

REGULATIONS FOR MEASURING OF ROUNDWOOD

recommended by the Timber Measurement Council

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I GENERAL MEASUREMENT REGULATIONS FOR ALL ROUND TIMBER ASSORTMENTS

GENERAL CONDITIONS FOR TIMBER MEASUREMENT

Timber measurement should be carried out carefully and according to regulations given for the measurement. If conditions don't admit measurement to be carried out carefully, it must not be done.

A delivery of round timber should be measured totally or by sample methods. Total measurement should be carried out by piece by piece measurement, stack measurement, counting of each unit of the delivery or weighing.

Sample measurement can be executed in two or more phases. The last phase should be carried out as piece by piece measurement, stack measurement, counting of each measurement unit or weighing.

Round timber should be measured in its existing condition. Damages on timber caused by the measurement should be ignored. Storage defects on the timber should also be ignored if seller and buyer have agreed about it.

Stacking of round timber

Stacking of timber for measuring on sites at road side, on vehicles or on conveyor has to be carried out according to the special instructions and agreements existing for the actual place of measurement. Thereby, the timber should be stacked so that inspection, measurement and, where appropriate, marking can be made without any problem. A boarderline between timber from different sellers in the same stack should be clearly marked.

Unloading of timber for measurement at roadside of public roads and certain private roads should also follow specific public regulations.

The height of a stack should not exceed 3.0 metres. This limit is not applicable to a stack on a vehicle.

A stack with logs of falling lengths should not exceed 6.0 metres.

Time for measurement

Measurement should be done as soon as possible after that timber in due order has been reported ready for measurement.

Refusal of measuring

Before measuring a delivery of timber the measurer has to control that the delivery is in accordance with existing instructions and agreements about stacking and quality of logs. If the delivery does not comply with these stipulations, measurement should be refused. Both seller and buyer should immediately be informed about the refusal of measurement and also about the reason for it. This information should also comprise figures about the quantity of the refused delivery. This is, however, not necessary if the parties have agreed that it should not be done.

If a log in a stack contains coal, soot, plastics, stones or metallic material or if the stack is estimated to contain refused logs (wreck) exceeding more than 10 % of the cross volume, measurement of the stack is refused, unless otherwise is not agreed upon.

Measuring equipment

Measuring equipment used by timber measurement should be suitable for its purpose.

Equipment for manual use should be controlled once a year and, if needed, more often by the person who makes the measurement.

All other kinds of equipment should, during the time for its use, be controlled every day by that person who makes the measurement. For this equipment, data about the time for the control, who has made the control and the result of the control should be recorded. Those data should be stored carefully and be available for the seller and buyer of the timber and the National Board of Forestry during a period of time of at least two years.

Instruments for manual measuring of the length of a log and the dimensions of a stack

For measuring the length of a log and the length and breadth of a stack, steel tape measures, steel wire measuring lines or graduated measuring rods of a resistant material shall be used. Instruments for measuring the length of a log shall have at least the same length as the log itself. For measuring the height of a stack a measuring rod shall be used which is at least as long as the greatest height of the stack.

Instruments for manual measuring of the diameter of a log

For measuring the diameter of a log a steel caliper of a resistant material shall be used. Diameters of minimum 44 cm may be measured also with instruments graded in cm used for measuring the length of a log.

Equipment for automatical measurement of length and diameter of a log

Length and diameter of a log can also be measured with equipment for optic or other types of untouchable measurement. Such equipment should fulfill those demands for the accuracy of measurement provided by the Timber Measurement Council and given in its special instructions for the approval and routine control and attendance of this kind of equipment.

Metal detector

Instrument for detecting metallic material in a log should be suitable for this purpose. The functioning of the instrument should continuously be controlled in accordance with instructions recommended by the Timber Measurement Council.

Equipment for weighing

For weighing of round timber on a vehicle, a weigh bridge with a capacity to weigh the whole vehicle or the lorry and the trailer each, should be used. Such a weigh bridge should be approved according to regulations given by the Swedish Testing and Research Institute (SP).

The accuracy of a weigh intended for use in a laboratory should regularly be controlled with a verified weight.

In questions concerning control and verification of weighing equipment reference is made to SP.

MEASUREMENT OF QUANTITY

Measuring the volume of a log (piece by piece measurement)

Measurement is carried out as

1. top- measuring
2. mid- measuring
3. top- but- measuring
4. measuring of sections

The measurement of a log shall refer to its dimensions (length and diameter) and the measures be recorded before reduction of length and diameter i.e. gross measures. The size of butting or topping or deduction of diameter should be recorded separately. A gross measure should be given in falling metric units of measurement.

Log length is measured as the shortest distance between the end centres of the log. The largest permitted unit for length is *1 dm*.

Log diameter is measured according to one of the following alternatives:

- 1) by *top*-measuring the measure is taken *10 cm* in from the centre at the top end of the log.
- 2) by *mid*-measuring the measure is taken at the half length of the log.
- 3) by *top - butt*-measuring measures are taken *10 cm* in from the centres of the ends of the log. For a butt log, however, the measure at the butt end shall be taken *50 cm* in from the end centre.
- 4) by *measuring of sections* the measures are taken at the middle of each section.

The diameter is measured at right angle to the centre line of the log. At least one measure has to be taken. Where there is an inward bend or a bulge at the point for measurement of diameter, a corresponding addition to or deduction of the measure should be done. The diameter measure may be taken on "meeting edge" with exception for logs obviously oval, which shall be cross calipered. By cross-calipering the diameter of the log is calculated as the average of the measures given in mm.

By automatical measurement the unit of measurement for diameter is *1 mm*. In all other cases the unit of measurement will be *1 cm*.

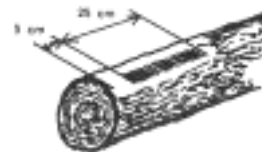
The measure of diameter is given either under bark (ub) or over bark (ob).

Deduction for bark

By measuring diameter over bark the measure under bark is obtained by deducting the double bark thickness (bark deduction). By measuring with caliper, so called *manual diameter measurement*, the size of the bark deduction is estimated by assessing the bark thickness. By *automatical diameter measurement*, the bark deduction is calculated, after the bark type has been assessed, by using special bark thickness functions for the bark types respectively.

Assessment area:

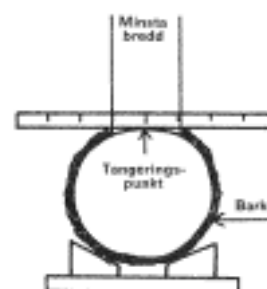
The bark type is assessed 5-30 cm in from top end of the log.



Bark type:

undamaged bark: Remaining bark on *pine* logs is, regarding to thickness, assessed as *thin bark*, *medium bark* or *thick bark*.

Remaining bark on *spruce* logs is normally given in only one thickness class



*damaged
(scraped) bark*

Damaged bark is considered as "no bark" if the damage is at least 2 cm long and so wide that the equipment can measure the diameter on "bare" wood.

By assessing logs on a transverse conveyor the damage is considered as "no bark" if it comprises more than half the circumference.

In report R90, 1974, from the Royal College of Forestry, the Institution of wood technology (Peter Zacco, Bark thickness by sawlogs) there are functions of the type $y = a + bx$, where y = double bark thickness, x = top diameter over bark and a and b constants. For pine there are functions for 13 different geographic areas and three thickness classes. For spruce there are functions for 11 different geographic areas without classification in thickness classes. For a measuring site with sawlogs from regions, which between themselves have different bark thickness, the bark functions in use should be adjusted with regard to the estimated geographical distribution of the total supply of sawlogs. If necessary, more than *one* bark function per species of tree may be used.

Correction of diameter and length

For snow, ice, earth or else unevenness on the place of measurement which will influence the measure of the log, a reasonable correction shall be made.

A loss of wood on a log (pick-up, damage from harvesting or such like) should be considered by a reasonable deduction of the measure for length or diameter of the log.

Volume calculation of logs and recording of volume of a lot of timber

The volume of a log shall be calculated on the mean value of the length and diameter class. If log diameter is recorded in mm or log length in cm, the volume, however, may be calculated on the rounded down value for diameter or length respectively.

By top-measurement and mid-measurement the volume is obtained as the product of the cross section area at the point of diameter measurement and the length of the log.

By top-butt-measuring the volume is calculated according to the following formula:

$$V = \frac{1}{100.000} \cdot \frac{\pi}{4} \cdot L [\alpha D_r^2 + (1-\alpha) D_t^2]$$

V being the volume of the log in m^3 , L being the length of the log in decimetres and D_r and D_t butt- and top-diameters in centimetres.

For the constant α in the formula, the values presented in the following table should be applied:

Top diameter, (cm)	Length class, cm		
	-349	350-449	450+
-14	0,485	0,485	0,485
15-24	0,465	0,460	0,455
25 -	0,440	0,430	0,420

The volume of a log is given in cubic metre with at least *three* decimal points.

The volume of a lot of logs is given in cubic metres solid volume, with at least **two** decimal points. It should be indicated whether the volume has been calculated on the basis of top-, mid- or top-butt-measuring (to, mi, tr) and whether volume under bark or over bark (ub or ob) is meant.

Measuring of stacked wood

The volume of a stack shall be calculated according to its dimensions (stack measurement) and solid volume percentage.

Measures of a stack.

A stack (fig 1 and 2) is measured by *length*, *width* and *height*. The measurements are taken as if the logs were enclosed in a well fitted rectangular box with lid. Where a stack is uneven at the log end side, or sides, the rule is that the corresponding end, or ends, of the imagined box should be placed so that a protruding log, or logs, compensate for shorter logs. The distance between the two opposite sides of the imagined box is measured at right angles to the sides. The measurements are taken at two measuring points opposite to each other. The measurements are given in falling centimetres.

