Form of the knots

The knots are divided into the following knot forms:

Round and oval knots are knots sawn more or less straight across and are located on the faces or the edges of a piece.

Arris knot. A knot located in the intersection of a face and an edge of a piece.

Splay knot. A splay knot is a knot on the inside face of a piece, which extends to the arris and which partly shows also on the edge. Top rupture occurred in growing trees, can create *vertical or cone-shaped knots*. These are classified as splay knots.

Spike knot. A spike knot is a knot on the inside face, which does not extend to the arris of the piece.

Location of knots

The knots are divided according to their location into *face knots, edge knots and arris knots*.

Internal position of the knots

The following are distinguished:

Scattered knots are knots which are spread along the piece and do not form knot clusters.

Knot cluster is a group of adjacent knots which have clearly separated grain deviations. If the knots are not clearly separated by undisturbed grain, they are considered as one knot. Knot clusters are evaluated on the outside face as well as on the edges. In order to be considered a knot cluster, it must contain at least 4 knots with a diameter bigger than 12 mm and the whole group of knots must be located within 150 mm of the length of the piece.

Different types of knots

Different types of knots are distinguished. These are evaluated in different ways in the grading, see tables.

Sound knot. A sound knot is intergrown to more than 3/4 with the surrounding wood.

Dead knot. A knot whose function in the growing tree has ceased.

- A black knot is a dark coloured dead knot.
- A pin knot is a very small dead knot, usually dark coloured, with a diameter of not more than 7 mm.

A dead knot can be tight or loose.

Barkringed knot. A barkringed knot is partly or completely surrounded by bark. If less than 1/4 is encircled by bark, it is evaluated and classified as a dead knot.

Unsound knot. An unsound knot is completely or partly damaged by rot.

Size and measuring - guidelines

Face knot (round and oval knots). The size is the mean value of the biggest diameter, D, and the smallest diameter, d.

Splay knot. The part visible on the inside face is measured as the sum of the length and width of the knot divided by three (the width is measured in the middle). The part of the knot visible on the edge is measured according to the rule for edge knots.

Spike knot. A spike knot on the inside face ceases before the arris. It is measured as the sum of the length and width of the knot divided by six (the width is measured in the middle).

Edge knots are measured at right angles to the lengthwise direction of the piece.

Arris knot. The part of the knot visible on the face is measured according to the rule for face knots. The part of the knot visible on the edge is measured according to the rule for edge knots.

Knot cluster. Measurement according to the guidelines in figure 7.1. If the knots are not clearly separated by undisturbed grain they are measured as one knot.

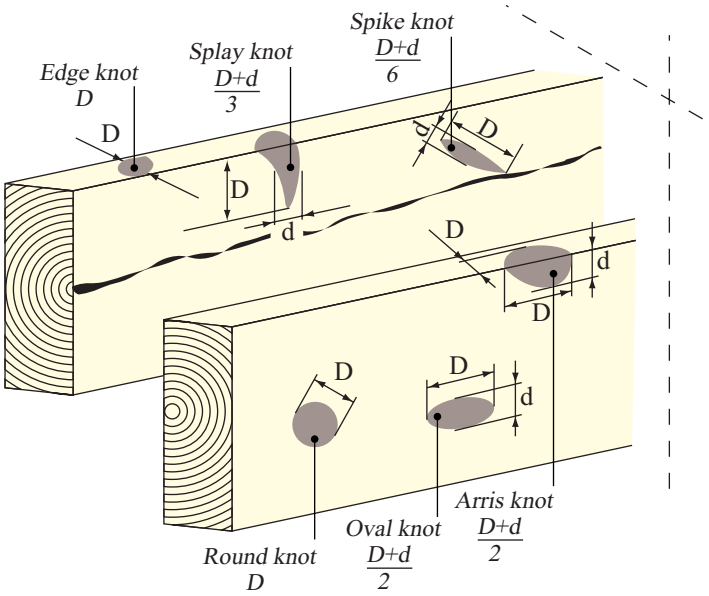


Figure 7.1
Guidelines for measuring the knot size

7.2 Fissures

Three different kinds of fissures are distinguished.

Drying checks

These fissures occur in the sawn timber in connection with seasoning. The drying checks can be parallel or diagonal to the length of the piece depending on the grain direction within the piece, see table 2.