Both length and height of a stack are measured at the log end sides with at least one measurement on each side. The length and height of a stack on a vehicle may, however, be measured according to fig. 2. The average of measurements of length and height taken for a stack is given as the length and the height of the stack.

The measurement of height and width of a stack on a vehicle may be limited to only one measure, so called one-sided measurement.

If a stack is more than 3 m long, measurements of width and height shall be taken in sections. The stack is divided into sections of equal length of maximum 3 m. The measuring is done section by section and as if each section filled a box. Measuring the width of the stack is made with one measurement for each section and of the height with one measurement at each log end side of the section. The averages of the measurements for width and height are calculated and given as the width and height of the stack.

Fig. 1. Section measurement of a stack with wood in standard length.

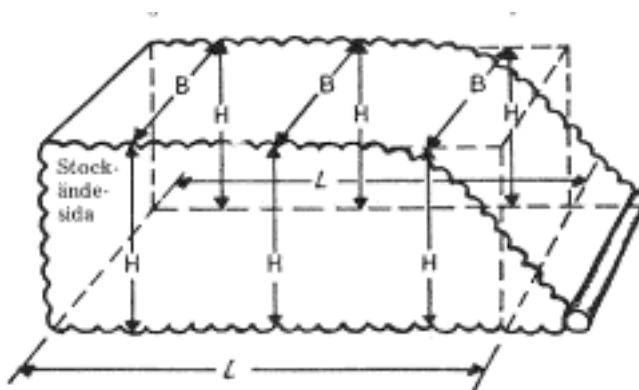
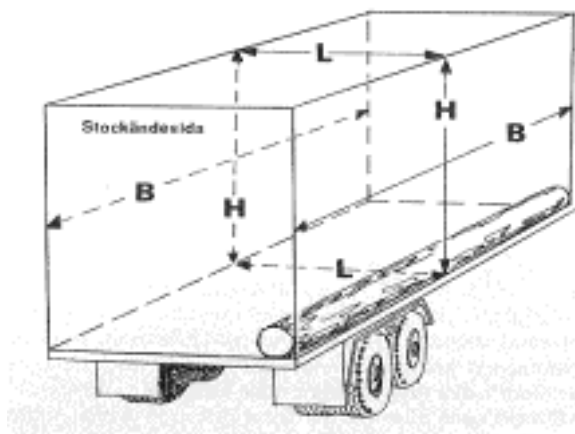


Fig. 2. Measurement of a stack on a vehicle.



Key of diagrams:
B = width of stack
H = height " "
L = length " "

The solid volume percentage of a stack.

The solid volume of a stack is measured and given in **whole** units of percentage of the stacked volume, *solid volume percentage*. The solid volume percentage foremost depends on the following factors:

Stack factors:

- stacking
- waste products, snow and ice
- position of the logs in the stack
- height of the stack
- share of butt logs
- mixture of tree species

Log factors:

- average diameter
- crookedness
- delimiting (incl. buttress)
- length
- taper
- bark volume

Calculating and recording the volume of a stack

The *stacked volume* of a stack is calculated as the product of *length*, *width* and *height*. The volume is given in cubic metres stacked volume (m^{3t}) with at least **three** decimal points.

The *solid volume* of a stack is calculated as the product of the stacked volume and the solid volume percentage divided by 100. The volume is given in cubic metres solid volume, with at least **two** decimal points, indicating volume under bark or over bark (ub or ob).

The solid volume in cubic metre for a batch of timber measured in stacks is given with at least **two** decimal points.

Weighing

In weighing gross and tare weights are to be given. A reasonable deduction in weight shall be made for snow, ice, stones, waste products etc. The largest permitted unit of measurement is 50 kg. The weight shall be given in metric tons with at least **two** decimal points.

In weighing including determination of the bone dry weight of a stack or load, its bone dry weight content should also be determined and recorded in whole units of percentage.

Measurement by random samples

Sample measurement should be carried out in two or more phases. The last phase should be performed as piece by piece measurement, stack measurement, counting or weighing.

Measurement by random samples is allowed for batches of round timber ("measuring collectives") consisting of well defined units i.e. individual logs, groups of logs, stacks, bundles or loads. Measuring by random samples means that all the units in a "collectiv" are determined with respect to number, volume or weight and that solid volume, green weight or bone dry weight and quality is estimated on a sample of these units.

For a "collective" intended for measurement by random samples there shall be information about the applied sample procedure, frequency for taking samples, methods of measurement and estimating procedure, in a so called collectiv description. The description shall be stored in a carefully way and be accessible for seller and buyer of the timber and The National Board of Forestry during at least two years after the description has been drawn up.

Samples are taken by simple random sampling or by systematic sampling aiming at a correct result.

Methods of measurement

Measurement by random samples can be made according to some of the following methods:

- *Counting* the total number of units in the "collective" and determination of the volume and quality of each unit by measuring the logs in the sample.
- Measuring the *stacked volume* of all the stacks in the "collective" and determination of the solid volume and quality per cubic metre by measuring the logs in the sample.
- *Weighing* all the units in the "collective" and determining the solid volume and quality per metric ton by measuring the logs in the sample.
- *Counting* the total number of units in the "collective" and determining the solid volume per stack in the sample by *stack measurement* and estimating the *solid volume percentage*.
- Measuring the *stacked volume* of all the stacks in the "collective" by *stack measurement* and assessment of the *solid volume percentage* and then determining the solid volume and quality per cubic metre of the units in the sample by measuring the logs *piece by piece*.

Further more, other methods of measurement by random samples, based on two or more methods of measurement may be applied, provided the sample in the last sampling phase will be measured according to the instructions given for the assortment in question.

Precision demands

The precision when estimating the quantity or value of a "collective" of timber is expressed by the simple standard error. The standard error is calculated as follows:

$$\varepsilon = \frac{s}{\sqrt{n}} \sqrt{\frac{N-n}{N-1}}$$

ε being the standard error, s being the standard deviation for the ratio for each sampling unit between the accurate and the extensive measurement, N being the total number of units in the "collective" and n being the number of units in the sample.

By calculating the size of the sample the total quantity and value of the "collective", as well as the cost for measuring the individual unit of the sample, has to be considered. As a general rule for the determination of the size of the sample there can be recommended, that the increased precision of the estimate of the value of a "collective" by taking an additional sample unit, ought to correspond at least to the double cost for the measurement of the unit. It shall also be possible for seller and buyer to make a special agreement about the precision demand for measurement by random samples. Furthermore, if a timber transaction between two parties comprises more than one "collective" at the same time, the parties may have the reason for considering this circumstance at the determination of the total size of the sample.

More detailed advice concerning the sample size by varying conditions as for the assortment in question, the total size and value of the collective and so on, has been worked out by the Swedish Timber Measurement Council.

Performance of the measurement.

Every unit in the delivery has to be measured according to the regulations for the specific measuring method. The measurement of the sampled units (logs or stacks) shall also be done according to the regulations for the specific assortment. When all the units of a "collective" are delivered by only one supplier/seller, assessment of quality and estimation of the solid volume percentage or weight deduction, as well as treatment, should only be done when measuring the sampled units.

Accuracy of measurement

For a lot of timber larger than 10 solid cubic metres, the determined solid volume or topp cylinder volume **must not** differ from the volume of the lot with more than that percentage given in Annex 2.

For a lot of timber weighing more than 10 metric tons, the determined total green weight or bone dry weight **must not** differ from the weight of the lot with more than that percentage given in Annex 2.

For a lot of timber the determined number of logs **must not** differ from the number of logs in the lot with more than that percentage given in Annex 2.

If a seller and buyer of timber has agreed on another precision demand for the measurement of a lot of timber than stated in paragraph 1, 2 or 3, the agreement shall be applied.

Assessment

Assessment of volume deduction and quality is not necessary unless it is intended to form the basis for the calculation of payment. Damage caused by investigation when measuring, shall not be regarded as a fault.

When measuring a log or a stack the assessment may be based on the quality of the visible part of the unit. For a log this will mean, that its end surfaces and at least two thirds of it's mantel surface must be available for assessment. Furthermore, the log must be so positioned or the stack so stacked, that the position of the individual log has been influenced only by random. Besides it should also be possible to make a complete treatment of the unit of measurement.

MARKING

A lot of timber measured in forest or at roadside must be labeled with information about date of measurement and measurement document. Other types of lots of timber must have information identifying the seller and origin of the timber.

When timber is measured in forest or at roadside, logs not valid for delivery must be marked with VR (wreck) in the centre of the log end.

DOCUMENTING OF MEASUREMENT DATA

All data from the measurement shall be recorded either in a written document or stored electronically. In the latter case, however, data must be possible to print out on a paper document (back-up).

To the data from each measurement information must be added about the person who has executed the measurement or the measurement team, about date and place for measurement and also about seller and buyer of the timber.

The recorded information must be stored in a careful way and be kept accessible for the seller and buyer of the timber, and for the National Board of Forestry for a period of time of at least two years after the measurement receipt has been sent to the seller and buyer.

The measurement receipt for a timber delivery shall have information about:

- * the enterprise having executed the measurement
- * date and place for measurement
- * seller and buyer of the timber
- * a unique number identifying the measurement receipt.

The measurement receipt must also have information about the quantity of the measured lot of timber and its distribution on quality classes.

2. MEASURING REGULATIONS FOR THE PIECE BY PIECE MEASUREMENT OF CONIFEROUS SAWLOGS

Coniferous saw logs is understood to mean roundwood from coniferous trees intended for sawing.

Preparation

A saw log must be suitably prepared for sawing. It must be harvested from a live part of the tree stem and be free from storage decay, insect damage and buttress higher than 15,0 cm. It should be well trimmed or, if other degree of trimming has been agreed, trimmed according to agreement and cut with a sawing tool.

A sawlog must not contain coal, soot, plastics, stone or metallic material.

Measuring of volume

A lot of sawlogs which by the measurement is divided into more than **one** quality class must be measured piece by piece. The measurement of volume is carried out as top measurement, top-butt measurement or measurement by sections. Measuring by random samples is permitted.

Assessment

General instructions

By assessing the quality of a sawlog, there should be considered width of annual rings and faults, knots, crookedness and taper, which by straight through sawing may effect the volume of the treatment cylinder or the quality of the log. Furthermore, irregularities at log end, should be considered.

Regarding to quality logs are divided into classes, class 1 to 5 for pine sawlogs and class 1 to 4 for spruce sawlogs.

If a seller and a buyer have agreed about, it the following departures are allowed:

- Quality classes can be put together or excluded. If all classes are put together, class 0 is recorded.
- Volume or quality of a sawlog can be determined without deduction on log length or diameter.

Assessment of volume reduction

Certain faults within 6 decimetres from log end causing reduction of the quality of the log or a fault on the mantle surface of the log and crookedness, which is estimated to influence its treatment cylinder, should be treated by deduction on log length or diameter. For an obviously oval log the smallest top diameter will constitute the diameter of the treatment cylinder. After volume deduction, length and diameter of a log must not be smaller than the minimum dimensions agreed by seller and buyer.

With reference to agreement, that deduction of volume in order to improve the quality of the log should not be made, see information under the headline "General instructions".

Deduction of length

Faults which may be treated by butting or topping are spike knot, aniline wood, forest rot, black wood and resinous wood in log end, crookedness other than spiral crook, harvesting or growth shake, open scar, other mechanical damage than damage caused by knobs on feeding rolls in harvester, root crevice and irregularity at log end caused by unsatisfactory cutting.

A log not satisfactory cut should be treated by a length reduction of 3 dm. A log with harvesting shake must be treated by deduction of length with at least 6 dm.

By shortening the length of a log, each half of the log shall be treated separately, each one representing 0.5 units of the log length. The total reduction of length is calculated with reference to the whole log and given rounded off to the nearest decimetre.

Deduction of diameter

Deduction of diameter must be done for faults on the log, with exception of damage caused by knobs on feeding rolls, which are assessed to cause a smaller sawing yield than would have been the case if the fault had not existed.

An example of fault causing deduction of diameter is spiral bend. A log with a fault causing a diameter deduction exceeding 2 cm on logs with a top diameter smaller than 30 cm or exceeding 3 cm on bigger logs, must be rejected.

Faults not possible for treatment

Heart shake, twisted growth, water wood, blue stain and insect damage in a log are faults which **must not be treated** by volume deduction.

Quality assessment

Assessment of the quality of a log should refer to the whole log after volume deduction of length or diameter, if any.

The assessment of the quality of a log regarding to knots must refer to that half of the mantle surface, which according to the presence of knots, has the **worst** quality. Other quality characteristics should be estimated on the whole mantle surface of the log or in its log ends. For a log on support logs or on a conveyor the assessment of the quality may be limited to the visible part of the log, provided the position of the log has not been intentionally influenced.

A knot or a fault within 2 decimetres from one of the ends of a log, valid for delivery, should be ignored.

If others has not been agreed, those quality requirements for **pine** and **spruce** given in the tables 1 and 2, must be applied.

For a log which has been classified not valid for delivery (VR) or quality been depreciated (NK), the reason for that must be given. Regarding to the codes applied including explanatory text, see Annex 3.

Table 1. Assessment of quality for pine

Maximum number and size of visible knots and faults permitted in saw logs of **pine**. The permitted presence of knots refers to that half of the log which in a range of 15 decimetres has the **worst** quality. The permitted number of knots of each type must be reduced by the number of existing knots of inferior type. For branch scars, however, this limitation will not be valid.

Type of log	Quality grades				
	1.	2.	3.	4.	5.
Type of log	Butt log or middle log	Top or middle log with it's first sound knot within 15 dm from it's thicker end	All types of logs		
Sound knots (≥ 15 mm)	Number: 1 on the whole log Size: Max 40 mm	Number: 20 Size: 50 % of log diameter or max 100 mm	Number: 12 Size: 40 % of log diameter or max 80 mm	Number: 20 Size: Max 100 mm	Number: Unlimited Size: Unlimited
Dead knots (≥ 9 mm)	Number 1 on the whole log Size: Max 20 mm	Number: 10, of which max 4 are black knots Size: Max 45 mm	Number: 7, including branch scars Size: Max 35 mm	Number: 14 Size: 30 % of log diameter or max 60 mm	Number: Unlimited Size: max 100 mm
Unsound knots and knots partly with bark, spike knots (≥ 9 mm)	Not permitted	Number: 1 Size: Max 15 mm	Number: 2 Size: Max 15 mm	Number: 8 Size: 30 % of log diameter or max 60 mm	Number: Unlimited Size: Max 100 mm
Branch scars (on the whole log)	Number: 1	Not permitted	Number: 2 For a butt log with at least 20 annual rings within the assessment area, however, there may be max 7 within the "worst" 15 dm	Permitted	
Number of annual rings within the assessment area	Min 20	Min 12		Min 10	No limit
Forest rot	Not permitted inside the treatment cylinder				
Compression wood (compact)	Permitted within small extent See note 2		Permitted up to 10 % of the cross section area of the treatment cylinder See note 3	Permitted up to 20 % of the cross section area of the treatment cylinder See note 4	Permitted
Sweep	Bow height not more than 1,0 % of the length of the log			Bow height not more than 2,0 % of the length of the log	
Sharp crookedness	Not permitted if the crook indicates compact compression wood or top failure				Permitted
Water wood and blue stain	Not permitted				Permitted
Harvesting or growth shake	Not permitted within the treatment cylinder				
Heart shake	The length of the shake must be max 80 mm and/or the width 2 mm				Permitted
Scar partly with bark affecting the treatment cylinder	Permitted up to a length of 7 cm on the mantel surface			Permitted up to a length of twice the top diameter on the mantel surface	Permitted
Resinous wood (caused by fungus)	Not permitted inside the top cylinder			Permitted	
Resinous wood (preferably in butt logs)	Resinous wood limited to only one end of the log is permitted up to 10 % of the area of the treatment cylinder. By larger extension a deduction of 6 dm is made.			Permitted	
Twisted growth	Max ½ turn per 45 dm log length	Max 1 turn per 45 dm log length		Permitted	

Table 2. Assessment of quality for spruce

Maximum number and size of visible knots and faults permitted in saw logs of **spruce**. The permitted presence of knots refers to that half of the log which in a range of 15 decimetres has the **worst** quality. The permitted number of knots of each type must be reduced by the number of knots of inferior type.

	Quality grades			
	1.	2.	3.	4.
Type of log	Butt log or middle log	Top or middle log with it's first sound knot within 15 dm from it's thicker end	All types of logs	
Sound knots (≥ 15 mm)	Number: 4 Size: Max 50 mm	Number: 20 Size: Max 50 mm	Number: 20 Size: 30 % of log diameter or max 60 mm	Number: Unlimited Size: Unlimited
Dead knots (≥ 9 mm)	Number: 4 Size: Max 20 mm	Number: 8 Size: Max 20 mm	Number: 20 Size: 30 % of log diameter or max 60 mm	Number: Unlimited Size: Max 80 mm
Knots partly with bark (≥ 9 mm)	Not permitted		Number: 20 Size: 30 % of log diameter or max 60 mm	Number: Unlimited Size: Max 80 mm
Spike knots	Not permitted		Number: 2 Size: 30 % of log diameter or max 60 mm	Number: Unlimited Size: Max 80 mm
Number of annual rings within the assessment area See note 1	Min 20	Min 12		No limit
Aniline wood, forest rot/black wood	Not permitted within the treatment cylinder			See note 5
Compression wood (compact)	Permitted within small extent See note 2		Permitted up to 20 % of the cross section area of the treatment-cylinder See note 3	Permitted up to 50 % of the cross section area of the treatment-cylinder See note 4
Sweep	Bow height not more than 1,0 % of the length of the log			Bow height not more than 2,0 % of the length of the log
Sharp crookedness	Not permitted if the crook indicates compact compression wood or top failure			Permitted
Water wood and blue stain	Not permitted			Permitted
Harvesting or growth shake	Not permitted within the treatment cylinder			
Heart shake	The length of the shake can be max 80 mm and/or the width 2 mm			Permitted
Scar partly with bark affecting the treatment cylinder	Permitted up to a length of 7 cm on the mantle surface		Permitted up to a length of twice the top diameter on the mantel surface	Permitted
Twisted growth	Max ½ turn per 45 dm log length	Max 1 turn per 45 dm log length		Permitted

Notes and comments regarding table 1 and 2

Note 1: The number of **annual rings** in log end should always be counted in that radial direction from the pith which gives the largest average annual growth. The number of annual rings is counted in the following ranges:

:

Butt log of spruce: 2 - 8 cm from the pith in the log's smaller end.

Other types of logs: 2 - 8 cm from the pith in the log's thicker end.

Note 2: With **small extent** is meant the following permitted presence of compact compression wood in the log end surface.

* The compression wood is situated close to the pith of the log and with an extension, in the direction of the radius, not exceeding 1/3 of the radius of the treatment cylinder. However, the compression wood must not cover more than half the circumference of the range in question.

* The compression wood is shaped like a sector not covering more than 1/6 of the radius of the treatment cylinder and along the annual rings over less than half of its circumference.