The depth and the width of the drying check is usually dependent on the length of the check.

Heart shakes

These are shakes that run along the radii from. the pith in the middle of the tree towards the surface. They are formed in the heartwood due to internal stresses within the tree. They are evaluated and classified according to the values for drying checks, see table 2.

Ring shakes

These are shakes that are running along the annual rings, concentric with each other. They can sometimes be distinguished on the end surface of newly cut timber, see table 2.

Measuring of the fissure length

The fissure length, S, is given as a percentage of the timber length:

$$\frac{a + b}{\textit{timber lenght}} * 100 = S\ \%$$

where (a+b) = the total length of the fissures in the piece, see figure 7.2.

Parallel drying checks run in one direction, parallel, through their whole length or part of the length. Drying checks can be oblique and they can also go through the arris. When evaluating the fissure length, they are considered as one single fissure.

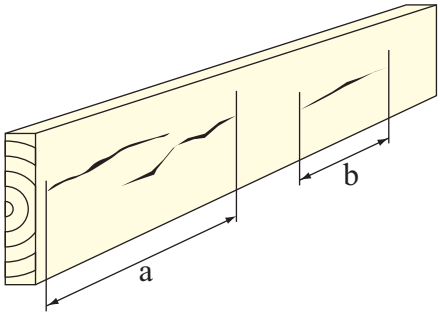


Figure 7.2
Measuring the fissure length

7.3 Wane

Wane is the part of the surface of the sawn timber, which has not been touched by the saw, see table 2.

The length and the depth of wane are given as a percentage of the nominal size of the sawn timber piece. The width is given in mm.

7.4 Resin pockets

A resin pocket is an opening between two annual rings of the sawn timber piece. It is usually filled with resin. The opening is occluded the same year it is formed, see table 3.

7.5 Bark pockets

A bark pocket is intergrown bark. The bark pocket can be formed e.g. by overlaying growth of a butt scar. It can also be caused by damage to the growing tree, which has been covered, see table 3.

7.6 Scars

A scar is an opening caused by damage to the growing tree, which has been healed over in the trunk by occlusion. The fibres of the occlusion are often irregular and mostly resinous, see table 3.

7.7 Slope of grain

Slope of grain means that the wood fibres do not run parallel to the lengthwise direction of the piece. The deviation of the grain direction from the lengthwise direction of the piece measured on the outside face is the value for slope of grain, see figure 7,3.

This can apply to a part or the whole piece of sawn timber. Slope of grain can be caused by spiral growth of the tree, a crook in the tree or a big taper, see table 3.

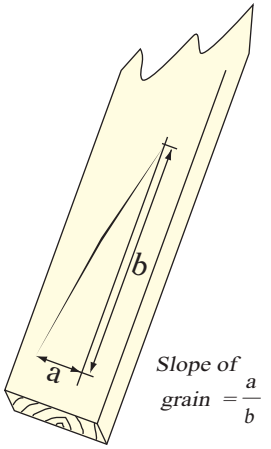


Fig. 7.3
Slope of grain

7.8 Top rupture

Top rupture is formed when the tree is broken and the growth tries to repair the damage. The grain deviation is usually followed by formation of compression wood and curly grain with lower strength properties as result.

The size of a top rupture is in proportion to the diameter of the trunk at the time of damage.
The damage can be evaluated in two ways depending on how it looks. If it has the character of a vertical knot, it is evaluated and classified as a splay knot.

If the damage is visible as a grain deviation, it is evaluated as a percentage of the timber width and classified as top rupture.

Measuring of top rupture takes place from the visible pith to the imagined pith, see table 3.

7.9 Compression wood

Compression wood is wood with abnormal fibre properties. It has been formed to compensate for abnormal compression stresses within the tree. The wood material is harder and often darker than the surrounding normal wood material, see table 3.

Compression wood is measured according to figure 7.4. The volume containing compression wood, V, is given as a percentage of the volume of the piece.

$$\frac{\text{Volume of compression wood (a*b*c)}}{\text{Volume of the piece (A*B*C)}} * 100 = V\%$$

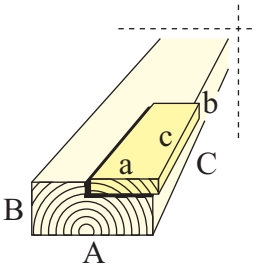


Figure 7.4
Measuring of the volume of compression wood

7.10 Curly grain

This kind of wood has very irregular grain, which runs in different directions. Curly grain is formed e.g. due to local disturbances of the growth, see table 3.