* The compression wood covers more than half the circumference in the log end surface but is limited to maximum three annual rings close to each other.

Note 3: The given tolerance is applicable for compact compression wood to more than "small extent", provided the log being so straight that volume deduction will not be necessary.

Note 4: The given tolerance is applicable for compact compression wood to more than "small extent", provided the deduction of the length of the log because of crookedness will not exceed 3 dm.

Note 5: Firm forest rot incl. anilinewood, which after a 6 dm deduction of log length, still affects one half of the treatment cylinder, is permitted in class 4 of spruce.

Note 6: The given tolerance is applicable for compact compression wood to more than "small extent", provided the deduction of the length of the log because of crookedness will not exceed 5 dm.

Treatment of harvesting damage

Damage in the wood.

A delivery of sawlogs must be treated for damages on the logs caused by feeding device on harvesters. The treatment will result in a *damage class* for the delivery. It shall be based on visual assessment of the depth of the damage into the wood, or if necessary, on measuring of the depth. The depth of the damage is determined by the largest depth according to the following table.

By determining the damage class of a lot of timber such *occasional* logs will be disregarded which have deeper damages in the wood than the logs in the rest of the lot. With *occasional* is meant not more than 5 percent of the number of logs in a lot.

Bark damage

Damage on the bark of logs in a lot of timber must be considered at the determination of the damage class for the lot. The damages are divided into the categories *moderate* and *widespread*. If there are damaged bark in the form of stripped bark on more than 20 % of the mantle surface of individual logs, the damages should be classified as *widespread*. In other case they are *moderate*. To this class belong even lots without any bark damage.

Harvesting damage on a delivery of sawlogs is determined and recorded in the following damage classes at which each class constitutes a combination of the damage depth in question and the size of the bark damage.

Type of damage/class 1)			
Bark damage	Damage depth, mm		
	< 5	5-8	> 8
moderate	1	2	3
widespread	4	5	6

1) Concerning recommended factors for reduction of value, see Annex 4.

Instructions for classification of harvesting damage:

1. The damage depths given in the table refer to the largest depth (hole and torn wood fibres), exclusive the deformation of underlying wood. The depth of the damage is determined either by visual assessment or measuring, when needed. The measurement should thereby be limited to damages on the upper side of the log within a distance of not more than 1 metre from the smaller end of the log.
2. The direction that *occasional* logs may have a damage depth exceeding a certain class limit, is applicable for both of the limits 5 and 8 mm.
3. For a lot of logs with harvesting damages which are assessed to be deeper than 8 mm, the depth of the damage must be determined by measuring with a 1 mm thick, blunt pin. This measurement, if needed, should be made on at least 20 randomly sampled, damaged logs.

3. MEASURING REGULATIONS FOR THE MEASUREMENT OF CONIFEROUS SAW LOGS IN A STACK

Coniferous saw logs are understood to mean roundwood from coniferous trees intended for sawing.

PREPARATION

A saw log must be suitably prepared for sawing. It must be cut from a living part of the tree stem and free from storage decay and insect damage.

Furthermore, it must be nearly straight; even sweep with a bow-height smaller than 1 % of the log length is permitted. On a log in a stack with logs of varying lengths, however, an end crook in its thicker end is permitted, provided the rest of the log is straight and the bow-height inclusive the end crook doesn't exceed 2,0 %.

Harvesting and growth shakes are not permitted as not buttres with a height of 15,0 cm or more over the mantle surface measured 20 cm in from butt end. However, a felling comb or another unevenness in log end doesn't exceed 10 cm and that more than half of the end cut is made by saw.

A saw log must be sufficiently delimbed or, if other degree of delimiting has been agreed, delimbed according to agreement.

A saw log must not contain coal, soot, plastics, stone or metallic material.

MEASUREMENT OF VOLUME

Saw logs in a stack must be measured by stack measurement with the estimation of solid volume percentage.

ASSESSMENT

A log should be assessed according to its fitness for the production of sawn timber for specified use. Volume and quality treatment must not be made. Treatment for harvesting damage is made in the same way as for measurement piece by piece.

A log must be of at least quality class 5 in the case of pine and quality class 4 in the case of spruce according to the instructions for measuring piece by piece. The following exceptions may, however, be made:

- * rot, black wood, aniline wood and blue stain is not allowed
- * root crevice and open scar is permitted if its depth into the wood is less than $\frac{1}{4}$ of the diameter in that cross section where the fault is to be found.
- * the number of annual rings in the area of assessment must be at least 10.

The assessment may be made according to the visible part of the stack. This means that this part of the stack shall be considered as a random sample giving the portion of logs not valid for delivery even in the rest of the stack.

When there are difficulties to make a proper assessment of the portion of logs not valid for delivery or of logs to be given a "lower" class, or if the portion of such logs in the stack is high, i.e. in the near of the limit for refusal of measurement, the stack must be put on support logs on the ground for assessment piece by piece.

4. MEASURING REGULATIONS FOR PULPWOOD

With pulpwood is meant roundwood intended for the manufacturing of chemical or mechanical pulp.

Quality

Assortment

Pulpwood is divided into assortment per species of tree or group of species according to agreement. The following grouping, among others, can be applied:

Spruce pulpwood in which only ordinary spruce (*Picea abies*) and Sitka spruce may be included.

Coniferous pulpwood which may include different species of coniferous trees according to agreement.

Birch pulpwood which may include only birch.

Aspen pulpwood which may include only aspen and poplar.

Deciduous pulpwood which may include different species of deciduous trees according to agreement.

Mixed pulpwood which may include different species of tree according to agreement.

Pulpwood consisting of only one species of tree may, according to agreement, contain a smaller share of another species of tree.

Preparation

Pulpwood must be suitable as raw material for the manufacturing of chemical or mechanical pulp.

Pulpwood must be *adequately delimbed* unless an alternative agreement has been made. Annoying buttress and unevenness causing inconvenience must be sufficiently leveled.

Open fork is permitted, unless alternative agreement has been made, if the log including the fork can be placed in a cylinder with a diameter smaller than 50 cm.

Width of curve must neither exceed the largest diameter of the log plus 30 cm, nor the agreed maximum diameter plus 10 cm.

Pulpwood (wood and bark) must be free from coal, soot, plastics, stone or metallic material.

Dimensions

A log must have minimum- and maximum dimension according to agreement. A deviation of less than ± 30 cm from the agreed standard length is permitted, unless an alternative agreement has been made.

MEASURING OF QUANTITY

The quantity of a batch of pulpwood should be estimated in solid volume under bark (wood volume), green weight or bone dry weight. Sampling methods are permitted.

The wood volume of a lot of timber must be estimated by stack measurement with the assessment of wood volume percentage or by piece by piece measurement carried out as top-butt measurement.

By measuring a stack on support logs of pulpwood, these logs shall belong to the volume of the stack.

ASSESSMENT OF QUALITY

The assessment of quality can be based either on all the logs in the lot or on a random sample of logs. By measuring pulpwood in a stack the assessment can be based either on the whole stack or on a random sample of logs from the stack. The presence of forest rot and storage decay shall be estimated in the log end side of the stack, the storage decay being estimated in a cross-section 15 centimetres in from log end.

The maximum permitted occurrence of forest rot and storage decay given below shall apply, unless others has been agreed. With forest rot is here meant only dark or loose rot.

The permitted presence of logs cut from standing, dry trees shall be stated in contract. Seller and buyer can also agree about the maximum permitted occurrence of forest or storage decay in a stack or load of timber on a vehicle.

Stack measurement and weighing with quality estimation of individual log

The assessment of a log must be carried out in the following order:

Log suitable for pulpwood

In *spruce* pulpwood forest rot is permitted up to 1/10 of the wood area in the log end. A log cut from a standing dead and dried tree is not permitted, nor a log with storage decay.

In pulpwood of *coniferous* and *deciduous* trees forest rot is permitted up to 1/2 of the wood area in the log end and storage decay up to 1/10 of the wood area in the cross section for assessment.

Assessment of forest rot in a log suitable for pulpwood

Wood damaged by rot and holes caused by rot are defects causing deduction of the corresponding volume. The volume deduction may be given together with the volume not suitable for pulpwood.

Assessment of storage decay in a log suitable for pulpwood

Storage decay in a log of *coniferous* and *deciduous pulpwood* up to 1/10 of the wood area in the cross section for assessment, must not be treated. A log with storage decay between 1/10 and 1/3 of the wood area in the cross section can - if agreement has been made - be given as *damaged by storage decay*.

Stack measurement with assessment of pulpwood in a stack

The assessment must be carried out in the following order:

Stack suitable for pulpwood

The stack will be suitable for pulpwood if the area damaged by rot doesn't exceed 1/2 of the wood area in the log end sides of the stack. With damage from rot is meant storage decay as well as loose and dark, compact forest rot.

Log suitable for pulpwood

A log of *spruce pulpwood* must be cut from a living part of the tree stem. It must be free from storage decay and loose or dark forest rot. Light forest rot and aniline wood is permitted.

In *coniferous pulpwood* forest rot is tolerated up to 1/2 of the wood area in log end. Storage decay in a log lately cut from a dead, dry tree, is tolerated up to 1/10 of the log end area. Forest rot and storage decay together is tolerated up to 1/2 of the wood area in the cross section for assessment.

In a log of *deciduous pulpwood* forest rot is tolerated up to 1/2 of the wood area in the cross section for assessment. Storage rot is not permitted.

Classification for rot of a stack

The total area of wood damaged by rot, including the rot in logs not valid for delivery, must be assessed and given in percent of the total wood area in the log end sides of the stack. The storage decay, however, will be assessed in a cross section 15 centimetres in from the log ends.

The estimated portion of rot must be recorded in whole units of percentage.

Co-ordination of the regulations for the assessment of dark and loose forest rot applied in different regions of Sweden, must be done latest 2000-08-01.

5 REGULATIONS FOR THE PIECE BY PIECE MEASUREMENT OF SAWLOGS OF BIRCH, ALDER AND ASPEN

With saw logs of birch, alder and aspen is meant round wood of these species of tree intended for sawing.

QUALITY

Assortment

Saw logs of birch, alder and aspen are divided into assortment according to species of tree.

Preparation

A saw log must be evenly cut at log ends and satisfactory straight. Furthermore, it must be *well delimbed* or, if another degree of delimiting has been agreed, delimbed according to agreement. A buttress or another unevenness causing trouble by the processing of the log must be adequately evened. It must be harvested from a live part of the tree stem and be free from storage decay and insect damage.

Dimensions

A log must have minimum and maximum dimensions according to agreement.

VOLUME MEASUREMENT

Measurement of the volume of a log should be carried out as top, mid or top-butt measurement according to agreement.

TREATMENT

By assessing a saw log there should be considered faults, knottines and bends, which by sawing straight through the log, can influence the volume and quality of the sawing yield.

Treatment of volume

Deduction of log length

A fault or knot in log end which is assessed to reduce the volume of the sawing yield from the log, must be treated by a reduction of log length, the size of which will be determined with regard to the estimated decrease of the yield.

Deduction of diameter

A fault on the log, which is assessed to cause a lower sawing yield than would have been the case if the fault had not existed, must result in a corresponding reduction of the diameter of the log.

Quality assessment

The assessment of the quality of a log shall refer to the whole log after deduction of length or diameter. The quality is divided into three classes: A, B or C according to those demands given in table 3.

Tabell 3. List of largest knots and some certain defects permitted by assessing the quality of saw logs of birch, alder and aspen.

Knot/fault	Class A	Class B	Class C
Sound knot	On each metre of the length of the log, not more than one knot with a diameter smaller than 20 % of the top diameter of the log will be permitted, however, max 5 cm	On each metre of the length of the log, not more than one knot with a diameter smaller than 30 % of the top diameter of the log will be permitted, however, max 8 cm. If the knots are smaller than 5 cm, max two knots on each metre of the log will be permitted	On each metre of the length of the log, not more than one knot with a diameter smaller than 40 % of the top diameter of the log will be permitted, however max 10 cm. If there are more or larger knots, a reduction of reasonable size must be made
Dead knot	Not permitted	On each metre of the length of the log one knot will be permitted if its diameter is maximum 2,5 cm	On each metre of the length of the log not more than one knot with a diameter smaller than 15 % of the top diameter of the log, or not more than two if their diameter is smaller, will be permitted. If there are more or larger knots, a reduction of reasonable size must be made.
Decayed knot	Not permitted	Not permitted	Only a few decayed knots will be permitted. Reduction must be made for the volume damaged by rot.
Adventitious branching	Permitted to a small number	Permitted	Permitted
Solid and loose rot and false heartwood	Not permitted	Not permitted when penetrating the whole log. Permitted up to an average diameter of 10 % of the top diameter of the log, however max 3 cm	Permitted up to an average diameter of 20 % of the top diameter of the log, however, max 5 cm. If the defect is larger, a reduction of reasonable size must be made
Sun shakes and other shakes	Only sun shakes are permitted	Only sun shakes are permitted	Only sun shakes are permitted. For other types of shakes a reduction of reasonable size must be made
Crook in one plane	The bow-height may be maximum 5 % of log length	The bow-height may be maximum 10 % of log length	The bow-height may be maximum 10 % of log length. If the deviation is larger, a reduction of reasonable size must be made.

Note: If there are other types of defects on the log than those given in the table, such as scars, bark inclusions etc, which are assessed to influence the sawing yield, there must be made a volume reduction for such defects corresponding to their influence on the yield.

The permitted defects given in the table will each one be the maximum for logs of smaller dimensions. The smaller, above all thicker, a log is, the more and larger defects can be permitted. The position of the defects on the log is also of importance. Defects on only one side of the log or near log end, will not reduce the usability of the log to the same extent as defects around the whole log or defects longer in from log end.

6 REGULATIONS FOR STACKMEASUREMENT OF SAWLOGS OF BIRCH, ALDER AND ASPEN IN STANDARD LENGTHS

With saw logs of standard lengths of birch, alder and aspen is meant roundwood of these species intended for sawing.

QUALITY

Assortment

Saw logs of standard lengths of birch, alder and aspen are divided into assortments according to species of tree, if others has not been agreed.

Preparation

A log must be suitably prepared for sawing. It must be harvested from a live part of the tree stem and be free from storage decay and insect damage. Furthermore, it must be satisfactory straight and free from stem fork. Aneven long crook is permitted if its bow-height is maximum 5 % of the length of the log. End crook and sharp crook is not permitted.

Shakes from harvesting or growth are not permitted and not either buttress with a height of 15 cm or more measured from the mantle surface 20 cm in from butt end.

A log must be evenly cut and satisfactory delimbed or, if others has been agreed, be delimbed according to agreement.

A log must not contain coal, soot, plastics, stone or metallic material.

Dimensions

A log must have agreed minimum and maximum dimensions.

MEASUREMENT OF VOLUME

Saw logs of standard lengths in a stack must be measured by stackmeasurement with the assessment of the solid volume percentage under bark.

TREATMENT

A log must be assessed with regard to its suitability for the production of sawn timber according to the purpose agreed by the parties. Reduction of volume or assessment of quality must not be made.

For the *quality* of a log the following demands will be applied:

Sound knot: Knots with a diameter of maximum 30 % of the top diameter of the log are permitted to a number of **two** per metre of the length of the log, or as an alternative, 3-4 smaller knots in the corresponding interval.

Dead knot: Dead knot with a diameter of maximum 2,5 cm is permitted to a number of maximum **one** per metre of the length of the log. A branch scar will be considered the same as a dead knot.

Decayed knot: Only **one** small decayed knot per metre of the length of the log is permitted.

Spike knot: Not permitted.

Rot/false heart: In a log with a diameter of at least 20 cm, false heart and/or solid rot to an extent of 20 % of the diameter in that log end where the defect occurs, will be permitted. Log with this type of defects may be present to a number of maximum **one** per solid cubic metre of volume valid for delivery.

The permitted defects listed above, will each one be the maximum permitted defect.

The assessment of the stack may be made with regard to its visible parts. This means that the visible parts should be considered as a sample. With this as a basis, the portion of logs not valid for delivery in the whole stack, must be estimated.

If there are difficulties to make a correct assessment of the portion of logs, which should be wrecked or depreciated with regard to quality, or if the portion of such logs is high, i.e. near the limit for refusal of measurement, the whole stack must be put on bed logs for assessment piece by piece.

7 REGULATIONS FOR THE MEASUREMENT OF BEAM TIMBER

With beam timber is meant roundwood intended for the production of beams and spars.

QUALITY

Preparation

A log of beam timber must be suitably prepared for sawing. It must be harvested from a live part of a tree stem and be free from storage decay and insect damage. Furthermore, it should be nearly straight and free from annoying buttress and felling comb. An even long crook with a bow-height smaller than 1 % of the length of the log is permitted.

A log should be *well delimbed*, or if another degree of delimiting has been agreed, delimited according to agreement. Furthermore, it must be free from wood damaged by rot, blue stain, insect damage in the wood and besides be free from defects causing obvious effect on the strength of the sawn timber. Large knots (especially in cluster) and shakes are examples of such defects.

Dimensions

A log must have minimum and maximum dimensions according to agreement.

MEASUREMENT OF VOLUME

Beam timber should be measured piece by piece carried out as top, mid or top-butt measurement according to agreement.

Even measurement by random samples based on piece by piece measurement of the samples is permitted.

TREATMENT

Volume reduction

A log of beam timber must be assessed with regard to its usability for sawing a spar or another yield with a square cross-section. By the assessing is presupposed that the log will be sawn straight through and that the face of the sawing yield has the same measure as the diameter of the treatment cylinder and that the sawing cut has at least touched each face in its whole length.

A log with a volume defect must be due to deduction of length or diameter to the nearest smaller dimension, which gives a full yield.

Treatment of harvesting damage

Damage in the wood.

A delivery of sawlogs must be treated for damages on the logs caused by feeding device on harvesters. The treatment will result in a *damage class* for the delivery. It shall be based on visual assessment of the depth of the damage into the wood, or if necessary, on measuring of the depth. The depth of the damage is determined by the largest depth according to the following table.

By determining the damage class of a lot of timber such *occasional* logs will be disregarded which have deeper damages in the wood than the logs in the rest of the lot. With *occasional* is meant not more than 5 percent of the number of logs in a lot.

Bark damage

Damage on the bark of logs in a lot of timber must be considered at the determination of the damage class for the lot. The damages are divided into the categories *moderate* and *widespread*. If there are damaged bark in the form of stripped bark on more than 20 % of the mantle surface of individual logs, the damages should be classified as *widespread*. In other case they are *moderate*. To this class belongs even lots without any bark damage.

Harvesting damage on a delivery of sawlogs is determined and recorded in the following damage classes at which each class constitutes a combination of the damage depth in question and the size of the bark damage.

Type of damage/class 1)			
Bark damage	Damage depth, mm		
	< 5	5-8	> 8
moderate	1	2	3
widespread	4	5	6

1) Concerning recommended factors for reduction of value, see Annex 4.