The volume containing curly grain is given as a percentage of the volume of the piece and is measured according to the guidelines for compression wood in figure 7.4.

7.11 Resin wood

Resin wood is wood containing an abnormal content of resin. It is usually darker than normal wood, see table 3. The amount of resin wood is given as a percentage of the volume of the piece and is measured according to the guidelines for compression wood in figure 7.4.

(Resin wood should not be confused with resin flow, which can occur when seasoning wood at high temperatures.)

7.12 Water stain

Water stain reduces the firmness of the wood and occurs mostly in streaks and blemishes, mainly in overmature trees, see table 3. The amount of water stain is given as a percentage of the volume of the piece and is measured according to the guidelines for compression wood in figure 7.4.

7.13 Fungus infection

Different kind of fungi, e.g. mould, stain and rot producing fungi, can infect the wood and cause light to strong discolouration. The infection can be superficial or penetrate deep into the sapwood.

Mould

Mould spreads only superficially. It is visible as discolouration and can occur after sawing and during seasoning. Mould has earlier been called yard or seasoning blue and it is often invisible in its first stage and disappears during planing.

Log blue stain

This blue stain penetrates usually deep into the wood or through the piece and it already exists in the log prior to sawing. The amount of log blue stain is given as a percentage of the volume of the piece and is measured according to the guidelines for compression wood in figure 7.4.

Rot

Rot is formed when the wood is infected by fungi producing rot. Two types of rot are distinguished. *Dote* (hard rot, incipient decay) means that the wood has not lost its firmness. *Soft rot* means that the wood is not firm any more and yields when pressed. The amount of rot is given as a percentage of the volume of the piece and is measured according to the guidelines for compression wood in figure 7.4.

7.14 Warp

Four different kinds of warp are distinguished. The amount of deformation is given in height in mm, see table 3.

Bow

The faces are bowed in the lengthwise direction of the piece. Bow is measured as the height of the bow in mm within 2 m of the piece, see figure 7.5.

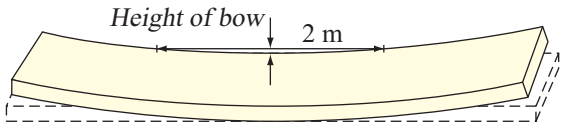


Figure 7.5
Bow

Spring

The edges are bowed in the lengthwise direction of the piece. Spring is measured as the height of the spring in mm within 2 m of the piece, see figure 7.6.

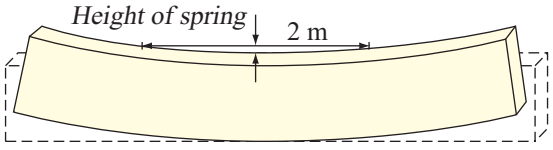


Figure 7.6
Spring

Cup

This is how concave or convex a piece of sawn timber is cross-directionally. It is measured as the height of cup across the width on the concave face and evaluated as a percentage of the timber width, see figure 7.7.

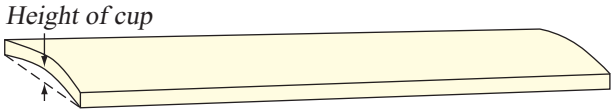


Figure 7.7
Cup

Twist

Twist is a flatways deviation in the form of a screw. It is measured as the height of deviation within 2 m of the piece from the level plane to the outside face of the piece and evaluated as a percentage of the timber width, see figure 7.8.

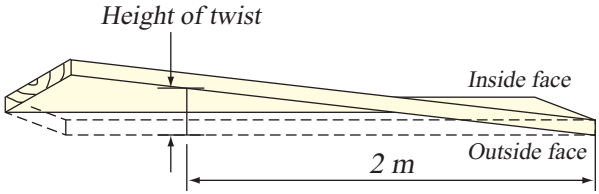


Figure 7.8
Twist

7.15 Other definitions

Moisture content. Moisture content is the weight of the water in the wood compared to the weight of absolutely dry wood. Moisture content is given as a percentage.

Width of annual rings. The width of annual rings means average width. The annual rings located more than 25 mm from the visible or imaginary pith are measured. For practical reasons the width of annual rings is usually measured in the butt end. Width of annual rings is given in mm.

Size deviation. Size deviation is the amount of deviation from the nominal size, which is greater than the permitted deviation, see Permitted size deviations, page 22.

Shrinkage of knots. This occurs when a loose dead knot shrinks from the plane of the surface of the piece during seasoning. The knot adheres to the wood at the end of seasoning and forms a bump on the other side of the piece. Shrinkage of knots is not considered if it stays within the permitted size deviations of the piece, otherwise the classification is done as for loose knot or knot hole, see table I, page 26.

Discolouration. Such superficial colouring as *bark-brown*, *weathering and mould* is called discolouration. They may develop during seasoning and storage, see page 23.

Handling damage. This is damage occurring during the handling of the goods, e.g. damage caused by infeed rollers or cutting tools. Such damage can also be caused by packages being dropped or in the package press, see page 23.

Water storage damage. This kind of damage may occur after storage in water for a long period or lengthy watering of logs stored on land. Such damage cannot be evaluated in normal grading.

Insect damage. Insect damage can be divided into wood wasp attack (e.g. hymenoptera, ants, bees, wasps) and insect holes (bark beetles). Insect holes are normally less than 2 mm in diameter, see also page 24.

8. Short history

Historical grading rules

The Norrland region of Sweden has had several printed rules since the 1880's. In 1888 the "Rules and Hints for Grading of Deals, Battens and Boards" were published.

Härnösands Districts Trävaruexportförening (the Sawn Timber Export Association of Härnösand Region) printed and published latest in 1926 the "Sorteringsregler för sågade trävaror inom Härnösand distrikt tillämpade sedan år 1880" ("Grading Rules for Sawn Timber within Härnösand Region applied since 1880").

South Sweden published in 1950 and 1954 the so-called "Gothareglema" ("Gotha-rules") for whitewood and redwood respectively.

In Finland the Puutekniikan Tutkimuksen Kannatusyhdistys r. y. (the Benevolent Association for Wood Technology Research, Registered Association) published in 1936 the "Instructions for the Grading of Export Timber".

In Norway the "Ofentlig Norsk Maaleinstitusjon" was established in 1893 for export to England. This was connected with the main export ports. The prevailing practice was documented in the "Östlandets Skurlastmåling" which in 1932 published rules for South Norway, with the last revision in 1955. These rules replaced the previous Oslo Grading, Fredriksstad Grading, Drammen Grading, Skiensfjord Grading etc.

"Guiding Principles for Grading of Sawn Timber" (1960): the Swedish "Green Book"

In the annual meeting on the 10th April, 1957, of the Association of Swedish Sawmillmen the board of directors was given the assignment to achieve a better uniformity in the application of the practice of evaluating sawn timber for export.

A committee was appointed and Messrs. Abr. Abrahamsson, Växjö, Tord Heime, Malmö, R. B. Hillman, Stockholm, E. J. Lindberg, Sundborn, Carl Malmström, Linköping, Henrik Paimborg, Sigtuna and Bertil Thunell were appointed as members of the committee.

In the establishment meeting on the 26th February, 1958, Mr. Torsten Thornander, Stockholm, was elected chairman of the committee and doctor Bertil Thunell vice chairman. Mr. Endel Saarman, Svenska Träforskningsinstitutet (the Swedish Forest Products Research Laboratory), Stockholm, was appointed secretary of the committee. The committee was named "1958 års virkessorteringskommitte" (the Sawn Timber Grading Committee of 1958).

The prepared instructions applied for export sawn timber and defined the upper limit within the respective qualities. The relative distribution of qualities was not considered, because it is mainly dependent of the composition of raw material in different sawmills.

The instructions were compiled in a small practical booklet, which according to the colour of the cover was called the "Green Book". The Swedish "Green Book" has been published in five editions. The latest revision was in 1987.

"Instructions for the Grading of Export Timber" (1960): the Finnish "Green Book"

The Association of Finnish Sawmillmen brought up the question of including sawn timber grading in the research programme in the Benevolent Association for Wood Technology Research. As a result of the multi-faceted and expansive research the Association published in 1936 the "Instructions for the Grading of Export Timber".