Instructions for classification of harvesting damage:

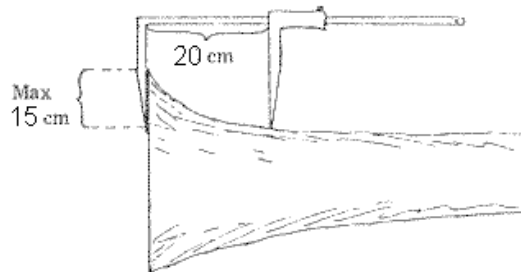
1. The damage depths given in the table refer to the largest depth (hole and torn wood fibres), exclusive the deformation of underlying wood. The depth of the damage is determined either by visual assessment or measuring, when needed. The measurement should thereby be limited to damages on the upper side of the log within a distance of not more than 1 metre from the smaller end of the log.
2. The direction that *occasional* logs may have a damage depth exceeding a certain class limit, is applicable for both of the limits 5 and 8 mm.
3. For a lot of logs with harvesting damages which are assessed to be deeper than 8 mm, the depth of the damage must be determined by measuring with a 1 mm thick, blunt pin. This measurement, if needed, should be made on at least 20 randomly sampled, damaged logs.

8. DEFINITIONS

<i>Aniline wood:</i>	Grey-violet wood, being a preliminary stage to root rot, surrounding wood in spruce decayed by root rot.
<i>Areal portion of dark and loose forest rot:</i>	The portion of dark and loose forest rot in the end surface of a log or logs.
<i>Areal portion of storage decay:</i>	The portion of storage decay in the cross section 15 cm in from the log end in logs from <i>dead trees</i> and logs <i>damaged by storage</i> respectively.
<i>Assessment:</i>	Assessment within an assortment of the quality or of the size of volume deduction.
<i>Assessment area:</i>	A radial and/or areal area in a log end or on the mantle surface of a log where the quality of the log is assessed.
<i>Assortment:</i>	Commercial goods with standardized demands according to the regulations in force for the measurement of the specific assortment.
<i>Bark damage:</i>	Loss of bark by handling of unbarked round timber causing the underlying wood bare.
<i>Bark inclusion:</i>	Ingrown bark, often in connection to occluding of a damage on stem, fork, spike knot or like.
<i>Bed timber:</i>	Logs put on the ground in order to protect the logs in a stack from getting in direct contact with the ground.
<i>Black wood:</i>	Water saturated dark often blue-grey, wood in spruce.
<i>Blue stain:</i>	Wood coloured blue to a depth of at least 5 mm from the mantle surface of a log under bark or to a distance of at least 50 mm from the log end surface.
<i>Bone dry content:</i>	Quotient of the mass of the wood in bone dry and green condition respectively.
<i>Bottom of measuring class:</i>	Lower limit of the class for measurement.
<i>Bow height:</i>	The largest distance between a straight line joining the end centres of a log and a line drawn through the middle of the log. See figure 5 on page 40.

Buttress: The connection of a sideroot to the stem above the ground. The measurement of buttress is carried out according to figure 3.

Figure 3. *Measurement of buttress.*



Butt end measure: Diameter at the butt end of a log. On a butt log the measure is taken 50 cm in from the butt end, in all other cases 10 cm in from the centre of the log end.

Branch scar: Unevenness in the bark or in the wood indicating an ingrown knot.

Closed fork: See fork.

Compression wood: Reactive wood established in coniferous trees on the underside of branches and leaning stems. The compression wood is more rich of lignin, darker and harder than the quite close lying normal wood and also has a great portion of late wood.

Conversion factor: The quotient of the quantity or value of a sample according to the "careful" measurement and the corresponding measurement result according to the "simple" measurement.

Crookedness: The deviation from the centre line of the log and a straight line through its end centres.

Cross-calliper measurement: Measuring in the same cross section of two diameters at right angles to each other.

Cross - grained wood: Wood with strongly irregular fiber direction.

Dark rot: See *rot*.

Dead knot: A knot, the floem of which, has no living contact with the floem of the stem.

Delimiting: *Well delimited log:* A log with all branches removed close to the trunk is considered as *well delimited* (remaining branches with a length smaller than 1,5 cm are permitted).

Sufficiently delimbed sawlog: A log is sufficiently delimbed if the number of remaining branches, with the length of 4-8 cm and the diameter of 1-3 cm ub, are not more than 4 on the whole log. Branches with a diameter smaller than 1,0 cm under bark are permitted irrespective of number end length as for branch stumps shorter than 4,0 cm irrespective of diameter and number.

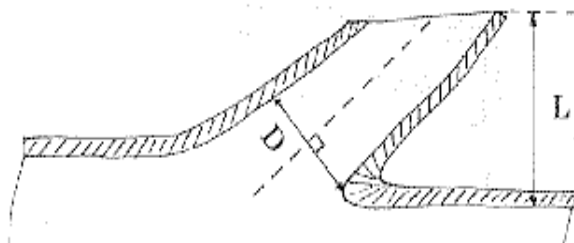
Sufficiently delimbed pulpwood log: A log of pulpwood should be trimmed close to the stem. Remaining branches are permitted within the following limits:

Diameter of the branch cm ub	The length of the branch, cm	
	coniferous	deciduous
- 1.0	unlimited	unlimited
1.1 +	< 8.0	< 16.0

In a stack of pulpwood remaining, broken branches thicker than 1,1 cm are permitted if the logs with such branches do not exceed 10 % of the total number of logs. Furthermore, the length of the remaining branches must not exceed 8.0 cm for coniferous logs and 16.0 cm for deciduous logs.

The measurement of the *length* and *diameter* of a branch is carried out according to figure 4.

Figure 4. *Measurement of the length and diameter of a branch.*



Key to the signs:

L = the length of a branch; constitutes the perpendicular distance from the mantle surface of the log under bark to the outermost firm part of the branch. To the mantle surface is also counted a swelling at the foot of the branch.

A broken remaining branch is not included in the length of the branch.

D = branch diameter under bark; is measured at right angles to the longitudinal direction of the branch.

Degree of delimiting:

The amount of remaining knots on a log expressed in number, diameter and length.

<i>Diameter deduction:</i>	Reduction of the diameter of a log in order to remove the influence of a defect or crookedness on its treatment cylinder.
<i>Dry weight:</i>	The product of the green weight and bone dry content of the wood.
<i>Evenly cut:</i>	A log is considered as evenly cut if the end surface is quite even or has a felling comb or another unevenness not higher than 5 cm from the felling cut or undercut. If there are several such cuts, the felling comb or the unevenness will be measured from that cut situated longest in on the log.
<i>Falling lengths:</i>	Lengths of logs varying between a minimum and a maximum length.
<i>Falling measure:</i>	Rounding off the proper measure to the lower limit of the measuring class.
<i>Felling comb:</i>	Unevenness in log end caused by a felling cut positioned too high compared with the undercut.
<i>Fork:</i>	Part of a stem with divided pith. <i>Closed fork:</i> Section of a log with both main and side stem, each of which with separate pith, being very tight together (without space between them). <i>Open fork:</i> Y-shaped part of a log formed by dividing of a stem into one main stem and one or several side stems with space between them.
<i>Freshness:</i>	A specified demand according to the possibility of debarking the timber, its moisture content, brightness and time for storing.
<i>Forest rot:</i>	See <i>rot</i> .
<i>Green weight:</i>	The mass of green timber.
<i>Growth shake:</i>	See <i>shake</i> .
<i>Heart shake:</i>	See <i>shake</i> .
<i>Harvesting damage:</i>	Deformation of the wood or loss of bark on a log caused by harvesting.
<i>Harvesting shake:</i>	See <i>shake</i> .
<i>Insect damage:</i>	Passageways and flight holes made by insects or larvae within the wood.
<i>Knot partly with bark:</i>	A knot more or less surrounded by bark into the treatment cylinder.

<i>Length deduction:</i>	Reduction of the length of a saw log in order to exclude certain defects influencing its treatment cylinder. The reduction can be made for one or both halves of the log.
<i>Living part of a stem:</i>	Part of a stem where the transport of nutriment, during the time for harvesting, took place in a major part of the floem of the stem.
<i>Log diameter:</i>	The diameter in a cross section of a log corresponding to the area of the cross section transformed to a circle.
<i>Log end surface:</i>	A cut of a stem made at right angle to its length axis.
<i>Log half:</i>	Part of a log delimited by a plane through the end centres of the treatment cylinder.
<i>Log length:</i>	The shortest distance between the end centres of the log.
<i>Log type:</i>	The division of a stem in: <i>butt log:</i> log from the butt end of a stem <i>middle log:</i> log from the middle of a stem between the butt log and the top log. <i>top log:</i> log from the top end of a stem.
<i>Loose rot:</i>	See <i>rot</i> .
<i>Mantle surface:</i>	The surface, over or under bark, of a log exclusive its end surface.
<i>Maximum dimension:</i>	The largest length or diameter of a log according to the regulations for the measurement of the volume of the log.
<i>Measurement collective:</i>	Lot of roundwood for which the conversion factor to commercial measure has been established by measurement by random samples.
<i>Measurement document:</i>	Paper or electronic media with recorded measurement data including identification of the measurement.
<i>Measurement piece by piece:</i>	Method for measuring log diameter by <i>top-measuring</i> , <i>mid-measuring</i> , <i>top-butt-measuring</i> or <i>measuring of sections</i> and measuring <i>log length</i> for the determination of solid volume or top cylinder volume.
<i>Measurement by random samples:</i>	Measurement of a delivery of timber in two or more phases. The last phase should be a complete and careful measurement of a sample of units from the delivery. The earlier phases of the measurement, however, will be carried out with more extensive methods, i.e. counting of units, weighing or measurement of stacks.