The second edition of the grading rules was published in 1947 by a committee consisting of members of the Association of Finnish Sawmillmen representing various shipping regions. The chairman of the committee was Professor Martti Levón and the secretary Mr. Eino Jussila. The contents of the 1936 grading rules were not revised in the new edition.

It was decided at the Association of Finnish Sawmillmen meeting on the 25th September, 1957, to appoint another committee to evaluate, revise and complete the grading rules of 1936. The chairman of this committee was Professor Martti Levón. The members of the committee were Messrs. René Harju-Jeanty, Olli Heikinheimo, Axel Naesman, Olavi Santa-holma, G. 0. Snellman, Toivo Vesa, Knut Virtanen and Professor F. E. Siimes.

Additionally, Mr. Heikki Aarnio participated in the work of the committee as a representative of the Suomen Sahanomis-tajayhdistys (the Finnish Sawmill Owners Association). Messrs. Olli Heikinheimo and Matti Kovanen functioned as secretaries of the committee.

The committee worked in close co-operation with the respective Swedish committee, which had been established on the initiative of the Association of Swedish Sawmillmen in early 1958. The co-operation led to the grading rules - which are mainly uniform - being published at the same time in the two countries.

The Finnish book was very much appreciated and gained a large circulation both in Finland and outside the country.

The Finnish "Green Book" has been published in three editions. The last revision was in 1979.

9. Photographic examples

Wood features and GRADE pictures A1 - C

1. Sound knot

Frisk kvist
Frisk kvist
Tuore oksa
Frisk knast
Gesunder Ast
Noeud sain
Nodo sano

2. Sound knot

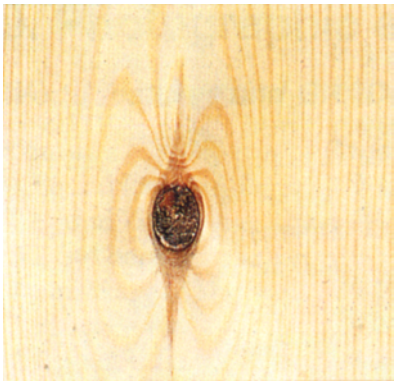
Frisk kvist
Frisk kvist
Tuore oksa
Frisk knast
Gesunder Ast
Noeud sain
Nodo sano

3. Dead knot

Torrkvist
Tørrkvist
Kuiva oksa
Tør knast
Toter Ast
Noeud mort
Nodo morto

4. Shrinkage of knot

Kvistkrypning
Kvistkryping
Oksakohouma / -painuma
Udkogte knast
Kriechast
Noeud, traversant
Nodo passante



5. *Black knot*

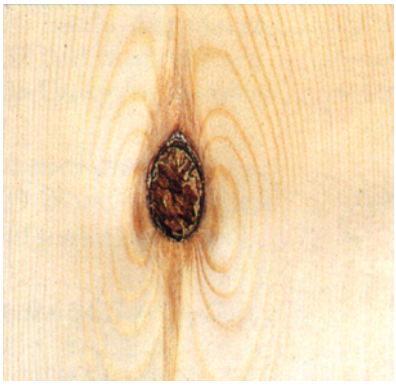
Svartkvist
Svartkvist
Musta oksa
Sort knast
Schwarzast
Noeud noir
Nodo nero

6. *Pin knot*

Pärlkvist
Perlekvist
Helmioksa
Perleknast
Punktast
Oeils perdrix
Nodi a spillo

7. *Barkringed knot*

Barkringskvist
Barkringkvist
Kuoren ympäröima oksa
Barkringsknast
Rindenumrandeter Ast
Noeud à entre écorce
Nodo con corteccia



8. *Unsound knot*

Rötkvist
Råtekvist
Laho-oksa
Rådknast
Faulast
Noeud vicieux
Nodo marcio

9. Round knot

Rund kvist
Rund kvist
Pyöreä oksa
Rund knast
Runder Ast
Noeud rond
Nodo rotondo

10. Oval knot

Oval kvist
Oval kvist
Soikea oksa
Oval knast
Ovaler Ast
Noeud ovale
Nodo ovale

11. Arris knot

Hörnkvist
Hjørnekvist
Särmäoksa
Hjørne knast
Kantenast
Noeud d'arête
Nodo di spigolo

12. Splay knot

Hornkvist
Hornkvist
Sarvioksa
Hornknast
Flügelast
Noeud tranchant
Nodo piatto

13.Spike knot

Bladkvist
Bladkvist
Lehtioksa
Bladknast
Länglicher Ast
Noeud plat
Nodo a baffo

14.Edge knot

Kantsidekvist
Kantsidekvist
Syrjäoksa
Kantknast
Schmalseitenast
Noeud de rive; noeud de chant
Nodo laterale

15.Scattered knots

Strökvistar
Spredte kvister
Hajaoksia
Enkelt knaster
Einzeläste
Noeuds isolés
Nodi isolati

16.Knot cluster

Kvistgrupp
Kvistgruppe
Oksaryhmä
Knastgrupper
Astansammiung
Noeuds groupés
Nidi di nodi

17.Parallel drying check

Rak torkmngsspricka
Rett tørkesprekk
Suora kuivumishalkeama
Lige tørrerevne
Gerader verlaufender
Trocknungsriß
Fente droite
Fenditura diritta

18.Oblique drying check

Sned torkmngsspricka
Skrå tørkesprekk
Vino kuivumishalkeama
Skrå tørrerevne
Schräg verlaufender
Trocknungsriß
Fente oblique
Fenditura obliqua

19.Ring shake

Ringspricka
Ringsprekk
Rengashalkeama
Ringrevne
Ringriß
Roulure
Cipollatura

20.Wane

Vankant
Vankant
Vajaasärmä
Vankant
Baurnkante
Flache
Smusso

21.Bark

Ytbark
Ytebark
Kuori
Ytebark
Rinde und Bast
Écorce
Corteccia

22.Resin pocket

Kådlåpor
Kvaelommer
Pihkakolot
Harpikslommer
Harzgallen
Poche de résirte
Sacche di resina

23.Bark pocket

Barkdrag
Barkflak
Kaarnaroso
Indgroet bark
Rindenemwuchs
Entre écorce
Sacche di corteccia

24.Scar

Lyra
Føyre
Koro
Overvoksning
Überwallungsstelle
Lyre (bourrelet de recouvrement)
Cicatrici

25. Slope of grain

Snedfibrighet
Fiberhelling
Vinosyisyys
Fiberhaeldning
Faserneigung
Contre fil (Pente de fil)
Fibratura controfilo

26. Top rupture

Toppbrott
Toppbrudd
Latvamurto
Topbrud
Wipfelbruch
Cassure (du bout)
Rottura di punta

27. Compression wood

Tjurved-Reaktionsved
Tennar-Reaksjonsved
Lyiy
Reaktionsved
Dmckholz-Reaktionsholz
Bois de compression
Canastro

28. Curly grain

Vresved
Fiberroser
Syyhäiriö
Maserved
Wirbelwuchs
Bois ronceux
Fibratura incrociata

29.Resin wood

Kådved
Tyri
Pihkaisuus
Fedt trae
Kienholz
Bois gras
Legno resinato

30.Log blue stain

Stockblånad
Tømmerblått
Tukkismi
Blasplint før opskæring af stammen
Stammbläue
Bleuissement de la grume
Bluettatura in tronco

31.Dote

Fast röta
Fast rate
Kova laho
Fast råd
Feste Fäule
Porriture faible
Rosato

32.Width of annual rings

Årsringsbredd
Årringbredde
Vuosiluston leveys
Årringebred
Jahrringbreite
Largeur de la croissance annuelle
Larghezza della crescita annuale

33. *Bark-brown*

Brakbrunhet
Barkbrunt
Kuoren aiheuttama ruskettuminen
Barkbrunt
Farbveränderungen durch Rinde
Teinte brune
Macchia scura

34. *Weathering*

Vädergrånad
Værgrått
Ilimoittuminen
Vejrgrå
Wettergräue
Grisonnement (Vieillissément)
Ossidazione