<i>Measurement receipt:</i>	A document which for seller and buyer gives the result of the measurement including prepared measurement data.
<i>Measuring of sections:</i>	Estimating the log diameter over or under bark at half the length of each section or at very close intervals along the log.
<i>Method of measurement:</i>	Method for measuring of timber. As methods of measurement are considered, on one hand, the methods for total measurement which are <i>measurement piece by piece</i> , <i>stack measurement</i> and <i>weighing</i> , and on the other hand, <i>measurement by random samples</i> .
<i>Mid measuring:</i>	Determining the log diameter over or under bark at a point on the middle of the length of the log.
<i>Middle of measuring class</i>	The arithmetical mean of the measures of the upper and lower class limits.
<i>Minimum dimension:</i>	The smallest permitted length or diameter of a log after topping and butting or diameter deduction.
<i>Number of annual rings:</i>	The number of annual rings in the assessment area of a log end counted in that radial direction which gives the largest width of the rings. The width of the rings must not be affected by buttress or knots.
<i>Obviously oval log:</i>	A log is obviously oval if the largest diameter at the cross section for measurement is more than 10 % larger than the smallest diameter.
<i>Open fork:</i>	See fork.
<i>Open scar:</i>	See scar
<i>Phase:</i>	See <i>total measurement</i> and <i>measurement by random samples</i> .
<i>Quality:</i>	The suitability of a log for specific processing or use.
<i>Relative standard error:</i>	The quotient of the simple standard error and the average of a certain characteristic within a "collective".
<i>Resinous wood:</i>	Wood extremely impregnated with resin, either in the root zone or in the crown of a pine tree. In the latter case resinous wood is caused by fungi in the area of thin bark or by an other kind of damage on the stem.
<i>Ring shake:</i>	See shake.
<i>Roller feeding damage:</i>	Damage on a log caused by its feeding through the delimiting equipment of a harvester.

Rot: Wood decomposed by fungi or other micro-organisms.

In regard to the *consistency*, wood damaged by rot is divided into:

Hard rot: Rot which, in unfrozen condition, exerts the same resistance to pressure from a hard, edged object as does adjacent sound wood.

Loose rot: (in extreme cases with rotten holes): Rot which, in an unfrozen condition, exerts less resistance to an hard edged object than does adjacent sound wood.

In regard to *origin*, rot is divided into:

Forest rot: Rotten wood established in living trees.

Storage rot: Rot established during storage of timber or in standing, dead trees. In an early stage the storage rot is seen as small, scattered spots or streaks in the sapwood.

In regard to *colour*, forest rot is divided into *light forest rot* and *dark forest rot*.

Root crevice: A fold between the continuation of the buttress up into the stem

Round timber: Delimbed and unbarked or debarked, and also in other respects untreated, logs or stems.

Scar: A more or less occluded, often longitudinal damage on surface of the stem.

Scar with ingrown bark: An occluded scar where the damage consists of bark and is indicated in the bark by a sign on the mantle surface.

Open scar: A scar, more or less occluded.

Scar with ingrown bark: See scar.

Shake: Longitudinal split of wood fibres.

Harvesting shake: Shake in the wood made by the harvesting. The shake will preferably be made by felling of trees or cutting of stems being in tension.

Heart shake: A radial, tapering shake through the pith of the log.

Ring shake: A shake following an annual ring.

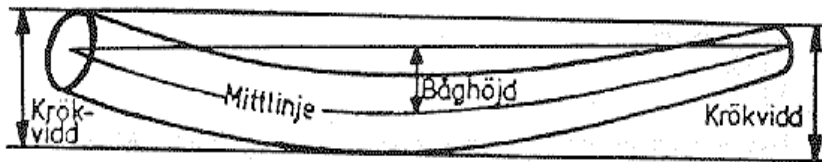
Growth shake: Non radial shake in living trees. Growth shakes will often be found in the zone between very fine-textured wood and fast-grown wood.

- Simple standard error:* The absolute value of the standard error.
- Skidding damage:* Damage in the wood of a log made by feeding rollers of a harvester skidding against the tree stem.
- Solid rot:* See *rot*.
- Solid volume:* The volume of one or several logs over or under bark. The solid volume of a stack of round timber will also include the volume of bed timber, if any.
- Solid volume percentage:* The solid volume of a stack over or under bark given in percentage of its stacked volume.
- Sound knot:* A knot of which the floem, somewhere in the mantle surface is connected with the floem of the stem.
- Spike knot:* A knot pointing strongly upwards, often with bark.
- Stack measuring:* Method for the measuring of length, height, width and stacked volume of a stack and for the determination of its solid volume percentage and solid volume.
- Stacked volume:* The product of the length, height and width of a stack.
- Standard deviation:* A measure of the deviation of the measuring data around their arithmetical mean.
- Standard length:* Logs of uniform length with a smaller length deviation according to agreement.
- Stand dry wood:* Wood from a dead tree, dried on root.
- Stop:* A clearly visible angle on the length axis of a log. The stop is often caused by a defect shoot growth or top break.
- Storage rot:* See *rot*.
- Storage damage:* Damage on the wood of a log arising by storing. Can also be found in logs from standing, dead trees. The damage is usually caused by insects or fungi.
- Sweep:* A crook at least 1 m long; when a sweep involves more than half the length of the log and lies in one plane, it is called an *even sweep*.

<i>Taper:</i>	Change in log diameter along a stem or log.
<i>Timber delivery:</i>	A limited quantity of saw logs or pulpwood according to a contract between seller and buyer intended to be measured by a certain method of measurement.
<i>Tolerance defect:</i>	Defect on a log which may not render in treatment.
<i>Top-butt-measuring:</i>	Measuring the diameters of a log over or under bark at a point 10 cm in from the centre of the top end of the log and 10 cm in from the centre of its thicker end. For a butt log, however, 50 cm in from the centre of the butt end.
<i>Top cylinder volume:</i>	Volume of a log calculated as the product of the cross section area according to top-measuring and the length of the log.
<i>Top diameter:</i>	The diameter of a log according to top-measuring.
<i>Top-measuring:</i>	Measuring the top diameter of a log over or under bark at a cross section 10 cm in from the centre of its top end.
<i>Total measuring:</i>	Measuring in one phase of all the units in a timber delivery.
<i>Treatment cylinder:</i>	An imagined cylinder of a log with a diameter equal to the log diameter according to top-measurement reduced with 1 centimetre, and the length equal to the length of the log. If a diameter deduction has to be made, the diameter of the imagined cylinder will be equal to the log diameter reduced with the above mentioned diameter deduction plus 1 centimetre. If a length deduction has to be made, the length of the imagined cylinder will be equal to the log length reduced with the size of the length deduction. For a log <i>obviously oval</i> at the point for diameter according to top-measurement, the treatment cylinder will be a cylinder with a diameter equal, either to the smallest diameter on the point of measurement or this smallest diameter reduced with the diameter deduction, if any.
<i>Tree species composition:</i>	The portion of different species of tree in a stack/lot of timber based upon volume, weight or number of measuring units.
<i>Twisted growth:</i>	Spiral formed fibre direction compared with the length axis of the stem.
<i>Unsound knot:</i>	A knot totally decayed by loose rot.
<i>Water wood:</i>	Heartwood in old pine and spruce with unnormally high moisture content.

Width of curve: The diameter of that imagined smallest cylinder through which the log can be passed.

Figure 5. *Bow height and width of curve.*



Krökvidd = Width of curve, Mittlinje = Centre line,
Båghöjd = Height of curve

Volume deduction: Reduction of the volume of a log as a consequence of topping and butting or diameter deduction.

Volume defect: Defect causing a reduced volume yield from a log.

Volume defects are divided into:

Deduction of log length: Volume defect resulting in a reduction of the usable length of the log.

Deduction of diameter: Volume defect resulting in a reduction of the usable cross section of the log.

Wood volume percentage:

The solid wood volume of a stack in percentage of its stacked wood.

Annex 1. Functions for the calculation of the size of the barkdeduction by opti-electronic diameter measurement

In the following functions y stands for the double bark thickness in mm and x the top-diameter of the log in mm..

Bark type region	Species of tree: Pine	Bark function
1. County of Norrbotten	thin bark: middle bark: thick bark:	y= 2,00+0,0153x y= 1,89+0,0238x y= -0,26+0,0458x
2. County of Västerbotten	thin bark: middle bark: thick bark:	y= 2,82+0,0151x y= 3,21+0,0215x y= 3,03+0,0383x
3. County of Västernorrland, county of Jämtland except those communities belonging to region 4.	thin bark: middle bark: thick bark:	y= 2,81+0,0156x y= 2,50+0,0270x y= 2,77+0,0406x
4. Community of Härjedalen in the county of Jämtland, county of Gävleborg except those communities belonging to region 5.	thin bark: middle bark: thick bark:	y= 2,73+0,0157x y= 2,72+0,0260x y= 2,72+0,0430x
5. Communities of Ockelbo, Gävle, Sandviken and Hofors in county of Gävleborg, county of Dalarna, community of Torsby and the northern part of community of Hagfors in county of Värmland.	thin bark: middle bark: thick bark:	y= 2,23+0,0161x y= 4,39+0,0167x y= 3,12+0,0394x
6. County of Värmland except those communities belonging to region 5, county of Örebro, county of Västmanland.	thin bark: middle bark: thick bark:	y= 3,33+0,0147x y= 3,83+0,0236x y= 2,40+0,0487x
7. County of Uppsala, county of Stockholm, county of Södermanland.	thin bark: middle bark: thick bark:	y= 2,46+0,0172x y= 1,36+0,0329x y= -3,15+0,0744x
8. Communities of Bengtsfors, Åmål, Mellerud, Färjelanda and Vänersborg in the former county of Älvsborg, county of Östergötland except those communities belonging to region 12.	thin bark: middle bark: thick bark:	y= 3,41+0,0166x y= 2,81+0,0373x y= 5,27+0,0494x
9. County of Västra Götaland except these areas belonging to the regions 8 and 11	thin bark: middle bark: thick bark:	y= 1,85+0,0281x y= 1,63+0,0507x y= 4,36+0,0625x
10. County of Halland	thin bark: middle bark: thick bark:	y= 2,90+0,0176x y= 3,84+0,0287x y= 0,27+0,0625x