35. *Mould*

Trämögel
Mugg
Puuhome
Skimmel
Hoizschimmel
Moisissure
Muffa

36. *Feed-roller marks*

Märken av matarvalsar
Merker fra matevalser
Syöttö1elan jälkiä
Mærker efter indføringsvalser
Spuren von Vorschubwalzen
Traces laissées par les rouleaux
Tracce di rulli

37. Bad sawn surface

Ojämn sågyta
Ujevn skurflate
Epätasainen sahauspinta
Dårlig beskæring
Schlechte Schnittfläche
Sciage rayé résultant mauvais avoyage des lames du chassis
Superficie mal segata

38. Dropping damage

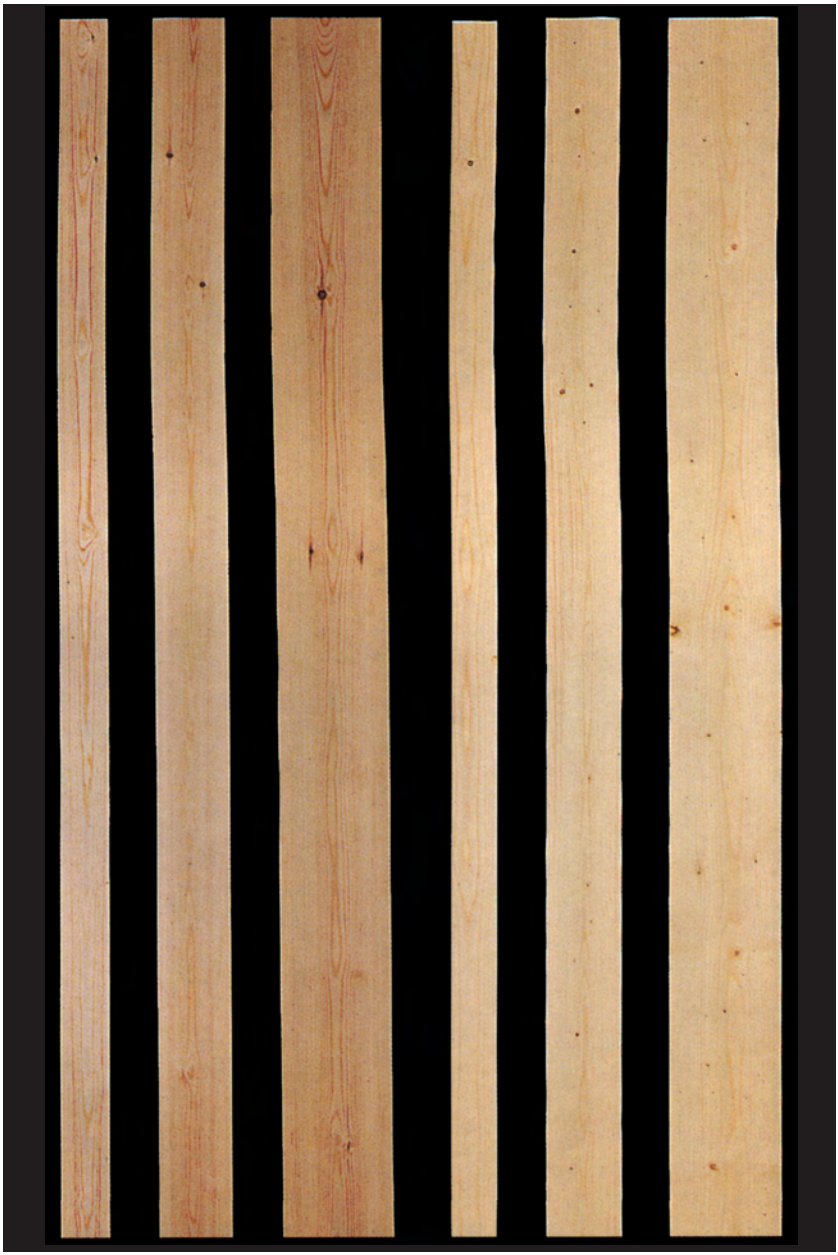
Fallskador
Fallskader
Pudotusvauriot
Fældskade
Fallschäden
Dégat de chute
Danño da caduta

39. Wood wasp attack

Insektshal
Insekthull
Hyönteisten reiät
Insektskade, store huller (dyptgående)
Insektenloch
Trou de sorti
Fori di insetti