Bark type region**Bark function****Species of tree: Pine**

11.	Former county of Älvsborg except those communities belonging to region 8, county of Jönköping, county of Kronoberg.	thin bark: middle bark: thick bark:	$y = 4,07 + 0,0102x$ $y = 4,91 + 0,0241x$ $y = -0,18 + 0,0728x$
12.	Eastern parts of the communities of Norrköping and Åtvidaberg and the Söderköping and Valdemarsvik communities of the county of Östergötland, county of Kalmar.	thin bark: middle bark: thick bark:	$y = 2,50 + 0,0231x$ $y = 4,17 + 0,0344x$ $y = 1,71 + 0,0671x$
13.	County of Blekinge, county of Skåne.	thin bark: middle bark: thick bark:	$y = 2,91 + 0,0144x$ $y = 4,86 + 0,0278x$ $y = 4,82 + 0,0547x$

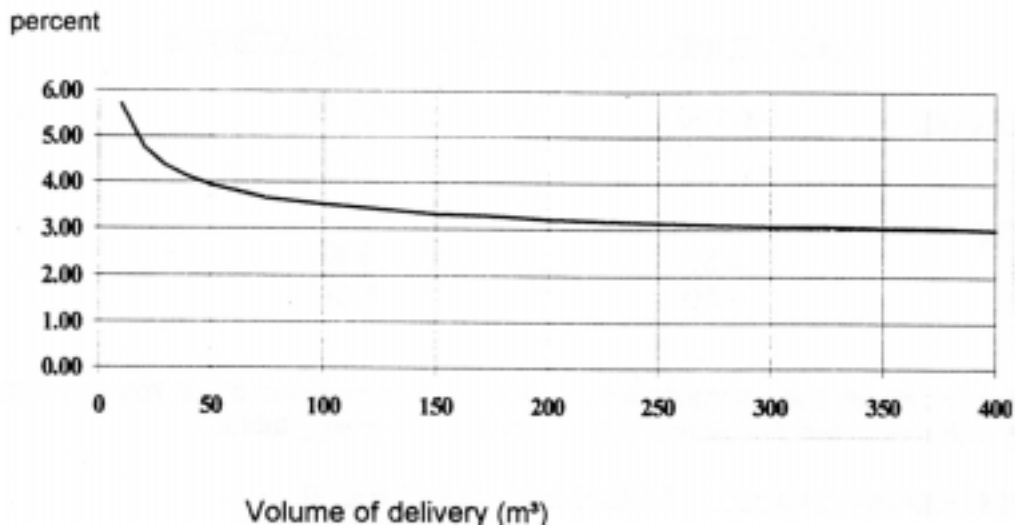
Species of tree: Spruce

1.	Counties of Norrbotten and Västerbotten north-west of a line Pajala-Arvidsjaur-Dorotea (=the inland railway).	$y = 3,10 + 0,0496x$
2.	Counties of Norrbotten and Västerbotten except these areas belonging to the regions 1 and 3.	$y = 2,54 + 0,0475x$
3.	Coast region of county of Västerbotten, i.e the area south-east of a line Skellefteå-Medle-Norrforss (=the coast land railway).	$y = 4,60 + 0,0342x$
4.	County of Jämtland north-west of a line Dorotea-Strömsund-Östersund-Svenstavik-Rätansbyn (=the inland railway) except the community of Härjedalen.	$y = -0,11 + 0,0540x$
5.	Counties of Västernorrland, Jämtland, Gävleborg, Dalarna, Örebro, Västmanland, Uppsala, Stockholm, Södermanland, Östergötland, Jönköping, Kronoberg and Västra Götaland except these areas belonging to the regions 4, 6, 7, 8, 9 and 10.	$y = 3,28 + 0,0370x$
6.	The coast regions of the counties Västernorrland and Gävleborg i.e. the area east of a line Norrforss-Bollstabruk-Stöde-Delsbo-Arbrå-Jädraås-Hofors.	$y = 2,47 + 0,0368x$
7.	Community Härjedalen in county of Jämtland.	$y = -0,92 + 0,0647x$
8.	The communities of Älvdalen and Malung and the western and northern parts of the community of Mora in county of Dalarna.	$y = 4,09 + 0,0426x$
9.	County of Värmland and former county of Skaraborg.	$y = 4,08 + 0,0294x$
10.	Eastern parts of the communities of Norrköping, Åtvidaberg, Söderköping and Valdemarsvik in the county of Östergötland, county of Kalmar.	$y = 3,18 + 0,0420x$
11.	The counties of Halland, Skåne and Blekinge	$y = 3,38 + 0,0323x$

For a measurement site with saw logs from different geographical regions, the bark functions applied should be adapted to the estimated, geographical distribution of the procured timber.

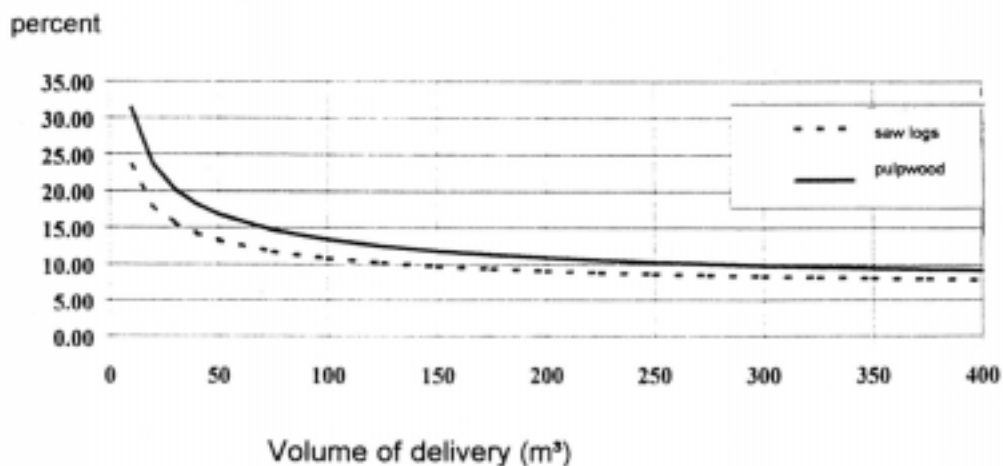
Annex 2. Accuracy demands by timber measurement appointed by the National Board of Forestry

Accuracy by piece by piece measurement



For a delivery of timber larger than 10 m³, the total solid volume or the top-cylinder volume according to measurement piece by piece must not differ from the volume of the delivery with more than that percentage given by the curve in the diagram. For a delivery larger than 400 m³, the difference must not be more than 3 percent.

Accuracy by stack measurement and measurement by random samples.



For a timber delivery larger than 10 m³, the total solid volume or top-cylinder volume according to stack measurement or measurement by random samples, must not differ from the volume of the delivery with more than that percentage given by the curves in the diagram. For a timber delivery larger than 400 m³ and consisting of saw logs, the difference must not be larger than 8 percent. For a timber delivery consisting of pulpwood, the corresponding difference will be 9 percent.

Accuracy demands by weighing and counting the number of measurement units

For a delivery of timber weighing more than 10 metric tons, the estimated total green weight or bone dry weight, must not differ from the weight of the delivery with more than that percentage given by the following table:

	<u>Weight in metric tons</u>	<u>Largest permitted differens</u>
<u>Green weight</u>	≤ 100	4,5 %
	> 100	3 %
<u>Bone dry weight</u>	≤ 50	9 %
	> 50	6 %

For a timber delivery the estimated total number of logs must not differ from the number in the delivery with more than that percentage given in the following table.

<u>Number of logs in the delivery</u>	<u>Largest permitted difference</u>
≤ 1000	4,5 %
> 1000	3 %

Annex 3. Code for the reason for depreciation of quality (NK) and wrecking (VR).

Code	Saw logs	Other assortments
0	Special stipulation according to contract	Special stipulation according to contract
1	Wrong assortment/species of tree or insect damage	Wrong assortment/species of tree
2	Volume deduction	Storage decay
3	Rot	Forest rot
4	Diameter	Dimension too small
5	Length	Dimension too large
6	Inferior quality because of knots	Unsatisfying delimiting
7	Unsatisfying processing; not acceptable delimiting, open fork, buttress, double stem etc.	Unsatisfying processing; too open fork, crook, etc.
8	Metal, plastics, stone, coal or soot	Metal, plastics, stone, coal or soot
9	Compression wood (coniferous timber)/ Red heart (hardwood timber)	Special stipulation according to contract.

Annex 4. Value reduction because of harvesting damage.

According to the existing instruction for the measurement of coniferous sawlogs and beam timber assessment of harvesting damage must be done. This assessment aims at promoting an as far as possible handling of the round timber during the harvesting process.

A working group formed by the Timber Measurement Council with the purpose of making an improvement of the assessment rules, has 1999-03-22 decided to recommend the following value reduction numbers for the damage classes in question.

Damage class	Value reduction number, %
1	0
2	3
3	15
4	0
5	3
6	15

The group has also made the statement that this recommendation must not form an obstacle to local solutions. This is specially valid for the damage classes with widespread bark damages (4, 5 and 6), where the parties concerned, according to the prevailing conditions (climate, delivery plans, storage situation etc.) shall be able to adapt the value reduction to these facts.