40. Insect holes

Insektssting
Insektstikk
Hyönteispistot
Insektskade, små huller (overfladisk)
Insektenstich
Trous d'insecte
Pinzato da insetti



25x100 50x150 75x200 25x100 50x150 75x200

41. Grade A1 red *Grade A1 white*

25x100 50x150 75x200 25x100 50x150 75x200

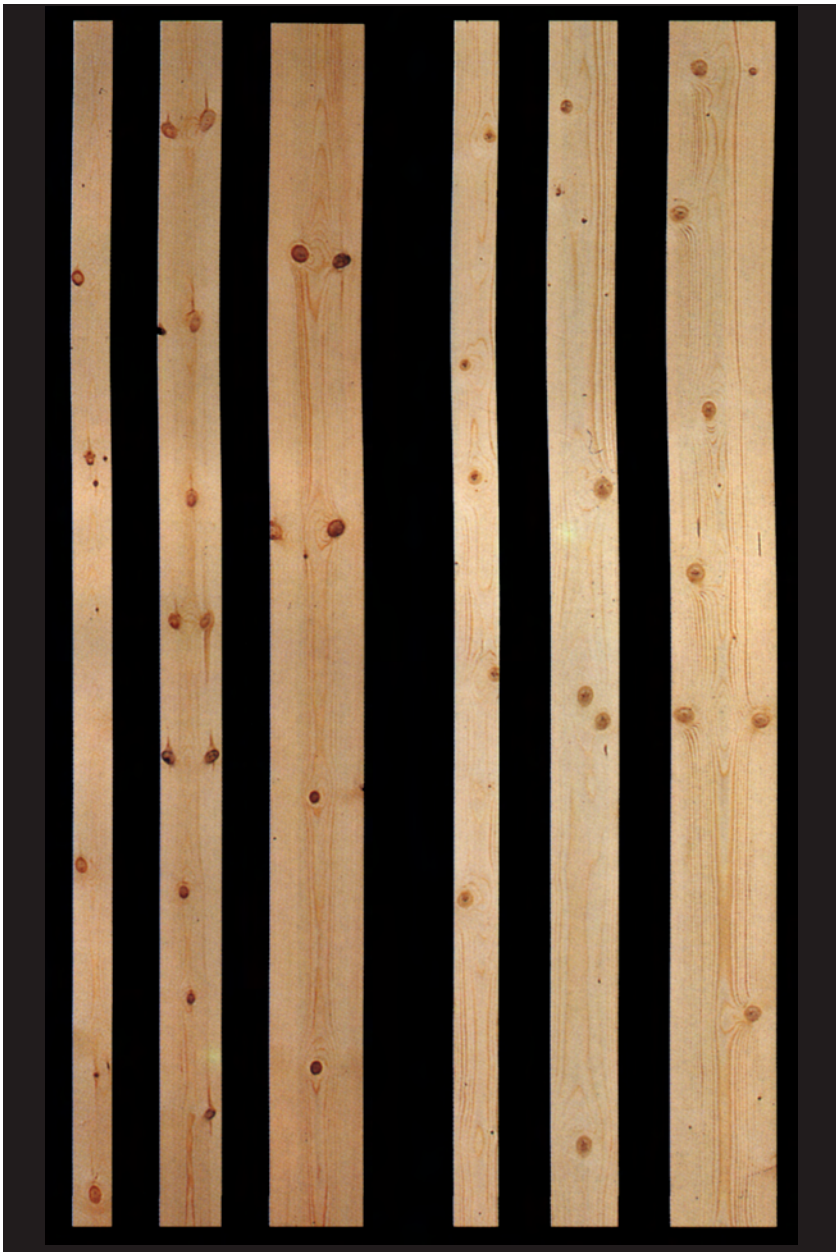
42. Grade A2 red *Grade A2 white*

25x100 50x150 75x200 25x100 50x150 75x200

43. Grade A3 red *Grade A3 white*

25x100 50x150 75x200 25x100 50x150 75x200

44. Grade A4 red *Grade A4 white*



25x100 50x150 75x200 25x100 50x150 75x200

45. Grade B red *Grade B white*

25x100 50x150 75x200 25x100 50x150 75x200

46. Grade C red *Grade C white*

NORDIC TIMBER

Grading rules